RECLAMATION

Managing Water in the West

San Luis Drainage Feature Re-evaluation

Feasibility Report

Appendix J

Comparison of Embankment Options for Evaporation Ponds

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Sacramento, California

November 2007

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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For the purpose of obtaining a basis of comparison between 3(H):1(V) embankment side slopes and that of vertical embankment, a generalized cost estimate was performed to quantify the relative difference. It should be noted that the designs and cost estimates provided herein are intended to provide the basis for a relative cost comparison amongst the various alternatives. It should not be used for budgeting purposes as not all items of work have been identified.

Three generalized alternatives were investigated; 3:1 embankment (baseline), sheetpile, and soil cement ¼:1. Each alternative was assumed to have a structural height of 10-feet taken from finished ground level. 3-feet of free board will be assumed as well as minimum water surface depth of 4-feet to inhibit plant growth. A 2-foot absolute minimum water surface will also be incorporated into the design as an additional deterrent for shore birds. The crest with will be set at 20-feet height for each alternative to allow for maintenance access. Only major differences that would affect costs are described.

3 to 1 Embankment Slopes

This alternative is the baseline design for the Evaporation Ponds.

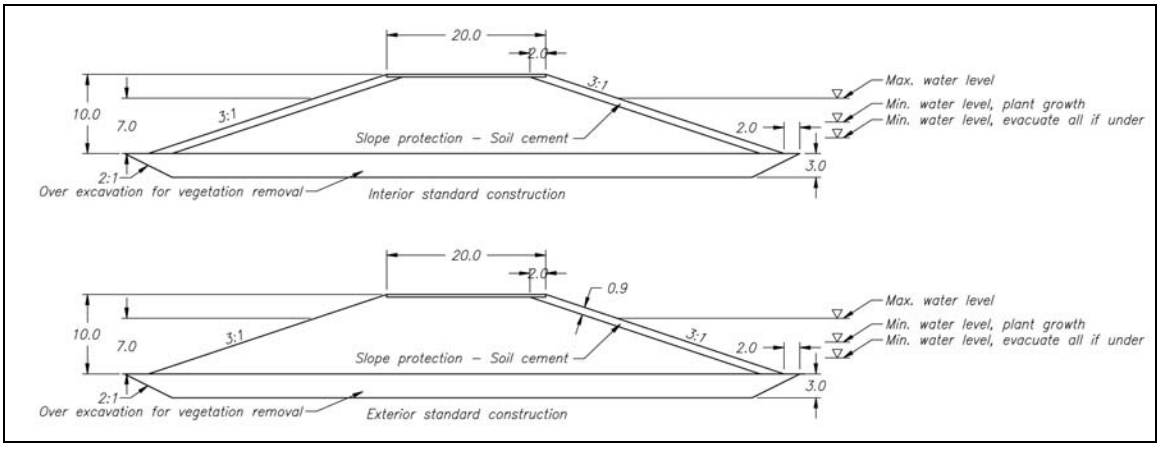

Figure 1. 3:1 embankment slopes.

Figure 1 shows a compacted soil embankment that has been constructed by first excavating 3 feet across the embankment foot print. Three feet of excavation

would be the minimum required to remove organics such as existing crops and root structures that would die and decay creating potential seepage pathways under the constructed embankment.

Compaction of local soils would construct the impervious zone of the embankment. A 0.9-foot thick soil-cement layer would be placed on the face of the embankment for erosion protection from the impounded water. Soil-cement is used in that other acceptable riprap would be too costly due to haul distances. Soil-cement was assumed to utilize local soils.

Soil Cement ¼:1 side walls

This alternative was investigated to provide a relatively more cost effective "vertical wall" option.

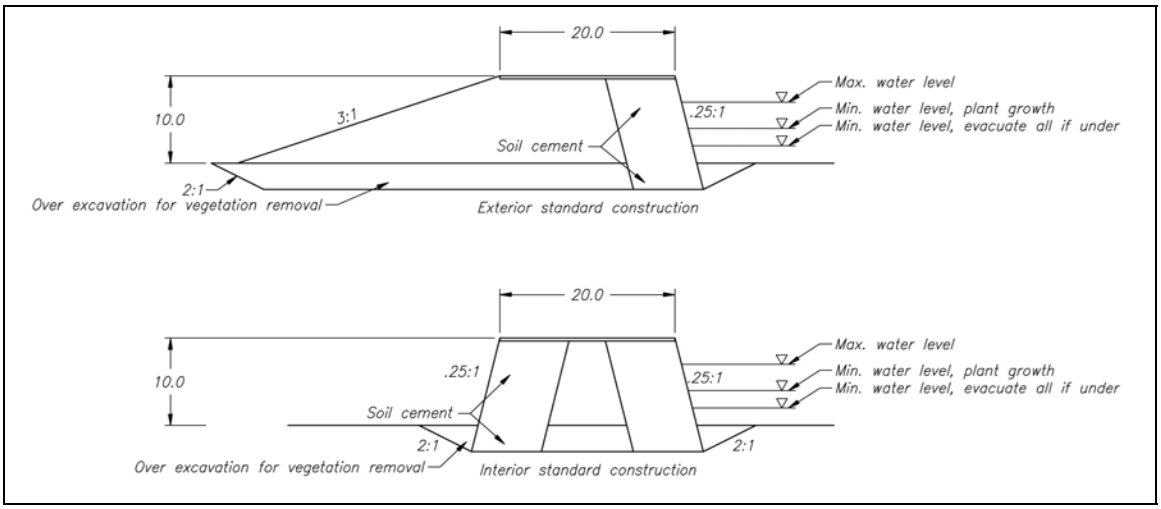

Figure 2. Soil cement ¼:1 side walls.

Construction would consist of excavation to a depth of 3-feet to remove organics. Center core of the embankment utilizes local clay soils. Outside slopes of the embankment would be a 10-foot wide section of soil-cement. Soil-cement would be manufactured on site using local borrow. Side slopes would be adjusted from vertical to allow for ease of forming. Minimum of ¼:1 slope would be allowed.

Vertical Sheetpile embankment side slopes

This option would be considered the "Cadillac". Composite sheetpiling will be used due to the high salt content of the impounded water.

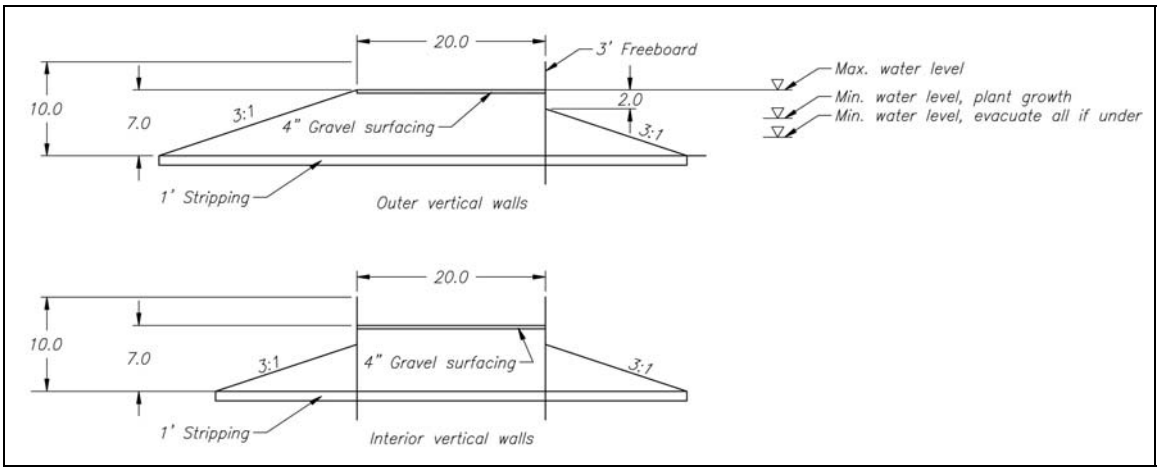

Figure 3. Vertical Sheetpile sidewalls.

Because foundation seepage would be controlled by the placement of a sheetpile cutoff to depth, there is only a minimal need to excavate. Surface stripping to 1-foot would be required to prepare the surface. There is no need to raise the embankment crest beyond the maximum water level. The extended sheetpile wall (3-feet) would provide for freeboard. Embankment would be first placed to height of downstream support embankment. Piles would be installed to depth providing seepage cutoff and required sheetpile embedment.
Both embankment crest and outer support embankment could be lowered depending on section modulus of sheetpile selection.

Relative Cost of Alternatives:

To generate costs, the following was assumed:

- Average length evaporation pond perimeter of 39,500 ft.
- Average length evaporation pond interior embankment of 31,400 ft.
- Mobilization (+/- 5%)
- Unlisted items (+/- 15%)
- Contingencies (+/- 25%)

Alternative	Total Cost	Cost per foot
3:1 Embankment Slopes	$23,000,000.00	$325
Soil Cement ¼:1 side walls	$32,000,000.00	$450
Vertical Sheetpile side walls	$44,000,000.00	$620

This cost estimate is intended to provide the basis for a relative cost comparison amongst the various alternatives. It should not be used for budgeting purposes as not all items of work have been identified. This cost estimate does not include any allowance for procurement strategy as is being proposed in the draft RM on cost estimating. Nor does it include budget for any "Non-Contract" costs associated with this project.