

CHAPTER 2: LAKE CHELAN EROSION CONTROL PLAN (NPS)

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SECTION 1: INTRODUCTION

Shoreline erosion sites along Lake Chelan within the Lake Chelan National Recreation Area (Lake Chelan NRA) were surveyed by Chelan PUD, the USDA Forest Service, NPS and other members of the erosion working group in spring 1999 (Inventory of Shoreline Erosion, Chelan PUD, 2000). The members of the working group that took part in the inventory included Chelan PUD, USDA Forest Service, the NPS and some independent members. The results of this survey are summarized in Figure 2-1. Additional work to survey erosion sites was performed by NPS staff in summer 2000. These two surveys identified 3.7 miles of eroding shoreline out of 10 miles of lakeshore in the Lake Chelan NRA. All but two of the sites were identified in a previous survey by Chelan PUD in the early 1980s.

Several of the surveyed sites received erosion control treatment by Chelan PUD in the mid-1980s, and by the NPS in the early 1990s. Much of the erosion control attempted previously by Chelan PUD in the 1980s has failed or is failing, while work by the NPS in the 1990s has been limited to severe problems. The failed or failing work (which was performed by Chelan PUD, in cooperation with the NPS and USDA Forest Service), was based on minimal repair techniques and use of on-site materials, with no follow-up maintenance. It appears that rocks available on site were generally too small, making the repairs susceptible to damage by wave action.

The erosion control plan contained in this Chapter is intended to stabilize the shoreline at 16 sites selected by the NPS. The repairs planned for these 16 sites cover 3,535 linear ft, which amounts to less than 20 percent of the total eroding shoreline within the Lake Chelan NRA. A description of conditions, projected impacts, and general erosion control strategy for each of the 16 sites is provided in Lake Chelan Erosion Control Plan (Chelan PUD, 2001b).

1.1 Site Selection

Of 38 sites identified in the inventory, 16 sites were selected as having the greatest need for treatment to mitigate erosion because erosion threatens public recreation, emergency response, or administration facilities. Recreation facilities include campgrounds and the lakeshore trail. Emergency response and administration facilities include the road to the fire station, NPS houses, and Search and Rescue (SAR) caches at Stehekin. Ownership of some sites is subject to easements.

For purposes of funding and mitigation planning, the 16 sites are placed into one of two groups, consisting of seven erosion sites and nine recreation sites. Funding allotted for erosion control efforts at each of the erosion sites is included in this Chapter. Any erosion control work on recreation sites will be done as a necessary part of development or maintenance of recreational or administrative sites. Funding for work on those sites is not included in this Chapter.

1.2 Responsibilities

Chelan PUD shall make available to the NPS \$576,500, to implement the erosion control effort described in this Chapter for erosion sites. Payment to the NPS is governed by a separate

administrative agreement between Chelan PUD and the NPS, pursuant to section 19 of the Agreement.

Chelan PUD and NPS anticipate the NPS will have lead responsibility for implementing the erosion control effort described in this Chapter. Chelan PUD shall become responsible for implementing this Chapter, but only to the extent that if unanticipated circumstances limit or preclude the ability of the NPS to do so. If such unanticipated circumstances arise, the NPS shall so notify Chelan PUD in writing. Upon receipt of such notification, Chelan PUD shall employ its best efforts to implement such portion of this Chapter as the NPS was unable to implement, but only to the extent of the funds remaining from the \$576,500 made available by Chelan PUD. Such expenditures by Chelan PUD shall include both payments to outside contractors and the cost of all work performed by Chelan PUD employees, including a reasonable allocation of overhead. Chelan PUD shall have no obligation to perform such work unless the NPS has provided written notice to Chelan PUD and FERC that such unanticipated circumstances exist.

The NPS is also responsible for designs of erosion control structures, and for obtaining any permits needed for construction from the U.S. Army Corps of Engineers (USACE) and the Washington State Department of Fish and Wildlife (WDFW). Both the NPS and Chelan PUD will cooperate and consult in the development of the progress report to be submitted to FERC.

SECTION 2: IMPLEMENTATION

2.1 Plan Implementation Schedule

For purposes of scheduling work, the 16 sites are prioritized as high, medium, and low; however, it should not be concluded that “low” priority sites should be ignored. In fact, all 16 sites are areas where active erosion is expected to threaten public facilities during the term of the New License for the Lake Chelan Project and are, therefore, of great importance.

From Table 2-1 there are eight high-priority sites, four medium-priority sites, and four low-priority sites. It is recommended that the stabilization of these sites occur in the first 25 years of the term of the New License, in accordance with a schedule outlined in section 2.2.

Adherence to a strict implementation schedule is not recommended for several reasons. First, variation in the lake level cycle from year to year may preclude work at any given site in any given year. Second, it may be cost-effective to work at some sites while other activities are taking place. For example, work on a dock at a campsite should be coordinated with design and implementation of erosion control at or near that site. Third, due to crew availability, material transportation, and weather, it is necessary to have a flexible implementation schedule. Finally, if the amount of work and funding levels are stable over a period of 5-10 years, it is much easier for the NPS to train and retain an erosion control crew.

2.2 Lake Chelan NRA Erosion Control And Recreation Enhancement Schedule Projection

FUNDING AMOUNTS AND SOURCES

A-Erosion Control = \$266,500 (Chapter 2)

(Sites 61, 79, 80, 81, 90, 109 and 110)

B-LWD Management = \$310,000 (Chapter 2)

(Crew, small barge and crane)

C-Recreation Improvements = \$622,500 (Chapter 11)

(Sites 71, 72, 73, 75, 76, 82, 83, 113, 210)

Total funds available = \$1,199,000

IMPLEMENTATION AND FUNDING SCHEDULE

A. License years 1-3 = Total \$294,995 as follows

1. Annual Costs (\$45,500/year)

- Work at site 75 = \$113,300

- Work at site 90 = \$12,400

(Coordinated with Manly Wham Project)

- LWD crew @ \$3600/yr x 3yr. = \$10,800

2. One-time purchases yr. 1 (\$140,000)

- Purchase barge/crane yr. 1 \$130,000

- Revegetation startup yr. 1 \$10,000

- NPS boat upgrade to push barge \$18,495

3. \$904,005 available after year 3

B. License years 4-10 = Total \$486,000 as follows:

1. Annual costs (total \$66,577/yr.)

- Work at high priority sites 71, 79,

82, 109, 110, and 210 = \$381,100

- Work at low priority site 73 = \$30,900

(Coordinate with Stehekin Landing project)

- Complete work at site 90b = \$28,800

- LWD crew \$3600/yr x 7yr. = \$25,200 total

2. Fixed cost for NPS barge boat maintenance. = \$20,000

3. \$418,005 available after year 10

C. License years 11-15 = \$220,378

1. Annual costs (\$44,075/year)

- Work at medium p. sites 61, 81, 83, and 113 = \$202,378
- LWD crew \$3600/yr = \$18,000

2. \$197,627 available after year 15

D. License years 16-20 = \$197,625

1. Annual costs (\$39,525/year)

- Work at site 76 = \$33,475
- Work at low priority rec. site 80 = \$30,900
- Work at remaining low priority sites 72 = \$77,250
- LWD crew funds = \$36,000

2. Fixed cost for NPS barge boat maintenance. = \$20,000

Table 2-1: Erosion Sites Requiring Treatment

Site No.	Priority	Site Category	Total length (ft)	Treatment length (ft)	Facility/resource/location
71	High	Recreation	1850	460	Weaver Point
75 ¹	High	Recreation	1405	440	Access road
76 ²	High	Recreation	1017	130	Lakeshore trail
79	High	Erosion	147	150	Lakeshore trail
82	High	Recreation	950	400	Lakeshore trail
109	High	Erosion	95	80	Lakeshore trail
110	High	Erosion	140	140	Lakeshore trail
210	High	Recreation	340	250	Stehekin Landing
61	Med	Erosion	145	125	Riddle Creek Cabins
81	Med	Erosion	960	260	Lakeshore trail
83	Med	Recreation	265	120	Lake trail, Flick Cr.
113 ³	Med	Recreation	280	280	Lakeshore trail
72	Low	Recreation	380-5000	300	Main Stehekin Road
73	Low	Recreation	790	120	Stehekin Landing
80	Low	Erosion	120	120	Manly Wham
90	Low	Erosion	156	160	Lakeshore trail
Subtotal		Recreation		2500	
Subtotal		Erosion		1035	
Total				3535	

¹ Site 75 length to be treated was increased from the inventory survey during subsequent field measurements by NPS.

² Site 76 is also a cultural resources site and may need additional treatment on that basis.

³ Site 113 had a measured length of 190 ft in the inventory report, but in a subsequent field visit was changed to 280 ft.

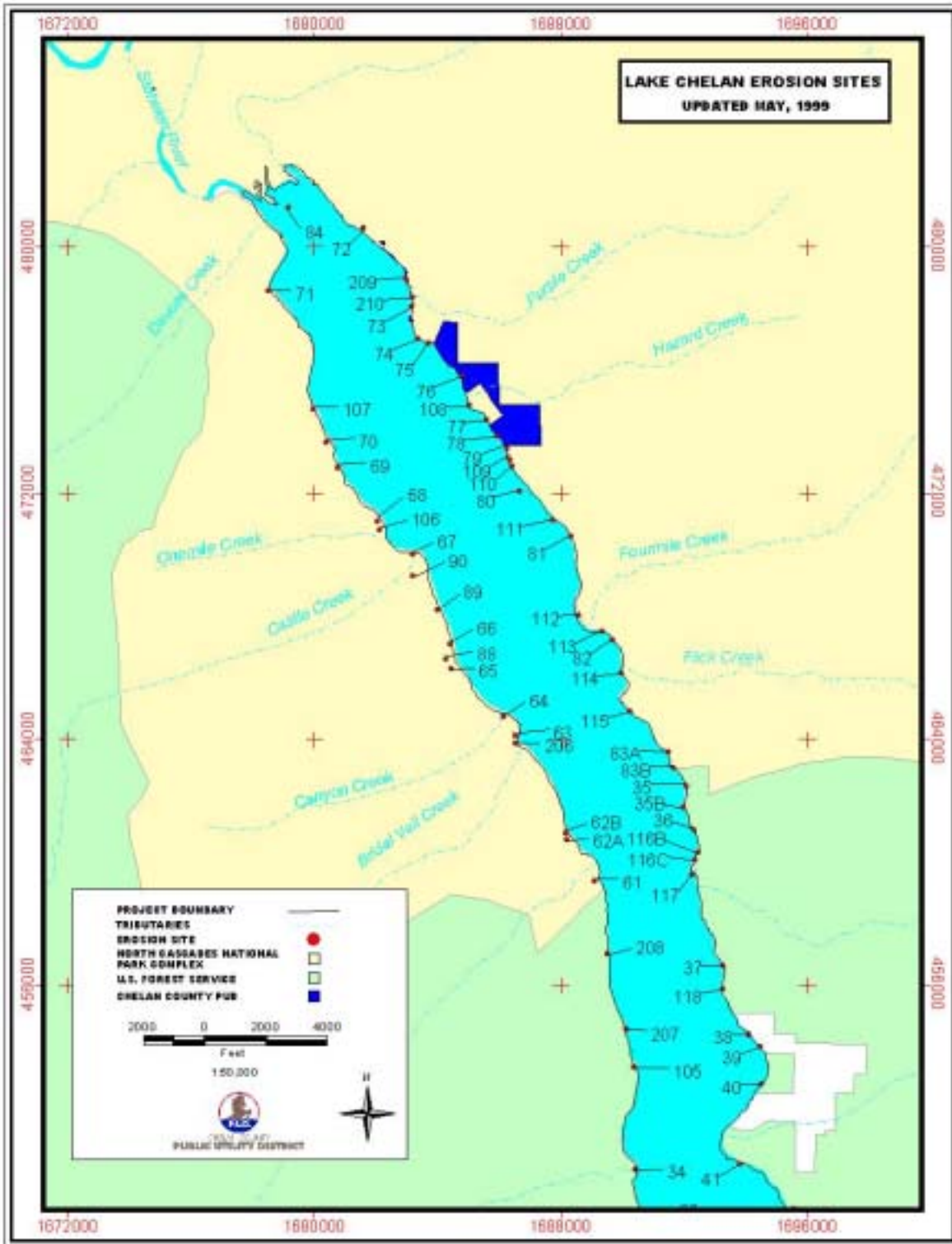


Figure 2-1: Location of Erosion Sites in Lake Chelan National Recreation Area

2.3 Erosion Control Techniques

Erosion control techniques used to stabilize each site will include use of native rock, logs, soil and vegetation. Designs for use of these materials to stabilize shorelines will generally follow those described in the Chelan PUD publication Erosion Control Techniques and Permitting (Chelan PUD 2001). The five basic designs will include rock walls, rock slope revetments, log/live cribbing, perched beaches, and large woody debris (LWD) accumulations (Figure 2-2 through Figure 2-6).

Table 2-2: Site Number, Name, Treatment Length, and Erosion Control Technique

Site No. - name	Length (ft.)	Preliminary Technique
61-Riddle Creek Camp	125	continue rock wall
71-Weaver Point Camp	460	260 ft rock + 200 ft logs
72-Stehekin Road	300	rock wall
73-above dock ramp	120	rock or rebuild existing crib
75-fire and SAR cache road	440	rock wall
76-Lakeshore trail	130	rock revetment
79-lakeshore trail	150	rock revetment
80-lakeshore trail	120	rock revetment
81-lakeshore trail	260	logs
82-lakeshore trail	400	rock revetment
83-Flick Creek Camp	120	rock wall
90-Manly Wham Camp	160	120 ft logs + 40 ft rock
109-lakeshore trail	80	rock revet. or log crib
110-lakeshore trail	140	rock revet. or log crib
113-lakeshore trail	280	rock revetment
210-Stehekin landing	250	rock wall

Preliminary application of these techniques to each of the 16 sites is given in Table 2-2. Sketch maps, profiles and further descriptions of anticipated treatment are included in Lake Chelan Erosion Control Plan (Chelan PUD, 2001b). The total linear feet of proposed stabilization by category includes 580 ft to be treated with logs, 1300 ft to be treated with rock revetment and logs, and 1275 ft to be treated with rock wall. Use of rock is generally favored over wood, due to its greater expected longevity. Rock walls will be used at recreational sites with docks and swimming areas. Logs and rock slope revetment are inappropriate techniques at these sites because they can present safety hazards. Logs and rock revetments will be used along trail sites, where there are no docks or camps.

Gabions, concrete, or other heavily engineered approaches will not be used. Use of these erosion control techniques is problematic in the Lake Chelan NRA because of aesthetics, visitor safety and access, and low habitat quality.

All techniques will incorporate native vegetation into designs. Guidelines and a budget for revegetation are given under separate heading below.

The detailed design for each site will be developed prior to construction.

2.4 Material Sources

Several sources will be used to obtain native rock, LWD, and other erosion control materials. Most large rock, sand, and gravel will be obtained from quarries near Lake Chelan. This material will be barged uplake to erosion control sites by private contractor. Smaller quantities of rock may be obtained from the Lake Chelan drawdown zone, where approved by the NPS archeologist and permitting agencies. LWD for work at several sites will be collected by the NPS from open water on Lake Chelan. It is anticipated that LWD will be collected by the NPS intermittently, following large flood pulses of wood into the lake, and stored for later use. The link between this plan and the management of LWD is discussed below in section 2.8.

2.5 Revegetation

Native vegetation will be incorporated into all erosion control designs. This vegetation will provide several benefits. First, it will enhance stability of erosion control structures through root-reinforcement of soil. Second, vegetation will provide a means to control pedestrian traffic at a site, to the benefit of the shoreline ecology and the erosion control structures. Third, it will help establish riparian vegetation in otherwise barren areas of the shoreline.

Protecting the genetic integrity of native plant populations is an important aspect of the revegetation program. Plant materials, including seeds, cuttings and transplants will be obtained from as near to the erosion control site as possible. Plant species used will include only those currently found at each site, but will generally focus on use of shrubs. Slow-growing trees with large root systems and fragile ground vegetation will not be used at most sites.

It is anticipated that revegetation efforts will be supported by the NPS Greenhouse in Marblemount, and potentially by a small nursery in Stehekin.

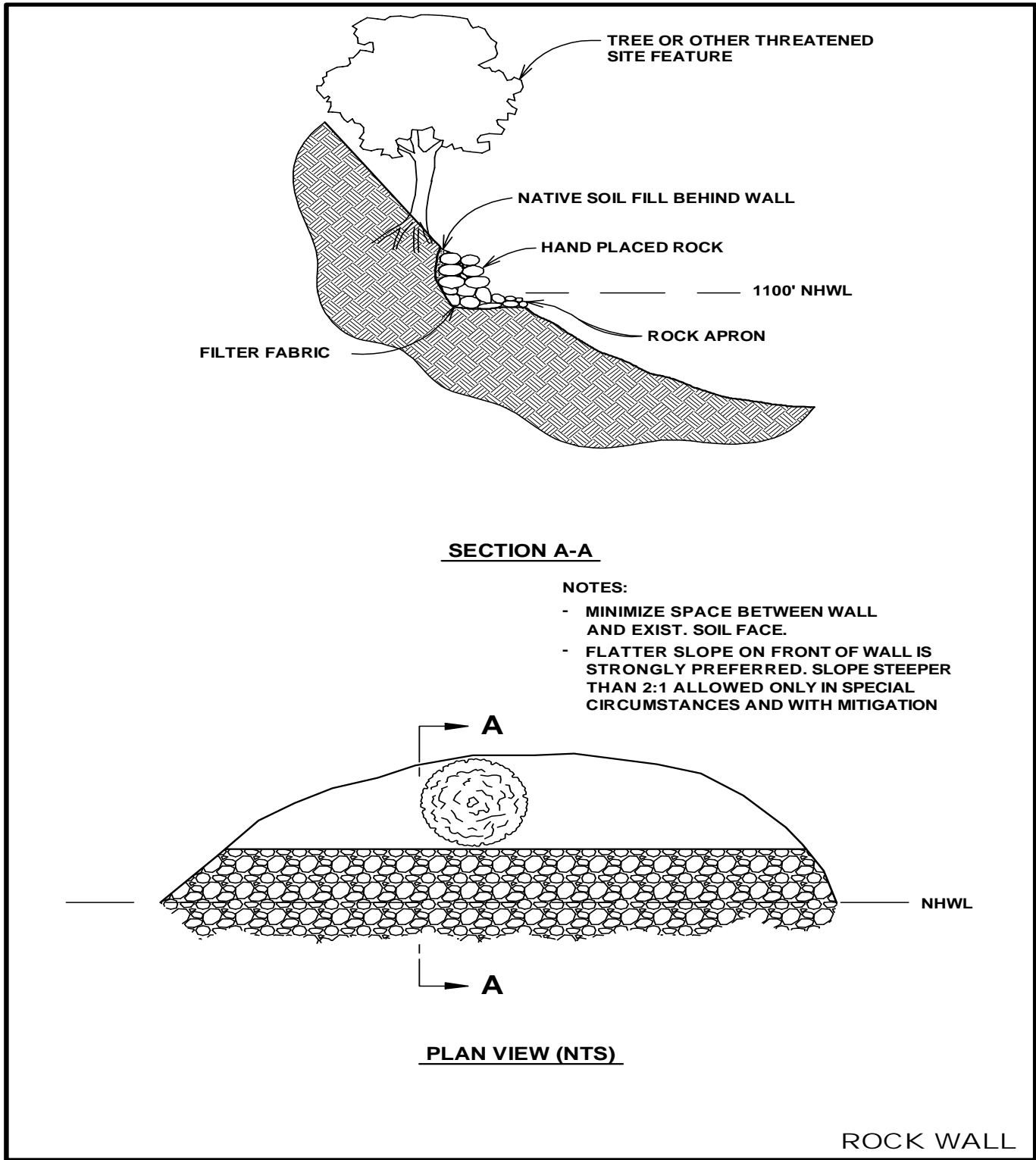


Figure 2-2: General Rock Wall Design

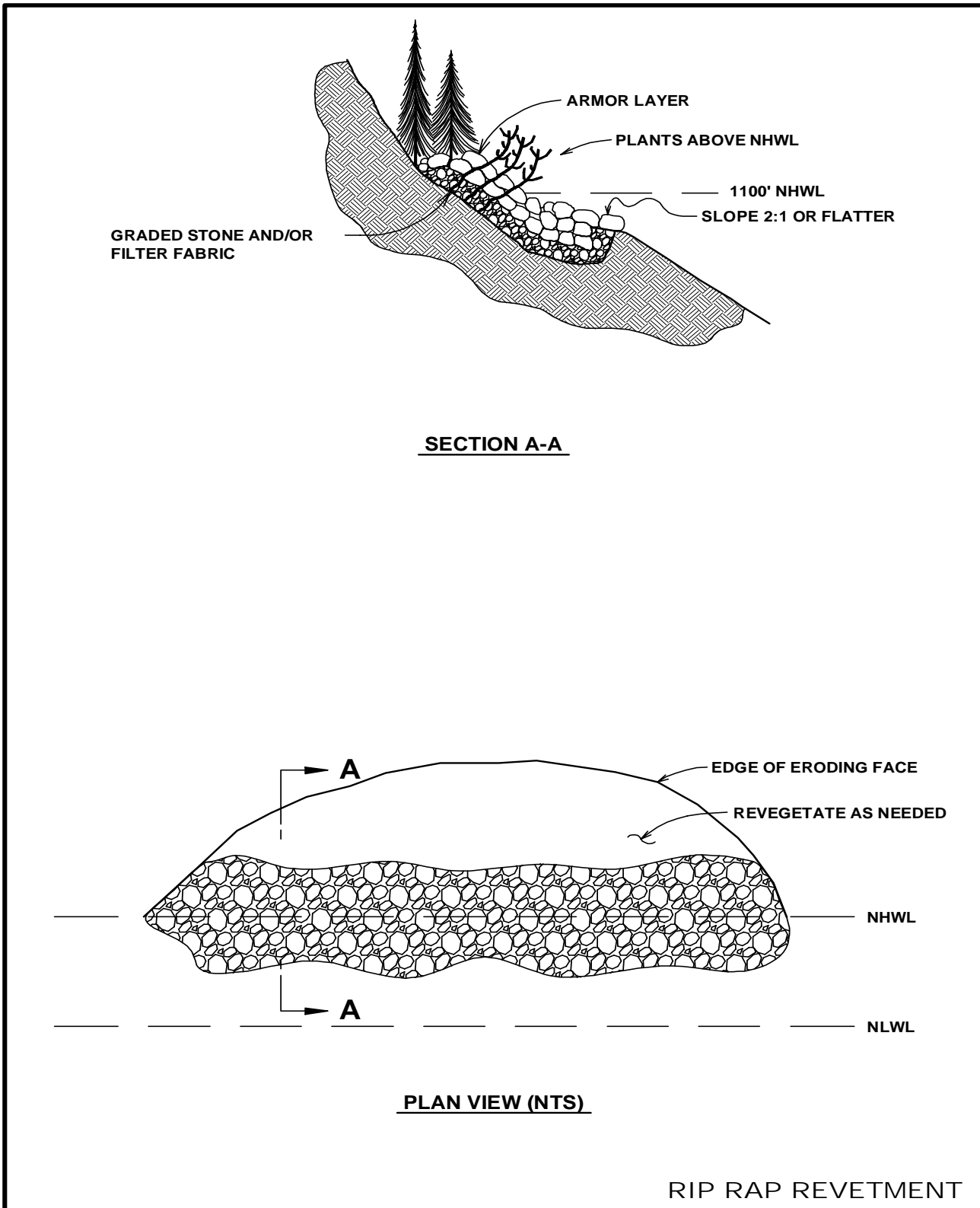


Figure 2-3: General Rock Slope Revetment Design

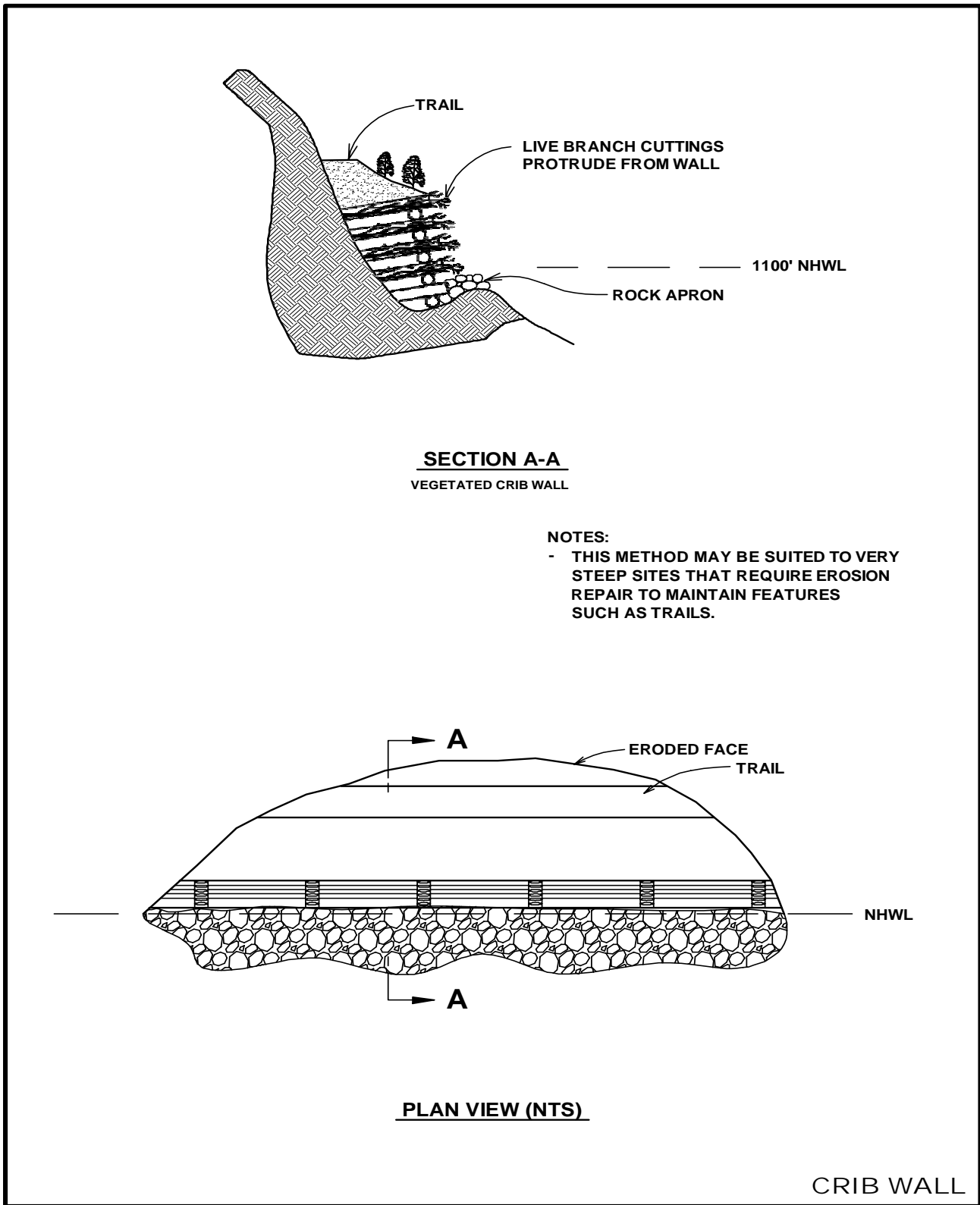


Figure 2-4: General Live Log Cribbing Design

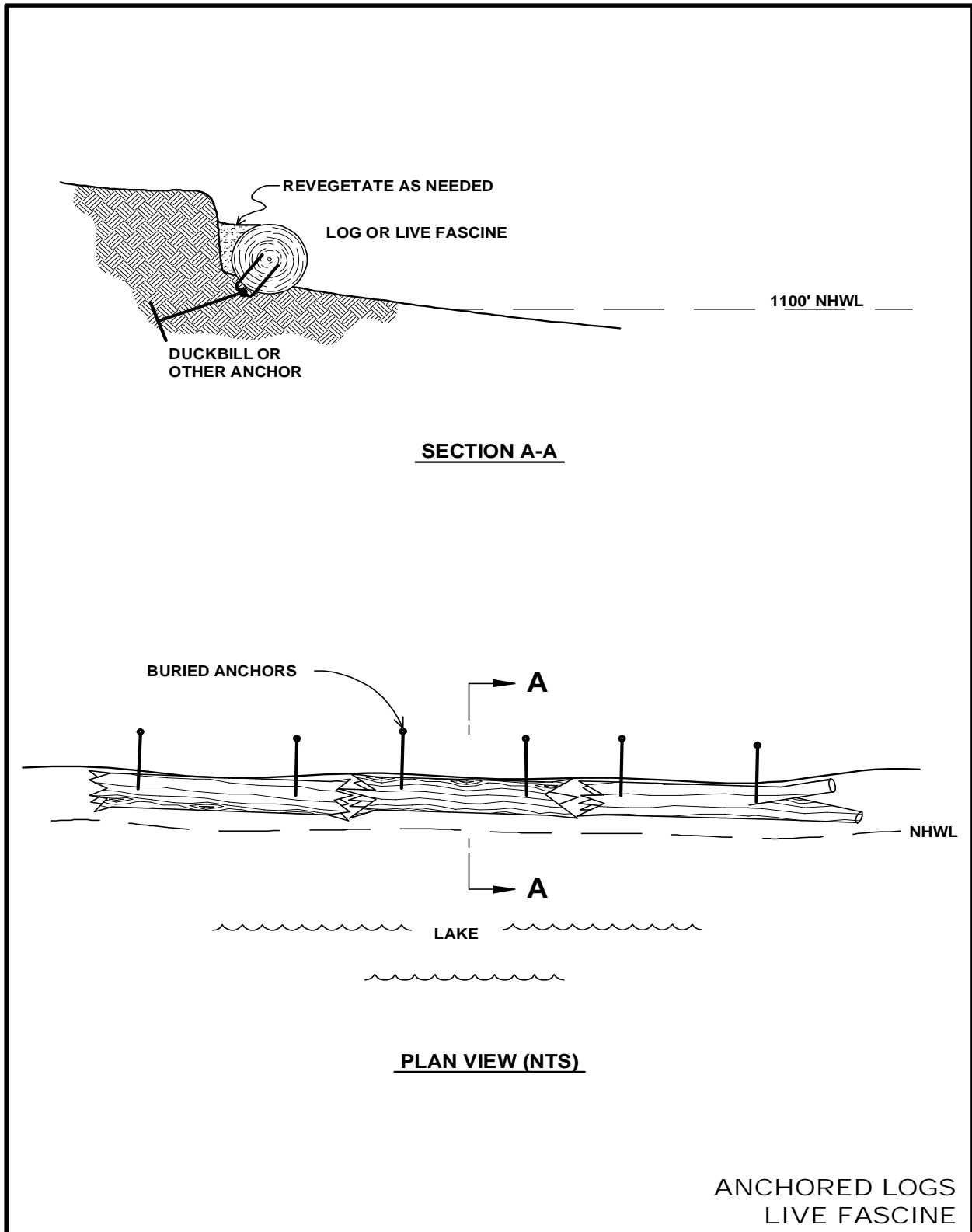


Figure 2-5: General Large Wood Design

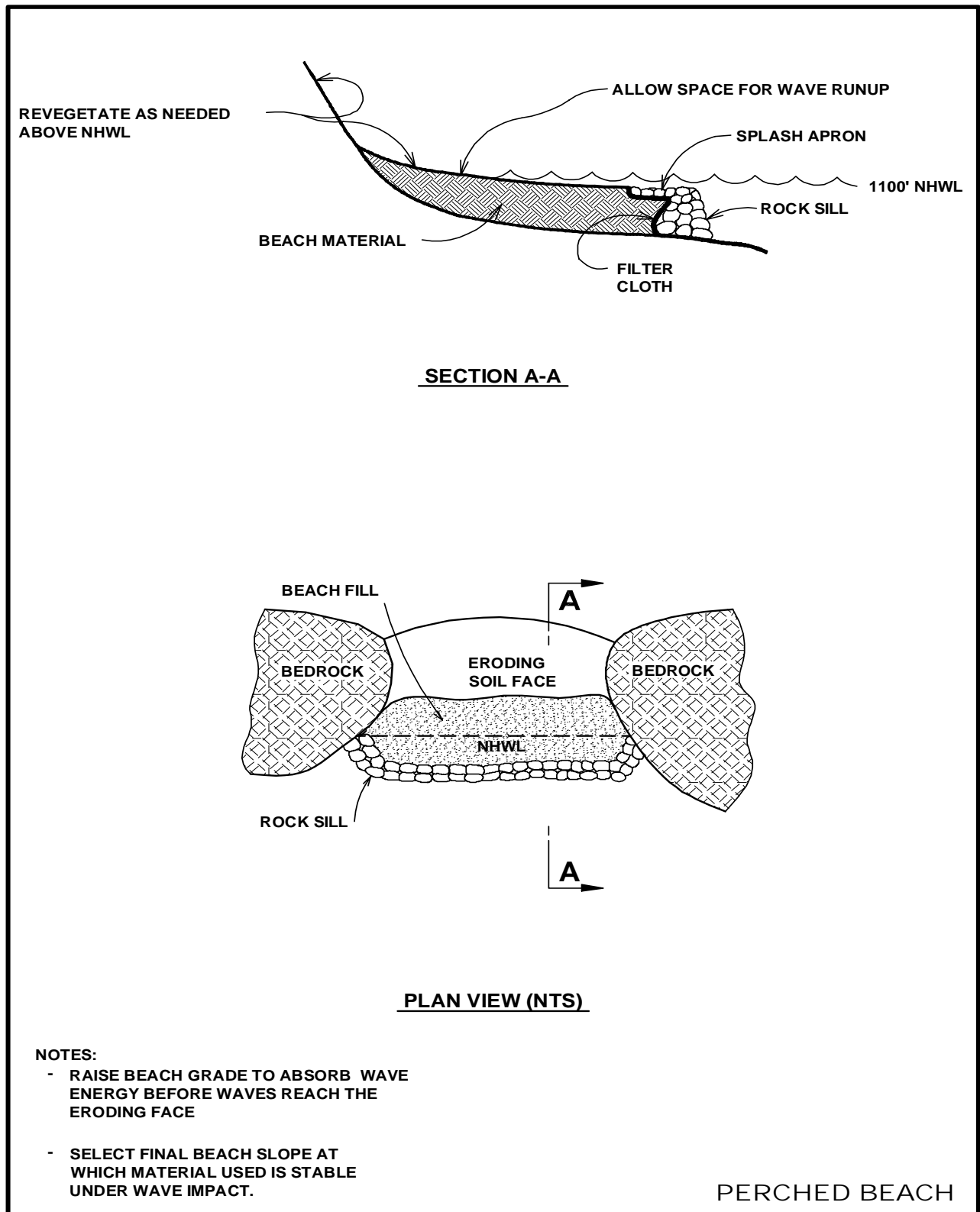


Figure 2-6: General Perched Beach Design

2.6 Monitoring and Maintenance

Monitoring of erosion control work will consist of: (1) monitoring of structures built under this plan from Table 2-1; and (2) monitoring of erosion rates and processes at selected sites from Table 2-3. This plan calls for systematic monitoring of existing structures and adjacent shorelines during the spring and/or fall drawdown periods. Necessary repairs will be made by the NPS to structures as soon as possible, coordinated with any similar or related work nearby. Maintenance will include rebuilding of rock aprons that protect the toe of the various types of erosion control structures. It will also include inspection and repair of the ends of structures.

All 38 erosion sites will be monitored at 20-year intervals using the 1999 inventory (Chelan PUD, 2000) as a baseline, together with reference photographs from the 1982 inventory. The NPS erosion control plan will include a schedule and strategy for monitoring and documentation of sites, including:

1. Trend monitoring (erosion rate and other significant changes) at selected sites; and
2. Updating the inventory of NPS sites contained in the 1999 study at 20-year intervals, starting on the 20th anniversary of the effective date of the New License. These updates will include photo documentation and current site sketches using the same or otherwise approved methodology.

The maintenance portion of the plan will include provisions for NPS to perform reasonable additional treatment on non-easement sites, based on agreement between Chelan PUD and NPS that observations from the monitoring program and/or observations at other times show a need for such treatment. It will include rough plans for treatment of non-easement areas not selected for mitigation in the erosion control plan, including previously identified sites that were not fully treated, new sites not previously identified, and the 14 sites identified and not selected for treatment in Table 2-3. In particular, the NPS may choose to add new or existing non-easement sites to the list of sites to be treated based on agreement between Chelan PUD and NPS that they meet the evaluation criteria used in the original analysis to select sites from Group 1 (Erosion) for treatment. As mentioned in section 1.1, selection of sites for treatment was based on a threat to NPS facilities.

Cost estimation for work at previously identified or new non-easement sites will follow the procedure used for the sites in the erosion control plan (i.e. \$60 x 4ft x site length). Additional funding for additional erosion control work shall be provided by Chelan PUD only once the total length of shoreline treatment on erosion sites (non-easement sites) exceeds the treatment length of 3,535 ft for which funds are already provided.

2.7 Cost Estimate

Cost estimates are provided in Table 2-4 for work to be performed on erosion sites as a basis for funding provided in this Chapter. This estimate is based generally on cost analysis of the Riddle Creek and Stehekin Landing Projects on Lake Chelan, where all material used was barged uplake. Estimated costs are provided in Table 2-5 for LWD and equipment to be used for mitigation work related to those sites and other work on NPS lands, including those in Chapter 4 and various recreational projects. Additional details on the cost estimation procedure are given

below in sections 2.6.1 and 2.6.2. The total estimated cost for all erosion control and LWD funding in this Chapter is \$576,500.

Table 2-3: Non-Easement Erosion Sites in Lake Chelan NRA Not Mitigated in the Erosion Control Plan

Site number	Site length	Active length	Location
63	350	100	Bridal Veil Creek
64	300	70	Canyon Creek
65	510	140	South Shore
66	210	50	South Shore
67	600	180	Castle Creek
68	740	340	One Mile Creek
69	75	20	South Shore
70	265	340	South Shore
88	290	40	South Shore
89	210	0	South Shore
106	210	50	South Shore
107	170	20	Lakeshore Trail
111	30	20	Lakeshore Trail
206	190	0	Bridal Veil Creek
Totals	4150	1370	

Table 2-4: Estimated Cost of Work to be Performed on Erosion Sites

Site No.	Erosion Control ¹	Reveg. Cost ²	Total Cost by Site	Site Name / Location
61	30,000	2,180	32,180	Riddle Cr. Cabins
79	36,000	2,620	38,620	Lake Trail
80	28,800	2,100	30,900	Lake Trail
81	62,400	4,550	66,950	Lake Trail
90	38,400	2,800	41,200	Manly Wham
109	19,200	1,400	20,600	Lake Trail
110	33,600	2,450	36,050	Lake Trail
Totals	248,400	18,100	266,500	

¹ Erosion control costs are based on a typical cost of \$60 per ft² for treatment of a 4-ft-tall strip. They include maintenance from year 10 to the end of the New License term, estimated to be \$50,000 for this group of sites, and equipment maintenance in years 10, 20, and 40 of the New License, estimated to be \$10,000 per occurrence.

² Revegetation costs are based on a cost of \$7 per plant and treating a 5-ft-wide strip with 1 plant per 2 ft².

Table 2-5: Estimated costs for LWD and related equipment

Item	Assumptions	Total Funds
LWD barge & gear	Purchased in year 1 of license	\$130,000
LWD crew & supplies	Average of \$3,600 per year	\$180,000

2.8 Erosion Cost Savings

Savings realized from erosion control work completed on individual sites will remain available for future site maintenance, cost overruns, monitoring and rehabilitation during the remainder of the New License term.

2.9 Relationship to Other Plans

The erosion control plan contained in this Chapter is closely related to the LWD management plan contained in Chapter 3 and the Stehekin Area Management Plan contained in Chapter 4.

In response to these needs and concerns, this plan calls for the NPS to build LWD structures at several key sites along the lake to mitigate for the construction of large rock walls without wood and to improve fish habitat. These sites include those where LWD is the primary erosion control agent (Figure 2-1; sites 71, 81, and 90), the mouths of two small tributaries from a list that includes Riddle, Hazard, Fourmile, Flick, Castle and Bridal Veil creeks, and may include dust source areas on Stehekin Flats.

Natural accumulations of LWD along shorelines will not be reduced to provide LWD for work described in this Chapter. The LWD management plan is not designed to remove all of the wood from Lake Chelan. Only large pieces of wood will be relocated to erosion control sites, or the sites listed above. However, not all large wood pieces floating in the lake will be collected and used. Some wood will continue to be allowed to move freely downlake from the Stehekin River.

Erosion control work at cultural sites on NPS land will be planned and funded as provided in Chapter 10, relating to Historic Properties and Cultural Resources Management.

2.10 Permits

Permits for erosion control work within the Lake Chelan NRA must be obtained from two agencies. WDFW issues hydraulic permits, while the USACOE issues Clean Water Act 404 permits. Under this plan the NPS would obtain appropriate permits for all 16 sites, as well as the LWD structures. Permit applications would be filed as final designs are completed in the year before an erosion control structure is installed. If possible, permits with a term of at least three years will be sought.

State of Washington Shoreline Management Act permits will not be acquired for work at these sites. The Shoreline Management Act does not apply to federal actions on federal lands.

SECTION 3: LITERATURE CITED

Chelan PUD, 2000. Inventory of Shoreline Erosion, Lake Chelan and Bypass Reach Study Report – Final, Lake Chelan Hydroelectric Project No. 637. Chelan PUD, Wenatchee, Washington. September 1, 2000.

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