FINAL REPORT

HUALAPAI RECREATION STUDIES

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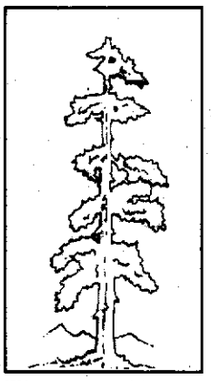

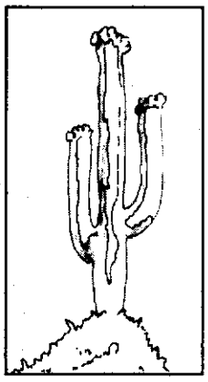

Prepared for

Hualapai Tribe

Prepared by

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February 1995

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EXECUTIVE SUMMARY

The Hualapai Tribe has a great interest, both economically and culturally, in the section of the Colorado River that runs through their lands. Much of their interest lies in the sediment deposits along the river which support riparian vegetation and wildlife as well as areas for recreation. With the injunction of the interim flow regime on August 1, 1991, the Tribe decided to monitor the effects of these flows on the campable area of their sediment deposits, crowding below Diamond Creek, and the economy of their river-related enterprise, the Hualapai River Runners.

As no previous studies of this kind had been conducted on the stretch of river below Diamond Creek, all data collected represent baseline data with which to monitor changes.

Campsite Size Study

Campsites below Diamond Creek are diminishing in both number and size. While a large amount of campable area was lost to natural forces -- wind, rain, and vegetation encroachment -- much area was lost due to controllable events on the Colorado River. Flow releases from the Glen Canyon Dam as dictated by the interim flow regime, wake from the commercially-operated jetboat that travels between Separation Canyon and Lake Mead, and fluctuating lake levels potentially contribute to the erosion of beaches in the lower Grand Canyon. While little can be done to mitigate the effects of wind, rain and vegetation growth, the extent of damage by dam releases, jetboat wake, and fluctuating lake levels, once identified, can be controlled to limit the loss of the few remaining campsites in this economically important reach of the Grand Canyon.

Attraction Site and Contact Study

Crowding at attraction sites and along the Colorado River in the lower Grand Canyon is at levels below those in the upper Grand Canyon from Lees Ferry to Diamond Creek. All but one attraction site, Diamond Creek, met the Colorado River Management Plan objective, established by the NPS, of river parties having a 20% or higher probability of no contact with other groups at attraction sites. When contact with other river parties was made, no negative reactions were expressed. From these data we conclude that the level of use along the river below Diamond Creek is at acceptable levels for recreational users.

Economic Study

River-related recreation on the Hualapai reservation contributes substantially to the Hualapai Tribe's gross revenue. In the 1980s, revenues generated by the HRR and the sale of river-related permits ranged from approximately 33 to 50 percent of the tribe's gross income. For the period of this study, the HRR revenues increased each year from 1992 to 1994. The number of launchings from Diamond Creek and HRR commercial trips steadily increased during this period while the number of take-outs and other permits fluctuated irregularly. David Harpman, an economic analyst with the Bureau of Reclamation is further analyzing the impact of interim flows on the Hualapai Tribe's economy.

CHAPTER 1. INTRODUCTION

Background

Hualapai lands extend for the lower 108 miles of the Colorado River through the Grand Canyon from National Canyon (River Mile (RM) 165.5) to the boundary with the Lake Mead National Recreation Area (RM 273.5) (Figure 1). The current area of recreational concern for the Hualapai Tribe exists from the river-access road at Diamond Creek (RM 226) to Lake Mead.

Although many commercial and private river trips launching at Lees Ferry (RM 0) take out at Diamond Creek, many trips continue to Pearce Ferry, stopping along the way at beaches on the Hualapai Reservation. Commercial and private trips also launch from Diamond Creek, making use of the sediment deposits (beaches) below Diamond Creek.

The National Park Service (NPS) conducted a survey in 1991 of sediment deposits that provide campsites along the Colorado River through the Grand Canyon. This survey revealed that in the lower Grand Canyon below Diamond Creek campsites are diminishing in number. An inventory of camps below Diamond Creek from the early 1980s prior to the 1983 floods documented 20 campsites below Diamond Creek (Stevens 1983). The 1991 NPS survey revealed that only 10 of the 20 campsites were still usable (Table 1).

Throughout the 1980s approximately one-third to one-half of the Hualapai Tribal revenues were generated from river-related recreational activities by the Hualapai River Runners (HRR). Over 70% of HRR revenues were generated from white-water boating below Diamond Creek. The continued decrease in number of campsites could be detrimental to the economy of the Hualapai Tribe.

With the completion of the Glen Canyon Dam in 1964, public and government agencies have expressed concern about how Glen Canyon Dam operations may be adversely affecting downstream resources. In response to these concerns, the Secretary of the Interior directed the Bureau of Reclamation to prepare an environmental impact statement (EIS) on Glen Canyon Dam operations. The EIS is to determine specific options that could be implemented to minimize adverse impacts on the downstream environmental and cultural resources and Native American interests in Glen and Grand Canyons. To protect downstream resources until completion of this EIS, Reclamation began testing proposed interim flows on August 1, 1991. An environmental assessment and a finding of no significant impact (Bureau of Reclamation, 1991) were completed, and the interim operating criteria were implemented on November 1, 1991. The interim flows are essentially the same as those detailed under the Interim Low Fluctuating Flow Alternative. Minimum flows would be no less than 8,000 cubic feet per second (cfs) between 7 a.m. and 7 p.m. and 5,000 cfs between 7 p.m. and 7 a.m. During fluctuating hourly releases, the maximum rate of release would be limited to 20,000 cfs. Any releases greater than 20,000 cfs (except for emergencies) would be steady on a daily basis and would be made in response to high inflow and storage conditions. Daily fluctuations would be limited to either 5,000, 6,000, or 8,000 cfs during any 24-hour period, depending on monthly release volumes.

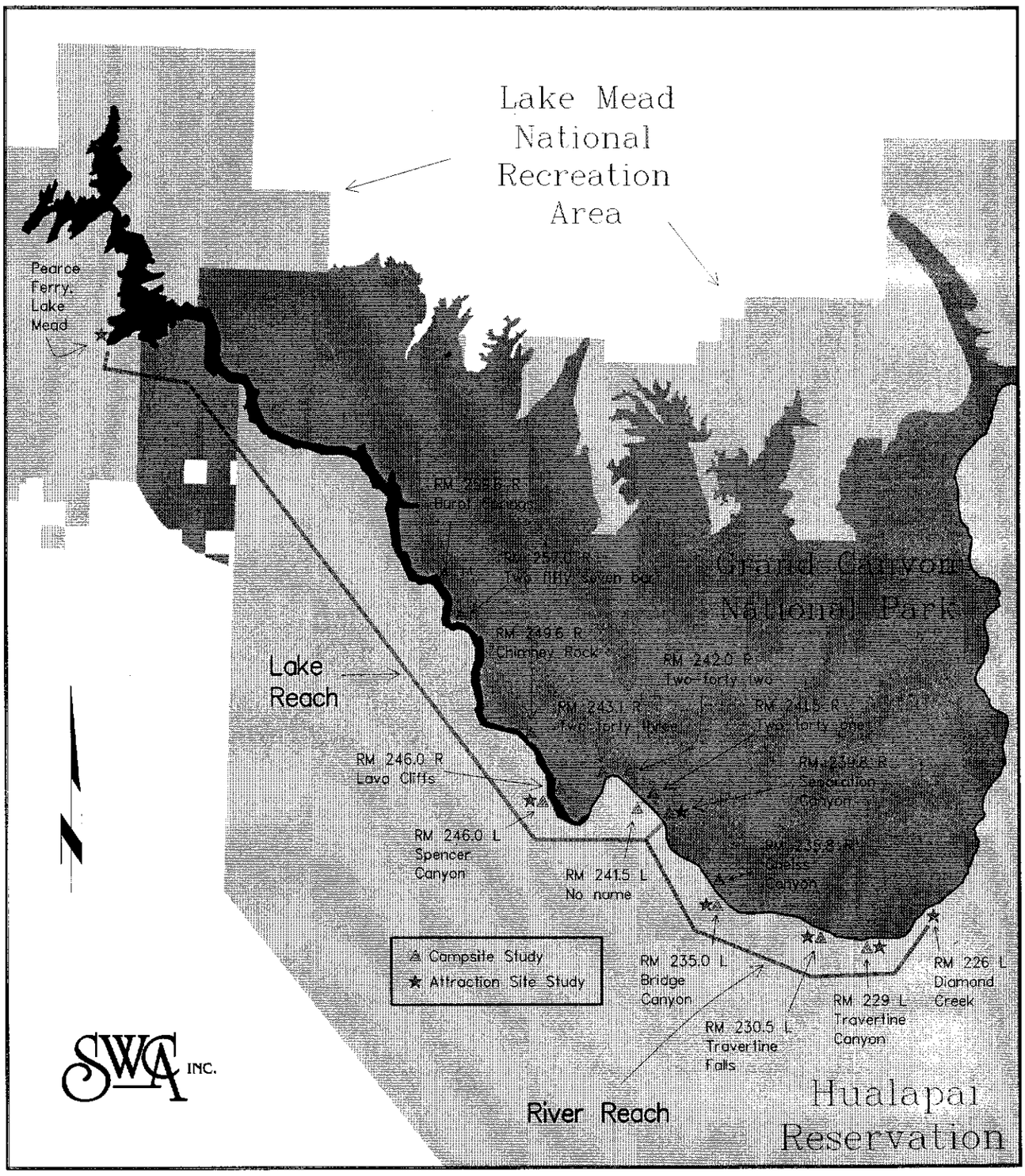

Figure 1. *Location map of the Colorado River through Hualapai Tribal lands. Symbols indicate location of campsite size and attraction site study sites.*

Table 1. *Inventory of Campsites from Diamond Creek to Lake Mead in the early 1980s and 1991. Size classes are as follows: (S)mall campsites can accommodate from 1 to 12 people; (M)edium from 13 to 24; and (L)arge from 25 to 36 people (Table taken from Kearsley, L. and K. Warren. 1993. River Campsites in Grand Canyon National Park: Inventory and effects of Discharge on Campsite Size and Availability. NPS, Grand Canyon National Park).*

MILE	SIDE	LOCATION	1982 SIZE	1991 SIZE
229.0	L	Travertine Canyon	S	M
230.5	L	Travertine Falls	S	M
235.0	L	Bridge Canyon	S	M
236.0	R	Gneiss Canyon	S	M
238.5	L	No Name	S	unusable
239.6	R	Separation Canyon	S	M
241.5	R	Two-forty-one Mile	S	M
243.1	R	Two-forty-three Mile	S	L
246.0	L	Spencer Canyon	S	unusable
246.3	R	Lava Cliffs	S	S
248.2	R	Surprise Canyon	S	S
252.2	L	Reference Point	M	unusable
259.5	R	Burnt Springs Canyon	M	L
260.1	L	Quartermaster Canyon	S	unusable
262.0	R	Below Wards Cave	S	unusable
262.4	R	No Name	M	unusable
268.5	R	No Name	M	unusable
274.5	L	Columbine Falls	M	unusable
274.8	L	Below Columbine	M	unusable
278.6	lake	Scorpion Island	M	unusable

Problem Statement

A primary objective of interim flow releases from Glen Canyon Dam is to reduce the level of impact to resources in the Colorado River corridor through the Grand Canyon. Sediment is one of these resources, providing the substrate for the riparian vegetation and wildlife community, habitat for aquatic species, and substrate for recreational use. The use of the Lower Grand Canyon for river running and other forms of recreation is a primary business for the Hualapai Tribe. Because camping beaches are essential for these activities, the Tribe is concerned that interim flows achieve their objective of reducing the level of impact to the remaining sediment resources. An in-depth analysis of the recreational resources as related to the sediment resources of the Hualapai Tribe is needed to assess the success of the interim flow regime. Monitoring of sediment resources, revenues generated by all river-related activities, and crowding at attraction sites will reveal both the short-term and long-term impacts of the dam-released flows.

The National Park Service (NPS) has monitored recreational use patterns and sediment deposit availability along the Colorado River from Lees Ferry (RM 0) to Diamond Creek. This is the first study of this kind to be conducted on the last 51 miles of the Colorado River through the Grand Canyon National Park (GCNP) and into Lake Mead. The results of this study will be essential for effective management of this reach of the river.

Objectives

Three objectives were developed to achieve a picture of the impact of the current dam-released flow regime on the river-related industry of the Hualapai Tribe.

1. Campsite size study: Monitor the physical location and total campable area of sediment deposits used by the Hualapai Tribal river operations and other commercial and private river runners in the Lower Grand Canyon and integrate that information into the long-term Glen Canyon Environmental Studies (GCES) monitoring program.

2. Attraction site and Contact study: Monitor the impact of interim flows and possible exception criteria from Glen Canyon Dam on the patterns and level of recreation use of the sediment resources at attraction sites and crowding along the Colorado River in the Lower Grand Canyon from Diamond Creek to Pearce Ferry.

3. Economic study: Monitor the value of the current Hualapai Tribe recreation industry and how it is impacted by interim flows and possible exception criteria.

Report Structure

In accordance with these objectives, our studies of recreational aspects were divided into three subjects: campsites, attraction sites and contacts, and economics. One chapter of this report is devoted to each of these subjects, with a collective discussion and recommendations chapter included at the end.

CHAPTER 2. CAMPSITE SIZE STUDY

Introduction

Diamond Creek, having the only river-access road in the Grand Canyon for 226 river miles upstream to Lees Ferry and 51 miles downstream to Lake Mead, is a site of much river-related activity. The Hualapai River Runners (HRR) launch commercial trips from Diamond Creek and sell permits for other commercial and private launchings or take-outs for trips originating at Lees Ferry. Trips travelling below Diamond Creek require campsites for their overnight stays.

Since the completion of the Glen Canyon Dam in 1964, river water flowing into the GCNP through Glen Canyon has been nearly devoid of sediments because the silt settles out in Lake Powell. Sources of sediment transported by the river are now restricted to tributaries downstream of the dam and to the river channel itself. This only amounts to a very small percentage of the predam load. With the reduction of these sediments, the river's capacity to erode has exceeded aggradation, resulting in a net loss of sediment and a loss of beaches. Sediment deposits are eroded by wind, river flows, fluctuating lake levels, human activity, jetboat wake, vegetation encroachment, arroyo erosion, and flash flooding.

Due to the economic importance of the camping beaches below Diamond Creek, the Hualapai Tribe determined that it was critical to examine the decline in the number of campsites to identify the causes of beach loss and to identify ways to mitigate further beach degradation. According to Kearsley (1993), further loss of campsites below Diamond Creek would limit recreation.

Study Area

The Colorado River runs into Lake Mead 51 miles below Diamond Creek. The effects of the lake waters backing up into the Grand Canyon are seen for many miles upstream of the lake, reaching Separation Canyon at RM 240. Therefore, the river below Diamond Creek is divided into two reaches--the river reach above RM 240, and the lake reach below RM 240.

The NPS in 1991 identified 13 beaches below Diamond Creek that were used as campsites. By 1992 one of these sites, Lava Cliffs, was unusable, and another site, Spencer Canyon, became usable due to new deposition in the natural flood of February 1993. Between 1992 and 1994, SWCA and the Hualapai Natural Resources Department (HNRD) conducted campsite size surveys of 13 camping beaches below Diamond Creek (Table 2).

Table 2. *Campsite Size Study Sites below Diamond Creek.*

CAMP NAME	RIVER MILE
RIVER REACH:	
1. Travertine Canyon (TC)	229.0L
2. Travertine Falls (TF)	230.5L
3. Bridge Canyon (BC)	235.0L
4. Gneiss Canyon (GC)	236.0R
LAKE REACH:	
5. Separation Canyon (SEP)	239.6R
6. Two forty one (241R)	241.5R
7. No name (241L)	241.5L
8. Two forty two (242R)	242.0R
9. Two forty three (243R)	243.1R
10. Spencer Canyon (SC)	246.0L
11. Chimney Rock (CR)	249.6R
12. Two fifty seven bar (257)	257.0R
13. Burnt Springs (BS)	259.5R

Methodology

Campsite Monitoring

SWCA researchers employed similar on-river observation methods used by Kearsley and Warren (1993) when they assessed campsite size from Lees Ferry to Diamond Creek for the NPS in 1991.

Researchers used the most recent aerial photographs available from Glen Canyon Environmental Studies (GCES) to record the location of campable areas of beaches biannually in April and October for 1992 through 1994. Polygons delineating campsites were drawn directly onto photocopies of aerial photographs of each study site. SWCA determined all campable areas by hand measuring each site in the field. The first three surveys, performed by HNRD researchers, relied on Map Image Processing System (MIPS), a computer-aided drawing program, for the determination of large, irregularly shaped areas. This procedure was replaced by hand measuring all areas after SWCA and the HNRD discerned that inherent distortions in the large-scale, aerial photographs could lead to imprecise areal measurements via MIPS. Data from the October 1992 and April 1993 surveys were included in analyses, but due to the use of MIPS at that time, the numbers may only be suggestive of the actual areas. The data from the first survey of April 1992 was not used due to refinement of techniques employed in subsequent surveys.

Changes in campable areas were attributed to one of six causative factors: river erosion, runoff, vegetation encroachment, new deposit, other loss, and other gain. All loss of campable area that involved calving (the slumping of large sections of a sediment deposit into the river) or cutbank activity was classified as river erosion. Loss of area due to precipitation (arroyo erosion, flash flooding of tributaries, or pooling of rainfall) fell into the runoff category. Vegetation encroachment was loss due to the growth of vegetation in a previously clear campsite. New deposit referred to the gain in campable area due to mainstem deposition, mainly from the natural flood in February 1993. Other gain and other loss included changes in slope or levelness mainly due to aeolian forces (wind), according to Kaplinski (per. comm. 1995), a GCES principal investigator of sediment deposit erosion in the upper Grand Canyon. Human influence and other minor factors also contributed to other gain and other loss.

Whenever a new researcher evaluated campable area (there were two former principal investigators), new sites were found that appeared to have been previously used, but had not been recorded. The addition of these sites gave the appearance of an increase in campable area where no increase had actually occurred. These previously unrecorded sites were taken into account in analyses of the surveys between October 1992 and April 1993 and between April 1993 and November 1993.

In addition, changes affecting the aesthetic value or usability of each site were noted when applicable.

Hydrograph Data

GCES hydrologists generated hydrographs of water releases from Glen Canyon Dam and the U.S. Geological Survey gaging station at Diamond Creek for the calendar years 1992, 1993, and 1994. These hydrographs were used to determine variances of dam releases and flows for each of the three years. We then used this information to correlate changes in campable areas to dam releases and river flows. Due to the contribution of tributaries below the dam and the distance of the study sites from the dam, dam releases are not always indicative of river flows.

Electronic Surveying

GCES surveyors performed electronic surveying with a Leitz total station in February 1994, providing topographic data on the beaches at Bridge Canyon and Gneiss Canyon to be incorporated by GCES into a Geographic Information Systems (GIS). The campable areas at all sites were delineated by electronic surveying to provide accurate campsite areal measurements and definitive three-dimensional data that will reveal aggregation or degradation of sediment at each site.

Remote Cameras

HNRD technicians maintained remote sensing cameras at six beaches (Travertine Canyon, Separation Canyon, 242 Right, Spencer Canyon, Lava Cliffs, and 257 Bar) for daily photodocumentation to allow assessment of surface changes between field surveys and in the future. The film and batteries in these cameras were replaced on a regular basis. Slides were reviewed by HNRD technicians, who noted changes in beach size and organized the slides into binders for future reference.

Results

Campsite Monitoring

The total area of each of the 13 study beaches during the five biannual surveys from October 1992 to October 1994 is shown in Table 3.

The total campable area of the 13 study beaches for surveys from April 1993 to October 1994 is shown in Figure 2. The data point on this graph for the October 1992 survey does not include areas for Travertine Canyon or Travertine Falls as no data were available. A dramatic increase in campable area between the October 1992 and April 1993 surveys is partially attributable to the inclusion of the data for Travertine Canyon and Travertine Falls in 1993 and 1994 as well as to a natural flood in February, 1993 which deposited new sediment on the beaches. Since April 1993, campable areas have steadily decreased on the 13 study beaches.

Table 3. *Total campable area (in square meters) per beach per survey.*

	SURVEY DATE				
BEACH	10/92	4/93	11/93	4/94	10/94
TRAV CYN	no data	267	111	97	108
TRAV FALLS	no data	202	155	136	144
BRIDGE	371	399	265	213	219
GNEISS	486	762	158	310	367
SEPARATION	307	131	110	208	156
241R	188	263	240	224	239
241L	179	259	92	84	113
242R	104	192	164	169	131
243R	408	416	300	199	345
SPENCER	0	562	981	837	483
CHIMNEY ROCK	183	352	115	216	104
257 BAR	32	0	0	0	0
BURNT SPRING	103	104	106	91	94
TOTAL	2361	3909	2798	2783	2504

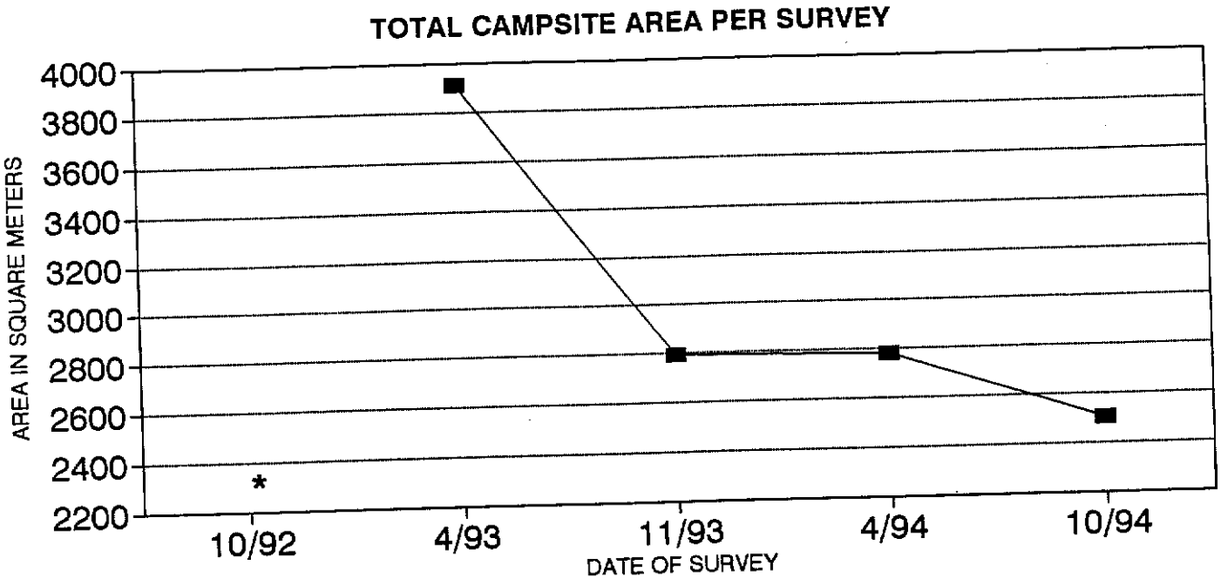

Figure 2. *Total campable area of 13 study beaches for surveys from April 1993 to October 1994. Data point for October 1992 survey does not include areas for Travertine Canyon or Travertine Falls.*

Three beaches gained campable area while ten sites lost campable area between October 1992 and October 1994 (Figure 3). Attributable changes for individual beaches from October 1992 to October 1994 are shown in Figure 4. Appendix A shows total attributable changes per beach; Appendix B details the attributable changes per individual beach between consecutive surveys.

Of the beaches in the river reach upstream of RM 240, only one, Gneiss Canyon, was affected by vegetation growth, losing 3.17% of the campable area to arrowweed encroachment. In the lake reach downstream of RM 240, seven sites experienced from 2% to 100% loss of campable area due to vegetation encroachment: 241 Right, 242 Left, 243 Right, Spencer Canyon, Chimney Rock, 257 Bar, and Burnt Springs.

River erosion and new depositions accounted for a large portion of change in the nine beaches in the lake reach while very little change due to these two factors occurred in the four beaches in the river reach. Beaches in both reaches experienced changes due to runoff, other gain, and other loss. While most of the changes in campable areas attributed to other loss or other gain were unidentifiable, a few were readily identifiable. One campsite at 241 Right beach was lost due to the invasion of pogo ants (*Pogonomermex* sp.). At several beaches a few campsites were lost to trails created by high levels of foot traffic. In a few cases areas were gained by the levelling of campsites or the clearing of vegetation by people.

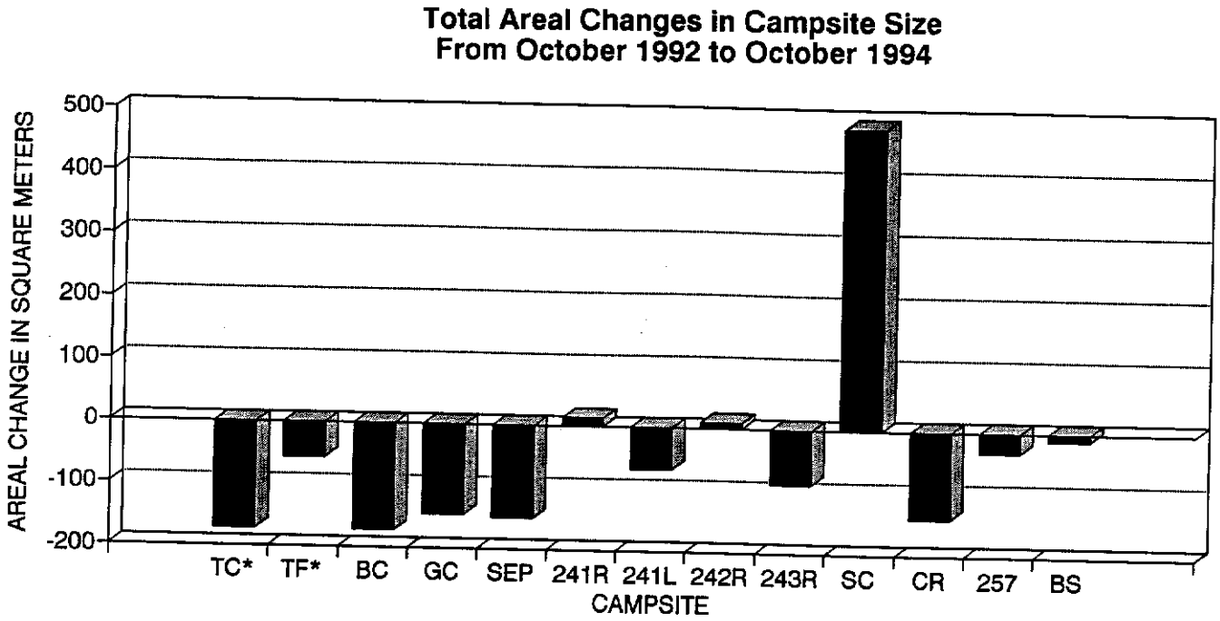

Figure 3. *Total change in campable area of each study beach from October 1992 to October 1994. *Areal change for Travertine Canyon and Travertine Falls is from April 1993 to October 1994.*

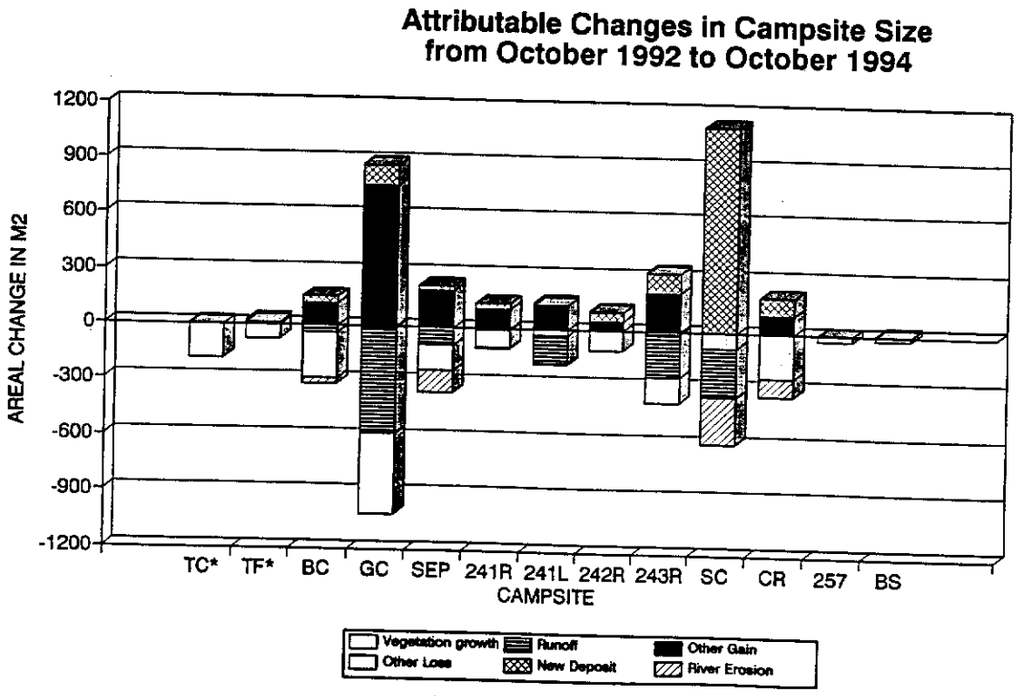

Figure 4. *Attributable changes in campable areas for all study beaches from October 1992 to October 1994. *Areal changes for Travertine Canyon and Travertine Falls is from April 1993 to October 1994.*

The total amount of change attributable to a specific cause between consecutive surveys is shown in Figure 5. No river erosion and much new deposition occurred from October 1992 to April 1993 for a net gain in area of 981 m^2. From April 1993 to November 1993 beaches experienced a net loss of 1214 m^2, mostly due to runoff. A net loss of 22 m^2 occurred between November 1993 and April 1994. Between April 1994 and October 1994, beaches lost area (293 m^2), mostly due to river erosion and vegetation encroachment.

Topographic surveys at 0.2 m intervals of the beaches at Bridge Canyon and Gneiss Canyon, surveyed February 2, 1994, are in Appendix C. Electronic survey data from the topographic surveys and delineation of campable areas for all beaches are on record with GCES.

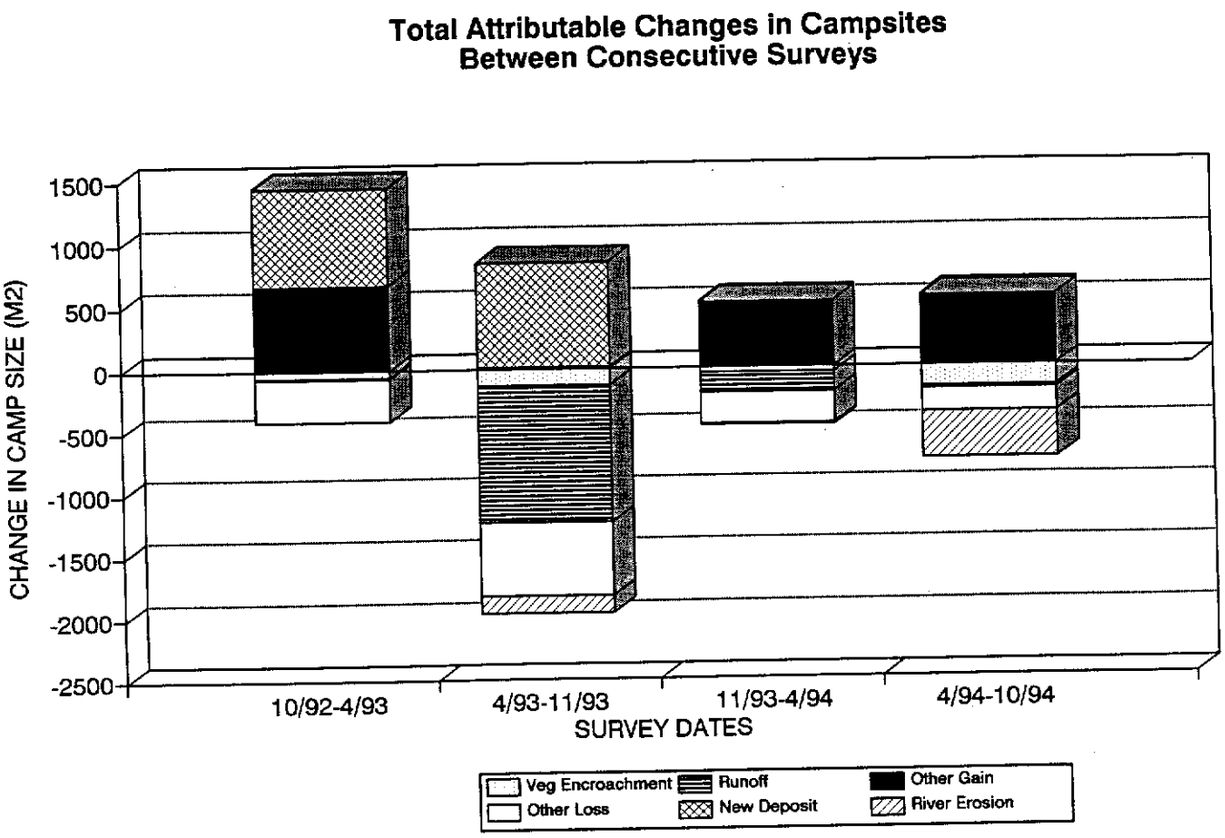

Figure 5. *Total attributable changes of all study beaches between consecutive surveys. *October 1992 survey does not include data from Travertine Canyon and Travertine Falls.*

Hydrographs of Glen Canyon Dam releases (Figure 6) and river flows at the Diamond Creek U. S. Geological Survey gaging station (Figure 7) for the calendar years 1992, 1993, and 1994 show little variation between the three years. Dam releases did not exceed 20,000 cubic feet per second (cfs) nor fall below 5,000 cfs for all three years. The few spikes in the hydrographs that approach 20,000 cfs and 5,000 cfs are most likely artifacts from the gages recording the data. Releases followed a similar pattern for all three years with the highest levels of water released between July and September. Water releases were fairly steady throughout the spring and fall, increasing slightly in the winter months. These releases were in accordance with the interim flows regime.

The hydrograph for river flows at Diamond Creek shows attenuated daily fluctuations due to the distance downstream from the dam (roughly 240 river miles). The gaps indicate missing data, and the occasional spike and the fairly steady flows at the end of 1993 are most likely artifacts from the gage and do not accurately reflect the flows of the river at those times. Again, the flows between years are similar, with the exception of high flows in February 1993. A natural flood occurred at this time due to heavy precipitation. River flows reached approximately 33,000 cfs during this flood. (The hydrograph scale only shows flows to 25,000 cfs).

Most beaches remained unchanged in aesthetic value and usability. However, a few beaches did experience factors which detracted from the recreational value of theses sites as campsites. We noted the spread of the exotic camel thorn (*Alhagi camelorum*) at several beaches. Camel thorn is a thorny, perennial plant that can quickly colonize sediment deposits, prohibiting camping and visitation. Also, fluctuating river and lake flows leave a band of slick silt along the water's edge. This muddy area can make travel to and from the river precarious. Jetboats running upstream in the early morning to pick up commercial passengers at Separation Canyon or below are also an annoyance due to the volume of noise generated by the operation of this boat. Furthermore, we noticed much calving of sediment and vegetation along most of the lake reach which left beach fronts unappealing as they were littered with dead trunks and large landscape scars from slumping sediment.

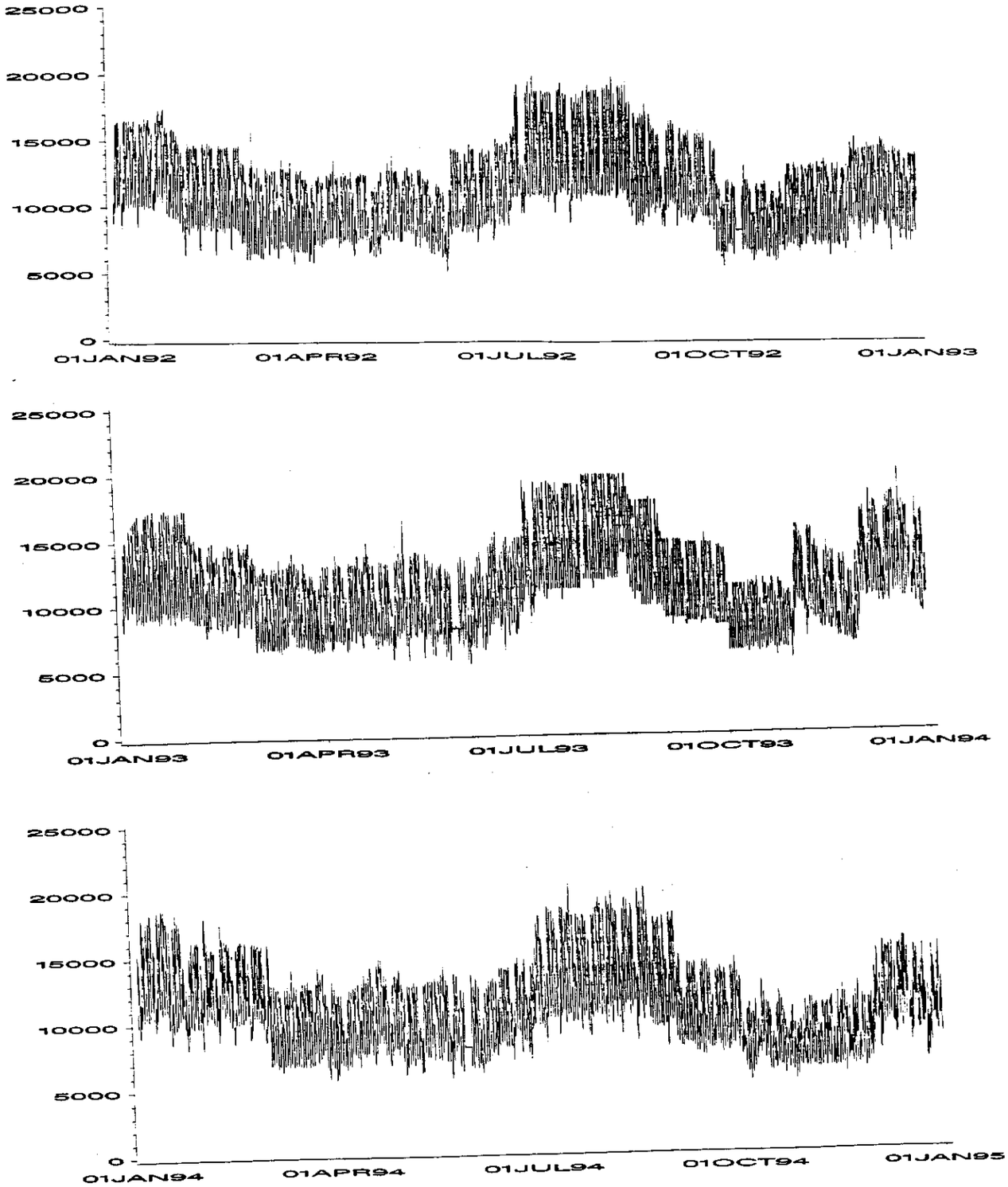

Figure 6. *Hydrographs of Glen Canyon Dam water releases for the calendar years 1992, 1993, and 1994.*

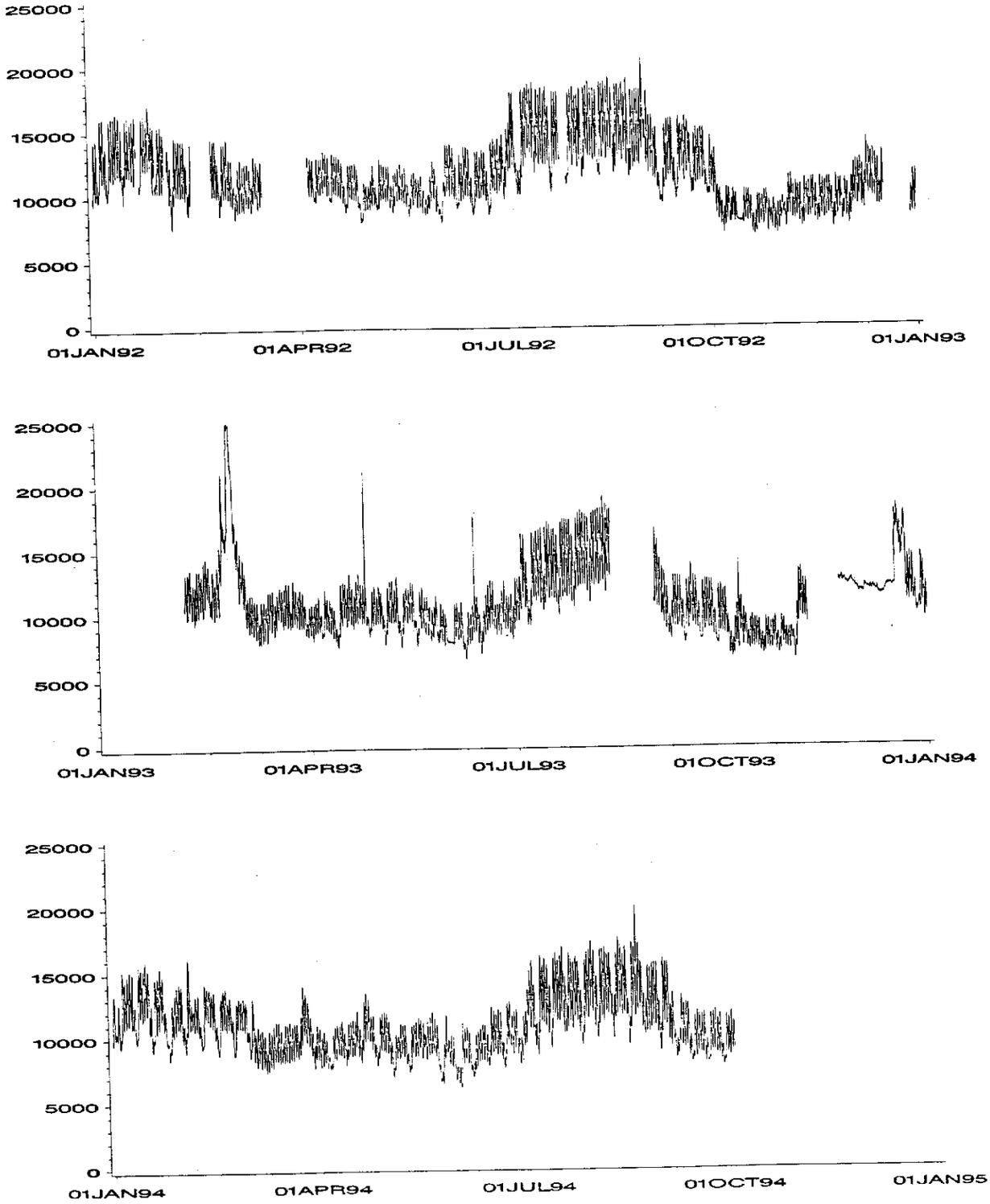

Figure 7. *Hydrographs of river flows at the Diamond Creek U.S. Geological Survey gaging station for the calendar years 1992, 1993, and 1994. Blank areas indicate missing data.*

CHAPTER 3. ATTRACTION SITE AND CONTACT STUDY

Introduction

The operations of Glen Canyon Dam determine the conditions and level of water flow that may influence the number of visitors an "attraction" site (a destination site with recreational value) receives as well as influencing crowding on and off the river. Overcrowding at an attraction site or on the river will ultimately have a negative effect on the natural resources and visitors' wilderness experience on the Hualapai Reservation. If visitors experience too much crowding on a river trip, a decline in the number of commercial and private trips might result, negatively affecting one of the main sources of income for the Hualapai Tribe.

The NPS documented crowding along the river corridor and at select attraction sites in the GCNP above Diamond Creek (Jalbert, 1991). The Hualapai Recreation study continued this assessment of crowding along the Colorado River from Diamond Creek to Lake Mead. This study of monitoring crowding is important not only for baseline data for correlation to the interim flows, but also for an index of what density of recreational use is acceptable to visitors.

Study Area

The attraction sites listed in Table 4 comprise all of the sites below Diamond Creek that potentially receive heavy use for recreational purposes. This study assessed crowding at all these sites.

Table 4. *Attraction Site Study Sites below Diamond Creek.*

CAMP NAME	RIVER MILE
1. Diamond Creek	226.0L
2. Travertine Canyon	229.0L
3. Travertine Falls	230.5L
4. Bridge Canyon	235.0L
5. Separation Canyon	239.6R
6. Spencer Canyon	246.0L
7. Burnt Springs Canyon	259.5R
8. Quartermaster Canyon	260.1L
9. Pearce Ferry	Lake Mead

Methodology

Attraction Site Study

The Hualapai Natural Resource Department (HNRD) monitored the use of attraction sites in 1993 and 1994 following the techniques of Jalbert's (1991) surveys for the GCNP from Lees Ferry (RM 0) to Diamond Creek (RM 226). Recreation technicians monitored all sites for three to seven days during both peak and shoulder seasons. Peak season ran from June 1 through September 15; shoulder season ran from April 1 through May 31 and September 16 to October 31. During each survey, the monitor completed an Attraction Site Form (Appendix D), detailing the time of use, number of boats, number of passengers, launch and take-out dates. At Diamond Creek and Pearce Ferry, the number of vehicles was also recorded. If a site received no visitation during the first year's survey, monitoring was terminated at that site.

At four of the seven sites (Diamond Creek, Separation Canyon, Spencer Canyon, and Pearce Ferry), users were categorized as day users or overnight users and as either commercial or private users. Commercial users were defined as employees and passengers of commercial companies and researchers. At the three lake sites (Separation Canyon, Spencer Canyon, and Pearce Ferry), users were categorized as either river-origin boaters or lake-origin boaters. River visitors were defined as those boaters originating at or upstream from Diamond Creek. Lake visitors were defined as those boaters originating anywhere on Lake Mead.

The GCNP Colorado River Management Plan (CRMP) (U.S. Department of the Interior, 1989) set management objectives for maximum acceptable crowding by river trips along the river and at specific attraction sites in GCNP. Separate objectives were set for peak and shoulder seasons (Table 5).

A Wilcoxan signed-rank test was used to analyze the difference in crowding between years, seasons and days of the week to assess for trends in crowding at different times.

Five of the campsite study beaches also serve as attraction sites. Using a Spearman rank correlation test we correlated change in campable area to change in use between 1993 and 1994.

Contact Survey Study

River contact surveys followed the methods of Jalbert (1991). During research trips, SWCA and HNRD technicians completed Contact Survey forms (Appendix E) to assess the number and nature of contacts encountered on the trip.

Table 5. *Colorado River Management Plan objectives for Grand Canyon National river corridor (U.S. Department of the Interior 1989).*

Peak Season Objectives	a) Launch limits 166 per day, 1000 per week b) 20% probability of contacting (seeing) more than 7 parties on the river per day c) 20% probability of no contact at attraction sites
Shoulder Season Objectives	a) Launch limits 166 per day, 700 per week b) 20% probability of contacting (seeing) more than 5 different parties on the river per day c) 49% probability of no contact at attraction sites

Results

Attraction Site Study

Some of the raw data were discarded by HNRD technicians after summarization. Therefore, for several surveys, the only data available to SWCA was a brief summary. Furthermore, due to the departure of key personnel within the HNRD in 1993, this project experienced a hiatus, and the surveys for Travertine Canyon and Travertine Falls were not conducted for the peak-use period. Consequently, all sites could not be analyzed equally.

Both Quartermaster and Burnt Springs saw no or limited use as attraction sites. These two sites were therefore eliminated from the list of attraction sites to monitor in 1994, according to the methods established for this study.

The mean number of visitors per day varied between the seven sites and two seasons as shown in Figure 8. Overall, Diamond Creek received the most visitation and Bridge Canyon the least. Both Diamond Creek and Pearce Ferry showed a marked decrease in use from the peak season to the shoulder season, while the other attraction sites experienced only a slight decrease in use. Overall, there was a significant difference in the mean number of users between the peak and shoulder seasons at all sites ($p = 0.018$, $z = -2.366$). The mean number of visitors differed very little between weekends and weekdays ($p = 0.237$), and there appeared to be no strong pattern of use over the course of the week (Figure 9).

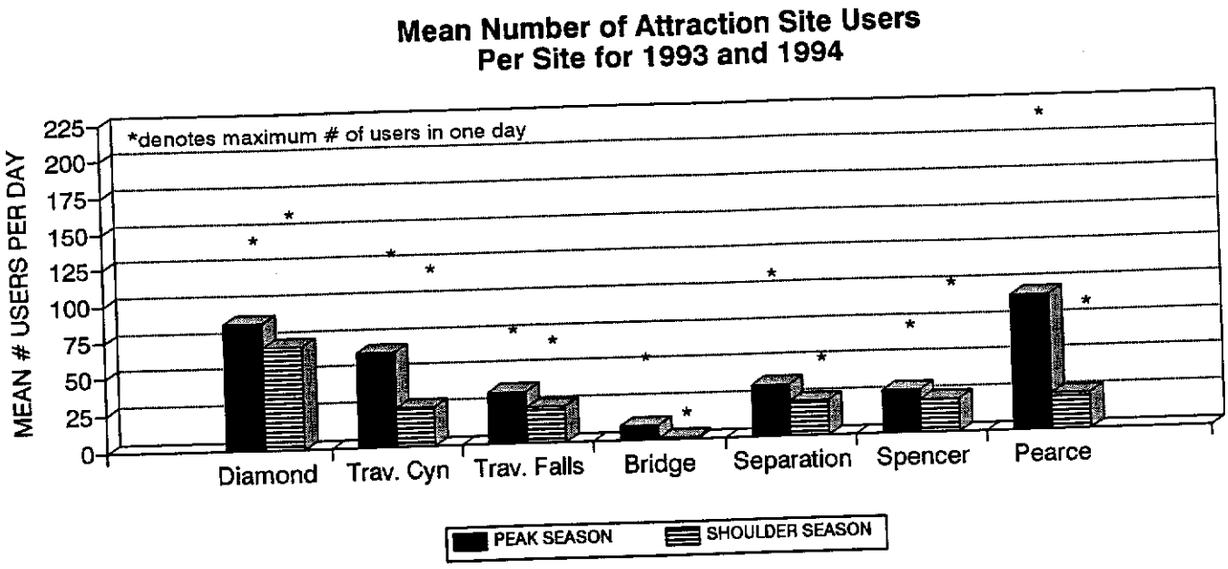

Figure 8. *Mean and maximum number of users per day at the seven attraction study sites during peak and shoulder seasons for 1993 and 1994.*

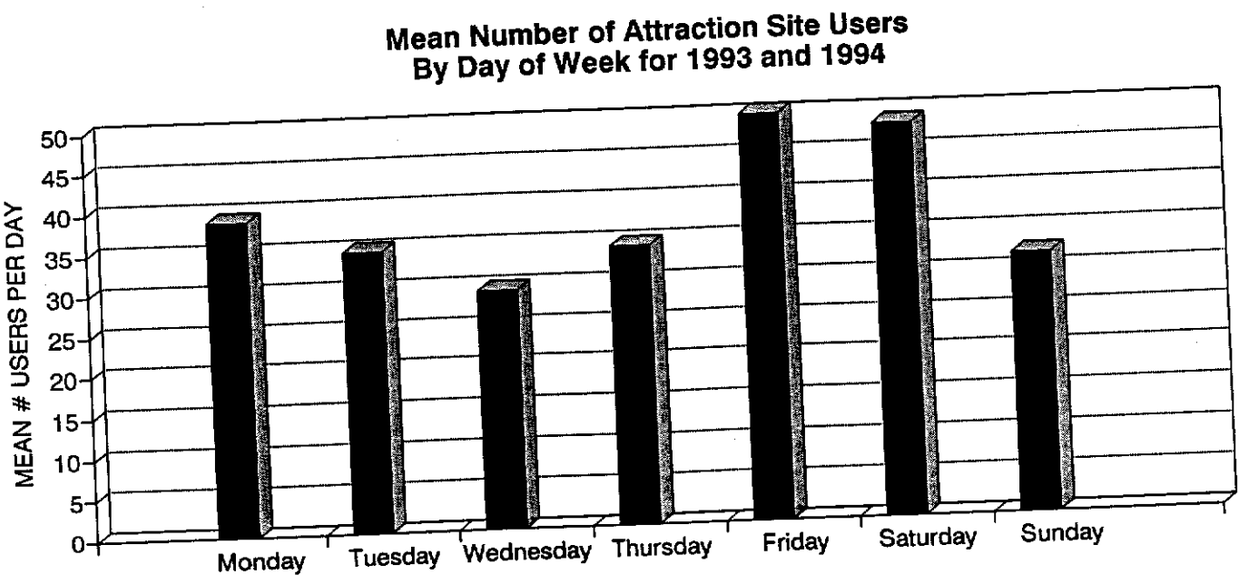

Figure 9. *Mean number of users for all attraction sites by day of the week for 1993 and 1994.*

The maximum number of visitors and campers are shown in Table 6. Pearce Ferry supported the highest number of visitors during a single day. Spencer Canyon supported the highest number of overnight campers.

Table 6. *Summary of attraction site surveys for 1993 and 1994.*

SITE	# DAYS SURVEYED PEAK	SHOULDER	MAXIMUM # USERS PER DAY	MAXIMUM # CAMPERS PER NIGHT
Diamond	16	6	154	15
Trav. Cyn	13	12	117	0
Trav. Falls	6	11	72	33
Bridge	14	13	48	28
Separation	12	95	106	20
Spencer	12	212	95	30
Pearce	14	13	212	8

Overnight users accounted for only 1%-6% of visitors at Diamond Creek, Separation Canyon and Pearce Ferry, while 22% of visitors at Spencer Canyon were overnight users (Figure 10). Most of the campers at Spencer Canyon were commercial users (69%). The sites receiving the highest number of visitors, overall, were also the sights receiving the lowest percentage of overnight users. Commercial users accounted for 65% to 76% of visitors to each site (Figure 11). Diamond Creek received the greatest percentage of private use (35%). The percentage of lake-origin boaters followed a foreseeable pattern: decreasing from Pearce Ferry upstream to Separation Canyon (Figure 12). At all sites the percentage of river-origin boaters was greater than 85%. See Appendix F for a data summary.

Figure 13 shows the difference in the mean number of visitors to each site between 1993 and 1994. The flow levels remained relatively equitable between the two years (Figure 7), although visitation levels differed. The elevation of Lake Mead averaged 1189 feet for 1993 and 1183 feet for 1994. At all sites upstream of the lake, the mean number of users increased. At the three lake sites, the mean number of visitors decreased from 1993 to 1994. However, there is not a statistically significant difference between years overall ($p=0.866$) nor a difference among sites upstream or downstream of RM 240, where the lake begins ($p > 0.07$).

In examining the relationship of the change in campable area to crowding (five camping beaches also served as attraction sites), a Spearman rank correlation indicated a negative relationship although not statistically significant ($p=0.117$). The small sample size of this study, due to the limited number of campsites and attraction sites in this reach, presented difficulties in showing significance with these kinds of tests.

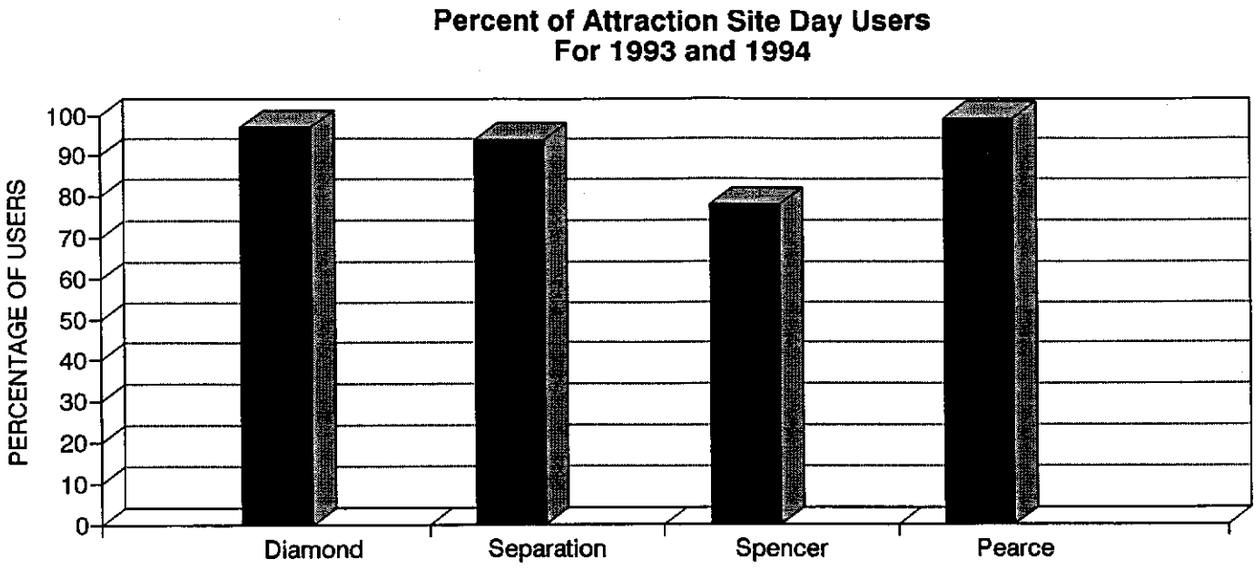

Figure 10. *Percentage of day users (as opposed to overnight users) at attraction sites for 1993 and 1994.*

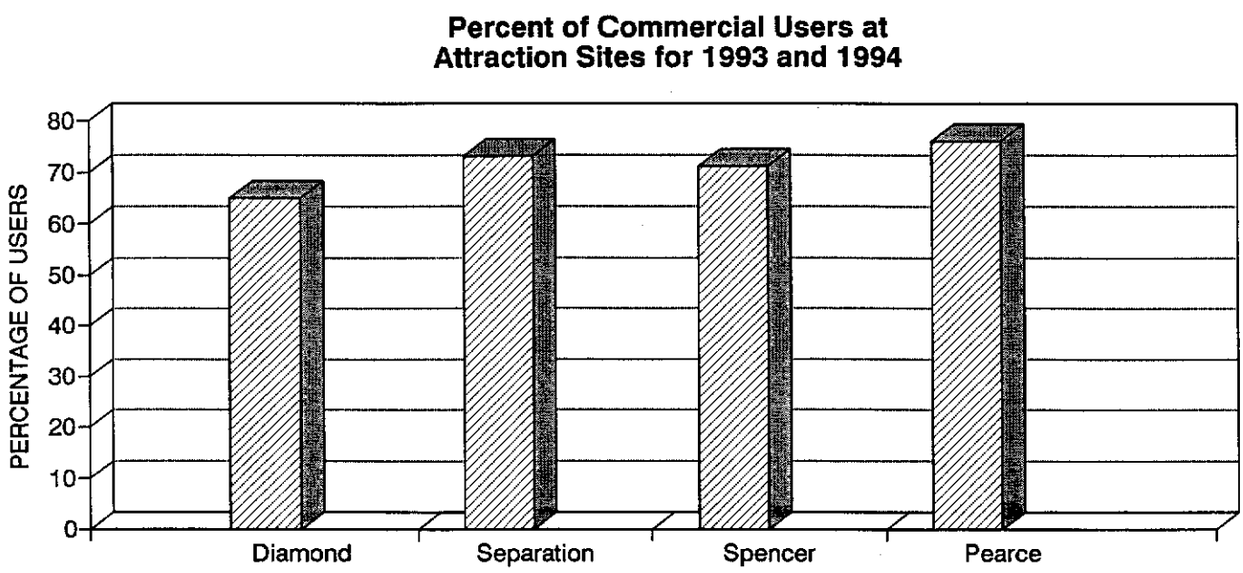

Figure 11. *Percentage of commercial users (as opposed to private users) at attraction sites for 1993 and 1994.*

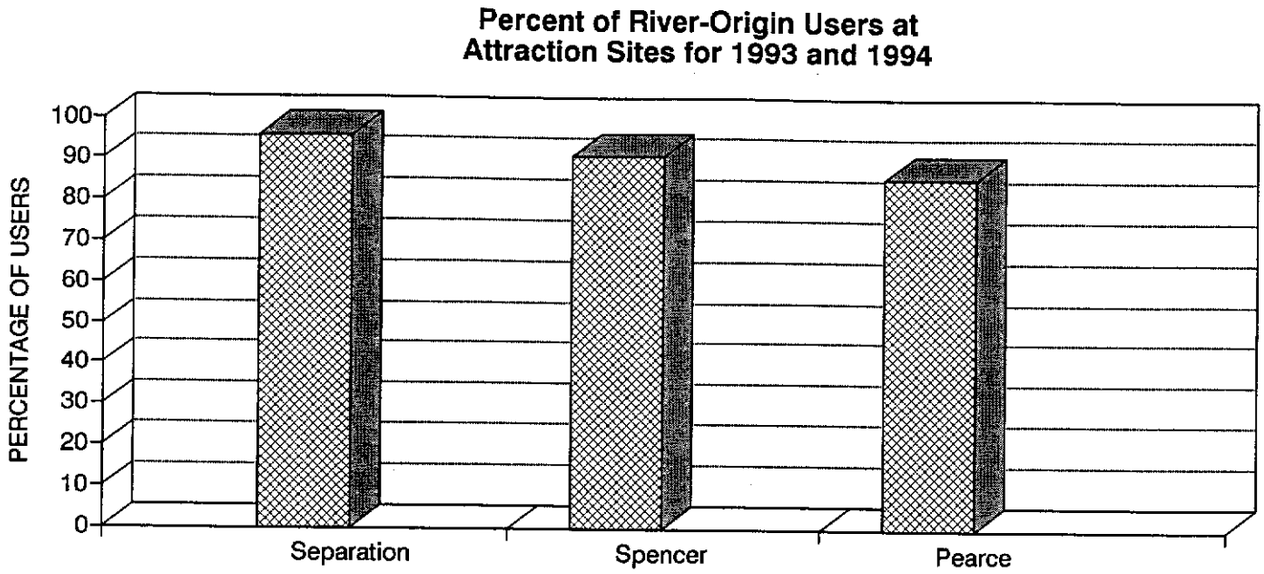

Figure 12. *Percentage of river-origin users (as opposed to lake-origin users) at attraction sites for 1993 and 1994.*

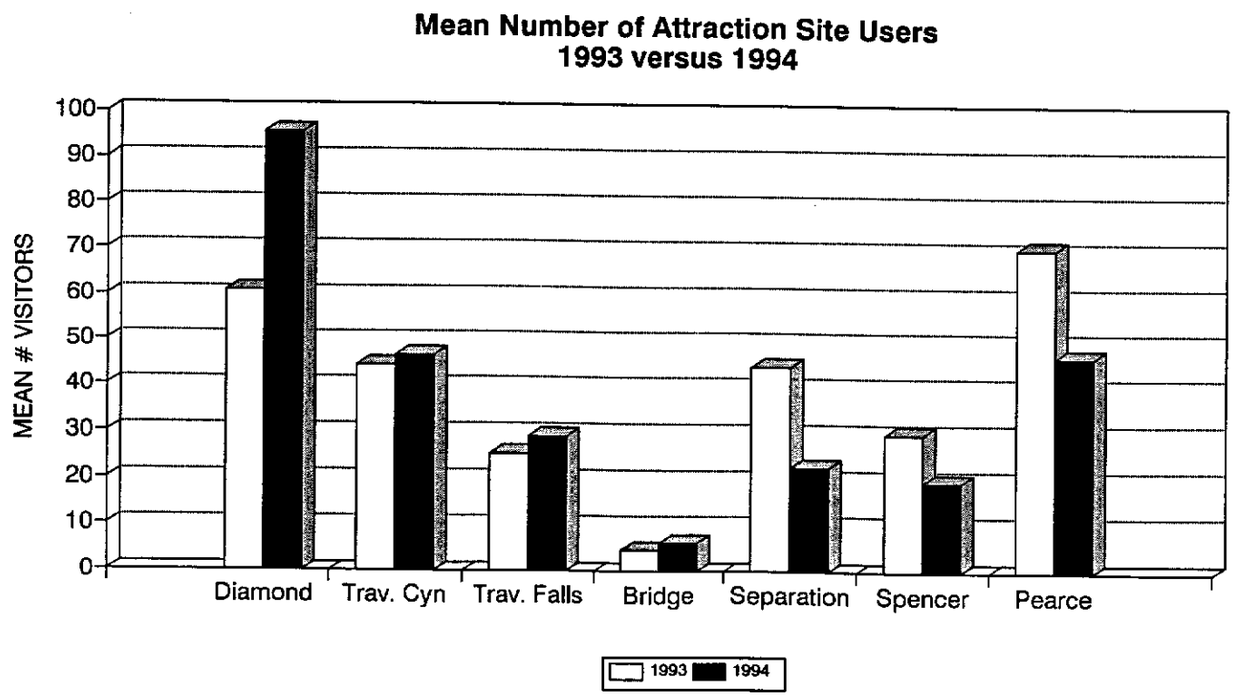

Figure 13. *Difference in the mean number of users at attraction sites between 1993 and 1994.*

SWCA followed the maximum acceptable crowding guidelines established by the NPS in the CRMP to evaluate Hualapai river corridor crowding (Tables 7 and 8). The number of launches from Diamond Creek were not evaluated. Only Diamond Creek and Pearce Ferry ever exceeded 70 users at a given time.

Table 7. *Percentage of trips encountering greater than 30, 50, 70, or 100 people while at each attraction site.*

SITE	SEASON	# TRIPS	% > 30	% > 50	% > 70	% > 100
Diamond Creek	Shoulder	127	-	-	17%	7%
	Peak	79	-	-	33%	10%
Bridge Canyon	Shoulder	0	0	0	0	0
	Peak	8	0	0	0	0
Separation Canyon	Shoulder	14	0	0	0	0
	Peak	21	38%	0	0	0
Spencer Canyon	Shoulder	18	33%	28%	0	0
	Peak	27	30%	0	0	0
Pearce Ferry	Shoulder	30	13%	0	0	0
	Peak	56	-	45%	16%	0

Table 8. *Number of trips having contact with other trips at each attraction site for all attraction site surveys in 1993 and 1994.*

SITE	TOTAL # TRIPS	# TRIPS WITH NO CONTACT	% TRIPS WITH NO CONTACT	MEETS CRMP OBJECTIVES?
Diamond	174	14	8%	no
Trav. Cyn	59	19	32%	yes
Trav. Falls	16	9	56%	yes
Bridge	8	8	100%	yes
Separation	21	16	76%	yes
Spencer	45	29	64%	yes
Pearce	86	35	41%	yes

Contact Study

A total of 25 days of river travel were surveyed for the contact study, 19 days during the shoulder seasons and 6 days during the peak season. No more than 12 contacts were ever made in a single day with no more than 10 different groups (Table 9). None of the contacts were characterized by negative reactions from the crew or the passengers of the contacted trip. The majority of the contacts were received with a reaction characterized as neutral (80%). Most trips interacted with the surveying trip by waving only or ignoring the research group (Table 10).

Table 9. *Number of trips, boats and people contacted per day during the river contact survey for 1993 and 1994. Contacted trips were categorized as commercial or private trips.*

DATE	# CONTACT	# TRIPS	# COMMERCIAL TRIPS	# PRIVATE TRIPS	# BOATS	# PEOPLE
6 April '93	2	2	1	1	4	20
7 April '93	8	3	1	2	10	40
8 April '93	1	1	0	1	2	6
7 May '93	2	1	1	0	4	36
8 May '93	5	4	4	0	5	54
9 May '93	6	6	5	1	7	38
10 May '93	3	2	1	1	4	26
11 May '93	12	10	4	6	12	61
10 May '93	2	1	1	0	4	50
11 May '93	7	6	2	4	11	68
12 July '94	10	3	3	0	10	115
13 July '94	8	1	1	0	8	55
14 July '94	4	3	1	2	4	19
15 July '94	0	0	0	0	0	0
16 July '94	1	1	0	1	19	22
17 July '94	1	1	0	1	7	7

Table 10. *The nature and reaction of passenger and boatman contact with the surveying trip.*

CONTACT CATEGORY	PASSENGER RESPONSE		BOATMAN RESPONSE	
	NATURE OF CONTACT*	REACTION TO CONTACT**	NATURE OF CONTACT*	REACTION TO CONTACT**
1	23	0	31	0
2	30	59	22	57
3	8	10	4	13
4	1	-	5	-
5	7	-	8	-

*Nature of Contact: 1) ignored; 2) wave; 3) verbal; 4) chat; 5) conversation

**Reaction to Contact: 1) negative; 2) neutral, 3) positive

CHAPTER 4. ECONOMIC STUDY

Introduction

A substantial portion of the Hualapai Tribe's gross revenue is generated from river-related activities. The largest portion of these monies is generated through white-water boating. The Tribe owns and operates Hualapai River Runners (HRR), a commercial white-water boating company. HRR is one of five tribal enterprises and was a major source of income in the 1980s ranging from 33 to 49 percent of gross tribal income.

A study by Bishop et al. (1987) for the stretch of river above Diamond Creek found that the economic value of white-water boating was related to flow. However, Bishop did not investigate the net economic value of white-water boating below Diamond Creek.

The small number of camps in the reach below Diamond Creek in 1991, (approximately 0.25 camps/mile) limited the size and quantity of trips that could be run in the Lower Gorge. By comparison, the number of campsites upstream of Diamond Creek ranged from 0.7 to 1.1 camps/mile for critical and noncritical reaches, respectively for the same year (Kearsley et. al, 1993). A critical reach was defined as any contiguous stretch of river in which the number of available campsites is limited. The number of campsites below Diamond Creek already falls significantly below the lowest density found in the upper Grand Canyon. Further loss of campsites would be detrimental to the recreation potential of this area and therefore of great economic loss to the Hualapai Tribe.

Study Area

The river-access road at Diamond Creek created a situation on the Hualapai Reservation that proved to be of great economic importance to the Tribe. Being the only access to the Colorado River for 226 miles upstream and 51 miles downstream, Diamond Creek is a site of much recreational activity that generates a substantial amount of revenue for the Tribe. Economic data involving use of the Diamond Creek or river area was assessed for this study.

Methodology

The HRR office compiled permit and revenue data pertaining to direct or indirect use of the Colorado River for 1992, 1993, and 1994. Data included the number of people purchasing permits, the price of each permit, and HRR's total revenue. The following types of river-related permits were included for consideration in this study: take-out (at Diamond Creek), ramp-off (permit to launch from Diamond Creek), one- and two-day HRR commercial river trips, sightseeing, camping, fishing, and hunting for bighorn sheep.

Data regarding the number of people taking out at or below Diamond Creek from 1992 to 1994 were obtained through GCNP river use reports. The NPS categorizes river users as recreational or non-recreational. Recreational users included all commercial passengers and private boaters.

Non-recreational users included all research and GCNP personnel along with commercial guides and staff.

HRR provided data requested by David Harpman of the Economic Analysis Branch of the Bureau of Reclamation, Denver office, for analysis and inclusion in the Glen Canyon Dam Environmental Impact Statement (GCDEIS). SWCA forwarded economic data received from the NPS and HRR to David Harpman in fulfillment of contractual obligations.

Results

Total revenues generated from all aspects of HRR increased over the period of this study (Figure 14). The increase between calendar years 1992 and 1993 was due to an increase in take-out and ramp-off fees from $12.50 to variable fees of $12.50, $14.50, and $16.50, depending on the number of people per group. The rates of the HRR commercial one- and two-day trips also increased between 1992 and 1993 from $165 to $245 for a one-day trip and from $265 to $355 for a two-day trip. A second contributing factor to the increase in revenues was the increase in the number people taking HRR commercial trips (Figure 15). The number of HRR trips continued to increase for 1994. Total take-outs fell from 1992 to 1993, then rose slightly in 1994. Total number of ramp-offs increased steadily through 1994.

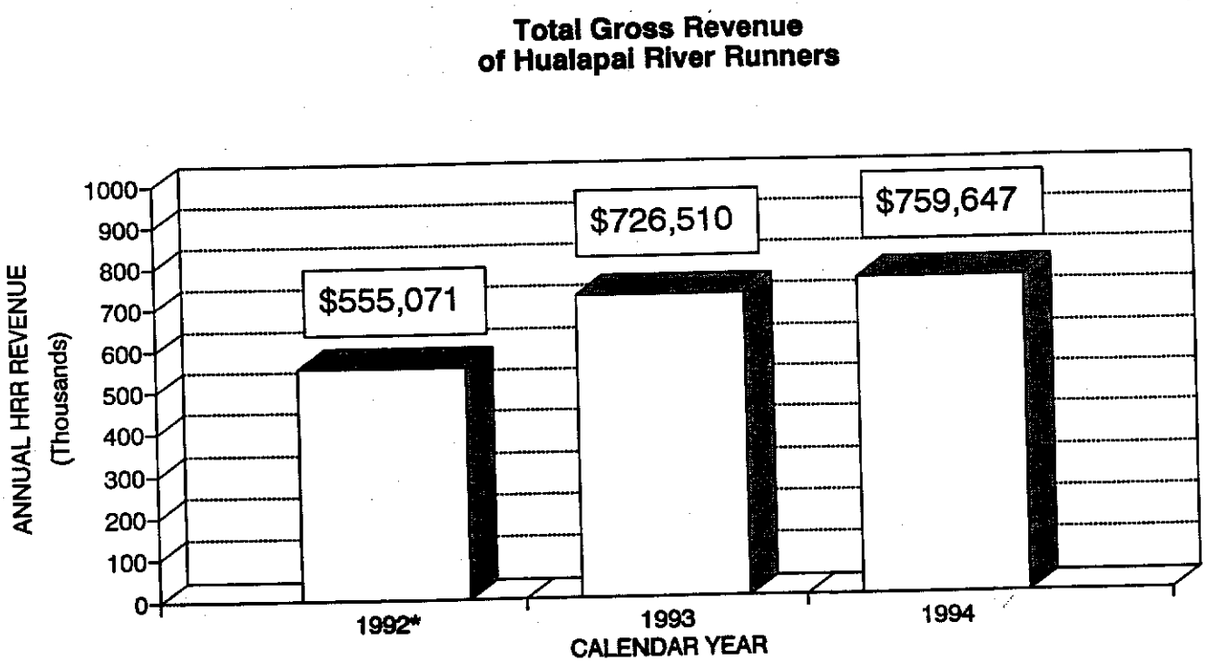

Figure 14. *Gross annual revenue of the Hualapai River Runners for calendar years 1992, 1993, and 1994. Revenues are generated through Commercial white-water boating and selling of permits for boating take-outs and launchings at Diamond Creek and river-related activities--sightseeing, camping, fishing, and hunting of bighorn sheep. *Figure for 1992 includes revenues from 10/1/91 through 12/31/92.*

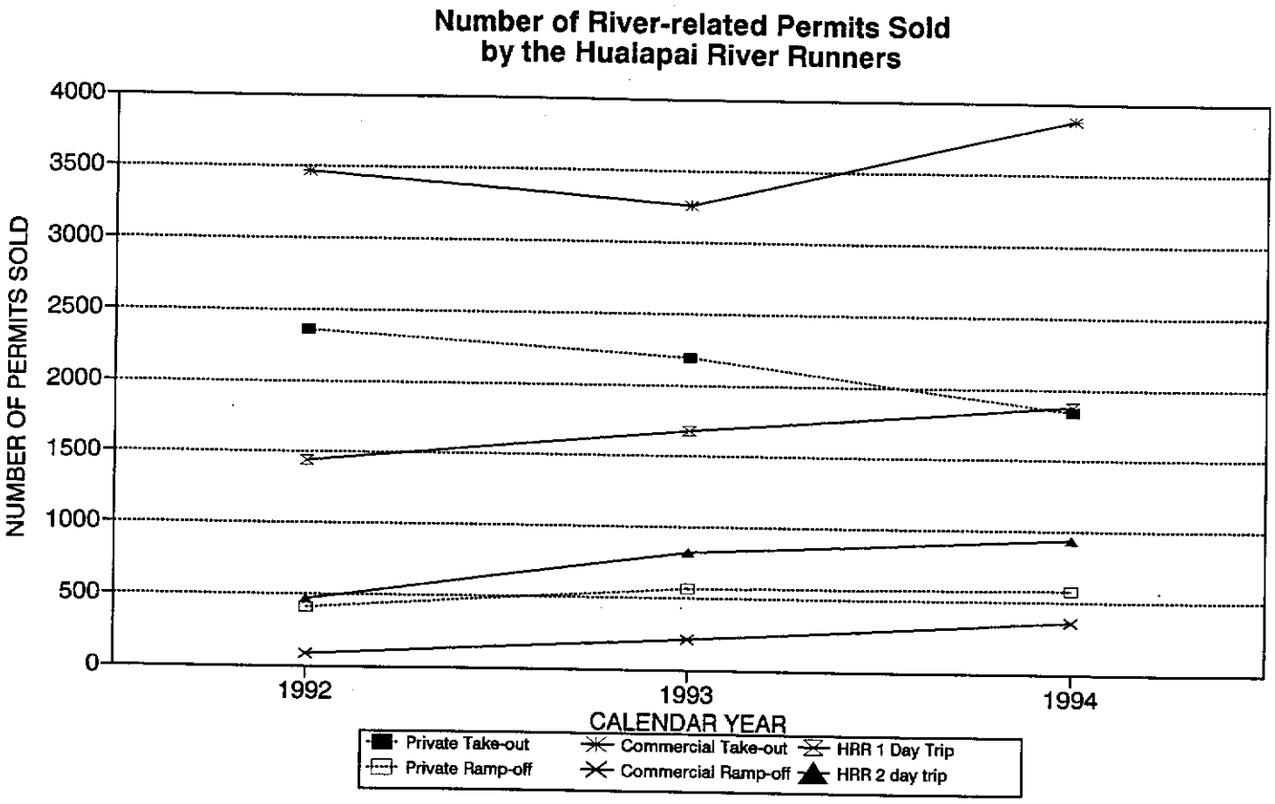

Figure 15. *Number of river-related permits sold by the HRR for Diamond Creek take-outs and launchings (ramp-offs) and number of people on HRR commercial trips for 1992, 1993, and 1994.*

The total number of river-related permits (sightseeing, camping, fishing, and big horn sheep hunting) fluctuated throughout the study. In 1992 a total of 291 permits were sold. This number increased to 340 permits in 1993, then fell to 258 permits in 1994.

River-use reports obtained from the GCNP showed a higher number of take-outs at Diamond Creek than the number of permits sold by HRR (Figure 16). If this discrepancy of 2,584 people for the three years is real, a minimum of $32,300 in additional revenues could have been generated through the collection of take-out fees.

Data from the GCNP river-use reports also revealed that 37% of all people launching at Lees Ferry left the river at Diamond Creek (Figure 17). These figures were consistent for all three years with 35% of recreational boaters and 43-48% of non-recreational boaters ending their trips at Diamond Creek.

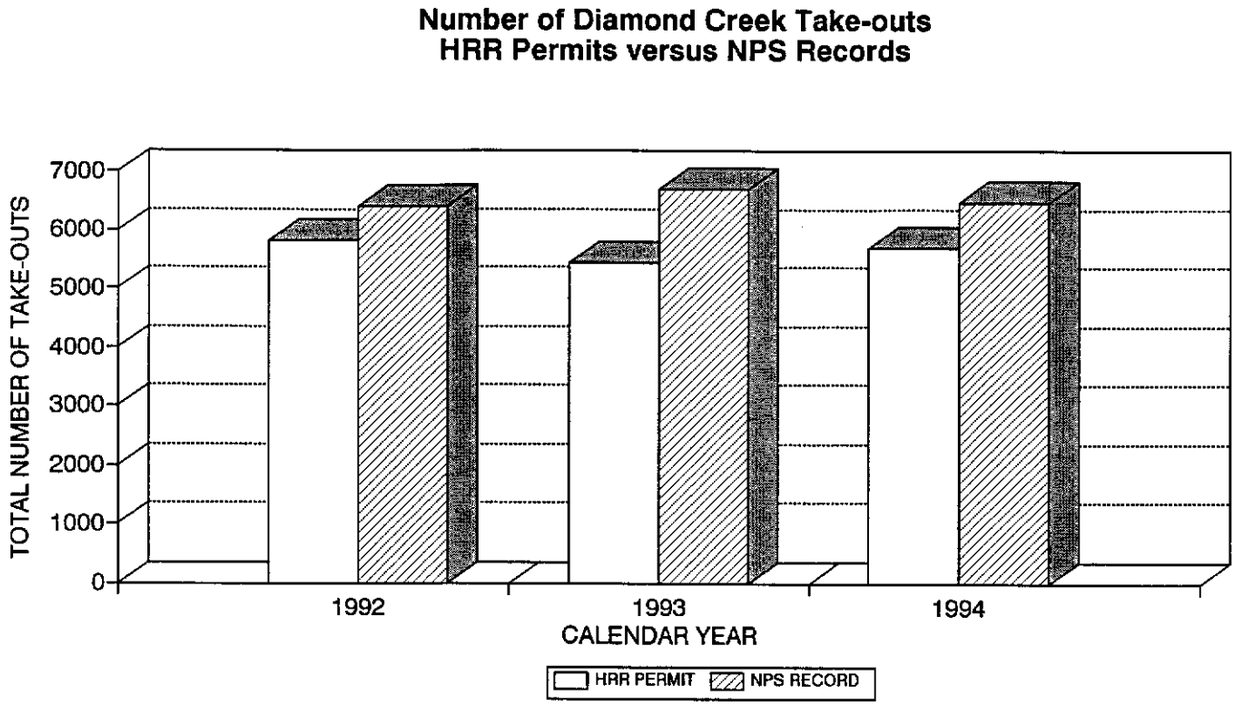

Figure 16. *Discrepancy of the number of Diamond Creek take-outs sold by HRR and the NPS river-use records for the number of take-outs for 1992, 1993, and 1994.*

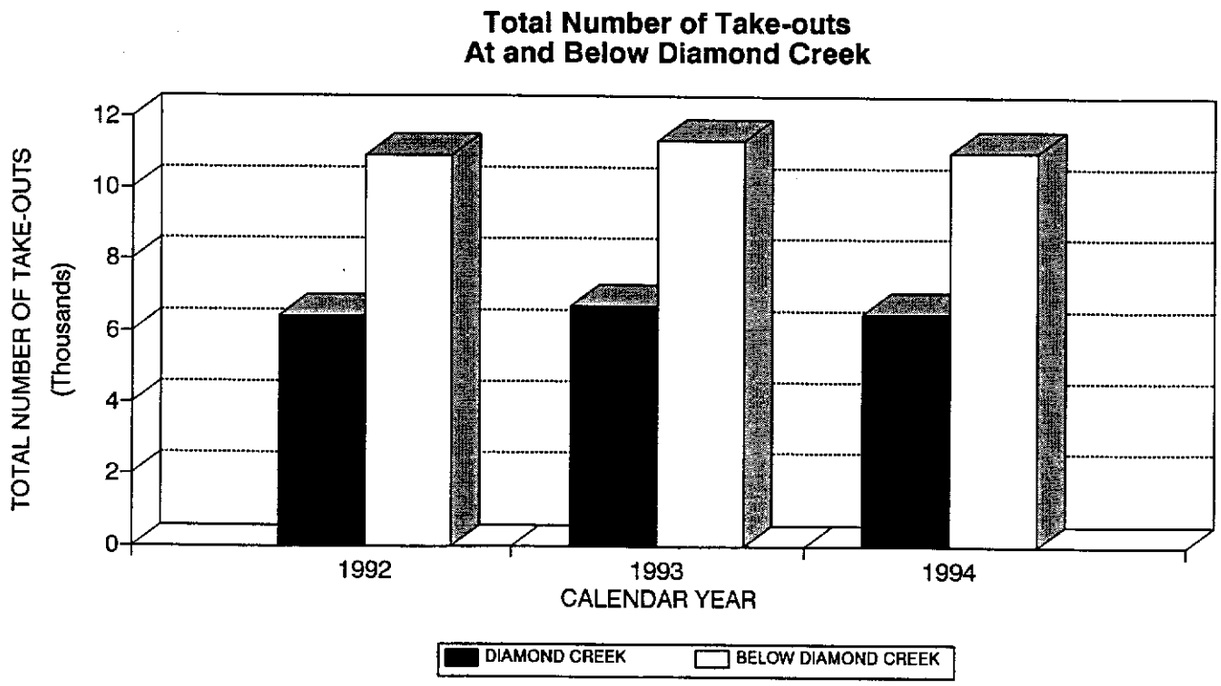

Figure 17. *NPS river-use records of the total number of take-outs at Diamond Creek or below Diamond Creek (Pearce Ferry or South Cove) for 1992, 1993, and 1994.*

CHAPTER 5. DISCUSSION AND RECOMMENDATIONS

Campsite Size Studies

For the two years that researchers monitored the 13 beaches for this study, many changes occurred, displaying the dynamic nature of these sand bar deposits. The total campable areas initially increased between October 1992 and April 1993 due to a natural flooding event in February 1993 that deposited sediments on beaches, creating new camping areas. Since the initial increase in campable area, the total campable area of beaches consistently decreased for the remainder of the study.

Increases or relative stability of total campable areas occurred over the winter months from the October to April surveys while decreases occurred over the summer months from the April to October surveys. All river erosion, except for a loss of 14 m^2 at 241 Right camp, transpired during the April to October period when dam releases increased from roughly 10,000 cfs in the spring to an annual peak of almost 20,000 cfs for July and August of all three years. The campsites that lost area to river erosion were low-lying campsites that might have been inundated in the peak summer flows. Another factor is the wake from the commercially operated jetboat that picks up commercial passengers at Separation Canyon or below and brings them to Pearce Ferry or South Cove (both on Lake Mead) during the main river-running season from May through September. This could well be the primary factor of river erosion as 92% of the loss in this category occurred in the lake reach where the jetboat travels. Another possible contributor of river erosion is the fluctuating levels of Lake Mead which influence the river below RM 240, the lake reach.

Lava Cliffs and 257 Bar camps both incurred significant calving between April 1992 and October 1992, the period just prior to the first data set used in analysis for this study. The majority of the data from the first survey in April 1992 was incomparable to data from all other surveys due to refinement of techniques employed in subsequent surveys, however, some changes could be accurately discerned from the data. Lava Cliffs lost all campable area due to river erosion between April and October 1992, and 257 Bar lost 632 m^2 in the same time period. Dam releases and river flows for this period varied little between the three years, as seen in the hydrographs, except for a dramatic decrease in early June 1992 when maximum flows fell below approximately 8,000 cfs for several days. If the remote cameras had been established at these sites during this period, we could have accurately determined the timing of these calving events and perhaps related them to river flows.

Both of these beaches are in the lake reach and are subject to fluctuating lake levels as well as wake from the jetboats. We recommend further studies to determine the effects of both jetboat wake and fluctuating lake levels on beach stability.

Another contributor to the loss of campable area over the summer months was vegetation encroachment. The majority of vegetation growth occurs in the warm, wet summers. Foot traffic

and other human activity, which are higher in the period from April to October, might also have contributed to the higher loss in campable area over the summer months.

Heavy precipitation in February 1993 led to flooding of the Colorado River through the Grand Canyon, raising the river flow to approximately 33,000 cfs. Previously, maximum flows were 20,000 cfs. This flood deposited substantial amounts of sediment on most beaches in the reach below Diamond Creek, accounting for a large percentage of the increase in campable area for the period from October 1992 to April 1993. Upstream of Diamond Creek, electronically surveyed sediment deposits received an average of 1 m of new sediment deposited on top of beaches from this flooding (Kaplinski et.al. 1994). Unfortunately, this aggradation was transient, and the majority of the new depositions upstream and downstream of Diamond Creek were eroded by the river. Kaplinski, who is studying sediment deposits from Lees Ferry to Diamond Creek for GCES, postulated that a larger flood of approximately 40,000 cfs would create a more stable situation for new deposits. It is rare that a naturally occurring flood could raise the river level to the 40,000 cfs stage. Therefore, if the Tribe desires to build up their beaches through flood deposition, a controlled flood through the Glen Canyon Dam is recommended.

One exception to the transience of the new deposits was the sand bar formed at Spencer Canyon. Prior to this flood, there was no campable area at this site. A large, low-lying beach was formed in the flooding event, and most of the campable area had been retained throughout this study, though campable area gradually decreased due to vegetation encroachment by tamarisk and arrowweed, runoff, and river erosion.

This beach quickly became the most highly used beach by the HRR for their overnight (2-day) commercial river trips. The attraction of an easily accessible, large camping area and a side canyon with great recreation potential made the campable beach at Spencer Canyon extremely valuable. We recommend the investigation of methods of stabilizing riparian beaches so that beaches such as the one at Spencer Canyon will have a longer period of usability.

While decreasing campable area of beaches is a threat to the continued recreational use of the lower Grand Canyon, other factors can jeopardize the enjoyment of visitors to this area. Factors with negative recreational value identified in this study included the invasion of beaches by pogo ants; the spread of the exotic, spiny shrub, camel thorn; the noise from the commercially operated jetboats; the slick mud deposits along the river's edge from dropping lake and river levels; and the unsightly appearance of beach fronts in the lake reach from calving which left downed and dying vegetation and large landscape scars. Each of these issues is addressed below.

Throughout the period of this study, we noticed an increase in the number of pogo ants (*Pogonomermex* sp.) at several beaches. One campable area at 241 Right camp was lost due to a nest of pogo ants at that site. These diurnal insects are not aggressive, yet can inject a highly toxic venom which will inflict several hours of extreme discomfort on the victim. Grand Canyon River Guides know of the direct correlation between the amount of food crumbs left on a beach and the number of pogo ants. The NPS has set guidelines for boaters, taking extensive measures to minimize the food left on a beach. On several occasions we observed substantial amounts of

food scraps on the beaches below Diamond Creek, and subsequently, we noted an increase in the number of pogo ants over the two years of the study.

We recommend the adoption of NPS protocol by the HRR, HNRD and all private and commercial trips launching at Diamond Creek to minimize food crumbs to control this increasing threat to the enjoyment of campsites and attraction sites.

Although no campable area was lost to the encroachment of the exotic camel thorn (*Alhagi camelorum*), an increase in the amount of this obnoxious plant was noted throughout this study. Camel thorn is a spiny shrub that can quickly colonize sand bars, prohibiting camping and visitation. Camel thorn is threatening the campable area of several beaches in the upper Grand Canyon. We noted camel thorn at several study beaches including Travertine Falls, Bridge Canyon, and 243 Right. We recommend manual clearing of this exotic plant from all sites. As with most vegetation invasion, it is relatively easy to control a species in the early stages of its establishment, and nearly impossible to control once it and its seed bank are strongly ensconced.

We also found that jetboats and fluctuating lake levels detracted from the aesthetic value of campable beaches. The noise of the jetboat in the early morning hours experienced at all campsites below Separation Canyon was objectionable. Also, the occasional dropping of lake levels created a band of slick silt at the water's edge which made walking in this area precarious. Both of these factors decreased the pleasurable experience of users in this reach. The impact of these annoyances on recreational users is another possible area for future study, as well as researching alternatives to the commercially run jetboats.

The appearance of beaches is a very important factor for many recreational users. Most of the beaches in the lake reach are experiencing calving of large pieces of beach fronts. This results in unattractive landscapes as river front vegetation is pulled into the water, exposing roots and large, unsightly cutbanks. Again, research into the stabilization of riparian beaches could uncover feasible actions that could be taken in the lower Grand Canyon to rectify this situation.

At several sites on the lake reach, manual clearing of vegetation was observed in campsites and along trails. Kearsley et. al. (1993) attributed the increase in campsite size from 1982 to 1991, shown in Table 1, to the cutting and clearing of vegetation. Had this action not been taken by unidentified individuals throughout the period of this study at existing sites such as Chimney Rock, more campable area would have been lost to vegetation encroachment.

To maintain campsites in this critical reach, we recommend the annual clearing of encroaching vegetation. The most efficacious time for clearing is early summer when the new growth is easily removed. Should other sites become campable, an effort should be made to maintain them.

Informal conversations with commercial river guides through this reach uncovered a desire for campsites between RM 260 and Lake Mead. The creation of such sites on Hualapai Land would require a substantial expenditure of time and money. Further research into the economic potential and feasibility of clearing and maintaining new campsites should be explored.

Electronic surveying of the beaches at Bridge and Gneiss canyons provided topographic maps of these sites. Resurveying these beaches will allow assessment of changes in volume and elevation of these sediment deposits. Results of such analysis will reveal aggradation or degradation of deposits. Resurveying the delineations of all individual campsites at all study beaches will reveal the exact locations of loss or gain in campable area as well as the aggradation or degradation of sediment. Such in-depth data will further reveal the way these beaches are changing. We recommend a repeat of these surveys and an analysis of the data to determine the usefulness of such information in controlling the loss of sediment deposits.

Attraction Site and Contact Study

With the exception of Diamond Creek, all attraction sites met the CRMP management objective of river parties having a 20% or higher probability of no contact with other groups at attraction sites. The fact that Diamond Creek is the only site within Grand Canyon accessible by car and is the only place for boaters to take-out for 225 river miles upstream and put-in for 55 river miles downstream explains the relatively large amount of use that this site receives. Even so, the number of people using Diamond Creek at the same time exceeded 100 people only 10% of the time during this study.

On the river, the limit of contacting no more than 5 different parties per day was exceeded during 30% of the shoulder season surveys. The peak season limit of 7 contacts with different parties was exceeded 33% of the time. It should be noted that these limits were frequently exceeded within GCNP as well.

For the 1993 and 1994 contact surveys, crowding along the lower Grand Canyon never exceeded levels of crowding observed in the upper Grand Canyon. NPS contact surveys in 1989 and 1990 revealed a mean of 6.0 daily contacts and a mean of 4.6 parties contacted per day, over both the primary shoulder and the primary high density seasons. Levels below Diamond Creek averaged 4.5 daily contacts and 2.8 parties contacted per day. These contact levels are within the CRMP objectives for the GCNP river corridor.

Since no negative reactions were observed in any of the contacts made, we are assuming that the level of crowding below Diamond Creek is acceptable to those trips encountered during this study.

The data collected in 1993 and 1994 constitute baseline data for recreational crowding and use along the Hualapai Tribe's most economically important land. The change in crowding cannot be determined based upon these data; the continuation of this study is essential to identify use trends on the Colorado River through the Hualapai Reservation. In order to determine the impact of interim flows on the level of recreational crowding in Lower Grand Canyon, monitoring during different flow regimes would be necessary.

Economic Study

The total number of recreation permits sold by the Hualapai Tribe increased five-fold between 1985 and 1991 (Glen Canyon Dam Draft Environmental Impact Statement, 1993). River-related recreation and HRR revenue continued to increase during the period of this study, from 1992 to 1994. This trend appears to be unrelated to flows released from Glen Canyon Dam or Lake Mead elevations, as they remained relatively equitable for these years.

The Hualapai Tribe is economically dependent on the sale of river-related permits and services. Variables that may influence the amount of river-related activity that takes place on Hualapai tribal lands and waters include the number and size of campsites and the degree of crowding along the river corridor and at attraction sites. Both of these factors are potentially impacted by the magnitude and timing of flow releases from Glen Canyon Dam, the elevation of Lake Mead, and the national and regional economic climate. David Harpman of the Bureau of Reclamation in Denver, Colorado, is currently analyzing the economic impact of the interim flow regime for the lower Grand Canyon. We recommend continued monitoring of all of these variables for changes that may further impact the economic stability of the Hualapai Tribe. This study provides necessary baseline data to determine when significant change occurs.

The discrepancy in the number of permits sold by HRR for take-outs at Diamond Creek and the NPS records of the number of Diamond Creek take-outs is an area that should be explored. The rectification of this situation could bring in approximately $10,000 annually.

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APPENDIX A
Total Attributable Changes in Campable Area Per Study Site

	VEG ENCROACHMENT	RUNOFF	OTHER GAIN	OTHER LOSS	NEW DEPOSIT	RIVER EROSION
TC*	0	0	6	-180.75	0	0
TF*	0	-3	22.75	-76.85	0	0
BC	0	-36.4	120.5	-259.15	44	-43.75
GC	-5	-586	765	-442	122	0
SEP	0	-94	200	-151	31	-136
241R	-6	0	106.5	-107.5	36	-17
241L	-30.5	-163	143.25	-20	0	0
242R	0	0	49.5	-105.5	63	0
243R	-15	-248.75	209.25	-153	118	0
SC	-84.5	-280	0	-0.6	1112	-264.6
CR	-239	0	107	0	103	-113.5
257	-32	0	0	0	0	0
BS	-16	0	6	-2.75	0	0
TOTAL	-428	-1411.15	1735.75	-1499.1	1629	-574.85

*No data for Travertine Canyon and Travertine Falls from October 1992 survey.

APPENDIX B
Attributable Changes in Campable Area for all Study Sites Between Consecutive Surveys

TRAVERTINE CANYON

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
4/93-11/93	0	0	0	-156	0	0
11/93-4/94	0	0	0	-8.75	0	0
4/94-10/94	0	0	6	-16	0	0
TOTALS	0	0	6	-180.75	0	0

TRAVERTINE FALLS

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
4/93-11/93	0	0	0	-47	0	0
11/93-4/94	0	0	9.5	-27.25	0	0
4/94-10/94	0	-3	13.25	-2.6	0	0
TOTALS	0	-3	22.75	-76.85	0	0

BRIDGE CANYON

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	73	-39	0	0
4/93-11/93	0	0	0	-159.25	44	-43.75
11/93-4/94	0	-4	3.5	-55.75	0	0
4/94-10/94	0	-32.4	44	-5.15	0	0
TOTALS	0	-36.4	120.5	-259.15	44	-43.75

GNEISS CANYON

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	315	-154	80	0
4/93-11/93	0	-566	0	-71	42	0
11/93-4/94	-5	-10	258	-92	0	0
4/94-10/94	0	-10	192	-125	0	0
TOTALS	-5	-586	765	-442	122	0

SEPARATION

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	-43	0	-133	0	0
4/93-11/93	0	-22	0	-14	31	-16
11/93-4/94	0	-28	126	0	0	0
4/94-10/94	0	-1	74	-4	0	-120
TOTALS	0	-94	200	-151	31	-136

241R CAMP

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	75	0	0	0
4/93-11/93	0	0	0	-97	36	0
11/93-4/94	-4	0	6	-4.5	0	-14
4/94-10/94	-2	0	25.5	-6	0	-3
TOTALS	-6	0	106.5	-107.5	36	-17

241L CAMP

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	-29.5	0	105	0	0	0
4/93-11/93	0	-163	4.5	-8	0	0
11/93-4/94	-1	0	0	-8	0	0
4/94-10/94	0	0	33.75	-4	0	0
TOTALS	-30.5	-163	143.25	-20	0	0

242R CAMP

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	41	0	47	0
4/93-11/93	0	0	4	-68	16	0
11/93-4/94	0	0	4.5	0	0	0
4/94-10/94	0	0	0	-37.5	0	0
TOTALS	0	0	49.5	-105.5	63	0

243R CAMP

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	52	-44	0	0
4/93-11/93	-8	-248.75	0	-4	118	0
11/93-4/94	-7	0	0	-94	0	0
4/94-10/94	0	0	157.25	-11	0	0
TOTALS	-15	-248.75	209.25	-153	118	0

SPENCER CANYON

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	0	0	562	0
4/93-11/93	0	-131	0	0	550	0
11/93-4/94	-11	-140	0	0	0	0
4/94-10/94	-73.5	-9	0	-0.6	0	-264.6
TOTALS	-84.5	-280	0	-0.6	1112	-264.6

CHIMNEY ROCK

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	2	0	103	0
4/93-11/93	-133.5	0	0	0	0	-103
11/93-4/94	-4	0	105	0	0	0
4/94-10/94	-101.5	0	0	0	0	-10.5
TOTALS	-239	0	107	0	103	-113.5

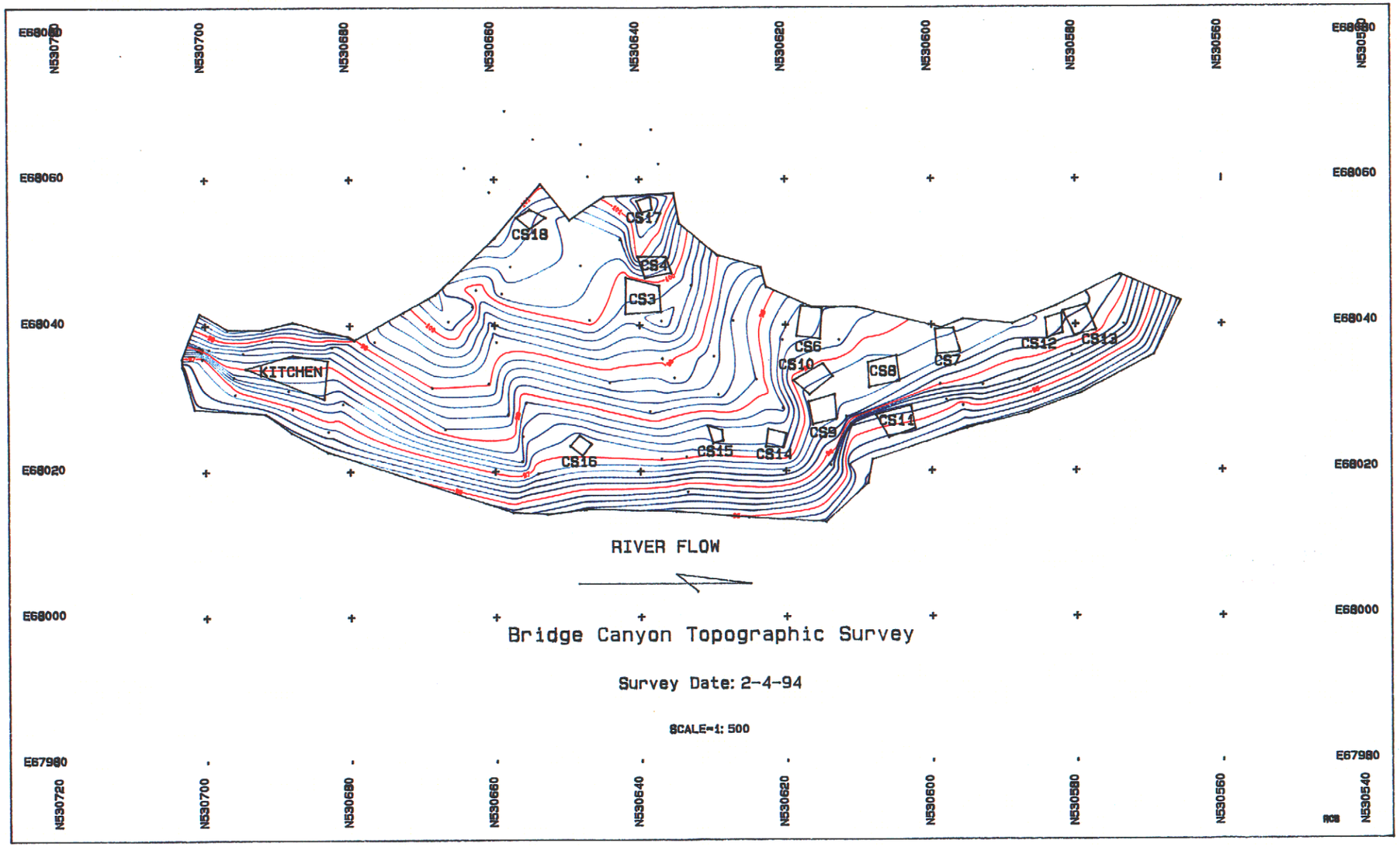
257 BAR

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	-32	0	0	0	0	0
4/93-11/93	0	0	0	0	0	0
11/93-4/94	0	0	0	0	0	0
4/94-10/94	0	0	0	0	0	0
TOTALS	-32	0	0	0	0	0

BURNT SPRINGS

	VEG	RUNOFF	OTHER +	OTHER -	NEW DEPOSIT	RIVER EROSION
10/92-4/93	0	0	0	0	0	0
4/93-11/93	0	0	0	0	0	0
11/93-4/94	-16	0	0	0	0	0
4/94-10/94	0	0	6	-2.75	0	0
TOTALS	-16	0	6	-2.75	0	0

APPENDIX C
Topographic Maps of Beaches at Bridge Canyon and Gneiss Canyon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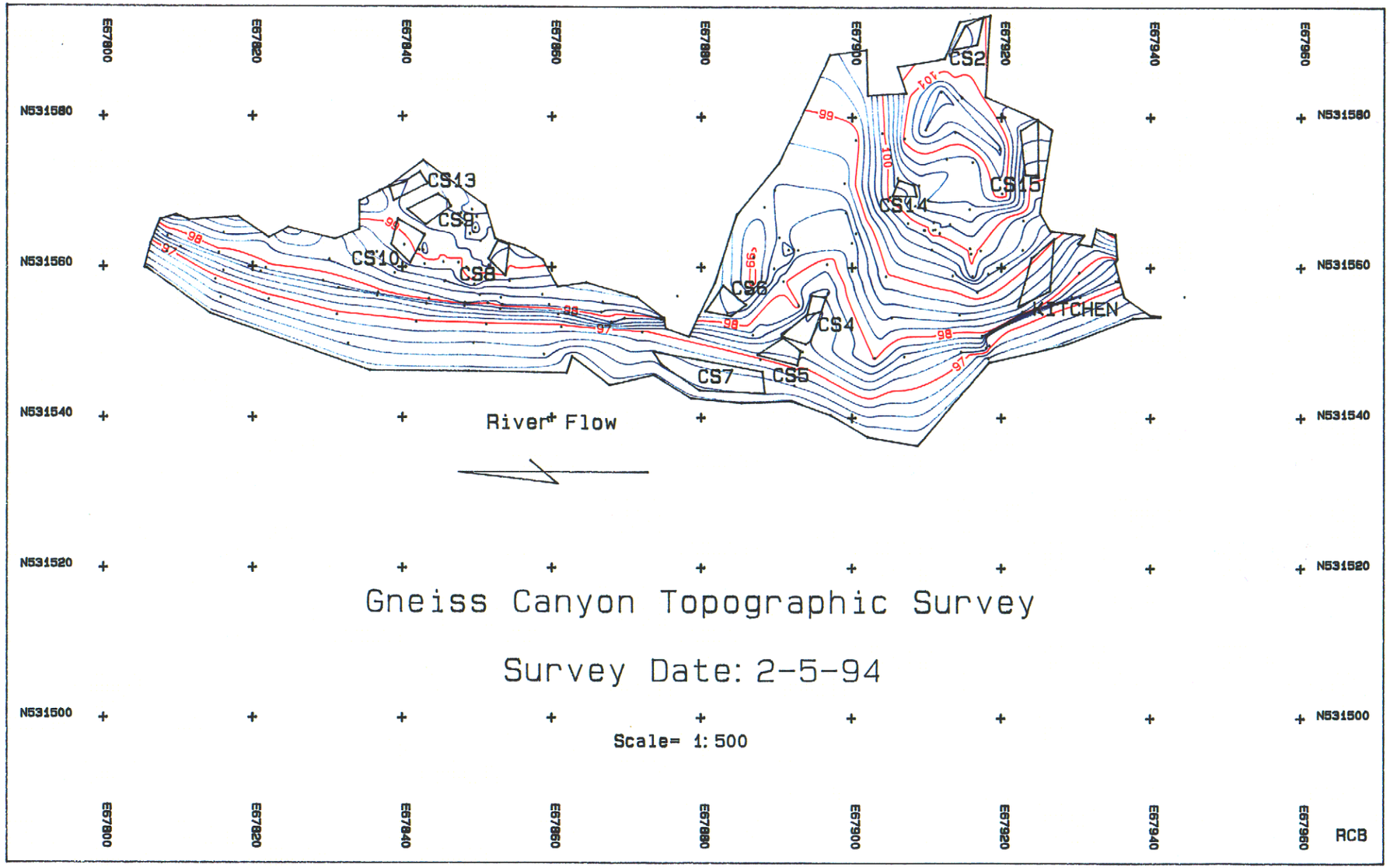
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CS7
CS5
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River Flow
Gneiss Canyon Topographic Survey
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APPENDIX D
Attraction Site Observation Form

ATTRACTION SITE OBSERVATION FORM NAME: _____ SITE: _____ DATE: _____

Outfitter or Private Leader	Number Boats		Number Passengers	Number Crew	Time Arrive	Time Leave	Time Spent	Type of Activities (Lunch, hike, swim)	Comments (Incl Launch Date)
	Motor	Oar							

APPENDIX E
Daily River Contact Form

DAILY RIVER CONTACTS

	Day _____ of _____										Title _____
	CONTACT	1	2	3	4	5	6	7	8	9	10
	Group Name										
	Time in Sight (min)										
	Duration of Contact										
Trip Type	1) Oar 2) Motor										
	1) Private 2) Commercial 3) NPS or Research										
Size of Contact	Total # People										
	Total # Boats										
	People per Boat										
Passenger Nature	1) Ignored 2) Wave Only 3) Verbal 4) Chat 5) Conversation										
Passenger Reaction	1) Negative 2) Neutral 3) Positive										
Boatman	Nature as above										
	Reaction as above										
	Adjustments										

Notes:

APPENDIX F
Summary of Attraction Site Study Data

SITE	YEAR	MONTH/DAY	SEASON	D.O.W.	USERS	RIVER BOATS	RIVER USERS	LAND VEHICLES	LAND USERS	CAMPERS	DAY USERS	COMMERCIAL USERS	PRIVATE USERS	LAKE BOATS	LAKE USERS	DERIG BOATS	DERIG USERS
DIAMOND CREEK	1993	4/10	S	S	28	19	28	0	0	0	0	0	28	-	-	0	0
DIAMOND CREEK	1993	4/5	S	M	44	2	10	11	30	2	42	4	40	-	-	2	4
DIAMOND CREEK	1993	4/6	S	T	12	2	8	1	4	0	12	12	0	-	-	0	0
DIAMOND CREEK	1993	4/7	S	W	30	3	18	4	9	1	29	19	11	-	-	2	3
DIAMOND CREEK	1993	4/8	S	TH	71	2	16	7	55	4	71	39	32	-	-	0	0
DIAMOND CREEK	1993	4/9	S	F	17	0	0	5	17	1	16	0	17	-	-	0	0
DIAMOND CREEK	1993	6/17	P	T	85	5	27	6	12	0	85	31	54	-	-	0	0
DIAMOND CREEK	1993	6/18	P	W	97	11	91	0	0	0	97	95	2	-	-	1	6
DIAMOND CREEK	1993	6/19	P	TH	88	9	78	0	0	0	88	88	0	-	-	0	0
DIAMOND CREEK	1993	6/20	P	F	56	7	45	1	4	0	56	32	24	-	-	4	7
DIAMOND CREEK	1993	6/21	P	S	134	10	71	0	0	0	134	122	12	-	-	16	63
DIAMOND CREEK	1993	6/22	P	SU	68	3	52	0	0	0	68	62	6	-	-	3	16
DIAMOND CREEK	1994	5/25	S	W	72	2	7	11	6	0	72	21	51	-	-	13	47
DIAMOND CREEK	1994	5/26	S	TH	135	7	37	22	65	3	135	73	62	-	-	14	36
DIAMOND CREEK	1994	5/27	S	F	154	9	76	28	39	8	145	106	48	-	-	8	38
DIAMOND CREEK	1994	5/28	S	S	89	4	25	22	53	15	74	38	51	-	-	8	11
DIAMOND CREEK	1994	8/31	P	W	82	6	45	12	13	3	79	78	4	-	-	6	24
DIAMOND CREEK	1994	9/1	P	T	129	17	43	18	55	1	128	91	38	-	-	6	31
DIAMOND CREEK	1994	9/2	P	F	111	5	36	16	20	0	111	85	26	-	-	22	55
DIAMOND CREEK	1994	9/3	P	S	21	0	0	6	14	5	16	9	12	-	-	6	7
DIAMOND CREEK	1994	9/4	P	SU	29	0	0	13	21	7	22	11	18	-	-	5	8
DIAMOND CREEK	1994	9/5	P	M	134	6	43	22	77	4	130	84	50	-	-	6	14
TRAVERTINE CYN.	1993	4/21	S	W	0	0	0	-	-	nc*	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	4/22	S	TH	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	4/23	S	F	114	16	114	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	4/24	S	S	51	16	51	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	4/25	S	SU	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	4/26	S	M	9	6	9	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	8/10	P	T	134	7	134	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	8/11	P	W	11	8	11	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	8/12	P	TH	37	9	37	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	8/13	P	F	100	10	100	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	8/14	P	S	56	10	56	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	8/15	P	SU	45	3	45	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1993	8/16	P	M	21	10	21	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE CYN.	1994	4/12	S	T	9	5	9	-	-	0	9	3	6	-	-	-	-
TRAVERTINE CYN.	1994	4/13	S	W	0	0	0	-	-	0	0	0	0	-	-	-	-
TRAVERTINE CYN.	1994	4/14	S	TH	58	6	58	-	-	0	58	58	0	-	-	-	-
TRAVERTINE CYN.	1994	4/15	S	F	35	5	35	-	-	0	35	20	15	-	-	-	-
TRAVERTINE CYN.	1994	4/16	S	S	0	0	0	-	-	0	0	0	0	-	-	-	-
TRAVERTINE CYN.	1994	4/17	S	SU	33	9	33	-	-	0	33	33	0	-	-	-	-
TRAVERTINE CYN.	1994	6/25	P	S	33	7	33	-	-	0	33	17	16	-	-	-	-
TRAVERTINE CYN.	1994	6/27	P	M	112	10	112	-	-	0	112	112	0	-	-	-	-
TRAVERTINE CYN.	1994	6/28	P	T	80	4	80	-	-	0	80	80	0	-	-	-	-
TRAVERTINE CYN.	1994	6/29	P	W	45	6	45	-	-	0	45	45	0	-	-	-	-
TRAVERTINE CYN.	1994	6/30	P	TH	39	13	39	-	-	0	39	39	0	-	-	-	-
TRAVERTINE CYN.	1994	7/1	P	F	117	10	117	-	-	0	117	117	0	-	-	-	-
TRAVERTINE FALLS	1993	5/20	S	TH	0	0	0	-	-	nc*	nc	nc	nc	-	-	-	-

SITE	YEAR	MONTH/DAY	SEASON	D.O.W.	USERS	RIVER BOATS	RIVER USERS	LAND VEHICLES	LAND USERS	CAMPERS	DAY USERS	COMMERCIAL USERS	PRIVATE USERS	LAKE BOATS	LAKE USERS	DERIG BOATS	DERIG USERS
TRAVERTINE FALLS	1993	5/21	S	F	31	2	31	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE FALLS	1993	5/22	S	S	34	6	34	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE FALLS	1993	5/23	S	SU	64	4	64	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE FALLS	1993	5/24	S	M	32	2	32	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE FALLS	1993	5/25	S	T	16	1	16	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE FALLS	1993	5/26	S	W	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
TRAVERTINE FALLS	1994	5/19	S	TH	19	6	19	-	-	0	19	19	0	-	-	-	-
TRAVERTINE FALLS	1994	5/20	S	F	63	5	63	-	-	33	30	54	9	-	-	-	-
TRAVERTINE FALLS	1994	5/22	S	SU	0	0	0	-	-	0	0	0	0	-	-	-	-
TRAVERTINE FALLS	1994	5/23	S	M	0	0	0	-	-	0	0	0	0	-	-	-	-
TRAVERTINE FALLS	1994	6/10	P	F	50	4	50	-	-	0	50	50	0	-	-	-	-
TRAVERTINE FALLS	1994	6/11	P	S	38	3	38	-	-	0	38	38	0	-	-	-	-
TRAVERTINE FALLS	1994	6/12	P	SU	28	3	28	-	-	17	11	28	0	-	-	-	-
TRAVERTINE FALLS	1994	6/7	P	T	0	0	0	-	-	0	0	0	0	-	-	-	-
TRAVERTINE FALLS	1994	6/8	P	W	21	8	21	-	-	0	21	8	13	-	-	-	-
TRAVERTINE FALLS	1994	6/9	P	TH	72	11	72	-	-	16	56	55	16	-	-	-	-
BRIDGE CANYON	1993	10/26	S	T	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
BRIDGE CANYON	1993	10/27	S	W	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
BRIDGE CANYON	1993	10/28	S	TH	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
BRIDGE CANYON	1993	10/29	S	F	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
BRIDGE CANYON	1993	10/30	S	S	10	2	10	-	-	nc	nc	nc	nc	-	-	-	-
BRIDGE CANYON	1993	10/31	S	SU	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
BRIDGE CANYON	1993	11/1	S	M	0	0	0	-	-	nc	nc	nc	nc	-	-	-	-
BRIDGE CANYON	1993	7/14	P	W	11	1	11	-	-	0	11	11	0	-	-	-	-
BRIDGE CANYON	1993	7/15	P	TH	26	5	26	-	-	0	26	0	26	-	-	-	-
BRIDGE CANYON	1993	7/16	P	F	15	2	15	-	-	0	15	15	0	-	-	-	-
BRIDGE CANYON	1993	7/17	P	S	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1993	7/18	P	SU	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1993	7/19	P	M	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1993	7/20	P	T	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	10/25	S	T	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	10/26	S	W	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	10/27	S	TH	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	10/28	S	F	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	10/29	S	S	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	10/30	S	SU	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	7/12	P	T	7	2	7	-	-	7	0	7	0	-	-	-	-
BRIDGE CANYON	1994	7/13	P	W	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	7/14	P	TH	48	11	48	-	-	28	20	48	0	-	-	-	-
BRIDGE CANYON	1994	7/15	P	F	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	7/16	P	S	22	4	22	-	-	0	22	19	3	-	-	-	-
BRIDGE CANYON	1994	7/17	P	SU	0	0	0	-	-	0	0	0	0	-	-	-	-
BRIDGE CANYON	1994	7/18	P	M	0	0	0	-	-	0	0	0	0	-	-	-	-
SEPARATION CYN.	1993	6/30	P	W	31	4	31	-	-	0	31	31	0	0	0	-	-
SEPARATION CYN.	1993	7/1	P	TH	1	1	1	-	-	0	1	0	1	0	0	-	-
SEPARATION CYN.	1993	7/2	P	F	53	5	53	-	-	0	53	53	0	0	0	-	-
SEPARATION CYN.	1993	7/3	P	S	78	14	78	-	-	0	78	67	11	0	0	-	-
SEPARATION CYN.	1993	7/4	P	SU	23	6	19	-	-	0	23	0	23	1	4	-	-

SITE	YEAR	MONTH/DAY	SEASON	D.O.W.	USERS	RIVER BOATS	RIVER USERS	LAND VEHICLES	LAND USERS	CAMPERS	DAY USERS	COMMERCIAL USERS	PRIVATE USERS	LAKE BOATS	LAKE USERS	DERIG BOATS	DERIG USERS
SEPARATION CYN.	1993	7/5	P	M	106	9	106	-	-	0	106	106	0	0	0	-	-
SEPARATION CYN.	1993	7/6	P	T	18	5	18	-	-	0	18	0	18	0	0	-	-
SEPARATION CYN.	1994	10/20	S	TH	0	0	0	-	-	0	0	0	0	0	0	-	-
SEPARATION CYN.	1994	10/21	S	F	8	1	8	-	-	0	8	0	8	0	0	-	-
SEPARATION CYN.	1994	10/22	S	S	39	6	37	-	-	0	39	25	14	1	2	-	-
SEPARATION CYN.	1994	10/23	S	SU	44	8	30	-	-	0	44	30	14	11	14	-	-
SEPARATION CYN.	1994	10/24	S	M	10	1	10	-	-	0	10	10	0	0	0	-	-
SEPARATION CYN.	1994	10/25	S	T	21	11	21	-	-	16	5	5	16	0	0	-	-
SEPARATION CYN.	1994	10/26	S	W	36	18	36	-	-	0	36	8	28	0	0	-	-
SEPARATION CYN.	1994	7/13	P	W	23	2	21	-	-	0	23	21	2	2	2	-	-
SEPARATION CYN.	1994	7/14	P	TH	20	6	20	-	-	0	20	20	0	0	0	-	-
SEPARATION CYN.	1994	7/15	P	F	27	5	27	-	-	0	27	27	0	0	0	-	-
SEPARATION CYN.	1994	7/16	P	S	40	10	40	-	-	20	20	20	20	0	0	-	-
SEPARATION CYN.	1994	7/17	P	SU	0	0	0	-	-	0	0	0	0	0	0	-	-
SPENCER CYN.	1993	6/30	P	W	37	4	37	-	-	0	37	37	0	0	0	-	-
SPENCER CYN.	1993	7/1	P	TH	0	0	0	-	-	0	0	0	0	0	0	-	-
SPENCER CYN.	1993	7/2	P	F	0	0	0	-	-	0	0	0	0	0	0	-	-
SPENCER CYN.	1993	7/3	P	S	45	9	45	-	-	0	45	36	9	0	0	-	-
SPENCER CYN.	1993	7/4	P	SU	27	10	27	-	-	1	26	10	17	0	0	-	-
SPENCER CYN.	1993	7/5	P	M	64	9	64	-	-	20	44	64	0	0	0	-	-
SPENCER CYN.	1993	7/6	P	T	23	5	23	-	-	23	0	23	0	0	0	-	-
SPENCER CYN.	1993	9/22	S	W	0	0	0	-	-	0	0	0	0	0	0	-	-
SPENCER CYN.	1993	9/23	S	TH	4	1	4	-	-	0	4	0	4	0	0	-	-
SPENCER CYN.	1993	9/24	S	F	34	4	32	-	-	0	34	32	2	1	2	-	-
SPENCER CYN.	1993	9/25	S	S	50	9	50	-	-	30	20	30	20	0	0	-	-
SPENCER CYN.	1993	9/26	S	SU	30	5	30	-	-	30	0	30	0	0	0	-	-
SPENCER CYN.	1993	9/27	S	M	4	0	0	-	-	0	4	0	4	2	4	-	-
SPENCER CYN.	1993	9/28	S	T	95	11	89	-	-	0	95	89	6	3	6	-	-
SPENCER CYN.	1994	10/25	S	T	2	1	2	-	-	2	0	0	2	0	0	-	-
SPENCER CYN.	1994	10/26	S	W	51	5	51	-	-	0	51	51	0	0	0	-	-
SPENCER CYN.	1994	10/27	S	TH	3	0	0	-	-	0	3	3	0	1	3	-	-
SPENCER CYN.	1994	10/28	S	F	2	2	2	-	-	0	2	2	0	0	0	-	-
SPENCER CYN.	1994	10/29	S	S	9	2	9	-	-	9	0	9	0	0	0	-	-
SPENCER CYN.	1994	10/30	S	SU	7	0	0	-	-	0	7	0	7	4	7	-	-
SPENCER CYN.	1994	10/31	S	M	13	3	13	-	-	0	13	0	13	0	0	-	-
SPENCER CYN.	1994	8/16	P	T	41	3	10	-	-	10	31	0	41	5	31	-	-
SPENCER CYN.	1994	8/17	P	W	3	0	0	-	-	0	3	0	3	2	3	-	-
SPENCER CYN.	1994	8/18	P	TH	59	8	59	-	-	15	44	44	15	0	0	-	-
SPENCER CYN.	1994	8/19	P	F	31	5	31	-	-	0	31	0	31	0	0	-	-
SPENCER CYN.	1994	8/22	P	M	13	4	9	-	-	0	13	0	13	2	4	-	-
PEARCE FERRY	1993	4/30	S	F	6	5	6	nc	nc	2	4	2	4	0	0	nc	nc
PEARCE FERRY	1993	5/1	S	S	82	14	82	nc	nc	0	82	73	9	0	0	nc	nc
PEARCE FERRY	1993	5/2	S	SU	34	7	34	nc	nc	0	34	14	20	0	0	nc	nc
PEARCE FERRY	1993	5/3	S	M	13	3	13	nc	nc	0	13	11	2	0	0	nc	nc
PEARCE FERRY	1993	5/4	S	T	0	0	0	nc	nc	0	0	0	0	0	0	nc	nc
PEARCE FERRY	1993	5/5	S	W	17	4	15	nc	nc	8	9	7	10	1	2	nc	nc
PEARCE FERRY	1993	5/6	S	TH	48	4	48	nc	nc	0	48	48	0	0	0	nc	nc
PEARCE FERRY	1993	6/17	P	TH	108	9	106	nc	nc	0	108	78	30	1	2	nc	nc

SITE	YEAR	MONTH/DAY	SEASON	D.O.W.	USERS	RIVER BOATS	RIVER USERS	LAND VEHICLES	LAND USERS	CAMPERS	DAY USERS	COMMERCIAL USERS	PRIVATE USERS	LAKE BOATS	LAKE USERS	DERIG BOATS	DERIG USERS
PEARCE FERRY	1993	6/18	P	F	133	16	133	nc	nc	0	133	95	38	0	0	nc	nc
PEARCE FERRY	1993	6/19	P	S	212	15	212	nc	nc	0	212	212	0	0	0	nc	nc
PEARCE FERRY	1993	6/20	P	SU	147	7	147	nc	nc	0	147	147	0	0	0	nc	nc
PEARCE FERRY	1993	6/21	P	M	122	8	122	nc	nc	0	122	122	0	0	0	nc	nc
PEARCE FERRY	1993	7/28	P	W	58	11	58	nc	nc	0	58	58	0	0	0	nc	nc
PEARCE FERRY	1993	7/29	P	TH	4	2	4	nc	nc	0	4	4	0	0	0	nc	nc
PEARCE FERRY	1994	4/1	S	F	37	5	37	nc	nc	0	37	5	32	0	0	nc	nc
PEARCE FERRY	1994	4/2	S	S	0	0	0	nc	nc	0	0	0	0	0	0	nc	nc
PEARCE FERRY	1994	4/3	S	SU	44	8	44	nc	nc	0	44	32	12	0	0	nc	nc
PEARCE FERRY	1994	4/4	S	M	14	3	14	nc	nc	0	14	0	14	0	0	nc	nc
PEARCE FERRY	1994	4/5	S	T	11	4	11	nc	nc	0	11	1	10	0	0	nc	nc
PEARCE FERRY	1994	4/6	S	W	3	2	3	nc	nc	0	3	3	0	0	0	nc	nc
PEARCE FERRY	1994	8/30	P	T	43	3	40	nc	nc	3	40	40	3	0	0	nc	nc
PEARCE FERRY	1994	8/31	P	W	102	10	40	nc	nc	0	102	98	4	3	62	nc	nc
PEARCE FERRY	1994	9/1	P	TH	17	0	0	nc	nc	5	12	0	17	1	3	nc	nc
PEARCE FERRY	1994	9/2	P	F	104	9	37	nc	nc	0	104	89	15	7	67	nc	nc
PEARCE FERRY	1994	9/3	P	SA	89	11	51	nc	nc	0	89	48	41	15	38	nc	nc
PEARCE FERRY	1994	9/4	P	SU	78	13	31	nc	nc	0	78	14	64	10	40	nc	nc
PEARCE FERRY	1994	9/5	P	M	65	16	44	nc	nc	0	65	7	58	1	2	nc	nc

*nc = not counted

SEASON: (S)houlder season = April 1 - May 31 and September 16 - October 31
D.O.W.: Day of Week
USERS: the total number of people using the site
RIVER BOATS: the number of boats originating at or upstream of Diamond Creek that stopped at the site
RIVER USERS: the number of people originating at or upstream of Diamond Creek
LAND USERS: the number of people using the site who did not travel by water to and/or from the site
LAND VEHICLES: (Diamond Creek only) the number of land vehicles that stopped at the site
CAMPERS: the number of people camping overnight
DAY USERS: the number of people using the site but not camping overnight
COMMERCIAL USERS: all guides, staff and passengers of commercial trips and all members of research trips using the site
PRIVATE USERS: all non-commercial and non-research users
LAKE BOATS: the number of boats originating downstream of Diamond Creek that stopped at the site
LAKE USERS: the number of people originating downstream of Diamond Creek
DERIG BOATS: (Diamond Creek only) the number of boats taking out at the site
DERIG USERS: (Diamond Creek only) the number of people using the site asa take-out site; these users may or may not have been participants on the river trip