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**CURRENT AND HISTORICAL RIPARIAN VEGETATION TRENDS  
IN GRAND CANYON, USING MULTITEMPORAL REMOTE SENSING  
ANALYSES OF GIS SITES**

**NAU-NPS COOPERATIVE AGREEMENT: CA 8000-8-0002**

Submitted to:

**Glen Canyon Environmental Studies**

**Northern Arizona University**

**National Park Service**

**GLEN CANYON ENVIRONMENTAL  
STUDIES OFFICE**

**FEB 5 1996**

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**GWENDOLYN L. WARING  
School of Forestry  
Northern Arizona University  
Flagstaff AZ**

**31 January, 1996**

**FINAL REPORT**

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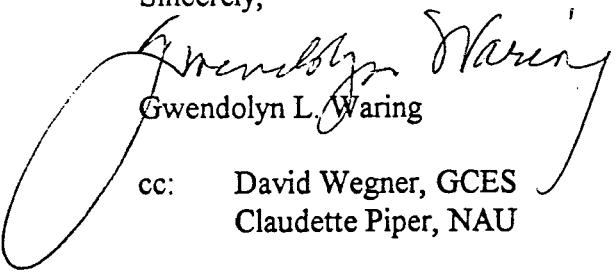
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Dear Peter,

Enclosed please find several copies of my final report that you were the original technical coordinator for. I am assuming that that is still the case. In the event that it is not, would you be kind enough to direct these documents to the appropriate person.

Thank you for your comments on my earlier draft final report. Many of them were incorporated, making for a better report.

Sincerely,



Gwendolyn L. Waring

cc: David Wegner, GCES  
Claudette Piper, NAU

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## ABSTRACT

A series of aerial photographs of the Colorado River in Grand Canyon was analyzed to determine the response of associated riparian vegetation to river regulation. Vegetation maps were drawn from photograph sets dating from 1965, 1973, 1984, 1990 and 1992 and entered into Glen Canyon Environmental Studies Geographic Information Systems (GCES-GIS).

Riparian vegetation cover in the New High Water zone, or along the active channel margin, in GCES' GIS Reaches 2, 4 and 5 in Grand Canyon National Park increased more than 160% between 1965 and 1992. This occurred despite a post-dam flooding period in the early 1980's that reduced vegetation cover by at least 10%, and illustrates how productive riparian vegetation can be in a stable setting such as that created by a regulated river.

Following the post-dam flooding event of the early 1980's, riparian vegetation cover again increased at a rapid rate, with the result that cover was greatest by the final date measured, 1992.

By contrast, the vegetation associated with the Old High Water zone did not vary significantly in amount of cover during the period studied.

While specific depositional settings, such those associated with channel margins, eddies, riffles and rapids, were not correlated with vegetation cover, there were significant differences in the area of vegetation cover in the three reaches studied between 1965 and 1992, that probably do relate to different geomorphic conditions on a larger scale. For instance, there was significantly less NHW zone vegetation cover than OHW zone vegetation in Reach 5 in 1965; however, there was no difference in plant cover in the two zones in following years, due to continued expansion of post-dam NHW vegetation. Different colonization patterns in other reaches may relate to large-scale availability of substrates.

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## INTRODUCTION

At a time when riparian habitat is being rapidly destroyed, the process of damming rivers has been found to have the potential to restore or create riparian habitat, and sometimes on a large scale (Turner and Karpiscak 1980; Waring 1993). Riparian habitat, although rare in the western United States, has a high level of productivity that supports a disproportionately large diversity of plants and animals relative to its rare occurrence. Within Arizona alone, riparian habitat supports nearly 50% of all animal species, although it comprises less than 0.05% of the landscape (Knopf et al. 1988, Simcox and Zube 1985, Brown et al. 1977). More than 50% of western wetland habitat has been lost to date (Dahl 1990). Perhaps ironically, extensive dam building has occurred concurrently with these losses and in certain circumstances has been found to actually promote the expansion of riparian vegetation along some rivers, due to flood control, or as in the case of the Platte River, to the conversion of an ephemeral river into a perennial one (Nagel and Dart 1980). While diversion dams may reduce or eliminate vegetation along rivers, vegetation along undiverted, dammed rivers may give rise to extensive riparian plant populations (Waring 1993). With proper management, dams may help to mitigate to some extent the loss of riparian habitat that has occurred due to other human activities.

While vegetation may increase along dammed rivers, equally important details such as the structure of the plant communities that develop and other environmental conditions that influence their development remain poorly understood (Waring 1993). This type of information is essential to sustain the productivity and diversity of these valuable habitats. Most studies of plant responses to impoundment focus on *either* single plant species (e.g., Knopf and Scott 1990, Rood and Mahoney 1990, Akashi 1988) *or* whole communities (e.g., McDonald and Sidle 1992), without considering both. Furthermore, few existing studies of impoundment effects on riparian vegetation consider the effects of different kinds of dam operations on vegetation: most emphasis is placed on the effects of initial river regulation.

The Colorado River in Grand Canyon has been dammed for more than 30 years. Several studies have investigated the dynamic history of riparian vegetation along the Colorado River in Grand Canyon (e.g., Johnson 1991, Turner and Karpiscak 1980, Carothers and Aitchison 1976, Martin 1971). Prior to the construction of Glen Canyon Dam, little vegetation persisted in the riparian corridor due to frequent flooding (Turner and Karpiscak 1980, Clover and Jotter 1944). Subsequent to the completion of the dam, an extensive and diverse community of riparian plants and animals has become established along the river in the 'New High Water' zone (NHW) (e.g., Stevens and Waring 1988, Warren and Schwalbe 1988, Brown and Johnson 1988, Pucherelli 1986, Turner and Karpiscak 1980, Carothers and Aitchison 1976, Martin 1971). By contrast, the riparian vegetation of the 'Old High Water' zone (OHW), comprised mainly of honey mesquite (*Prosopis glandulosa*) and catclaw acacia (*Acacia greggii*), has been reported to be in a state of gradual decline due to limited water availability resulting from flood control (Anderson and Ruffner 1988, Pucherelli 1986).

Analysis of aerial photography offers a unique means for studying large-scale phenomena in ecosystems. Its application in Grand Canyon has enabled quantification of large-scale change in riparian vegetation coverage along the Colorado River over a 20 year period (1965-1985) (Pucherelli 1986). In this study, Michael Pucherelli of the Glen Canyon Environmental Studies Phase I Program (GCES) quantified the influence of the completion of Glen Canyon Dam, and floods in 1983 and 1984 on riparian vegetation cover. Pucherelli identified a significant increase



in New HighWater zone (NHW) vegetation cover along the Colorado River from 1965 until extensive post-dam flooding in 1983-1984. NHW vegetation cover decreased dramatically during these flooding events; however, the long-term responses of vegetation to these events have not been studied.

Colorado River flow patterns have been altered again, due to another change in Glen Canyon Dam operations, this time in an attempt to reduce beach erosion throughout the river corridor. An understanding of the impact of these 'interim' flows on riparian vegetation is necessary to provide a more thorough understanding of impoundment effects on riparian vegetation. The interim flow regime, implemented in 1991, was designed to minimize daily fluctuations in Colorado River flows. Annual aerial photographic coverage of the river corridor is ongoing, and will make it possible to study the relationship between interim flows and riparian vegetation in Grand Canyon.

The primary objective of this research was to investigate the impact of river regulation on riparian vegetation, by studying changes in vegetation cover following the impoundment event itself and subsequent dam operations. I determined historical patterns of riparian vegetation cover in the NHW zone and the OHW zone between 1965 to 1992, measuring responses of riparian vegetation to the completion of Glen Canyon Dam, the flood years of 1983-1984 and interim flows between 1990 and 1992. An historical analysis of vegetation cover in geographic information systems (GIS) reaches, through events such as the completion of Glen Canyon Dam and floods in 1983 and 1984, provides an important context from which to consider interim flow effects as well as future conditions. While a photogrametric analysis of historical vegetation change was conducted in 1988 (Pucherelli 1988), nearly all of this effort was concentrated in non-GIS reaches.

This research compared vegetation coverage along the river one year before and one year after the initiation of the current 'interim' flow regime. This flow regime was designed to minimize fluctuations and ramping rates of the Colorado River. Analysis of the extent of riparian vegetation cover with aerial photography provides a test of the ability of interim flows to minimize resource losses. A finding of stable or increased vegetation cover in the NHW zone would support this assumption about interim flows.

Apparently, interim flow effects on riparian vegetation were discernible as early as Fall, 1991, approximately two months after the initiation of interim flows (Lawrence Stevens, personal communication). Specifically, clonal plants including coyote willow (*Salix exigua*) were extending their distributions closer to the river level.

I also measured change in vegetation cover in different environmental settings, including different azimuths, depositional environments (e.g., runs, eddies, rapids) and reaches that differed in sediment supply potential. These types of variables are rarely considered in describing vegetation responses to impoundment, and yet they may have an enormous influence on vegetation. This will provide an understanding of possible interactions between environmental structure and interim flow effects on riparian vegetation cover. Schmidt and Graf (1990) identified four types of sediment depositional settings including separation bars, reattachment bars, upper pools and channel margins. Vegetation may colonize these environments differently during interim flows.

One reach studied encompassed regions with different sediment supply potential, which permitted a test of the effect of sediment supply on vegetation cover response to interim flows: GIS Reach 5 encompasses the Little Colorado River, a major contributor of sediments.

### SPECIFIC OBJECTIVES:

1. Study the effects of interim flows on riparian vegetation cover in the NHW and OHW zones between 1990 and 1992 within GIS Reaches 2, 4 and 5. This enabled a quantitative comparison of vegetation cover one year before and one year after the initiation of the interim flow regime.
2. Determine historical patterns of riparian vegetation cover in the two zones from 1965 to 1992 in the same three reaches. Responses of riparian vegetation to the completion of Glen Canyon Dam, the flood years of 1983-1984 and subsequent recolonization patterns were quantified.
3. Study change in vegetation cover in response to interim flows, post-dam flooding and impoundment in different environmental settings including different sides of the river, depositional environments (e.g., separation bars, reattachment bars) and reaches that differ in sediment supply potential.

### STUDY AREA

The riparian plant community associated with the Colorado River in Grand Canyon National Park was studied. The river there has been regulated since the completion of Glen Canyon Dam in 1963. This dam was designed to provide flood control, hydroelectric power and water storage. Flooding (Fig. 1), sediment load and water temperature were all reduced following damming. Lake Powell, above the dam, was in the filling phase from 1963 to 1980. Low flows associated with this period were replaced by post-dam floods for several years after Lake Powell filled and above average snowpack occurred in the Rocky Mountains in 1983 and 1984. River flows following the early 1980's were characterized by daily fluctuations, generated in response to power demands. Daily fluctuations accelerated the rate at which beach sediments were eroding (Glen Canyon Dam Environmental Impact Statement, USBOR, 1995), and as a result, an 'interim flows' regime was established in 1990. Interim flows reduce the magnitude of daily fluctuations in flow that are released from Glen Canyon Dam, in an effort to reduce erosion rates.

Vegetation along the Colorado River is distributed in zones that relate to present and historical river flood levels, as well as vegetation types. The OHW zone of vegetation through the study sites is comprised predominantly of hackberry (*Celtis reticulata*) and Apache plume (*Fallugia paradoxa*) in GIS Reach 2 (river miles -4.0 to 2.0); and of honey mesquite (*Prosopis glandulosa*) and catclaw acacia (*Acacia greggii*) in GIS Reaches 4, (river miles 51.0 to 56.0), and 5, (river mile 60.0 to 72.0). These populations were thought to have been established during large, historical flooding events (Johnson 1991). The new high water (NHW) zone vegetation is directly riverside, extending up to the boundary of the OHW zone at an elevation that corresponds to 120,000 cfs pre-dam flooding. Native coyote willow (*Salix exigua*) and introduced tamarisk (*Tamarix ramosissima*) are the dominant woody plants within the NHW zone.

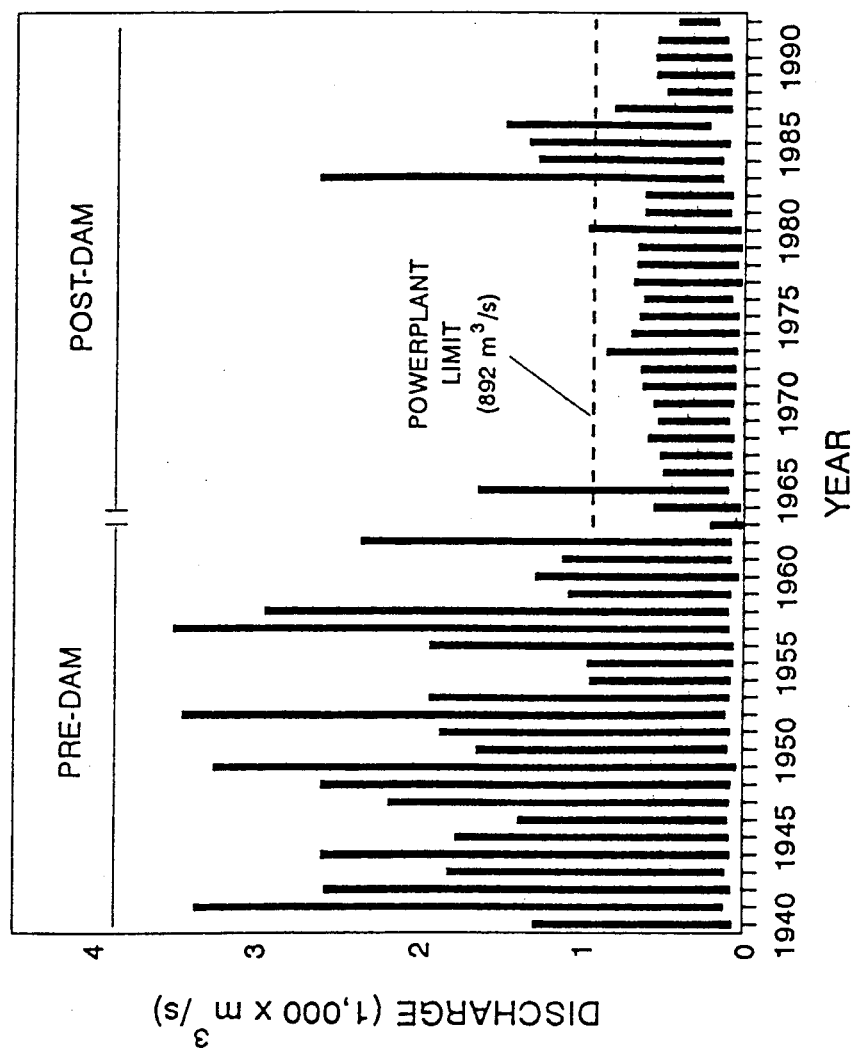


Figure 1. Minimum and maximum pre-and post-dam flow patterns of the Colorado River between 1940 and 1992. From Stevens et al. 1995.

## METHODS

Aerial photography of Grand Canyon GCES GIS Reaches 2, 4 and 5 (Fig. 2) from five years (1965, 1973, 1984, 1990 and 1992; Table 1) was analyzed. Vegetation data from 1990 photographs were provided by the Bureau of Reclamation's Remote Sensing Division in Denver, Colorado. All photographs were developed as close to a 1:2,400 scale as possible for ease of interpretation; this also conforms with 1990 GIS base maps prepared for all Glen Canyon Environmental Studies GIS reaches. Vegetation polygons were traced on high transparency mylar sheets overlying the photographs. Three categories of vegetation were designated, including NHW zone, OHW zone, and TARA (*Tamarix ramosissima* in the OHW zone). Vegetation density classes of 1 (0-20% coverage), 2 (21-40%), 3 (41-60%), 4 (61-80%) or 5 (81-100%) were assigned to the polygons, following visual inspection of the aerial photographs. All designations were verified with ground-truthing during two 10-day river trips.

Orthogonalized base maps at a scale of 1:2,400 were used in this study to provide georeference points for the mapping process. These maps were generated by the Bureau of Reclamation's Remote Sensing Division from 1990 aerial photography of the Colorado River in Grand Canyon. By matching geographic features common to these rectified maps and our vegetation maps, we were able to avoid potential problems stemming from scale differences (between photograph sets), photodistortion and mosaicing.

Maps generated from historical photographs dating from 1965, 1973 and 1984 were assigned approximately 25 reference points per river mile. The maps were then digitized into the GCES GIS, and given coordinate values established for the GCES GIS. The maps were 'rubber sheeted' into line with ortho base map points. The transformation and rubber sheeting processes provided some rectification of these data. This methodology provided area measurements of vegetation polygons from these dates.

Maps generated from 1992 aerial photographs were scaled and rectified with the use of a Zeiss © zoom transfer scope. This method served to correct distortions in the 1992 aerial photography, and provided accurate area and location information. These data were compared with 1990 vegetation data to understand vegetation change in response to interim flows, and to earlier photo sets to address patterns of historical change in vegetation cover.

Georeferenced maps were digitized by the Remote Sensing Division of BOR's Engineering and Research Center in Denver, Colorado. The resulting data set included the following variables for each vegetation polygon: date; GIS reach; river mile; 1/10th mile section; side of river; vegetation category (the three aforementioned categories); area ( $m^2$ ); and x and y coordinates. Vegetation data are presented in Appendix I. While output presented data to the nearest 1/1000th  $m^2$  (Appendix I), results of analyses are presented to the nearest whole number.

Vegetation cover in  $m^2$  per 1/10th mile was compared among years 1965, 1973, 1984, 1990 and 1992 to determine patterns of change from the initial phase of impoundment through post-dam flows and the initial phase of interim flows. Vegetation cover adjusted for density was analyzed. Density-adjusted polygons were treated by multiplying area by % density.

Environmental conditions, including side of the river, depositional environments (e.g., runs and eddies) and reaches that differ in sediment supply potential (the Little Colorado River in Reach 5), were determined from photos, and river maps, and through ground-truthing and consultation with other GCES scientists. These variables were factored into analyses of river regulation effects on NHW vegetation cover.

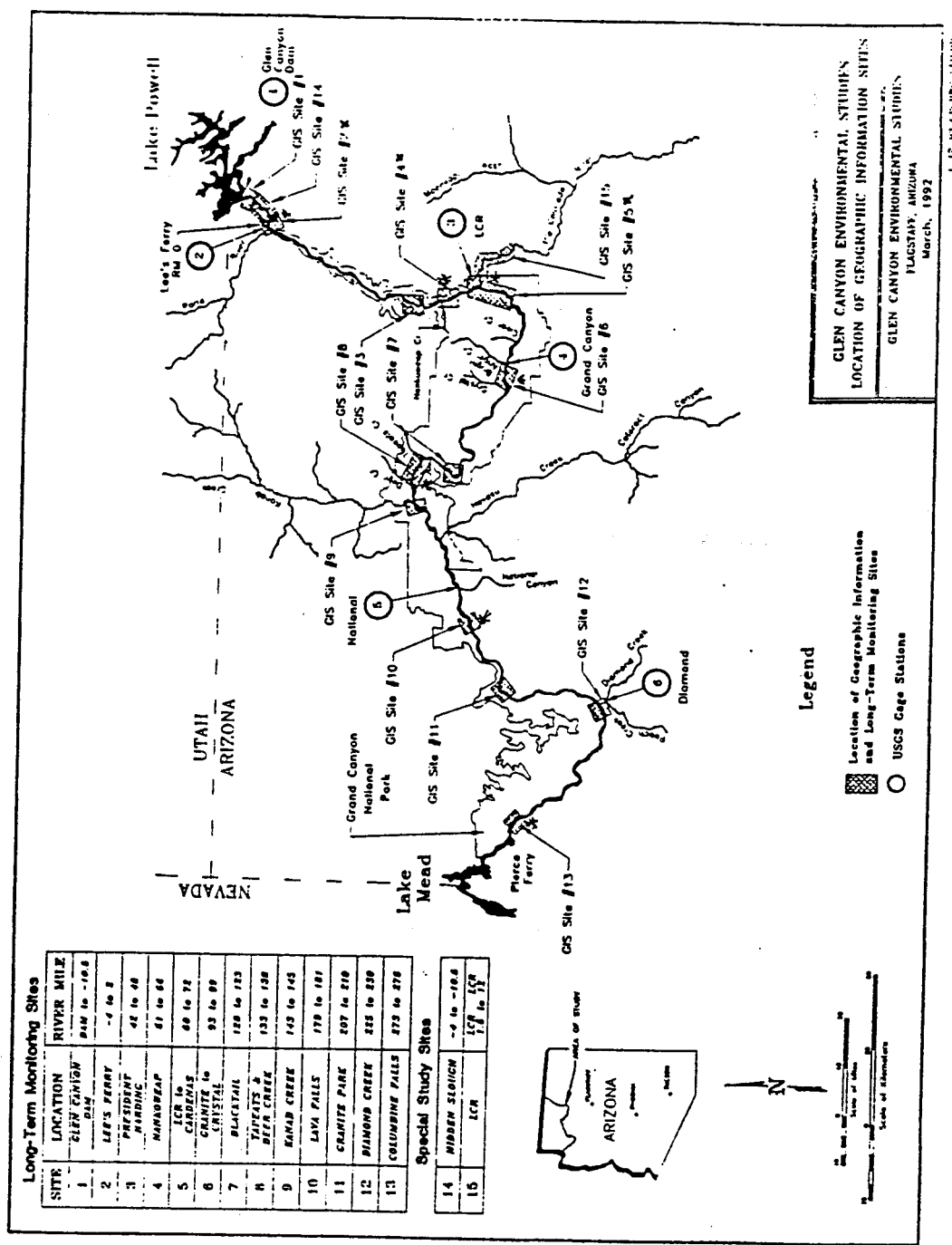


Figure 2. Location of GCES GIS Reaches in the Grand Canyon. Locations of Reaches 2, 4 and 5 are indicated on the map and in the box at upper left.

Table 1. Aerial photography used in this study.

YEAR	SCALE	FILM	DATE
1965	1:12,000	Black&White	5-14-65
1973	1:6,000	Black&White	6-16-73
1984	1:3,000	Black&White	10-22-84
1990	1:4,800	Color Infrared	6-3-90
1992	1:4,800	Color	10-12-92

GIS-derived data were transferred into an ASCII format, and then reformatted using Word for Windows 6.0 and Excel for Windows 6.0. Data were analyzed using SYSTAT for Windows (Wilkinson 1991).

Because 1990 OHW vegetation cover was lower than in all other years, 1990 data were adjusted with the development of a correlation coefficient to bring them into line with the other data sets. This difference may have derived from different entities being involved in the mapping procedure, leading to different interpretations. With BOR in Denver, I developed a correlation coefficient between their mapping of 1990 vegetation with my interpretation of 1990 vegetation. Vegetation was mapped from 1990 photographs for the three reaches, in the NHW and OHW zones, and then my measurements for 1990 polygons were correlated with those generated by BOR. The resulting correlation coefficient was derived by correlating the two data sets: Adjusted 1990 cover =  $38.077 + 1.110$  (unadjusted 1990 cover).

Multiple stepwise regression analyses detected significant correlation in vegetation cover between some adjacent 1/10th mile intervals of vegetation in each year in each reach in each zone, and on each side of the river. Most correlations were low (Appendix II). Levels of autocorrelation in the data set for each reach were determined by conducting multiple stepwise regression of vegetated area with each of the next consecutive 4-1/10th mile intervals. This analysis was done for each reach/year/side/zone combination, for a total of four zone/side analyses in each of 5 years, for a total of 20 multiple regression analyses in each reach (Appendix II). Autocorrelation effects were eliminated by removing autocorrelated 1/10th intervals.

The Friedman test, a nonparametric test, was used to address patterns of vegetation change among years in each reach. Vegetation change through time was analyzed with 1/10th mile intervals as blocks and years as repeated measures (Conover 1984). If OHW zone vegetation in Reach 2 on river left showed correlation between adjacent 1/10th miles, two data sets consisting of every other 1/10th mile were created and each was analyzed with a Friedman test. In several data sets there was correlation between vegetation cover in 1/10th mile intervals that were as much as 4-1/10th miles apart; in these cases, up to four subsets of data for each reach/side/zone combination were produced and up to four Friedman analyses were performed. The significance of all Friedman p values combined were evaluated with a serial Bonferroni test (Rice 1989). If individual Friedman tests were significant at  $p < 0.05$ , a Gibbons (1984) multiple comparisons test was used to determine which years were different.

The Mann-Whitney test was used to assess the relation between different sides of the river on vegetation cover for each year ( $n=5$ )/ reach (3)/ zone (2) combination for a total of 30 tests. Test p values were subjected to a serial Bonferroni test (Rice 1989). A similar procedure was used to compare differences between NHW and OHW vegetation zones.

Pearson correlation analyses were used to measure correlation between NHW zone vegetation cover and physical parameters including geomorphology. Assessment of vegetation trends in relation to geomorphology involved categorizing each 1/10th mile on each side of the river into one of the following five geomorphic categories: run, eddy, upper pool, riffle, rapid and correlating these with vegetation cover. The relationship between geomorphology and vegetation was studied with Reach 4 and 5 data only, due to a lack of historical photo coverage for Reach 2.

For a comparison of vegetation cover change above and below the confluence of the Little Colorado River (LCR), data from mile 60.1 to 61.0 constituted the upstream section and data

from mile 61.7 to 62.6 represented the downstream section. The lower section was situated below a riffle downstream from the confluence of the LCR.

'Fish Island', a cobble island at mile 66 in Reach 5, was represented with such clear resolution in all photographs that vegetation patterns on it were compared as a means of describing vegetation change in an island setting and to provide a corroborative test of other vegetation data.

## RESULTS

Vegetation data in three GIS reaches for five separate dates between 1965 and 1992 are now entered into GCES's GIS. This constitutes a major contribution to the GIS, as all riparian vegetation in 23 miles along the Colorado River are now accounted for within the GIS.

### Vegetation Change Through Time: 1965 to 1992

Pre-Dam Vegetation Along the Colorado River in Grand Canyon. Aerial photographs from 1965 revealed a large population of tamarisk at the lower boundary of the OHW zone. In 1965 tamarisk covered 31,2604 m<sup>2</sup> in the three reaches (Table 2). These large, well-established plants occurred commonly in protected reaches of the river, particularly along runs or straight sections and at the top of separation bars. There appeared to be little other vegetation along the river at this time (see below). The amount of area covered by tamarisk in the OHW zone has increased slightly during the last 30 years (36,255 m<sup>2</sup> in 1965 versus 45,538 in 1992; Table 2). Two-thirds of all OHW zone tamarisk measured in this study were found in Reach 2, particularly near the Paria River confluence.

Post-Dam Vegetation. Overall, riparian vegetation cover along the Colorado River in Grand Canyon increased 44% between 1965 and 1992. Area of vegetation cover in GIS Reaches 2, 4 and 5 increased from 1,135,692 m<sup>2</sup> to 1,638,370 m<sup>2</sup> between 1965 and 1992 (Table 2). This large change occurred despite post-dam flooding and indicates how productive riparian vegetation can be in a stabilized river system.

Nearly all post-dam increases in vegetation cover occurred in the NHW zone (Table 2, 3). NHW vegetation cover in the three reaches increased from 270,383 to 719,291 m<sup>2</sup> or nearly 160% between 1965 and 1992 (Table 2). NHW vegetation cover increased significantly between 1965 and 1992 in GIS reaches 4 and 5 (Table 3). In both reaches 4 and 5 significant differences occurred among three groups of vegetation cover data: 1) 1965, 2) 1973, 1984 and 1990, and 3) 1992 (Table 3). Overall, the trend is one of increased vegetation cover with time.

While the results indicate a consistent pattern of vegetation loss associated with the post-dam flooding of 1983 and 1984, this was not a significant pattern (Table 2, 3).

A low and stable flow period followed the post-dam flooding in the early 1980's (Fig. 1). The amount of increase in NHW vegetation cover during the eight years from 1984 to 1992 and the eight years from 1965-1973 are remarkably similar: between 1965 and 1973 NHW vegetation increased by 268,563 m<sup>2</sup>; and between 1984 and 1992 it increased by 232,207 m<sup>2</sup> (Table 2). Because post-dam flooding occurred into 1986, vegetation cover probably did not increase



Table 2. Cumulative riparian plant cover (in square meters) in GIS Reaches 2, 4 and 5, 1965-1992.

	YEAR:				
	1965	1973	1984	1990	1992
REACH 2					
OHW:*	46,900	40,240	61,851	26,478	50,738
OHW-TARA:**	22,502	20,908	21,788	---	21,202
NHW:	31,435	41,625	39,096	46,374	54,097
TOTAL:	100,838	102,774	122,736	72,852	126,038
REACH 4					
OHW:*	398,005	378,096	448,879	332,051	422,361
OHW-TARA:**	2,624	2,868	3,829	---	3,528
NHW:	91,285	170,241	161,011	166,044	226,311
TOTAL:	491,915	551,205	613,720	498,096	652,201
REACH 5					
OHW:*	388,415	391,467	404,671	303,987	408,156
OHW-TARA:**	6,861	11,018	8,096	---	13,091
NHW:	147,662	327,334	286,975	308,679	438,881
TOTAL:	542,938	729,820	699,743	612,667	860,129

\* OHW coverage excluding *Tamarix ramosissima*

\*\*OHW excluding *T. ramosissima*

Table 3. Analysis of NHW and OHW vegetation coverage through time, with data organized by reach, zone, and side of the river\*. Friedman tests, using Gibbon's multiple comparison test and a serial Bonferroni adjusted probability ( $p < .05$ ) are reported.

n	REACH	ZONE	SIDE	REP.	FRIEDMAN P	BONFERRONI P	1965	1973	1984	1990	1992	GIBBONS CRITICAL VALUE (p<.05)	
21	2	L	L	1	17.07	.002	NS	42.0	60.0	64.0	65.0	84.0	28.8
6	2	L	R	1	6.33	.175	NS	10.5	24.0	17.5	18.5	14.5	15.37
7	2	L	L	2	6.40	.171	NS	16.0	26.0	15.0	22.0	16.0	16.61
6	2	L	R	3	2.00	.645	NS	13.5	21.5	17.0	20.0	18.0	15.37
21	2	H	L	1	8.91	.063	NS	63.5	63.5	78.5	48.0	61.5	28.76
21	2	H	R	2	15.19	.004	*	66.5	58.0	80.0	42.0	68.5	28.76
25	4	L	L	1	59.32	.000	*	30.0	87.0	72.0	72.0	114.0	31.38
24	4	L	L	2	57.76	.000	*	29.0	72.0	71.0	76.0	112.0	30.75
12	4	L	R	1	24.38	.000	*	16.5	44.0	30.5	37.0	52.0	21.79
13	4	L	R	2	17.70	.001	*	27.5	33.0	33.5	43.0	58.0	22.63
13	4	L	R	3	24.30	.000	*	21.0	34.0	38.0	47.0	58.0	22.63
12	4	L	R	4	13.86	.007	NS	21.0	34.0	38.0	39.0	49.0	21.74
17	4	H	L	1	19.62	.000	*	57.0	36.0	62.0	35.0	65.0	25.88
17	4	H	L	2	11.76	.019	NS	50.5	48.5	62.5	34	59.5	25.88
17	4	H	L	3	15.90	.003	*	59.0	46.0	66.0	32.0	52.0	25.88
25	4	H	R	1	39.71	.000	*	71.0	80.0	106.0	37.0	81.0	31.38
26	4	H	R	2	31.98	.000	*	81.5	79.5	105.5	42.0	81.5	32.00
38	5	L	L	1	54.93	.000	*	62.5	112.0	105.0	129.0	161.5	38.69
39	5	L	L	2	66.52	.000	*	60.5	124.5	105.5	122.0	172.5	39.20
40	5	L	L	3	61.80	.000	*	69.0	129.0	101.5	124.5	176.0	39.70
30	5	L	R	1	58.81	.000	*	45.5	90.5	76.5	101.5	136.0	34.38
29	5	L	R	2	52.03	.000	*	40.0	87.0	83.5	100.5	124.0	33.80
28	5	L	R	3	58.17	.000	*	38.0	84.0	74.0	100.5	124.0	33.21
59	5	H	L	1	13.97	.007	NS	159.5	200.0	170.0	153.5	202.0	48.21
58	5	H	L	2	13.57	.009	NS	159.5	170.0	178.5	182.5	209.5	47.80
31	5	H	R	1	15.81	.003	*	90.0	83.5	108.5	70.5	112.5	34.95
30	5	H	R	2	35.18	.000	*	79.0	79.0	107.5	60.0	124.5	34.38
28	5	H	R	3	20.79	.000	*	88.0	83.5	89.0	53.5	106.0	33.21
28	5	H	R	4	16.89	.002	*	77.0	77.5	96.0	63.0	106.5	33.21

\* n: number of 1/10th mile samples; zone: H = OHW zone, L = NHW zone; side: L = left side of river, R = right side of river; rep: number of replicates using increasingly larger-spaced intervals (lags) of data (see Methods).

substantially until after that period. These data suggest that a large part of post-flood vegetation gain occurred during the interim flow period.

NHW vegetation cover increased significantly in reaches 4 and 5 between 1990 and 1992 (Table 3). Visual inspection alone of 1990 and 1992 aerial photographs reveals an increase in NHW zone vegetation during this initial period of interim flows. There was also significantly more NHW zone vegetation cover in 1992 than any previous year (Table 2, 3).

By contrast, there has been little change in vegetation cover in the old high water zone (OHW) during the years since Glen Canyon Dam was completed (Table 2, 3). Cover of OHW riparian vegetation increased from 833,320 m<sup>2</sup> to 881,256 m<sup>2</sup> or 5.7%, between 1965 and 1992 (Table 3). The occurrence of this mature, mesquite-dominated zone at such a high elevation above this river may explain its small overall changes in cover since 1965.

Significant differences in OHW vegetation cover did occur in some instances between 1990 data and other dates, and were probably related to methodology rather than real change (Table 3, see Methods).

### **Vegetation Change and Other Environmental Effects**

Reaches and vegetation zones. Patterns of vegetation distribution in the NHW and OHW zones differ strongly among reaches 2, 4 and 5. NHW zone and OHW zone vegetation occupied a comparable area in Reach 2 among all years, with the exception of 1990. This difference appears to be related to methodology rather than a real difference in vegetation cover (Table 4, 5, see Methods). By contrast, there was significantly more OHW than NHW vegetation coverage in Reach 4 in all years (Table 4, 5), due to limited colonizable substrate in the NHW zone. In Reach 5 there was significantly more OHW than NHW zone vegetation coverage in 1965 only; following this year there were no significant differences in zone coverage, due to rapid vegetation colonization of the NHW zone (Table 4, 5).

Side of the river and vegetation distribution. Significantly more NHW vegetation in Reach 2 occurred along the right side of the river, probably due to the influence of the Paria River delta (Table 4, 5). There was no significant difference in OHW vegetation cover on different sides of the river in this reach. There was also no difference in riparian vegetation cover on either side of the river in either vegetation zone in Reach 4. There was significantly more vegetation on the right side of the river in both NHW and OHW zones in Reach 5 in all years measured (Table 4), due to the presence of a large cobble bar at mile 67.5 and deltas at Basalt Creek and Unkar Creek. All of these areas have been colonized by large stands of vegetation.

Geomorphology and vegetation. There were no significant differences in patterns of vegetation colonization in five depositional settings (runs, eddies, upper pools, riffles and rapids), indicating that depositional settings and local velocity gradients do not play an important role in the distribution of NHW vegetation (Table 6).

Depositional Environments. Plant cover in the mile above and the mile below the Little Colorado River (LCR), a major tributary of the Colorado River, was measured to determine the possible influence of added sediments on cover. As in all NHW vegetation stands, there were large increases in vegetation cover above and below the LCR between 1965 and 1992 (Fig. 3). Levels of cover increase in both sections are comparable and not significantly different ( $p > .05$ ,  $df = 1,18$ ), indicating that vegetation cover downstream was not increasing at a faster rate due to possible sediment input by the LCR (Fig. 3).

Table 4. Vegetation Zone Tests. Mann Whitney test, p (in parentheses) and serial Bonferroni adjusted significance levels (indicated by \*), for comparisons of vegetation cover on both sides of the river within reaches, zones and years.

REACH	SIDE OF RIVER	1965	1973	1984	1990	1992
2	L	252 (.982) n=46	304 (.550) n=47	230 (.600) n=45	316 (.075) n=44	306 (.521) n=47
2	R	229 (.553) n=45	381 (.040) n=48	236 (.516) n=46	359 (.005)* n=44	293 (.914) n=48
4	L	274 (.000)* n=100	624 (.000)* n=102	428 (.000)* n=102	589 (.000)* n=102	747 (.000)* n=102
4	R	415 (.000)* n=102	544 (.000)* n=102	555 (.000)* n=102	771 (.000)* n=102	731 (.000)* n=101
5	L	4773 (.000)* n=236	6521 (.206) n=240	6418 (.095) n=242	7240 (.970) n=241	7915 (.116) n=338
5	R	4029 (.000)* n=236	5990 (.029) n=240	5830 (.006) n=242	6526 (.210) n=240	6487 (.263) n=238

Table 4. (cont.) Side of River Tests. Mann Whitney test, p (in parentheses) and serial Bonferroni adjusted significance levels (indicated by \*), for comparisons of vegetation cover on both sides of the river within reaches, zones and years.

REACH	ZONE	1965	1973	1984	1990	1992
2	NHW	417 (.000)* n=45	439.5 (.001)* n=48	441.0 (.000)* n=46	342.5 (.006) n=43	453.0 (.000)* n=48
2	OHW	326.5 (.076) n=21	391.0 (.008) n=47	340.0 (.043) n=45	304.5 (.180) n=45	361.0 (.061) n=48
4	NHW	1321 (.621) n=100	1598 (.046) n=102	1468 (.262) n=102	1446 (.330) n=102	1504 (.121) n=101
4	OHW	1451 (.315) n=102	1322 (.886) n=102	1400 (.505) n=102	1545 (.102) n=102	1402 (.500) n=102
5	NHW	5195 (.000)* n=236	5087 (.000)* n=240	5404 (.000)* n=242	5019 (.000)* n=241	4748 (.000)* n=238
5	OHW	4411 (.000)* n=236	4710 (.000)* n=240	4870 (.000)* n=242	4430 (.000)* n=240	4039 (.000)* n=238

Table 5. Mean, standard deviation and number of tenth mile sections of vegetation cover in three reaches of the Colorado River by side (left and right) and vegetation zone (NHW, OHW) from 1965 to 1992.

REACH	SIDE	ZONE	1965	1973	1984	1990	1992
2	Left	NHW	1189.4	1391.5	1524.0	1586.8	1816.6
			1717.4	1385.3	1406.0	1540.1	1547.6
			23	24	23	22	24
2	Left	OHW	2350.2	2119.1	2961.1	1155.8	2460.3
			2847.0	3106.3	3643.5	1609.8	3400.3
			22	23	22	22	23
2	Right	NHW	185.5	342.9	175.8	545.9	437.5
			337.0	533.3	415.3	887.6	793.3
			22	24	23	21	24
2	Right	OHW	769.5	517.1	804.2	45.7	639.8
			1631.1	1271.4	1599.6	91.4	1361.5
			23	24	23	23	24
4	Left	NHW	745.5	1914.2	1657.7	1636.9	2475.6
			836.6	1790.8	1532.2	1407.2	2212.7
			49	51	51	51	51
4	Left	OHW	4321.5	3816.9	4744.6	3729.0	4426.7
			2812.9	2423.0	3275.4	2587.4	3133.9
			51	51	51	51	51
4	Right	NHW	1076.7	1423.9	1499.4	1622.6	2001.1
			1508.7	1635.1	1588.2	1786.1	2073.4
			51	51	51	51	50
4	Right	OHW	3671.5	3802.7	4132.0	2858.0	3924.1
			2517.7	2664.6	2900.2	2021.4	2822.5
			51	51	51	51	51
5	Left	NHW	334.5	748.2	767.4	698.8	1032.3
			1112.6	1686.8	1896.1	1459.0	1885.5
			118	120	121	121	119
5	Left	OHW	691.6	621.4	595.7	563.3	696.1
			1267.7	1063.7	1110.6	1028.2	1338.3
			118	120	121	120	119
5	Right	NHW	561.9	1148.1	1092.0	1392.3	1752.7
			1103.5	1771.9	1577.7	2270.3	2050.2
			118	120	121	120	119
5	Right	OHW	2251.5	1922.9	2362.9	1493.8	2376.0
			2670.0	2255.4	3178.7	1689.4	2542.1
			118	120	121	120	119

Table 6. Pearson correlation analysis (r), p and serial Bonferroni test (indicated by \*) of vegetation cover within Reaches 4 and 5 in variable depositional environments in the NHW zone. \*\*

		DEPOSITIONAL ENVIRONMENT	
		r	p
<b>REACH 4</b>			
1965		.117	.074
1973		.077	.234
1984		.065	.313
1990		.074	.255
1992		.071	.273
<b>REACH 5</b>			
1965		.046	.659
1973		.001	.993
1984		-.049	.637
1990		-.060	.564
1992		.025	.812

\* Depositional environment = -2=eddy, -1=upper pool, 0=run, 1=riffle, 2=rapid;

## VEGETATION COVER, 1965 AND 1992

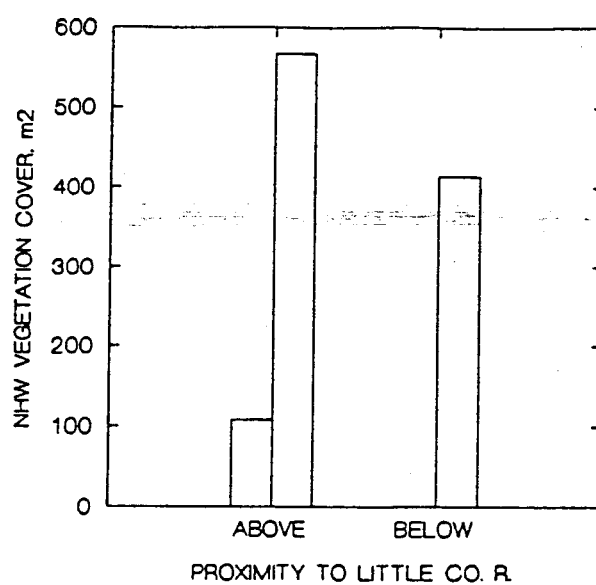


FIGURE 3. Mean NHW vegetation cover ( $\text{m}^2/ 1/10\text{th mile}$ ) in one mile above and one mile below the Little Colorado River in 1965 and 1992 (1965 = left bar; 1992 = right bar associated with 'above' and 'below').



Vegetation growth on 'Fish Island'. Cover of mesquite, as well as NHW plants on 'Fish Island' increased dramatically between 1965 and 1992 (Fig. 4, Table 7). Mesquite on this island occur at the boundary of the OHW-NHW line, while other NHW vegetation occurs below it. The pattern of vegetation increase on this island follows the general pattern of vegetation expansion elsewhere, although the amount of increase is much higher (mesquite cover increased >200% between 1965-1992, while NHW cover increased at a rate of greater than 1,500%). This may be due to reduced scour and greater water availability in an island setting.

The pattern of cover change on this island provides tacit corroboration for patterns found in NHW and OHW vegetation through the 3 reaches. Specifically, NHW vegetation shows a decrease in cover in 1984, while OHW vegetation shows a slight increase in cover during this period of high flows.

## DISCUSSION

*Riparian vegetation and river regulation:* A 160% increase in NHW zone vegetation cover along the Colorado River following impoundment leaves no doubt about the impact of river regulation on the riparian plant community along this river. This increase occurred despite a four year period of post-dam flooding that reduced NHW plant cover between 1982 and 1986 (Pucherelli 1986, Stevens and Waring 1988). This pattern lies in sharp contrast with existing patterns of extensive riparian habitat loss that are occurring due to other human activities.

This extensive vegetation expansion began soon after the gates of Glen Canyon Dam were closed in 1963. Aerial photographs from 1965 show large stands of young NHW vegetation along the shoreline. The only other vegetation visible in these photographs includes older tamarisk at the NHW-OHW boundary, and other OHW vegetation. By 1973, eight years later, NHW vegetation cover had increased by nearly 100%, creating new habitat for riparian plants and higher trophic levels.

The next river regulation event, post-dam flooding, had a destructive impact on this new plant community. While these data indicate a 11% decrease in NHW vegetation cover between 1973 and 1984, the actual amount of loss due to this event was higher. Studies that measured pre-flood vegetation cover at dates closer to the flooding event (e.g., in the early 1980's) provide a more accurate estimate flood-related vegetation loss because these plant populations were expanding vigorously up until that time. Several studies indicate that as much as 30 to 50% of NHW vegetation cover was lost due to flooding (Pucherelli 1986, Stevens and Waring 1988). This loss was due to a combination of scouring and drowning of plants (Stevens and Waring 1988).

Following post-dam flooding, another low and stable flow period ensued in Grand Canyon, leading up to the present interim flow period. Between 1984 and 1992, vegetation cover increased nearly the same amount that it did during the eight year period following the closing of Glen Canyon Dam. It is likely that this second phase of plant expansion actually occurred in a narrower time interval of six years or less, since post-dam flooding occurred into 1986. This suggests that the rate of increase in vegetation cover exceeded that which occurred prior to post-dam flooding. These data suggest that a large share of the post-flood increases in vegetation cover occurred during the initial phases of interim flows. Interim flows have created a new shoreline habitat that is being actively colonized by vegetation. Creation of this habitat brings

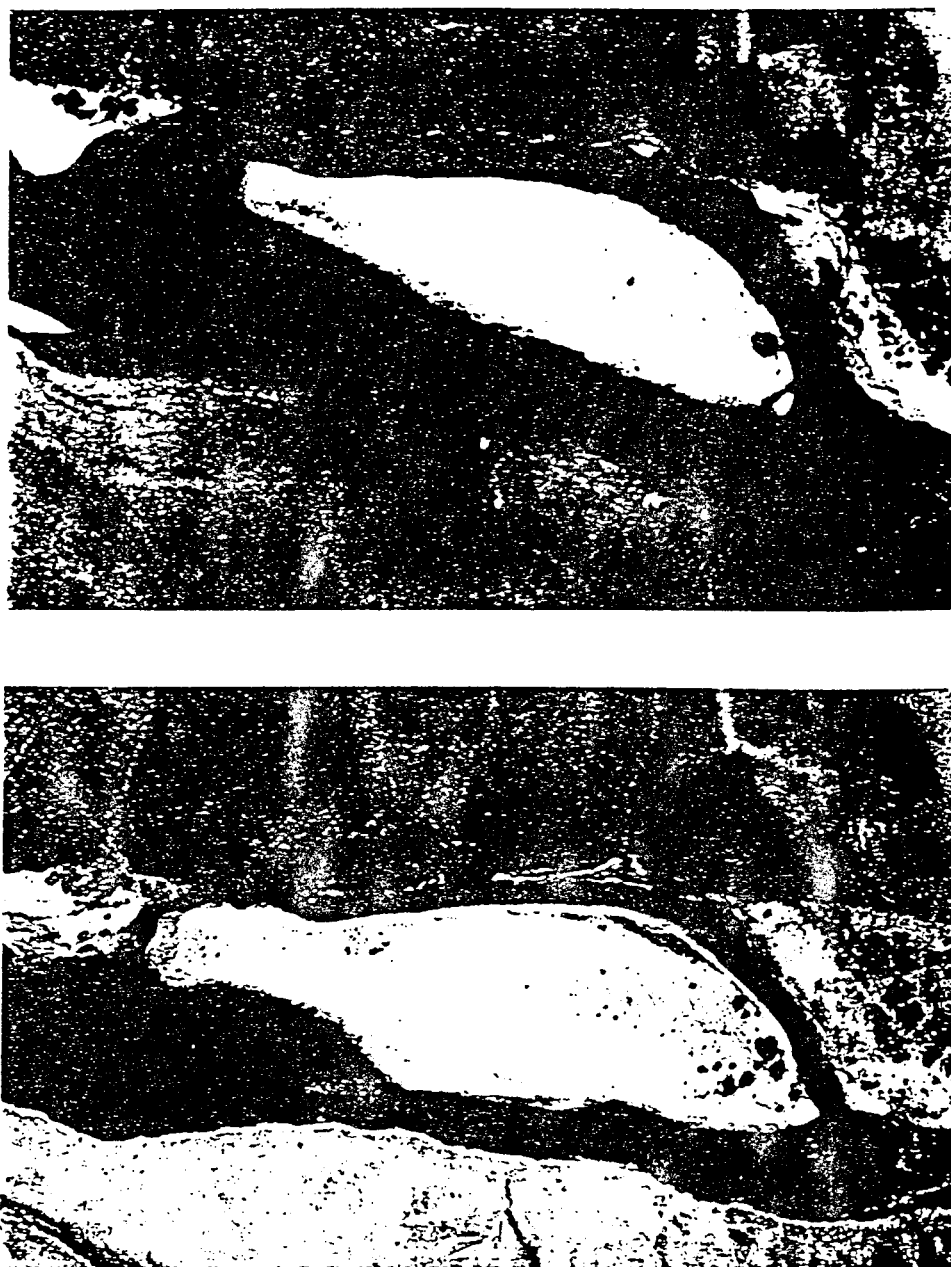


FIGURE 4. 1965 (above) and 1992 (below) photography of 'Fish Island' at mile 66 on the Colorado River. Increase in mesquite occurred in the right or downstream end of the island between 1965 and 1992.

Table 7. Increase in vegetation cover (m<sup>2</sup>) in Fish Island, 1965-1992.

YEAR	AREA IN M <sup>2</sup>		TOTAL
	NHW MESQUITE	NHW OTHER*	
1965	535	325	869
1973	739	3,186	3,927
1984	1,213	2,367	3,589
1990	1,174	2,006	
	3,180		
1992	1,748	5,941	7,689

\*including primarily *Salix exigua* and *Tamarix ramosissima*

vegetation closer to the active channel than during any other period, which may help to stabilize shoreline sediments. However, it may also make colonizing plants more susceptible to scouring during future flooding events.

The OHW zone vegetation, comprised mainly of honey mesquite (*Prosopis glandulosa*), appears to have changed relatively little during the post-dam era in Grand Canyon. According to this study, cover of these populations decreased slightly following the completion of Glen Canyon Dam, and was followed by a small increase in cover during post-dam flooding.

*Riparian vegetation and depositional settings:* While this study detected no significant relationships between vegetation cover and geomorphic characteristics that I used (e.g., runs, eddies), different responses of NHW and OHW vegetation in the three reaches to impoundment probably are related to larger-scale geomorphic differences. Following impoundment, NHW plant cover increased to levels comparable to that of OHW cover in Reach 5 but not in Reach 4, probably due to differing amounts of available colonizable substrate. Also, Reach 5 is a higher-gradient reach, and this characteristic may have limited plant establishment when the river was unregulated. Levels of plant cover also varied by side of the river in some reaches, and larger areas of vegetation appear to be related to the presence of large tributaries.

The prediction that riparian vegetation cover would increase at a greater rate downstream of the LCR than upstream of it, due to greater sediment contributions, was not borne out in this study. While the LCR is one of the principal contributors of sediments in this sediment-limited system, it does not aggrade sediments within several miles downstream of it that result in measurable increases in vegetation cover. It may be that aggradational effects occur further downstream or that these sediments are only minimally or briefly involved in beach building (Schmidt and Graf 1990).

This study confirms that the regulation of the Colorado River through Grand Canyon has directly resulted in the creation of an extensive riparian plant community. Many animals now rely on this plant community, and as a result, make it all the more diverse as a western riparian reserve for biodiversity (e.g., Warren and Schwalbe 1988, Brown and Johnson 1988). While this community has withstood river regulation, including extensive flooding events, the future may represent a significant departure from post-dam history to date. If the Colorado River drainage through Grand Canyon continues to lose sediments, habitat for plant communities will similarly become limited. There will be less recovery of vegetation from what may be inevitable post-dam flooding events, and the plant and animal community may decline.

## MANAGEMENT CONCLUSIONS

Riparian vegetation in 23 miles along the Colorado River are now accounted for within GCES' GIS. These vegetation data in three GIS reaches and five separate dates between 1965 and 1992 exist as a permanent record that can be accessed for future reference and comparison. This constitutes a valuable tool for the National Park Service and other entities that may conduct research on riparian vegetation and its relationship to other elements of the river ecosystem.

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APPENDIX I. VEGETATION COVER DATA FOR REACHES 2, 4 and 5, FOR YEARS 1965,  
1973, 1984, 1990 and 1992.

25

# Reach 2

	TENTH	ZONES	COVER65	COVER73	COVER84	COVER90	COVER92
CASE 1	0.000	H	7469.633	9753.630	10361.400	2831.700	9826.476
CASE 2	0.000	H	0.000	0.000	38.179	0.000	2.639
CASE 3	0.000	L	6951.430	5150.362	3822.664	5838.304	5839.817
CASE 4	0.000	L	258.249	732.476	699.590	1943.310	1031.292
CASE 5	0.000	T	0.000	0.000	0.000	0.000	0.000
CASE 6	0.000	T	2664.099	1571.000	1520.586	0.000	1658.390
CASE 7	0.100	H	8358.510	12352.050	12885.150	4254.947	11538.930
CASE 8	0.100	H	0.000	0.000	0.000	0.000	0.000
CASE 9	0.100	L	3426.162	1131.163	1733.890	1488.121	2113.982
CASE 10	0.100	L	0.000	2002.298	1924.643	586.555	1382.838
CASE 11	0.100	T	0.000	0.000	0.000	0.000	0.000
CASE 12	0.100	T	0.000	0.000	0.000	0.000	0.000
CASE 13	0.200	H	8600.565	7237.936	8742.052	4065.142	8894.646
CASE 14	0.200	H	0.000	48.333	0.000	0.000	0.000
CASE 15	0.200	L	566.069	3083.280	4090.124	3624.412	2772.758
CASE 16	0.200	L	0.000	710.652	445.830	460.686	467.286
CASE 17	0.200	T	0.000	0.000	0.000	0.000	0.000
CASE 18	0.200	T	0.000	0.000	0.000	0.000	0.000
CASE 19	0.300	H	-1.000	0.000	0.000	0.000	45.810
CASE 20	0.300	H	-1.000	40.809	72.668	0.000	9.347
CASE 21	0.300	L	-1.000	0.000	0.388	338.374	0.000
CASE 22	0.300	L	-1.000	276.898	102.496	122.741	511.887
CASE 23	0.300	T	-1.000	0.000	0.000	0.000	0.000
CASE 24	0.300	T	-1.000	0.000	0.000	0.000	0.000
CASE 25	0.400	H	3558.395	2707.401	2903.713	1968.270	374.912
CASE 26	0.400	H	0.000	154.376	69.200	0.000	75.257
CASE 27	0.400	L	5.877	182.071	483.789	414.287	779.641
CASE 28	0.400	L	0.000	129.985	28.069	201.006	307.474
CASE 29	0.400	T	0.000	0.000	0.000	0.000	1418.641
CASE 30	0.400	T	0.000	0.000	0.000	0.000	0.000
CASE 31	0.500	H	1894.915	2273.215	3215.837	1573.742	2280.457
CASE 32	0.500	H	0.000	0.000	0.000	0.000	0.000
CASE 33	0.500	L	678.733	1223.972	1119.007	804.608	2147.611
CASE 34	0.500	L	0.000	181.590	0.000	279.218	401.450
CASE 35	0.500	T	0.000	0.000	0.000	0.000	0.000
CASE 36	0.500	T	0.000	0.000	0.000	0.000	0.000
CASE 37	0.600	H	3143.500	2971.639	4003.340	2217.428	3049.436
CASE 38	0.600	H	0.000	0.000	0.000	0.000	0.000
CASE 39	0.600	L	1326.005	1615.288	1952.922	1041.873	2231.151
CASE 40	0.600	L	0.000	14.415	0.000	0.000	0.000
CASE 41	0.600	T	0.000	0.000	0.000	0.000	0.000
CASE 42	0.600	T	0.000	0.000	0.000	0.000	0.000
CASE 43	0.700	H	3866.608	3757.579	4229.531	2655.217	3858.850
CASE 44	0.700	H	0.000	0.000	0.000	0.000	0.000
CASE 45	0.700	L	288.079	1264.260	2768.730	1500.596	2045.594
CASE 46	0.700	L	0.000	0.000	0.000	0.000	0.000
CASE 47	0.700	T	0.000	0.000	0.000	0.000	0.000
CASE 48	0.700	T	0.000	0.000	0.000	0.000	0.000
CASE 49	0.800	H	2613.463	2570.377	3480.402	2185.048	2844.966
CASE 50	0.800	H	0.000	0.000	0.000	0.000	0.000
CASE 51	0.800	L	888.276	1777.386	1832.074	1152.675	2932.879
CASE 52	0.800	L	0.000	0.000	0.000	0.000	0.000
CASE 53	0.800	T	0.000	0.000	0.000	0.000	0.000
CASE 54	0.800	T	0.000	0.000	0.000	0.000	0.000
CASE 55	0.900	H	1178.031	1225.529	1059.685	847.090	1217.637
CASE 56	0.900	H	0.000	0.000	0.000	0.000	0.000
CASE 57	0.900	L	333.730	1195.325	688.969	791.919	1471.782
CASE 58	0.900	L	0.000	7.175	26.456	0.000	0.000
CASE 59	0.900	T	0.000	0.000	0.000	0.000	0.000
CASE 60	0.900	T	0.000	0.000	0.000	0.000	0.000
CASE 61	1.000	H	101.728	709.259	0.000	0.000	130.936
CASE 62	1.000	H	0.000	0.000	0.000	0.000	0.000
CASE 63	1.000	L	2374.376	2069.340	2245.290	6728.987	2142.146
CASE 64	1.000	L	0.000	0.000	0.000	0.000	0.000
CASE 65	1.000	T	4318.353	7163.243	5660.466	0.000	5223.102
CASE 66	1.000	T	0.000	0.000	0.000	0.000	0.000
CASE 67	1.100	H	0.000	889.997	0.000	0.000	0.000
CASE 68	1.100	H	0.000	0.000	41.257	14.217	19.341
CASE 69	1.100	L	3741.532	3990.721	4440.547	6330.983	4297.197
CASE 70	1.100	L	0.000	32.038	66.861	0.000	0.000
CASE 71	1.100	T	4409.986	3432.663	3557.651	0.000	3223.402



CASE	72	1.100	T	0.000	0.000	0.000	0.000	0.000
CASE	73	1.200	H	33.797	479.194	62.428	0.000	0.000
CASE	74	1.200	H	63.563	0.000	77.604	41.857	228.352
CASE	75	1.200	L	255.529	160.200	427.588	374.151	298.741
CASE	76	1.200	L	19.824	210.283	170.735	61.663	28.183
CASE	77	1.200	T	568.288	142.679	211.637	0.000	120.588
CASE	78	1.200	T	0.000	0.000	0.000	0.000	0.000
CASE	79	1.300	H	0.000	53.715	100.948	0.000	0.000
CASE	80	1.300	H	473.618	0.000	637.369	235.079	476.656
CASE	81	1.300	L	197.975	152.304	0.000	0.000	0.000
CASE	82	1.300	L	765.922	894.275	123.112	305.145	305.738
CASE	83	1.300	T	0.000	0.000	0.000	0.000	0.000
CASE	84	1.300	T	0.000	0.000	0.000	0.000	0.000
CASE	85	1.400	H	256.874	207.191	244.177	0.000	0.000
CASE	86	1.400	H	17.021	0.000	126.835	60.935	61.014
CASE	87	1.400	L	25.251	90.079	83.606	28.003	59.090
CASE	88	1.400	L	0.000	216.420	31.316	0.000	0.000
CASE	89	1.400	T	0.000	0.000	30.738	0.000	118.648
CASE	90	1.400	T	0.000	0.000	0.000	0.000	0.000
CASE	91	1.500	H	0.000	0.000	0.000	0.000	0.000
CASE	92	1.500	H	0.000	106.601	919.412	252.749	731.012
CASE	93	1.500	L	389.863	640.652	425.361	567.291	864.502
CASE	94	1.500	L	0.000	302.124	91.585	29.793	147.781
CASE	95	1.500	T	0.000	0.000	0.000	0.000	0.000
CASE	96	1.500	T	0.000	0.000	0.000	0.000	0.000
CASE	97	1.600	H	0.000	25.431	116.331	0.000	25.287
CASE	98	1.600	H	679.465	279.911	719.734	263.578	804.859
CASE	99	1.600	L	1086.377	2376.329	2279.570	2370.781	3536.523
CASE	100	1.600	L	74.653	148.632	50.403	111.029	180.653

26

100 CASES AND 15 VARIABLES PROCESSED.  
 SYSTAT FILE CREATED AND SAVED TO 92DATA.SYS

Reach 2 cover (cont.)

CASE 195	-1.000L	-1.000	-1.000	761.775	338.006	626.952
CASE 196	-1.000L	-1.000	-1.000	1537.032	340.173	382.181
CASE 197	-1.000T	-1.000	-1.000	0.000	0.000	0.000
CASE 198	-1.000T	-1.000	-1.000	0.000	0.000	0.000
CASE 199	-1.100H	-1.000	-1.000	0.000	0.000	0.000
CASE 200	-1.100H	-1.000	-1.000	0.000	0.000	0.000
CASE 201	-1.100L	-1.000	-1.000	670.927	252.131	715.957
CASE 202	-1.100L	-1.000	-1.000	1058.806	104.540	346.352
CASE 203	-1.100T	-1.000	-1.000	0.000	0.000	0.000
CASE 204	-1.100T	-1.000	-1.000	0.000	0.000	0.000
CASE 205	-1.200H	-1.000	-1.000	0.000	0.000	0.000
CASE 206	-1.200H	-1.000	-1.000	13.456	0.000	10.852
CASE 207	-1.200L	-1.000	-1.000	209.157	108.505	266.239
CASE 208	-1.200L	-1.000	-1.000	527.732	87.975	222.758
CASE 209	-1.200T	-1.000	-1.000	0.000	0.000	0.000
CASE 210	-1.200T	-1.000	-1.000	0.000	0.000	0.000
CASE 211	-1.300H	-1.000	-1.000	0.000	0.000	0.000
CASE 212	-1.300H	-1.000	-1.000	119.259	0.000	58.716
CASE 213	-1.300L	-1.000	-1.000	116.627	72.355	325.786
CASE 214	-1.300L	-1.000	-1.000	494.260	164.664	478.046
CASE 215	-1.300T	-1.000	-1.000	0.000	0.000	0.000
CASE 216	-1.300T	-1.000	-1.000	0.000	0.000	56.585
CASE 217	-1.400H	-1.000	-1.000	0.000	0.000	0.000
CASE 218	-1.400H	-1.000	-1.000	783.907	0.000	419.511
CASE 219	-1.400L	-1.000	-1.000	330.274	22.738	309.715
CASE 220	-1.400L	-1.000	-1.000	1017.041	651.568	1006.643
CASE 221	-1.400T	-1.000	-1.000	0.000	0.000	0.000
CASE 222	-1.400T	-1.000	-1.000	0.000	0.000	56.354
CASE 223	-1.500H	-1.000	-1.000	0.000	0.000	0.000
CASE 224	-1.500H	-1.000	-1.000	0.000	0.000	0.000
CASE 225	-1.500L	-1.000	-1.000	232.512	39.052	278.553
CASE 226	-1.500L	-1.000	-1.000	1133.310	249.270	714.499
CASE 227	-1.500T	-1.000	-1.000	0.000	0.000	0.000
CASE 228	-1.500T	-1.000	-1.000	0.000	0.000	0.000
CASE 229	-1.600H	-1.000	-1.000	0.000	0.000	0.000
CASE 230	-1.600H	-1.000	-1.000	0.000	0.000	42.572
CASE 231	-1.600L	-1.000	-1.000	45.507	23.257	71.851
CASE 232	-1.600L	-1.000	-1.000	1078.341	220.481	417.938
CASE 233	-1.600T	-1.000	-1.000	0.000	0.000	0.000
CASE 234	-1.600T	-1.000	-1.000	0.000	0.000	0.000
CASE 235	-1.700H	-1.000	-1.000	0.000	0.000	0.000
CASE 236	-1.700H	-1.000	-1.000	0.000	0.000	68.111
CASE 237	-1.700L	-1.000	-1.000	0.000	0.000	16.134
CASE 238	-1.700L	-1.000	-1.000	398.060	105.535	209.363
CASE 239	-1.700T	-1.000	-1.000	0.000	0.000	0.000
CASE 240	-1.700T	-1.000	-1.000	0.000	0.000	0.000
CASE 241	-1.800H	-1.000	-1.000	0.000	0.000	0.000
CASE 242	-1.800H	-1.000	-1.000	217.271	0.000	9.170
CASE 243	-1.800L	-1.000	-1.000	341.125	9.477	171.091
CASE 244	-1.800L	-1.000	-1.000	1673.600	310.238	1057.094
CASE 245	-1.800T	-1.000	-1.000	0.000	0.000	0.000
CASE 246	-1.800T	-1.000	-1.000	0.000	0.000	0.000
CASE 247	-2.000H	-1.000	-1.000	0.000	0.000	0.000
CASE 248	-2.000H	-1.000	-1.000	0.000	0.000	0.000
CASE 249	-2.000L	-1.000	-1.000	266.703	86.792	275.106
CASE 250	-2.000L	-1.000	-1.000	285.164	180.871	531.405
CASE 251	-2.000T	-1.000	-1.000	0.000	0.000	0.000
CASE 252	-2.000T	-1.000	-1.000	0.000	0.000	0.000
CASE 253	-2.100H	-1.000	-1.000	0.000	0.000	0.000
CASE 254	-2.100H	-1.000	-1.000	25.812	0.000	48.812
CASE 255	-2.100L	-1.000	-1.000	0.000	56.499	52.532
CASE 256	-2.100L	-1.000	-1.000	2836.103	2548.921	3469.897
CASE 257	-2.100T	-1.000	-1.000	0.000	0.000	0.000
CASE 258	-2.100T	-1.000	-1.000	0.000	0.000	0.000
CASE 259	-2.200H	-1.000	-1.000	6.551	0.000	0.000
CASE 260	-2.200H	-1.000	-1.000	0.000	0.000	5.854
CASE 261	-2.200L	-1.000	-1.000	510.831	275.192	459.455
CASE 262	-2.200L	-1.000	-1.000	1329.872	1250.055	1405.172
CASE 263	-2.200T	-1.000	-1.000	0.000	0.000	0.000
CASE 264	-2.200T	-1.000	-1.000	0.000	0.000	0.000
CASE 265	-2.300H	-1.000	-1.000	294.043	0.000	0.000
CASE 266	-2.300H	-1.000	-1.000	522.588	6.126	0.000
CASE 267	-2.300L	-1.000	-1.000	804.294	245.840	500.481
CASE 268	-2.300L	-1.000	-1.000	3025.128	2511.628	2809.938
CASE 269	-2.300T	-1.000	-1.000	0.000	0.000	0.000
CASE 270	-2.300T	-1.000	-1.000	0.000	0.000	0.000
CASE 271	-2.400H	-1.000	-1.000	131.344	0.000	0.000
CASE 272	-2.400H	-1.000	-1.000	2996.856	1054.192	223.515
CASE 273	-2.400L	-1.000	-1.000	85.974	25.097	92.389
CASE 274	-2.400L	-1.000	-1.000	9525.597	6227.777	9625.925
CASE 275	-2.400T	-1.000	-1.000	0.000	0.000	0.000
CASE 276	-2.400T	-1.000	-1.000	0.000	0.000	0.000
CASE 277	-2.500H	-1.000	-1.000	374.841	0.000	0.000
CASE 278	-2.500H	-1.000	-1.000	1871.068	0.000	117.062
CASE 279	-2.500L	-1.000	-1.000	354.303	31.405	445.320
CASE 280	-2.500L	-1.000	-1.000	6478.891	6342.582	7245.691
CASE 281	-2.500T	-1.000	-1.000	0.000	0.000	0.000
CASE 282	-2.500T	-1.000	-1.000	0.000	0.000	0.000
CASE 283	-2.600H	-1.000	-1.000	125.256	0.000	0.000
CASE 284	-2.600H	-1.000	-1.000	3378.584	0.000	20.261
CASE 285	-2.600L	-1.000	-1.000	389.136	141.050	504.890
CASE 286	-2.600L	-1.000	-1.000	6705.994	4113.131	6031.609
CASE 287	-2.600T	-1.000	-1.000	0.000	0.000	0.000
CASE 288	-2.600T	-1.000	-1.000	0.000	0.000	0.000
CASE 289	-2.700H	-1.000	-1.000	82.131	0.000	0.000
CASE 290	-2.700H	-1.000	-1.000	2038.362	737.245	1558.516
CASE 291	-2.700L	-1.000	-1.000	191.891	33.593	158.905
CASE 292	-2.700L	-1.000	-1.000	8232.157	4030.488	6324.311
CASE 293	-2.700T	-1.000	-1.000	0.000	0.000	0.000
CASE 294	-2.700T	-1.000	-1.000	0.000	0.000	0.000

Reach 2  
Cover Cont

CASE 295	-2.800H	-1.000	-1.000	33.647	0.000	0.000
CASE 296	-2.800H	-1.000	-1.000	4616.384	926.534	1302.014
CASE 297	-2.800L	-1.000	-1.000	38.202	19.466	46.937
CASE 298	-2.800L	-1.000	-1.000	8631.348	6971.646	6699.347
CASE 299	-2.800T	-1.000	-1.000	0.000	0.000	0.000
CASE 300	-2.800T	-1.000	-1.000	0.000	0.000	0.000
CASE 301	-2.900H	-1.000	-1.000	1188.302	0.000	1457.238
CASE 302	-2.900H	-1.000	-1.000	3296.615	0.000	355.592
CASE 303	-2.900L	-1.000	-1.000	4029.002	3773.411	3908.378
CASE 304	-2.900L	-1.000	-1.000	5002.005	2562.545	4415.363
CASE 305	-2.900T	-1.000	-1.000	0.000	0.000	0.000
CASE 306	-2.900T	-1.000	-1.000	0.000	0.000	0.000
CASE 307	-3.000H	-1.000	-1.000	8284.861	0.000	8750.534
CASE 308	-3.000H	-1.000	-1.000	22.910	0.000	0.000
CASE 309	-3.000L	-1.000	-1.000	6233.942	6856.929	5188.209
CASE 310	-3.000L	-1.000	-1.000	722.562	369.651	606.313
CASE 311	-3.000T	-1.000	-1.000	0.000	0.000	69.458
CASE 312	-3.000T	-1.000	-1.000	0.000	0.000	0.000
CASE 313	-3.100H	-1.000	-1.000	14219.260	58.290	10396.740
CASE 314	-3.100H	-1.000	-1.000	326.898	90.754	178.225
CASE 315	-3.100L	-1.000	-1.000	3102.731	5191.899	2234.273
CASE 316	-3.100L	-1.000	-1.000	244.961	232.292	346.200
CASE 317	-3.100T	-1.000	-1.000	0.000	0.000	0.000
CASE 318	-3.100T	-1.000	-1.000	0.000	0.000	0.000
CASE 319	-3.200H	-1.000	-1.000	9593.076	310.853	3983.592
CASE 320	-3.200H	-1.000	-1.000	595.765	127.604	97.825
CASE 321	-3.200L	-1.000	-1.000	4478.283	5252.098	4983.343
CASE 322	-3.200L	-1.000	-1.000	0.000	541.352	927.911
CASE 323	-3.200T	-1.000	-1.000	0.000	0.000	0.000
CASE 324	-3.200T	-1.000	-1.000	0.000	0.000	0.000
CASE 325	-3.300H	-1.000	-1.000	2374.992	0.000	39.411
CASE 326	-3.300H	-1.000	-1.000	0.000	322.622	489.146
CASE 327	-3.300L	-1.000	-1.000	8475.450	7963.486	8963.812
CASE 328	-3.300L	-1.000	-1.000	0.000	1058.291	713.547
CASE 329	-3.300T	-1.000	-1.000	0.000	0.000	0.000
CASE 330	-3.300T	-1.000	-1.000	0.000	0.000	0.000
CASE 331	-3.400H	-1.000	-1.000	19.334	0.000	0.000
CASE 332	-3.400H	-1.000	-1.000	0.000	659.365	531.390
CASE 333	-3.400L	-1.000	-1.000	8867.407	7613.373	9393.750
CASE 334	-3.400L	-1.000	-1.000	378.094	331.100	611.678
CASE 335	-3.400T	-1.000	-1.000	0.000	0.000	0.000
CASE 336	-3.400T	-1.000	-1.000	0.000	0.000	0.000
CASE 337	-3.500H	-1.000	-1.000	8.106	0.000	0.000
CASE 338	-3.500H	-1.000	-1.000	341.590	381.055	599.706
CASE 339	-3.500L	-1.000	-1.000	5529.252	4185.259	6839.933
CASE 340	-3.500L	-1.000	-1.000	831.937	328.595	822.058
CASE 341	-3.500T	-1.000	-1.000	0.000	0.000	0.000
CASE 342	-3.500T	-1.000	-1.000	0.000	0.000	0.000
CASE 343	-3.600H	-1.000	-1.000	0.000	0.000	0.000
CASE 344	-3.600H	-1.000	-1.000	212.829	505.515	333.260
CASE 345	-3.600L	-1.000	-1.000	2751.136	2700.797	5184.962
CASE 346	-3.600L	-1.000	-1.000	1171.877	454.626	1468.731
CASE 347	-3.600T	-1.000	-1.000	0.000	0.000	0.000
CASE 348	-3.600T	-1.000	-1.000	0.000	0.000	0.000
CASE 349	-3.700H	-1.000	-1.000	493.698	100.015	816.446
CASE 350	-3.700H	-1.000	-1.000	616.744	97.238	335.191
CASE 351	-3.700L	-1.000	-1.000	2415.207	1325.572	3446.273
CASE 352	-3.700L	-1.000	-1.000	209.155	268.218	635.378
CASE 353	-3.700T	-1.000	-1.000	0.000	0.000	0.000
CASE 354	-3.700T	-1.000	-1.000	0.000	0.000	0.000
CASE 355	-3.800H	-1.000	-1.000	4598.378	636.137	4079.909
CASE 356	-3.800H	-1.000	-1.000	442.702	197.733	458.653
CASE 357	-3.800L	-1.000	-1.000	1459.057	447.264	2017.271
CASE 358	-3.800L	-1.000	-1.000	295.311	115.049	455.139
CASE 359	-3.800T	-1.000	-1.000	0.000	0.000	0.000
CASE 360	-3.800T	-1.000	-1.000	0.000	0.000	0.000
CASE 361	-3.900H	-1.000	-1.000	9398.529	979.659	8863.325
CASE 362	-3.900H	-1.000	-1.000	159.671	146.667	72.988
CASE 363	-3.900L	-1.000	-1.000	863.568	2599.541	4133.680
CASE 364	-3.900L	-1.000	-1.000	1242.739	743.346	1280.384
CASE 365	-3.900T	-1.000	-1.000	0.000	0.000	0.000
CASE 366	-3.900T	-1.000	-1.000	0.000	0.000	0.000
CASE 367	-4.000H	-1.000	-1.000	9756.264	619.565	9212.318
CASE 368	-4.000H	-1.000	-1.000	4298.980	175.127	2399.678
CASE 369	-4.000L	-1.000	-1.000	100.836	5711.835	5991.033
CASE 370	-4.000L	-1.000	-1.000	1524.817	273.858	1712.088
CASE 371	-4.000T	-1.000	-1.000	0.000	0.000	0.000
CASE 372	-4.000T	-1.000	-1.000	0.000	0.000	0.000

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Reach 2  
Cover Count!

Reach 4

		TENTH	ZONES	COVER65	COVER73	COVER84	COVER90	COVER92
CASE	1	51.000	H	1994.983	9.968	1969.052	1270.440	1209.705
CASE	2	51.000	H	2255.178	5441.112	5608.810	5257.770	8573.860
CASE	3	51.000	L	0.000	157.415	1162.128	47.691	111.396
CASE	4	51.000	L	303.415	1183.498	3363.978	3237.265	3868.152
CASE	5	51.000	T	0.000	0.000	0.000	0.000	0.000
CASE	6	51.000	T	0.000	0.000	0.000	0.000	0.000
CASE	7	51.100	H	354.535	442.834	790.239	406.711	732.860
CASE	8	51.100	H	8709.515	6721.348	9164.408	5957.949	10783.620
CASE	9	51.100	L	0.000	18.821	0.703	8.570	216.484
CASE	10	51.100	L	1669.289	578.474	3122.138	3230.924	3170.294
CASE	11	51.100	T	0.000	0.000	0.000	0.000	0.000
CASE	12	51.100	T	0.000	0.000	0.000	0.000	0.000
CASE	13	51.200	H	591.629	588.038	422.951	320.884	726.733
CASE	14	51.200	H	3554.943	3863.174	4358.651	3358.537	4377.549
CASE	15	51.200	L	8.347	290.561	198.237	440.763	1148.908
CASE	16	51.200	L	2092.367	1454.191	3964.313	3775.180	7100.672
CASE	17	51.200	T	0.000	0.000	0.000	0.000	0.000
CASE	18	51.200	T	0.000	90.691	49.587	0.000	68.284
CASE	19	51.300	H	1404.852	1399.515	1642.109	1490.665	1860.287
CASE	20	51.300	H	4987.022	4956.125	5446.781	4422.671	5223.763
CASE	21	51.300	L	609.439	1395.045	800.784	1254.019	1437.807
CASE	22	51.300	L	3054.836	1675.203	4103.806	5398.987	6883.548
CASE	23	51.300	T	160.729	185.424	255.671	0.000	170.644
CASE	24	51.300	T	307.783	99.901	108.161	0.000	121.235
CASE	25	51.400	H	1190.118	1290.623	1289.508	638.977	1573.611
CASE	26	51.400	H	8347.455	7016.129	8565.692	6595.343	8972.506
CASE	27	51.400	L	153.401	792.977	1094.723	857.889	1112.796
CASE	28	51.400	L	4493.039	4631.787	3963.846	4502.053	5276.691
CASE	29	51.400	T	0.000	0.000	0.000	0.000	0.000
CASE	30	51.400	T	126.785	95.553	194.131	0.000	118.085
CASE	31	51.500	H	4433.231	4779.098	6035.963	1837.292	4070.184
CASE	32	51.500	H	2173.812	2802.697	3099.132	1497.559	2716.753
CASE	33	51.500	L	1284.252	1386.170	1399.808	1235.853	1789.853
CASE	34	51.500	L	5114.532	2401.246	1938.677	3239.201	3841.974
CASE	35	51.500	T	0.000	0.000	0.000	0.000	0.000

35 CASES AND 15 VARIABLES PROCESSED.  
NO SYSTAT FILE CREATED.

CASE	34	51.500	L	5114.532	2401.246	1938.677	3239.201	3841.974
CASE	35	51.500	T	0.000	0.000	0.000	0.000	0.000
CASE	36	51.500	T	545.882	411.467	627.058	0.000	867.204
CASE	37	51.600	H	6611.716	3388.573	3459.733	2348.814	3053.003
CASE	38	51.600	H	2737.591	3463.717	4660.106	3438.117	4594.466
CASE	39	51.600	L	1372.981	4038.461	2132.543	2246.511	4113.795
CASE	40	51.600	L	3183.498	2881.168	2580.727	2370.068	3239.326
CASE	41	51.600	T	0.000	0.000	0.000	0.000	0.000
CASE	42	51.600	T	0.000	0.000	0.000	0.000	0.000
CASE	43	51.700	H	4757.184	2901.119	3002.326	1247.021	2956.586
CASE	44	51.700	H	4714.613	3504.745	4438.762	4151.080	4569.229
CASE	45	51.700	L	411.444	2516.166	1644.104	1686.343	1945.987
CASE	46	51.700	L	6154.571	4359.122	4519.703	3831.884	5766.654
CASE	47	51.700	T	0.000	0.000	0.000	0.000	0.000
CASE	48	51.700	T	532.344	650.268	792.004	0.000	771.083
CASE	49	51.800	H	3380.599	2555.862	2322.468	1685.689	2575.042
CASE	50	51.800	H	3508.563	3803.116	3467.003	2703.076	3069.908
CASE	51	51.800	L	721.137	1929.029	2541.144	1824.677	2378.557
CASE	52	51.800	L	3768.784	4552.187	4262.504	4003.027	4549.627
CASE	53	51.800	T	0.000	0.000	0.000	0.000	0.000
CASE	54	51.800	T	0.000	0.000	0.000	0.000	0.000
CASE	55	51.900	H	4757.140	2605.551	3785.175	1874.686	2828.508
CASE	56	51.900	H	2697.829	1954.266	3079.581	2003.339	2617.245
CASE	57	51.900	L	156.635	1494.006	2150.922	1621.823	2813.515
CASE	58	51.900	L	1540.672	2888.744	2033.884	2329.818	2695.258
CASE	59	51.900	T	0.000	0.000	0.000	0.000	89.761
CASE	60	51.900	T	0.000	0.000	0.000	0.000	0.000
CASE	61	52.000	H	5400.139	5195.453	8708.114	3843.927	6528.352
CASE	62	52.000	H	3199.360	1969.810	2693.051	1423.223	2015.789
CASE	63	52.000	L	303.031	1229.065	567.190	858.830	1496.805
CASE	64	52.000	L	30.081	574.683	420.162	117.769	558.042
CASE	65	52.000	T	0.000	0.000	0.000	0.000	0.000
CASE	66	52.000	T	0.000	0.000	0.000	0.000	0.000
CASE	67	52.100	H	8825.705	7955.730	13590.370	10669.220	11535.310
CASE	68	52.100	H	2482.233	2239.238	2942.915	1729.362	2449.588
CASE	69	52.100	L	580.755	1730.921	2021.335	1456.322	2551.630
CASE	70	52.100	L	84.104	1040.437	428.276	283.438	706.703
CASE	71	52.100	T	0.000	0.000	0.000	0.000	15.349
CASE	72	52.100	T	0.000	0.000	0.000	0.000	0.000
CASE	73	52.200	H	5082.307	7189.880	9182.701	8032.443	9231.801
CASE	74	52.200	H	789.764	869.895	1056.751	595.088	504.384
CASE	75	52.200	L	149.088	1536.575	1773.117	1680.192	1978.030
CASE	76	52.200	L	0.000	0.000	0.000	0.000	118.426
CASE	77	52.200	T	0.000	0.000	0.000	0.000	0.000
CASE	78	52.200	T	0.000	0.000	0.000	0.000	0.000
CASE	79	52.300	H	9173.661	10071.180	13348.360	7987.544	12492.020
CASE	80	52.300	H	303.298	452.762	448.136	251.321	328.504
CASE	81	52.300	L	336.735	1992.427	1782.864	1266.648	2121.905
CASE	82	52.300	L	0.000	0.000	0.000	0.000	50.945
CASE	83	52.300	T	0.000	0.000	91.526	0.000	58.439
CASE	84	52.300	T	0.000	0.000	0.000	0.000	0.000
CASE	85	52.400	H	7110.932	7635.722	8785.651	4307.383	8178.833
CASE	86	52.400	H	341.162	350.202	528.216	157.344	438.314
CASE	87	52.400	L	785.749	975.987	1207.439	332.701	1424.003
CASE	88	52.400	L	0.000	0.000	0.000	2.731	16.405
CASE	89	52.400	T	0.000	0.000	0.000	0.000	0.000
CASE	90	52.400	T	0.000	0.000	0.000	0.000	0.000
CASE	91	52.500	H	10845.440	9129.025	10869.970	6177.142	12219.860
CASE	92	52.500	H	253.706	441.188	620.848	161.759	325.574
CASE	93	52.500	L	129.718	320.424	465.728	146.468	690.519
CASE	94	52.500	L	0.000	0.000	0.000	0.000	73.617
CASE	95	52.500	T	0.000	0.000	0.000	0.000	0.000
CASE	96	52.500	T	0.000	0.000	0.000	0.000	0.000
CASE	97	52.600	H	7094.394	4702.923	5003.086	3691.492	8544.824
CASE	98	52.600	H	5586.788	5347.605	6542.674	2141.975	4655.102
CASE	99	52.600	L	20.317	467.428	740.544	118.367	837.016
CASE	100	52.600	L	0.000	172.162	0.000	12.629	65.691
CASE	101	52.600	T	0.000	0.000	0.000	0.000	0.000
CASE	102	52.600	T	0.000	0.000	0.000	0.000	0.000
CASE	103	52.700	H	3437.845	2798.424	4348.966	2237.585	3250.683
CASE	104	52.700	H	10224.380	9676.644	12022.290	5167.986	10800.770
CASE	105	52.700	L	0.000	51.748	99.351	18.617	138.069
CASE	106	52.700	L	9.173	129.239	166.090	110.096	241.617
CASE	107	52.700	T	0.000	0.000	0.000	0.000	0.000
CASE	108	52.700	T	0.000	0.000	0.000	0.000	0.000
CASE	109	52.800	H	7409.265	2860.422	5670.954	5401.023	9238.244
CASE	110	52.800	H	9470.134	9434.650	11094.310	5443.211	10254.680
CASE	111	52.800	L	354.370	1111.983	587.655	489.205	1188.466
CASE	112	52.800	L	0.000	17.700	0.000	43.417	149.355
CASE	113	52.800	T	0.000	0.000	0.000	0.000	0.000
CASE	114	52.800	T	0.000	0.000	0.000	0.000	0.000
CASE	115	52.900	H	6019.996	3294.892	8564.925	5106.942	11042.270
CASE	116	52.900	H	413.523	1498.811	4874.869	599.377	1789.541
CASE	117	52.900	L	105.929	196.965	125.517	151.133	376.027
CASE	118	52.900	L	0.000	0.000	0.000	0.000	30.560
CASE	119	52.900	T	0.000	0.000	0.000	0.000	0.000
CASE	120	52.900	T	0.000	0.000	0.000	0.000	0.000
CASE	121	53.000	H	7346.064	4259.903	8255.390	6088.880	10550.120
CASE	122	53.000	H	322.234	283.809	898.781	48.088	449.214
CASE	123	53.000	L	205.511	566.268	404.306	414.685	636.956
CASE	124	53.000	L	0.000	0.000	0.000	49.513	18.623
CASE	125	53.000	T	0.000	255.254	202.675	0.000	255.283
CASE	126	53.000	T	0.000	0.000	0.000	0.000	0.000
CASE	127	53.100	H	7667.479	2535.993	6140.070	4452.197	6143.563
CASE	128	53.100	H	1520.058	1068.519	1107.409	748.204	1893.632
CASE	129	53.100	L	3185.310	6866.304	7997.178	6156.079	9438.441
CASE	130	53.100	L	0.000	7.666	0.000	28.940	124.870
CASE	131	53.100	T	0.000	393.010	511.701	0.000	324.818
CASE	132	53.100	T	0.000	0.000	0.000	0.000	0.000
CASE	133	53.200	H	8236.979	3451.531	4597.573	2634.361	7649.510

REACH 4 31  
COVER (cont.)

CASE 134	53.200	H	1686.740	1529.469	60.535	1080.503	2094.435
CASE 135	53.200	L	670.797	2236.571	4313.261	4677.477	5776.917
CASE 136	53.200	L	15.376	1604.061	57.870	42.362	153.660
CASE 137	53.200	T	0.000	0.000	0.000	0.000	0.000
CASE 138	53.200	T	0.000	0.000	0.000	0.000	0.000
CASE 139	53.300	H	8420.369	8317.928	4390.397	2226.148	5867.758
CASE 140	53.300	H	1253.771	1792.413	0.000	1017.779	2534.822
CASE 141	53.300	L	2122.020	4775.925	2468.775	2297.566	4500.627
CASE 142	53.300	L	301.757	241.959	147.462	144.478	462.303
CASE 143	53.300	T	0.000	0.000	0.000	0.000	0.000
CASE 144	53.300	T	0.000	0.000	0.000	0.000	0.000
CASE 145	53.400	H	5268.756	4132.674	1895.863	1366.744	3880.103
CASE 146	53.400	H	1570.094	2078.409	2197.136	1557.312	2716.119
CASE 147	53.400	L	1504.471	2846.552	180.729	1808.024	2370.650
CASE 148	53.400	L	111.483	796.791	1062.581	197.882	603.738
CASE 149	53.400	T	0.000	0.000	0.000	0.000	0.000
CASE 150	53.400	T	0.000	0.000	0.000	0.000	0.000
CASE 151	53.500	H	4630.327	3115.245	4121.803	3017.742	3447.131
CASE 152	53.500	H	2664.374	3106.589	2473.286	1460.220	2141.965
CASE 153	53.500	L	64.490	184.443	0.000	40.669	366.469
CASE 154	53.500	L	714.505	371.088	560.918	191.620	742.402
CASE 155	53.500	T	0.000	0.000	0.000	0.000	0.000
CASE 156	53.500	T	0.000	0.000	0.000	0.000	0.000
CASE 157	53.600	H	2445.463	2243.294	2360.986	1812.206	1643.650
CASE 158	53.600	H	5458.796	6264.721	6421.300	4668.528	5443.327
CASE 159	53.600	L	26.878	223.928	374.308	163.305	330.174
CASE 160	53.600	L	2413.864	1553.906	2589.459	1821.680	4311.057
CASE 161	53.600	T	0.000	0.000	0.000	0.000	0.000
CASE 162	53.600	T	0.000	0.000	0.000	0.000	0.000
CASE 163	53.700	H	1711.151	900.812	1123.921	1341.467	1228.741
CASE 164	53.700	H	3178.189	3422.364	4211.962	2337.851	3124.032
CASE 165	53.700	L	0.000	200.108	90.480	40.241	129.173
CASE 166	53.700	L	800.932	795.826	1067.924	720.180	899.053
CASE 167	53.700	T	0.000	0.000	0.000	0.000	0.000
CASE 168	53.700	T	0.000	0.000	0.000	0.000	0.000
CASE 169	53.800	H	3583.382	2975.012	3868.843	2517.428	3877.957
CASE 170	53.800	H	5045.076	5750.531	6643.761	3623.538	5745.333
CASE 171	53.800	L	360.514	768.607	725.423	616.869	984.654
CASE 172	53.800	L	0.000	20.545	165.170	108.913	215.899
CASE 173	53.800	T	0.000	0.000	0.000	0.000	0.000
CASE 174	53.800	T	0.000	0.000	0.000	0.000	0.000
CASE 175	53.900	H	4786.959	4944.104	5925.773	3795.361	4456.820
CASE 176	53.900	H	5089.052	5546.691	5717.096	2660.419	4895.886
CASE 177	53.900	L	443.183	2112.216	1167.194	1576.138	3215.195
CASE 178	53.900	L	186.521	0.000	221.760	200.452	339.147
CASE 179	53.900	T	0.000	0.000	0.000	0.000	0.000
CASE 180	53.900	T	0.000	0.000	0.000	0.000	0.000
CASE 181	54.000	H	7579.575	5011.767	5570.017	3562.804	5569.891
CASE 182	54.000	H	3779.395	3628.637	4499.768	2521.433	3423.965
CASE 183	54.000	L	695.590	4149.939	2063.576	2665.699	4127.148
CASE 184	54.000	L	97.111	136.716	171.893	150.636	112.564
CASE 185	54.000	T	0.000	0.000	11.371	0.000	14.708
CASE 186	54.000	T	449.001	756.295	0.000	0.000	0.000
CASE 187	54.100	H	2944.585	3608.975	2794.143	1757.003	2595.657
CASE 188	54.100	H	4853.484	4347.467	5374.913	4019.883	3855.843
CASE 189	54.100	L	617.890	556.794	974.792	1400.994	1389.735
CASE 190	54.100	L	71.788	1146.903	236.327	142.039	1225.147
CASE 191	54.100	T	153.475	186.120	174.492	0.000	108.422
CASE 192	54.100	T	48.641	50.726	0.000	0.000	0.000
CASE 193	54.200	H	4158.390	2523.171	3652.500	2089.160	3409.008
CASE 194	54.200	H	3480.160	3990.752	4471.825	2205.001	3274.304
CASE 195	54.200	L	2082.883	2790.559	2841.633	1829.370	2465.509
CASE 196	54.200	L	18.982	228.517	0.000	6.064	184.096
CASE 197	54.200	T	0.000	0.000	0.000	0.000	0.000
CASE 198	54.200	T	0.000	0.000	0.000	0.000	0.000
CASE 199	54.300	H	7538.937	7270.089	12045.760	5585.218	10130.870
CASE 200	54.300	H	1815.388	1435.815	1912.475	321.938	1091.335
CASE 201	54.300	L	1441.189	2527.778	1262.396	2610.392	3181.584
CASE 202	54.300	L	32.929	305.520	434.098	308.084	473.946
CASE 203	54.300	T	0.000	0.000	0.000	0.000	0.000
CASE 204	54.300	T	0.000	0.000	0.000	0.000	0.000
CASE 205	54.400	H	5147.142	5852.178	9229.270	4170.417	6476.335
CASE 206	54.400	H	430.951	351.589	622.008	93.446	335.546
CASE 207	54.400	L	473.128	4052.185	1995.314	2981.324	4530.740
CASE 208	54.400	L	221.741	789.040	1088.647	827.570	1120.496
CASE 209	54.400	T	0.000	0.000	0.000	0.000	0.000
CASE 210	54.400	T	0.000	0.000	0.000	0.000	0.000
CASE 211	54.500	H	7077.677	7786.225	7303.262	4447.491	5309.048
CASE 212	54.500	H	2512.533	2620.602	3722.415	2322.466	3067.903
CASE 213	54.500	L	1409.794	2464.061	3303.648	2654.572	3271.884
CASE 214	54.500	L	721.192	2305.161	1727.459	1980.140	2588.415
CASE 215	54.500	T	0.000	0.000	0.000	0.000	0.000
CASE 216	54.500	T	0.000	0.000	0.000	0.000	0.000
CASE 217	54.600	H	3903.426	2879.803	4573.521	2409.404	5007.497
CASE 218	54.600	H	2126.007	2572.195	2567.218	1333.496	1614.640
CASE 219	54.600	L	462.440	2049.669	1826.531	1649.210	3153.238
CASE 220	54.600	L	2867.386	6177.641	5711.293	4567.777	6681.961
CASE 221	54.600	T	0.000	0.000	0.000	0.000	24.785
CASE 222	54.600	T	0.000	0.000	0.000	0.000	0.000
CASE 223	54.700	H	9291.061	6611.386	8426.070	5590.683	7943.842
CASE 224	54.700	H	3899.009	3900.186	4237.450	1934.674	3584.159
CASE 225	54.700	L	944.067	4127.486	4317.959	4296.704	5824.666
CASE 226	54.700	L	176.877	1671.095	1183.208	1318.235	2400.557
CASE 227	54.700	T	0.000	0.000	0.000	0.000	0.000
CASE 228	54.700	T	0.000	0.000	0.000	0.000	0.000
CASE 229	54.800	H	2245.504	3103.951	4355.482	1430.287	2239.657
CASE 230	54.800	H	2102.426	2520.686	2594.616	994.264	1830.819
CASE 231	54.800	L	1446.666	3572.232	3571.384	2152.462	5009.423
CASE 232	54.800	L	229.618	1174.289	1247.329	1181.861	1659.802
CASE 233	54.800	T	0.000	0.000	0.000	0.000	0.000

REACH 4<sup>32</sup>  
COVER (cont.)

CASE 234	54.800	T	0.000	0.000	0.000	0.000	0.000
CASE 235	54.900	H	1366.581	3478.022	3017.414	1606.878	2603.192
CASE 236	54.900	H	3288.152	4344.702	4218.216	2879.025	3625.353
CASE 237	54.900	L	291.012	1021.426	1776.175	1702.195	2358.757
CASE 238	54.900	L	1574.227	2003.785	2422.681	2004.956	2032.324
CASE 239	54.900	T	0.000	0.000	0.000	0.000	0.000
CASE 240	54.900	T	0.000	0.000	0.000	0.000	0.000
CASE 241	55.000	H	1757.356	4849.154	3256.091	1813.254	101.808
CASE 242	55.000	H	8047.058	10319.820	9226.458	6937.479	2221.361
CASE 243	55.000	L	29.812	833.861	729.609	1953.322	7481.073
CASE 244	55.000	L	1536.646	3228.505	1992.263	704.556	953.926
CASE 245	55.000	T	0.000	0.000	0.000	0.000	2403.480
CASE 246	55.000	T	0.000	0.000	0.000	0.000	0.000
CASE 247	55.100	H	1241.914	1403.040	1820.805	345.036	0.000
CASE 248	55.100	H	5873.922	8532.418	6909.357	3256.446	1499.251
CASE 249	55.100	L	20.453	152.836	141.610	477.940	6460.885
CASE 250	55.100	L	2737.579	3739.235	3531.623	4135.981	171.172
CASE 251	55.100	T	0.000	0.000	0.000	0.000	4094.179
CASE 252	55.100	T	157.480	0.000	134.187	0.000	0.000
CASE 253	55.200	H	1115.800	1089.375	1279.716	318.596	167.691
CASE 254	55.200	H	5498.137	8620.400	6327.940	3681.491	2093.414
CASE 255	55.200	L	169.123	675.106	591.607	599.642	6555.332
CASE 256	55.200	L	2049.904	3197.095	3423.892	3341.992	1196.375
CASE 257	55.200	T	0.000	0.000	0.000	0.000	4627.892
CASE 258	55.200	T	0.000	0.000	0.000	0.000	0.000
CASE 259	55.300	H	3489.783	4514.396	2603.251	1323.467	0.000
CASE 260	55.300	H	5781.579	3052.988	5514.292	3385.614	2568.190
CASE 261	55.300	L	1141.601	1664.296	3189.677	2922.098	5134.030
CASE 262	55.300	L	2931.134	6514.710	4151.798	3698.035	3087.339
CASE 263	55.300	T	0.000	0.000	0.000	0.000	4120.393
CASE 264	55.300	T	0.000	0.000	0.000	0.000	0.000
CASE 265	55.400	H	4217.205	2534.864	2732.655	2432.195	0.000
CASE 266	55.400	H	3547.444	3056.085	4194.500	2095.287	3420.549
CASE 267	55.400	L	1165.142	1686.481	1501.452	1576.981	3990.846
CASE 268	55.400	L	39.061	1253.413	723.727	718.434	1781.932
CASE 269	55.400	T	199.114	0.000	0.000	0.000	1159.261
CASE 270	55.400	T	0.000	0.000	0.000	0.000	224.469
CASE 271	55.500	H	4316.413	3529.396	4136.923	8442.806	0.000
CASE 272	55.500	H	2196.403	1766.361	2198.997	900.166	4478.968
CASE 273	55.500	L	2861.546	8072.026	5004.040	655.159	1878.256
CASE 274	55.500	L	0.000	435.024	577.040	382.249	9242.375
CASE 275	55.500	T	392.594	449.684	542.369	0.000	485.446
CASE 276	55.500	T	0.000	0.000	0.000	0.000	0.000
CASE 277	55.600	H	1879.095	1193.418	1645.126	5000.634	0.000
CASE 278	55.600	H	3175.503	2956.262	2417.898	1266.321	2145.871
CASE 279	55.600	L	3335.049	6142.658	3357.855	868.441	1748.251
CASE 280	55.600	L	243.547	1045.319	2308.189	2141.810	8007.561
CASE 281	55.600	T	0.000	0.000	134.201	0.000	2450.130
CASE 282	55.600	T	0.000	0.000	0.000	0.000	124.580
CASE 283	55.700	H	2315.703	1516.276	3114.340	2603.625	0.000
CASE 284	55.700	H	4169.083	4019.640	4808.116	2482.174	3190.711
CASE 285	55.700	L	1209.218	2041.185	1567.310	953.785	4280.635
CASE 286	55.700	L	1359.600	519.040	2154.565	2346.870	1882.071
CASE 287	55.700	T	0.000	0.000	0.000	0.000	1821.176
CASE 288	55.700	T	0.000	0.000	0.000	0.000	0.864
CASE 289	55.800	H	3327.104	2827.366	3379.308	2460.899	0.000
CASE 290	55.800	H	7553.910	8247.138	8064.413	5725.639	3532.552
CASE 291	55.800	L	1395.805	1687.134	1547.249	1820.354	7586.636
CASE 292	55.800	L	1309.498	2116.889	2524.427	2526.550	2232.556
CASE 293	55.800	T	0.000	0.000	0.000	0.000	3579.765
CASE 294	55.800	T	0.000	0.000	0.000	0.000	0.000
CASE 295	55.900	H	4495.952	4619.513	4434.567	6473.064	0.000
CASE 296	55.900	H	5902.871	6103.129	5435.153	2646.359	2999.788
CASE 297	55.900	L	984.760	2424.782	2761.903	2119.896	7559.521
CASE 298	55.900	L	851.418	687.718	116.688	322.818	4322.309
CASE 299	55.900	T	0.000	0.000	0.000	0.000	663.143
CASE 300	55.900	T	0.000	0.000	0.000	0.000	0.000
CASE 301	56.000	H	3495.702	2622.817	3774.185	4140.306	0.000
CASE 302	56.000	H	1370.075	1001.263	0.000	553.769	4009.521
CASE 303	56.000	L	69.837	518.834	0.000	36.854	1225.002
CASE 304	56.000	L	0.000	9.526	0.000	0.000	445.722
CASE 305	56.000	T	0.000	0.000	0.000	0.000	14.763
CASE 306	56.000	T	0.000	0.000	0.000	0.000	6.352

306 CASES AND 15 VARIABLES PROCESSED.  
NO SYSTAT FILE CREATED.

33  
REACH 4  
COVER (CONT.)

Reach 5

	TENTH	ZONES	COVER65	COVER73	COVER84	COVER90	COVER92
CASE 1	60.000H		492.839	603.577	419.255	200.765	754.696
CASE 2	60.000H		934.865	549.343	1173.516	378.292	757.743
CASE 3	60.000L		22.267	50.634	133.052	58.730	23.576
CASE 4	60.000L		0.000	45.381	0.000	36.200	39.886
CASE 5	60.000T		0.000	0.000	0.000	0.000	0.000
CASE 6	60.000T		0.000	0.000	0.000	0.000	0.000
CASE 7	60.100H		90.158	100.342	80.686	41.409	138.401
CASE 8	60.100H		41.198	62.568	50.444	37.817	31.381
CASE 9	60.100L		36.652	119.729	100.835	62.609	167.507
CASE 10	60.100L		0.000	33.050	56.662	113.100	127.067
CASE 11	60.100T		0.000	0.000	0.000	0.000	0.000
CASE 12	60.100T		0.000	0.000	0.000	0.000	0.000
CASE 13	60.200H		312.543	148.669	121.974	118.506	208.851
CASE 14	60.200H		2760.484	2593.590	3157.606	1989.920	3001.384
CASE 15	60.200L		0.000	11.454	0.000	0.000	2.026
CASE 16	60.200L		230.963	1066.342	962.504	1308.606	1422.057
CASE 17	60.200T		0.000	0.000	0.000	0.000	0.000
CASE 18	60.200T		50.630	67.660	102.855	0.000	153.537
CASE 19	60.300H		0.000	0.000	0.000	0.000	0.000
CASE 20	60.300H		184.964	200.591	146.571	160.229	223.812
CASE 21	60.300L		0.000	0.000	0.000	0.000	0.000
CASE 22	60.300L		319.271	680.524	668.680	573.130	809.263
CASE 23	60.300T		0.000	0.000	0.000	0.000	0.000
CASE 24	60.300T		0.000	0.000	0.000	0.000	0.000
CASE 25	60.400H		0.000	38.987	59.294	30.445	18.418
CASE 26	60.400H		124.414	247.872	201.675	90.895	108.135
CASE 27	60.400L		0.000	18.713	0.000	0.000	39.694
CASE 28	60.400L		63.842	357.674	311.520	235.373	378.568
CASE 29	60.400T		0.000	0.000	0.000	0.000	0.000
CASE 30	60.400T		0.000	0.000	0.000	0.000	0.000
CASE 31	60.500H		2.494	18.148	0.000	0.000	0.000
CASE 32	60.500H		369.860	288.610	465.827	271.379	376.932
CASE 33	60.500L		0.000	71.257	38.110	31.505	127.448
CASE 34	60.500L		78.310	295.957	363.578	282.530	445.986
CASE 35	60.500T		0.000	0.000	0.000	0.000	0.000
CASE 36	60.500T		0.000	0.000	0.000	0.000	0.000
CASE 37	60.600H		1261.761	944.464	966.336	608.511	921.054
CASE 38	60.600H		342.106	567.401	186.634	192.777	379.291
CASE 39	60.600L		350.843	969.561	1181.666	1212.720	1731.413
CASE 40	60.600L		52.411	84.379	62.093	75.038	80.057
CASE 41	60.600T		0.000	0.000	0.000	0.000	0.000
CASE 42	60.600T		0.000	0.000	0.000	0.000	0.000
CASE 43	60.700H		18.165	46.517	111.197	47.117	33.579
CASE 44	60.700H		470.296	296.062	400.742	444.751	405.279
CASE 45	60.700L		88.864	118.403	249.879	132.551	281.459
CASE 46	60.700L		104.969	316.235	141.933	214.297	391.435
CASE 47	60.700T		0.000	0.000	0.000	0.000	0.000
CASE 48	60.700T		0.000	0.000	0.000	0.000	0.000
CASE 49	60.800H		0.000	27.998	20.284	0.000	0.000
CASE 50	60.800H		331.376	436.103	418.102	348.305	408.132
CASE 51	60.800L		0.000	79.229	73.403	53.139	183.994
CASE 52	60.800L		220.441	1666.392	827.505	862.344	1695.309
CASE 53	60.800T		0.000	0.000	0.000	0.000	0.000
CASE 54	60.800T		0.000	0.000	0.000	0.000	0.000
CASE 55	60.900H		0.000	94.745	52.435	0.000	115.247
CASE 56	60.900H		1808.780	1875.536	2195.880	1692.514	2128.904
CASE 57	60.900L		0.000	35.807	30.746	43.901	35.356
CASE 58	60.900L		127.884	838.204	560.313	769.193	1322.007
CASE 59	60.900T		0.000	0.000	0.000	0.000	0.000
CASE 60	60.900T		0.000	0.000	0.000	0.000	7.177
CASE 61	61.000H		33.837	110.463	11.896	1.446	66.722
CASE 62	61.000H		1284.531	1318.250	1699.683	1341.603	1751.108
CASE 63	61.000L		13.585	270.400	239.174	174.281	573.503
CASE 64	61.000L		461.648	970.634	906.669	963.381	1519.220
CASE 65	61.000T		0.000	0.000	0.000	0.000	0.000
CASE 66	61.000T		0.000	0.000	0.000	0.000	0.000
CASE 67	61.100H		195.716	343.835	332.846	150.967	242.765
CASE 68	61.100H		443.359	715.770	458.461	313.562	552.322
CASE 69	61.100L		56.485	718.979	842.461	349.957	1068.903
CASE 70	61.100L		257.852	461.994	426.347	443.775	900.176
CASE 71	61.100T		0.000	0.000	0.000	0.000	12.623
CASE 72	61.100T		0.000	0.000	0.000	0.000	0.000
CASE 73	61.200H		142.185	138.633	172.203	133.598	122.085
CASE 74	61.200H		0.000	8.776	0.000	0.000	13.613
CASE 75	61.200L		7.234	43.570	9.421	6.212	46.383
CASE 76	61.200L		39.270	1137.996	1153.886	1254.779	4483.616
CASE 77	61.200T		0.000	0.000	0.000	0.000	0.000



CASE 78	61.200T	0.000	0.000	0.000	0.000	0.000
CASE 79	61.300H	275.833	240.725	268.287	221.440	282.614
CASE 80	61.300H	0.000	62.927	0.000	10.768	42.587
CASE 81	61.300L	0.000	0.494	0.000	0.000	15.960
CASE 82	61.300L	9.622	322.163	637.317	865.351	1454.064
CASE 83	61.300T	0.000	0.000	0.000	0.000	0.000
CASE 84	61.300T	0.000	0.000	0.000	0.000	0.000
CASE 85	61.400H	50.827	75.285	60.900	63.959	53.572
CASE 86	61.400H	0.000	15.929	38.377	16.006	30.056
CASE 87	61.400L	0.000	627.114	25.534	129.584	1221.151
CASE 88	61.400L	0.000	22.339	0.000	0.000	75.027
CASE 89	61.400T	0.000	0.000	0.000	0.000	0.000
CASE 90	61.400T	0.000	0.000	0.000	0.000	0.000
CASE 91	61.500H	450.109	562.037	742.152	486.536	580.531
CASE 92	61.500H	119.852	558.000	0.000	201.008	139.500
CASE 93	61.500L	19.977	911.238	477.115	829.848	1274.302
CASE 94	61.500L	0.000	0.000	0.000	0.000	1863.000
CASE 95	61.500T	0.000	0.000	0.000	0.000	0.000
CASE 96	61.500T	0.000	0.000	0.000	0.000	0.000
CASE 97	61.600H	813.733	1306.396	1611.589	1217.063	1733.092
CASE 98	61.600H	77.714	88.691	267.466	56.127	336.045
CASE 99	61.600L	73.207	25.487	32.670	502.702	268.209
CASE 100	61.600L	0.000	3.177	0.000	82.073	8.273
CASE 101	61.600T	0.000	0.000	0.000	0.000	11.062
CASE 102	61.600T	0.000	0.000	0.000	0.000	0.000
CASE 103	61.700H	0.000	20.884	11.800	0.000	0.000
CASE 104	61.700H	1338.250	897.526	1344.798	412.841	1494.174
CASE 105	61.700L	0.000	0.000	0.000	13.711	57.811
CASE 106	61.700L	0.000	61.116	57.175	0.000	157.662
CASE 107	61.700T	0.000	0.000	0.000	0.000	0.000
CASE 108	61.700T	0.000	0.000	0.000	0.000	0.000
CASE 109	61.800H	0.000	-1.000	0.000	-1.000	-1.000
CASE 110	61.800H	10.074	-1.000	1.152	-1.000	-1.000
CASE 111	61.800L	0.000	-1.000	0.000	-1.000	-1.000
CASE 112	61.800L	0.000	-1.000	24.529	-1.000	-1.000
CASE 113	61.800T	0.000	-1.000	0.000	-1.000	-1.000
CASE 114	61.800T	0.000	-1.000	0.000	-1.000	-1.000
CASE 115	61.900H	-1.000	19.275	0.000	11.354	0.000
CASE 116	61.900H	-1.000	0.000	36.265	0.000	43.134
CASE 117	61.900L	-1.000	4.874	0.000	0.000	141.990
CASE 118	61.900L	-1.000	0.000	0.000	0.000	0.000
CASE 119	61.900T	-1.000	0.000	0.000	0.000	0.000
CASE 120	61.900T	-1.000	0.000	0.000	0.000	0.000
CASE 121	62.000H	0.000	26.501	0.000	0.000	0.000
CASE 122	62.000H	0.000	91.548	0.000	22.716	20.597
CASE 123	62.000L	19.677	394.094	701.129	755.346	1261.780
CASE 124	62.000L	0.000	0.000	0.000	0.000	54.867
CASE 125	62.000T	0.000	0.000	0.000	0.000	0.000
CASE 126	62.000T	0.000	0.000	0.000	0.000	0.000
CASE 127	62.100H	1590.753	1619.515	1985.370	1675.548	2046.695
CASE 128	62.100H	0.000	0.000	0.000	0.000	0.000
CASE 129	62.100L	0.000	346.847	255.158	487.214	1247.808
CASE 130	62.100L	0.000	0.000	0.000	0.000	0.000
CASE 131	62.100T	0.000	0.000	0.000	0.000	0.000
CASE 132	62.100T	0.000	0.000	0.000	0.000	0.000
CASE 133	62.200H	193.889	113.170	76.161	56.887	144.698
CASE 134	62.200H	0.000	0.000	0.000	0.000	0.000
CASE 135	62.200L	0.000	26.150	55.390	68.829	198.077
CASE 136	62.200L	0.000	0.000	0.000	0.000	0.000
CASE 137	62.200T	0.000	0.000	0.000	0.000	0.000
CASE 138	62.200T	0.000	0.000	0.000	0.000	0.000
CASE 139	62.300H	1618.982	1353.125	1742.663	1083.605	1388.530
CASE 140	62.300H	0.000	12.259	0.000	13.478	0.000
CASE 141	62.300L	0.000	245.421	304.529	449.026	1345.863
CASE 142	62.300L	0.000	28.745	0.000	0.000	31.440
CASE 143	62.300T	0.000	0.000	0.000	0.000	0.000
CASE 144	62.300T	0.000	0.000	0.000	0.000	0.000
CASE 145	62.400H	122.595	164.762	2.068	87.584	104.356
CASE 146	62.400H	0.000	0.000	0.000	0.000	0.000
CASE 147	62.400L	0.000	0.000	50.737	36.506	88.415
CASE 148	62.400L	0.000	0.000	0.000	0.000	0.000
CASE 149	62.400T	0.000	0.000	0.000	0.000	0.000
CASE 150	62.400T	0.000	0.000	0.000	0.000	0.000
CASE 151	62.500H	597.881	614.891	688.738	592.031	740.746
CASE 152	62.500H	0.000	2.390	0.000	0.000	0.000
CASE 153	62.500L	0.000	381.885	32.648	96.446	1000.101
CASE 154	62.500L	0.000	0.000	0.000	0.000	0.000
CASE 155	62.500T	0.000	0.000	0.000	0.000	0.000
CASE 156	62.500T	0.000	0.000	0.000	0.000	0.000
CASE 157	62.600H	109.761	395.549	162.215	23.090	41.357
CASE 158	62.600H	0.000	21.011	0.000	0.000	0.000
CASE 159	62.600L	0.000	698.201	761.810	923.589	1515.455
CASE 160	62.600L	0.000	205.636	274.757	70.364	326.129
CASE 161	62.600T	0.000	0.000	0.000	0.000	0.000
CASE 162	62.600T	0.000	0.000	0.000	0.000	0.000
CASE 163	62.700H	-1.000	53.183	142.827	0.000	-1.000
CASE 164	62.700H	-1.000	0.000	0.000	0.000	-1.000
CASE 165	62.700L	-1.000	4.672	0.000	12.734	-1.000
CASE 166	62.700L	-1.000	542.322	13.288	0.000	-1.000
CASE 167	62.700T	-1.000	0.000	0.000	0.000	-1.000
CASE 168	62.700T	-1.000	0.000	0.000	0.000	-1.000
CASE 169	62.800H	0.000	70.915	44.850	40.201	38.261
CASE 170	62.800H	751.166	1127.708	757.142	265.931	926.734
CASE 171	62.800L	0.000	87.907	0.000	0.000	103.658
CASE 172	62.800L	0.000	395.325	0.000	70.439	379.931
CASE 173	62.800T	0.000	0.000	0.000	0.000	0.000
CASE 174	62.800T	0.000	0.000	0.000	0.000	0.000
CASE 175	62.900H	564.102	839.184	422.629	504.646	666.728
CASE 176	62.900H	3416.989	3623.778	3365.817	2510.038	4471.620
CASE 177	62.900L	0.000	0.000	0.000	0.000	0.000

REACH 5  
COVER (cont.)<sup>35</sup>

CASE 178	62.900L	180.588	380.996	701.532	137.248	1100.183
CASE 179	62.900T	0.000	0.000	0.000	0.000	0.000
CASE 180	62.900T	0.000	66.837	0.000	0.000	0.000
CASE 181	63.000H	578.874	706.355	613.713	703.375	728.447
CASE 182	63.000H	0.000	0.000	0.000	231.421	0.000
CASE 183	63.000L	32.280	111.694	61.077	0.000	271.262
CASE 184	63.000L	0.000	138.493	275.589	2.887	644.774
CASE 185	63.000T	0.000	0.000	0.000	0.000	0.000
CASE 186	63.000T	0.000	0.000	0.000	0.000	0.000
CASE 187	63.100H	943.366	650.719	661.602	421.650	729.538
CASE 188	63.100H	0.000	40.406	6.026	0.000	22.802
CASE 189	63.100L	0.000	0.000	0.000	0.000	36.859
CASE 190	63.100L	0.000	14.838	0.000	0.000	45.320
CASE 191	63.100T	0.000	0.000	0.000	0.000	0.000
CASE 192	63.100T	0.000	0.000	0.000	0.000	0.000
CASE 193	63.200H	4312.064	4136.563	4359.509	3163.777	4339.731
CASE 194	63.200H	455.028	650.929	696.069	305.743	565.720
CASE 195	63.200L	0.000	37.575	15.922	3.951	379.098
CASE 196	63.200L	74.675	288.452	412.949	315.517	723.571
CASE 197	63.200T	0.000	0.000	0.000	0.000	0.000
CASE 198	63.200T	0.000	0.000	0.000	0.000	0.000
CASE 199	63.300H	1608.095	1074.742	1258.516	767.070	1162.650
CASE 200	63.300H	0.000	0.000	0.000	0.000	5.495
CASE 201	63.300L	0.000	21.910	0.000	44.992	124.812
CASE 202	63.300L	0.000	0.000	0.000	3.130	16.903
CASE 203	63.300T	0.000	0.000	0.000	0.000	0.000
CASE 204	63.300T	0.000	0.000	0.000	0.000	0.000
CASE 205	63.400H	2573.077	1143.159	1102.942	1166.416	1859.378
CASE 206	63.400H	2094.694	1925.875	1783.290	1628.884	2502.959
CASE 207	63.400L	0.000	0.000	0.000	32.792	29.193
CASE 208	63.400L	28.531	685.586	946.759	1202.028	1550.871
CASE 209	63.400T	0.000	0.000	0.000	0.000	0.000
CASE 210	63.400T	0.000	0.000	0.000	0.000	0.000
CASE 211	63.500H	1760.646	1635.554	1778.182	1312.605	2597.417
CASE 212	63.500H	3680.525	3296.326	4445.302	3168.248	4190.065
CASE 213	63.500L	114.893	156.621	114.377	235.409	407.876
CASE 214	63.500L	1477.629	2554.034	3073.403	2340.742	2702.882
CASE 215	63.500T	0.000	0.000	0.000	0.000	0.000
CASE 216	63.500T	0.000	0.000	0.000	0.000	0.000
CASE 217	63.600H	1398.349	954.714	758.016	782.904	1506.418
CASE 218	63.600H	21.649	194.654	974.646	158.624	560.708
CASE 219	63.600L	0.000	39.848	222.113	292.441	834.326
CASE 220	63.600L	149.205	1063.058	1595.038	793.148	1237.901
CASE 221	63.600T	0.000	0.000	0.000	0.000	0.000
CASE 222	63.600T	0.000	0.000	0.000	0.000	0.000
CASE 223	63.700H	1343.261	1578.177	1649.850	1205.732	1776.318
CASE 224	63.700H	2331.700	1198.704	3339.428	2147.847	2761.588
CASE 225	63.700L	0.000	3.814	5.901	81.551	95.311
CASE 226	63.700L	5.326	664.036	26.431	242.561	1191.319
CASE 227	63.700T	0.000	0.000	0.000	0.000	0.000
CASE 228	63.700T	0.000	0.000	0.000	0.000	0.000
CASE 229	63.800H	88.180	274.223	228.824	80.371	173.507
CASE 230	63.800H	1623.239	1833.877	2792.985	1514.986	2008.658
CASE 231	63.800L	0.000	9.248	28.294	66.345	219.641
CASE 232	63.800L	9.328	370.199	841.376	1489.264	1200.025
CASE 233	63.800T	0.000	0.000	0.000	0.000	0.000
CASE 234	63.800T	0.000	0.000	0.000	0.000	0.000
CASE 235	63.900H	836.195	555.997	556.166	433.934	849.821
CASE 236	63.900H	1311.264	1066.566	1178.129	720.505	1479.859
CASE 237	63.900L	0.000	56.007	351.677	451.670	1101.873
CASE 238	63.900L	381.064	1572.392	2303.235	2065.981	1150.350
CASE 239	63.900T	0.000	0.000	0.000	0.000	0.000
CASE 240	63.900T	0.000	0.000	0.000	0.000	0.000
CASE 241	64.000H	1080.916	890.280	858.735	661.235	1167.717
CASE 242	64.000H	1996.345	1772.313	2080.736	1638.167	2558.559
CASE 243	64.000L	98.272	293.959	290.304	206.956	487.776
CASE 244	64.000L	0.000	772.199	169.435	382.279	882.810
CASE 245	64.000T	0.000	0.000	0.000	0.000	0.000
CASE 246	64.000T	0.000	0.000	0.000	0.000	0.000
CASE 247	64.100H	123.875	90.648	75.628	11.973	87.606
CASE 248	64.100H	546.849	527.506	571.463	390.361	846.845
CASE 249	64.100L	269.433	676.301	830.563	893.133	1797.247
CASE 250	64.100L	0.000	32.810	55.055	105.866	345.439
CASE 251	64.100T	0.000	0.000	0.000	0.000	0.000
CASE 252	64.100T	0.000	0.000	0.000	0.000	0.000
CASE 253	64.200H	26.907	46.757	53.078	0.000	148.253
CASE 254	64.200H	1893.769	2028.249	2832.350	965.982	2719.673

REACH 5<sup>36</sup>  
COVER (Cont.)

CASE 254	64.200	H	1893.769	2028.249	2832.350	965.982	2719.673
CASE 255	64.200	L	311.982	754.062	728.944	650.892	1111.624
CASE 256	64.200	L	331.818	1170.629	994.422	849.608	1677.306
CASE 257	64.200	T	0.000	0.000	0.000	0.000	0.000
CASE 258	64.200	T	0.000	0.000	0.000	0.000	0.000
CASE 259	64.300	H	597.963	204.496	251.583	166.696	315.193
CASE 260	64.300	H	1135.657	1141.492	1282.953	1066.511	1754.465
CASE 261	64.300	L	62.693	882.443	538.288	692.384	1481.890
CASE 262	64.300	L	883.982	1845.336	3574.778	2249.045	2834.133
CASE 263	64.300	T	0.000	0.000	0.000	0.000	0.000
CASE 264	64.300	T	0.000	0.000	0.000	0.000	0.000
CASE 265	64.400	H	4009.693	3312.407	2460.880	2071.048	3602.771
CASE 266	64.400	H	0.000	0.000	41.055	0.000	0.000
CASE 267	64.400	L	119.759	361.903	223.715	325.063	688.938
CASE 268	64.400	L	0.000	0.000	0.000	25.488	242.625
CASE 269	64.400	T	0.000	0.000	0.000	0.000	167.251
CASE 270	64.400	T	0.000	0.000	0.000	0.000	0.000
CASE 271	64.500	H	263.554	330.755	307.655	173.023	336.385
CASE 272	64.500	H	0.000	0.000	148.417	17.757	451.765
CASE 273	64.500	L	8.704	714.730	1091.633	1580.818	2224.036
CASE 274	64.500	L	0.000	105.583	0.000	47.571	240.177
CASE 275	64.500	T	0.000	0.000	0.000	0.000	0.000
CASE 276	64.500	T	0.000	0.000	0.000	0.000	0.000
CASE 277	64.600	H	22.498	108.720	58.316	0.000	104.939
CASE 278	64.600	H	8.206	112.856	0.000	0.000	47.004
CASE 279	64.600	L	0.000	23.583	0.000	33.295	159.487
CASE 280	64.600	L	0.000	221.731	185.871	230.286	578.028
CASE 281	64.600	T	0.000	0.000	0.000	0.000	0.000
CASE 282	64.600	T	0.000	0.000	0.000	0.000	0.000
CASE 283	64.700	H	25.762	0.000	0.000	0.000	0.000
CASE 284	64.700	H	154.128	325.627	519.915	198.499	325.779
CASE 285	64.700	L	195.933	261.270	394.925	232.542	579.317
CASE 286	64.700	L	314.577	923.570	829.254	965.093	1401.545
CASE 287	64.700	T	0.000	0.000	0.000	0.000	0.000
CASE 288	64.700	T	0.000	0.000	0.000	0.000	0.000
CASE 289	64.800	H	46.982	51.492	52.799	0.000	59.155
CASE 290	64.800	H	1039.865	1095.257	829.182	592.453	1151.176
CASE 291	64.800	L	0.000	137.165	218.734	148.135	443.769
CASE 292	64.800	L	219.766	369.787	998.136	1155.604	1458.345
CASE 293	64.800	T	0.000	0.000	0.000	0.000	0.000
CASE 294	64.800	T	0.000	0.000	0.000	0.000	0.000
CASE 295	64.900	H	172.187	585.593	350.770	391.232	730.937
CASE 296	64.900	H	2598.612	2616.370	3514.199	2036.772	3126.356
CASE 297	64.900	L	335.507	270.527	602.383	313.372	537.072
CASE 298	64.900	L	34.867	671.308	1361.618	1181.957	2249.701
CASE 299	64.900	T	0.000	0.000	0.000	0.000	0.000
CASE 300	64.900	T	0.000	0.000	0.000	0.000	0.000
CASE 301	65.000	H	0.000	15.794	11.721	0.000	42.907
CASE 302	65.000	H	4665.738	3656.399	3564.354	2887.103	4208.089
CASE 303	65.000	L	0.000	5.819	0.000	1.774	2.765
CASE 304	65.000	L	5254.758	4903.098	4176.928	3719.864	4622.036
CASE 305	65.000	T	0.000	0.000	0.000	0.000	0.000
CASE 306	65.000	T	73.448	383.554	357.420	0.000	525.536
CASE 307	65.100	H	1009.488	330.764	1242.544	753.098	1522.285
CASE 308	65.100	H	6280.054	4267.750	4308.847	2578.599	4025.717
CASE 309	65.100	L	16.438	1193.016	272.521	211.574	423.680
CASE 310	65.100	L	2460.284	3783.936	3175.272	3270.311	2797.460
CASE 311	65.100	T	0.000	0.000	0.000	0.000	0.000
CASE 312	65.100	T	434.615	76.442	229.129	0.000	334.326
CASE 313	65.200	H	4143.133	3905.705	2900.461	1619.750	3495.981
CASE 314	65.200	H	3649.395	2890.725	3147.942	1629.915	3740.136
CASE 315	65.200	L	37.530	510.152	565.848	943.637	1229.071
CASE 316	65.200	L	69.077	1028.076	1430.641	1207.591	1790.286
CASE 317	65.200	T	0.000	0.000	0.000	0.000	263.542
CASE 318	65.200	T	0.000	0.000	0.000	0.000	0.000
CASE 319	65.300	H	2651.458	142.247	202.626	85.965	223.918
CASE 320	65.300	H	2283.373	1536.851	2600.196	562.731	1891.194
CASE 321	65.300	L	98.777	48.435	72.906	0.000	165.635
CASE 322	65.300	L	51.756	953.067	225.407	87.432	992.569
CASE 323	65.300	T	0.000	0.000	0.000	0.000	0.386
CASE 324	65.300	T	0.000	0.000	0.000	0.000	0.000
CASE 325	65.400	H	33.094	19.029	75.708	15.080	87.115
CASE 326	65.400	H	3502.944	2882.713	3909.434	1937.552	4278.955
CASE 327	65.400	L	0.000	1.399	0.000	0.000	87.125
CASE 328	65.400	L	55.974	383.122	325.604	324.528	1735.453
CASE 329	65.400	T	0.000	0.000	0.000	0.000	0.000
CASE 330	65.400	T	0.000	29.037	93.469	0.000	0.000
CASE 331	65.500	H	0.000	3.308	20.989	0.000	122.684
CASE 332	65.500	H	1930.658	1515.461	2235.941	1374.595	3501.825
CASE 333	65.500	L	0.000	31.289	0.000	17.126	61.540
CASE 334	65.500	L	569.593	99.859	12.232	33.789	1195.623
CASE 335	65.500	T	0.000	0.000	0.000	0.000	0.000
CASE 336	65.500	T	0.000	539.741	672.883	0.000	378.275
CASE 337	65.600	H	14.552	26.967	35.363	17.591	327.947
CASE 338	65.600	H	2959.266	2270.990	3171.482	1686.375	4968.947
CASE 339	65.600	L	50.267	76.664	0.000	4.370	39.535
CASE 340	65.600	L	113.729	199.302	170.104	346.631	563.486
CASE 341	65.600	T	0.000	0.000	0.000	0.000	0.000
CASE 342	65.600	T	503.598	0.000	26.055	0.000	0.000
CASE 343	65.700	H	0.000	13.927	84.841	12.234	144.239
CASE 344	65.700	H	4094.720	2262.918	5480.441	1993.175	5802.556
CASE 345	65.700	L	10.184	48.808	0.000	21.017	55.765
CASE 346	65.700	L	231.708	359.898	413.297	317.239	771.003
CASE 347	65.700	T	0.000	0.000	0.000	0.000	0.000
CASE 348	65.700	T	0.000	0.000	0.000	0.000	0.000
CASE 349	65.800	H	0.000	254.444	88.195	9.755	188.230
CASE 350	65.800	H	2324.240	2252.522	3912.546	1220.289	1461.719
CASE 351	65.800	L	33.013	37.599	24.834	32.920	130.067
CASE 352	65.800	L	924.944	3068.643	2102.854	1861.743	6588.837
CASE 353	65.800	T	0.000	0.000	0.000	0.000	0.000

REACH 5<sup>37</sup>  
COVER (CONT.)

CASE 354	65.800	T	0.000	0.000	0.000	0.000	0.000
CASE 355	65.900	H	1365.965	1408.390	1454.879	692.708	1257.992
CASE 356	65.900	H	1412.335	1411.639	1993.989	891.410	1587.313
CASE 357	65.900	L	40.631	183.304	83.773	182.538	484.605
CASE 358	65.900	L	132.588	490.718	579.228	185.846	973.900
CASE 359	65.900	T	0.000	0.000	0.000	0.000	0.000
CASE 360	65.900	T	0.000	0.000	0.000	0.000	13.703
CASE 361	66.000	H	499.173	478.334	638.134	361.828	601.723
CASE 362	66.000	H	3870.589	3287.188	5299.520	1314.212	4675.954
CASE 363	66.000	L	53.667	39.170	82.324	60.719	163.223
CASE 364	66.000	L	457.151	780.102	784.004	1583.854	2133.616
CASE 365	66.000	T	0.000	0.000	0.000	0.000	0.000
CASE 366	66.000	T	715.706	777.357	0.000	0.000	0.000
CASE 367	66.100	H	9.393	120.850	212.991	3.762	28.151
CASE 368	66.100	H	891.317	1162.548	1795.314	1317.707	1276.879
CASE 369	66.100	L	0.000	18.147	100.521	13.358	51.343
CASE 370	66.100	L	360.891	189.848	671.900	570.605	824.215
CASE 371	66.100	T	0.000	0.000	0.000	0.000	0.000
CASE 372	66.100	T	499.557	721.295	711.744	0.000	632.607
CASE 373	66.200	H	0.000	110.421	21.441	0.000	0.000
CASE 374	66.200	H	596.939	525.011	696.183	190.579	674.546
CASE 375	66.200	L	0.000	0.000	76.653	0.000	0.000
CASE 376	66.200	L	53.347	306.480	346.480	604.314	540.872
CASE 377	66.200	T	0.000	0.000	0.000	0.000	0.000
CASE 378	66.200	T	0.000	0.000	0.000	0.000	0.000
CASE 379	66.300	H	0.000	253.511	40.187	0.000	0.000
CASE 380	66.300	H	0.000	105.002	100.740	15.728	69.921
CASE 381	66.300	L	0.000	0.000	47.323	0.000	0.000
CASE 382	66.300	L	15.742	157.983	128.548	388.809	643.022
CASE 383	66.300	T	0.000	0.000	0.000	0.000	0.000
CASE 384	66.300	T	0.000	0.000	0.000	0.000	0.000
CASE 385	66.400	H	0.000	132.486	40.547	0.000	0.000
CASE 386	66.400	H	0.000	185.414	148.743	63.941	85.714
CASE 387	66.400	L	0.000	0.000	32.235	0.000	0.000
CASE 388	66.400	L	55.322	1010.001	505.344	481.947	1842.445
CASE 389	66.400	T	0.000	0.000	0.000	0.000	0.000
CASE 390	66.400	T	0.000	0.000	0.000	0.000	0.000
CASE 391	66.500	H	0.000	0.000	0.000	0.000	0.000
CASE 392	66.500	H	142.271	237.735	0.000	127.218	362.387
CASE 393	66.500	L	0.000	0.000	0.000	0.000	0.000
CASE 394	66.500	L	199.976	847.968	649.301	956.700	1740.881
CASE 395	66.500	T	0.000	0.000	0.000	0.000	0.000
CASE 396	66.500	T	0.000	0.000	0.000	0.000	0.000
CASE 397	66.600	H	0.000	0.000	18.464	0.000	0.000
CASE 398	66.600	H	5667.925	4817.546	6693.665	3851.226	6335.648
CASE 399	66.600	L	0.000	0.000	0.000	0.000	0.000
CASE 400	66.600	L	211.347	1377.924	608.984	434.002	1899.634
CASE 401	66.600	T	0.000	0.000	0.000	0.000	0.000
CASE 402	66.600	T	0.000	0.000	0.000	0.000	131.709
CASE 403	66.700	H	0.000	0.000	37.608	0.000	0.000
CASE 404	66.700	H	5750.493	3837.576	4745.673	2988.892	4757.072
CASE 405	66.700	L	0.000	0.000	0.000	0.000	0.000
CASE 406	66.700	L	467.852	618.784	707.675	795.329	1005.241
CASE 407	66.700	T	0.000	0.000	0.000	0.000	0.000
CASE 408	66.700	T	0.000	0.000	0.000	0.000	0.000
CASE 409	66.800	H	0.000	0.000	41.958	0.000	0.000
CASE 410	66.800	H	7572.430	5454.699	5137.718	4645.642	6227.291
CASE 411	66.800	L	0.000	8.445	0.000	0.000	7.662
CASE 412	66.800	L	1627.201	784.904	1146.000	2242.239	1162.935
CASE 413	66.800	T	0.000	0.000	0.000	0.000	0.000
CASE 414	66.800	T	0.000	973.353	1100.208	0.000	1208.659
CASE 415	66.900	H	73.219	60.493	34.471	46.542	82.019
CASE 416	66.900	H	12550.270	6940.080	7934.331	6296.113	8297.333
CASE 417	66.900	L	21.764	20.006	0.000	0.000	79.114
CASE 418	66.900	L	3839.879	3739.383	4389.608	5400.930	3705.601
CASE 419	66.900	T	0.000	0.000	0.000	0.000	0.000
CASE 420	66.900	T	0.000	1626.274	1876.361	0.000	2093.859
CASE 421	67.000	H	47.930	69.671	113.774	15.172	118.409
CASE 422	67.000	H	8577.791	7322.050	8224.648	6470.693	8728.029
CASE 423	67.000	L	0.000	24.069	0.000	1.735	16.909
CASE 424	67.000	L	1727.359	2478.777	1924.990	1655.068	2402.995
CASE 425	67.000	T	0.000	0.000	0.000	0.000	0.000
CASE 426	67.000	T	0.000	0.000	0.000	0.000	44.756
CASE 427	67.100	H	34.382	74.138	194.737	37.853	118.185
CASE 428	67.100	H	5427.481	5025.172	4462.905	2837.440	5104.026
CASE 429	67.100	L	0.000	72.554	0.000	43.281	192.091
CASE 430	67.100	L	27.914	293.137	68.189	198.952	287.687
CASE 431	67.100	T	0.000	0.000	0.000	0.000	0.000
CASE 432	67.100	T	0.000	0.000	70.537	0.000	0.000
CASE 433	67.200	H	0.000	74.021	35.630	26.127	78.787
CASE 434	67.200	H	3888.657	3069.947	3108.394	1331.070	3564.675
CASE 435	67.200	L	149.058	58.586	0.000	26.627	45.292
CASE 436	67.200	L	0.000	46.185	0.000	0.000	57.440
CASE 437	67.200	T	0.000	0.000	0.000	0.000	0.000
CASE 438	67.200	T	0.000	0.000	0.000	0.000	0.000
CASE 439	67.300	H	0.000	0.000	0.000	2.168	0.846
CASE 440	67.300	H	5439.992	3750.079	1235.837	1567.825	5379.924
CASE 441	67.300	L	29.384	58.115	0.000	0.000	72.494
CASE 442	67.300	L	0.000	208.082	0.000	26.744	145.926
CASE 443	67.300	T	0.000	0.000	0.000	0.000	0.000
CASE 444	67.300	T	0.000	0.000	0.000	0.000	0.000
CASE 445	67.400	H	0.000	0.000	0.000	0.000	0.000
CASE 446	67.400	H	4957.710	4730.984	2210.654	2262.013	4291.341
CASE 447	67.400	L	0.000	0.000	0.000	0.000	2.194
CASE 448	67.400	L	586.740	200.154	648.391	95.565	1240.333
CASE 449	67.400	T	0.000	0.000	0.000	0.000	0.000
CASE 450	67.400	T	0.000	0.000	0.000	0.000	0.000
CASE 451	67.500	H	269.591	184.649	0.000	0.000	209.664
CASE 452	67.500	H	4403.044	5510.900	5148.630	3831.649	5614.548
CASE 453	67.500	L	0.000	87.281	0.000	21.172	111.974

REACH 5<sup>38</sup>  
COVER (cont.)

CASE 454	67.500	L	2440.440	205.862	2714.119	126.645	3657.664
CASE 455	67.500	T	0.000	0.000	0.000	0.000	0.000
CASE 456	67.500	T	0.000	0.000	0.000	0.000	0.000
CASE 457	67.600	H	1276.544	982.463	0.000	814.631	1919.652
CASE 458	67.600	H	4948.025	4688.503	3944.043	3096.873	4765.146
CASE 459	67.600	L	0.000	0.000	0.000	0.000	66.793
CASE 460	67.600	L	2137.589	3219.321	2873.182	2956.227	4283.725
CASE 461	67.600	T	0.000	0.000	0.000	0.000	0.000
CASE 462	67.600	T	0.000	0.000	0.000	0.000	0.000
CASE 463	67.700	H	213.903	153.920	425.798	0.000	0.000
CASE 464	67.700	H	5423.714	3085.193	4016.549	2331.910	6667.810
CASE 465	67.700	L	0.000	0.000	0.000	0.000	21.824
CASE 466	67.700	L	679.938	4179.819	3005.569	4573.004	2996.762
CASE 467	67.700	T	0.000	0.000	0.000	0.000	0.000
CASE 468	67.700	T	0.000	0.000	0.000	0.000	0.000
CASE 469	67.800	H	328.105	311.963	627.951	216.725	425.943
CASE 470	67.800	H	4883.306	4755.870	4711.930	3572.599	6241.010
CASE 471	67.800	L	222.062	0.000	0.000	0.000	54.619
CASE 472	67.800	L	555.757	1588.978	1952.217	3511.458	2850.165
CASE 473	67.800	T	0.000	0.000	0.000	0.000	0.000
CASE 474	67.800	T	123.267	172.794	113.640	0.000	285.603
CASE 475	67.900	H	479.057	356.973	307.835	341.318	430.229
CASE 476	67.900	H	968.144	2919.205	3862.464	2596.685	1975.844
CASE 477	67.900	L	88.943	284.237	62.890	0.000	123.937
CASE 478	67.900	L	3421.323	4253.006	4759.581	5008.116	5044.849
CASE 479	67.900	T	0.000	0.000	0.000	0.000	0.000
CASE 480	67.900	T	350.969	575.040	702.055	0.000	1365.095
CASE 481	68.000	H	368.015	451.328	256.111	344.748	381.243
CASE 482	68.000	H	3901.919	4455.786	6105.720	3872.388	5695.310
CASE 483	68.000	L	14.324	379.422	95.068	0.000	130.554
CASE 484	68.000	L	1816.902	3380.952	2336.473	2984.208	4272.834
CASE 485	68.000	T	0.000	0.000	0.000	0.000	0.000
CASE 486	68.000	T	0.000	0.000	0.000	0.000	0.000
CASE 487	68.100	H	43.419	148.916	50.954	118.516	368.607
CASE 488	68.100	H	409.726	630.833	1363.025	248.830	1621.414
CASE 489	68.100	L	37.074	362.572	284.036	25.488	227.538
CASE 490	68.100	L	1633.677	6356.415	4937.784	5177.425	5032.874
CASE 491	68.100	T	0.000	0.000	0.000	0.000	0.000
CASE 492	68.100	T	0.000	0.000	0.000	0.000	0.000
CASE 493	68.200	H	787.399	613.918	752.240	515.683	933.401
CASE 494	68.200	H	0.000	107.004	0.000	101.587	0.000
CASE 495	68.200	L	35.357	363.458	845.325	160.518	743.605
CASE 496	68.200	L	0.000	101.422	13.278	77.129	1142.055
CASE 497	68.200	T	0.000	0.000	0.000	0.000	0.000
CASE 498	68.200	T	0.000	0.000	0.000	0.000	0.000
CASE 499	68.300	H	1572.123	1215.183	1645.525	2402.792	1393.083
CASE 500	68.300	H	0.000	34.422	0.000	0.000	0.000
CASE 501	68.300	L	2254.164	6296.228	6037.827	3059.693	8424.789
CASE 502	68.300	L	0.000	0.000	0.000	0.000	891.740
CASE 503	68.300	T	0.000	0.000	0.000	0.000	31.544
CASE 504	68.300	T	0.000	0.000	0.000	0.000	0.000
CASE 505	68.400	H	1221.059	912.380	1260.491	1517.574	1178.997
CASE 506	68.400	H	0.000	0.000	268.142	0.000	55.285
CASE 507	68.400	L	4020.106	5641.023	4400.068	3029.617	5796.391
CASE 508	68.400	L	0.000	0.000	0.000	0.000	0.000
CASE 509	68.400	T	0.000	0.000	0.000	0.000	58.380
CASE 510	68.400	T	0.000	0.000	0.000	0.000	0.000
CASE 511	68.500	H	2172.161	2266.781	2185.261	2085.779	2324.553
CASE 512	68.500	H	2222.140	2590.294	3659.629	1402.275	2689.296
CASE 513	68.500	L	1749.410	3595.847	3403.774	2662.256	3298.489
CASE 514	68.500	L	185.148	911.348	702.921	1018.315	1933.006
CASE 515	68.500	T	0.000	0.000	0.000	0.000	0.000
CASE 516	68.500	T	0.000	0.000	0.000	0.000	0.000
CASE 517	68.600	H	1072.349	993.826	1002.538	1085.104	1062.616
CASE 518	68.600	H	3390.789	4059.691	5212.828	2914.895	5039.712
CASE 519	68.600	L	55.632	1745.025	909.132	1060.069	2662.674
CASE 520	68.600	L	103.730	571.694	662.104	560.659	862.065
CASE 521	68.600	T	0.000	0.000	0.000	0.000	0.000
CASE 522	68.600	T	0.000	68.169	96.200	0.000	112.018
CASE 523	68.700	H	425.424	768.735	814.222	769.856	911.830
CASE 524	68.700	H	6525.901	5690.233	6820.606	5194.097	8696.941
CASE 525	68.700	L	865.877	2068.667	2022.483	1847.090	4235.164
CASE 526	68.700	L	167.351	224.892	29.735	18.514	246.086
CASE 527	68.700	T	0.000	0.000	0.000	0.000	0.000
CASE 528	68.700	T	0.000	0.000	0.000	0.000	0.000
CASE 529	68.800	H	0.000	8.704	0.000	4.414	7.244
CASE 530	68.800	H	710.623	584.773	691.826	857.299	816.509

REACH 5  
COVER (cont.)

530 CASES AND 15 VARIABLES PROCESSED.  
NO SYSTAT FILE CREATED.

CASE 514	68.500	L	185.148	911.348	702.921	1018.315	1933.006
CASE 515	68.500	T	0.000	0.000	0.000	0.000	0.000
CASE 516	68.500	T	0.000	0.000	0.000	0.000	0.000
CASE 517	68.600	H	1072.349	993.826	1002.538	1085.104	1062.616
CASE 518	68.600	H	3390.789	4059.691	5212.828	2914.895	5039.712
CASE 519	68.600	L	55.632	1745.025	909.132	1060.069	2662.674
CASE 520	68.600	L	103.730	571.694	662.104	560.659	862.065
CASE 521	68.600	T	0.000	0.000	0.000	0.000	0.000
CASE 522	68.600	T	0.000	68.169	96.200	0.000	112.018
CASE 523	68.700	H	425.424	768.735	814.222	769.856	911.830
CASE 524	68.700	H	6525.901	5690.233	6820.606	5194.097	8696.941
CASE 525	68.700	L	865.877	2068.667	2022.483	1847.090	4235.164
CASE 526	68.700	L	167.351	224.892	29.735	18.514	246.086
CASE 527	68.700	T	0.000	0.000	0.000	0.000	0.000
CASE 528	68.700	T	0.000	0.000	0.000	0.000	0.000
CASE 529	68.800	H	0.000	8.704	0.000	4.414	7.244
CASE 530	68.800	H	710.623	584.773	691.826	857.299	816.509
CASE 531	68.800	L	257.951	374.780	364.205	266.224	629.049
CASE 532	68.800	L	214.749	1080.697	725.805	78.624	1015.687
CASE 533	68.800	T	0.000	0.000	0.000	0.000	0.000
CASE 534	68.800	T	0.000	0.000	0.000	0.000	0.000
CASE 535	68.900	H	0.000	87.039	116.290	74.316	141.846
CASE 536	68.900	H	1130.819	1290.651	2255.632	1915.179	1946.600
CASE 537	68.900	L	466.929	403.205	84.782	594.210	1081.463
CASE 538	68.900	L	292.902	1297.230	1063.019	8.708	1464.379
CASE 539	68.900	T	0.000	0.000	0.000	0.000	0.000
CASE 540	68.900	T	0.000	0.000	0.000	0.000	0.000
CASE 541	69.000	H	-1.000	0.000	0.000	0.000	0.000
CASE 542	69.000	H	-1.000	0.000	0.000	0.000	0.000
CASE 543	69.000	L	-1.000	10.121	0.000	0.000	33.169
CASE 544	69.000	L	-1.000	333.939	134.864	290.112	743.279
CASE 545	69.000	T	-1.000	0.000	0.000	0.000	0.000
CASE 546	69.000	T	-1.000	0.000	0.000	0.000	0.000
CASE 547	69.100	H	0.000	0.000	0.000	0.000	97.071
CASE 548	69.100	H	478.011	736.104	987.103	1756.754	797.382
CASE 549	69.100	L	0.000	464.261	5896.546	151.850	491.224
CASE 550	69.100	L	734.590	1246.494	1563.182	488.192	1968.327
CASE 551	69.100	T	0.000	0.000	0.000	0.000	0.000
CASE 552	69.100	T	0.000	0.000	0.000	0.000	0.000
CASE 553	69.200	H	0.000	0.000	123.512	0.000	0.000
CASE 554	69.200	H	7116.891	6464.054	8460.144	7126.215	5192.735
CASE 555	69.200	L	10.688	455.339	7464.732	146.594	440.523
CASE 556	69.200	L	2617.868	3782.801	4626.736	4130.445	9135.671
CASE 557	69.200	T	0.000	0.000	0.000	0.000	0.000
CASE 558	69.200	T	0.000	391.619	393.733	0.000	0.000
CASE 559	69.300	H	10.245	19.609	0.000	0.000	35.359
CASE 560	69.300	H	1017.081	1338.098	768.381	550.653	1226.954
CASE 561	69.300	L	1709.820	8300.668	12523.330	5428.635	11503.450
CASE 562	69.300	L	533.672	566.435	1717.006	1727.989	1610.295
CASE 563	69.300	T	0.000	0.000	0.000	0.000	0.000
CASE 564	69.300	T	0.000	0.000	0.000	0.000	0.000
CASE 565	69.400	H	3187.944	3621.022	3016.834	2878.955	4230.862
CASE 566	69.400	H	178.967	431.549	0.000	0.000	585.284
CASE 567	69.400	L	2857.299	5882.440	4229.830	4077.406	10025.100
CASE 568	69.400	L	0.000	0.000	0.000	267.693	26.321
CASE 569	69.400	T	0.000	0.000	0.000	0.000	0.000
CASE 570	69.400	T	0.000	0.000	0.000	0.000	0.000
CASE 571	69.500	H	9750.030	7699.359	9388.154	7481.679	11313.120
CASE 572	69.500	H	612.020	214.061	0.000	73.785	232.124
CASE 573	69.500	L	471.789	1295.675	87.448	612.010	1645.799
CASE 574	69.500	L	0.000	0.000	0.000	0.000	0.000
CASE 575	69.500	T	0.000	0.000	0.000	0.000	0.000
CASE 576	69.500	T	0.000	0.000	0.000	0.000	0.000
CASE 577	69.600	H	2540.715	2268.116	2376.645	2007.632	3380.010
CASE 578	69.600	H	380.069	320.534	0.000	343.870	412.268
CASE 579	69.600	L	105.798	262.232	125.216	213.548	402.344
CASE 580	69.600	L	186.590	1659.087	0.000	771.988	1678.900
CASE 581	69.600	T	0.000	0.000	0.000	0.000	0.000
CASE 582	69.600	T	0.000	0.000	0.000	0.000	0.000
CASE 583	69.700	H	251.205	432.417	436.602	277.956	271.094
CASE 584	69.700	H	4051.568	3781.964	3.292	3086.339	4565.222
CASE 585	69.700	L	116.278	206.776	175.392	238.944	544.751
CASE 586	69.700	L	30.090	963.437	14.985	801.491	1139.724
CASE 587	69.700	T	0.000	0.000	0.000	0.000	0.000
CASE 588	69.700	T	0.000	0.000	0.000	0.000	0.000
CASE 589	69.800	H	175.576	380.576	362.391	179.021	154.262
CASE 590	69.800	H	7856.043	6292.149	3473.236	2917.079	6639.340
CASE 591	69.800	L	175.979	309.326	236.320	413.718	1044.002
CASE 592	69.800	L	16.453	895.934	500.364	1269.629	884.244
CASE 593	69.800	T	0.000	0.000	0.000	0.000	0.000
CASE 594	69.800	T	0.000	0.000	0.000	0.000	0.000
CASE 595	69.900	H	410.456	114.846	32.694	18.273	129.253
CASE 596	69.900	H	8160.407	7336.999	12858.530	2325.859	6425.691
CASE 597	69.900	L	293.793	906.436	1029.393	1316.364	1385.857
CASE 598	69.900	L	1311.448	2675.179	2266.959	2581.864	3907.266
CASE 599	69.900	T	0.000	0.000	0.000	0.000	6.889
CASE 600	69.900	T	0.000	0.000	0.000	0.000	0.000
CASE 601	70.000	H	13.875	21.208	20.387	23.675	56.727
CASE 602	70.000	H	7596.935	6556.690	8490.816	3132.946	5641.571
CASE 603	70.000	L	167.235	344.146	338.454	577.175	765.914
CASE 604	70.000	L	1015.965	2967.610	4302.527	4134.998	5035.189
CASE 605	70.000	T	0.000	0.000	0.000	0.000	0.000
CASE 606	70.000	T	0.000	0.000	0.000	0.000	0.000
CASE 607	70.100	H	77.531	8.690	0.000	0.000	93.240
CASE 608	70.100	H	6926.674	6350.690	8380.395	3812.530	6927.048
CASE 609	70.100	L	139.092	553.588	372.578	541.707	903.438
CASE 610	70.100	L	376.217	1009.835	1092.273	816.887	1694.406
CASE 611	70.100	T	0.000	0.000	0.000	0.000	0.000
CASE 612	70.100	T	0.000	0.000	0.000	0.000	6.220
CASE 613	70.200	H	412.197	531.441	339.251	102.003	466.575

REACH 5<sup>40</sup>  
COVER (cont.)

CASE 614	70.200	H	6391.029	5767.133	8448.885	4627.852	5638.597
CASE 615	70.200	L	313.125	840.002	854.619	643.045	2137.066
CASE 616	70.200	L	111.989	667.430	607.512	824.056	950.443
CASE 617	70.200	T	0.000	0.000	0.000	0.000	0.000
CASE 618	70.200	T	454.941	0.000	638.774	0.000	987.963
CASE 619	70.300	H	1579.848	1438.710	1306.975	1089.679	1127.664
CASE 620	70.300	H	1613.081	1127.828	2971.913	894.221	2109.618
CASE 621	70.300	L	252.349	1055.937	290.421	2649.209	5140.441
CASE 622	70.300	L	187.566	147.303	134.800	614.337	683.870
CASE 623	70.300	T	0.000	0.000	0.000	0.000	0.000
CASE 624	70.300	T	0.000	0.000	0.000	0.000	0.000
CASE 625	70.400	H	1011.039	418.500	1132.362	0.000	0.000
CASE 626	70.400	H	22.523	16.021	19.038	1057.672	34.777
CASE 627	70.400	L	865.306	3569.600	738.377	0.000	0.000
CASE 628	70.400	L	103.043	88.103	24.538	1003.164	132.284
CASE 629	70.400	T	0.000	0.000	0.000	0.000	0.000
CASE 630	70.400	T	0.000	0.000	0.000	0.000	0.000
CASE 631	70.500	H	0.000	9.771	59.017	0.000	25.610
CASE 632	70.500	H	559.810	517.739	733.550	346.783	1187.330
CASE 633	70.500	L	2936.146	3700.425	3409.579	3662.388	1710.230
CASE 634	70.500	L	0.000	343.346	0.000	170.508	360.547
CASE 635	70.500	T	0.000	0.000	0.000	0.000	23.186
CASE 636	70.500	T	0.000	0.000	0.000	0.000	0.000
CASE 637	70.600	H	168.329	203.213	143.862	125.181	113.045
CASE 638	70.600	H	483.549	411.986	878.766	328.206	1057.921
CASE 639	70.600	L	9631.905	10662.590	9872.224	9892.666	6671.194
CASE 640	70.600	L	0.000	225.382	241.744	215.784	393.093
CASE 641	70.600	T	0.000	0.000	0.000	0.000	0.000
CASE 642	70.600	T	0.000	0.000	0.000	0.000	0.000
CASE 643	70.700	H	2294.750	1596.100	1704.065	1841.317	1253.231
CASE 644	70.700	H	1041.543	764.020	1018.793	740.366	1560.261
CASE 645	70.700	L	3978.693	6552.925	5551.370	4795.417	2360.222
CASE 646	70.700	L	56.387	557.465	736.685	627.291	1110.944
CASE 647	70.700	T	0.000	0.000	0.000	0.000	69.630
CASE 648	70.700	T	0.000	0.000	0.000	0.000	0.000
CASE 649	70.800	H	3282.272	3231.961	2137.900	2058.286	217.327
CASE 650	70.800	H	1962.117	1240.298	1295.853	880.322	1881.594
CASE 651	70.800	L	1485.586	2288.444	2782.010	1890.405	1784.849
CASE 652	70.800	L	825.040	2684.755	2527.701	3067.207	4651.944
CASE 653	70.800	T	0.000	0.000	0.000	0.000	0.000
CASE 654	70.800	T	0.000	0.000	0.000	0.000	0.000
CASE 655	70.900	H	1724.563	1641.177	1193.539	718.327	1206.165
CASE 656	70.900	H	3409.505	2795.374	4016.723	1484.930	3770.699
CASE 657	70.900	L	5.082	322.229	179.153	42.882	240.122
CASE 658	70.900	L	1622.968	3963.288	6057.667	6267.773	6950.726
CASE 659	70.900	T	0.000	0.000	0.000	0.000	0.000
CASE 660	70.900	T	536.072	354.386	0.000	0.000	389.024
CASE 661	71.000	H	964.090	1037.509	698.849	572.309	838.843
CASE 662	71.000	H	8827.638	8543.160	9068.645	1297.005	9209.778
CASE 663	71.000	L	3.628	89.410	51.772	13.215	141.895
CASE 664	71.000	L	5429.082	9558.001	8409.826	15379.700	11199.150
CASE 665	71.000	T	0.000	0.000	0.000	0.000	0.000
CASE 666	71.000	T	2190.895	2185.567	0.000	0.000	1785.184
CASE 667	71.100	H	519.256	357.274	212.476	337.520	454.576
CASE 668	71.100	H	4497.359	4096.884	3525.990	3047.656	3552.621
CASE 669	71.100	L	26.688	44.895	167.312	6.397	221.252
CASE 670	71.100	L	1995.815	2341.459	1372.342	1645.375	5112.971
CASE 671	71.100	T	0.000	0.000	0.000	0.000	0.000
CASE 672	71.100	T	0.000	0.000	0.000	0.000	0.000
CASE 673	71.200	H	341.771	498.318	476.717	405.500	657.991
CASE 674	71.200	H	3725.389	3099.095	3149.246	1938.182	3974.856
CASE 675	71.200	L	117.061	325.845	167.614	243.168	354.022
CASE 676	71.200	L	5451.267	7329.999	6633.966	6395.874	7000.171
CASE 677	71.200	T	0.000	0.000	0.000	0.000	40.036
CASE 678	71.200	T	0.000	2.591	0.000	0.000	0.000
CASE 679	71.300	H	268.035	350.120	638.375	138.514	332.762
CASE 680	71.300	H	1034.093	1039.606	1926.765	290.010	1405.855
CASE 681	71.300	L	149.407	701.257	1044.075	574.877	1365.856
CASE 682	71.300	L	3597.345	10457.750	5854.796	8688.956	8528.455
CASE 683	71.300	T	0.000	0.000	0.000	0.000	0.000
CASE 684	71.300	T	199.551	851.515	0.000	0.000	642.490
CASE 685	71.400	H	127.792	157.384	119.506	59.147	171.846
CASE 686	71.400	H	375.270	316.617	538.410	261.795	240.270
CASE 687	71.400	L	185.634	595.037	1063.829	1033.095	2416.024
CASE 688	71.400	L	235.043	798.071	581.095	719.975	1235.611
CASE 689	71.400	T	0.000	0.000	0.000	0.000	0.000
CASE 690	71.400	T	0.000	0.000	0.000	0.000	0.000
CASE 691	71.500	H	360.379	593.192	540.108	317.035	288.874
CASE 692	71.500	H	30.380	115.388	287.178	116.606	223.451
CASE 693	71.500	L	307.326	606.662	1394.902	1158.744	2110.857
CASE 694	71.500	L	48.235	329.671	752.648	338.927	570.002
CASE 695	71.500	T	0.000	0.000	0.000	0.000	0.000
CASE 696	71.500	T	0.000	0.000	0.000	0.000	0.000
CASE 697	71.600	H	524.047	557.091	883.398	233.857	136.562
CASE 698	71.600	H	74.498	56.380	119.751	31.221	400.138
CASE 699	71.600	L	57.830	1085.391	350.090	923.126	1853.351
CASE 700	71.600	L	74.058	177.382	262.364	251.146	673.767
CASE 701	71.600	T	0.000	0.000	0.000	0.000	0.000
CASE 702	71.600	T	0.000	0.000	0.000	0.000	0.000
CASE 703	71.700	H	108.586	130.670	2468.845	90.365	104.824
CASE 704	71.700	H	201.151	175.447	781.284	244.406	563.189
CASE 705	71.700	L	0.000	1387.530	0.000	2733.141	4487.377
CASE 706	71.700	L	301.648	531.700	565.860	682.442	1307.729
CASE 707	71.700	T	0.000	0.000	0.000	0.000	0.000
CASE 708	71.700	T	0.000	0.000	0.000	0.000	0.000
CASE 709	71.800	H	0.000	73.646	69.492	44.183	72.655
CASE 710	71.800	H	466.804	607.231	1672.903	365.870	954.167
CASE 711	71.800	L	0.000	38.490	0.000	135.386	215.493
CASE 712	71.800	L	14.208	908.964	1663.334	2948.895	4249.754
CASE 713	71.800	T	0.000	0.000	0.000	0.000	0.000

REACH 5<sup>41</sup>  
COVER (cont.)

CASE 714	71.800	T	0.000	0.000	0.000	0.000	0.000
CASE 715	71.900	H	51.981	81.590	49.117	35.763	46.202
CASE 716	71.900	H	1464.753	1611.489	3295.347	1720.479	1914.345
CASE 717	71.900	L	0.000	0.000	0.000	0.000	88.978
CASE 718	71.900	L	52.006	910.030	1653.530	1819.960	4996.226
CASE 719	71.900	T	0.000	0.000	0.000	0.000	0.000
CASE 720	71.900	T	0.000	0.000	0.000	0.000	0.000
CASE 721	72.000	H	3417.678	2362.185	13687.820	1645.090	2007.569
CASE 722	72.000	H	5958.241	293.799	21340.290	1588.103	1470.417
CASE 723	72.000	L	264.823	1810.084	1279.040	1901.040	2408.837
CASE 724	72.000	L	175.612	590.745	1071.829	1198.401	1840.520
CASE 725	72.000	T	0.000	0.000	0.000	0.000	0.000
CASE 726	72.000	T	0.000	0.000	0.000	0.000	0.000
CASE 727	0.000	H	368.230	90.524	156.208	107.968	238.476
CASE 728	0.000	H	0.000	6.593	146.706	0.000	0.000
CASE 729	0.000	L	0.000	82.805	134.990	107.019	113.944
CASE 730	0.000	L	549.441	565.781	891.618	701.349	1903.526
CASE 731	0.000	T	0.000	0.000	0.000	0.000	0.000
CASE 732	0.000	T	0.000	168.810	12.614	0.000	163.202
CASE 733	0.100	H	77.798	62.614	9.838	5.288	14.515
CASE 734	0.100	H	1827.131	1192.453	642.032	260.490	1349.479
CASE 735	0.100	L	0.000	0.000	0.000	0.000	12.397
CASE 736	0.100	L	3836.971	2678.888	2444.719	2897.456	3621.498
CASE 737	0.100	T	0.000	0.000	0.000	0.000	0.000
CASE 738	0.100	T	297.502	521.122	461.581	0.000	392.297
CASE 739	0.200	H	0.000	82.948	-1.000	-1.000	71.256
CASE 740	0.200	H	1167.879	-1.000	-1.000	390.630	1580.874
CASE 741	0.200	L	116.622	-1.000	-1.000	55.476	55.373
CASE 742	0.200	L	1857.632	-1.000	-1.000	2196.061	2548.873
CASE 743	0.200	T	0.000	-1.000	-1.000	0.000	0.000
CASE 744	0.200	T	0.000	-1.000	-1.000	0.000	0.000
CASE 745	0.300	H	0.000	-1.000	-1.000	0.000	33.099
CASE 746	0.300	H	1915.774	-1.000	-1.000	869.148	1886.211
CASE 747	0.300	L	218.849	-1.000	-1.000	112.452	144.758
CASE 748	0.300	L	871.765	-1.000	-1.000	1574.703	2187.784
CASE 749	0.300	T	0.000	-1.000	-1.000	0.000	0.000
CASE 750	0.300	T	0.000	-1.000	-1.000	0.000	0.000
CASE 751	0.400	H	11.860	-1.000	-1.000	0.000	14.561
CASE 752	0.400	H	1440.813	-1.000	-1.000	537.687	1430.937
CASE 753	0.400	L	210.975	-1.000	-1.000	19.182	29.102
CASE 754	0.400	L	1494.800	-1.000	-1.000	767.941	1478.763
CASE 755	0.400	T	0.000	-1.000	-1.000	0.000	0.000
CASE 756	0.400	T	0.000	-1.000	-1.000	0.000	0.000
CASE 757	0.500	H	143.941	-1.000	-1.000	102.142	389.515
CASE 758	0.500	H	1866.748	-1.000	-1.000	1273.348	2391.583
CASE 759	0.500	L	193.511	-1.000	-1.000	295.682	273.527
CASE 760	0.500	L	145.765	-1.000	-1.000	367.470	683.288
CASE 761	0.500	T	0.000	-1.000	-1.000	0.000	0.000
CASE 762	0.500	T	0.000	-1.000	-1.000	0.000	0.000
CASE 763	0.600	H	533.198	-1.000	-1.000	475.704	661.764
CASE 764	0.600	H	156.380	-1.000	-1.000	149.097	133.255
CASE 765	0.600	L	615.636	-1.000	-1.000	554.747	854.419
CASE 766	0.600	L	0.000	-1.000	-1.000	277.268	154.656
CASE 767	0.600	T	0.000	-1.000	-1.000	0.000	0.000
CASE 768	0.600	T	0.000	-1.000	-1.000	0.000	0.000
CASE 769	0.700	H	1556.016	-1.000	-1.000	921.164	314.831
CASE 770	0.700	H	85.370	-1.000	-1.000	165.190	0.000
CASE 771	0.700	L	175.428	-1.000	-1.000	564.558	233.982
CASE 772	0.700	L	453.066	-1.000	-1.000	267.553	0.000
CASE 773	0.700	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 774	0.700	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 775	0.800	H	551.984	-1.000	-1.000	489.811	-1.000
CASE 776	0.800	H	150.646	-1.000	-1.000	116.652	-1.000
CASE 777	0.800	L	198.502	-1.000	-1.000	185.782	-1.000
CASE 778	0.800	L	1256.967	-1.000	-1.000	1778.967	-1.000
CASE 779	0.800	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 780	0.800	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 781	0.900	H	375.104	-1.000	-1.000	223.074	-1.000
CASE 782	0.900	H	495.602	-1.000	-1.000	393.098	-1.000
CASE 783	0.900	L	11.793	-1.000	-1.000	585.442	-1.000
CASE 784	0.900	L	1089.592	-1.000	-1.000	1168.292	-1.000
CASE 785	0.900	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 786	0.900	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 787	1.000	H	115.113	-1.000	-1.000	66.895	-1.000
CASE 788	1.000	H	1601.744	-1.000	-1.000	933.842	-1.000
CASE 789	1.000	L	18.977	-1.000	-1.000	141.827	-1.000
CASE 790	1.000	L	957.522	-1.000	-1.000	1158.477	-1.000
CASE 791	1.000	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 792	1.000	T	0.000	-1.000	-1.000	0.000	-1.000
CASE 793	1.100	H	0.000	-1.000	-1.000	-1.000	-1.000
CASE 794	1.100	H	147.572	-1.000	-1.000	-1.000	-1.000
CASE 795	1.100	L	0.000	-1.000	-1.000	-1.000	-1.000
CASE 796	1.100	L	21.978	-1.000	-1.000	-1.000	-1.000
CASE 797	1.100	T	0.000	-1.000	-1.000	-1.000	-1.000
CASE 798	1.100	T	0.000	-1.000	-1.000	-1.000	-1.000

REACH 5<sup>42</sup>  
COVER (cont.)

798 CASES AND 15 VARIABLES PROCESSED.  
NO SYSTAT FILE CREATED.



**APPENDIX II.** Autocorrelation patterns among adjacent 1/10th mile intervals within GIS Reaches 2, 4 and 5. Results are based on multiple stepwise regression analyses. For each year R2 and then p are presented.

REACH ZONE SIDE			1965	1973	1984	1990	1992					
2	L	L	.000	.000	.065	.000	.941	.000	.764	.027	.218	
2	L	R	.129	.043	.173	.138	.050*	.268	.013*	.143	.042*	
2	H	L	.494	.033	.209	.236	.017*	.306	.007*	.279	.008*	
2	H	R	.298	.006	.285	.005*	.222	.016*	.000	.659	.006*	
4	L	L	.134	.007*	.110	.012*	.100	.014*	.207	.000*	.162	.002*
4	L	R	.499	.000*	.277	.000*	.402	.507	.000*	.447	.000*	
4	H	L	.177	.001*	.236	.000*	.294	.287	.000*	.282	.000*	
4	H	R	.136	.005*	.248	.000*	.219	.167	.002*	.216	.000*	
5	L	L	.344	.000*	.401	.000*	.440	.293	.000*	.221	.000*	
5	L	R	.225	.000*	.204	.000*	.232	.193	.000*	.255	.000*	
5	H	L	.121	.000*	.116	.000*	.125	.282	.000*	.143	.000*	
5	H	R	.418	.000*	.401	.000*	.235	.282	.000*	.381	.000*	

**APPENDIX III****Administrative Report on Cooperative Agreement: CA 8000-8-0002****CURRENT AND HISTORICAL RIPARIAN VEGETATION TRENDS  
IN GRAND CANYON, USING MULTITEMPORAL REMOTE SENSING  
ANALYSES OF GIS SITES**

This project began in April, 1993 and will be concluded with the submission of a final report in August, 1995. Our budget was \$124,190.40. Costs associated with this project include the following:

1. Capital expenditures: for a computer & aerial photographs	\$9,817.32
2. Smaller expenditures: for mylar, pens, etc.	\$1,869.73
3. Travel:	\$953.10
4. Indirect:	\$20,698.84
5. Salaries:	\$90,852.41

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**TOTAL COSTS: \$124,191.40**