PRELIMINARY EVALUATION
OF BOAT LAUNCHING AND BOARDING OPTIONS

Incline Village, Nevada

Prepared for:

Incline Village General Improvement District
Parks and Recreation

By:

Earl G. Hagadorn, P.E.
Consulting Civil Engineer

In Association With:

Randall L. Moory
Consulting Water Science

February 29, 1996

Contents Page

Contents **Page**

Tables

Figures **Following Page**

Contents **Page**

PRELIMINARY EVALUATION
OF BOAT LAUNCHING AND BOARDING OPTIONS

I. SUMMARY AND CONCLUSIONS

Introduction

The Incline Village General Improvement District has an existing boat ramp near the east end of Incline Beach, and has considered relocating that launching facility to either Burnt Cedar Park or near the west end of Incline Beach. The existing and potential sites are shown in Figure 1, and this study is intended to provide a preliminary evaluation of improvement options at each of these sites.

Background

The existing Incline Village boat ramp is located at Ski Beach between Third and Incline Creeks as shown in Figure 2. It is a shallow ramp with the lake end only 3 inches above the mean low water elevation of 6223, Lake Tahoe Datum. The ramp has no boarding pier, and is effectively useable only when lake elevations exceed 6226.

In April, 1991 the lake level was at elevation 6222.33 with projections that, after rising to just above 6223.0 in early summer, it could fall to 6222.0 by the end of September. The ramp would be unusable under those conditions, and IVGID secured approval in May, 1991 from the TRPA Governing Board to place a temporary 170 foot extension to the ramp. The extension would have utilized military landing mats, but it was never constructed and the TRPA permit expired.

The drought continued with a record low water elevation of 6220.5 in the fall of 1992. Lake levels were slow to recover, and in April, 1995, TRPA granted IVGID a permit for a temporary extension of 50 feet to the boat ramp. Lake levels rose rapidly after the wet winter and were projected to rise to 6227, and the extension was not constructed.

On July 20, 1993, the IVGID Director of Parks and Recreation, Douglas A. Doolittle, met with the TRPA Shorezone Committee to discuss the continued problems of launching boats at the existing ramp. Earlier in the same meeting, Richard Mudgett, an Incline Village resident, had presented suggestions for alternatives to the existing ramp which included the construction of a new boat ramp facility at Burnt Cedar Beach. Committee members discouraged the proposal for a Burnt Cedar facility, and while they agreed that IVGID had a problem, they could not suggest any solutions. The problems of launching at low lake levels, and boater safety during high wave activity were stressed to the Committee together with concerns that current TRPA codes did little to assure that future solutions would be permissable.

On July 29, 1993, the IVGID Board of Trustees sponsored a Shorezone Workshop to facilitate discussion between Board members and a panel of invited experts, with public

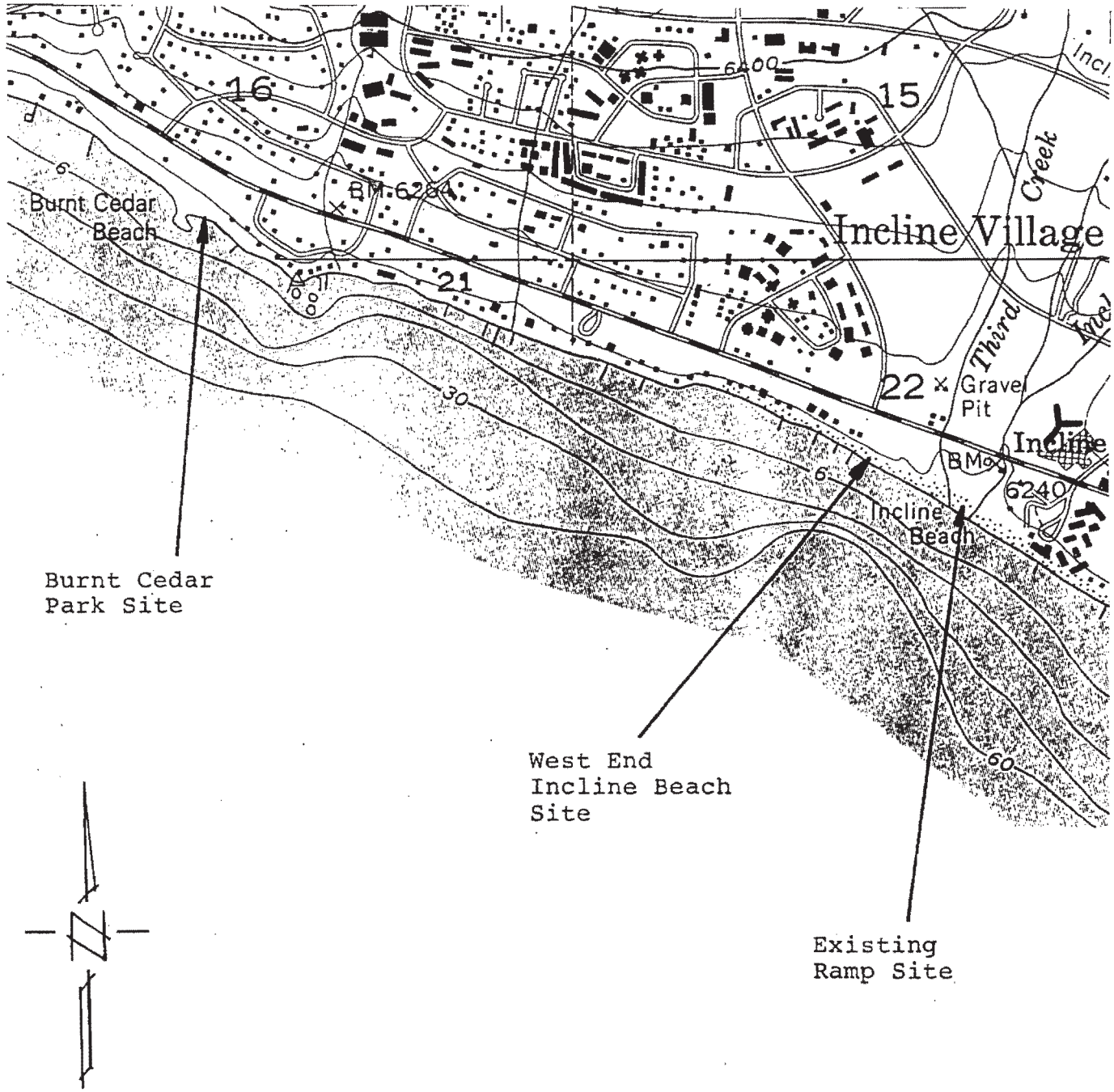


Figure 1 Location of Existing and Potential Launching Sites

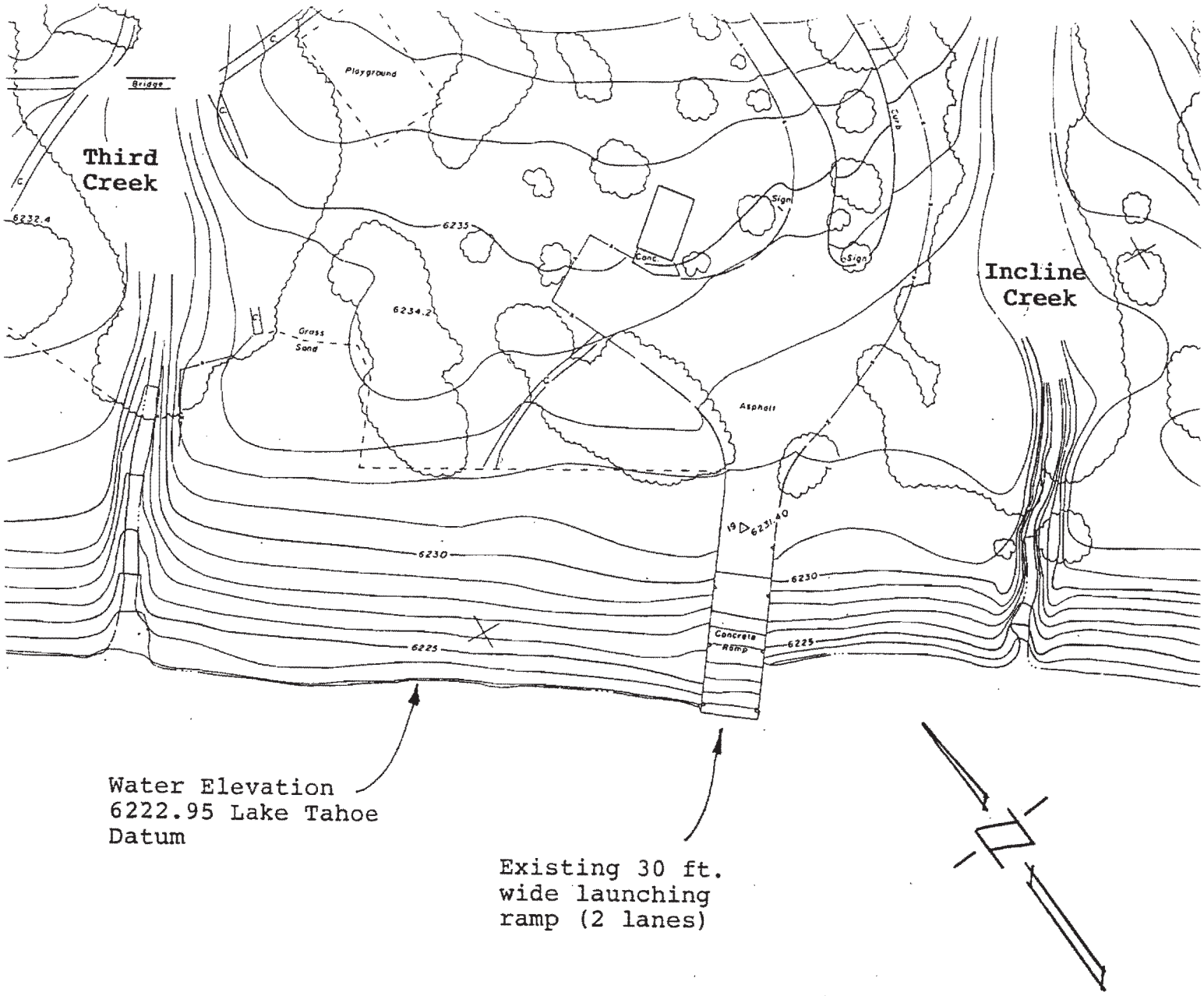


Figure 2 Existing Launching Ramp

presentations and comments thereafter. The Workshop was intended to be a "thinking" meeting to provide a basis for determining future steps that might be taken to improve launching and retrieval for local boaters.

Scope of the Preliminary Evaluation

At a meeting on June 30, 1995, IVGID staff expressed their preferences for a preliminary evaluation of options as opposed to more detailed site investigations and analyses such as site specific littoral drift studies and computer modeling of design waves. The focus of the evaluation was to be on a review of information already compiled for the existing boat ramp and the alternative launching sites at Burnt Cedar Park and the west end of Incline Beach; the general familiarity of the consultants with the wave climate and littoral transport characteristics of the area; the knowledge of the consultants regarding launching ramp design and use parameters; and discussions with the staffs of concerned regulatory and administrative agencies.

Evaluation of Options

Options for improving the existing facility or for constructing a new facility have been compared in terms of the following evaluation criteria:

1. That a breakwater be provided for boater safety that would not involve an attendant risk of significant shoreline erosion or deposition.

   A breakwater should be at least 300 feet from the shoreline in order to minimize the risk of significant shoreline erosion or deposition. (See "Breakwater Options" in Part II)

2. That the facility be useable at the mean low water elevation of 6223, and preferably during an extreme low lake level of 6220; and that the ramp and access features comply with accepted design criteria for features such as slope and lane width.

   A ramp toe elevation of 6220 is required for use at the mean low water elevation, and 6217 for preferred useability at the extreme low lake level.

3. That the option is possible under the existing regulations and policies of the Tahoe Regional Planning Agency and the Nevada Division of Wildlife.

The following is a summary description of the options and a tabular comparison in regard to the evaluation criteria.

Existing Ramp Facility

Permanent physical improvements of any kind, such as a new boarding pier or breakwater, will not be permitted since the existing ramp lies within 120 feet of Incline Creek, and new improvements within 200 feet of a creek mouth are prohibited by TRPA ordinances. The Nevada Department of Wildlife has pending restoration and fish stocking projects for Incline Creek and would not support new improvements to the existing facility.

Therefore, the existing facility is evaluated in its present condition as a "no project" option.

Past Proposal for a New Facility at Burnt Cedar Park

The July 6, 1993 proposal for a launching ramp facility at Burnt Cedar Park is shown in Figure 3 and appears to have a ramp toe elevation of about 6217 and access to the lake that would be achieved by dredging out to deeper water. It also proposed a rock rip rap breakwater extension to the existing jetty to protect the ramp. The proposal showed both the breakwater and the dredged channel as encroaching past the lakeward extension of the park boundary onto submerged lands in front of private properties to the east.

Any modification to this proposal to meet the evaluation criteria would involve the same elements as the modified proposal for a Multiple Use Facility at the West End of Incline Beach, but with greater potential costs and impacts on neighboring residential properties. Therefore, only the past proposal is evaluated for this site.

Past Proposal for a New Facility at West End Incline Beach

The February 9, 1994 proposal for a launching facility at this site is shown in Figure 4, and included a ramp with a toe elevation of 6217 that would be achieved without dredging. The ramp and adjacent access pier was aligned to the south and wave protection provided by breakwater segments beneath the pier and lakeward of the end of the ramp.

A subsequent survey of bottom elevations by IVGID staff showed that this ramp would not reach a toe elevation of 6217 without dredging. That fact, together with the close proximity to shore of the proposed breakwater elements and the potential for shoreline erosion, prompted the revisions evaluated under a separate Multiple Use Facility option. The past proposal is evaluated below without revision.

Potential Multiple Use Facility at West End Incline Beach

In order to provide wave protection at either the Burnt Cedar or West End Incline Beach sites, the breakwater would have to be located about 300 feet from shore to avoid significant shoreline erosion and deposition. By locating the breakwater further offshore,

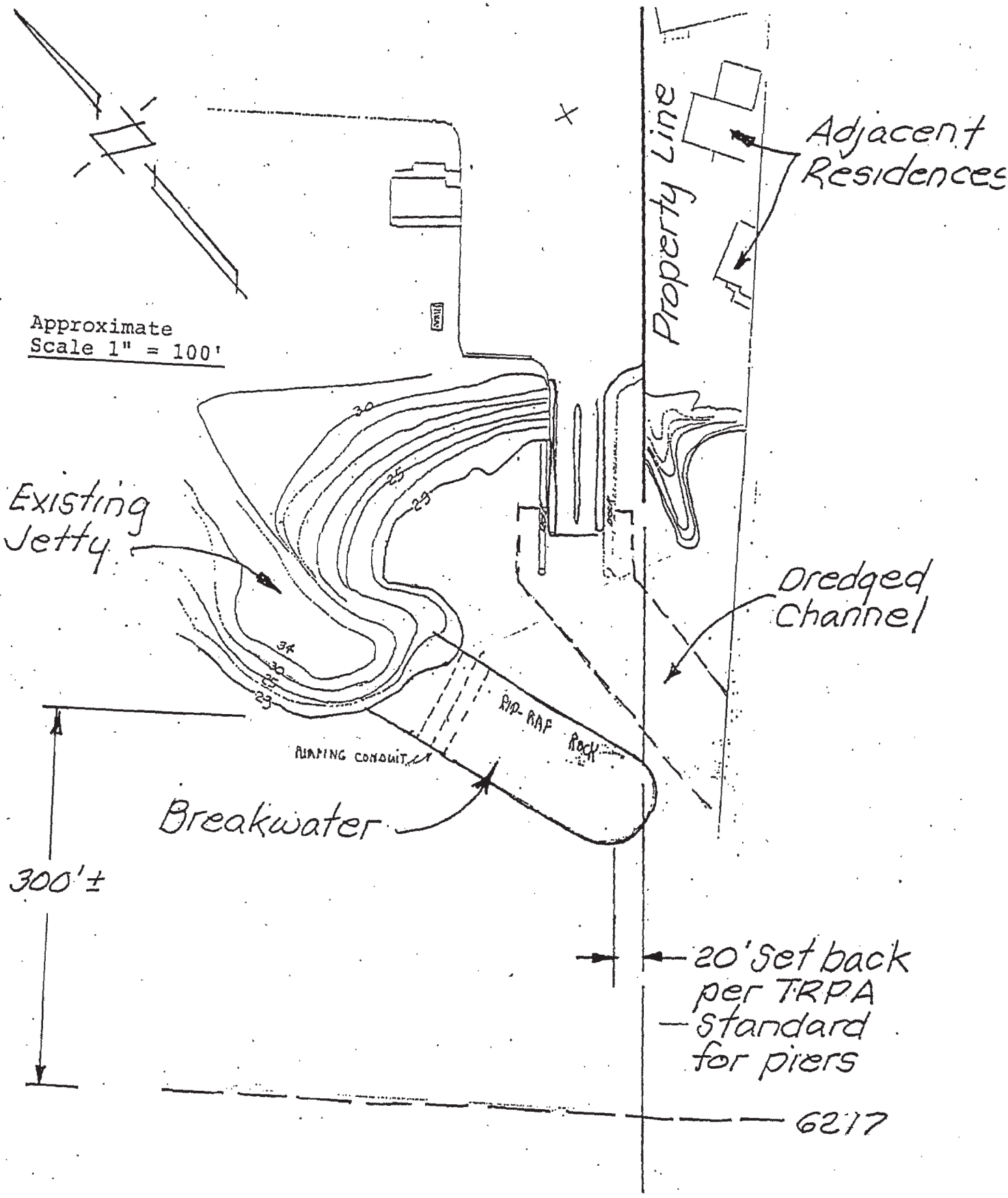
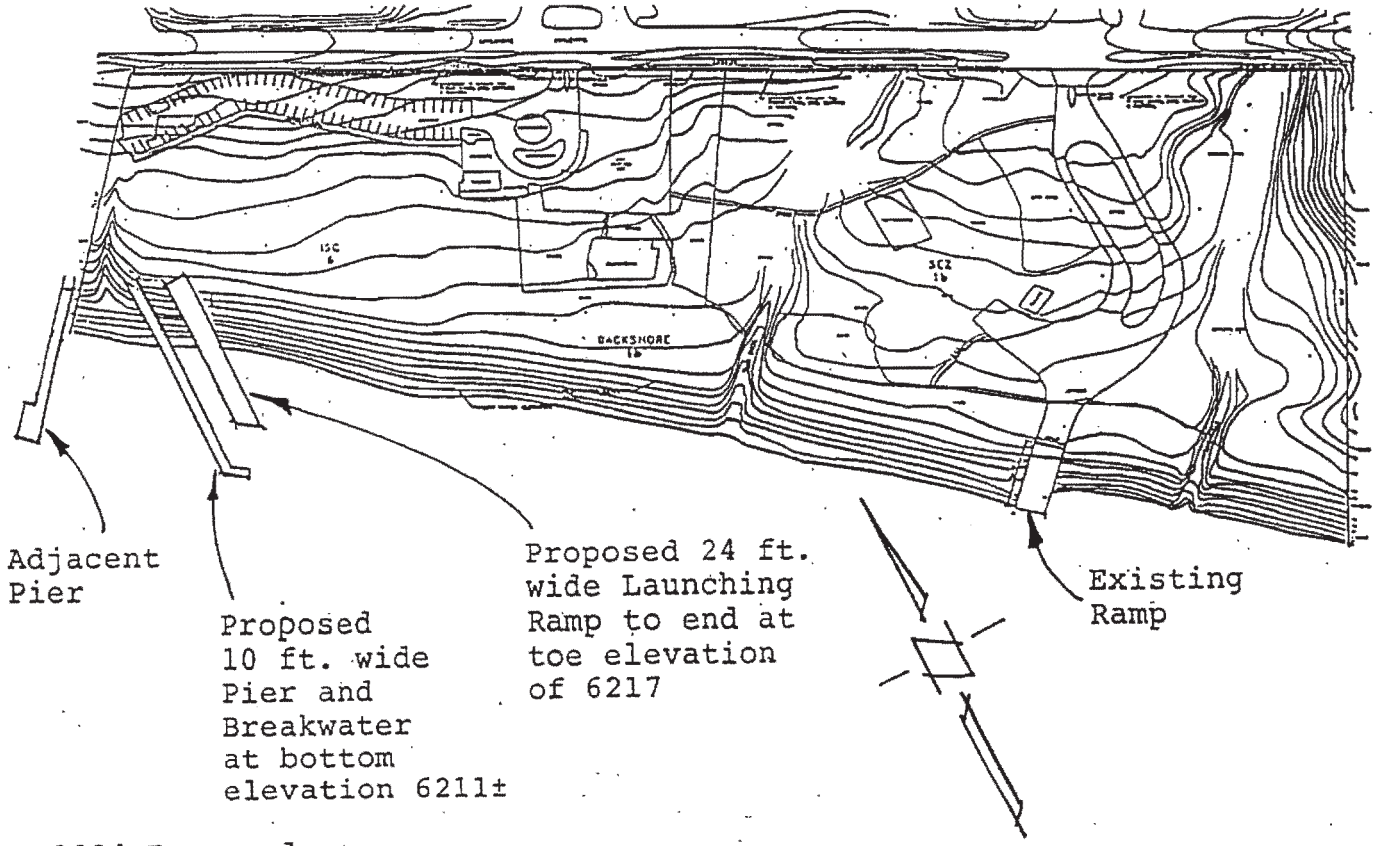
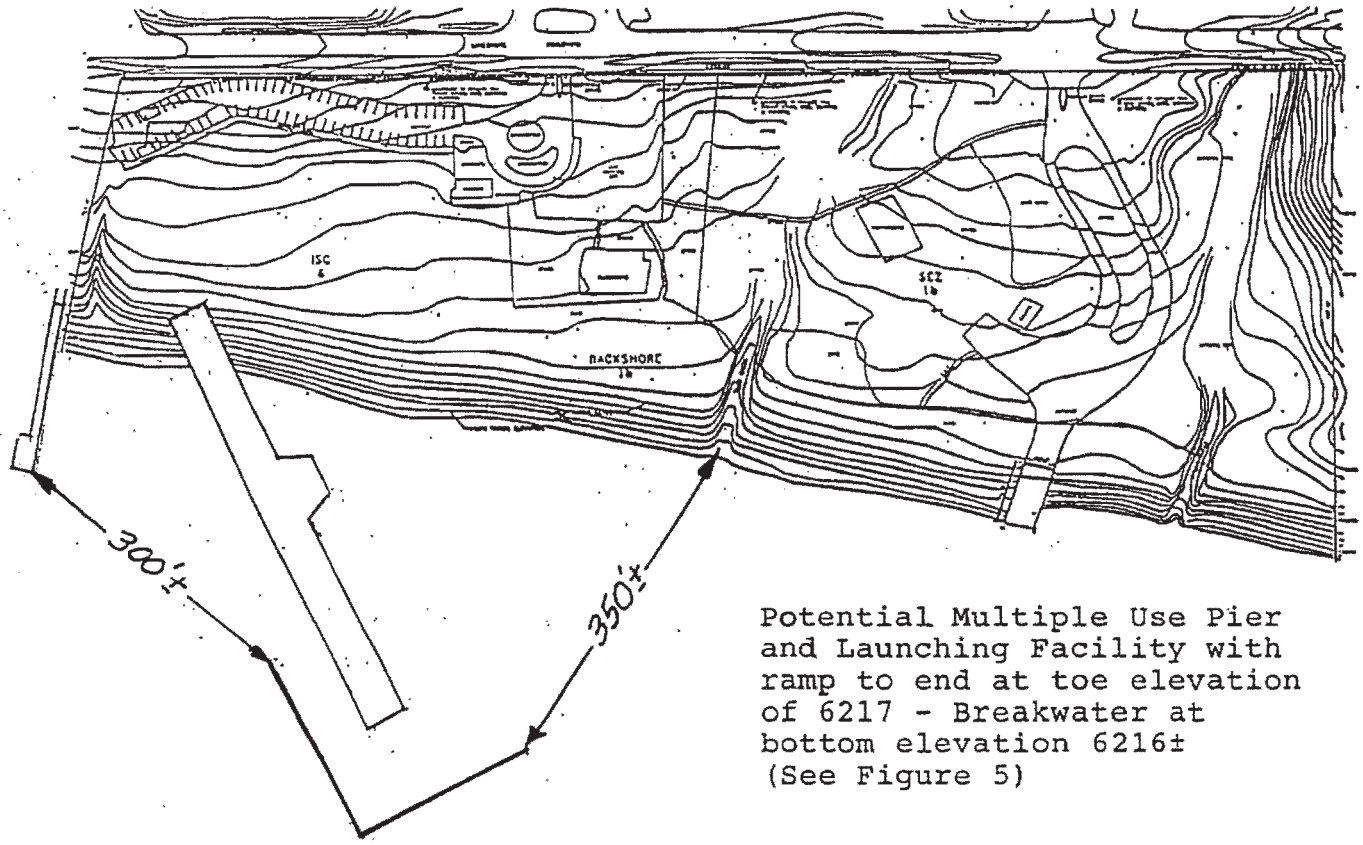


Figure 3 1993 Proposal for a L ing Ramp at Burnt Cedar Park



1994 Proposal



Potential Multiple Use Pier and Launching Facility with ramp to end at toe elevation of 6217 - Breakwater at bottom elevation 6216± (See Figure 5)

Conparison to Potential Multiple Use Facility

Figure 4 1994 Proposal for Launching Facility at West End Incline Beach

the ramp can also be placed in deeper water that would meet extreme low lake launching objectives.

A potential multiple use facility is shown in Figure 5, and would consist of an open piling vehicular access pier with the launching ramp at the end and a lakeward breakwater that would protect both the ramp and the boarding area. The pier would also provide pedestrian access along a walkway adjacent to the vehicular lanes and separated by a safety railing. A turnaround would be provided midway along the access pier to limit the distance that drivers would have to back to reach the ramp.

As shown in Figure 4, the easterly end of the breakwater would be about 350 feet from the mouth of Third Creek, and the westerly end would be about 300 feet from the adjacent single family pier.

There is the possibility that the facility could be used for tour boat or over water transport access. TRPA staff pointed out that the Hyatt is considering a long pier for such a purpose, and that benefits to both Hyatt and IVGID might be realized by abandoning the proposed Hyatt pier and incorporating that lake access into a District multiple use facility at the west end of Incline Beach. Potential benefits from incorporation of a tour boat access under such a joint sponsorship include lower capital costs by joint participation for both the lakeward facility and upland support parking, as well as income generated from an agreement with tour boat or water transport operators.

Table 1 Comparison of Options

	Attainment of Evaluation Criteria		
Option	Wave Protection	Useability	Regulatory Constraints
Existing Facility - No Project	No	No	Nonconforming
Past Proposal Burnt Cedar Site	No		No
At mean low water 6223		Yes	
At extreme low lake 6220		Yes	
Past Proposal West End of Incline Beach	No		No
At mean low water6223		Yes	
At extreme low lake 6220		No	
Multiple Use Facility West End of Incline Beach	Yes		Possible
At mean low water 6223		Yes	
At extreme low lake 6220		Yes	

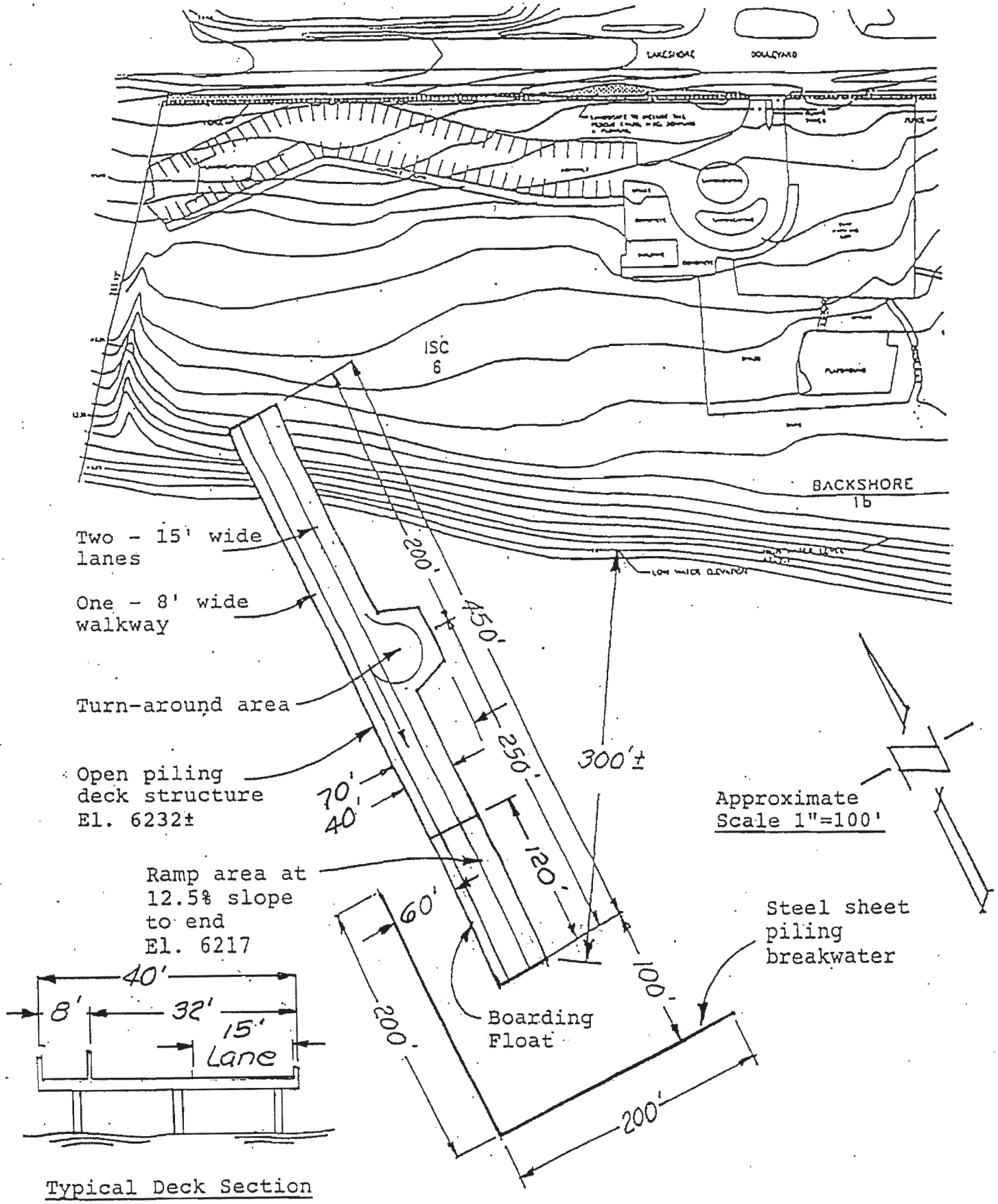


Figure 5 Self-Launching Boat Ramp Facility at West End Incline Beach

Regulatory Constraints

TRPA advance planning staff does not consider the potential for increase in persons using a new multiple use facility to be an insurmountable problem since the allocations for new lakeside recreational use are "underused." It was also emphasized that unrestricted public access has not been adopted as a board policy, and that the definition of public access in future projects would be dealt with in specific project application reviews.

The scenic aspects of a new breakwater and those portions of the pier structure visible from the lake will be closely addressed by TRPA, and it will be important to soften the visual impacts. This can be done by minimizing the profile of the pier and varying the top line of the breakwater as shown in Figure 6. For purposes of estimating potential costs, the steel sheet breakwater alternative with varied top line elevations is used since a rock rubble breakwater could increase breakwater costs by up to 30 percent.

Both the TRPA and Nevada Division of Wildlife staff representatives believe that any identified impacts on fish habitat or spawning areas might be significantly mitigated by the removal of the existing ramp, and that the potential of consolidating the pending Hyatt proposal for a new tour boat pier east of Incline Beach with the IVGID proposal could add further mitigation.

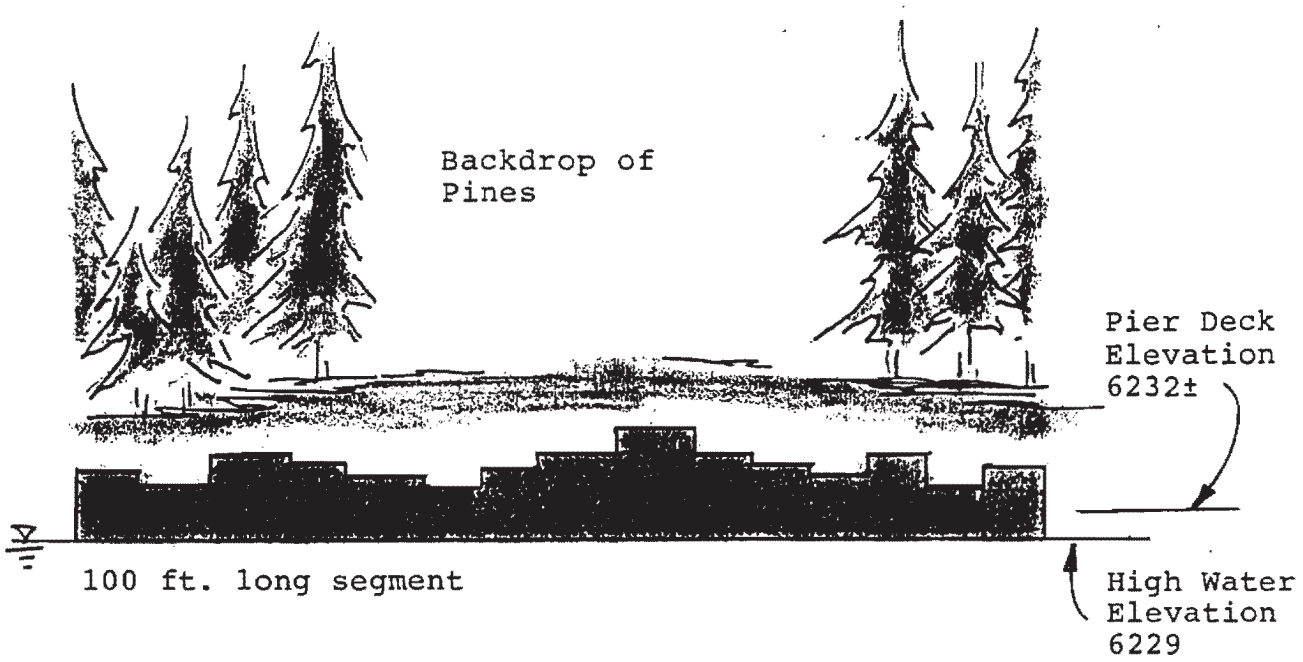
Conclusions

The West End Incline Beach is recommended as the best and only practical site for a new facility that can provide boat launching under extreme low water conditions with potentially acceptable environmental impacts given the attendant removal of the existing boat ramp.

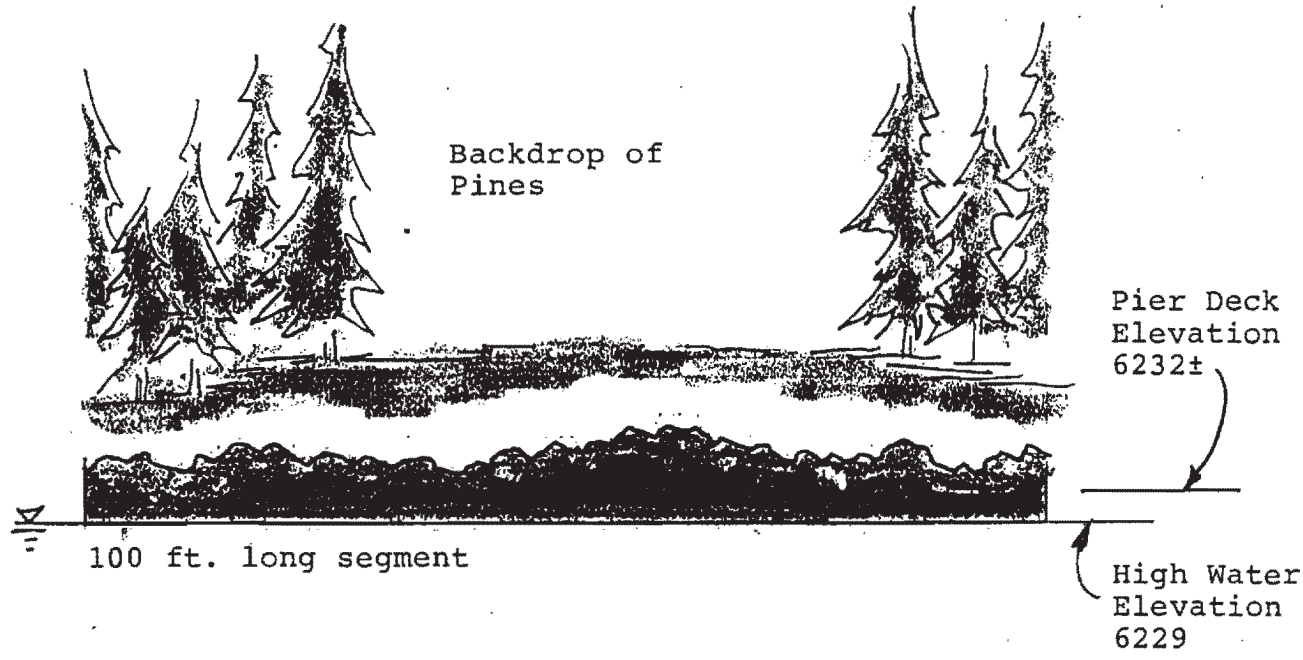
The possible installed cost of the Multiple Use Facility at this site, excluding upland costs for parking and access could approach $ 3,200,000; and the District must decide whether further investigations of this option are feasible. It has been reported that such a facility might prompt a legal challenge from adjacent owners, but no attempt has been made to quantify such a risk or the cost of responding to such a challenge.

Should the Board of Trustees decide to investigate this option further, then they should authorize detailed planning studies and the preparation of a complete project plan that includes both the lakeward launching facility and the upland access and parking components. The project plan would also include an environmental information report that would include visual graphics to address TRPA scenic value concerns as well as other required technical and site investigations to demonstrate the viability of the project.

As a prelude to detailed planning studies, it is recommended that District staff be authorized to explore the potential for cooperative efforts with the Hyatt regarding the tour boat/water transport access and upland support facilities.



Steel Sheet Piling Breakwater with Top that varies from 6234 to 6240



Rock Rubble Mound Breakwater

Figure 6 Illustrations of Softening Breakwater Profile

II. PRELIMINARY STUDIES AND INVESTIGATIONS

Where technical terms are italicized in the following sections, their definitions may be found in the Glossary, Appendix A.

General Description of the Wind and Wave Climate

Deepwater wave conditions for Crystal Bay are some of the most significant in Lake Tahoe. Presented in the following tables are predicted *wave heights* and *periods* for extreme events and for normal seasonal conditions. The extreme event analysis focuses on winter periods when wave growth is greatest. The seasonal predicted wave heights and periods are for warm month conditions from late spring to early fall.

An Army Corps of Engineers numerical model was used for these predictions. The model inputs included wind directions, wind duration and speed, *fetch length*, and temperature differences between the lake water and the atmosphere. The model predicted that wind developed waves from the south southwest would have the greatest impact on the existing and potential sites, and that the *longshore component* of these waves would develop an easterly flow in the *littoral zone*. Tables 2 and 3 show wave conditions predicted for Incline Beach.

It should be noted that although winds may come from the south and southeast, waves generated by these winds will be turned by *refraction* as they pass over the shallower bottom contours and approach the shoreline from a more southwesterly direction. Therefore, boats being launched or retrieved on a ramp may often be subjected to wind forces from one direction, and wave forces from another direction. It is essential for boater safety that at least one set of these forces be blocked, and it is usually the wave forces that are blocked by a protective breakwater.

Table 2. Deepwater Wave Characteristics During Extreme Events

Wind Speed (mph)	Wave Height (ft)	Wave Period (sec)
50	8-9	5.8-6.0
60	10-12	6.5-7.5
70	13-15	7.0-7.5
80	15.5-17.0	7.7-7.9

Table 3. Deepwater Wave Characteristics During Normal Warm Season Conditions

Wind Speed (mph)	Wave Height (ft)	Wave Period (sec)
10	0.5-2.0	2.4-3.0
20	2.4-2.6	3.4-3.5
25	3.3-3.5	3.9-4.2
30	4.3-4.5	4.3-4.4
40	6.0-7.0	5.1-5.4

Littoral Zone Characteristics

Longshore sediment movement along the Crystal Bay shorezone is described in "Sedimentology of the Littoral Zone in Lake Tahoe, California-Nevada" (Osborne, Robert H. et al., 1985). Dr. Osborne finds an easterly movement of sediments along the Crystal Bay shoreline. This study also documented an easterly flow near the Incline Beach project sites. His conclusions are that there is a resultant eastward component to *longshore transport* in Crystal Bay, that *bi-directional transport* is also evident, and that these transport vectors are of minor importance when compared to *onshore-offshore transport.*

Osborne examined the presence of sediments derived from volcanic rocks found in a seawall directly adjacent to Incline Beach. This presence of volcanic rock *petrofacies* in the littoral zone documents the easterly *littoral transport* trend. The presence also documents the intensity of the transport. Osborne states, "The analysis of *synoptic* winds . . . indicates that Crystal Bay might be expected to experience rather persistent, eastward-directed, longshore sand transport. If this were the case, the minor volcanic-enriched petrofacies at stations 61 and 62 should be diluted beyond identification by much more voluminous sand from the west. Although some dilution may occur, the temporal persistence of the minor petrofacies suggests that there is little net transport to the east."

The impact of Third and Incline Creeks was also studied by Osborne in June, 1983 by sampling stream deposits and the characteristics of the beach 50 feet from the mouths of the streams. Dr. Osborne concluded that the influence of sand discharges from Third and Incline Creeks could not be found on the beaches 50 feet away from the mouths, a

conclusion that reinforces the strong onshore-offshore transport and the minor longshore transport.

The Osborne study also documents a canyon near the site of one of the proposed launch facility sites at the west end of Incline Beach. This canyon acts as a sink and removes longshore transported sediment material from the littoral zone.

Third and Incline Creeks obviously contribute sand to the shorezone of Crystal Bay, and Glancy (1971) examined the contribution from the discharge of sediment from Third Creek. Glancy reported a total sand discharge of 3,128 cubic yards in 1970. During the highest recorded stream flow for that year, 35 percent of the discharged sand was coarser than 1.0 mm, and only 19 percent was coarser than 2.0 mm. Mean grain sizes that are *hydrodynamically stable* on the beaches range from 0.75 mm to 2.15 mm in diameter. Thus, a maximum of 1,095 cubic yards of sand sized sediment was delivered and remained on the beaches in 1970. Assuming an annual delivery of this volume of sand, a beach of up to 44 feet long and 20 feet wide could be maintained by sand contributed from Third Creek. Since Osborne found no evidence of this discharge 50 feet away from the mouth of Third Creek, it illustrates that a great deal of the sediment delivered by the streams is carried out into the *nearshore area* with the finer particles (less than 0.75 mm) lost to deep offshore waters beyond the littoral zone.

In summary, the severe winter storms mobilize these stable sands in the deeper waters of the littoral zone and bring them up to the shallower waters where they are gradually moved back out to deeper water by the summer storms.

Breakwater Options

There are a number of *wave attenuation* methods that could be used, and they range from fixed to floating breakwaters. Fixed breakwaters include rock rubble mounds and steel sheet piling structures. Floating breakwaters range from partially submerged bouy fields to floating structural shapes of several different geometries, all of which are anchored to the bottom. Air bubble plumes rising from perforated pipes on the bottom also attenuate waves, but they are not effective against the high energy wave *regime* in Crystal Bay, nor are they effective in irregular, choppy conditions.

The difficulty of anchoring floating breakwater devices in the high energy waves that will be encountered, and the attendant wear on anchoring cables and connections have prompted the use of fixed breakwater options for the purpose of this evaluation. The possibility of floating breakwaters may be revisited if final design investigations are undertaken which would include information about the offshore bottom materials.

The problem with all of these devices is that they, by design, block wave energy from a given segment of shoreline where the protection is desired, and cause deposition of littoral sediments behind the breakwater as the waves are attenuated and lose their power to move material. Material trapped behind the breakwater can no longer replenish sands

lost to the shoreline on either side of the breakwater, and this loss may be replaced instead by sands newly eroded from the shoreline.

As a breakwater segment is placed further from shore, it casts a smaller "shadow" on the shoreline until its effect is diminished to the point that the resulting deposition of littoral sediments becomes negligible. Figures 7 and 8 illustrate the way that incoming waves are *diffracted* around the ends of a breakwater with attendant loss of wave height and energy.

A breakwater about 300 feet in length parallel to the shore and more than 300 feet from the low water mark should not cause significant erosion or deposition along the Crystal Bay shoreline. Some deposition will occur offshore behind the breakwater, but this can be addressed in preliminary design studies that would review the efficacy of such features as low level openings in the breakwater through which fine sands might be sluiced out to deeper water.

Boat Ramp Design Considerations

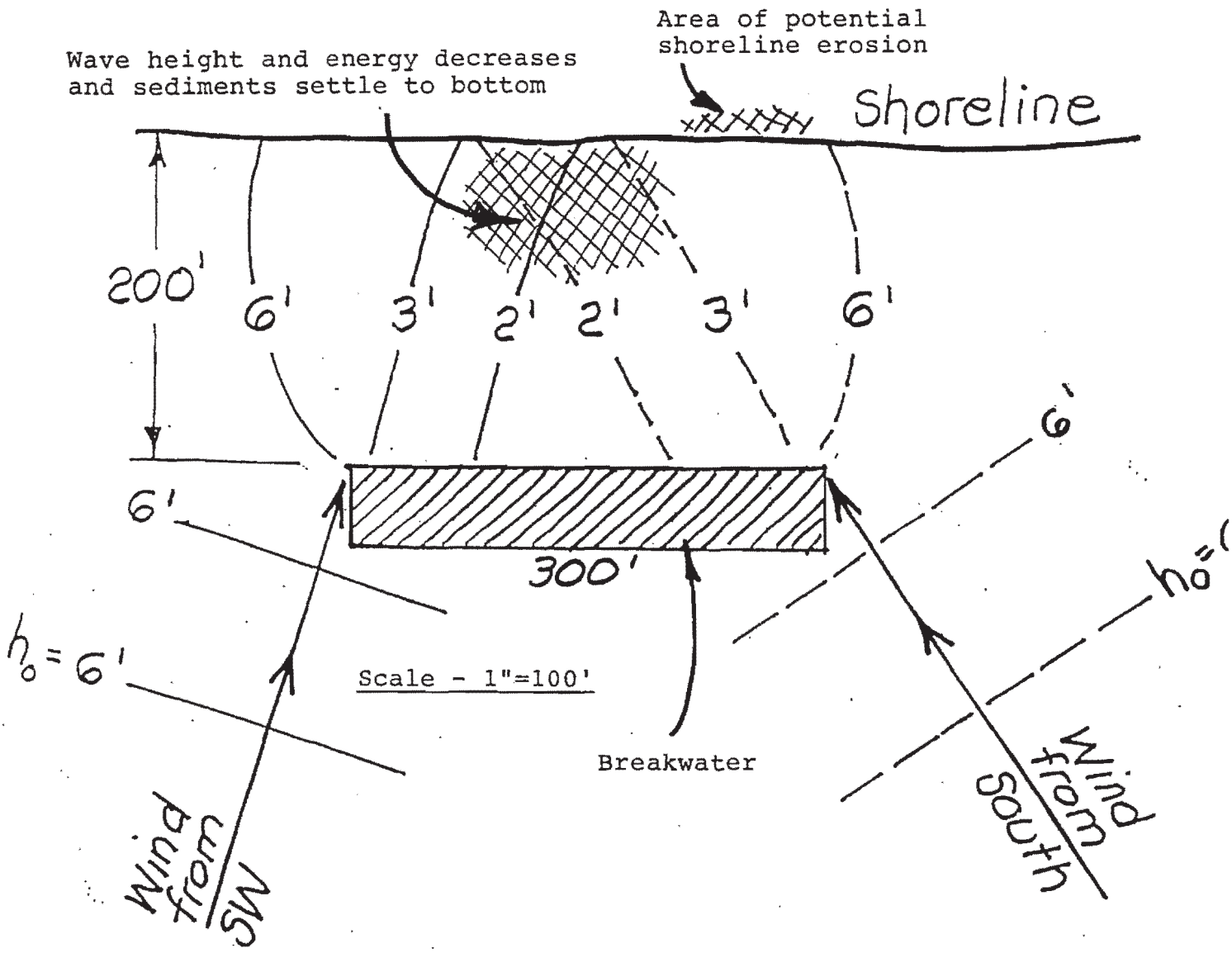
The California Department of Boating and Waterways generally requires that the toe elevation at the end of the ramp be at least 3 feet below design low water, and that the slope of the ramp be no less than 12 percent nor greater than 15 percent. Flatter slopes present the risk of losing submerged brakes before the water is deep enough to float the boat, and steeper slopes are not appropriate to safe launching.

The record low lake level is 6220.5, and the mean low water is 6223.0 *Lake Tahoe Datum*. Recent proposals by Incline Boaters for new ramps at Burnt Cedar Beach and Incline Beach were for ramps with toe elevations of 6217.0 in order to maintain effective use during extreme low lake levels. That toe elevation is used for the purposes of this preliminary evaluation of options, and the question of changing this criteria can be addressed in subsequent preliminary design should the District decide to proceed with such studies, and wish to identify the reduction in costs from raising the toe elevation.

The existing and potential sites all have shallow water conditions that would preclude their effective use during low lake levels without the use of an elevated deck to get out far enough to have a ramp at the end that would have a toe elevation of 6217 and a slope within the recommended design criteria.

Although the 170 foot long extension to the existing ramp proposed in 1991 would have ended at a bottom depth of about 6217 as measured in March, 1994, the slope of that extension would have been less than 1 percent for the lakeward 120 feet in comparison to the minimum recommended slope for launching ramps of 12 percent.

Any dredging of the bottom sediments to achieve lower ramp elevations would be quickly filled in with sediments mobilized by the high energy wave climate, not to mention the probability that permits for such work would be denied by the regulatory agencies.



Incident Deep Water Wave (h_o)

Wind speed - 40 mph
Wave height - 6 ft.
Period - 5.1 sec.
Length - 130 ft.±

Figure 7 Potential Shoreline Erosion and Deposition Behind Nearshore Breakwater

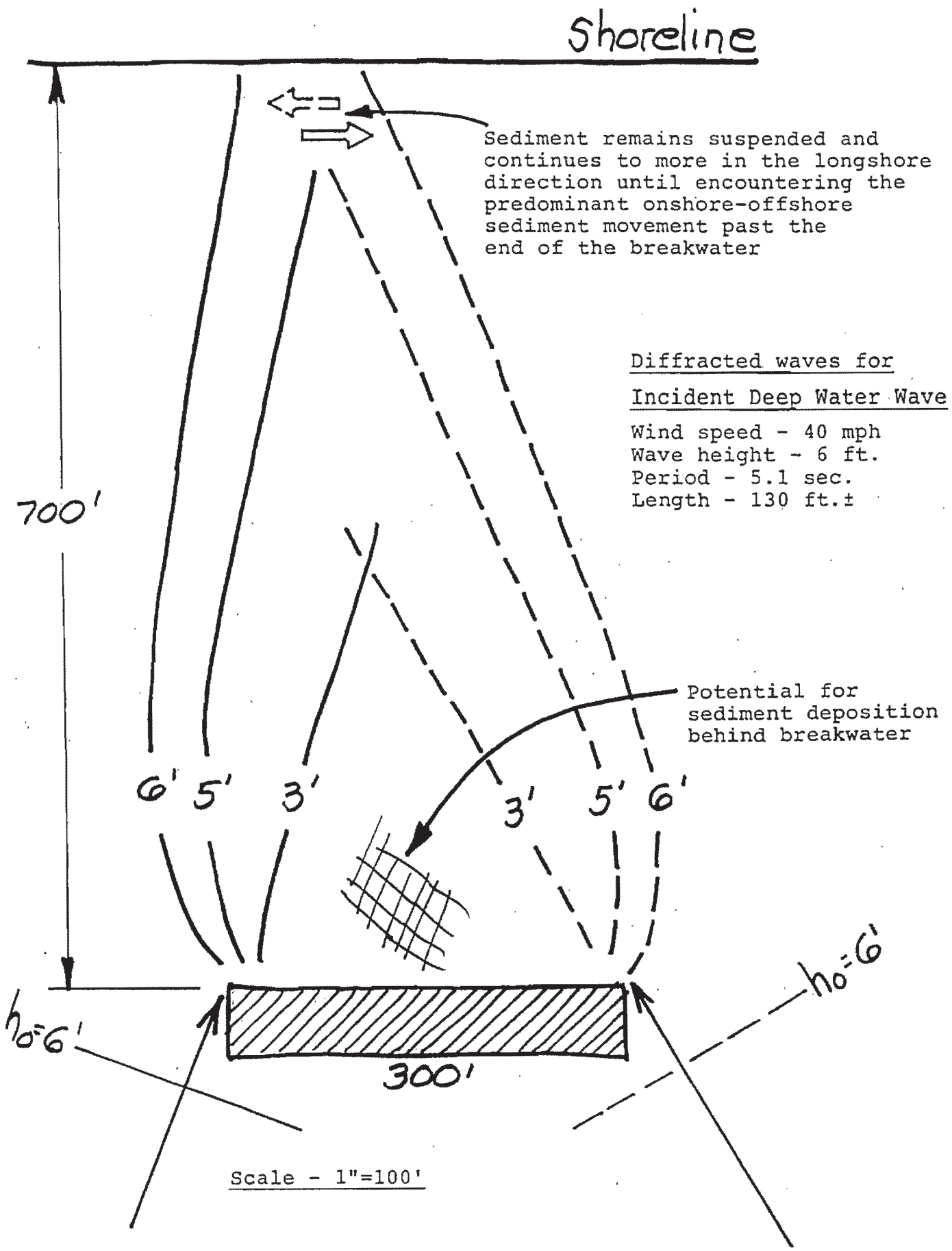


Figure 8 Sediment Movements Behind Offshore Breakwater

Therefore, an elevated deck is required and must be supported on open pipe piling since the use of a solid or semi-permeable support such as steel sheet piling or rock rip rap jetty would not be appropriate due to potential adverse shoreline erosion and deposition.

Randy Moory previously studied the impacts of structures supported by open piling in Lake Tahoe, and found that the open piling would present some interference with longshore sediment transport. Through statistical analysis of over 30 piers in Lake Tahoe, Mr. Moory found that these structures induced a *fining trend* across the width of the pier by disrupting wave flow through the open pilings, but determined that this effect was insignificant.

Potential for a Multiple Use Facility at West End Incline Beach

Offshore Water Depths

The offshore canyon mentioned in the Osborne study is shown in Figure 9 which is taken from U.S. Coast and Geodetic Survey Chart 18665 for Lake Tahoe. This chart indicates a bottom elevation of 6216 approximately 360 feet from the shoreline. The actual bottom elevations would have to be confirmed, but the foregoing may be accepted as an indicator that depths of 3 feet or more may exist some 300 feet from shore during an extreme low lake level of 6220.

The foregoing is in general agreement with bottom shots obtained by IVGID in March, 1994 and shown in Figure 10. The open-piling pier and ramp are in the same general location and alignment as those proposed by Richard L. Mudgett in February, 1994. However, the end of ramp in that proposal would have been at a bottom elevation of 6219 rather than the 6217 indicated, and Figure 10 shows a structure long enough to achieve the desired toe elevation about 300 feet from the low water line.

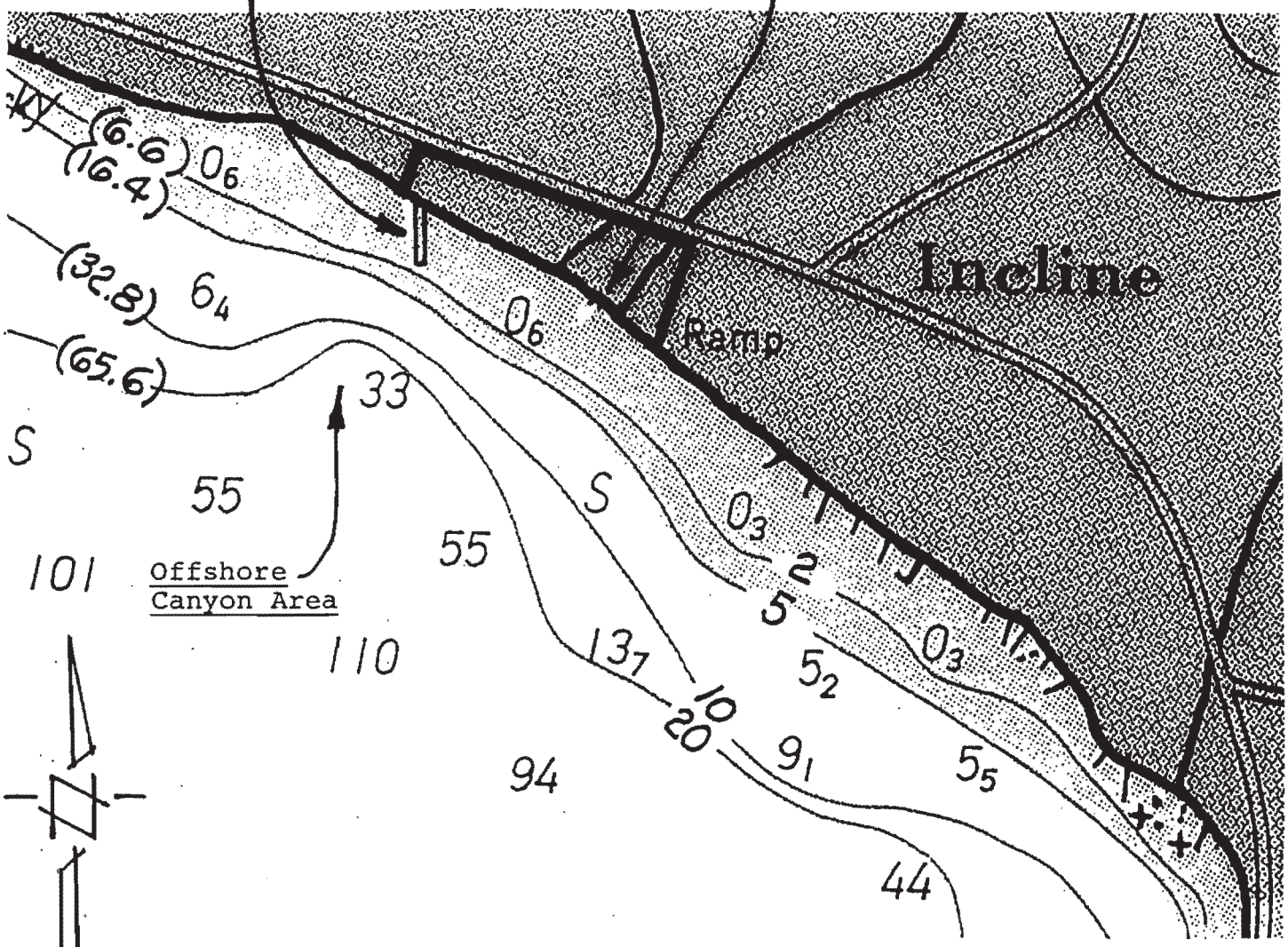
Possible Features of a Multiple Use Pier at Incline Beach

Boat Launching

The options for launching off an open pile pier structure range from a broad access deck and conventional end ramp that could provide self-launching by boat owners, to a rail system along narrow lanes to vertical hoist launching facilities that would be operated by trained staff. All options include wave protection for the launching and boarding area.

Self-Launching Option

A broad access deck and conventional end ramp arrangement with two lanes would require a width of 15 feet per lane and a turn-around near the lake end of the pier as shown in Figure 5. This plan shows an 8 foot wide access walk on one side of the pier that leads to a boarding float.



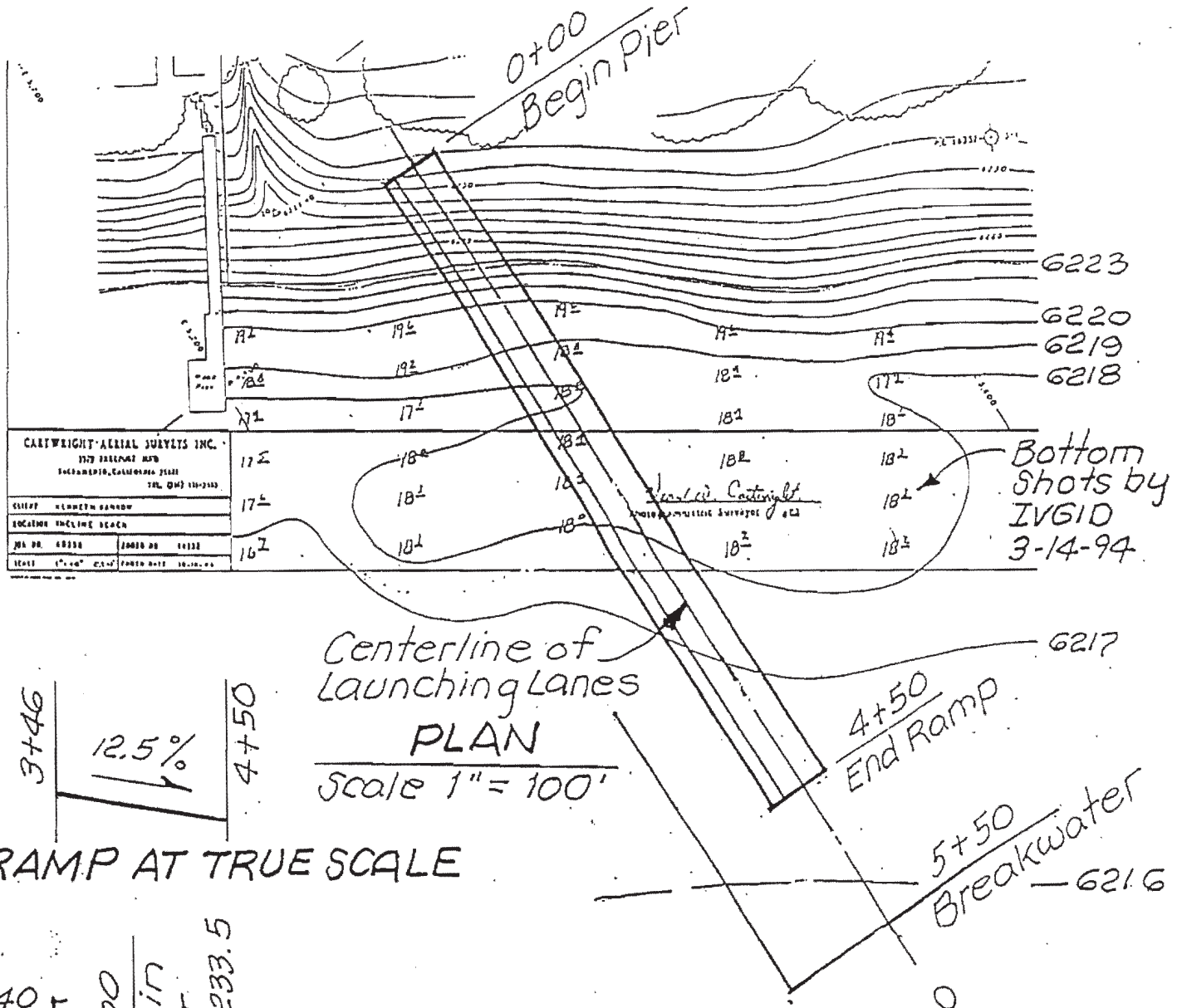
LEGEND	
5	Depth in meters
(16.4)	Depth in feet

Notes:

1. Map is an enlargement from a portion of Lake Tahoe Chart 18665 NOAA Coast and Geodetic Survey, June 1992.

2. All depths are in meters below the Low Water Mark of 1896 meters (6223.0 feet) above mean sea level.

Figure 9 Offshore Bottom Topography at Incline Beach



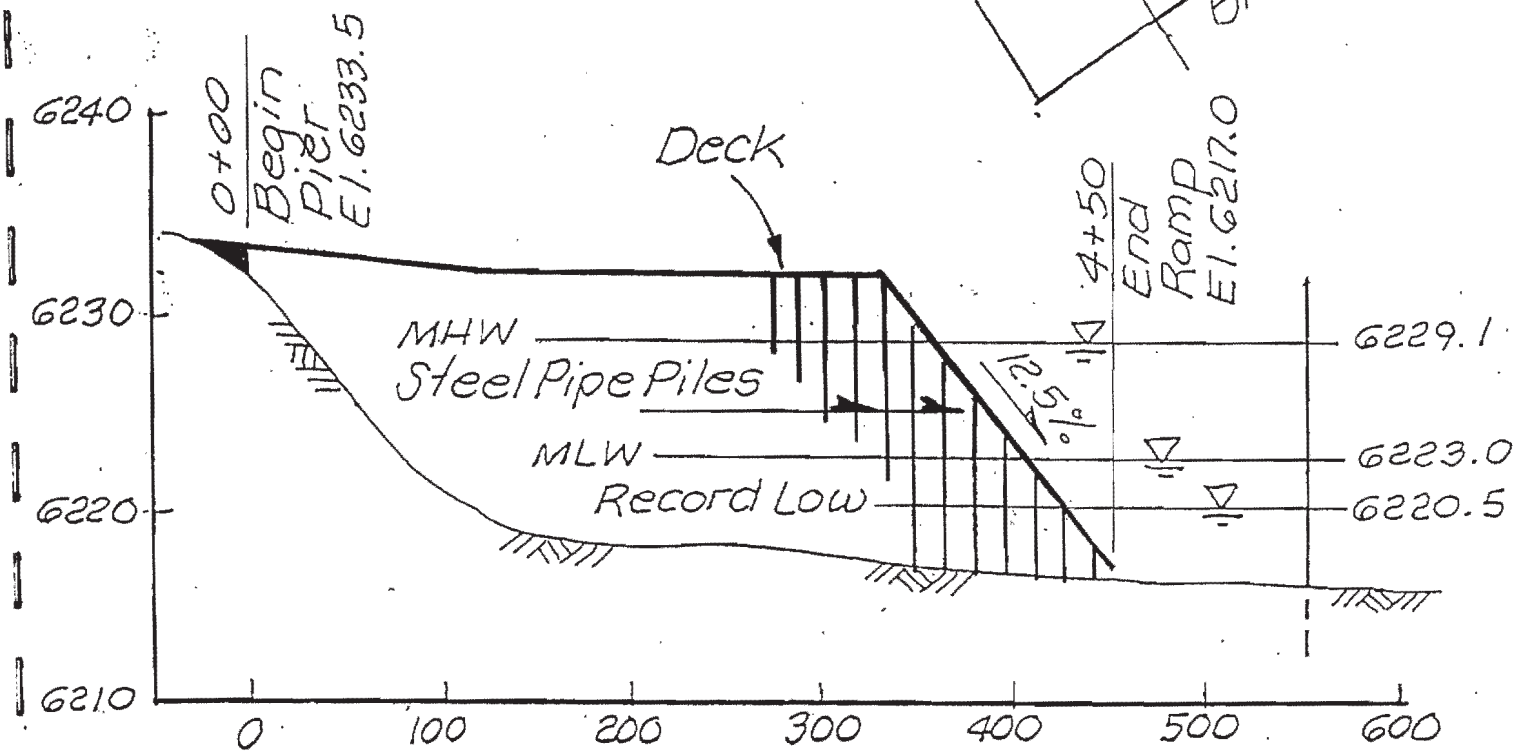


Figure 10 Deck and Ramp Profile Multiple Use Facility at West End Incline Beach

The turn-around is based on the following general requirement for small craft boat launching facilities set forth in the March 1991 Layout, Design and Construction Handbook published by the California Department of Boating and Waterways.

> *On all launching ramps over 200' long and less than 60' wide (4 launching lanes), a 60' minimum diameter turn-around area should be provided every 200 ' to minimize car-trailer backing distances.*

The disadvantages of this arrangement include the potential hazards and congestion caused by inexperienced users. The regulatory disadvantages are primarily those of scenic impact resulting from the broad pier structure.

Rail Launching Facilities

A possible rail launching facility would consist of a cradle or sling carrier on which the boat is loaded at the land end and which then carries the boat over fixed rails to the launching area at the end of the pier. The carrier moves onto a vertical hoist platform which is then lowered into the water.

Use of such facilities by boat owners would not be an option due to safety reasons and the need to maintain an efficient operation and minimize congestion. However, relocation of the existing ramp operation to a site near the pier might be considered in order to continue to offer self-launching opportunity during high lake levels. Such a relocated ramp would not have protection from waves since they would diffract around the offshore breakwater and still impact the ramp.

Figure 11 shows a possible option for a pier plan that would provide two 10 foot wide launching lanes with an 8 foot wide center access walkway leading to a boarding float.

Pier launching operations could be provided by IVGID staff or by a qualified outside contractor. The initial structure for launching charges would be determined on the basis of estimated capital and annual costs, and after other issues have been resolved such as use of the facility by the general public, and whether or not tour boat docking will be a feature of the plan.

Tour Boat Option and General Public Access

IVGID may wish to consider providing public access to tour boats as a means to offset capital and operating costs of a multiple use facility. Unrestricted public access is not now required by TRPA, and the definition of public access to a new launching ramp facility would be established during the project permit process. The potential for a multiple use pier and the issue of public access is reflected in the following statements contained in the recently released TRPA Shorezone Environmental Statement identified below.

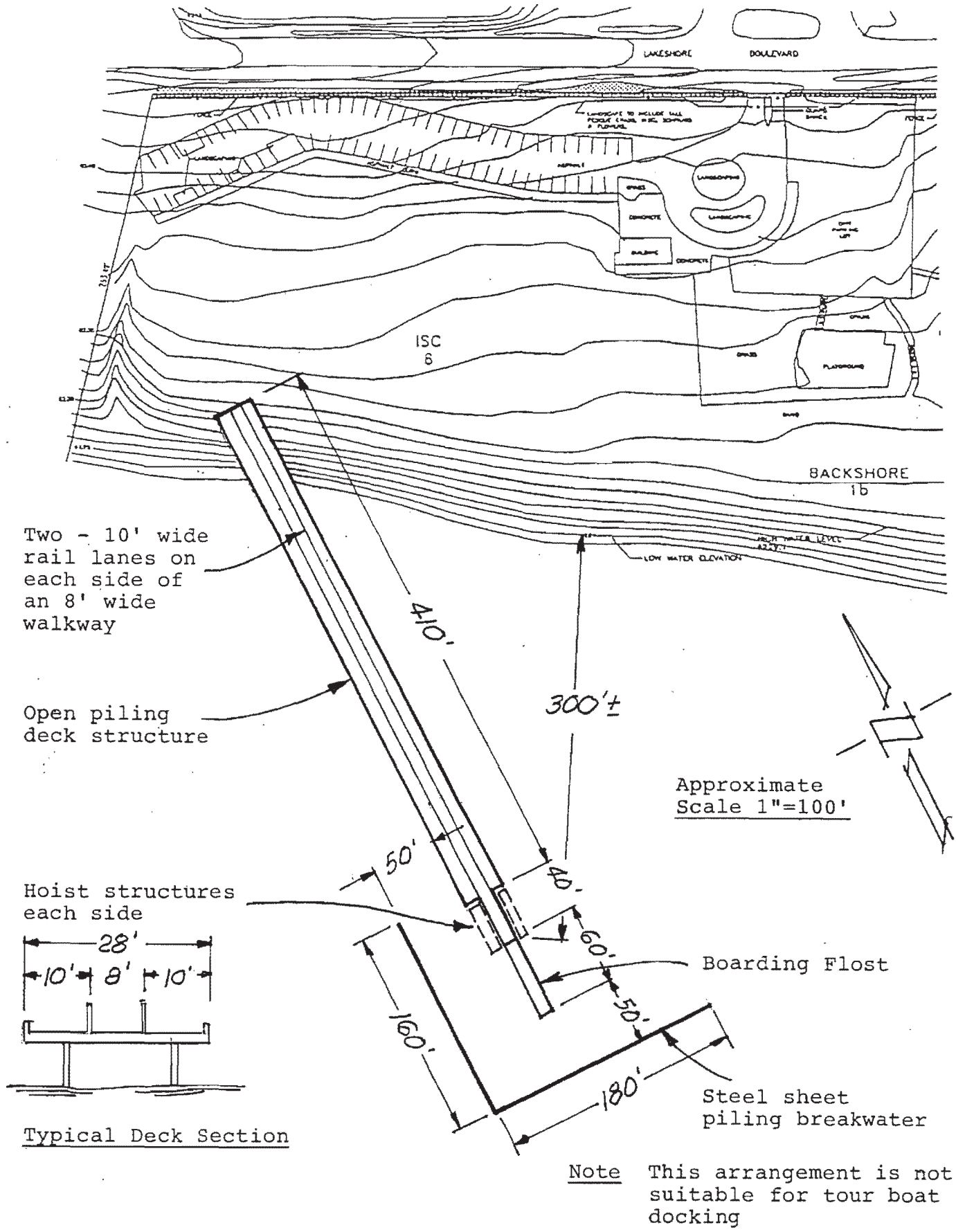


Figure 11 Rail Launching Facility at West End Incline Beach

Lake Tahoe Shorezone Development Cumulative Impact Analysis
Draft Environmental Impact Statement. September, 1995

Excerpt from Chapter 3.10 Recreation

Expansion of public access to the shores of the Lake is critical towards enhancing nearly all recreational activities in the shorezone. (Pg. 3.10-21)

Excerpt from Chapter 4.9 Scenic Resources

(Description of a Photosimulation of Alternative 3 at Incline Beach)

This photograph simulates the addition of a public multiple use pier and buoy field at Incline Beach. All existing private structures can be maintained but no expansion of or construction of new private structures can occur under Alternative 3. The public pier placed on Incline Beach is for example purposes only. Because the general public does not have access to this Beach, this site would not be eligible for a pier under Alternative 3. (Underlining added for emphasis).

TRPA staff emphasized that the foregoing was only an EIS option and was not an adopted policy.

The photosimulation did not include boat launching facilities. A public pier and buoy field without such facilities would presume that boats are launched and retrieved at some other location during low lake levels.

The potential multiple use facility would be significantly larger in plan view than the pier envisioned in Alternative 3; however, the primary scenic impact would be the lake view of the structure profile, and with the exception of the breakwater, the facility would not have a much greater profile impact than Alternative 3.

Upland Parking and Access

Although this preliminary evaluation is not intended to address upland considerations, it should be noted that the following questions would have to be addressed if more detailed planning studies are undertaken that include a general public access option.

1. Would public access require remote parking of vehicles and boat trailers with shuttle vehicle service to the pier, and are sites available for this purpose?

2. Would Incline Village residents want to have access to a tour boat or a water transit service, and, if so, what would be the support parking and ground transportation requirements?

Potential for a Multiple Use Facility at Burnt Cedar Park

1993 Proposal for a Launching Ramp

In July, 1993, Richard L. Mudgett proposed the plan shown in Figure 3. This plan proposed a rock rip rap breakwater that would be a 200 foot extension to the existing jetty in order to provide wave protection to the ramp.

The proposed breakwater would have to be shortened by 30 feet or more in order to comply with the 20 foot setback from the projected property line required by TRPA ordinance provisions for piers and this would reduce its effectiveness in protecting the proposed ramp.

The breakwater would also change the existing erosion and deposition patterns of bottom sediments in the shallow nearshore waters. The proposal shows a "pumping conduit" through the rip rap breakwater in anticipation of the need to remove accumulated sediments, but its effectiveness would have to be demonstrated to prove to TRPA that maintenance dredging would not be required.

The most significant problem however is that the proposed ramp would not meet the criteria of having a toe elevation of 6217 without dredging. As shown in Figure 3, a bottom elevation of 6217 is not reached until some 300 feet lakeward of the existing jetty. Other problems would include the close proximity of the ramp and upland support roads and parking to existing residences on the east and lead to the conclusion that the 1993 proposal was not an appropriate solution to providing effective boat launching facilities.

The Option of a Multiple Use Facility

The same self-launching and rail launching facilities utilizing an open piling access pier that were evaluated for Incline Beach would be required to provide protected launching at the Burnt Cedar site.

However, the Burnt Cedar pier would be from 200 to 250 feet longer than the comparable facility at the Incline Beach site depending on whether the Incline Beach pier was perpendicular to the shoreline or angled as shown in Figures 4 and 5, and the costs would be proportionately greater.

Regulatory Agency Responses to Options

Tahoe Regional Planning Agency (TRPA)

In discussion with Colleen Shade, TRPA advance planning staff, the following items were discussed with the objective of identifying any elements which might not be possible under the rules and regulations of the Agency.

1. Would the TRPA approve any new improvements at the existing ramp site such as a new boarding pier, or other physical improvement?

   TRPA could not support due to the location of the ramp within 200 feet of the mouth of Incline Creek.

2. Would "unrestricted public access" be imposed as an approval condition on any new multiple use facility as implied in the Lake Tahoe Shorezone Development Impact Analysis, Draft Environmental Statement dated September, 1995?

   No, that condition was part of one of the scenarios evaluated as options in the Environmental Statement and is not an adopted policy. The definition of "public" would be established during the processing of a project application

3. Will limitations on "Persons At One Time" (PAOTs) in a shorezone recreation area pose an obstacle to a new multiple use facility?

   Definitely not if there is no increase in the capacity of the new facility over that of the existing one - such as a four lane launching ramp compared to the two lane existing ramp.

   Even with an increase in capacity there would not be a problem at this time since lakeshore recreational PAOT allocations in the Incline area are now underused. The only qualification is that such PAOTs are on a first-come, first-served basis within a given area, and a problem could arise if some other development comes in first and claims all or most of the available new PAOTs.

4. What visual features would probably be considered most important in the Agency's scenic analysis?

   The new breakwater would be the single most important visual feature viewed from the lake, and every effort should be made to "soften" its outline. A rock rubble breakwater with an varying top elevation could achieve this soltening effect, particularly with the background of the pine covered upland.

   An actual evaluation of scenic impacts could not be made until specific project proposals were submitted and mitigating efforts evaluated.

Nevada Division of Wildlife

In discussion with Pat Sollberger, Fisheries Biologist, the following issues were adddressed.

1. Would the Division of Wildlife support any new improvements at the existing ramp site?

   No, the Division is planning to restore the Third Creek stream environment, and to follow up that restoration with fish stocking. The Division will support an IVGID project to establish safe, useable boat launching facilities at another site that includes removal of the existing ramp.

2. Would development within presently designated fish habitat or spawning areas be opposed by the Division?

   Not if the project gives adequate assurance that there would be minimal disturbance of the existing fish habitat. Boating activities should not conflict with spawning runs since the runs occur earlier or later than the normal boating season, but the project would be reviewed to determine if potential impacts might result from project relateded extensions of the boating season.

Copies of this report will be provided to both Colleen Shade of TRPA and Pat Sollberger, and Pat will comment in writing to TRPA.

Magnitude of Project Costs for the Lakeward Portion of a Multiple Use Facility at West End Incline Beach

The estimated project costs are set forth in Table 4. They are preliminary only and subject to change based on final design studies.

Table 4 Preliminary Estimate of Project Costs

Item	Quantity	Unit Price	Amount
Pier and Ramp			
Vehicular Deck	16,200 SF	30	486,000
Steel Pipe Piles	105 Ea	1,200	126,000
Pile Cap Beams	100,000 Lb	6	600,000
Pedestrian Deck	2,800 SF	20	56,000
Safety Railings	1,050 LF	20	21,000
Boarding Walk	800 SF	50	40,000
Subtotal			1,329,000
Steel Sheet Piling Breakwater			
Front Wall	200 LF	2,500	500,000
Front Toe Rip Rap	600 CY	70	42,000
Side Wall	200 LF	1,800	360,000
Side Toe Rip Rap	400 CY	70	28,000
Subtotal (1)			930,000
Total			2,259,000
Plus 15% Contingencies			338,850
Total Construction			2,597,850
20 % Allowance for Installation Services and Fees (2)			519,570
Total Project			3,117,420

(1) A rock rubble breakwater is estimated to cost approximately 30% more than the steel sheet piling breakwater.

(2) Such as site investigations, design studies, plans and specifications, environmental documentation, and regulatory permit fees and processing.

APPENDIX A

Glossary of Technical Terms

FINING TREND (Open Pile Piers).

As waves lose energy passing through open piles, the heavier sand particles in suspension drop out first, and the finer, lighter sands are carried further - thus the "fining trend."

HYDRODYNAMICALLY STABLE (Bottom Sands).

Where sands are small and light enough to be picked up by wave action near the shoreline, but too heavy to be carried out into deeper water and lost to the nearshore area - thus they remain, are "stable" within the nearshore area and are moved about in that area by the hydrodynamic forces of the waves.

LAKE TAHOE DATUM (For Lake Level Elevations)

The United States has the right to store water in Lake Tahoe between elevations 6223.0 (mean low water), and 6229.1 (mean high water), and those elevations are measured with respect to the top surface of a bolt in the abutment wall of the present Lake Tahoe dam at the outlet in Tahoe City. The elevation assigned to that bolt was elevation 6230.0 feet on the Lake Tahoe Datum, notwithstanding the fact that the U.S. Geological Survey has determined that the bolt is at elevation 6228.86 feet above the mean sea level datum used for U.S. Geological Surveys and mapping.

LITTORAL.

Of or pertaining to a shore. Usually in connection with nearshore areas where water is shallow enough that wave action will suspend and move bottom sands and sediments.

NEARSHORE (Zone).

In beach terminology an indefinite zone extending from the shoreline well beyond the breaker zone. The Tahoe Regional Planning Agency defines the nearshore as lying between the mean low water line elevation 6223.0 and a bottom elevation of 6193.0 - a water depth of 30 feet.

PETROFACIES.

The aspect, appearance, and characteristics of a rock unit, usually reflecting the conditions of its origin; especially as differentiating it from adjacent or associated units.

In essence - "rock faces" or the faceting of sand grains that is characteristic due to the typical structure and hardness of the material from which the grains came.

SYNOPTIC (Winds).

Literally "winds over a given area at a given time" as in a weather map.

TRANSPORT (Sediment in the Littoral Zone).

Littoral Transport. The *movement* of sedimentary material (bottom sands) in the littoral zone under the influence of waves and currents.

Longshore Transport. Movement of sedimentary material parallel to the shoreline. When material is moved in one direction along the shoreline by winds from particular directions, and then moved in the opposite direction by wind from other directions, it is known as **Bi-Directional Transport.**

Onshore-Offshore Transport. Movement of material directly toward (perpendicular to) the shoreline, or directly away from the shoreline. When waves approach the shoreline from an oblique direction there are resultant forces that are both perpendicular to the shoreline and parallel to the shoreline - or **Longshore Components.** It is these longshore components which move sands along the shoreline in a zig-zag motion until they pile up against an obstacle such as a rock jetty.

WAVE.

Deepwater Waves. Surface waves in water so deep that they are little affected by the bottom over which they pass. It is these waves that are predicted by the strength, direction and duration of winds and the distance over water (the **fetch**) that they pass.

Wave Height and Period. The vertical distance between a crest and the preceding trough; and the time for two successive wave crests to pass a fixed point.

Wave Regime. The array of wave heights and periods that are associated with selected design wind speeds, directions, durations, and the "fetches" over which they pass.

Diffracted (Wave Diffraction). The phenomenon by which energy is transmitted laterally along a wave crest. When a part of a train of waves is interrupted by a barrier, such as a breakwater, the effect of diffraction is manifested by propagation (bending) of waves into the sheltered region behind the breakwater.

Refraction (Wave Refraction). The process by which the direction of a wave moving in shallow water at an angle to the bottom contours is changed: the part of the

wave advancing in shallower water moves more slowly than that part still advancing in deeper water, causing the wave crest to bend toward alignment with the bottom contours.

Wave Attenuation. A lessening of wave height due to energy lost in passing under obstructions such as floating breakwaters, or passing through porous breakwaters such as rock rubble mounds or rock and timber cribs.