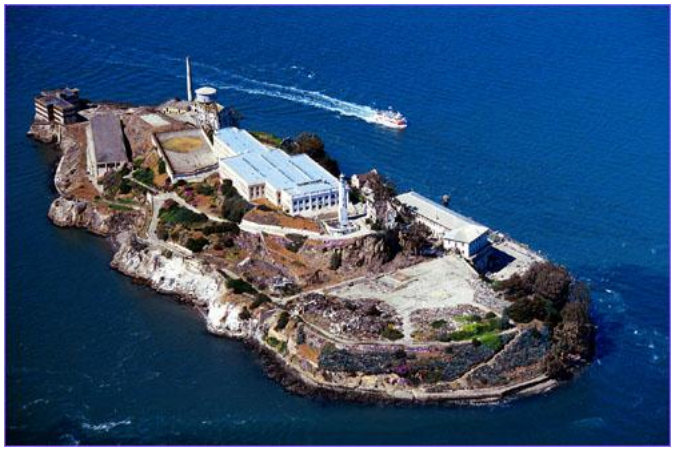
Park Studies Laboratory
University of Vermont

RSG INC.
RESOURCE SYSTEMS GROUP, INC.

30 November 2011

Visitor Use Monitoring in Muir Woods and on Alcatraz Island



Submitted to:

Golden Gate National Recreation Area

National Park Service

U.S. Department of Interior

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1.0 INTRODUCTION

Muir Woods National Monument and Alcatraz parklands are managed by Golden Gate National Recreation Area (GGNRA). Each of these areas receives intensive public use, with more than one million people visiting each area annually. The National Park Service (NPS) is revising GGNRA's General Management Plan (GMP) and developing Implementation Plans to guide management of visitor use at Muir Woods and Alcatraz. This planning is framed by objective based management, with a key component involving the development of indicators and standards of quality for visitor experiences.

NPS initiated this study with the University of Vermont (UVM) and Resource Systems Group (RSG) to collect visitor use information designed to support GMP and Implementation planning efforts for GGNRA. In supporting GGNRA's management by objective approach, this study's purpose is to monitor indicators of experiential quality at each area. Indicators of quality are specific, sensitive, measurable and manageable proxies for management objectives. Identification and monitoring of indicators allows managers to document resource and experiential conditions and track changes in quality over time or following managerial action. This study deploys a number of indicators at locations throughout Muir Woods and Alcatraz. The indicators monitored at each location were selected by park managers in consultation with study investigators based upon their measurement feasibility, salience to visitor experiences, and management objectives. Specific site—indicator pairings are described in the following sections of this report.

Indicators were monitored by direct observation. Observations were collected during the summer of 2009 by a five field staff from the University of Vermont and Student Conservation Association. These staff collected observations at each area for 20 days, staggering early and late shifts to capture daily peak and off-peak usage. At most sites indicators were monitored via visitor counts. At regular intervals of time staff counted the number of individuals within the indicator site's boundaries. Notable exceptions to this general method include the monitoring conducted on the Hillside Trail in Muir Woods and within Michigan Avenue on Alcatraz.

This report is organized in two primary sections, one for Muir Woods and one for Alcatraz. Each of these primary sections is further divided into subsection for each indicator site. The subsections present site and indicator specific methodological details and summaries of the sampling effort and monitoring results including:

- Average daily usage
- Usage percentiles and maxima
- Differences in usage by weekday vs. weekend
- Differences in usage by hour of day

These results document the current condition of indicators of quality at each site and are intended to provide an empirical basis to support NPS decisions about indicators and standards of quality for visitor experiences.

2.0 MUIR WOODS

This section of the report presents the results of visitor use counts and observations conducted in Muir Woods during summer 2009. The results provide detailed information about the current condition of the following crowding-related indicators of quality in Muir Woods:

- People at one time (PAOT) in the Redwood Cross Section area.
- PAOT in the Pinchot Tree area.
- People per view (PPV) on valley floor trails.
- Inter-group encounters on the Hillside Trail.

Analyses presented in this section include statistical comparisons of weekend versus weekday conditions of the crowding-related indicators noted, where weekends include Friday through Sunday and weekdays include Monday through Thursday.

2.1Redwood Cross Section *PAOT*

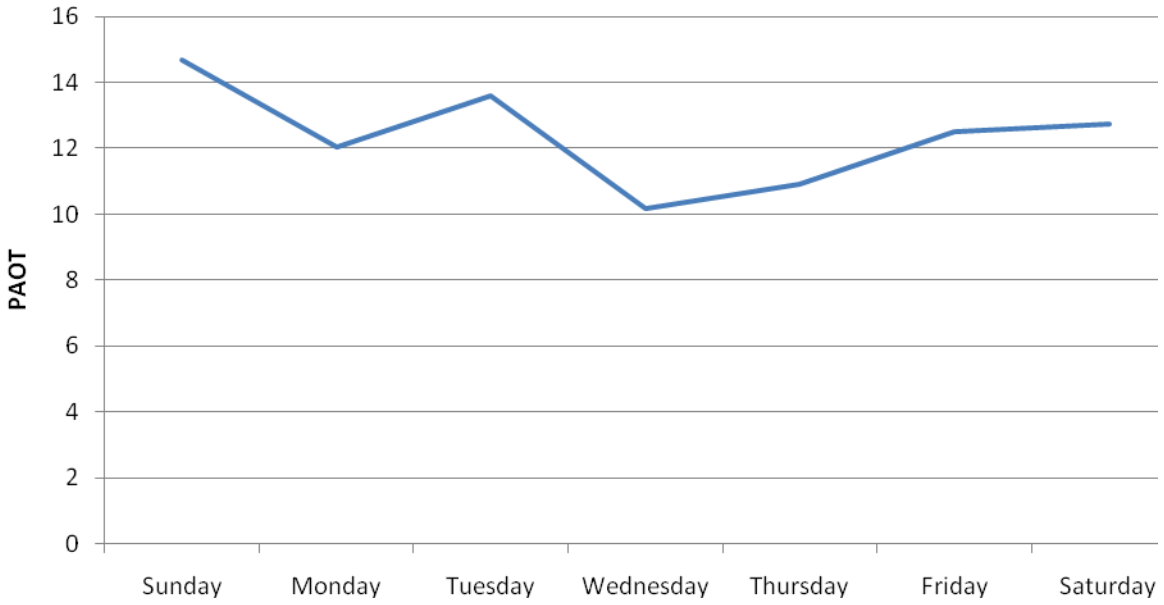
Counts of PAOT within the Redwood Cross Section interpretive area were conducted at 5 minute intervals between 9 AM and 6 PM on 20 days between June 26 and August 13, 2007. A total of 1,307 usable observations were collected (Table 1).

Table 1. Sampling Effort – Redwood Cross Section PAOT

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	12	36	12	-	24	12	23	119
10:00	12	34	12	-	24	12	30	124
11:00	12	36	12	-	24	12	24	120
12:00	48	48	12	12	46	34	24	224
13:00	48	46	12	12	48	35	24	225
14:00	47	35	11	12	48	35	24	212
15:00	36	-	-	12	25	24	-	97
16:00	36	-	-	12	23	24	-	95
17:00	35	-	-	12	20	24	-	91
Total	286	235	71	72	282	212	149	1,307

Daily average PAOT within the Redwood Cross Section area ranges between 10 and 15 (Figure 1). Daily average PAOT is highest on Sundays, and statistically higher on this day than on Wednesdays and Thursdays (F=4.597, $p<0.001$). Mondays, Tuesdays, Fridays, and Saturdays are not statistically different than any other day of the week, with respect to daily average PAOT.

Figure 1. Daily Average PAOT in the Redwood Cross section Area, by Day of the Week



Percentages are reported in Table 2 to document the frequency with which various PAOT levels are exceeded in the Redwood Cross Section area. Overall, there are more than 12 PAOT in the cross section area 50% of the time between the hours of 9 AM and 4 PM; on weekends, there are more than 13 PAOT in the area 50% of the time. Across all days of the week, visitor use in the Redwood Cross Section area exceeds 22 PAOT only 10% of the time between the hours of 9 AM and 4 PM; on weekends, visitor use exceeds 23 PAOT only 10% of the time. The maximum level of visitor use observed in the Redwood Cross Section area was 44 PAOT.

Table 2.Percent Time in Excess of PAOT in the Redwood Cross Section Area, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	7	6	8
50%	12	11	13
25%	17	16	18
10%	22	21	23
Maximum	44	39	44

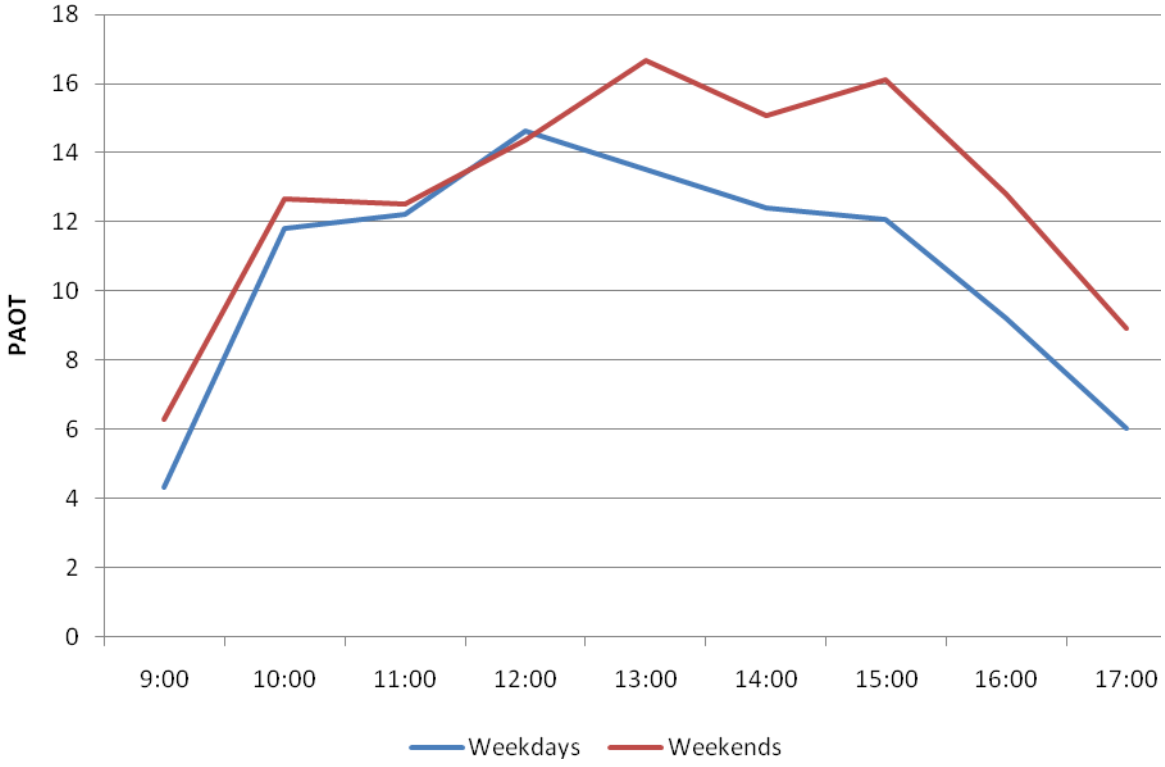
Weekdays and weekends are not statistically different between 10 AM and 1 PM, with respect to hourly average PAOT in the Redwood Cross Section area. However, during the 9 AM hour and between 1 PM and 6 PM, hourly average PAOT in the Redwood Cross Section area is significantly higher on weekends than on weekdays (Table 3 and Figure 2).

Table 3. Hourly Average PAOT in the Redwood Cross Section Area, by Day of Week Category

Hour of the Day	Weekdays	Weekends
9:00*	4.31	6.28
10:00	11.81	12.65
11:00	12.21	12.50
12:00	14.64	14.38
13:00*	13.52	16.66
14:00*	12.39	15.08
15:00*	12.05	16.10
16:00*	9.23	12.80
17:00*	6.03	8.93

* Denotes statistically significant difference at α = 0.05

Figure 2. Hourly Average PAOT in the Redwood Cross Section Area, by Day of Week Category



Results of ANOVA post-hoc tests suggest that, on weekdays, the peak period of visitor use in the Redwood Cross Section area is between the hours of 10 AM and 4 PM (Table 4). On weekends, visitor use in the cross section area peaks between the hours of 12 PM and 4 PM (Table 5).

Table 4. Weekday Hourly Average PAOT in the Redwood Cross Section Area, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05			
9:00	4.31	-	-	-
10:00	-	-	11.81	11.81
11:00	-	-	12.21	12.21
12:00	-	-	-	14.64
13:00	-	-	-	13.52
14:00	-	-	12.39	12.39
15:00	-	-	12.05	12.05
16:00	-	9.23	9.23	-
17:00	6.03	6.03		-

Table 5. Weekend Hourly Average PAOT in the Redwood Cross Section Area, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05			
9:00	6.28	-	-	-
10:00	-	-	12.65	-
11:00	-	12.50	12.50	-
12:00	-	-	14.38	14.38
13:00	-	-	-	16.66
14:00	-	-	15.08	15.08
15:00	-	-	16.10	16.10
16:00	-	-	12.80	-
17:00	8.93	8.93	-	-

2.2Pinchot Tree *PAOT*

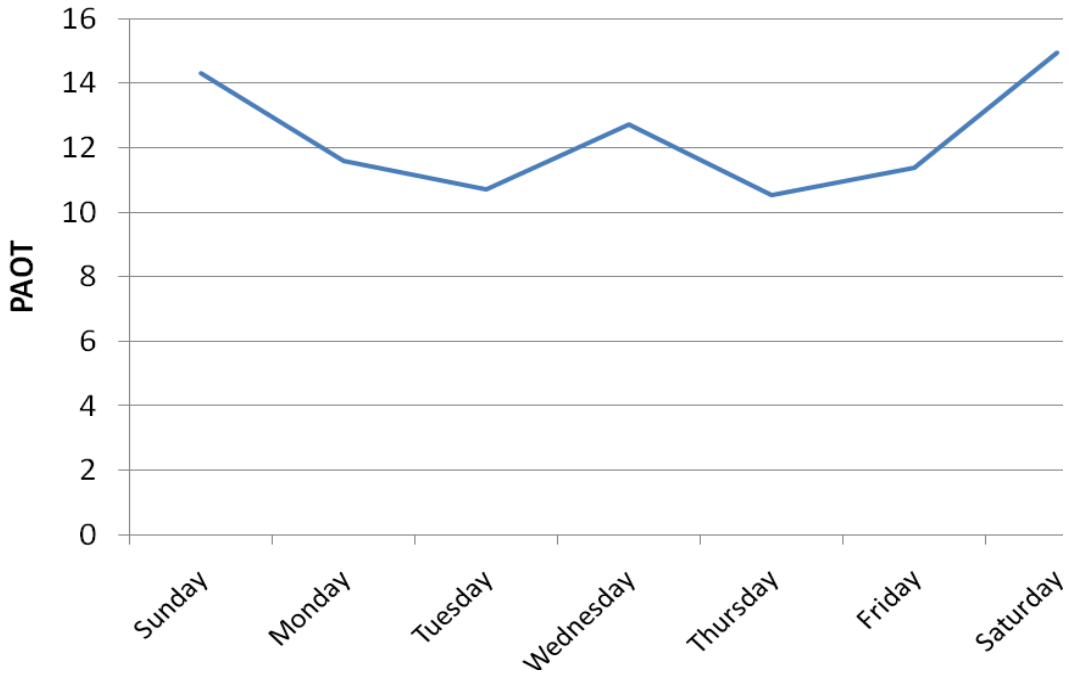
Counts of PAOT within the Pinchot Tree interpretive area were conducted at 5 minute intervals between 9 AM and 6 PM on 20 days between June 26 and August 13, 2007. A total of 1,357 usable observations were collected (Table 6).

Table 6. Sampling Effort - Pinchot Tree PAOT

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	12	36	12	-	23	12	24	119
10:00	12	36	12	-	24	18	24	126
11:00	12	36	12	-	24	12	24	120
12:00	48	48	12	12	48	21	36	225
13:00	48	47	12	12	48	24	36	227
14:00	48	36	12	12	48	24	36	216
15:00	36	12	-	12	24	12	12	108
16:00	36	12	-	12	24	12	12	108
17:00	36	12	-	12	24	12	12	108
Total	288	275	72	72	287	147	216	1,357

Daily average PAOT within the Pinchot Tree area ranges between 11 and 15 (Figure 3). Daily average PAOT is highest on Saturdays and Sundays, and statistically higher on these days than on Tuesdays and Thursdays (F=6.338, $p<0.001$). Mondays, Wednesdays, and Fridays are not statistically different than any other day of the week, with respect to daily average PAOT.

Figure 3. Daily Average PAOT in the Pinchot Tree Area, by Day of the Week



Percentages are reported in Table 7 to document the frequency with which various PAOT levels are exceeded in the Pinchot Tree area. Overall, there are more than 10 PAOT in the Pinchot Tree area 50% of the time between the hours of 9 AM and 4 PM; on weekends, there are more than 12 PAOT in the area 50% of the time. Across all days of the week, visitor use in the Pinchot Tree area exceeds 25 PAOT only 10% of the time between the hours of 9 AM and 4 PM; on weekends, visitor use exceeds 27 PAOT only 10% of the time. The maximum level of visitor use observed in the Pinchot Tree area was 84 PAOT.

Table 7. Percent Time in Excess of PAOT in the Pinchot Tree Area, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	6	5	7
50%	10	9	12
25%	17	15	20
10%	25	23	27
Maximum	84	84	84

Weekdays and weekends are not statistically different during morning hours, with respect to hourly average PAOT within the Pinchot Tree area. However, between the hours of 1 PM and 5 PM, hourly average PAOT in the Pinchot Tree area is significantly higher on weekends than on weekdays (

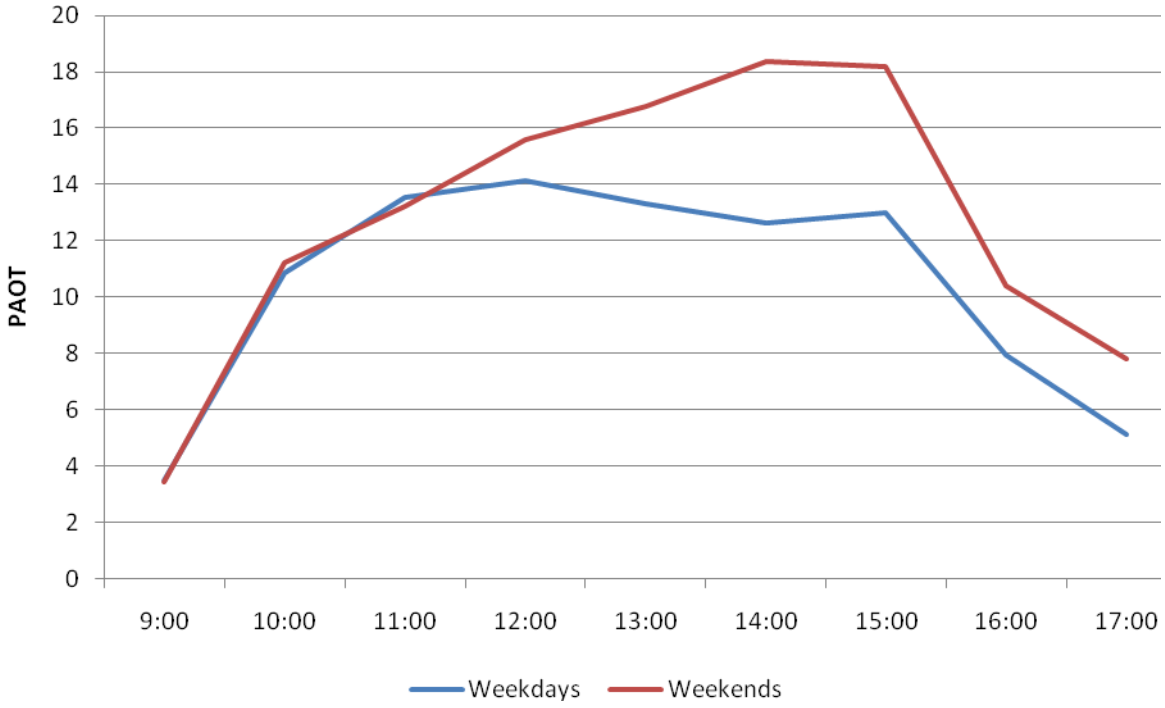
Table 8 and Figure 4).

Table 8. Hourly Average PAOT in the Pinchot Tree Area, by Day of Week Category

Hour of the Day	Weekdays	Weekends
9:00	3.49	3.46
10:00	10.85	11.22
11:00	13.53	13.23
12:00	14.12	15.59
13:00*	13.33	16.80
14:00*	12.64	18.37
15:00*	13.00	18.17
16:00*	7.94	10.38
17:00*	5.10	7.78

* Denotes statistically significant difference at α = 0.05

Figure 4. Hourly Average PAOT in the Pinchot Tree Area, by Day of Week Category



Results of ANOVA post-hoc tests suggest that, on weekdays, the peak period of visitor use in the Pinchot Tree area is between the hours of 10 AM and 4 PM (Table 9). On weekends, visitor use in the Pinchot Tree area peaks between the hours of 1 PM and 4 PM (Table 10).

Table 9. Weekday Hourly Average PAOT in the Pinchot Tree Area, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	3.49	-	-
10:00	-	10.85	10.85
11:00	-	-	13.53
12:00	-	-	14.12
13:00	-	-	13.33
14:00	-	12.64	12.64
15:00	-	13.00	13.00
16:00	7.94	7.94	-
17:00	5.10	-	-

Table 10. Weekend Hourly Average PAOT in the Pinchot Tree Area, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05					
9:00	3.46	-	-	-	-	-
10:00	-	11.22	11.22	11.22	-	-
11:00	-	-	13.23	13.23	13.23	-
12:00	-	-	-	15.59	15.59	15.59
13:00	-	-	-	-	16.80	16.80
14:00	-	-	-	-	-	18.37
15:00	-	-	-	-	18.17	18.17
16:00	-	10.38	10.38	-	-	-
17:00	7.78	7.78	-	-	-	-

*2.3*Valley Floor Trail Interpretive Section *PPV*

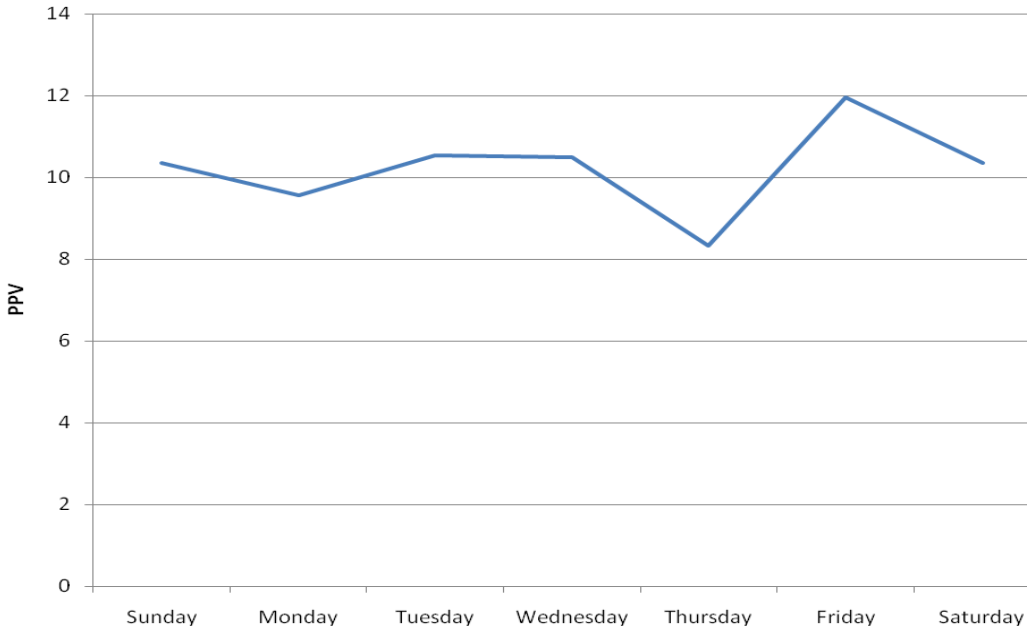
Counts of PPV along an interpretation-oriented section of the valley floor trail, including the “Family Circle” interpretive sign, were conducted at 5 minute intervals between 9 AM and 6 PM on 20 days between June 26 and August 13, 2007. A total of 679 usable observations were collected (Table 11).

Table 11.Sampling Effort – Valley Floor Trail Interpretive Section PPV

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	12	12			24		12	60
10:00	12	12			24		12	60
11:00	12	12			23		11	58
12:00	12	20	9	12	12	30	12	107
13:00	12	23	12	12	12	36	12	119
14:00	10	12	12	12	12	36	12	106
15:00	21	9			8		12	50
16:00	24	12			12		12	60
17:00	23	12			12		12	59
Total	138	124	33	36	139	102	107	679

Daily average PPV along the interpretive section of the valley floor trail ranges between 8 and 12 (Figure 5). Daily average PPV is highest on Fridays, and statistically higher on this day than on Thursdays ($F=2.915$, $p=0.008$). Sundays, Mondays, Tuesdays, Wednesdays, and Saturdays are not statistically different than any other day of the week, with respect to daily average PPV.

Figure 5. Daily Average PPV along the Valley Floor Trail Interpretive Section, by Day of the Week



Percentages are reported in Table 12 to document the frequency with which various PPV levels are exceeded along the interpretive section of the valley floor trail. Overall, there are more than 9 PPV along the trail section 50% of the time between the hours of 9 AM and 4 PM; on weekends, there are more than 10 PPV along the interpretive trail section 50% of the time. Across all days of the week, visitor use exceeds 20 PPV only 10% of the time between the hours of 9 AM and 4 PM; on weekends, visitor use exceeds 21 PPV only 10% of the time. The maximum level of visitor use observed along the interpretive section of the valley floor trail was 34 PPV.

Table 12. Percent Time in Excess of PPV along the Valley Floor Trail Interpretive Section, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	5	4	6
50%	9	8	10
25%	14	13	15
10%	20	19	21
Maximum	34	34	34

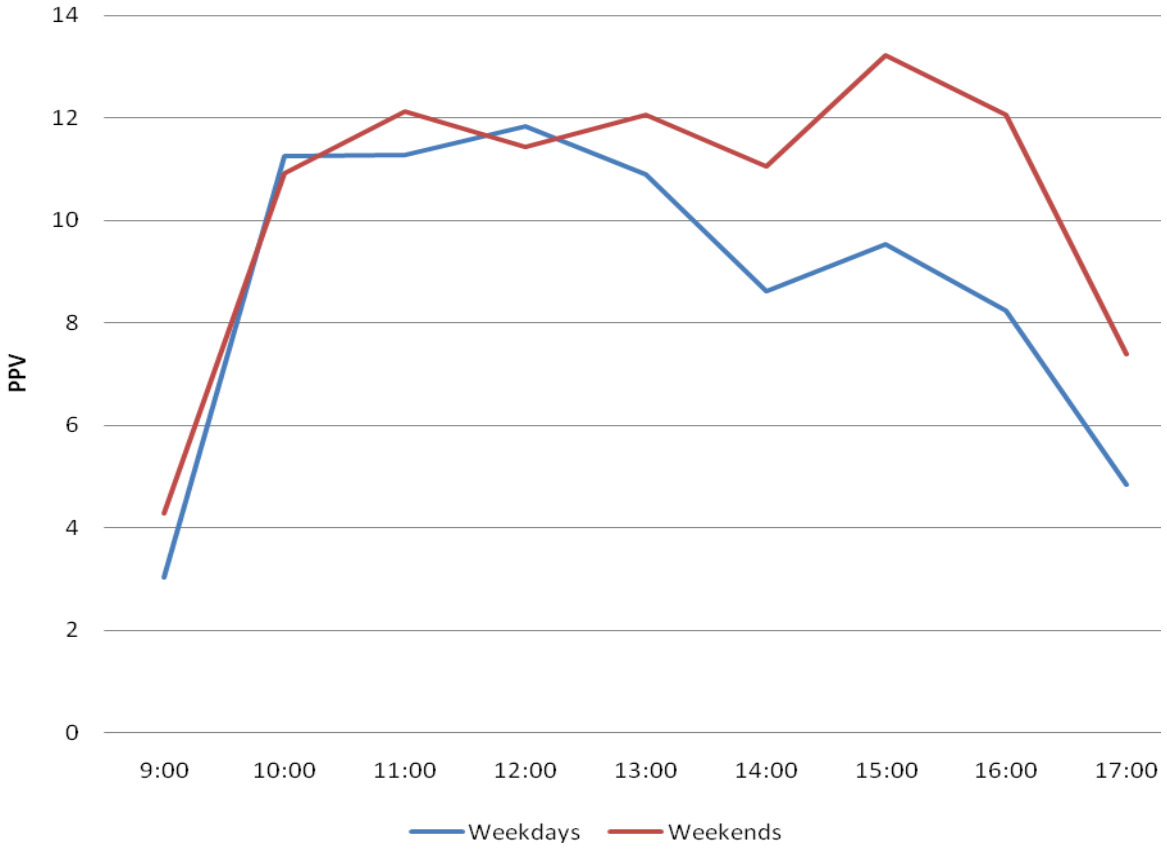
Weekdays and weekends are not statistically different during morning and midday hours, with respect to hourly average PPV along the valley floor trail interpretive section. However, between the hours of 4 PM and 6 PM, hourly average PPV along the valley floor trail interpretive section is significantly higher on weekends than on weekdays (Table 13 and Figure 6).

Table 13. Hourly Average PPV along the Valley Floor Trail Interpretive Section, by Day of Week Category

Hour of the Day	Weekdays	Weekends
9:00	3.03	4.29
10:00	11.25	10.92
11:00	11.29	12.13
12:00	11.83	11.43
13:00	10.90	12.05
14:00	8.63	11.05
15:00	9.53	13.21
16:00*	8.25	12.06
17:00*	4.83	7.40

* Denotes statistically significant difference at $\alpha = 0.05$

Figure 6. Hourly Average PPV along the Valley Floor Trail Interpretive Section, by Day of Week Category



Results of ANOVA post-hoc tests suggest that, on both weekdays and weekends, the peak period of visitor use along the valley floor trail interpretive section is between the hours of 10 AM and 5 PM (Table 14 and Table 15).

Table 14. Weekday Hourly Average PPV along the Valley Floor Trail Interpretive Section, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	3.03	-	-
10:00	-	-	11.25
11:00	-	-	11.29
12:00	-	-	11.83
13:00	-	-	10.90
14:00	-	8.63	8.63
15:00	-	9.53	9.53
16:00	-	8.25	8.25
17:00	4.83	4.83	-

Table 15. Weekend Hourly Average PPV along the Valley Floor Trail Interpretive Section, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	4.29	-	-
10:00	-	10.92	10.92
11:00	-	12.13	12.13
12:00	-	11.43	11.43
13:00	-	12.05	12.05
14:00	-	11.05	11.05
15:00	-	-	13.21
16:00	-	12.06	12.06
17:00	7.40	7.40	-

*2.4*Valley Floor Trail Thru-Travel Section *PPV*

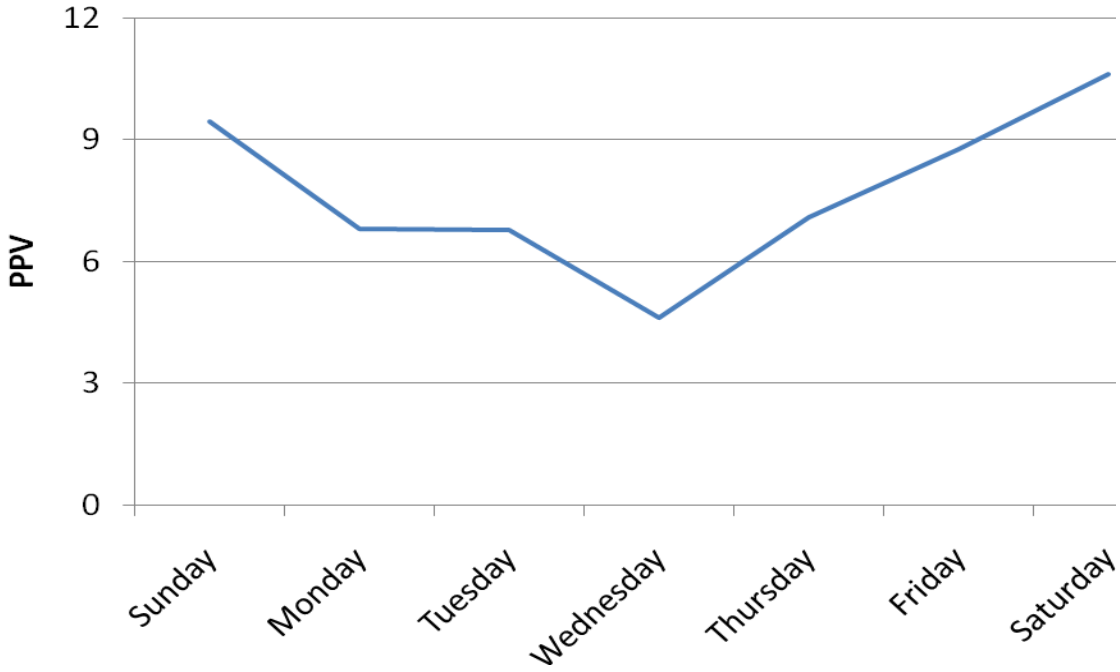
Counts of PPV along a thru-travel section of the valley floor trail (i.e., containing no benches or interpretive displays) were conducted at 5 minute intervals between 9 AM and 6 PM on 20 days between June 26 and August 13, 2007. A total of 693 usable observations were collected (Table 16).

Table 16.Sampling Effort – Valley Floor Trail Thru-Travel Section PPV

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	-	24	12	-	-	12	12	60
10:00	-	24	12	-	-	12	12	60
11:00	-	23	12	-	-	12	10	57
12:00	34	22	-	-	32	-	23	111
13:00	36	24	-	-	35	-	24	119
14:00	34	24	-	-	36	-	22	116
15:00	11	-	-	9	10	20	-	50
16:00	12	-	-	12	12	24	-	60
17:00	12	-	-	12	12	24	-	60
Total	139	141	36	33	137	104	103	693

Daily average PPV along the thru-travel section of the valley floor trail ranges between 5 and 11 (Figure 7). Daily average PPV is highest on Saturdays and statistically higher on Fridays, Saturdays, and Sundays than on Wednesdays (F=6.841, $p<0.001$). Mondays, Tuesdays, and Thursdays are not statistically different than any other day of the week, with respect to daily average PPV.

Figure 7. Daily Average PPV along the Valley Floor Trail Thru-Travel Section, by Day of the Week



Percentages are reported in Table 17 to document the frequency with which various PPV levels are exceeded along the thru-travel section of the valley floor trail. Overall, there are more than 7 PPV along the trail section 50% of the time between the hours of 9 AM and 4 PM; on weekends, there are more than 8 PPV along the interpretive trail section 50% of the time. Across all days of the week, visitor use exceeds 17 PPV only 10% of the time between the hours of 9 AM and 4 PM; on weekends, visitor use exceeds 19 PPV only 10% of the time. The maximum level of visitor use observed along the interpretive section of the valley floor trail was 49 PPV.

Table 17. Percent Time in Excess of PPV along the Valley Floor Trail Thru-Travel Section, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	3	3	4
50%	7	6	8
25%	11	10	13
10%	17	14	19
Maximum	49	28	49

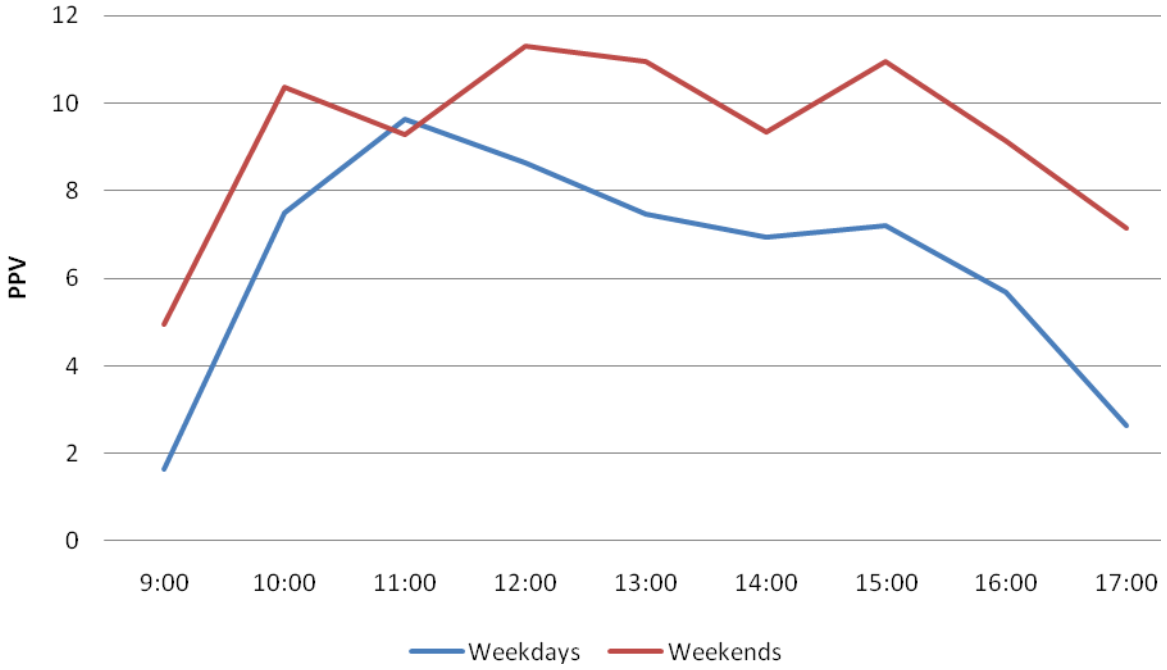
Weekdays and weekends are not statistically different during mid-morning to early afternoon, with respect to hourly average PPV along the valley floor trail thru-travel section. However, during the 9 AM hour and between the hours of 1 PM and 6 PM, hourly average PPV along the valley floor trail interpretive section is significantly higher on weekends than on weekdays (Table 18 and Figure 8).

Table 18. Hourly Average PPV along the Valley Floor Trail Thru-Travel Section, by Day of Week Category

Hour of the Day	Weekdays	Weekends
9:00*	1.64	4.96
10:00	7.50	10.38
11:00	9.63	9.27
12:00	8.65	11.30
13:00*	7.47	10.95
14:00*	6.93	9.34
15:00*	7.21	10.94
16:00*	5.67	9.14
17:00*	2.63	7.14

* Denotes statistically significant difference at $\alpha = 0.05$

Figure 8. Hourly Average PPV along the Valley Floor Trail Thru-Travel Section, by Day of Week Category



Results of ANOVA post-hoc tests suggest that, on weekdays, the peak period of visitor use along the valley floor trail thru-travel section is between the hours of 10 AM and 4 PM (Table 19). On weekends, visitor use along the valley floor trail thru-travel section is characterized by a broad, flat peak between the hours of 10 PM and 6 PM (Table 20).

Table 19. Weekday Hourly Average PPV along the Valley Floor Trail Thru-Travel Section, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05			
9:00	1.64	-	-	-
10:00	-	-	7.50	7.50
11:00	-	-	-	9.63
12:00	-	-	8.65	8.65
13:00	-	-	7.47	7.47
14:00	-	-	6.93	6.93
15:00	-	-	7.21	7.21
16:00	-	5.67	5.67	-
17:00	2.63	2.63	-	-

Table 20. Weekend Hourly Average PPV along the Valley Floor Trail Thru-Travel Section, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05	
9:00	4.96	-
10:00	10.38	10.38
11:00	9.27	9.27
12:00	-	11.30
13:00	-	10.95
14:00	9.34	9.34
15:00	-	10.94
16:00	9.14	9.14
17:00	7.14	7.14

2.5Hillside Trail Inter-group Encounters

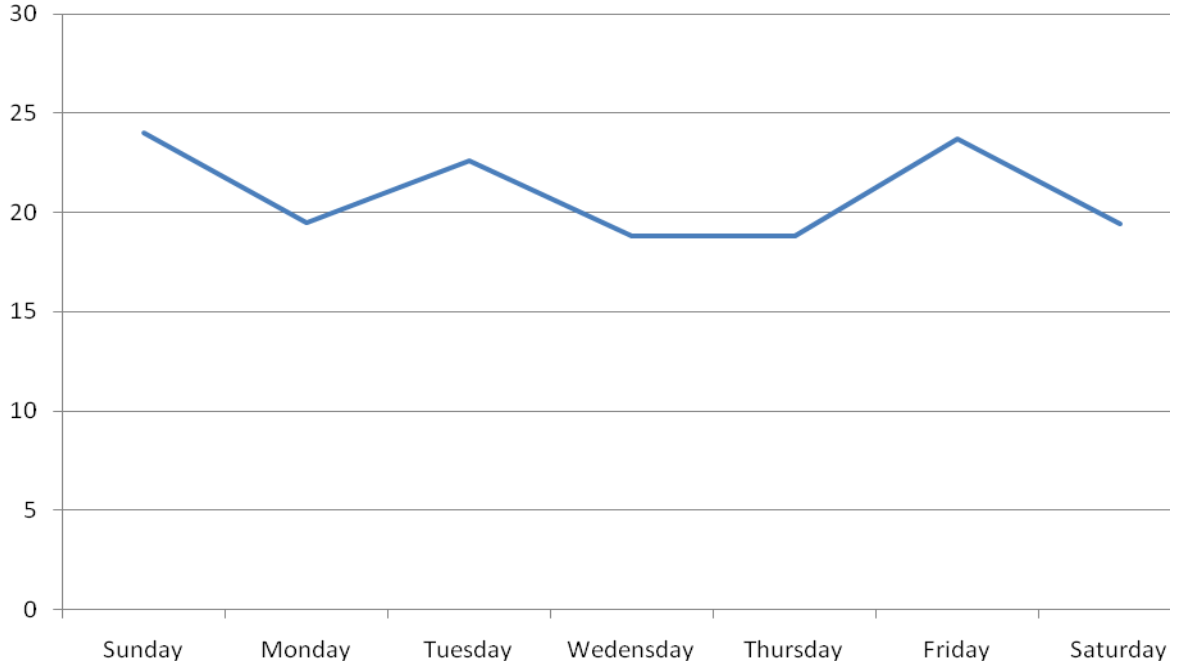
Observations of the number of inter-group encounters on the Hillside Trail were conducted between 9 AM and 6 PM on 20 days between June 26 and August 13, 2007. A total of 167 usable observations were collected (Table 21). Observations of inter-group encounters were made by randomly selecting a visitor group at one end of the Hillside Trail, following the selected group from a distance where the observer could not be noticed by the group being followed, and recording the number of groups encountered by the observed group during the course of their hike on the trail. At the end of the observation, the next arriving group was selected for observation during their hike in the opposite direction on the Hillside Trail. This process of subject selection and observation was repeated throughout the sampling day. Encounters reported in this section refer to the number of *groups* (rather than *individuals*) encountered while hiking from one end of the Hillside Trail to the other. The size of groups observed on the Hillside Trail ranged from 1 to 13, with a mean of 3.13 and a standard deviation of 1.67.

Table 21. Sampling Effort – Hillside Trail Inter-group Encounters

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	2	3	1	1	5	3	2	17
10:00	1	3	2	3	8	3	1	21
11:00	4	3	2	2	9	2	2	24
12:00	5	6	1	2	11	5	4	34
13:00	3	5	1	1	8	7	2	27
14:00	3	3	1	2	6	5	3	23
15:00	2	2	-	-	1	3	-	8
16:00	2	1	-	-	2	4	-	9
17:00	1	1	-	-	1	1	-	4
Total	23	27	8	11	51	33	14	167

The daily average number of inter-group encounters while hiking on the Hillside Trail ranges between 18 and 24 (Figure 9). Daily average encounters is highest on Sundays, however there are no statistical differences among daily average inter-group encounters, by day of the week (F=0.790, *p*=0.579).

Figure 9. Daily Average Inter-group Encounters on the Hillside Trail, by Day of the Week



Percentages are reported in Table 22 to document the frequency with which various visitor encounter levels are exceeded on the Hillside Trail. Overall, 50% of groups observed had more than 19 encounters with other groups while hiking on the Hillside Trail; on weekends, 50% of groups observed had more than 22 encounters with other groups. Across all days of the week, 10% of groups observed had more than 40 inter-group encounters while hiking on the Hillside Trail; on weekends, 10% of groups observed had more than 41 encounters with other groups. The maximum number of inter-group encounters any visitor group was observed to have was 65.

Table 22. Percent Time in Excess of Inter-group Encounters on the Hillside Trail, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	10	9	13
50%	19	16	22
25%	29	28	29
10%	40	39	41
Maximum	65	52	65

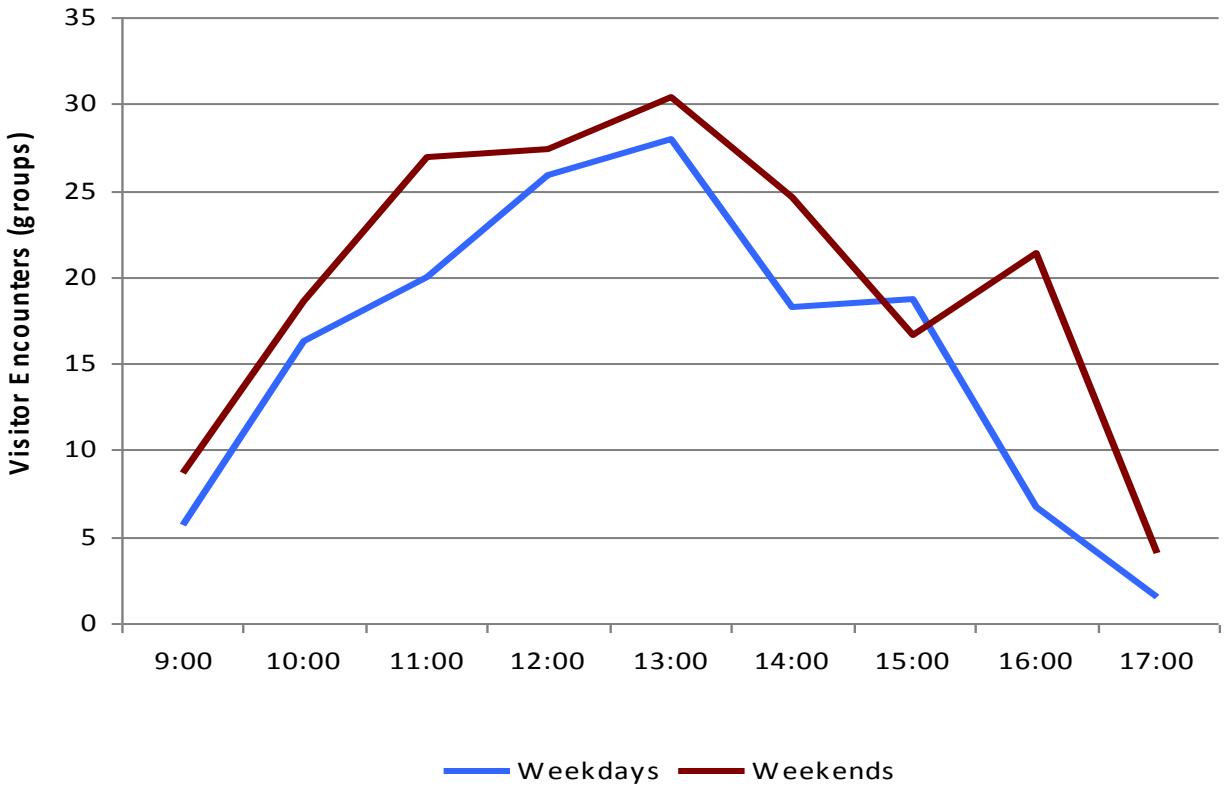
Weekends and weekdays do not differ significantly, with respect to the hourly average number of inter-group encounters visitors have while hiking on the Hillside Trail (Table 23 and Figure 4).

Table 23. Hourly Average Inter-group Encounters on the Hillside Trail

Hour of the Day	Weekdays	Weekends
9:00	5.70	8.71
10:00	16.31	18.60
11:00	20.00	26.88
12:00	25.90	27.43
13:00	27.93	30.33
14:00	18.25	24.64
15:00	18.67	16.60
16:00	6.67	21.33
17:00	1.50	4.00

* Denotes statistically significant difference at α = 0.05

Figure 10. Hourly Average Inter-group Encounters on the Hillside Trail, by Day of Week Category



Results of ANOVA post-hoc tests suggest that the peak period of visitor use and associated inter-group encounters on the Hillside Trail is between the hours of 10 AM and 5 PM (Table 24).

Table 24. Hourly Average Inter-group encounters on the Hillside Trail, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	6.94	6.94	-
10:00	16.86	16.86	16.86
11:00	-	-	22.29
12:00	-	-	26.53
13:00	-	-	29.00
14:00	-	21.30	21.30
15:00	17.38	17.38	17.38
16:00	16.44	16.44	16.44
17:00	2.75	-	-

3.0 ALCATRAZ ISLAND

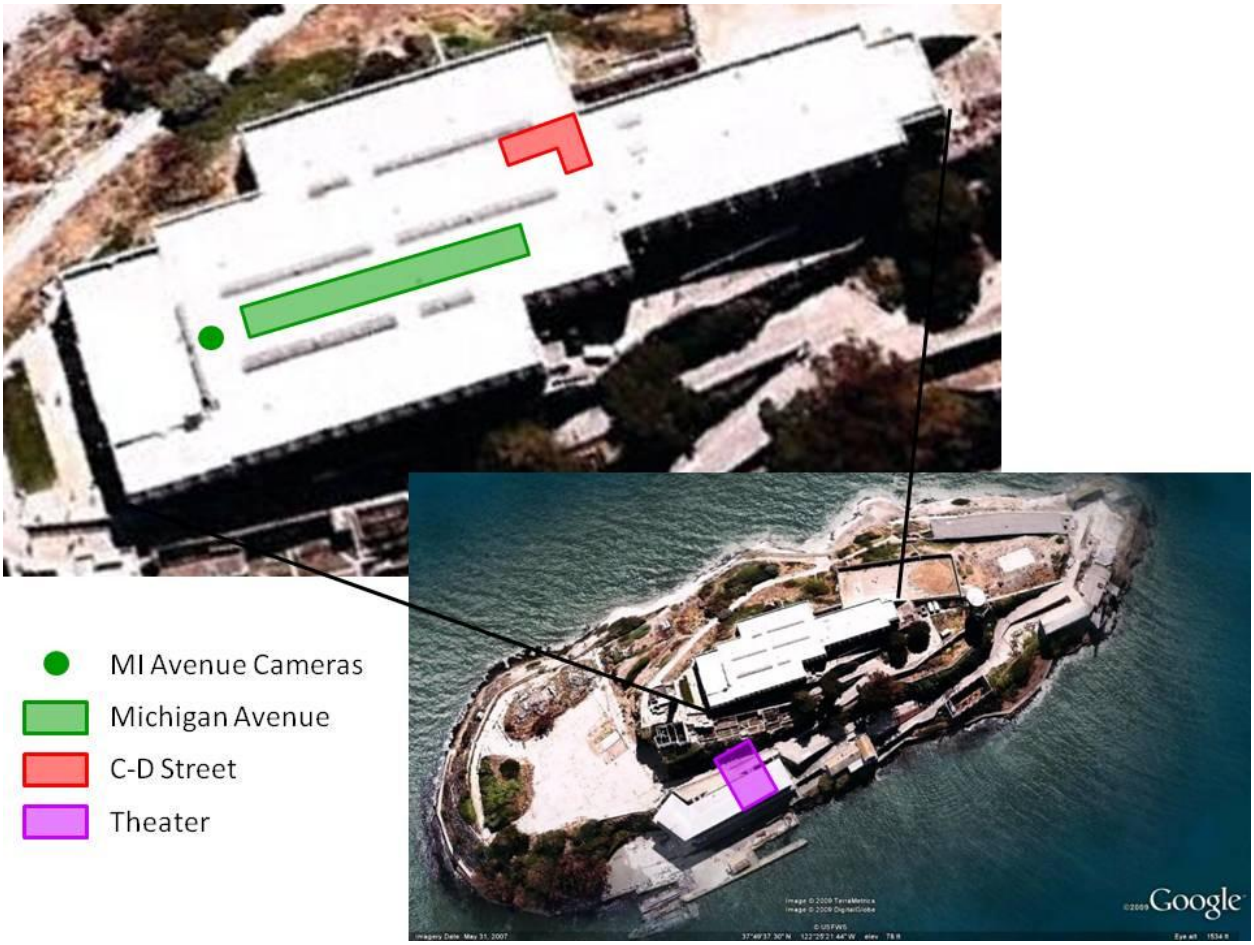
This section of the report presents the results of visitor use counts and observations conducted on Alcatraz Island during summer 2009. The results provide detailed information about the current condition of the following crowding-related indicators of quality:

- People at one time (PAOT) on C-D Street near the recreation yard door.
- PAOT in the orientation film theater.
- People per view (PPV) and PAOT on in Michigan Avenue.

Analyses presented in this section include statistical comparisons of weekend versus weekday conditions of the crowding-related indicators noted, where weekends include Saturday and Sunday and weekdays include Monday through Friday.

Sampling and survey recruitment took place at three basic locations on Alcatraz: C-D Street near the recreation yard door, the orientation film theater, and Michigan Avenue. These locations are depicted in Figure 11.

Figure 11. Alcatraz Island Sampling Locations



3.1 C-D Street *PAOT*

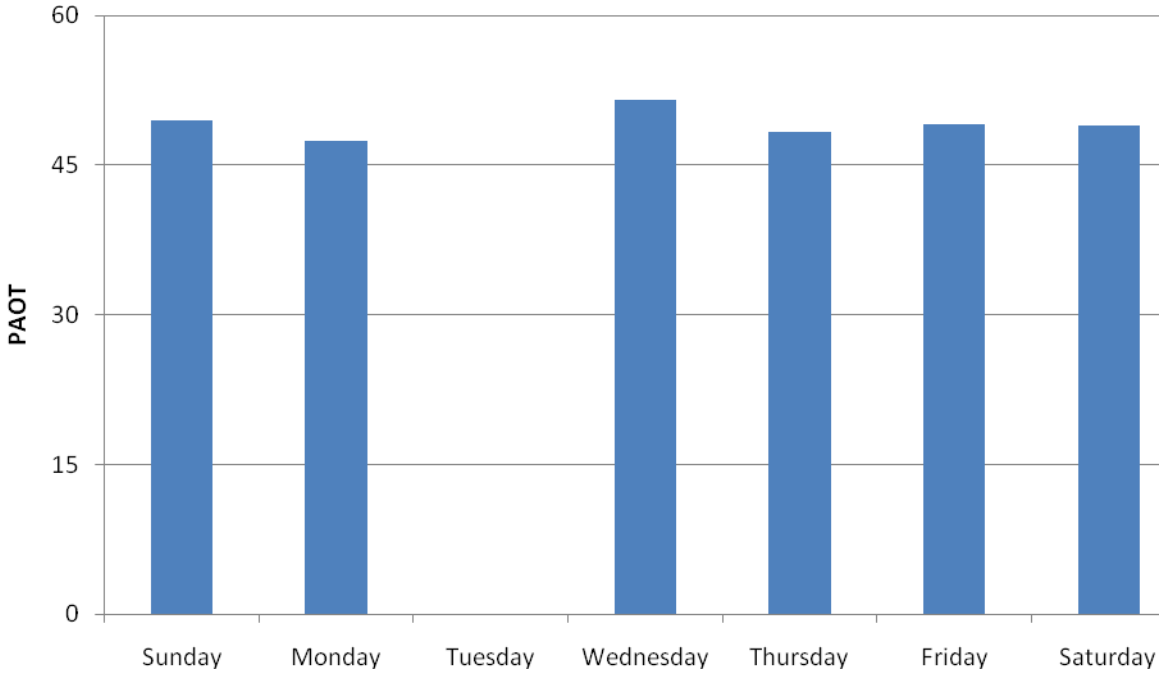
Counts of the number of PAOT in the C-D Street area of the Cellhouse were conducted at 5 minute intervals between 9 AM and 6 PM on 20 days between July 9 and August 16, 2007. A total of 1,355 usable observations were collected (Table 25).

Table 25. Sampling Effort – C-D Street PAOT

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	14	-	-	4	8	4	8	38
10:00	36	-	-	12	24	12	24	108
11:00	48	12	-	24	35	60	60	239
12:00	29	11	-	18	24	54	48	184
13:00	48	12	-	24	36	60	60	240
14:00	42	6	-	18	30	35	41	172
15:00	30	12	-	18	24	48	47	179
16:00	12	11	-	12	12	48	36	131
17:00	6	6	-	6	6	24	16	64
Total	265	70	-	136	199	345	340	1,355

Daily average PAOT in the C-D Street area ranges between 47 and 51 (Figure 12). Daily average PAOT is highest on Wednesdays, however there are no statistically significant differences in daily average PAOT across the days of the week (F=0.924, *p*=0.464).

Figure 12. Daily Average PAOT on C-D Street, by Day of the Week



Percentages are reported in Table 26 to document the frequency with which various PAOT levels are exceeded on C-D Street. On both weekends and weekdays, there are more than 49 PAOT on C-D Street 50% of the time between the hours of 9 AM and 5 PM. Overall, visitor use on C-D Street exceeds 72 PAOT only 10% of the time between the hours of 9 AM and 5 PM; on weekends, visitor use exceeds 74 PAOT only 10% of the time. The maximum level of visitor use observed on C-D Street was 110 PAOT.

Table 26. Percent Time in Excess of PAOT on C-D Street, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	38	39	38
50%	49	49	49
25%	61	61	61
10%	72	71	74
Maximum	110	105	110

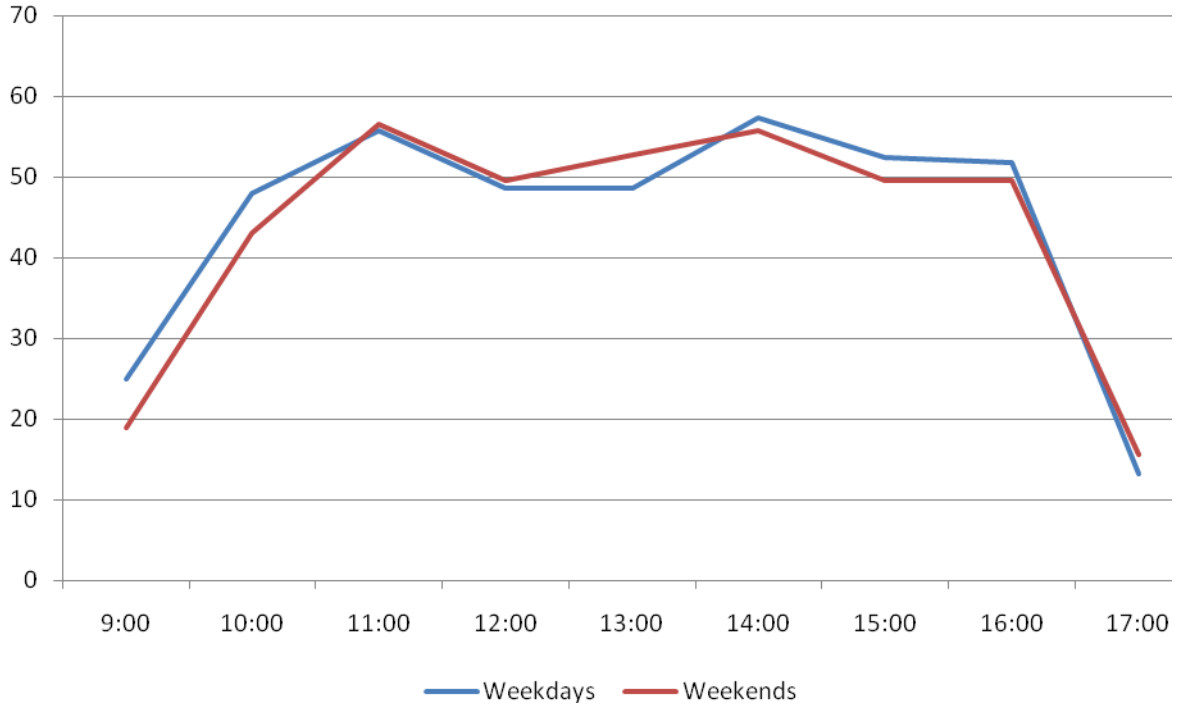
With the exception of the 1 PM hour, weekdays and weekends are not statistically different, with respect to hourly average PAOT on C-D Street (Table 27 and Figure 13).

Table 27. Hourly Average PAOT on C-D Street, by Day of Week Category

Hour of the Day	Weekdays	Weekends
9:00	25.00	19.00
10:00	48.02	43.08
11:00	55.79	56.59
12:00	48.52	49.57
13:00*	48.65	52.71
14:00	57.28	55.77
15:00	52.34	49.53
16:00	51.76	49.58
17:00	13.29	15.64

* Denotes statistically significant difference at $\alpha = 0.05$

Figure 13. Hourly Average PAOT on C-D Street, by Day of Week Category



Results of ANOVA post-hoc tests suggest that, on weekdays, the peak period of visitor use on C-D Street is between the hours of 2 PM and 5 PM, accompanied by an hour of peak use in the morning between 11 AM and 12 PM (Table 28). On weekends, visitor use on C-D Street peaks between the hours of 11 AM and 5 PM (Table 29).

Table 28. Weekday Hourly Average PAOT o, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05			
9:00	-	25.00	-	-
10:00	-	-	48.02	-
11:00	-	-	55.79	55.79
12:00	-	-	48.52	-
13:00	-	-	48.65	-
14:00	-	-	-	57.28
15:00	-	-	52.34	52.34
16:00	-	-	51.76	51.76
17:00	13.29	-	-	-

Table 29. Weekend Hourly Average PAOT on C-D Street, by Statistically Different Hours

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	19.00	-	-
10:00	-	43.08	-
11:00	-	-	56.59
12:00	-	49.57	49.57
13:00	-	52.71	52.71
14:00	-	-	55.77
15:00	-	49.53	49.53
16:00	-	49.58	49.58
17:00	15.64	-	-

*3.2*Orientation Film Theater *PAOT*

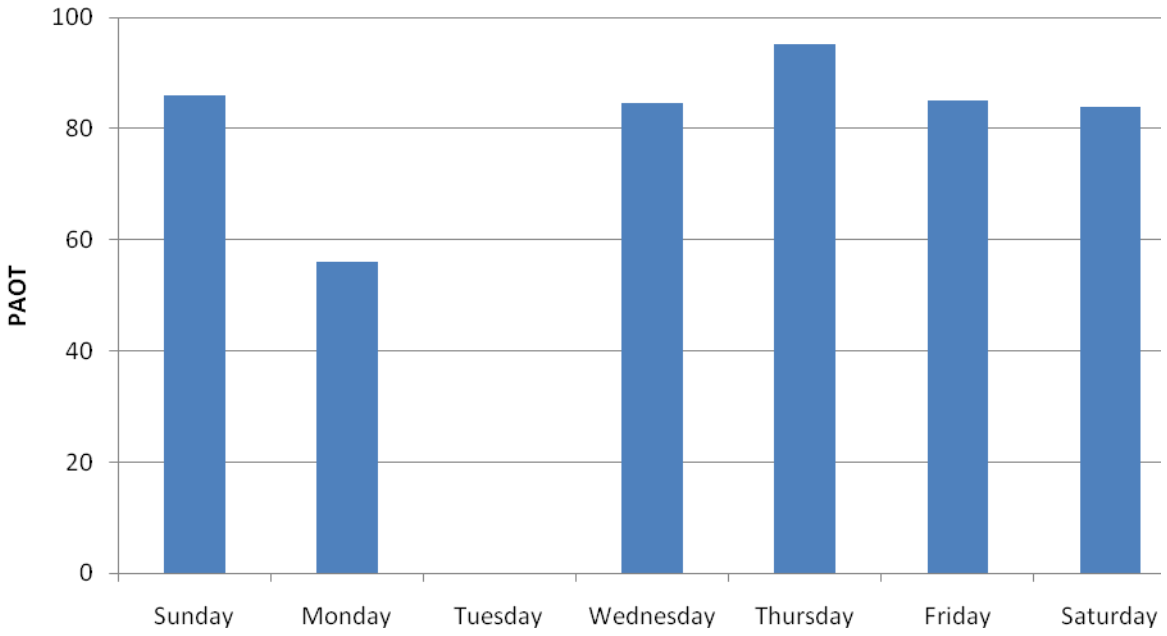
Counts of PAOT in the orientation film theater were conducted at 10 minute intervals between 9 AM and 6 PM on 20 days between July 9 and August 16, 2007. A total of 1,355 usable observations were collected (Table 30).

Table 30. Sampling Effort – Orientation Film Theater PAOT

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	11	-	-	5	9	5	10	40
10:00	12	1	-	6	15	6	13	53
11:00	18	6	-	12	18	30	30	114
12:00	12	6	-	9	12	27	24	90
13:00	18	6	-	12	18	30	30	114
14:00	15	3	-	9	15	18	21	81
15:00	13	6	-	10	12	25	26	92
16:00	6	6	-	6	6	24	18	66
17:00	3	4	-	4	5	15	8	39
Total	108	38	-	73	110	180	180	689

Daily average PAOT within C-D Street ranges between 56 and 95 (Figure 14). Daily average PAOT is highest on Thursdays, however there are no statistically significant differences in daily average PAOT across the days of the week (F=1.728, *p*=0.126).

Figure 14. Daily Average PAOT in the Orientation Film Theater, by Day of the Week



Percentages are reported in Table 31 to document the frequency with which various PAOT levels are exceeded in the orientation film theater. Overall, there are more than 68 PAOT in the theater 50% of the time between the hours of 9 AM and 6 PM; on weekends, there are more than 69 PAOT in the area 50% of the time. Overall, visitor use in the theater exceeds 143 PAOT only 10% of the time between the hours of 9 AM and 6 PM; on weekends, visitor use exceeds 171 PAOT only 10% of the time. The maximum level of visitor use observed in the film theater was 286 PAOT.

Table 31. Percent Time in Excess of PAOT in the Orientation Film Theater, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	19	20	18
50%	68	68	69
25%	143	143	140
10%	181	184	171
Maximum	286	254	286

Weekends and weekdays do not differ significantly, with respect to hourly average PAOT in the orientation film theater (Table 32 and Figure 15).

Table 32. Hourly Average PAOT in the Orientation Film Theater

Hour of the Day	Weekdays	Weekends
9:00	53.79	65.57
10:00	102.04	104.80
11:00	120.61	102.08
12:00	114.89	109.92
13:00	87.59	96.08
14:00	70.13	61.72
15:00	75.53	79.03
16:00	63.95	55.83
17:00	15.04	22.64

* Denotes statistically significant difference at $\alpha = 0.05$

Figure 15. Hourly Average PAOT in the Orientation Film Theater

Results of ANOVA post-hoc tests suggest that the peak period of visitor use on weekdays in the orientation film theater occurs between the hours of 9 AM and 3 PM (Table 33). Peak visitor use of the theater extends over a longer period, from 9 AM to 5 PM, on Weekends (Table 34).

Table 33. Weekday Hourly Average PAOT in the Orientation Film Theater

Hour of the Day	Statistically Different Grouping at α=0.05				
9:00	-	-	102.04	102.04	102.04
10:00	-	-	-	-	120.61
11:00	-	-	-	114.89	114.89
12:00	-	87.59	87.59	87.59	87.59
13:00	-	70.13	70.13	70.13	-
14:00	-	75.53	75.53	75.53	75.53
15:00	-	63.95	63.95	-	-
16:00	15.04	-	-	-	-
17:00	53.79	53.79	-	-	-

Table 34. Weekend Hourly Average PAOT in the Orientation Film Theater

Hour of the Day	Statistically Different Grouping at α=0.05	
9:00	65.57	65.57
10:00	-	104.80
11:00	-	102.08
12:00	-	109.92
13:00	-	96.08
14:00	61.72	61.72
15:00	79.03	79.03
16:00	55.83	55.83
17:00	22.64	-

3.3 Michigan Avenue *PPV*

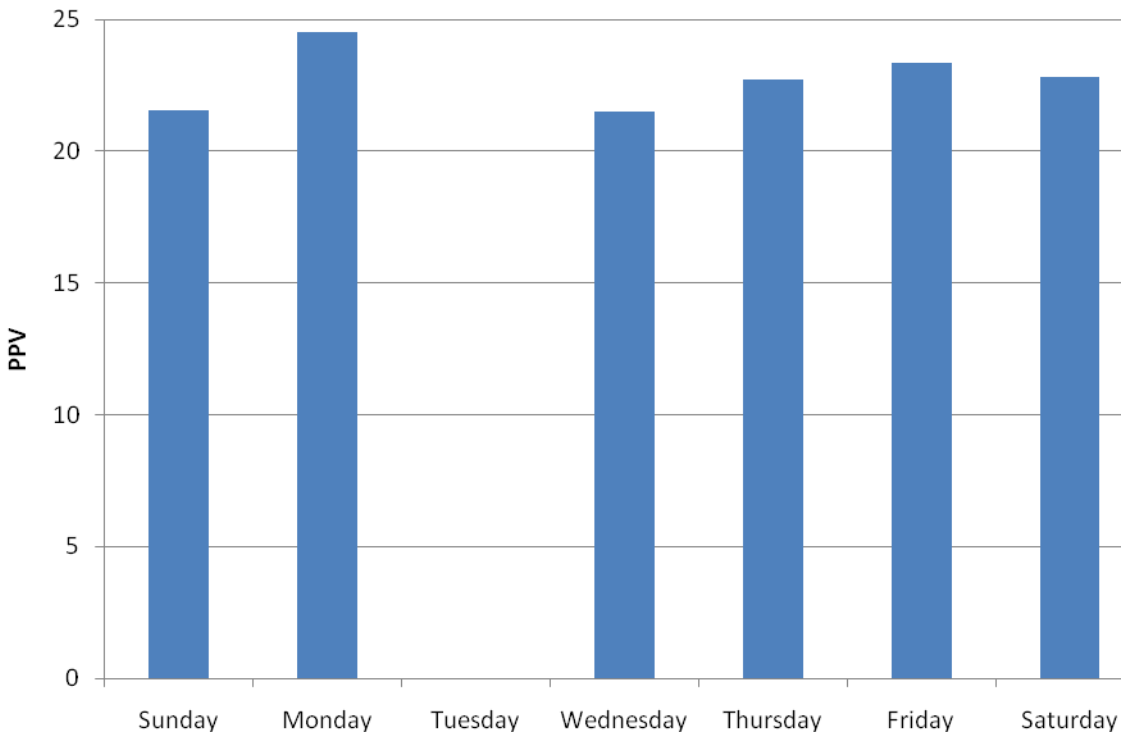
Photographic observations of PPV on Michigan Avenue were conducted at 15 minute intervals between 9:30 AM and 5:30 PM on 20 days between July 9 and August 16, 2007. A total of 513 usable observations were collected (Table 35).

Table 35. Sampling Effort – Michigan Avenue PPV

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	6		-	2	5	2	4	19
10:00	12		-	4	8	4	8	36
11:00	16	4	-	8	12	20	20	80
12:00	15	4	-	8	12	19	20	78
13:00	16	4	-	8	12	20	20	80
14:00	16	3	-	8	10	20	19	76
15:00	13	4	-	7	10	17	18	69
16:00	4	4	-	4	4	16	12	44
17:00	3	3	-	3	2	12	8	31
Total	101	26	-	52	75	130	129	513

Daily average PPV on Michigan Avenue ranges between 21 and 25 (Figure 16). Daily average PPV is highest on Monday, however there are no statistically significant differences in daily average PPV across the days of the week (F=1.291, *p*=0.266).

Figure 16. Daily Average PPV on Michigan Avenue, by Day of the Week



Percentages are reported in Table 36 to document the frequency with which various PPV levels are exceeded on Michigan Avenue. Throughout the week, there are more than 24 PPV on Michigan Avenue 50% of the time between the hours of 9 AM and 6 PM (Figure 17). Overall, visitor use on Michigan Avenue exceeds 31 PPV only 10% of the time between the hours of 9 AM and 6 PM (Figure 18); on weekends, visitor use exceeds 30 PPV only 10% of the time. The maximum number of visitors visible on Michigan Avenue was 38 PPV.

Table 36. Percent Time in Excess of PPV on Michigan Avenue, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	20	20	20
50%	24	24	24
25%	28	28	27
10%	31	31	30
Maximum	38	38	37

Figure 17. 24 PPV on Michigan Avenue

Figure 18. 31 PPV on Michigan Avenue

With the exception of the 11:00 AM hour, weekends and weekdays do not differ significantly, with respect to hourly average PPV on Michigan Avenue *(Table 37 and*

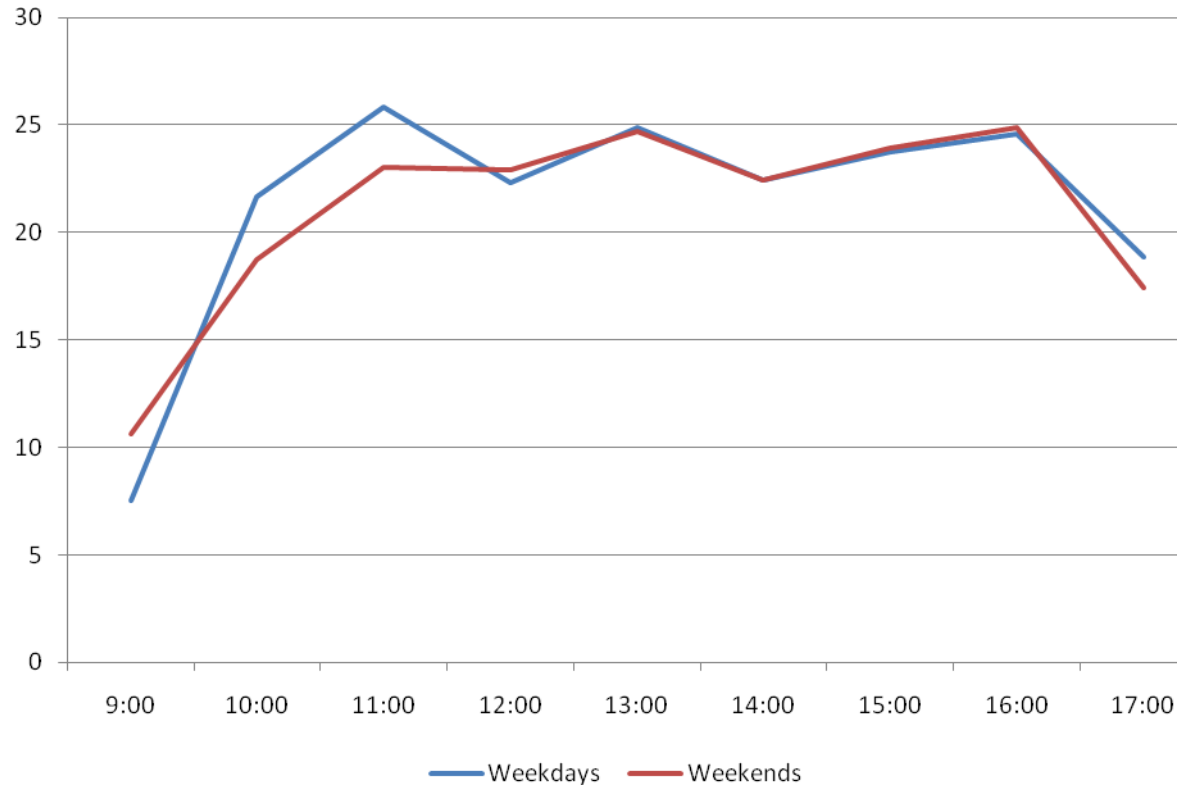
Figure 19).

Table 37. Hourly Average PPV on Michigan Avenue

Hour of the Day	Weekdays	Weekends
9:00	8	11
10:00	22	19
11:00*	26	23
12:00	22	23
13:00	25	25
14:00	22	22
15:00	24	24
16:00	25	25
17:00	19	17

* Denotes statistically significant difference at α = 0.05

Figure 19. Hourly Average PPV on Michigan Avenue



Results of ANOVA post-hoc tests suggest that, on both weekdays and weekends, the peak period of visitor use on Michigan Avenue, in terms of PPV, occurs between the hours of 10 AM and 5 PM (Table 38 & Table 39).

Table 38. Weekday Hourly Average PPV on Michigan Avenue

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	7.67	-	-
10:00	-	21.94	21.94
11:00	-	-	26.09
12:00	-	22.51	22.51
13:00	-	-	25.14
14:00	-	22.68	22.68
15:00	-	23.95	23.95
16:00	-	24.89	24.89
17:00	-	19.00	-

Table 39. Weekend Hourly Average PPV on Michigan Avenue

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	10.90	-	-
10:00	-	19.05	19.05
11:00	-	23.22	23.22
12:00	-	23.06	23.06
13:00	-	-	24.97
14:00	-	22.63	22.63
15:00	-	24.19	24.19
16:00	-	-	25.19
17:00	-	17.64	-

3.4 Michigan Avenue *Visitor PPV Evaluation*

With support from the Golden Gate Parks Conservancy, a survey of visitor evaluation of PPV on Michigan Avenue was conducted at 15 minute intervals between 10:00 AM and 5:15 PM on 20 days between July 9 and August 16, 2007. A total of 411 usable observations were collected (Table 40). 86.6% of solicited respondents agreed to participate in the survey.

Table 40. Sampling Effort – Michigan Avenue Visitor PPV Evaluation

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
10:00	8	-	-	3	5	3	3	22
11:00	14	4	-	7	12	18	23	78
12:00	7	2	-	6	7	18	14	54
13:00	9	6	-	5	11	18	19	68
14:00	12	2	-	9	11	14	15	63
15:00	8	4	-	6	10	16	16	60
16:00	4	4	-	3	4	16	12	43
17:00	2	2	-	3	2	8	6	23
Total	64	24	-	42	62	111	108	411

Upon completion of their audio tours, respondents were asked to reflect upon their experience on Michigan Avenue and choose the photograph from a poster, Figure 20, that most resembled the level of crowding they remembered experiencing on Michigan Avenue.

Figure 20. Visitor PPV Evaluation Poster

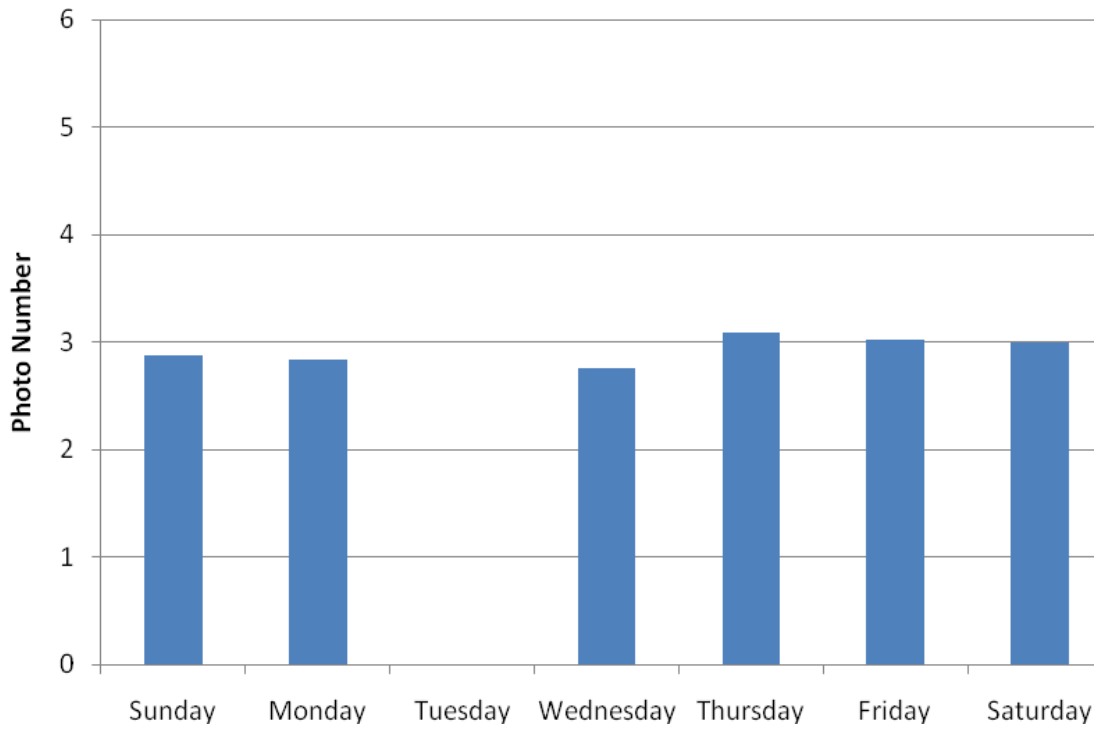
The visitor PPV evaluation poster depicts a range of PPV conditions on Michigan Avenue ranging from 10 PPV to 70 PPV (Table 41).

Table 41. Visitor PPV Evaluation Poster

Photo Number	PPV
1	10
2	22
3	34
4	46
5	58
6	70

Daily average visitor evaluation of PPV on Michigan Avenue ranges between 2.8 and 3.1 (Figure 21). Daily average PAOT is highest on Thursday, however there are no statistically significant differences in daily average visitor evaluations of PPV across the days of the week (F=1.145, *p*=0.336).

Figure 21. Daily Average Visitor Evaluation of PPV on Michigan Avenue, by Day of the Week



Percentages are reported in Table 42 to document the frequency with which visitors evaluated various PPV levels to be exceeded on Michigan Avenue. Throughout the week, visitors evaluate their PPV experience on Michigan Avenue as being most similar to conditions depicted in Photo 3 (34 PPV) 50% of the time. Overall, visitors perceive PPV on Michigan Avenue to reach or exceed 46 PPV (Photo 4) only 10% of the time.

Table 42. Percent Time in Excess of PPV on Michigan Avenue as Evaluated by Visitors, by Day of Week Category

Percent	All Days	Weekdays	Weekends
	Photo Number		
75%	2	2	2
50%	3	3	3
25%	3	3	3
10%	4	4	4
Maximum	6	6	5

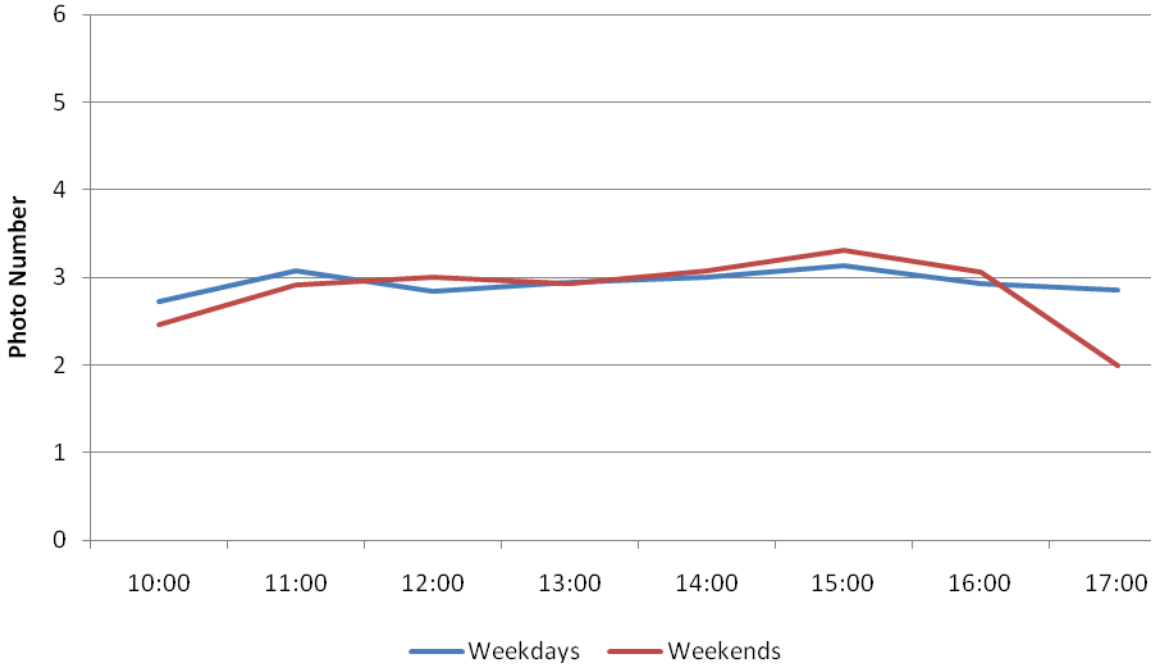
With the exception of the 5 PM hour, weekends and weekdays do not differ significantly, with respect to visitor evaluations of PPV on Michigan Avenue *(Table 43 & Figure 22).*

Table 43. Hourly Average PPV as Evaluated by Visitors on Michigan Avenue

Hour of the Day	Weekdays	Weekends
	Photo Number	
10:00	2.7	2.5
11:00	3.1	2.9
12:00	2.8	3.0
13:00	3.0	2.9
14:00	3.0	3.1
15:00	3.1	3.3
16:00	2.9	3.1
17:00*	2.9	2.0

* Denotes statistically significant difference at α = 0.05

Figure 22. Hourly Average PPV As Evaluated by Visitors on Michigan Avenue



Results of ANOVA post-hoc tests suggest that on weekdays there is no difference in visitor evaluations of PPV on Michigan Avenue by hour of the day (F=0.572, *p*=0.778). On weekends, ANOVA indicates that the visitor evaluations of PPV on Michigan Avenue peak between the hours of 11 AM and 5 PM (Table 44).

Table 44. Weekend Hourly Average PPV on Michigan Avenue as Evaluated by Visitors (Photo Number)

Hour of the Day	Statistically Different Grouping at α=0.05		
10:00	2.5	2.5	-
11:00	-	2.9	2.9
12:00	-	3.0	3.0
13:00	-	2.9	2.9
14:00	-	3.1	3.1
15:00	-	-	3.3
16:00	-	3.1	3.1
17:00	2.0	-	-

3.5 Michigan Avenue *PAOT*

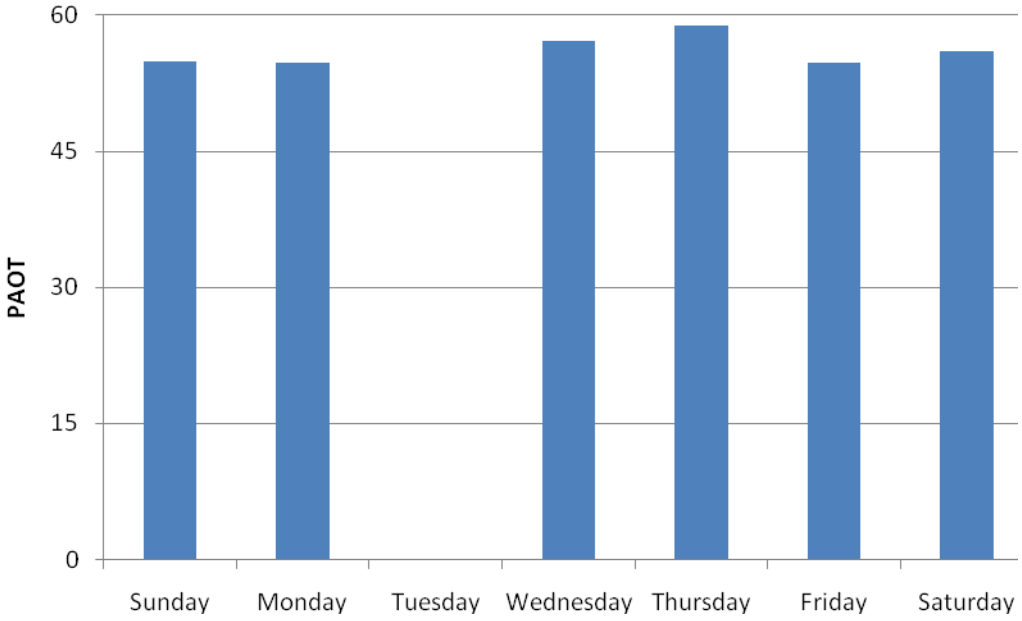
Photographic observations of PAOT on Michigan Avenue were conducted at 15 minute intervals between 9:30 AM and 5:30 PM on 20 days between July 9 and August 16, 2007. A total of 493 usable observations were collected (Table 45).

Table 45. Sampling Effort – Michigan Avenue PAOT

Hour of the Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	*Total*
9:00	6	-	-	2	4	4	4	20
10:00	11	-	-	4	9	4	8	36
11:00	15	4	-	8	12	20	20	79
12:00	12	4	-	7	10	20	18	71
13:00	15	4	-	8	12	20	20	79
14:00	12	3	-	7	10	15	17	64
15:00	13	4	-	7	10	17	18	69
16:00	4	4	-	4	4	16	12	44
17:00	3	3	-	3	2	12	8	31
Total	91	26	-	50	73	128	125	493

Daily average PAOT on Michigan Avenue ranges between 55 and 57 (Figure 23). Daily average PAOT is highest on Thursday, however there are no statistically significant differences in daily average PAOT across the days of the week (F=0.541, *p*=0.745).

Figure 23. Daily Average PAOT on Michigan Avenue, by Day of the Week



Percentages are reported in Table 46 to document the frequency with which various PAOT levels are exceeded on Michigan Avenue. Throughout the week, there are more than 58 PAOT on Michigan Avenue 50% of the time between the hours of 9 AM and 6 PM (*Figure 24*). Overall, visitor use on Michigan Avenue exceeds 77 PAOT only 10% of the time between the hours of 9 AM and 6 PM (*Figure 25*); on weekends, visitor use exceeds 76 PAOT only 10% of the time. The maximum number of visitors on Michigan Avenue was106 PAOT.

Table 46. Percent Time in Excess of PAOT on Michigan Avenue, by Day of Week Category

Percent	All Days	Weekdays	Weekends
75%	47	48	47
50%	58	59	57
25%	67	68	67
10%	77	78	76
Maximum	106	106	100

Figure 24. 58 PAOT on Michigan Avenue

Figure 25. 77 PAOT on Michigan Avenue

With the exception of the 12:00 PM hour, weekends and weekdays do not differ significantly, with respect to hourly average PAOT on Michigan Avenue *(*

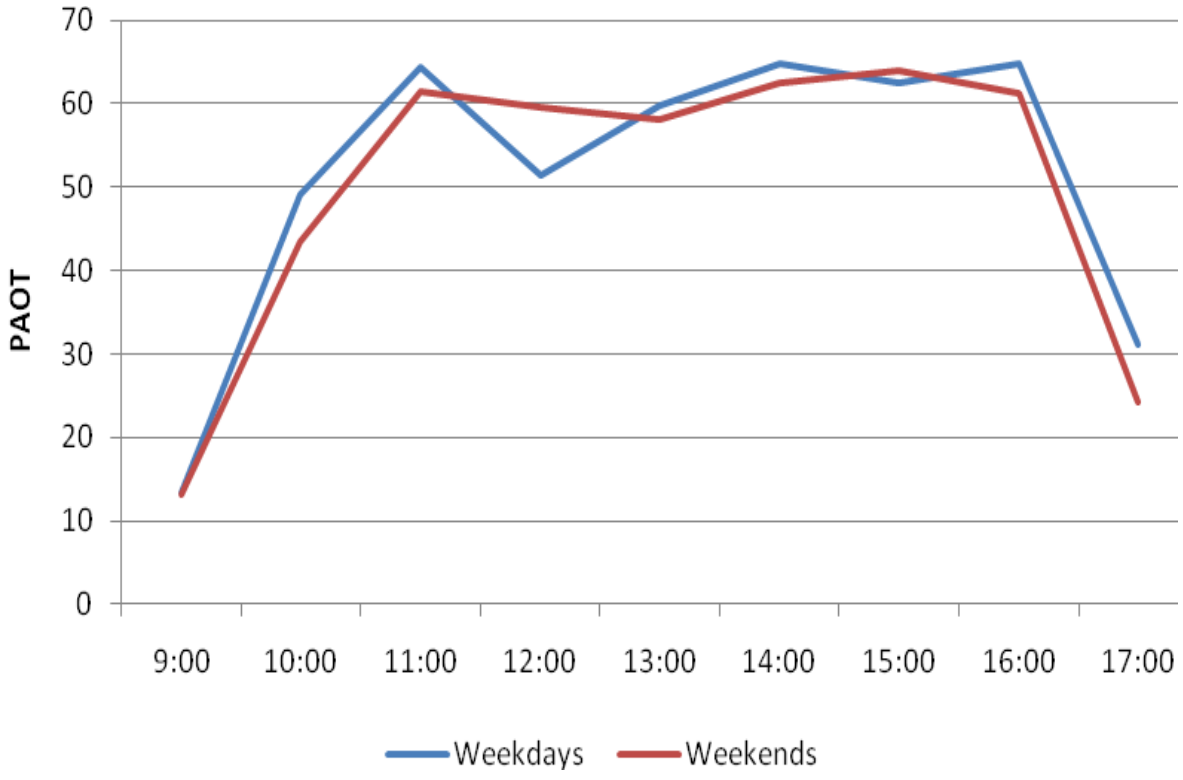
Table 47 and Figure 26).

Table 47. Hourly Average PAOT on Michigan Avenue

Hour of the Day	Weekdays	Weekends
9:00	13	13
10:00	49	43
11:00	64	61
12:00*	51	60
13:00	60	58
14:00	65	620
15:00	63	64
16:00	65	61
17:00	31	24

* Denotes statistically significant difference at α = 0.05

Figure 26. Hourly Average PAOT on Michigan Avenue



Results of ANOVA post-hoc tests suggest that, on both weekdays and weekends, the peak period of visitor use on Michigan Avenue, in terms of PAOT, occurs between the hours of 11 AM and 5 PM (Table 48 and Table 49).

Table 48. Weekday Hourly Average PAOT on Michigan Avenue

Hour of the Day	Statistically Different Grouping at α=0.05				
9:00	13.38	-	-	-	-
10:00	-	-	49.29	-	-
11:00	-	-	-	-	64.41
12:00	-	-	51.39	51.39	-
13:00	-	-	59.91	59.91	59.91
14:00	-	-	-	-	64.89
15:00	-	-	-	62.58	62.58
16:00	-	-	-	-	64.79
17:00	-	31.20	-	-	-

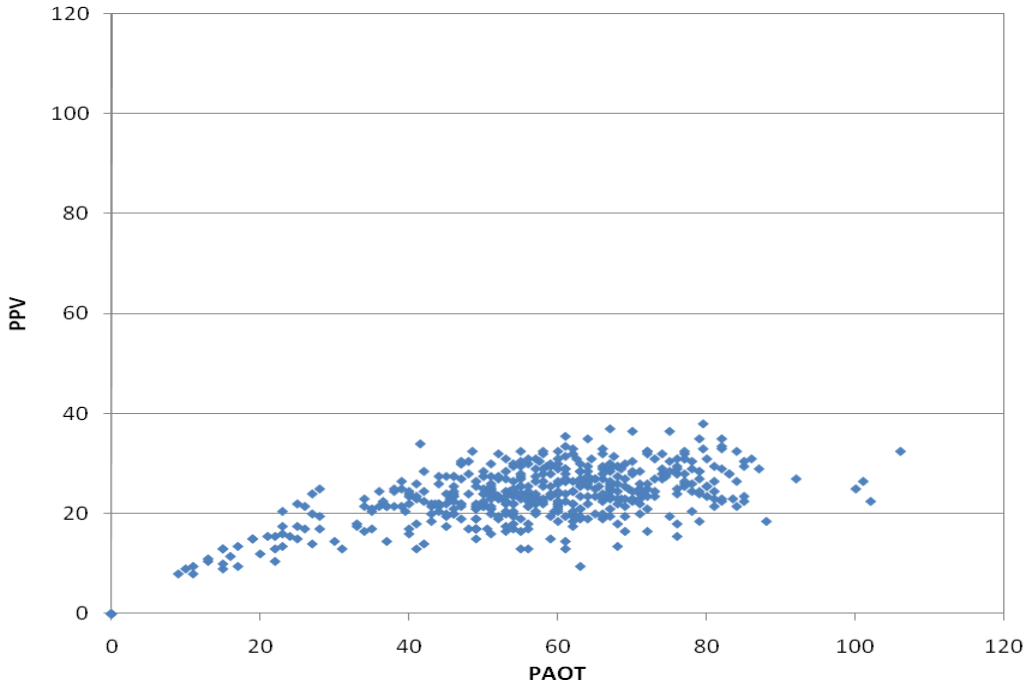
Table 49. Weekend Hourly Average PAOT on Michigan Avenue

Hour of the Day	Statistically Different Grouping at α=0.05		
9:00	15.70	-	-
10:00	-	43.37	-
11:00	-	-	61.40
12:00	-	-	59.67
13:00	-	-	58.14
14:00	-	-	62.48
15:00	-	-	63.97
16:00	-	-	61.19
17:00	24.148	-	-

3.6 Michigan Avenue PAOT – PPV Relationship

Four hundred eighty nine (489) of the PAOT and PPV photographic observations collected on Michigan Avenue can be paired based on their time of collection (). Through regression modeling the number of visitors on Michigan Avenue visible from its southeast end (PPV) can be predicted from the total number of people observable on Michigan Avenue (PAOT).

Figure 27. Paired Photographic Observations of PAOT & PPV on Michigan Avenue



The linear regression model used to predict PPV on Michigan Avenue from PAOT within that space is presented in Equation 1.

Equation 1: PPV = β (PAOT)

The specific regression model presented in Equation 2 accounts for 94.3% of the variation in the paired PAOT – PPV observations (R^2 = 0.943).

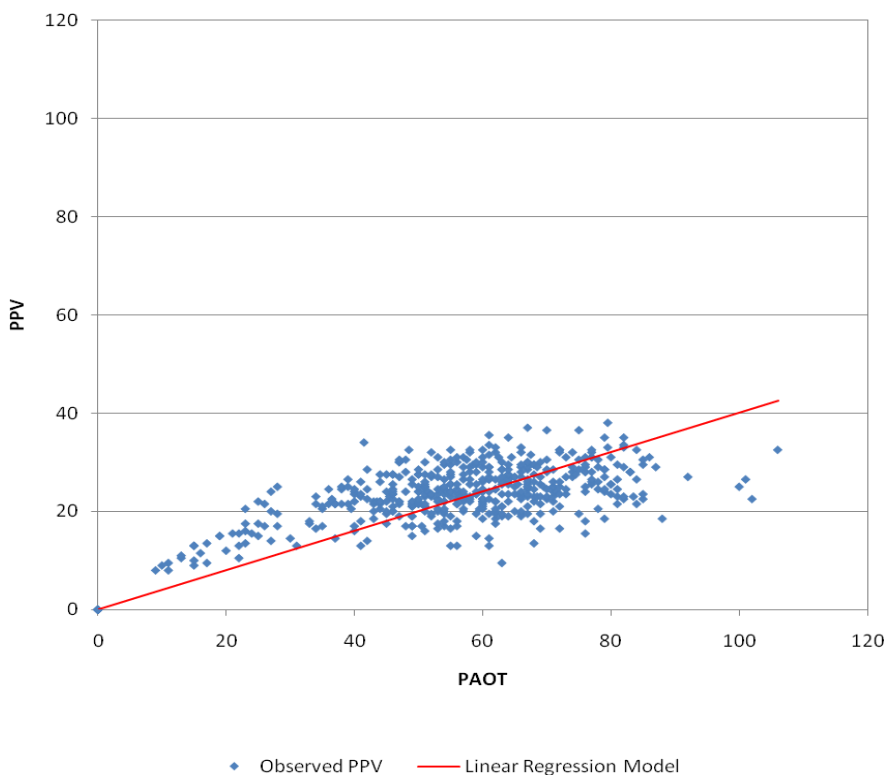
Equation 2: PPV = 0.402 (PAOT)

Table 50 presents further parameters of the regression model. Figure 28 plots this regression model over the paired PAOT – PPV observations.

Table 50. PAOT – PPV Regression Model for Michigan Avenue

β	Standard Error	T Value	*P* Value	Confidence Interval Bounds	
				Lower	Upper
0.402	0.004	89.789	< 0.001	0.394	0.411

Figure 28. PAOT – PPV Regression Model for Michigan Avenue



While the regression model presented in Equation 2 and depicted in Figure 28 provides the best lineal fit through the observed PAOT – PPV data, some details should be noted to properly interpret and apply these findings. At low PAOT levels, generally less than 35 to 40 visitors on Michigan Avenue, the regression model may underestimate the number of visitors visible from the southeast end of Michigan Avenue. As PAOT levels increase PPV also increases, until approximately 60 PAOT is reached. As PAOT increases beyond this point, PPV growth levels asymptotically to approximately 30 to 40 PPV. In predicting constant increases in PPV with rising PAOT, the regression model overestimates PPV at higher PAOT levels. This interpretation is lent support by the maximum observed PPV level of 38 presented in Table 36. Therefore, this study concludes that PPV on Michigan Avenue reaches a maximum of approximately 40 PPV regardless of increasing PAOT. While noting these underestimations (at low PAOT levels) and overestimations (at high PAOT levels) of PPV, the regression model presented here accurately and adequately predicts PPV from PAOT under the majority of use level conditions observed on Michigan Avenue.

The regression model was used to estimate the number of people visible on Michigan Avenue (PPV), given varying numbers of people within the entire Michigan Avenue space (PAOT, Table 51). For example, results of these computations suggest that four visitors will be visible from the southeast end of Michigan Avenue when 10 visitors are on the entirety of Michigan Avenue; when PAOT exceeds 50, 20 PPV can be expected. It should be noted, however, that these estimates represent general expectation with respect to the number of visitors visible given total use levels. Factors not explained by the statistical model, including the location of interpretive sites along Michigan Avenue and the timing and routing of the cellhouse audio tour may also influence the relationship between PAOT and PPV. That being said, the results provide a reliable empirical basis for generalizing about the relationship between total visitor use on Michigan Avenue and the number of individuals visible from the observation location at the southeast end of the corridor.

Table 51. Estimated Number of Visitors Visible on Michigan Avenue as a Function of Total Number of Visitors on Michigan Avenue at One Time

Observed PAOT	Predicted PPV	Observed PAOT	Observed PPV
5	2	60	24
10	4	70	28
20	8	80	32
30	12	90	36
40	16	100	40
50	20		

Figures 29 through 34 present paired PAOT and PPV observations that depict the relative levels of use (PAOT) and visibility (PPV) as described by the regression model.

Figure 29. 20 PAOT on Michigan Avenue, July 17th 5:30 PM

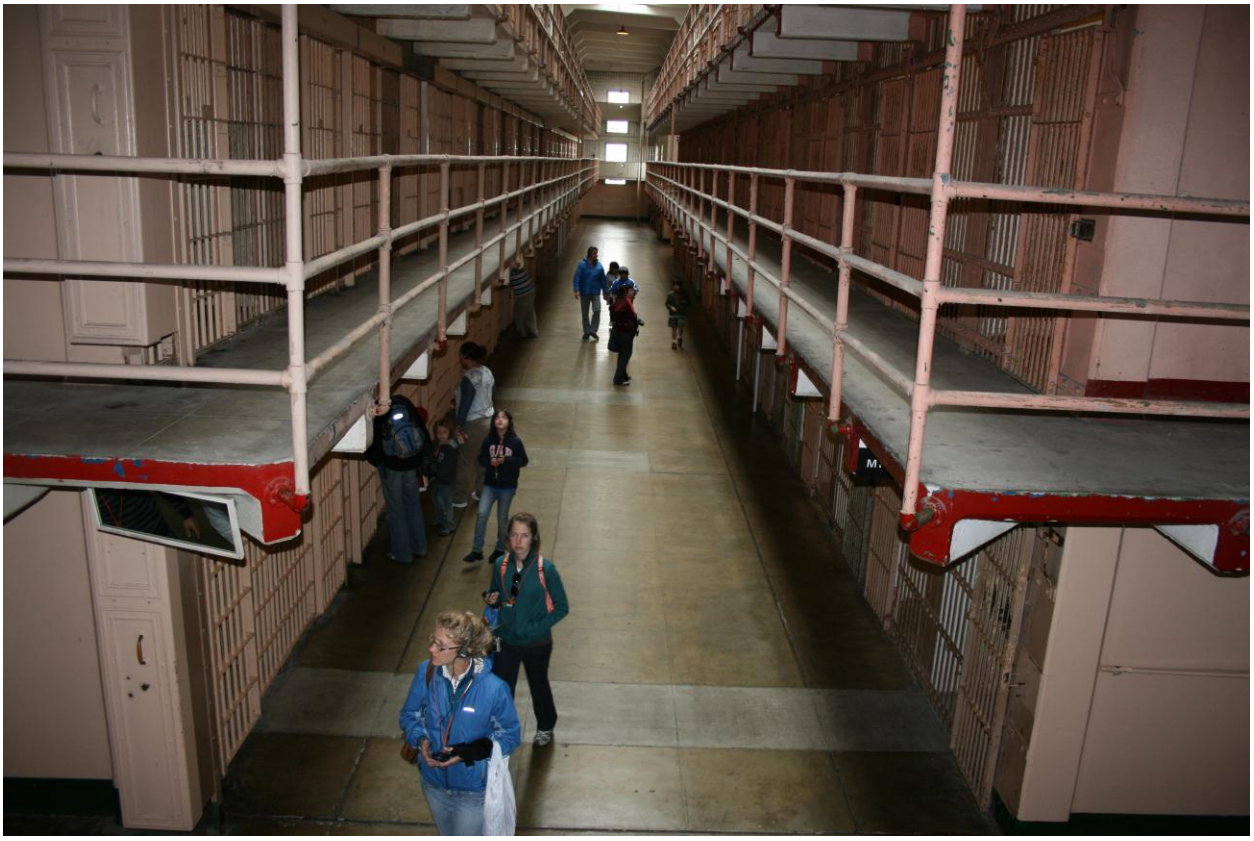


Figure 30. 12 PPV on Michigan Avenue, July 17th 5:30 PM

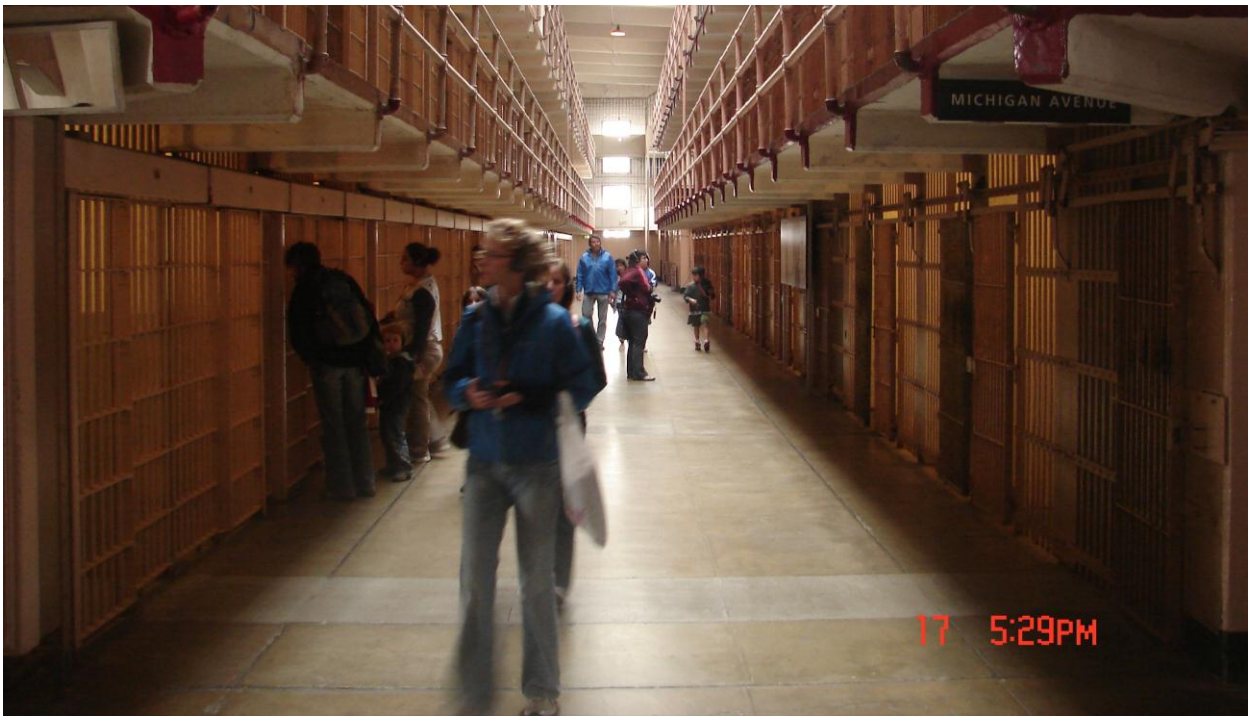
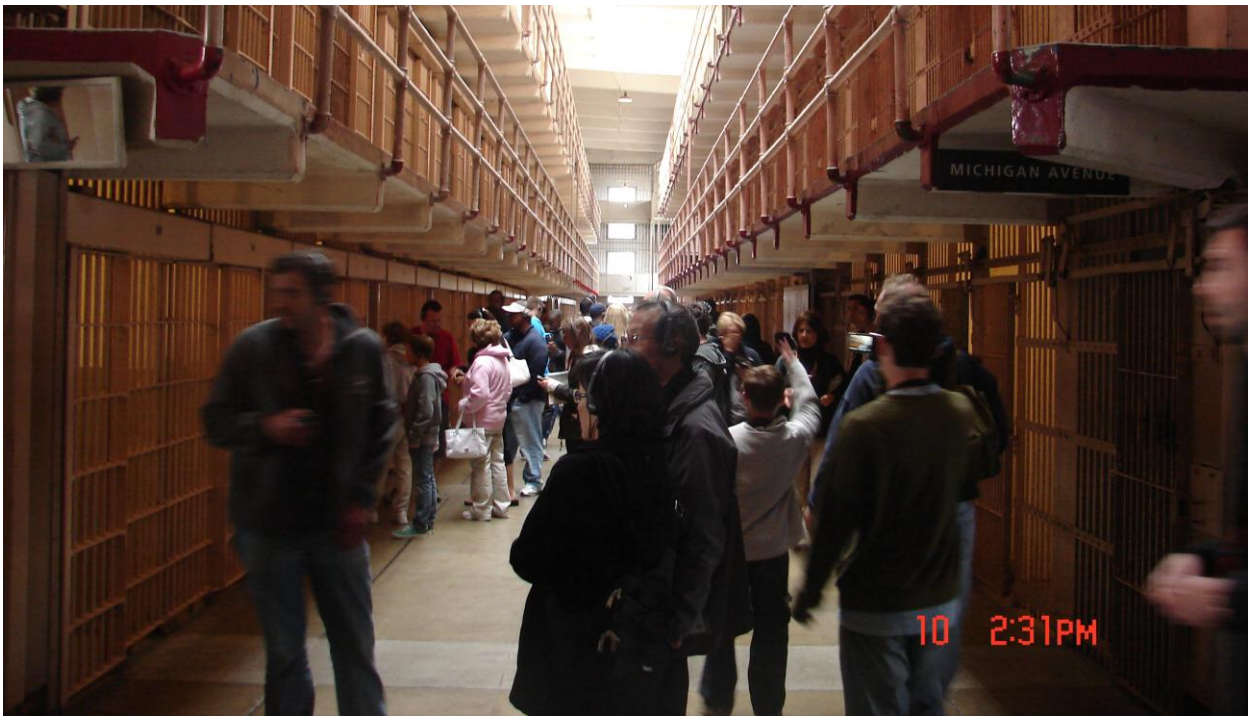


Figure 31. 50 PAOT on Michigan Avenue, July 16th 12:00 PM

Figure 32. 22 PPV on Michigan Avenue, July 16th 12:00 PM

Figure 33. 82 PAOT on Michigan Avenue, July 10th 2:30 PM

Figure 34. 34 PPV on Michigan Avenue, July 10th 2:30 PM



3.7 Integration of Results with Previous Research

Portions of the research presented in section three of this report is an expansion and reapplication of previous indicators and standards based visitor experience research conducted on Alcatraz Island since 1998. Specifically, the current research was designed to produce results that are comparable with the results of previous studies in two ways. One point of comparison between this and earlier studies is the visitor evaluation of PPV experienced on Michigan Avenue. The other specific point of comparison is the relationship between PPV and PAOT on Michigan Avenue. Additionally, some previous prescriptive research on visitor use levels for Michigan Avenue was conducted and may be of interest for review here.

3.7.1 Visitor Evaluations of PPV on Michigan Avenue: 1998, 2005, 2007 & 2009

Visitors were presented with, and asked for evaluations of, simulated PPV photographs (Figure 20) in studies conducted on Alcatraz Island in 1998, 2005, 2007 and 2009. The same photographs were used in each of these studies. Also, as part of each study, visitors were asked to select the photograph that most closely depicted the typical number of visitors they saw on Michigan Avenue. Each photograph contains a different number of people within view, as described in Table 41. When the number of individuals visible in the photographs selected by visitor respondents are averaged and compared across the four study years, a pattern of statistical differences emerges through ANOVA and pos hoc testing. The average PPV experienced by Alcatraz visitors on Michigan Avenue, as evaluated by visitors themselves through comparison of experienced condition with photographic simulations, was significantly lower in 2009 than in 2007, which was itself lower than the PPV experienced by visitors in 2005 and 1998 ($F=41.747$, $p<0.001$; Table 52).

Table 52. Average PPV on Michigan Avenue as Evaluated by Visitors through Photographic Simulation

Year of Study	Statistically Different Groupings at α=0.05		
1998	-	-	41
2005	-	-	42
2007	-	38	-
2009	34	-	-

3.7.2 PAOT–PPV Relationship on Michigan Avenue: 1999 & 2009

Primary among the aims of this research was to empirically examine the relationship between PAOT and PPV on Michigan Avenue. Earlier research beginning to examine this relationship was conducted with a discrete event simulation model. The model estimated PAOT on Michigan Avenue given specific use parameters. When those parameters were set to represent the levels of usage experienced by visitors who responded to the PPV photographic evaluation survey, discussed above, an average of 70 PAOT on Michigan Avenue was estimated. Via the photographic evaluations, visitors chose photographs that produced and average PVV of 35 on Michigan Avenue as being most similar to the conditions they experienced. This method of analysis suggests that there is an approximate 2 to 1 relationship between the number of people present on Michigan Avenue and the number of people visible from Michigan Avenue's southeast end. The empirical approach taken by the current research confirms and refines the results of the original, simulation based work. Through analysis of simultaneously collected photographic observations of PAOT and PPV this study finds an approximately 2.5 to 1 relationship between the number of persons present on Michigan Avenue (PAOT) and the number of visitors visible from Michigan Avenue's southeast terminus (PPV).

3.7.3 Potential Standards

The results of previous research reported thus far are descriptive, characterizing the conditions that exist in the Michigan Avenue area. While useful for monitoring crowding, these results have little to say about what the visitor experience ought to be. In 2002 prescriptive survey research was conducted to collect visitors' perspectives on the acceptability of crowding conditions and their preferences for visitor use levels in the Michigan Avenue area. The responses from this survey can be interpreted as potential standards of quality. These potential standards are thresholds for indicators of quality below which resource or experiential qualities fail to meet the requirements set by managers to achieve their objectives. While the establishment of standards of quality must ultimately be a judgment made by Alcatraz's manager, the perspectives of visitor can be helpful in the selection of standards.

The prescriptive research was conducted in a manner similar to and using the same simulated photographs as the visitor evaluations of PPV described in section 3.4. While considering the six photographs depicted in Figure 20 visitors were asked a series of questions to elicit their preferred visitor use level, the minimally acceptable use level, and the use level at which NPS should take action to manage crowds. The responses to these questions were transformed from their original format as photograph numbers to PPV values by interpolating between the numbers of individual depicted in each photo. At the most basic level, this research revealed that visitors generally preferred to see 25 PPV on Michigan Avenue and that at a PPV above 44 social condition of crowding became both unacceptable and warranted management action. While these prescriptive means can provide a gauge to help managers judge and interpret the results of monitoring programs on Michigan Avenue it is important that they be understood in context. The preferences of and minimally acceptable condition for visitors are but individual pieces of information managers should consider when establishing standards of quality. While important, these visitor evaluations should be accompanied by consideration of the sensitivity of resources to impacts, facilitation of access to the public, managerial capacities to manage visitor use and maintain resource qualities, and management objectives for cellhouse.

3.8 Monitoring Indicators of Quality

This study employed, and reports the results of, a number of techniques for monitoring indicators of experiential quality for visitors to the Alcatraz cellhouse. Those employed here include real-time counting, photographic observation, and visitor surveying. This versatile set of methods can collect data on a range of indicators of quality from objective densities to visitor perceptions. The lessons learned from this study's application of monitoring techniques can inform managers about their relative strengths and weaknesses. Consideration of such requirements as time, technology, staff, etc. can facilitate both the quality and sustainability of a monitoring program. This section reviews the relative strengths and weakness of the monitoring techniques employed in this study, also introducing addition techniques of potential.

3.8.1 Real-Time Counting

Real-time counting, as termed here, is the counting of visitors as they occupy the study space. This study employed live counts to monitor PAOT in the orientation film theater and at the C-D Street intersection. A strength of live counting is the immediacy of data generation. Upon conclusion of a count, a data point has been generated and ready for inclusion in analysis. This hastens progress from data collection to analytical result and limits resource requirements for post-processing of raw data. In live counts conducted by this study a single technician walked through there area in a "sweep" pattern, counting individuals they went. The counts were conducted on five minute intervals, requiring the constant attention of a dedicated staff person but yielding high quality data. Beyond the time and data-processing characteristics of live counts, the practicality of live counting vis-à-vis time and space must be considered. As spaces become larger, more crowded, and more complicated live counting becomes more difficult and resource intensive. Multiple entrances to spaces, in particular, can pose difficulty in collecting accurate counts, allowing the number of individuals to change unobserved by a single technician. This problem can be mitigated with the use, and commitment, of multiple technicians.

3.8.2 Photographic Observation

Photographic observation employs a camera to record raw data in the field and technicians to processes it afterward, coding the data for analysis. This study used photographic observation on Michigan Avenue to monitor PAOT and PPV indicators. Photographic observation creates a rich raw data set from which many variables can be extracted. The photographs create a record of visitor use conditions at a moment in time, more closely realizing the "at one time" and "per view" elements of crowding indicators than can the real-time counts described above. Additionally, they preserve literal snapshots of indicator conditions for other uses including visualization and future data mining. There are technological requirements for photographic observation, including camera equipment and photo-editing software, but these need not be exorbitant or complex. The expense of photographic observation comes in the form of time involved in post-processing and coding photographs. While collecting the raw photographic data requires at most an individual to periodically operate the shutter or at least the installation of a timer-operated camera, extraction of usable analytical data from the photographs is repetitive and time consuming. Digital photos must be opened in photo-editing software, the individuals apparent in the photograph inspected, differentiated, coded and counted, the count recorded, and the coded photograph saved and filed. Generally speaking, this process can take between five and fifteen minutes per photograph depending on level of crowding, quality of the photograph and computer processing speed. Thus, processing one day's worth of photos for this study could have taken as much as 6 hours, nearly an additional day. With training and diligence, this burden can be minimized, but data post-processing is a necessary commitment when working with photographic observations.

3.8.3 Visitor Surveys

Rather than collecting direct observations of visitor use and crowding, surveys ask visitors to report their perceptions of the conditions they experienced. This study employed a visitor survey, funded by the Golden Gate National Parks Conservancy, to monitor crowding on Michigan Avenue. Its basis in visitors' own perspectives and perceptions can be understood as this monitoring method's greatest strength. If the objective of managers is to provide for high quality visitor experiences, then asking visitors what they experienced is perhaps the more relevant way of examining crowding than abstracted counts or periodic

photographs. Similar to the real-time counts above, usable data is made relatively accessible with visitor survey without extensive post-processing. The implementation of a visitor survey based monitoring program does, however, involve an element of complexity not present with other monitoring methods – visitors themselves. Survey based indicator monitoring places a burden upon visitors, albeit a voluntary and minimal one, and requires sampling planning and collection and reporting of response rates. Additionally, the values generated through survey research are not as straight-forward as those generated by other, more direct monitoring methods. Each survey result is the product of an individual and reflects the uniqueness of that individual's emotional and intellectual totality, rather than the singular values generated by counting. Further, it is difficult to be certain that surveyed visitors are responding to the specific question posed to them or responding more generally with respect to their cumulative experience and preferences. Understanding these characteristics of survey based monitoring as limitations, survey based monitoring remains the only method that explicitly incorporates visitors' perceptions of crowding.

3.8.4 Simulation Modeling

While not employed in this study, simulation modeling could be an effective, efficient and flexible monitoring technique for visitor management on Alcatraz. A simulation model uses easy to collect data inputs, such as the number of visitors arriving to Alcatraz Island on each boat, and a simplified representation of visitor movement to estimate use levels at locations and in ways that align with indicators of crowding and quality. Developing the model requires an initial data collection effort to characterize the routing and scheduling of visitor movement around the island and cellhouse and validate the estimates generated by the model. After this initial effort, however, managers will have a tool able not only to monitor indicator conditions throughout the island but also test alternative management scenarios for their affects on experiential quality.