Appendix L. Lake Lowell Recreation Data

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Deer Flat National Wildlife Refuge—Lake Lowell Water Based Recreation Data Summary

By Rudy M. Schuster

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U.S. Geological Survey

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Deer Flat National Wildlife Refuge—Lake Lowell Visitor Use Data Summary

By Rudy M. Schuster

Introduction

Established in 1909, Deer Flat National Wildlife Refuge is one of the oldest refuges in the National Wildlife Refuge System. The Refuge has two units, Lake Lowell and the Snake River Islands. The Lake Lowell Unit is 10,636 acres and includes the almost 9,000-acre Lake Lowell and surrounding lands. The Refuge offers the six priority wildlife-dependent activities (fishing, hunting, wildlife observation, wildlife interpretation, wildlife photography and environmental education) as defined in The National Wildlife Refuge System Administration Act as amended by the Refuge System Improvement Act of 1997 as well as other non-wildlife-dependent activities. The purpose of this study is to describe use characteristics of recreational boaters on Lake Lowell. This study does not address use in other parts of the Refuge or other recreational activities.

The sampling and data collection consisted of observations of boat activity made from fixed vantage points on the west and east pools of Lake Lowell to develop vessels-at-one-time (VAOT) estimates for three areas: the West Pool, the Headquarters section of the East Pool, and the East section of the East Pool. A complete description of the sampling locations and a map are provided below.

Traffic counters were also used to collect data on the number of vehicles entering the parking lots. Data were collected between April 15 and September 30, 2011.

Sampling Methods: Lake Lowell

Boater Observation Data Collection Methods

Observers were located on-shore at three vantage points (see Figure 1) that provided a view of activity on the Lake. The observers collected data in 20 minute intervals (three times an hour). Based on the sampling blocks (described below), there was a maximum of 10 observation periods when vessels were counted per sampling day, per observer. Boat activity was recorded the first time the boat was observed during the 20 minute observation period. However, any individual boat could be counted again at the next observation period. Thus, each observation is a stand-alone VAOT estimate for that observation period. The following data was collected at each observation period: time of day, type of vessel, and vessel size, activity, and speed. Compliance with the no-wake postings were recorded within the no-wake portion of the East section of the East Pool only since neither the Headquarters section of the East Pool or the West Pool have large no-wake zones. Data were collected on a field data sheet. Following each survey, weather conditions, average wind speed, average temperature, and water surface conditions were also recorded to summarize the conditions during the survey period. A copy of the boater observation data collection sheet can be found in Appendix 1. The observation categories are listed in Table 1.

Table 1. Categories for variables on observation collection sheet

Variable	**Categories**							
Vessel Type	Motorboat	Pontoon boat	Human powered	Sail boat	Personal watercraft	Kite board	Wind surfer	Other

Speed	Idle	Slow	Plowing	Cruising	Planing	Under Sail	Paddling
Activity	Travel	Milling	Skiing & Tubing	Fishing	Recreation-other		
Size	Less than 16 feet	16 to 25 feet	26 to 39 feet				

Travel was defined as a vessel moving through the survey area in a single direction from one point to another. Milling was assigned to vessels transitioning through the survey area in several directions (greater than two headings) with no apparent destination. Vessels classified as ski/tubing or fishing included only those that were actively engaged in those activities. The mere observation of fishing poles, skis, wakeboards, inner tubes, or other recreational equipment on a vessel did not result in an activity being classified as fishing or ski/tubing. Vessels classified as recreational included wind surfers and kite boarders, or vessels anchored with people swimming nearby or picnicking and not fishing and/or observing wildlife.

Speed classifications were qualitatively determined for each vessel pass observed in the survey area based largely on Gorzelany (2005). Speed classifications assigned to vessels under power included Idle, Slow, Plowing, Cruising, and Planing. Wind powered (i.e. under sail) and human powered (i.e. oar/paddle) speeds were recorded as applicable following the same criteria listed below. Speed classifications were defined as follows:

- Idle Speed – The minimum speed that maintains steerage of a vessel, or the speed at which a vessel is normally docked. Little or no displacement of water is observable from either the bow or stern, and the vessel remains level in the water at all times. This speed is estimated at approximately one to three miles per hour.
- Slow Speed – The speed at which all vessels are completely off plane and fully settled in the water. Some minimal water displacement at either the bow or stern (or both) may be observed. This speed is estimated at approximately five to seven miles per hour.

- Plowing Speed – An intermediate speed between cruising speed and slow speed. The bow of the vessel typically rides higher than the stern, and substantial displacement of water occurs. Depending on the size and type of vessel, plowing may occur at a variety of speeds. This speed designation is used specifically for vessels with planing-type hulls. For the purpose of this study, Plowing Speed is estimated at approximately eight to 10 miles per hour.
- Cruising Speed – A qualitative speed designation uniquely applied to a relatively fast moving vessel with a non-planing type hull (i.e. a pontoon boat or displacement hull vessel). This speed classification is identified by noticeable water displacement from the bow and/or stern and an observed speed faster than the previously defined speed classifications. Vessels at Cruising Speed are estimated to travel at speeds between 11 and 20 miles per hour.
- Planing Speed - A vessel traveling at sufficient speed to partially raise the bow out of the water. The majority of planing vessels are estimated to travel at speeds in excess of 15mph, however vessel planing speeds vary widely depending on vessel size and hull design.

Vessel speed was qualitatively determined and is therefore subject to individual observer interpretation. Physical and environmental factors, including wind speed/direction, may affect vessel speed as well as the degree of water displacement from the bow and/or stern. Observers were instructed to consider these factors and request the opinion of their fellow observer (when possible) if they were undecided between two vessel speeds. In instances where a decision between two speeds was difficult, observers selected the slower speed. This may provide a potential underestimate or more conservative assessment.

Boater compliance was evaluated for the no wake zone in the east section of the east pool and classified as either compliant (a vessel which is maintaining a speed that did not produce a wake) or non-compliant (a vessel that was determined to be producing a wake in an area posted as “no wake”). This assessment was made by the observer in the field.

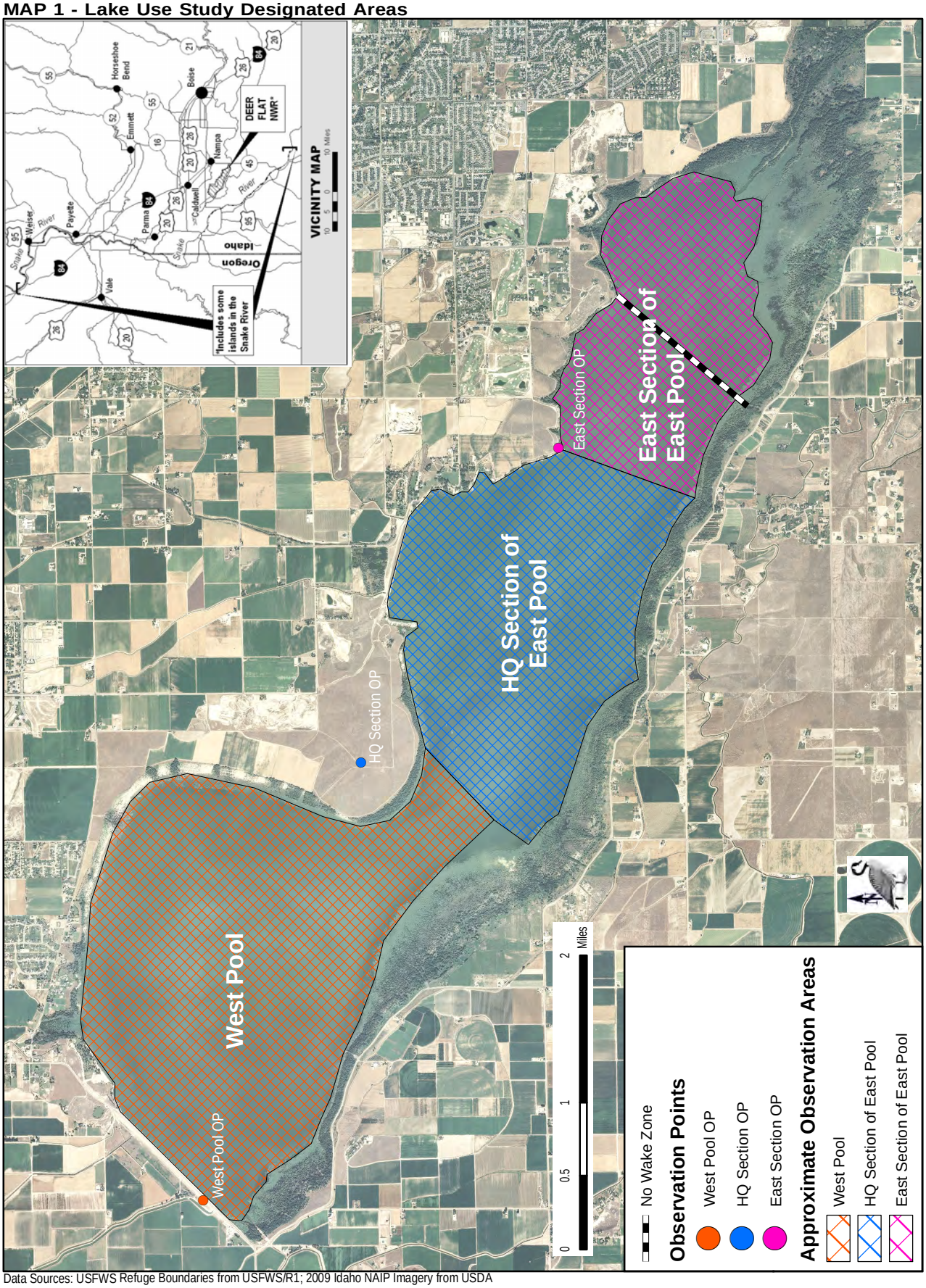
Efforts were made throughout the survey to ensure the quality and consistency of the data collected. Training sessions were conducted at each site prior to study commencement. The training session allowed the observers to gain familiarity with the field data collection sheets, data collection methods, and geographic characteristics unique to each survey site. Binoculars and spotting scopes were available to observers.

Boater Observation Sampling Locations, Time Blocks, & Sampling Schedule

Use levels on the Lake were organized into three categories: 1) Low use, 2) High use, and 3) Peak use days. *Peak use days* are times that are known to be the highest levels of use on the lake (e.g. Memorial Day, Labor Day). *High use days* are non-holiday days when use levels are known to be high (e.g. weekends in August, opening day). Finally, *low use days* are week days and other less popular times. For the purposes of this study, these use estimates were made based on the expert judgment of Refuge management.

Lake Lowell was organized into the following three use zones for the purpose of this study. The west pool was observed from the *Lower Dam* observation point. Two vantage points were necessary in the east pool due to the topography of the area; the east section of the east pool was observed from the *Viewing Platform* east of the Visitor Center (Headquarters section of the East Pool or Headquarters section) and the *Gotts Point* observation point (East section of the East Pool or East section). Refer to Map 1.

MAP 1 - Lake Use Study Designated Areas



Data Sources: USFWS Refuge Boundaries from USFWS/R1; 2009 Idaho NAIP Imagery from USDA
File: 12-005-9 Map Date: 05/03/2012

The plan included allowing observers to be in the field collecting data between 7am and 9pm. Five time blocks were used for the study. The blocks were three hours long; except for block 5 that was a two hour block. The time blocks used were: 7am to 10am; 10am to 1pm; 1pm to 4pm; 4pm to 7pm; and 7pm to 9pm. These time blocks accounted for the variation in recreation activity styles (e.g., morning fishing, afternoon water skiing, after dinner cruising). Actual observation times in the field were dependent on the random schedule generated and the availability of observers from the Refuge. The full sampling schedule can be found in Appendix 2. The schedule was stratified into the three zones on the Lake as described in the sampling location section. A combination of purposive and random methods were used to design the schedule. Peak use days were purposively sampled. Peak days represent potential boater conflicts and other stresses on the system that are important for management to identify and understand. Low and high use days were randomly selected.

The following definitions apply to the sampling schedule. A *Sampling Day* is a single date that sampling took place (e.g. April 15 or July 4). A S*ampling Block* is the three hour block that the field technician spends in the field. A *Sampling Episode* is when data is being collected from one of the vantage points (e.g. on April 15 observations will be made at the Gotts Point vantage point). An *Observation period* is when the field technician records boat data on the lake. One observation period occurs every 20 minutes, allowing for a maximum of 10 observation periods during each three hour sampling block.

There are a total of 169 potential sampling days between April 15, 2011 and September 30, 2011: 9 holiday days (3 holiday weekends), 42 regular weekend days, and 118 regular weekdays. The original sampling plan included the following. Each of the 3 lake zones would be sampled twice on peak use holiday weekends. This would result in a total of 6 sampling days during peak use times. Each zone would be sampled 3 times in each time block during high use days, resulting in 15 sampling days during

high use days. Finally, each zone would be sampled 4 days in each time block during low use times, resulting in 20 sampling days on low use days.

Minor modifications were necessary due to issues such as weather, availability of field personnel, and other unforeseen issues. Prior to each field day the data collection team consulted local weather forecasts to avoid poor weather that may influence boat traffic patterns or compromise personal safety. When possible, the next available sampling day of the same use type in the same use zone was selected to replace the missed sampling episode.

The final sampling schedule resulted in the following number of observations at each location: 903 observations at the west pool; 740 observations at the Headquarters section of the East Pool; and 453 observations at the East section of the East Pool. The data collection methods produced a diversity of types of use days (low, medium, and high), times of day, and locations on the Lake. However, the results may not apply to locations, days, and times of the day that were not included in the analyses.

Parking Lot and Vehicle Count Method

An NC-200 Portable Traffic Analyzer which utilizes Vehicle Magnetic Imaging was used to count vehicles entering the parking areas. These devices count vehicles in only one direction of travel. Traffic counters and support for using the counters was provided by U.S. Department of Transportation, Central Federal Lands Highway Division (CFLHD) located in Lakewood Colorado.

A sampling schedule was designed to collect traffic data from each of the use level days at five different parking areas. The parking areas were: 1) Upper Dam West Entrance, 2) Upper Dam East Entrance, 3) Parking Lot 1, 4) Lower Dam Recreation Area Entrance, and 5) Parking Lot 7. Traffic data collection consisted of setting up the counter and collecting data for 14 continuous days. This occurred twice for each parking area. The 14 day sampling periods included all three use level designations (low use days, high use days, and peak use days). The two week periods were: May 19 to June 1 and

September 1 to September 14. A technical issue meant that data were collected at Parking Lot 7 only in September.

A single set-up configuration was designed for each of the parking areas and used during both sampling episodes. A research technician was stationed at the parking area to do a one-time calibration of the traffic count method. For a two-hour period the observer counted the number of vehicles entering the area and the number of boats. Observer vehicle counts were compared to traffic counter data to confirm the accuracy of the counters.

A ratio of vehicles with trailers and without was established to estimate the total number of vessels entering the system on the sample days. The ratio was created using data from regular parking lot vehicle counts performed by Refuge staff and volunteers. One parking lot count consisted of a Refuge volunteer spending one hour in each parking lot and counting the number of vehicles, trailers, number of people per vehicle, and their apparent activity. Data were used from a total of 87 parking lot counts across all lots with traffic counters. Counts were conducted throughout the 2011 season (May to September), distributed across times of the day (morning, afternoon, evening), and conducted on weekdays and weekends. Specific day and time blocks for parking lot counts were determined by a pre-existing random sampling schedule established by the refuge.

Ratio weights were established by dividing the average number of trailers by the average number of vehicles observed during the observations for that lot. For example, if 100 vehicles entered a parking area and 50 of them were pulling trailers, the ratio weight used for that lot would be 0.50. A weight of 0.50 indicates that half of the vehicles were pulling trailers. Outliers in the data were adjusted because there is the possibility of peak use levels during holiday events. Any values beyond three standard deviations from the average were brought into the third standard deviation based on data for each individual lot. Only two outliers were identified and adjusted.

Results

Number of Vessels Observed

This section reports the number of vessels-at-one-time (VAOT) observed in the East section of the East Pool, Headquarters section of the East Pool, and West Pool for the particular time block. The range provides a sense of the variation in Lake use. The observations were made at 20 minute intervals. The data are stratified by the use level categories: weekday low use, weekend high use, and holiday peak use. The results are shown in Tables 2, 3, and 4.

East section of the East Pool

Use in the East section of the East Pool during low use and high use days was not very different; with the exception of one day when the peak number of vessels on a weekend day was 11. The highest number of vessels observed on the East section of the East Pool was 23 during the 4th of July weekend.

Table 2. East section of the East Pool: Low and Peak number of vessels during observation period

Date	Use Level Designation	Time interval	Low # vessels observed	Peak # vessels observed	Range
5/13/11	Weekday low use	1:00 pm to 3:40 pm	2	7	5
8/15/11	Weekday low use	4:00 pm to 6:40 pm	1	1	
9/16/11	Weekday low use	10:00 am to 12:40 pm	1	2	1
4/30/11	Weekend high use	1:00 pm to 3:40 pm	1	3	2
6/4/11	Weekend high use	10:00 am to 12:40 pm	6	11	5
7/16/11	Weekend high use	7:00 pm to 8:40 pm	3	8	5
8/14/11	Weekend high use	10:00 am to 12:40 pm	2	8	6
7/2/11	Holiday peak use	4:00 pm to 6:40 pm	11	23	12
9/5/11	Holiday peak use	10:00 am to 12:20 pm	1	8	7

Headquarters section of the East Pool

Peak use in the Headquarters section of the East Pool on low use days ranged from 1 to 11 vessels. Peak use on weekend high use days ranged from 4 to 51 vessels. However, the report of 51 is not consistent with other counts from this area. The observer indicated that the number was accurate and that July 10th 2011 was an unusually high use day. Holiday peak use days were similar to other weekend high use days; peak use ranged from 6 to 14. Use levels in the Headquarters section of the East Pool were consistent across the three use strata.

Table 3. Headquarters section of the East Pool: Low and Peak number of vessels during observation period

Date	Use Level Designation	Time interval	Low # vessels observed	Peak # vessels observed	Range
5/5/11	Weekday low use	10:00 am to 12:40 pm	1	11	10
5/23/11	Weekday low use	1:00 pm to 4:00 pm	1	2	1
6/24/11	Weekday low use	10:00 am to 12:40 pm	3	10	7
7/19/11	Weekday low use	7:40 pm to 8:20 pm	3	4	1
8/10/11	Weekday low use	1:00 pm to 3:40 pm	2	10	8
9/1/11	Weekday low use	12:00 pm to 12:20 pm	1	1	
9/26/11	Weekday low use	4:00 pm to 6:00 pm	1	3	2
4/24/11	Weekend high use	10 am to 12:40 pm	1	4	3
6/18/11	Weekend high use	1:00 pm to 1:20 pm	3	4	1
7/10/11	Weekend high use	4:30 pm to 7:00 pm	30	51	21
8/6/11	Weekend high use	10:00 am to 12:40 pm	5	11	6
8/28/11	Weekend high use	4:00 pm to 7:00 pm	1	13	12
5/30/11	Holiday peak use	1:00 pm to 4:00 pm	1	6	5
9/3/11	Holiday peak use	10 am to 12:40 pm	3	14	11

West Pool

Peak use in the West Pool on low use days ranged from 1 to 21 vessels. The peak of 21 vessels on August 5th 2011 was again not consistent with other low use day observations. The next highest report was 9. Weekend high use peak use ranged from 1 to 23 vessels. Finally, peak use on holiday peak use days ranged from 3 to 19 vessels. In general, the low use days are lower than both the weekend and holiday days. The weekend and holiday days were similar. The highest number of vessels observed in the West Pool was 23 at one time.

Table 4. West Pool: Low and Peak number of vessels during observation period

Date	Use Level Designation	Time interval	Low # vessels observed	Peak # vessels observed	Range
5/3/11	Weekday low use	9:00 pm to 9:40 pm	1	2	1
5/18/11	Weekday low use	11:00 am to 12:40 pm	2	1	1
6/29/11	Weekday low use	1:00 pm to 3:20 pm	2	2	
7/11/11	Weekday low use	10:00 am to 12:40 pm	3	5	2
8/5/11	Weekday low use	7:00 pm to 9:00 pm	10	21	11
8/23/11	Weekday low use	7:00 pm to 9:00 pm	1	9	8
9/21/11	Weekday low use	1:00 pm to 3:40 pm	4	8	4
4/16/11	Weekend high use	3:00 pm to 6:00 pm	3	19	16
5/7/11	Weekend high use	4:00 pm to 7:00 pm	1	1	
6/12/11	Weekend high use	10:00 am to 12:40 pm	1	21	20
7/24/11	Weekend high use	7:00 pm to 9:00 pm	4	21	17
8/20/11	Weekend high use	1:00 pm to 3:40 pm	6	23	17
5/29/11	Holiday peak use	10:00 am to 12:40 pm	1	3	2
7/3/11	Holiday peak use	7:00 pm to 8:40 pm	11	19	8

Boater Characteristic Description

Results of the boater characteristics data are reported in both raw numbers and percentages of boats observed. Percentages allow for comparison across the three pools. The observers collected data in 20 minute intervals; one observation every 20 minutes.

Vessel Type

Results of the vessel type data are shown in Table 5. The majority of vessels on Lake Lowell are motorboats. The Headquarters section of the East Pool has the most pontoon boats (3%) compared to the West Pool and East section of the East Pool (2% and <1%, respectively). The distribution of human powered boats was similar. Less than 1% of all boats observed were sailboats in the Headquarters section of the East Pool and none were observed in the West Pool or East section of the East Pool. The largest percentage of personal watercraft were observed in the Headquarters section of the East Pool (7%); closely followed by the West Pool (6%) and finally the East section of the East Pool (4%). No windsurfers were observed.

Table 5. Vessel type summary data for all observations

	West Pool		Headquarters section		East section		Total	
	#	%	#	%	#	%	#	%
Motorboat	799	88%	613	85%	415	92%	1827	88%
Pontoon Boat	19	2%	19	3%	1	<1%	39	2%
Human powered[1]	27	3%	30	4%	16	3%	73	3%
Sailboat			6	<1%			6	<1%
Personal watercraft	57	6%	54	7%	19	4%	130	6
Kite surfer								
Wind surfer								
Other	1	<1%					1	<1%
Total observations	903		722		451		2073	

[1]Kayak\canoe\float

Vessel Size

The vessel size data are shown in Table 6. Almost all of the vessels are 25 feet long or less. The majority are 16 to 25 feet long. The smaller vessels (<16 feet) appear to use the West Pool and Headquarters section of the East Pool more than the East section of the East Pool. Less than 1% of the vessels observed were larger than 25 feet. Most of them were observed in the West and Headquarters section of the East Pools.

Table 6. Vessel size summary data for all observations

	West Pool		Headquarters section		East section		Total	
	#	%	#	%	#	%	#	%
Less than 16 feet	134	14%	99	14%	37	8%	270	13%
16 to 25 feet	759	84%	615	85%	414	92%	1788	86%
26 to 39 feet	7	<1%	8	<1%			15	<1%
Total observations	900		722		451		2073	

Location in the Pool

The location data are shown in Table 7. The totals indicate that the majority of boaters were observed in open water. The East section of the East Pool had the largest variation with 64% on open water, 15% in emergent beds, 18% on the edge of emergent beds, and 3% at the bank. The West Pool had the second most variation and the Headquarters section of the East Pool was the most homogeneous.

Table 7. Location summary data for all observations

	West Pool		Headquarters section		East section		Total	
	#	%	#	%	#	%	#	%
Open Water	652	72%	602	83%	288	64%	1542	74%
Emergent bed	105	12%	24	3%	69	15%	198	9%
Edge of emergent bed	76	8%	40	6%	83	18%	199	9%
Bank	15	2%	7	<1%	11	3%	33	2%
Dock	55	6%	48	7%			103	5%
Total observations	903		721		451		2075	

Recreational boating activity

The recreational activity data are shown in Table 8. Most boats were engaged in some kind of activity when observed; the totals show that only 21% of observed vessels were traveling or milling. The most popular activity was fishing (38% of total observations). Fishing was the most popular activity on both the West Pool and the East section of the East Pool and second most popular on the Headquarters section of the East Pool. Skiing and tubing was the second most popular activity overall. Skiing and tubing was the most popular activity on the Headquarters section of the East Pool and second most popular on the West Pool and East section of the East Pool. Travel was the third most popular activity on all three pools.

Table 8. Activity summary data for all observations

	West Pool		Headquarters section		East section		Total	
	#	%	#	%	#	%	#	%
Travel	179	20%	149	21%	61	13%	389	19%
Milling	17	2%	17	2%	9	2%	43	2%
Skiing & Tubing	198	22%	209	29%	96	21%	503	24%
Fishing	360	40%	195	27%	238	53%	793	38%

Recreation[1]	91	10%	96	13%	45	10%	232	11%
Docked	57	6%	56	8%	2	1%	115	6%
Total observations	902		722		451		2075	

[1]Vessels classified as recreational included wind surfers and kite boarders, or vessels anchored with people swimming nearby or picnicking and not fishing and/or observing wildlife.

Activity summary for locations in pools

Tables 9, 10, and 11 show that the majority of people in all three Pools were located in open water (East section 72%; HQ section 83%, West Pool 64%). The most popular activities in open water were consistent in the three pools: skiing & tubing, fishing and travel. Almost all of the boats in the emergent beds and on the edge of the emergent beds were being used for the activity of fishing.

Table 9. Location of Activities in West Pool

	Travel		Milling		Skiing & Tubing		Fishing		Recreation		Docked		Total
	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#
Open Water	162	25%	16	2%	196	30%	191	29%	84	13%	2	<1%	652
Emergent Bed	4	4%					100	95%	1	1%			105
Edge of Emergent Bed	6	8%	1	1%	2	3%	67	88%					76
Bank	5	33%					1	7%	6	40%	3	20%	15
Dock	2[2]	4%					1	2%			52	95%	55

1Percentage of vessels being used for this activity of the total number of vessels observed in this location
2 Two vessels were observed pulling away or approaching the dock and were classified as traveling while in proximity to the dock.

Table 10. Location of Activities in Headquarters section of the East Pool

	Travel		Milling		Skiing & Tubing		Fishing		Recreation		Docked		Total
	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#
Open Water	145	24%	17	3%	209	35%	136	23%	91	15%	4	1%	602
Emergent Bed	4	17%					20	83%					24
Edge of Emergent Bed							39	97%	1	3%			40
Bank									4	57%	3	43%	7
Dock											48	100%	48

1Percentage of vessels being used for this activity of the total number of vessels observed in this location

Table 11. Location of Activities in East section of the East Pool

	Travel		Milling		Skiing & Tubing		Fishing		Recreation		Docked		Total
	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#	%[1]	#
Open Water	60	21%	9	3%	95	33%	80	28%	44	15%			288
Emergent Bed	1	1%					67	97%	1	1%			69
Edge of Emergent Bed							83	100%					83
Bank					1	9%	8	73%			2	18%	11
Dock													

1Percentage of vessels being used for this activity of the total number of vessels observed in this location

Compliance with no wake zone

The compliance data for the no wake zone in the East section of the East Pool are shown in Table 12. Vessels were classified as either Compliant – A vessel which is maintaining a speed that did not produce a wake, or Non-compliant – A vessel that was determined to be producing a wake in an area posted as "no wake." Vessel speed was qualitatively determined and is therefore subject to individual observer interpretation. Physical and environmental factors, including wind speed/direction, may affect vessel speed as well as the degree of water displacement from the bow and/or stern. Observers were instructed to consider these factors and request the opinion of their fellow observer (when possible) if they were undecided between two vessel speeds. In instances where a decision between two speeds was difficult, observers selected the slower speed. This may provide a potential underestimate or more conservative assessment. A total of 346 vessels were observed in the East section of the East Pool no wake zone. Of the vessels in the no wake zone, 88% were compliant and 12% were not.

Table 12. Compliance summary for vessels in East section of the East Pool no wake zone

	#	%
Compliant	303	88%
Non-compliant	43	12%
Total observations	346	

Vessel Speed

The largest percentage of the observed vessels were idling (see Table 13). This is consistent with the recreational activity summary indicating that most vessels were fishing. The second largest category was planing. This is also consistent with skiing and tubing being second most popular activities and travel as the third most popular.

Table 13. Vessel speed summary data for all observations

	West Pool		Headquarters		East section of the East Pool		Total	
	#	%	#	%	#	%	#	%
Idle	439	49%	271	38%	268	59%	978	47%
Slow	118	13%	76	10%	16	4%	210	10%
Plowing	19	2%	11	1%	11	3%	41	2%
Cruising	31	3%	44	6%	22	5%	97	5%
Planing	296	33%	319	44%	128	28%	743	36%
Under sail			1	<1%			1	<1%
Paddling					6	<1%	6	<1%
Total observations	903		722		451		2076	

Summary of boater characteristics

The following description is based on the summary data in tables 5 through 13. The typical vessel on Lake Lowell is a motorboat between 16 to 25 feet in length and can be found in open water.

The most common activities people in the vessels participate in are fishing or skiing and tubing. Most of the vessels are not moving (fishing or standing) and many are moving at a planing speed while skiing and tubing. Of the vessels that do enter the no wake zone in the east section of the east pool, most comply with the no wake regulation.

Parking Lot Traffic Counter Data

The traffic counter data are displayed in Tables 14 through 29. One table is provided for each 14-day sampling episode and one summary table for each parking lot sampled. Vehicle trailer ratios were created as described in the methods section and used to estimate the number of trailers entering the system based on the traffic counts. This provides an estimate of the vessels being launched on Lake Lowell on a given day. The vehicle to trailer ratio weights, that indicate what portion of the vehicles in the parking lot are apparently pulling trailers, are shown in Table 14 for each parking lot. Parking Lot 1, the Lower Dam Entrance, and the Upper Dam East entrance had the largest trailer traffic of the five lots. Parking Lot 7 had the lowest vehicle to trailer ratio.

Table 14. Vehicle to trailer weighting ratios[1] from parking lot counts from 4/15-9/30/11

Parking Lot	Ratio/weight
Upper Dam West Entrance	0.52
Upper Dam East Entrance	0.70
Parking Lot 1	0.78
Lower Dam Recreation Area Entrance	0.73
Parking Lot 7	0.14

1Weighting ratios indicate the proportion of vehicles in the parking lot pulling trailers.

The summary descriptive statistics for the traffic counter data collected during all of the days in each of the parking lots is shown in Tables 15 and 16. The range and standard deviation are indicators of the variability in use at each parking lot. Given the difference in parking lot size it is not appropriate to

directly compare the variability between the lots. Within each lot a low range and standard deviation indicate that the amount of use at the parking lot is relatively consistent. A high range and standard deviation would suggest that use levels are variable.

Table 15. Summary descriptive statistics for vehicle traffic counts from magnetic counter

Parking Lot	Range	Minimum	Maximum	Average	Standard Deviation
Upper Dam West Entrance	105	32	137	70	28.9
Upper Dam East Entrance	180	62	242	110	38.2
Parking Lot 1	50	4	54	22	12.0
Lower Dam Recreation Area Entrance	601	99	700	240	147.9
Parking Lot 7	29	14	43	27	9.3

Table 16. Minimum, maximum and average number of trailers estimated using trailer weight ratios

Parking Lot	Minimum	Maximum	Average
Upper Dam West Entrance	17	71	36
Upper Dam East Entrance	43	169	77
Parking Lot 1	3	42	17
Lower Dam Recreation Area Entrance	72	511	175
Parking Lot 7	2	6	4

Parking lot traffic count results: Upper Dam West Entrance

The traffic counter data for the Upper Dam West Entrance are displayed in Tables 17, 18, and 19. The number of vehicles entering the Upper Dam West parking lot on low use weekdays ranged from 32 to 68 with 17 to 35 trailers respectively; and the average number of vehicles on low use days was 53 with 28 trailers. There was not much difference between the weekend high use and peak use day results. The number of vehicles on weekend high use days ranged from 69 to 124 (36 to 64 trailers). The

number of vehicles on peak use days ranged from 62 to 137 (32 to 71 trailers). The average for high use days was 99 and peak use days was 100 (52 and 51 trailers, respectively).

Table 17. Parking lot traffic count results: Upper Dam West Entrance, 5/19/11 to 6/1/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
5/19/11	Thursday	Weekday low use	40	21
5/20/11	Friday	Weekday low use	70	36
5/23/11	Monday	Weekday low use	33	17
5/24/11	Tuesday	Weekday low use	57	30
5/25/11	Wednesday	Weekday low use	38	20
5/26/11	Thursday	Weekday low use	39	20
5/27/11	Friday	Weekday low use	32	17
5/31/11	Tuesday	Weekday low use	78	41
6/1/11	Wednesday	Weekday low use	54	28
5/21/11	Saturday	Weekend high use	114	59
5/22/11	Sunday	Weekend high use	69	36
5/28/11	Saturday	Holiday peak use	62	32
5/29/11	Sunday	Holiday peak use	72	37
5/30/11	Monday	Holiday peak use	109	57

[1]The vehicle to trailer weighting ratio is 0.52

Table 18. Parking lot traffic count results: Upper Dam West Entrance, 9/1/11 to 9/14/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
9/1/11	Thursday	Weekday low use	68	35
9/2/11	Friday	Weekday low use	47	24
9/6/11	Tuesday	Weekday low use	74	38
9/7/11	Wednesday	Weekday low use	59	31
9/8/11	Thursday	Weekday low use	64	33
9/9/11	Friday	Weekday low use	55	29
9/12/11	Monday	Weekday low use	51	27

9/13/11	Tuesday	Weekday low use	57	30
9/14/11	Wednesday	Weekday low use	51	27
9/10/11	Saturday	Weekend high use	90	47
9/11/11	Sunday	Weekend high use	124	64
9/3/11	Saturday	Holiday peak use	110	57
9/4/11	Sunday	Holiday peak use	112	58
9/5/11	Monday	Holiday peak use	137	71

[1]The vehicle to trailer weighting ratio is 0.52

Table 19. Average number of vehicles per day Upper Dam West Entrance

Use Level Designation	Average number of vehicles	Trailer Estimate[1]
Holiday peak use	100	52
Weekend high use	99	51
Weekday low use	53	28

[1]The vehicle to trailer weighting ratio is 0.52

Parking lot traffic count results: Upper Dam East Entrance

The traffic counter data for the Upper Dam East Entrance are displayed in Tables 20, 21, and 22. The number of vehicles entering the Upper Dam East parking lot on low use weekdays ranged from 62 to 123 with 43 to 86 trailers respectively; and the average on low use days was 90 vehicles with 63 trailers. There was overlap of the high use day and peak use day ranges. However, there appears to be the potential for extreme peak use levels at this parking area. The number of vehicles on weekend high use days ranged from 131 to 156 (92 to 109 trailers). The number of vehicles on peak use days ranged from 79 to 242 (55 to 169 trailers). The average for high use days was 142 and peak use days was 145 (99 and 102 trailers, respectively). The highest vehicle use count observed in this lot during the data collection was 242 on September 5, 2011.

Table 20. Parking lot traffic count results: Upper Dam East Entrance, 5/19/11 to 6/1/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
5/19/11	Thursday	Weekday low use	85	60
5/20/11	Friday	Weekday low use	123	86
5/23/11	Monday	Weekday low use	65	46
5/24/11	Tuesday	Weekday low use	110	77
5/25/11	Wednesday	Weekday low use	88	62
5/26/11	Thursday	Weekday low use	63	44
5/27/11	Friday	Weekday low use	65	46
5/31/11	Tuesday	Weekday low use	97	68
6/1/11	Wednesday	Weekday low use	62	43
5/21/11	Saturday	Weekend high use	156	109
5/22/11	Sunday	Weekend high use	134	94
5/28/11	Saturday	Holiday peak use	79	55
5/29/11	Sunday	Holiday peak use	111	78
5/30/11	Monday	Holiday peak use	152	106

[1]The vehicle to trailer weighting ratio is 0.70

Table 21. Parking lot traffic count results: Upper Dam East Entrance, 9/1/11 to 9/14/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
9/1/11	Thursday	Weekday low use	80	56
9/2/11	Friday	Weekday low use	107	75
9/6/11	Tuesday	Weekday low use	88	62
9/7/11	Wednesday	Weekday low use	92	64
9/8/11	Thursday	Weekday low use	102	71
9/9/11	Friday	Weekday low use	106	74
9/12/11	Monday	Weekday low use	102	71
9/13/11	Tuesday	Weekday low use	90	63
9/14/11	Wednesday	Weekday low use	106	74
9/10/11	Saturday	Weekend high use	148	104

9/11/11	Sunday	Weekend high use	131	92
9/3/11	Saturday	Holiday peak use	149	104
9/4/11	Sunday	Holiday peak use	140	98
9/5/11	Monday	Holiday peak use	242	169

[1]The vehicle to trailer weighting ratio is 0.70

Table 22. Average number of vehicles per day Upper Dam East Entrance

Use Level Designation	Average number of vehicles	Trailer Estimate[1]
Holiday peak use	145	102
Weekend high use	142	99
Weekday low use	90	63

[1]The vehicle to trailer weighting ratio is 0.70

Parking lot traffic count results: Parking Lot 1

The traffic counter data for Parking Lot 1 are displayed in Tables 23, 24, and 25. The number of vehicles entering Parking Lot 1 on low use weekdays ranged from 4 to 34 with 3 to 27 trailers respectively; and the average on low use days was 19 vehicles with 15 trailers. There was not much difference between the high use day and peak use day ranges. The number of vehicles on weekend high use days ranged from 13 to 54 (10 to 42 trailers). The number of vehicles on peak use days ranged from 12 to 47 (9 to 37 trailers). The average for high use days (31 vehicles) was higher than the average for peak use days (24 vehicles) (24 and 19 trailers, respectively). The highest vehicle count for Parking Lot 1 was observed during a regular high use weekend and not during a holiday peak use weekend (54 vehicles on May 22, 2011).

Table 23. Parking lot traffic count results: Parking Lot 1, 5/19/11 to 6/1/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
5/19/11	Thursday	Weekday low use	34	27
5/20/11	Friday	Weekday low use	30	23
5/23/11	Monday	Weekday low use	25	20
5/24/11	Tuesday	Weekday low use	20	16
5/25/11	Wednesday	Weekday low use	21	16
5/26/11	Thursday	Weekday low use	24	19
5/27/11	Friday	Weekday low use	29	23
5/31/11	Tuesday	Weekday low use	33	26
6/1/11	Wednesday	Weekday low use	22	17
5/21/11	Saturday	Weekend high use	43	34
5/22/11	Sunday	Weekend high use	54	42
5/28/11	Saturday	Holiday peak use	28	22
5/29/11	Sunday	Holiday peak use	16	12
5/30/11	Monday	Holiday peak use	47	37

[1]The vehicle to trailer weighting ratio is 0.78

Table 24. Parking lot traffic count results: Parking Lot 1, 9/1/11 to 9/14/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
9/1/11	Thursday	Weekday low use	4	3
9/2/11	Friday	Weekday low use	18	14
9/6/11	Tuesday	Weekday low use	13	10
9/7/11	Wednesday	Weekday low use	6	5
9/8/11	Thursday	Weekday low use	18	14
9/9/11	Friday	Weekday low use	16	12
9/12/11	Monday	Weekday low use	15	12
9/13/11	Tuesday	Weekday low use	8	6
9/14/11	Wednesday	Weekday low use	12	9
9/10/11	Saturday	Weekend high use	13	10
9/11/11	Sunday	Weekend high use	13	10

9/3/11	Saturday	Holiday peak use	16	12
9/4/11	Sunday	Holiday peak use	12	9
9/5/11	Monday	Holiday peak use	23	18

[1]The vehicle to trailer weighting ratio is 0.78

Table 25. Average number of vehicles per day Parking Lot 1

Use Level Designation	Average number of vehicles	Trailer Estimate[1]
Holiday peak use	24	19
Weekend high use	31	24
Weekday low use	19	15

[1]The vehicle to trailer weighting ratio is 0.78

Parking lot traffic count results: Lower Dam Recreation Area Entrance

The traffic counter data for the Lower Dam Recreation Area Entrance are displayed in Tables 26, 27, and 28. The number of vehicles entering the Lower Dam Recreation Area parking lot on low use weekdays ranged from 99 to 353 with 72 to 258 trailers respectively; and the average on low use days was 157 vehicles with 115 trailers. There was overlap between the high use day and peak use day ranges. There was also an extreme peak use value observed at this lot. The number of vehicles on weekend high use days ranged from 312 to 486 (228 to 355 trailers). The number of vehicles on peak use days ranged from 197 to 700 (144 to 511 trailers). The average for high use days was 387 and peak use days was 390 (283 and 285 trailers, respectively). The highest vehicle count observed during the data collection was 700 on September 5, 2011.

Table 26. Parking lot traffic count results: Lower Dam Recreation Area Entrance, 5/19/11 to 6/1/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
5/19/11	Thursday	Weekday low use	162	118
5/20/11	Friday	Weekday low use	353	258
5/23/11	Monday	Weekday low use	129	94
5/24/11	Tuesday	Weekday low use	174	127
5/25/11	Wednesday	Weekday low use	117	85
5/26/11	Thursday	Weekday low use	137	100
5/27/11	Friday	Weekday low use	112	82
5/31/11	Tuesday	Weekday low use	176	128
6/1/11	Wednesday	Weekday low use	200	146
5/21/11	Saturday	Weekend high use	405	296
5/22/11	Sunday	Weekend high use	486	355
5/28/11	Saturday	Holiday peak use	197	144
5/29/11	Sunday	Holiday peak use	216	158
5/30/11	Monday	Holiday peak use	357	261

[1]The vehicle to trailer weighting ratio is 0.73

Table 27. Parking lot traffic count results: Lower Dam Recreation Area Entrance, 9/1/11 to 9/14/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
9/1/11	Thursday	Weekday low use	138	101
9/2/11	Friday	Weekday low use	192	140
9/6/11	Tuesday	Weekday low use	161	118
9/7/11	Wednesday	Weekday low use	143	104
9/8/11	Thursday	Weekday low use	170	124
9/9/11	Friday	Weekday low use	115	84
9/12/11	Monday	Weekday low use	144	105
9/13/11	Tuesday	Weekday low use	111	81
9/14/11	Wednesday	Weekday low use	99	72
9/10/11	Saturday	Weekend high use	344	251
9/11/11	Sunday	Weekend high use	312	228

9/3/11	Saturday	Holiday peak use	380	277
9/4/11	Sunday	Holiday peak use	489	357
9/5/11	Monday	Holiday peak use	700	511

[1]The vehicle to trailer weighting ratio is 0.73

Table 28. Average number of vehicles per day Lower Dam Recreation Area Entrance

Use Level Designation	Average number of vehicles	Trailer Estimate[1]
Holiday peak use	390	285
Weekend high use	387	283
Weekday low use	157	115

[1]The vehicle to trailer weighting ratio is 0.73

Parking lot traffic count results: Parking Lot 7

The traffic counter data for Parking Lot 7 are displayed in Tables 29 and 30. Data were only collected for one two-week period in this lot. The number of vehicles entering Parking Lot 7 on low use weekdays ranged from 14 to 36 with 2 to 5 trailers respectively; and the average on low use days was 23 vehicles with 3 trailers. There was not much difference between the high use day and peak use day ranges. The number of vehicles on weekend high use days ranged from 23 to 42 (3 to 6 trailers). The number of vehicles on peak use days ranged from 26 to 43 (4 to 6 trailers). The average for high use days was 32 and peak use days was 35 (4 and 5 trailers, respectively).

Table 29. Parking lot traffic count results: Parking Lot 7, 9/1/11 to 9/14/11

Date	Day of week	Use Level Designation	Number of vehicles	Trailer Estimate[1]
9/1/11	Thursday	Weekday low use	19	3
9/2/11	Friday	Weekday low use	31	4
9/6/11	Tuesday	Weekday low use	18	3
9/7/11	Wednesday	Weekday low use	22	3
9/8/11	Thursday	Weekday low use	29	4

9/9/11	Friday	Weekday low use	36	5
9/12/11	Monday	Weekday low use	21	3
9/13/11	Tuesday	Weekday low use	19	3
9/14/11	Wednesday	Weekday low use	14	2
9/10/11	Saturday	Weekend high use	42	6
9/11/11	Sunday	Weekend high use	23	3
9/3/11	Saturday	Holiday peak use	26	4
9/4/11	Sunday	Holiday peak use	43	6
9/5/11	Monday	Holiday peak use	37	5

[1]The vehicle to trailer weighting ratio is 0.14

Table 30. Average number of vehicles Parking Lot 7

Use Level Designation	Average number of vehicles	Trailer Estimate[1]
Holiday peak use	35	5
Weekend high use	32	4
Weekday low use	23	3

[1]The vehicle to trailer weighting ratio is 0.14

Parking lot traffic count summary

The Lower Dam Recreation Area was the highest use lot and exhibited the largest variation in use levels with the highest individual count of vehicles (700 vehicles on September 5, 2011). Parking Lots 1 and 7 were similar in terms of use with averages of 22 and 27 respectively. However, Parking Lot 1 displayed greater variation in use with a range of 50 vehicles compared to 29 vehicles in Lot 7. Sampling occurred on both Memorial Day (5/28 to 5/30 2011) and Labor Day (9/3 to 9/5 2011) weekends. Parking lot counts were consistently higher on Labor Day weekend compared to Memorial Day weekend.

References Cited

Gorzelany, J.F., 2005 Recreational boater traffic surveys of Broward County, Florida: technical report submitted to Florida Fish and Wildlife Conservation Commission, 89 pp.

Appendix 1: Lake Use Observation Data Sheet

Lake Lowell Recreational Lake Use Study

Page #: of:

ZONE:	WEATHER:
DATE:	WIND SPEED / DIRECTION:
TIME WINDOW:	AVERAGE TEMPERATURE:
OBSERVER(S):	LAKE SURFACE CONDITION:

CODES

TYPE: motorboat (1), pontoon boat (2), human powered -kayak/canoe/float (3), sailboat (4), personal watercraft (5), kite boarder (6), wind surfer (7), other (8)

SIZE: less than 16 ft (1), 16 - 25 (2), 26 - 39 (3), 40 - 64 (4), 65 - 109 (5)

SPEED: Idle (0), Slow (1), Plowing (2), Cruising (3), Planing (4), Under sail (5) Paddling (6)

LOCATION: Open water (1), Emergent bed (2), edge of emergent bed (3), bank (4), Dock (5)

ACTIVITY: Travel (1), Milling (2), Skiing & tubing (3), Fishing (4), Recreation (5), Docked (6),

COMPLIANCE: Compliant (0), Non-compliance (1), Not Applicable (NA)

RECORD #	TIME	TYPE	SIZE	ACTIVITY	LOCATION	SPEED	COMPLIANCE	COMMENTS

Appendix 2: Boater Observation Sampling Schedule

date	use level	survey location	time block
Sunday, April 24, 2011	high	2=HQ Platform	2=10am to 1pm
Tuesday, April 26, 2011	low	1=lower dam	1=7am to 10am
Saturday, April 30, 2011	high	3=Gotts Point	3=1pm to 4pm
Thursday, May 05, 2011	low	2=HQ Platform	2=10am to 1pm
Saturday, May 07, 2011	high	1=lower dam	4=4pm to 7pm
Friday, May 13, 2011	low	3=Gotts Point	3=1pm to 4pm
Sunday, May 15, 2011	high	2=HQ Platform	1=10am to 1pm
Wednesday, May 18, 2011	low	1=lower dam	1=10am to 1pm
Monday, May 23, 2011	low	2=HQ Platform	4=4pm to 7pm
Sunday, May 29, 2011	peak	1=lower dam	2=10am to 1pm
Monday, May 30, 2011	peak	2=HQ Platform	3=1pm to 4pm
Saturday, June 04, 2011	high	3=Gotts Point	1=10am to 1pm
Tuesday, June 07, 2011	low	3=Gotts Point	5=7pm to 9pm
Sunday, June 12, 2011	high	1=lower dam	2=10am to 1pm
Thursday, June 16, 2011	low	1=lower dam	4=4pm to 7pm
Saturday, June 18, 2011	high	2=HQ Platform	3=1pm to 4pm
Friday, June 24, 2011	low	2=HQ Platform	2=10am to 1pm
Wednesday, June 29, 2011	low	3=Gotts Point	3=1pm to 4pm
Saturday, July 02, 2011	peak	3=Gotts Point	4=4pm to 7pm
Sunday, July 03, 2011	peak	1=lower dam	5=7pm to 9pm
Sunday, July 10, 2011	high	2=HQ Platform	4=4pm to 7pm
Monday, July 11, 2011	low	1=lower dam	2=10am to 1pm
Saturday, July 16, 2011	high	3=Gotts Point	5=7pm to 9pm
Tuesday, July 19, 2011	low	2=HQ Platform	5=7pm to 9pm
Sunday, July 24, 2011	high	1=lower dam	5=7pm to 9pm
Thursday, July 28, 2011	low	3=Gotts Point	1=10am to 1pm
Friday, August 05, 2011	low	1=lower dam	5=7pm to 9pm
Saturday, August 06, 2011	high	2=HQ Platform	1=10am to 1pm
Wednesday, August 10, 2011	low	2=HQ Platform	3=1pm to 4pm
Sunday, August 14, 2011	high	3=Gotts Point	2=10am to 1pm
Monday, August 15, 2011	low	3=Gotts Point	4=4pm to 7pm
Saturday, August 20, 2011	high	1=lower dam	3=1pm to 4pm
Tuesday, August 23, 2011	low	1=lower dam	5=7pm to 9pm
Sunday, August 28, 2011	high	2=HQ Platform	4=4pm to 7pm
Thursday, September 01, 2011	low	2=HQ Platform	1=10am to 1pm
Saturday, September 03, 2011	peak	2=HQ Platform	1=10am to 1pm
Monday, September 05, 2011	peak	3=Gotts Point	2=10am to 1pm
Friday, September 16, 2011	low	3=Gotts Point	2=10am to 1pm
Saturday, September 17, 2011	high	3=Gotts Point	5=7pm to 9pm
Wednesday, September 21, 2011	low	1=lower dam	3=1pm to 4pm
Monday, September 26, 2011	low	2=HQ Platform	4=4pm to 7pm

Appendix 3: Parking Lot Count Data Sheet

LAKE LOWELL PARKING LOT COUNTS

Date:_____ Weekend Weekday

Area: Lower Dam Upper Dam West Upper Dam East Parking Lot 1 or 7

Time Block: 7am to 9 am 1pm to 3pm 5pm to 7pm

Observer: _____

Time Start: _____ Time End:_____

Weather:_____

Time	Car	Truck/Van	Vehicle w/ Trailer			Motor-cycle	RV	Approx Length	Activity	Comment
			Motorized Boat	Nonmotorized Boat	Jet ski					

Activity: 1 = Fishing 2 = Water Skiing 3 = Jet skiing 4 = Sailing 5 = Other Recreation