

Opportunities for Solitude in Salt Lake Ranger District Wilderness Areas; Uinta-Wasatch-Cache National Forest

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Executive summary

Project Purpose:

The purpose of this project was to gather field-based data to inform the goals and standards for opportunities for solitude within the Twin Peaks, Mount Olympus, and Deseret Peak Wilderness areas in the Salt Lake Ranger District of the Uinta-Wasatch-Cache National Forest. The collected data, analysis, and final report can be used to inform management standards for monitoring solitude according to the National Minimum Protocol for Monitoring Outstanding Opportunities for Solitude and the Revised Forest Plan for the Uinta-Wasatch-Cache National Forest. This data, analysis, and report also provide a framework for the solitude element of the Wilderness Stewardship Performance Ratings, and will provide direction for the Salt Lake Ranger District's Wilderness areas solitude rating for the next 5-10 years.

Research Approach:

The research approach to this project involved multiple procedures. The main systems of data collection involved the use of GPS and infrared counter data to ascertain the number of recreational users within nine different monitoring areas in three separate designated wilderness areas. These procedures were repeated at each of the monitoring locations 10 times during the high-use summer season to best account for the wilderness areas being able to provide for a sense of solitude. The collected data were analyzed using both tabular comparisons of total groups and total encounters, as well as mapped to provide visual analyses of where encounters were most likely to occur within the nine monitoring areas, and to provide comparison across monitoring areas. The goals of this project were to a) provide an accurate set of data that can show perceived amounts of solitude within the district's highly used wilderness areas, b) identify if the opportunity for solitude can still be an expectation for those visitors within the medium-use and high-use areas of the three wilderness areas, and c) see if the Wilderness Recreation Opportunity Prescription that is highlighted in the Uinta-Wasatch-Cache Forest Plan has remained durable and accurate since its publication in 2003. It should be noted that the collected data and report will be used to inform future planning, but will not be a final decision document. This research report will assist in defining the measures and actions needed to collect solitude data and to provide direction in the analysis of the solitude data. The data collected from the opportunities for solitude monitoring will be taken into consideration in the future management of the Salt Lake Ranger District's wilderness areas, and in future Forest Plan Wilderness Prescriptions.

Project Conclusions:

Data and analyses from the nine monitoring areas demonstrate that use across the summer season is highly variable. Popular trails such as Lake Blanche (in Twin Peaks Wilderness) and Mount Olympus (in Mount Olympus Wilderness) have consistently high use and visitor encounters, while trails both nearby (i.e., Broads Fork, Butler Fork) and distant (i.e., Mill Fork) have much less documented use and visitor encounters. In addition to the high variability between trails within wilderness areas, there is also variability across time; trail use and encounters were higher during weekend and holiday periods than during the week, with some exceptions. Researchers have suggested some minor modifications in existing wilderness classification schemes so that these areas better represent actual visitor use tendencies during high use seasons. Data show that in many monitoring areas, the number of visitors using trails may exceed the intended quality of these wilderness areas. The Salt Lake Ranger District may need to continue steps designed to mitigate

overuse, and disperse increased numbers of outdoor recreationists that are expected with further population growth and recreational demand along the Wasatch Front. Finally, as many of these wilderness areas and trails also experience high use in non-summer seasons, there is a need for continued monitoring through an extension of this project to account for visitor use during winter and spring months, when the Uinta-Wasatch-Cache National Forest is thought to experience increased visitor use with snow-based recreation.

General Findings:

Visitor encounters were assessed in three wilderness areas (Twin Peaks Wilderness, Mount Olympus Wilderness, and Deseret Peak Wilderness) on the following nine monitoring areas (trails): Lake Blanche, Broads Fork, Cardiff Pass, Ferguson Canyon, Mount Olympus, Neff's Canyon, Butler Fork, Deseret Peak Loop, and Mill Fork. While campsites observed throughout the three wilderness areas were infrequent, the number of groups encountered were 429 groups in Twin Peaks Wilderness, 304 groups in Mount Olympus Wilderness, and 77 groups in Deseret Peak Wilderness. This total of 810 groups accounted for traveling encounters with a total of 2,462 visitors to the wilderness areas. Of the nine monitoring areas, Lake Blanche in the Twin Peaks Wilderness had the most visitor encounters (1,041 traveling encounters in 290 groups), while Mill Fork in the Deseret Peaks Wilderness had the fewest visitor encounters (43 traveling encounters in 17 groups) across the summer monitoring period. In addition to these metrics of traveling encounters with visitors in wilderness areas, researchers were also able to document overall encounters in monitoring areas, including traveling encounters outside of designated wilderness areas. Our research indicates that approximately 25% more groups and visitors were encountered in monitoring areas outside of wilderness boundaries, usually near trailheads, parking areas, and along the initial stretches of trail.

Infrared trail counters were installed on Lake Blanche, Broads Fork, and Mount Olympus trails. Trail counters indicated that Broads Fork and Mount Olympus trails each averaged approximately 200 visitors per week, while Lake Blanche averaged more than 600 visitors per week. These counts correspond with our researcher-documented trail encounter data, supporting the validity of both metrics. These data suggest that in these monitoring areas, the number of visitors using trails may exceed the intended quality of these wilderness areas.

Some general conclusions can be drawn from these data. There is a differential amount of solitude within the Salt Lake Ranger District's wilderness areas, with many visitor encounters concentrated on Lake Blanche and Mount Olympus trails. Other trails with higher visitor encounters include Ferguson Canyon, Deseret Peak Loop, and Butler Fork. Meanwhile, other trails within those same wilderness areas see much fewer encounters, such as Neff's Canyon, Mill Fork, and Cardiff Pass. In sum, substantially more visitors are encountered in Mount Olympus Wilderness and Twin Peaks Wilderness than in Deseret Peak Wilderness. These conclusions align with the spatial proximity of these wilderness areas to the metropolitan core of the Salt Lake Valley, with a high population concentration. It is unlikely that visitors can expect to gain a sense of solitude along Lake Blanche and Mount Olympus trails, though they may find solitude in other locations within the Twin Peaks Wilderness area and the Mount Olympus Wilderness area. There are subsequent recommendations for minor changes in wilderness classifications for some of the monitoring areas. This report

recommends that these findings be used to update the existing 2003 Uinta-Wasatch-Cache Forest Plan so that managers can best distribute visitors according to a matrix of resource availability, expected population geographies, and visitor interest.

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1.0 – Overview:

Congressionally designated wilderness areas constitute some of the most unique recreational opportunities for individuals seeking solitude, as these areas are managed to best preserve their unimpaired status. Wilderness areas, within some parameters, must provide visitors with a sense of solitude. In 2014, the U.S. Forest Service documented the minimum protocols for monitoring solitude in designated wilderness areas in national forests¹. In addition to these minimum standards, additional monitoring and documentation efforts may provide more robust understandings of wilderness solitude.

This document outlines data collection and data management strategies for monitoring solitude in three wilderness areas (Twin Peaks, Mount Olympus, and Deseret Peak) in the Salt Lake Ranger District of the Uinta-Wasatch-Cache National Forest. Sampling for the project took place across four months (June, July, August, and September) during the summer high-season of 2016. The following monitoring areas (including their wilderness classification, see below) in the Uinta-Wasatch-Cache National Forest were monitored for their respective opportunities for solitude:

Twin Peaks Wilderness:

- Lake Blanche/Mill B South (including Mount Superior) (class 1.3)
- Broads Fork (class 1.2)
- Cardiff Pass – Superior Peak
- Ferguson Canyon (class 1.2)

Mount Olympus Wilderness

- Mount Olympus Trail including summit and Bonneville Shoreline Trail (class 1.3)
- Neff's Canyon (class 1.2)
- Butler Fork/Mill A to Baker Pass (class 1.2)

Deseret Peak Wilderness

- Mill Fork to South Willow Lake (class 1.3/1.2)
- Eastern Front of the Deseret Peak Wilderness: peak loop trail (class 1.3)

A minimum of 10 days (5 weekdays and 5 weekends or holidays) of monitoring sessions were accomplished for each monitoring area. Dates for monitoring areas and trips were randomized (providing for a consistent work schedule) to provide a rigorous, representative, and more defensible dataset. With nine monitoring areas (in three different wilderness areas), a total of 90 monitoring days were needed.

¹ Please see the U.S. Forest Service National Minimum Protocol for Monitoring Outstanding Opportunities for Solitude document, which includes an overview, data collection procedures, forms, and definitions of terms.

1.1 – Monitoring Areas:

The following wilderness areas and monitoring sites within the Salt Lake Ranger District were chosen by USFS managers and researchers to best reflect the areas that may receive substantial visitor use. Below is a brief description of each monitoring area, including round-trip hiking mileage.

Twin Peaks Wilderness:

- Lake Blanche/Mill B South (to include Mount Superior)
 - 6.9 miles, 2,690 Vertical Feet, Class 1.3
 - Mill B South to Lake Blanche is a popular hiking experience due to the accessibility to lakes and craggy panoramic views.
- Broads Fork
 - 4.3 miles, 2,034 Vertical Feet, Class 1.2
 - Accessed from Mill B South, Broads Fork allows hiking access to Broads Fork Basin and a route to the Wasatch Mountains' highest peak, Twin Peaks.
- Cardiff Pass – Superior Peak
 - 2.1 miles, 846 Vertical Feet
 - Located in Little Cottonwood Canyon across from Snowbird and Alta Ski Resorts, Cardiff Pass is a steep climb to reach less-maintained trails to peaks such as Superior and Monte Cristo.
- Ferguson Canyon
 - 6.3 miles, 3,661 Vertical Feet, Class 1.2
 - Located between Big and Little Cottonwood Canyon, Ferguson canyon offers views of Salt Lake City as well as opportunities for rock climbing.

Mount Olympus Wilderness:

- Mount Olympus Trail including summit and Bonneville Shoreline Trail
 - 6.6 miles, 3,910 Vertical Feet, Class 1.3
 - Located southeast of downtown Salt Lake City, Mount Olympus is a popular hike close to town, with views of the Wasatch Mountains, the Oquirrh Mountains, and the Salt Lake Valley.
- Neff's Canyon
 - 6.2 miles, 2,982 Vertical Feet, Class 1.2
 - Located near Olympus Cove, Neff's Canyon is frequented by families from the surrounding neighborhoods, and is popular with dog owners.
- Butler Fork/Mill A to Baker Pass
 - 7.3 miles, 2,890 Vertical Feet, Class 1.2
 - Located 8 miles up Big Cottonwood Canyon, Butler Fork to Baker Pass is a scenic hike providing views of the Wasatch Mountains.

Deseret Peak Wilderness

- Eastern Front of the Deseret Peak Wilderness: peak loop trail
 - 9.2 miles, 4,032 Vertical Feet, Class 1.3
 - Deseret Peak offers access to an 11,000ft. peak, with a moderate climb to the summit, and panoramic views.

- Mill Fork to South Willow Lake
 - 7 miles, 1,786 Vertical Feet, Class 1.3/1.2
 - Located an hour from Salt Lake City, South Willow Lake offers views of the Stansbury Range outside of Grantsville, UT.

1.2 – Wilderness Opportunity Classes:

Because wildernesses vary dramatically in size and use, wildernesses have been classified into three types for this protocol, based on use level and trail miles from the national complexity classifications. These classifications come from the U.S. Forest Service National Minimum Protocol for Monitoring Outstanding Opportunities for Solitude:

- 1.1 Opportunity Class 1:** This area in existing Wilderness is characterized by an unmodified natural environment. Human induced change is temporary and minor. Outstanding opportunities for solitude and unconfined recreation are available for visitors, who travel in small groups, practice excellent Wilderness ethics, and spend extra effort to leave no trace. Encounters with others are rare.
- 1.2 Opportunity Class 2:** This area in existing Wilderness is characterized by predominately unmodified natural environment. Human induced change is evident, but will recover (slowly in higher elevation areas). Outstanding opportunities for solitude and unconfined recreation exist. Encounters with others are more frequent than Class 1.
- 1.3 Opportunity Class 3:** This area in existing Wilderness is characterized by predominately unmodified natural environment, but impacts could persist from year to year. During peak season and in popular areas concentrated use is more common and opportunities for solitude and unconfined recreation more limited.

These outlined opportunity classes have been already assigned to all of the nine monitoring areas within the three Salt Lake Ranger District Wilderness areas addressed, and will coincide with the National Minimum Protocol for Monitoring Outstanding Opportunities for Solitude.

National Minimum Protocol for Monitoring Outstanding Opportunities for Solitude.

The U.S. Forest Service published the National Minimum Protocol for Monitoring Outstanding Opportunities for Solitude in May of 2014. This protocol highlights “encounters,” which are defined as “specifically seeing or hearing other people during a wilderness trip.” Such encounters have been determined to be the best indicator of opportunities for solitude.

The protocols classify three types of Wilderness areas:

Type 1: “High” or “Medium” use wildernesses with > 75 miles of travel corridor; “Low” use wildernesses with > 100 miles of travel corridor.

Type 2: “High” or “Medium” use wildernesses with 1-75 miles of travel corridor; “Low” use Wildernesses with 1-100 miles of travel corridor.

Type 3: Wildernesses with no miles of travel corridor.

Subsequently, there are specific monitoring procedures outlined for the wilderness type, which is described below in the Methods.

2.0 – Introduction and Rationale:

A sense of solitude is one among many criteria that managers use to evaluate a landscape for inclusion as designated wilderness. The 1964 Wilderness Act declares that wilderness must provide outstanding opportunities for solitude or primitive and unconfined recreation. Solitude is thought to bring about connection to nature and a chance for reflection. Wilderness areas are required to be managed such that opportunities for solitude are available. In some wilderness areas, managers have assumed that outstanding opportunities must be provided everywhere, at all times. Others argue that if most of a wilderness remains unused, the wilderness does provide outstanding opportunities for solitude, even if it has several heavily used destinations. Whether managers decide to manage for solitude everywhere or just in some places, they must evaluate opportunities that exist.

Usually evaluating the presence of opportunities for solitude has been accomplished by monitoring encounters between groups. Encounters are seemingly objective and measurable, and a wealth of research suggests that encounters with other users and/or groups affect the overall quality of wilderness experiences. Monitoring opportunities for solitude is a substantial undertaking, as it requires significant hours of in-the-field research, with each monitoring session constituting at least four hours. Despite these human resource needs, these techniques are consistently considered superior to only using trail counters, as trail counters alone may not effectively capture appropriate visitor use data.

3.0 – Methods:

Monitoring sessions consisted of a member of the research team hiking the length of a trail over the course of multiple hours. During each monitoring session, there were a number of protocols that needed to be followed to ensure that the data collection process was adequate. All of the sessions occurred during a four-hour period within an 8:00 a.m. through 6:00 p.m. window for monitoring. During a monitoring session, the researchers carried a handheld Garmin Oregon 650t GPS device, an Olympus Tough Camera, and a clipboard for the data collection. With these tools the researchers were able to obtain all of the data for this study. Additionally, researchers were required to carry appropriate personal gear for the day (food, water, clothing, map, first aid, etc.) to support issues of field safety.

Once the researchers arrived at the monitoring area and/or trailhead, they began their field session by counting the number of vehicles in the parking area. The researcher took a photo of the parking area, and created a GPS waypoint of the location from which the photo was taken. They also recorded the time and waypoint name on a spreadsheet. This process established a baseline of how many people were potentially on the trail at the start of the monitoring session. After this process

was completed, the researcher then created another GPS waypoint at the start of the monitoring area trail and created a new track using the GPS device. At this point, the researcher then began hiking along the formalized trail. GPS waypoints were then created every time a researcher passed the wilderness boundary, also recording this information within the data spreadsheet as well. The main task of the researchers during the hiking portion of a monitoring session was the recording of visitor encounters, campsites, and other audio/visual readings which are not included in this report. For the encounters, the researchers created a waypoint and recorded the number of people within the group, which typically took place when passing visitors on an established trail. Further, data were recorded as to how many dogs were in the group, and if the group appeared to be of day use or overnight use.

Additionally, researchers stopped every half mile to record further trail data. During these half mile waypoints, the researcher also took a photo up the trail to show the view that they were seeing during the observation, as well as, a photo down the trail to simulate a return trip photo and observation. These half mile readings only occurred during the outgoing trip and not the return trip. Also, campsites were recorded in the same manner as encounters; a waypoint was created at its location, the number of people at the campsite was recorded, and the number of tents was recorded. Researchers also took a photo of campsites for documentation. When the researchers reached the turnaround point of the hike, they created a waypoint to signify the location where the outgoing trip stopped for the day. During the return trip, the researchers repeated all of the same procedures except for the half mile waypoints, readings, and photos. After the researchers reached the trailhead, they once again created a waypoint to signify the end of the return trip and monitoring for the day, and they also then recorded the amount of cars in the parking area, created a waypoint of their location, and took a photo. After this the researchers, had completed their monitoring for the day. Finally, data from infrared counters were used as well, to better understand wilderness use when researchers were not present. Such data is presented where available.

Once the all the data was collected, the researchers then began the mapping and tabulation processes. For one of the sets of figures in this project, the researchers created density maps. For these “heat maps,” the data shown for each monitoring area is completely relative to that area specifically, indicating that each map’s heat display does not relate to displays on other maps in this report. Heat maps are helpful when the data is so dense that it is difficult to see and analyze the data, regardless of the scale of the map. The data often appears to have a uniform distribution throughout the map, but a heat map can bring out differences in density across spatial scales. These maps show heat density of group encounters displayed from blue (meaning low density) to red (meaning high density). This visual effect provides an important display, because it shows which areas along these trails are most heavily trafficked during the monitoring sessions. Using the point density data, researchers calculated the likely (or expected average) encounters per mile of trail on a typical hiking day in the monitoring area. This calculation allows for increased comparability of different sized monitoring areas.

4.0 – Discussion:

Using encounter data for monitoring vast wilderness areas for opportunities for solitude is a massive undertaking, requiring thoughtful preparation, hundreds of human hours, and careful data management. In addition to the tabulated and comparable metrics of group encounters and traveling encounters, this research has extended these results visually and geographically by providing a series of maps that document the location of group encounters, as well as the relative

density of these encounters through heat maps. The combination of tabulated encounters and visualized encounters demonstrates that the total encounters do not take place in a vacuum, but in specific locations that have explainable and defensible assessments. This spatialization of the data provides a more thorough, nuanced perspective on existing encounter data, enabling managers to better allocate resources across particular monitoring areas. In the results that follow, researchers have provided tabulated results for all three wilderness areas (Twin Peaks, Mount Olympus, and Deseret Peak), as well as data for each of the nine specific monitoring areas. Additionally, each wilderness area, and each monitoring session, have a map of total encounters and the heat map of these encounters. The combination of these analytical techniques provides a comprehensive assessment of opportunities for solitude within the Salt Lake Ranger District wilderness areas.

5.0 – Results:

Within this section of the report, the data collected from this monitoring study is presented in tables and figures for each monitoring area, as well as for each wilderness area. The tables deconstruct the data between the *total* campsites, group encounters, and traveling encounters and also *wilderness* campsites, group encounters, and traveling encounters. Group encounters refers to the number of clearly distinct groups, while traveling encounters refers to the total number of people encountered.² Subsequent figures are based on group encounter data and displayed as a map of total group encounters, displaying point data and a map of total group encounters displayed through heat density.

² These terms are defined, outlined, and established in the U.S. Forest Service National Minimum Protocol for Monitoring Outstanding Opportunities for Solitude document.

Table 1: Total Results for all monitoring areas (Total/Wilderness)

TOTAL					WILDERNESS		
<i>Monitoring Area:</i>	<i># of Campsites</i>	<i># of Groups Encountered</i>	<i># of Traveling Encounters</i>	<i>Percentage of Total Group Encounters within the 1st Mile of Trail</i>	<i># of Campsites</i>	<i># of Groups Encounters</i>	<i># of Traveling Encounters</i>
<u>Twin Peaks Wilderness</u>							
Lake Blanche	9	334	1,220	28%	9	290	1,041
Broads Fork	0	40	103	27%	0	32	82
Cardiff Pass	0	24	68	54%	0*	0*	0*
Ferguson Canyon	0	122	311	80%	0	85	224
<u>TOTAL:</u>	9	520	1,702	-	9	429	1,415
<u>Mount Olympus Wilderness</u>							
Mount Olympus	0	251	669	44%	0	221	603
Neff's Canyon	0	142	258	78%	0	10	15
Butler Fork	0	81	184	33%	0	73	176
<u>TOTAL:</u>	0	474	1,111	-	0	304	794
<u>Deseret Peak Wilderness</u>							
Deseret Peak	0	61	202	51%	0	60	200
Mill Fork	0	28	53	32%	0	17	43
<u>TOTAL:</u>	0	79	255	-	0	77	243
OVERALL TOTALS	9	1,073	3,068	51%	9	810	2,452

* Cardiff Pass was a key monitoring area for this study, though it is not located in a designated wilderness area.

Table 1 shows the total data collected from all of the monitoring areas, with specific attention to the number of encounters in designated wilderness areas during the entire study period. All wilderness areas that had monitoring sites were totaled and then an overall total was created. Over the four-month study period there were 3,068 total traveling encounters, 2,462 of which occurred within wilderness boundaries. Lake Blanche and Mount Olympus monitoring areas had the most

group and traveling encounters, while Neff's Canyon and Mill Fork had the fewest group and traveling encounters.

In the following sections, data included in Table 1 are stratified into analyses based upon both individual wilderness areas and individual monitoring areas, complete with tabular results and heat map visualizations of documented encounters. The report concludes with recommendations for leveraging these data into assessments of opportunities for solitude across the three wilderness areas.

5.1 – Twin Peaks Wilderness Area:

The Twin Peak wilderness area in the Uinta-Wasatch-Cache National Forest is located southeast of Salt Lake City, between Big Cottonwood Canyon and Little Cottonwood Canyon. This wilderness area contains three different monitoring areas for this study: Lake Blanche, Broads Fork, and Ferguson Canyon. A fourth monitoring area, Cardiff Pass, is a nearby trail that is outside of the Twin Peaks wilderness boundaries, and was also included as a monitoring area in this study. These four monitoring areas vary in distance, proximity to the urban population center, opportunity class scale ranking, and total number of group and traveling encounters. The Twin Peaks wilderness area contained the monitoring area with the largest amount of encounters during the study, Lake Blanche.

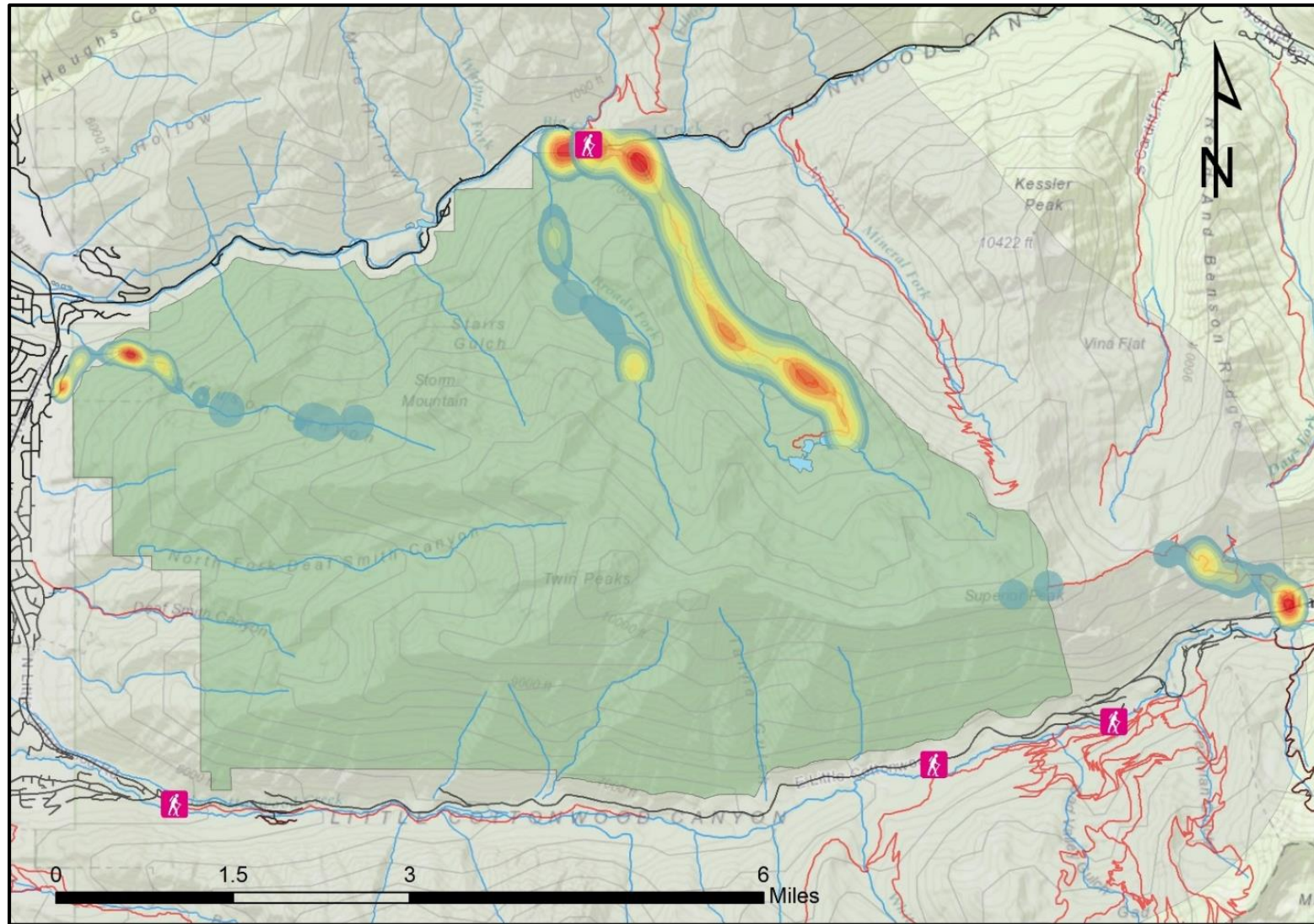


Figure 1: Heat Map of Total Group Encounter Locations of Twin Peaks Wilderness

Figure 1 shows the relative density for all the monitoring areas within Twin Peaks Wilderness, which is shaded green. The areas with large heat displays had more encounters than the areas with smaller heat displays, with particular concentrations near the Mill B South trailhead, the Cardiff Pass trailhead, and climbing areas in Ferguson Canyon. (Note: Broads Fork and Lake Blanche heat map displays overlap at the origins of the trails, the Mill B South trailhead, near the “S Curves” area of Big Cottonwood Canyon.)

5.1.1 – Lake Blanche:

Lake Blanche is a popular hiking area in the Uinta-Wasatch-Cache National Forest. The trailhead is located at Mill B South in Big Cottonwood Canyon. Hundreds of people frequent this trail each day. Trailhead parking is limited, so there are often a large number of cars parked along Big Cottonwood Canyon Road (UT-190). To reach Lake Blanche and the nearby Sundial Peak, one must travel 3.45 miles and 2,690 vertical feet. On average one reaches the lake in about 2 hours with a round trip of 3.5 to 4 hours. This trail was ranked as a 1.3 on the wilderness opportunity class scale, primarily due to the high amount of people frequenting the trail and lakes area.

Table 2: Lake Blanche Weekday Encounters

Monitoring Area: Lake Blanche	Weekday: TOTAL				Weekday: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	Average Traveling Encounters per Mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/7/2016	0	25	60	8.5	0	25	60
6/13/2016	0	21	45	7.0	0	18	34
6/30/2016	0	13	44	6.2	0	9	27
7/6/2016	0	22	65	9.3	0	17	55
8/8/2016	0	15	39	5.6	0	14	36
TOTAL	0	96	253	7.3	0	83	212

Table 2 shows the number of campsites, traveling encounters, and group encounters observed during the five weekday monitoring sessions. Across all monitoring periods for this area, approximately 43% of encounters occurred within the first mile from the trailhead. As shown within the data, researchers encountered a total of 253 traveling encounters, 212 of them within designated wilderness boundaries, over the five days, with an average of 51 traveling encounters per day, and 42.4 traveling encounters within wilderness per monitoring period.

Table 3: Lake Blanche Weekend Encounters

Monitoring Area: Lake Blanche	Weekend: TOTAL				Weekend: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/19/2016	0	53	267	38.1	0	50	234
7/10/2016	0	41	183	26.1	0	36	166
7/23/2016	9	56	251	35.9	9	52	220
8/28/2016	0	70	181	25.9	0	54	134
9/11/2016	0	18	85	12.1	0	15	75
Total	9	238	967	27.6	9	207	829

Table 3 shows the number of campsites, traveling encounters, and group encounters observed during the five weekend monitoring sessions. As shown within the data, researchers encountered a total of 967 traveling encounters, 829 of them within designated wilderness boundaries, over the five days, with an average of 193 traveling encounters per day, and 165.8 traveling encounters within wilderness per monitoring period.

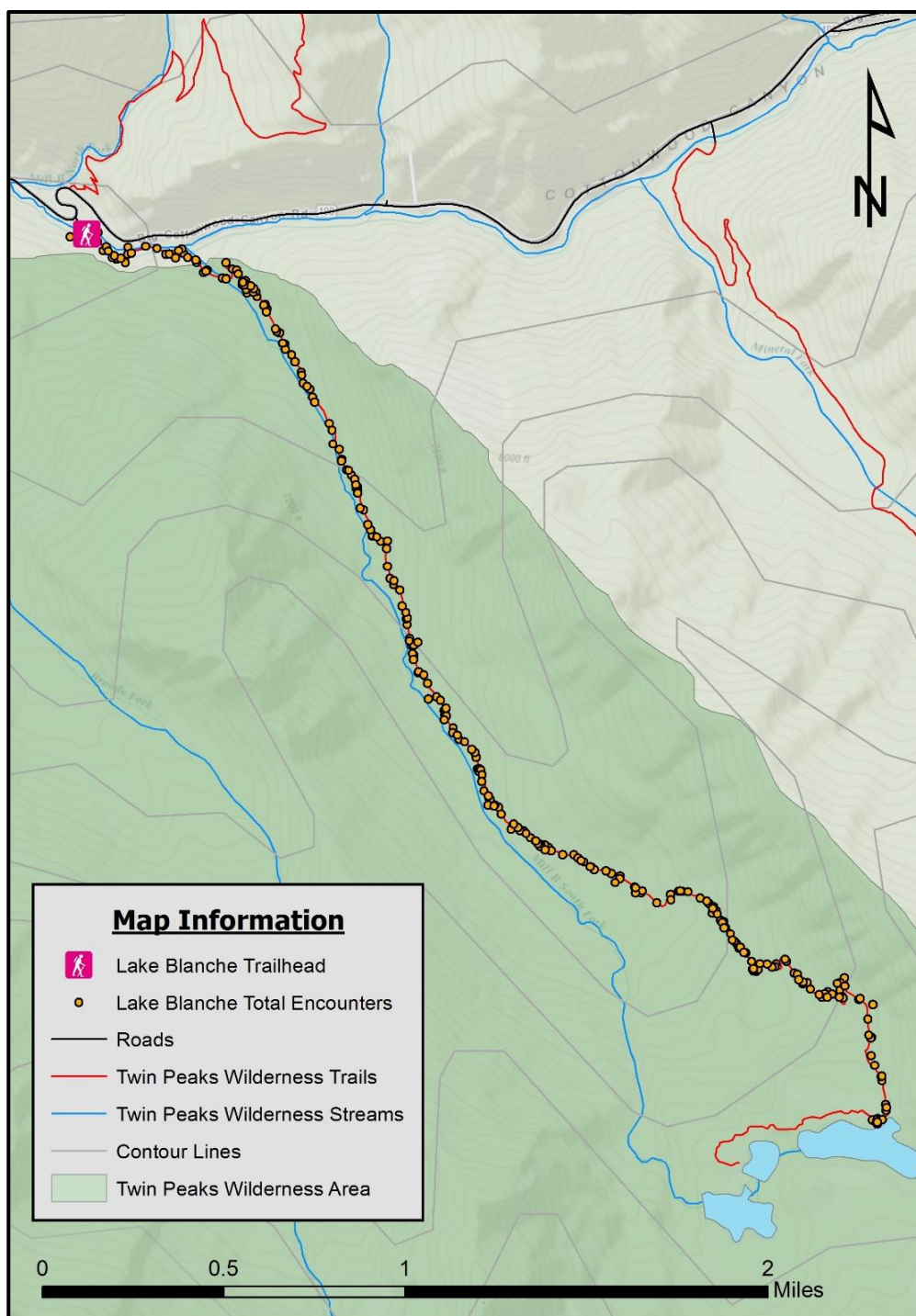


Figure 2: Lake Blanche Total Trail Group Encounters

Figure 2 shows the total group encounters ($N = 334$) for the Lake Blanche trail over the course of the study period. There were consistent encounters with visitors in almost all areas of the trail. The majority of the group encounters occur within the Twin Peaks Wilderness boundary, as displayed on the map.

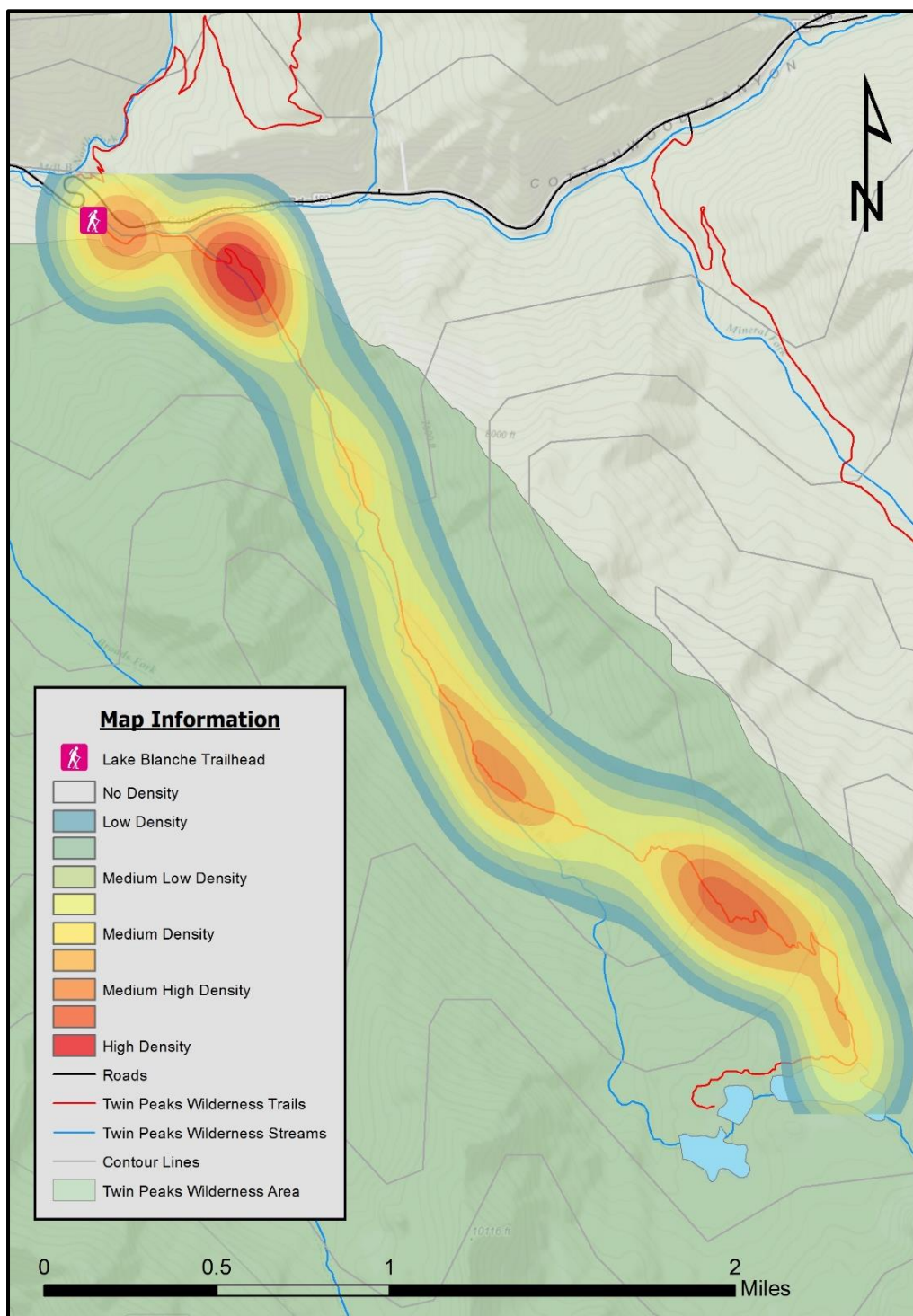


Figure 3: Heat Map of Total Group Encounter Locations on Lake Blanche Trail

Figure 3 shows density of the total group encounter locations on the Lake Blanche trail. Red areas are high encounter areas, yellow is medium encounter areas, and blue are low encounter areas. This map shows that there was a high amount of encounters within the first mile of the trail, though there are a continual amount of encounters throughout the length of the trail. Particular encounter

locations include near the parking areas and near the bridge, where there is a bench, serving as a natural attraction area for visitors. Other high-encounter areas are places on the trail where there are views and at the lakes, where hikers often rest before returning down the trail.

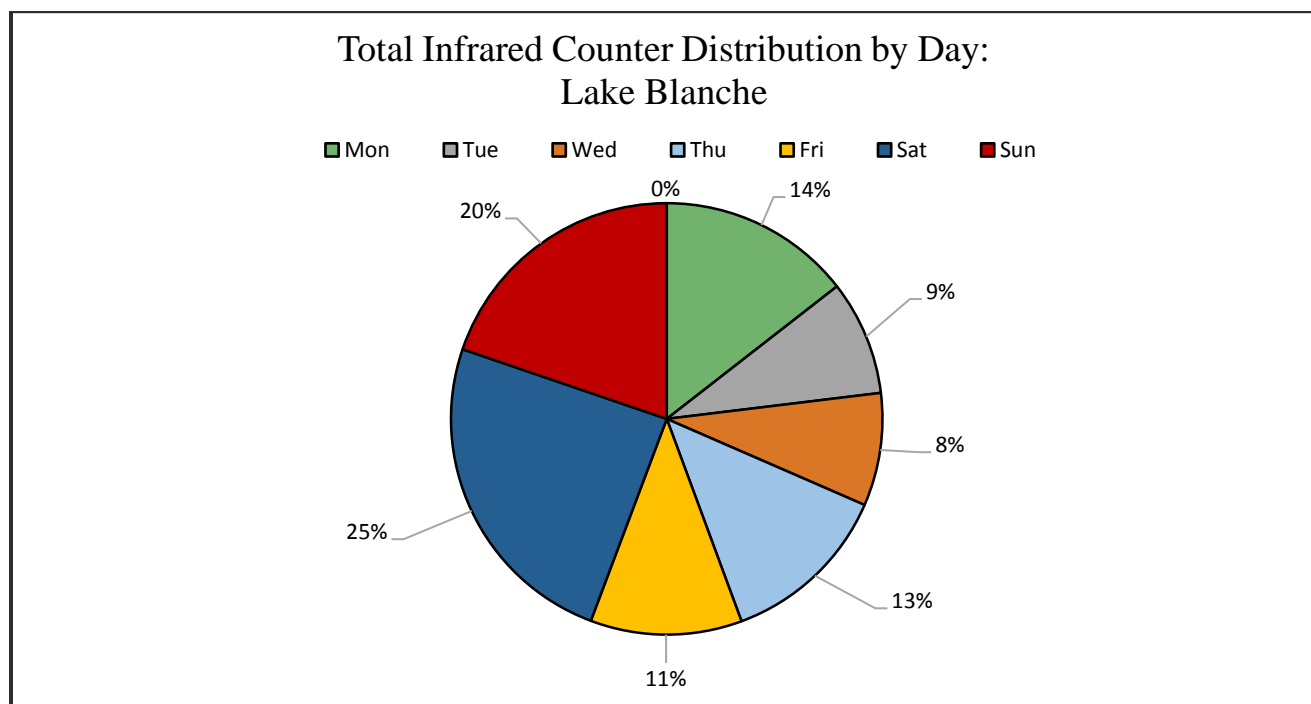


Figure 4: Total Counter Distribution by Day

Counter Data:

Lake Blanche	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Daily Averages	93.05	55.3	54.4	82.5	73.05	157.55	127.1

Figure 4 shows the daily averages of readings from an infrared counter installed along the trail, within the wilderness boundaries. Both of the weekend daily readings showed the highest percentages of visitor use; Saturday, 25%, and Sunday, 20%, indicating that 45% of the average weekly hikers on the Lake Blanche trail were weekend users.

Lake Blanche Summary:

From the data above, Lake Blanche is a consistently popular hike in the Wasatch Front during the summer season. The Lake Blanche trail had the highest number of group encounters out of all of the monitoring areas, as well as the highest numbers of traveling encounters. Lake Blanche is described in multiple guidebooks about hiking in the Wasatch Range, and is generally considered a unique hike due to being able to reach alpine lakes and craggy ridgelines and summits. This trail was ranked as a 1.3 on the opportunity class scale due to the extremely high amount of people frequenting the trail and area, and this ranking seemed to hold through the duration of the study. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.1.2 – Broads Fork:

Broads Fork trail is a relatively less traveled hiking trail located in the Twin Peaks Wilderness. Not many people frequent this trail on a daily basis, even though it is located at the same trailhead as Lake Blanche Trail in Big Cottonwood Canyon (along UT-190). Similar to Lake Blanche, parking is limited, so there are usually a large number of cars parked along the road (UT-190). In addition to views and forests, there are also limited rock climbing opportunities along the early part of the trail, attracting some visitors. To reach the Broads Fork basin at the top of the maintained trail, one must travel 4.3 miles, round trip, and 2,034 vertical feet of elevation. The trail was ranked as a 1.2 on the opportunity class partially due to the low amount of traffic the trail receives.

Table 4: Broads Fork Weekday Encounters

Monitoring Area: Broads Fork	Weekday: TOTAL				Weekday: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/23/2016	0	3	3	1.4	0	3	3
6/28/2016	0	2	8	1.9	0	2	8
7/20/2016	0	4	7	1.6	0	4	7
7/28/2016	0	0	0	0.0	0	0	0
9/1/2016	0	2	2	0.5	0	1	1
Total	0	11	20	1.1	0	10	19

Table 4 shows the number of campsites, traveling encounters, and group encounters seen during the five weekday monitoring sessions. As shown within the data, researchers encountered a total of 20 traveling encounters, and 19 of which were within wilderness boundaries, over the five days, with an average of 4 traveling encounters overall, and 3.8 encounters within wilderness boundaries per monitoring period.

Table 5: Broads Fork Weekend Encounters

Monitoring Area: Broads Fork	Weekend: TOTAL				Weekend: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/11/2016	0	11	25	5.8	0	6	13
6/26/2016	0	4	16	3.7	0	4	16
8/6/2016	0	2	3	0.7	0	2	3
8/20/2016	0	7	20	4.7	0	5	14
9/3/2016	0	6	19	4.4	0	5	17
Total	0	29	83	3.9	0	22	63

Table 5 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data, researchers documented a total of 83 traveling encounters, and 63 traveling encounters within wilderness boundaries, over the five

days of monitoring, which is an average of 16.6 traveling encounters overall, and 12.6 traveling encounters within wilderness boundaries per monitoring period.

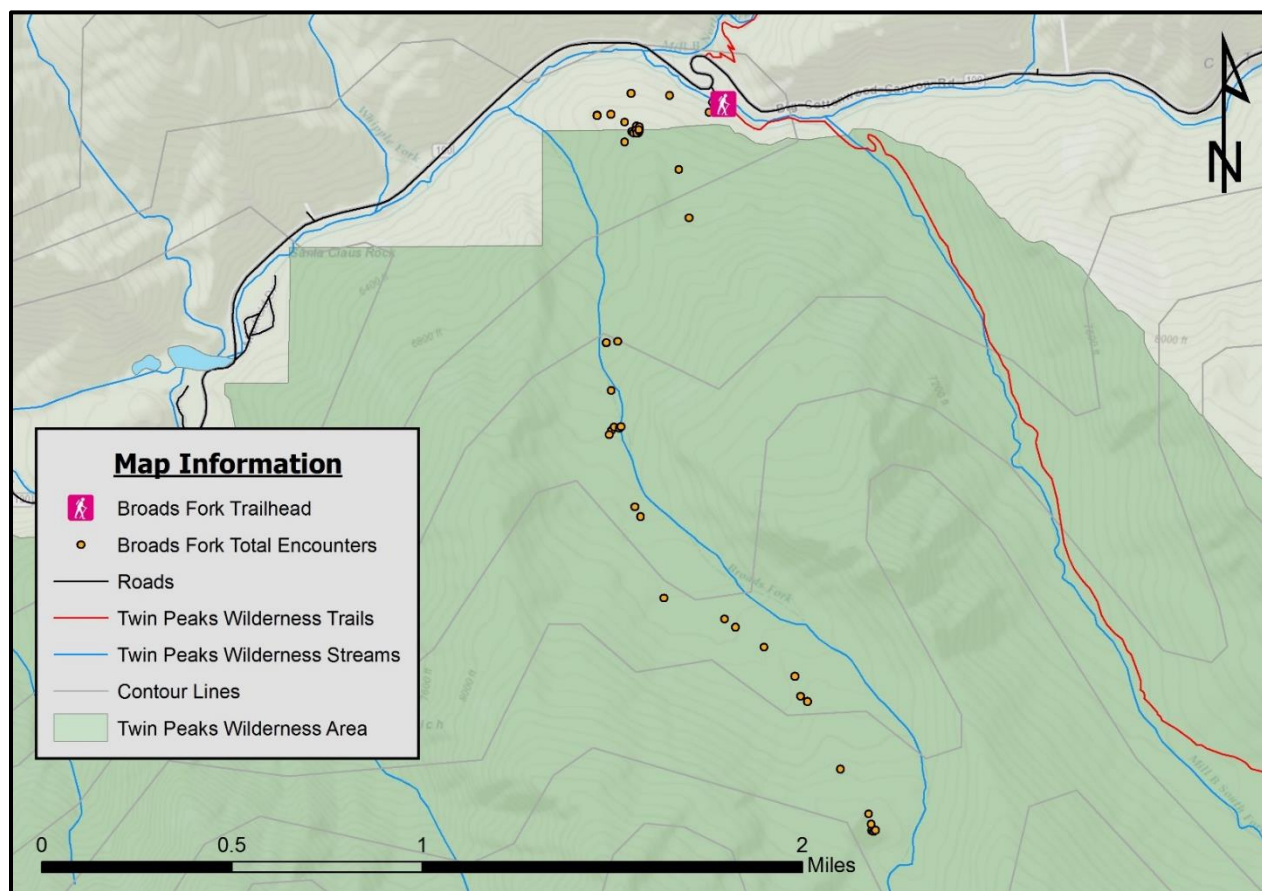


Figure 5: Broad Fork Total Trail Group Encounters

Figure 5 shows the total group encounters ($N = 40$) for the Broad Fork trail over the course of the study period. Encounters with visitors on this trail are low and sporadic in almost all areas. The majority of the group encounters occur within the Twin Peaks Wilderness boundary, as displayed on the map.

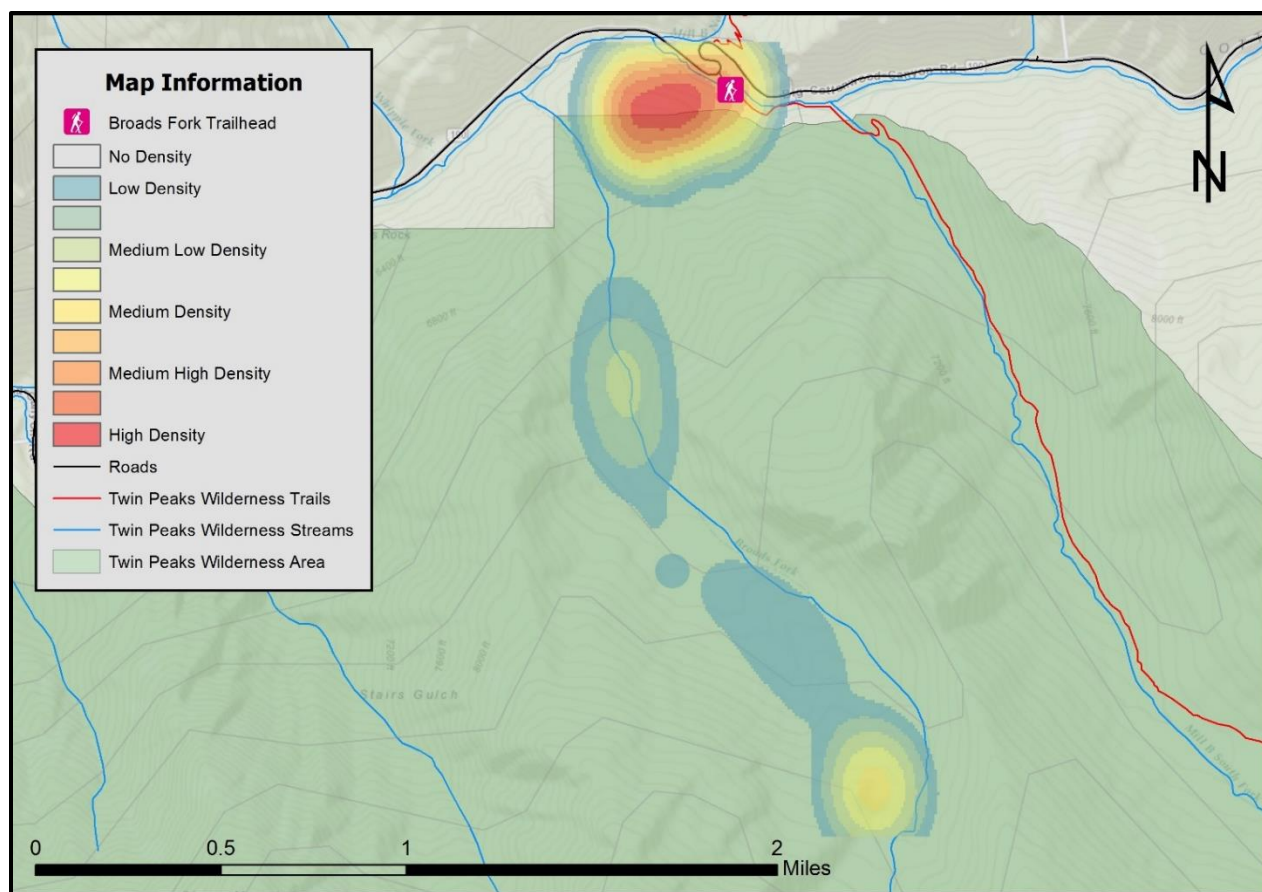


Figure 6: Heat Map of Total Group Encounter Locations on Broads Fork Trail

Figure 6 shows density of the total group encounter locations on the Broads Fork trail. Red areas are high encounter areas, yellow is medium encounter areas, and blue are low encounter areas. This map shows that there was a high amount of encounters within the first mile of the trail (which is also relatively steep), though there is one area at the end of the trail with higher density. Visitor encounters at established rock climbing areas remained relatively low.

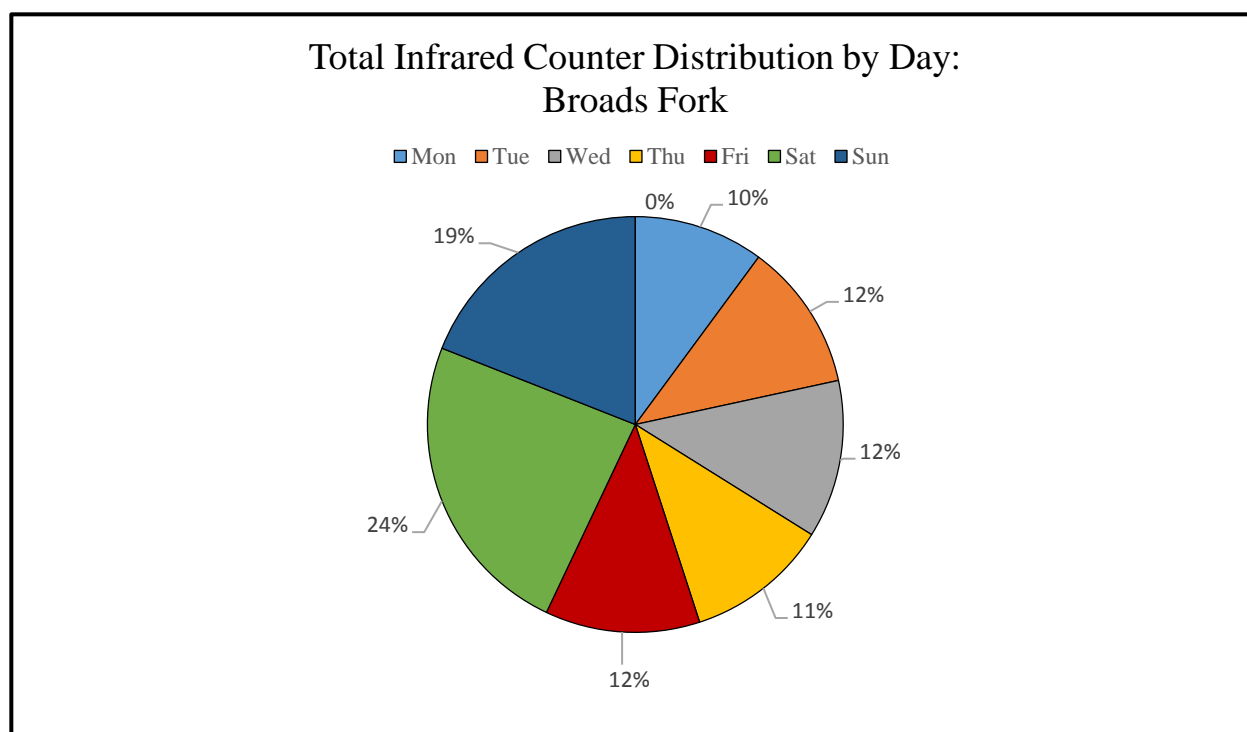


Figure 7: Total Counter Distribution by Day

Counter Data:

Site Name	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Daily Averages	18.3	20.8	22.25	20.2	21.8	43.35	34.45

Figure 7 shows the daily averages of readings from an infrared counter installed along the trail within the wilderness boundaries. Both of the weekend daily readings showed the highest percentages of readings; Saturday, 24%, and Sunday, 19%, making up 43% of the average weekly hikers. However, it is notable that all days of the week saw steady hikers, though encounters were low.

Broads Fork Summary:

From the data above, Broads Fork is a consistently but lightly traveled hike in the Wasatch Front during the summer season. The Broads Fork trail had some of the lowest number of group encounters out of all of the monitoring areas. This trail was ranked as a 1.2 on the wilderness opportunity class scale due to the low amount of people frequenting the trail and area, and this ranking seemed to hold through the duration of the study. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.1.3 – Cardiff Pass:

Located across from Snowbird and Alta Ski Resorts, Cardiff Pass is a quick and steep climb, but allows one to reach rugged alpine peaks such as Superior and Monte Cristo. One must travel 2.1 miles and 846 vertical feet to reach the top of the pass. Because the trail itself is not within the boundaries of Twin Peaks Wilderness, the trail was not originally ranked on the wilderness

opportunity class scale. However, it does have a fair amount of travel due to the access to the two popular peaks, both of which are located within wilderness boundaries. Additionally, the Cardiff Pass trail was the only monitoring area in this study which was accessed from Little Cottonwood Canyon Road.

Table 6: Cardiff Pass Weekday Encounters

Monitoring Area: Cardiff Pass	Weekday: TOTAL				Weekday: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/23/2016	0	3	4	1.3	0	0	0
6/28/2016	0	0	0	0.0	0	0	0
7/20/2016	0	3	6	2.0	0	0	0
7/28/2016	0	4	8	2.7	0	0	0
9/1/2016	0	1	3	1.0	0	0	0
Total	0	11	21	1.2	0	0	0

Table 6 shows the number of campsites, traveling encounters, and group encounters documented during the five weekday monitoring sessions. As shown within the data, researchers encountered a total of 21 traveling encounters, one within wilderness boundaries, over the five days, which is an average of 4.2 traveling encounters and 0.2 encounters within wilderness boundaries per monitoring period.

Table 7: Cardiff Pass Weekend Encounters

Monitoring Area: Cardiff Pass	Weekend: TOTAL				Weekend: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/11/2016	0	4	9	3.0	0	0	0
6/26/2016	0	6	11	3.7	0	0	0
8/6/2016	0	6	16	5.3	0	0	0
8/20/2016	0	2	3	1.0	0	0	0
9/3/2016	0	5	8	2.7	0	0	0
Total	0	13	47	3.1	0	0	0

Table 7 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data, researchers documented a total of 47 traveling encounters, none of which were within wilderness boundaries over the five days, which comes out to an average of 9.4 total traveling encounters.

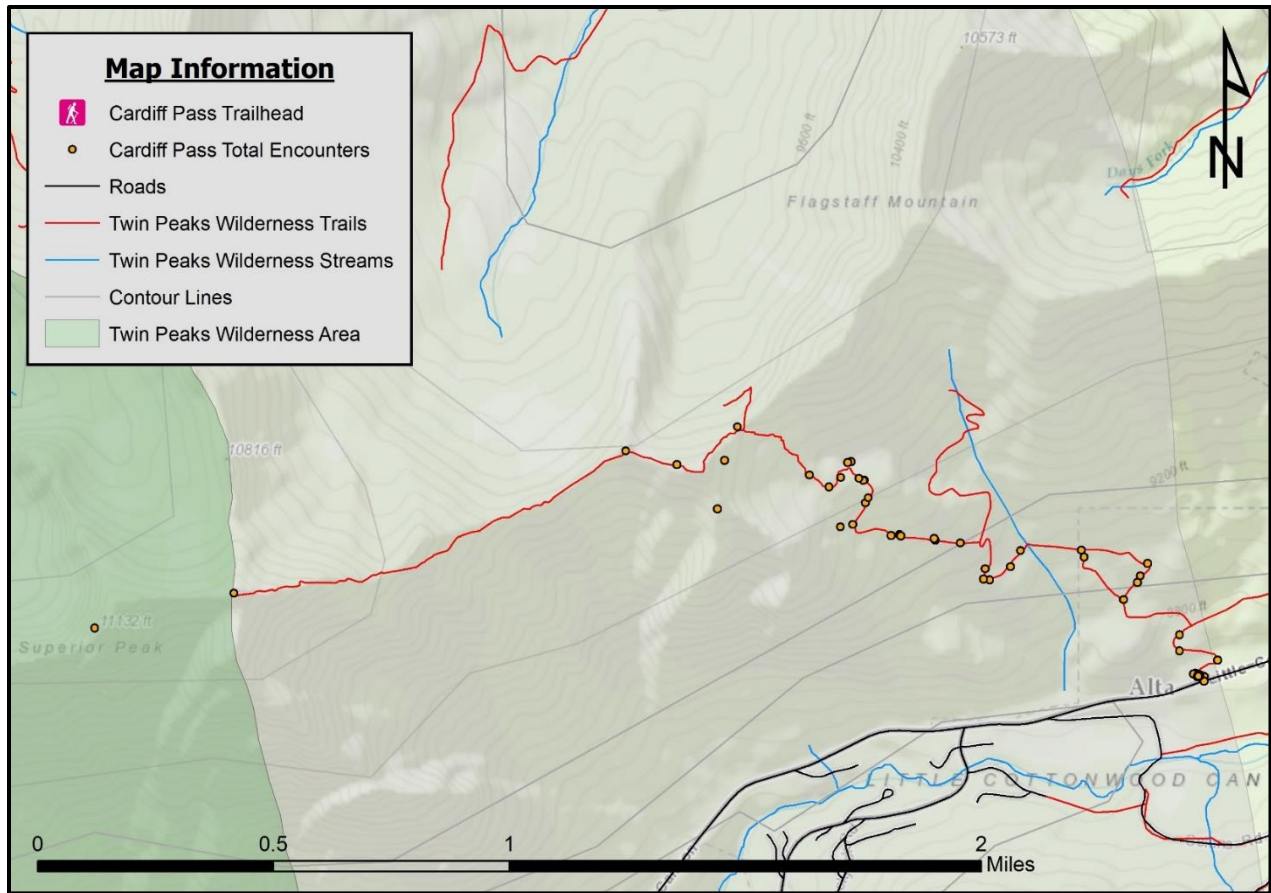


Figure 8: Cardiff Pass Total Trail Group Encounters

Figure 8 shows the total group encounters ($N = 24$) for Cardiff Pass trail over the course of the study period. Relatively few encounters occurred within wilderness boundaries. The number of encounters along the trail is low in almost all areas, as hikers tended to be relatively well dispersed throughout the hiking trail. The majority of the group encounters occurred around the trailhead and near the Little Cottonwood Canyon Road (UT 210). However, there was only one encounter within Twin Peaks Wilderness area, as displayed on the map. Cardiff Pass had the second lowest number of encounters (behind Mill Fork, in the Deseret Peak Wilderness) of the nine monitoring areas assessed in this study.

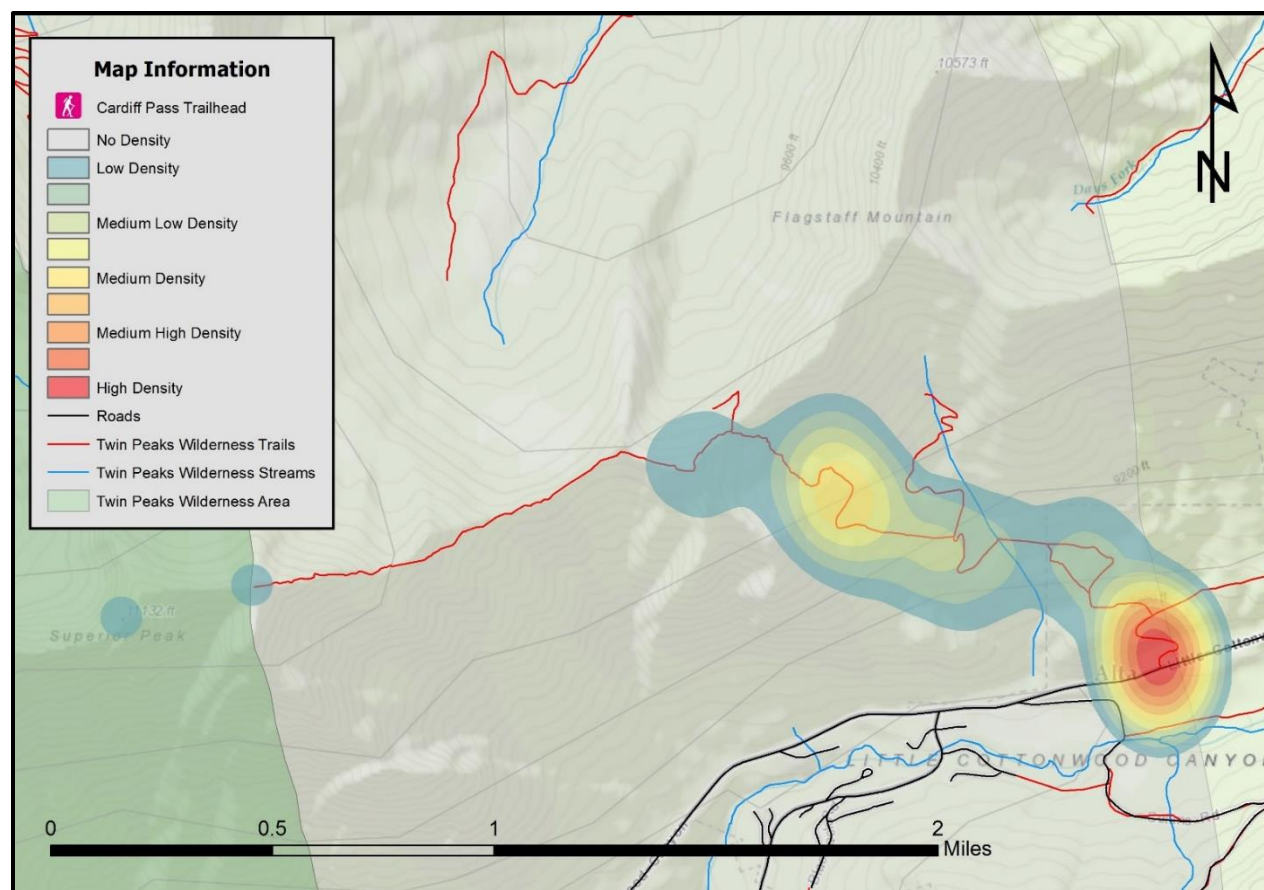


Figure 9: Heat Map of Total Group Encounter Locations on Cardiff Pass Trail

Figure 9 shows density of the total group encounter locations on the Cardiff Pass trail. Red areas are high encounter areas, yellow are medium encounter areas, and blue are low encounter areas. This map shows that there was a high amount of encounters within the first ¼ mile of the trail, though there are medium encounters within the first mile. The likelihood of visitor encounters near the summit and along the ridgeline are low, as is similar for encounters within the wilderness boundary. There is an additional area of relatively increased encounters at an area of the trail that flattens out somewhat, enticing visitors to stop and rest.

Cardiff Pass Summary:

From the data above, Cardiff Pass is a consistently and lightly traveled hike in the Wasatch Front during the summer season, due to access to Mount Superior and Monte Cristo Peaks. An additional use of the Cardiff Pass trail is as a descent route for climbers ascending the South Ridge of Mount Superior. Cardiff Pass trail had a fairly low number of group encounters in comparison to the other monitoring areas. Because the trail itself is not within wilderness boundaries, this trail has not been ranked on the wilderness opportunity class scale; however, it had the amount of encounters to warrant a ranking of 1.2 on the wilderness opportunity class scale due to the low amount of people frequenting the trail and area, and this ranking seemed to hold through the duration of the project. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.1.4 – Ferguson Canyon:

Located between the mouths of Big Cottonwood Canyon and Little Cottonwood Canyon, Ferguson Canyon offers views of Salt Lake City, as well as opportunities for rock climbing. Additionally, Ferguson Canyon receives increased visitor use due to it being one of the few trails in the Wasatch Range that allows dogs, as most of the other similar trails are located within Watershed Management boundaries. The Ferguson Canyon trailhead is located in a residential area in close proximity to Wasatch Boulevard. To travel up Ferguson Canyon one must hike 6.3 miles (round trip) and 3,661 vertical feet. This trail is ranked as a 1.2 on the opportunity class scale. During the duration of the study this trail saw a large amount of traffic due to the access to rock climbing.

Table 8: Ferguson Canyon Weekday Encounters

<i>Monitoring Area: Ferguson Canyon</i>	<i>Weekday: TOTAL</i>				<i>Weekday: WILDERNESS</i>		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encounters	# of Traveling Encounters
6/10/2016	0	17	44	6.9	0	12	31
6/22/2016	0	12	23	3.7	0	9	19
7/8/2016	0	5	15	2.4	0	1	1
8/9/2016	0	7	13	2.1	0	7	13
8/26/2016	0	12	23	3.7	0	9	19
Total	0	53	118	3.8	0	38	83

Table 8 shows the number of campsites, traveling encounters, and group encounters seen during the five weekday monitoring sessions. As shown within the data, researchers documented a total of 118 traveling encounters, and 83 encounters within wilderness boundaries, over the five days, which is an average of 23.6 total traveling encounters and 16.6 encounters within wilderness boundaries per monitoring period.

Table 9: Ferguson Canyon Weekend Encounters

<i>Monitoring Area: Ferguson Canyon</i>	<i>Weekend: TOTAL</i>				<i>Weekend: WILDERNESS</i>		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encounters	# of Traveling Encounters
6/5/2016	0	23	64	10.2	0	22	63
7/31/2016	0	9	22	3.5	0	2	4
8/20/2016	0	11	31	4.9	0	4	16
8/29/2016	0	11	40	6.3	0	6	28
9/10/2016	0	15	36	5.7	0	13	30
Total	0	69	193	6.1	0	47	141

Table 9 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data the researchers documented a total of 193 traveling encounters, 141 of which occurred within wilderness boundaries, over the five days, which is an average of 38.6 total traveling encounters, and 28.2 within wilderness boundaries per monitoring period.

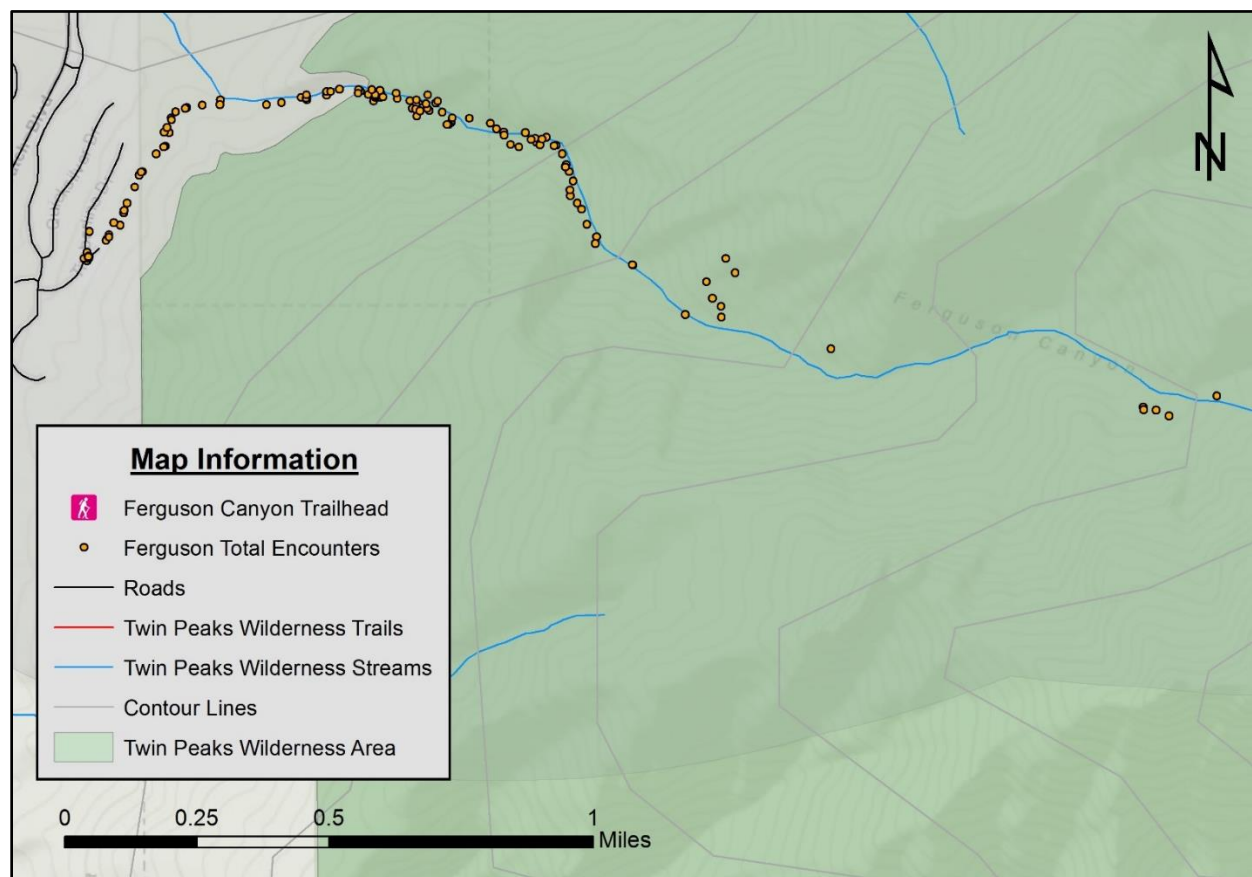


Figure 10: Ferguson Canyon Total Trail Group Encounters

Figure 10 shows the total group encounters ($N = 122$) for the Ferguson Canyon trail over the course of the study period. The number of encounters along the trail is highest within the first mile, but then begins to taper off. These initial group encounters are probably due to the location and access to rock climbing in this area.

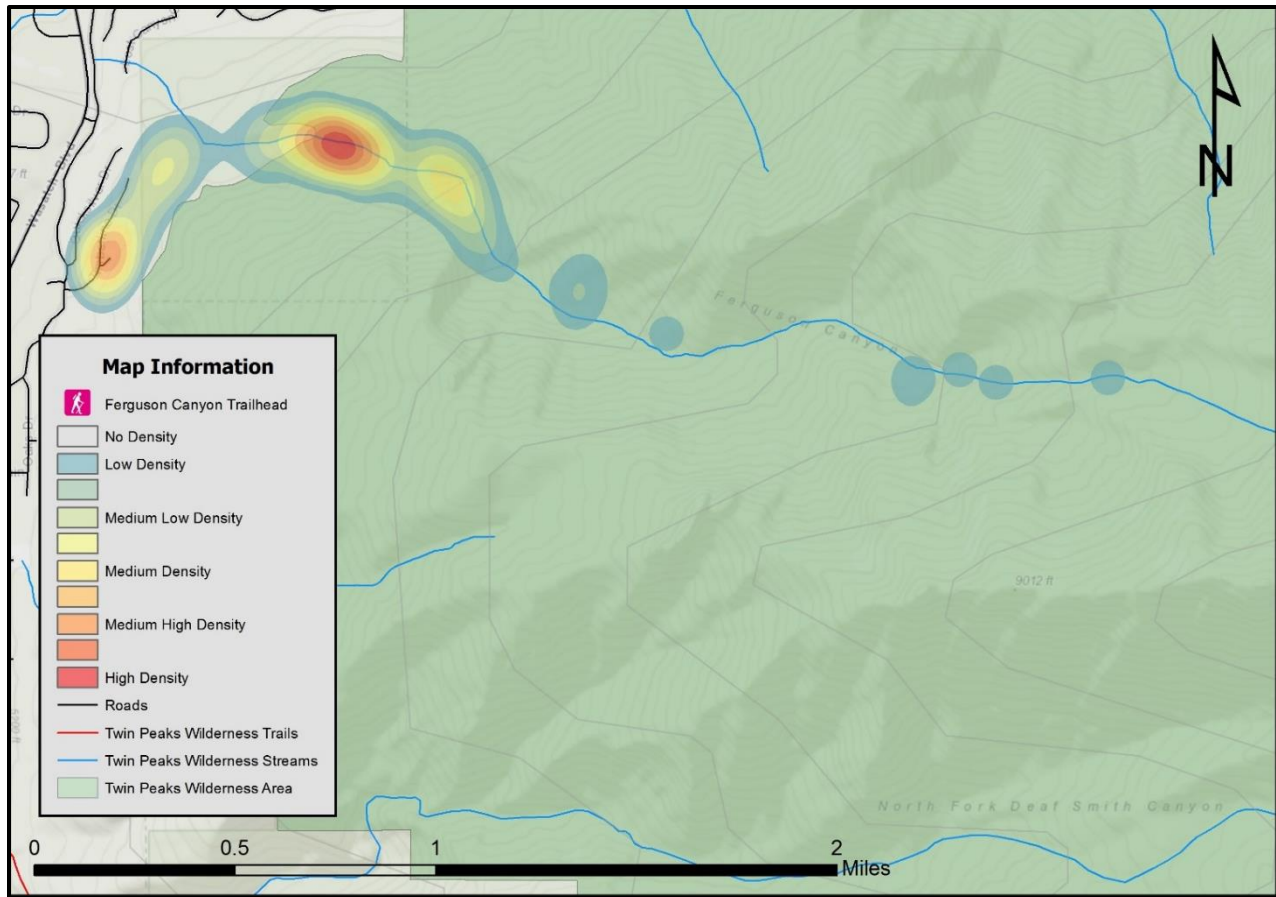


Figure 11: Heat Map of Total Group Encounter Locations on Ferguson Canyon Trail

Figure 11 shows density of the total group encounter locations on the Ferguson Canyon trail. Red areas are high encounter areas, yellow are medium encounter areas, and blue are low encounter areas. This map shows that there was a high amount of encounters within the first mile of the trail, though there are medium encounters toward the end of the trail. While the high concentrations of visitors were near rock climbing sites, there were much fewer encounters higher in the canyon, where hiking is the primary recreational activity.

Ferguson Canyon Summary:

From the data above, Ferguson Canyon is a consistently traveled hike in the Wasatch Front during the summer. However, this consistency is only based upon the fact that the Ferguson Canyon trail had a high number of group encounters within the first mile of the trail, and other parts of the trail provided relatively sparse encounters. This trail has a ranking of 1.2 on the opportunity class scale, which accounts for the high number of encounters within the first mile of the trail, and the much lower number of encounters beyond the rock climbing areas. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.2 – Mount Olympus Wilderness:

The Mount Olympus Wilderness Area in the Uinta-Wasatch-Cache National Forest is located to the southeast of Salt Lake City, between Mill Creek Canyon, and Big Cottonwood Canyon. This wilderness area contains three different monitoring areas for this study: Mount Olympus Trail, Neff's Canyon Trail, and Butler Fork Trail. These trails are accessed from along the Wasatch Front, as well as from Big Cottonwood Canyon Road. These monitoring areas vary in amount of group and traveling encounters and have different opportunity class ratings.

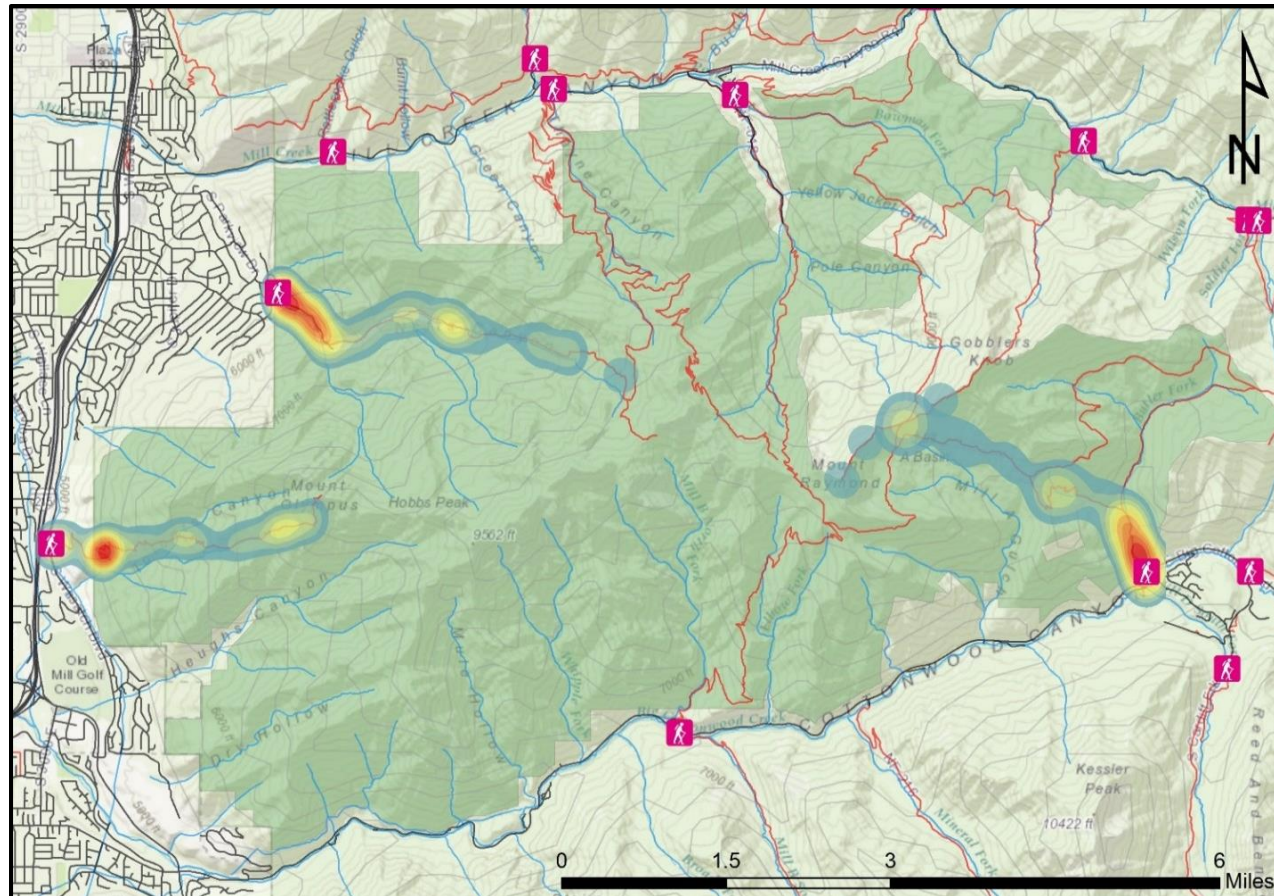


Figure 12: Heat Map of Total Group Encounter Locations in Mount Olympus Wilderness

Figure 12 shows the relative density for all the monitoring areas within the Mount Olympus Wilderness. The areas with large heat displays had more encounters than the areas with smaller heat displays. The three monitoring areas displayed show that this wilderness area had a high number of group encounters, particularly along trailheads and the first mile of trails, though peaks, passes, ridgelines, and other prominent vistas also were places that saw increased visitor encounters.

5.2.1 – Mount Olympus:

Located southeast of downtown Salt Lake City, Mount Olympus trail is highly trafficked. The trailhead is located on Wasatch Boulevard, a busy commuter route with quick access to the city, and often had many cars parked along the road itself, due to limited parking spots available. The trail brings visitors all the way to the summit of Mount Olympus, a 6.6-mile round trip hike, and nearly 4,000 vertical feet of elevation change. A short scramble is required to reach the summit of Mount Olympus, which rises prominently above Salt Lake City along the western edge of the Wasatch Range. This trail was ranked as a 1.3 on the opportunity class scale due to the high amounts of traffic on the trail.

Table 10: Mount Olympus Weekday Encounters

<i>Monitoring Area: Mount Olympus</i>	<i>Weekday: TOTAL</i>				<i>Weekday: WILDERNESS</i>		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encounters	# of Traveling Encounters
6/6/2016	0	18	30	4.5	0	15	24
6/29/2016	0	15	27	4.1	0	12	20
7/22/2016	0	18	39	5.9	0	13	31
8/11/2016	0	11	21	3.2	0	8	15
8/18/2016	0	11	14	2.1	0	8	10
Total	0	73	131	4.0	0	56	100

Table 10 shows the number of campsites, traveling encounters, and group encounters seen during the five weekday monitoring sessions. As shown within the data, researchers documented a total of 131 traveling encounters, 100 of which occurred within wilderness boundaries, over the five days, which is an average of 26.2 total traveling encounters, and 20 encounters within wilderness boundaries per monitoring period.

Table 11: Mount Olympus Weekend Encounters

Monitoring Area: Mount Olympus	Weekend: TOTAL				Weekend: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encounters	# of Traveling Encounters
6/18/2016	0	51	176	26.7	0	46	168
7/9/2016	0	42	121	18.3	0	42	121
8/21/2016	0	16	44	6.7	0	15	41
9/3/2016	0	41	106	16.1	0	34	82
9/10/2016	0	28	91	13.8	0	28	91
Total	0	178	538	16.3	0	165	503

Table 11 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data, researchers documented a total of 538 traveling encounters, 503 of which occurred within wilderness boundaries, over the five days, which is an average of 107.6 total traveling encounters, and 100.6 encounters within wilderness boundaries per monitoring period.

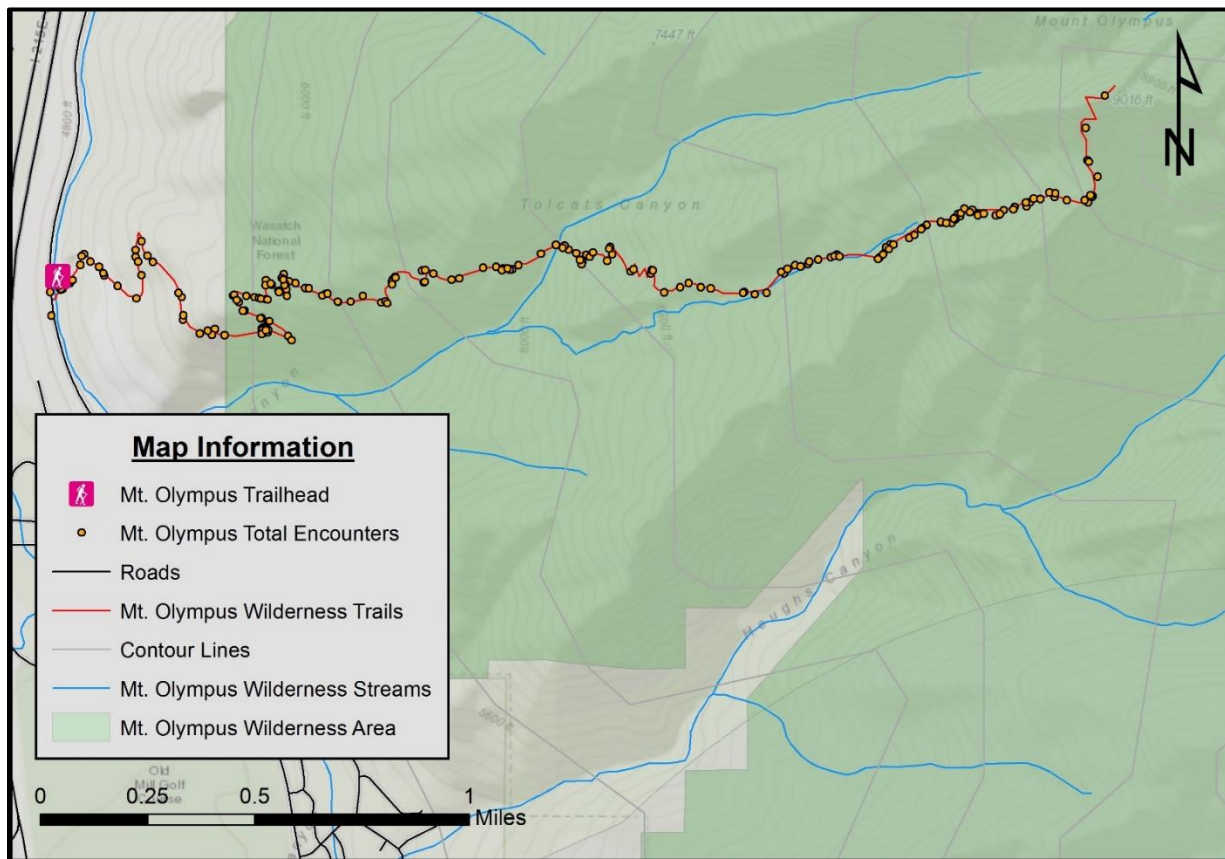
**Figure 13: Mount Olympus Total Trail Group Encounter:**

Figure 13 shows the total group encounters (N = 251) for Mount Olympus trail over the course of the study period. The number of visitor encounters along the trail is high along the entirety of the trail, though there were increased encounters near stream crossings and viewpoints. The majority of the group encounters occur within the Mount Olympus Wilderness boundary, as displayed on the map.

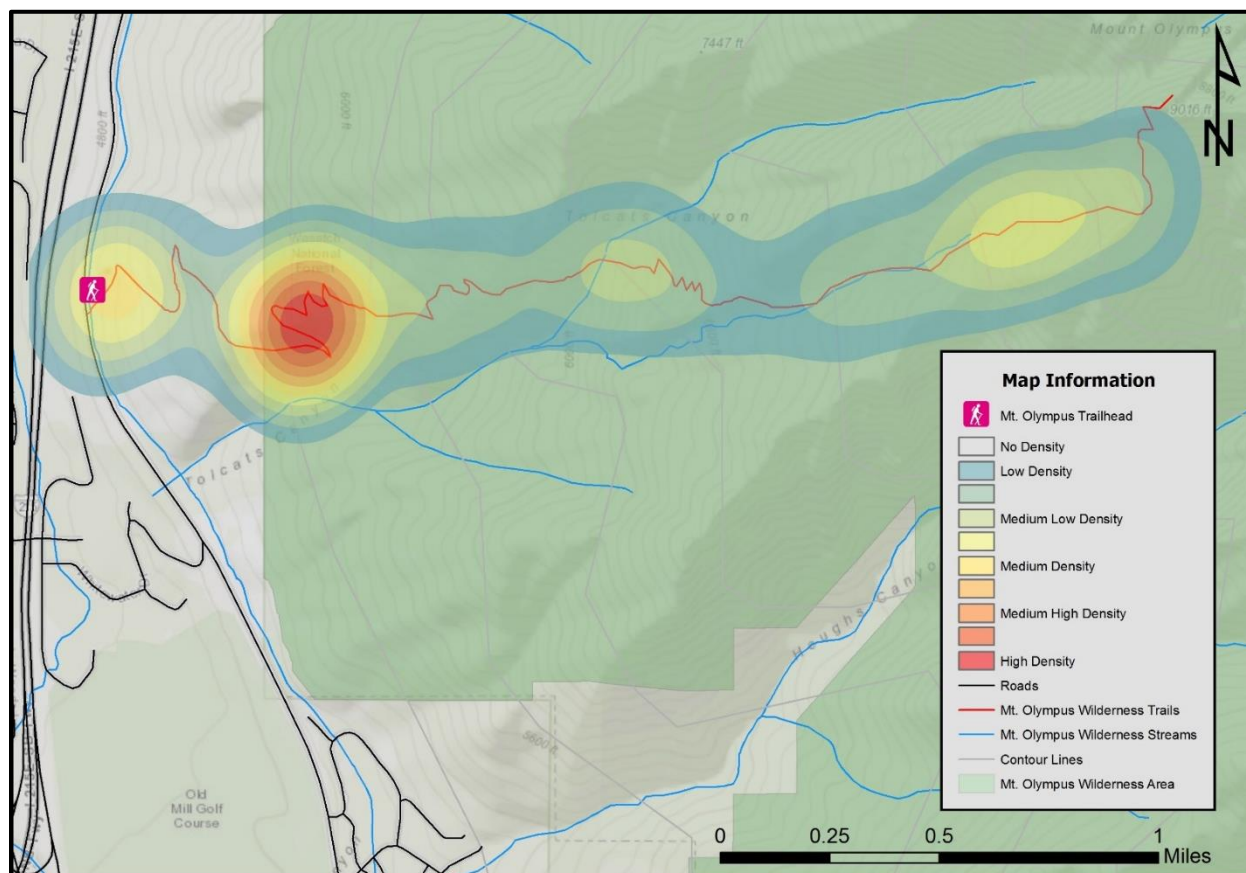


Figure 14: Heat Map of Total Group Encounter Locations on Mount Olympus Trail

Figure 14 shows the relative density of the total group encounter locations on the Mount Olympus trail. Red areas are high encounter areas, yellow is medium encounter areas, and blue are low encounter areas. This map shows that there was a relatively high amount of encounters within the first mile of the trail, though there are medium encounters throughout the remainder of the trail. Again, there were consistent encounters throughout the monitoring area (as seen in Figure 13), but this heat map illustrates that there were *relatively* more encounters in particular locations. The lower section of the trail is steep, though still providing substantial views of the Salt Lake Valley and the Oquirrh Mountains; there is also accessible rock climbing along the lower part of the trail. Other areas of the trail with increased encounter densities are the intersection with the Bonneville Shoreline Trail, as well as areas with substantial views toward the south. The sustained steepness of the trail also tends to encourage hikers to rest, particularly along shady areas in the hot summer months.

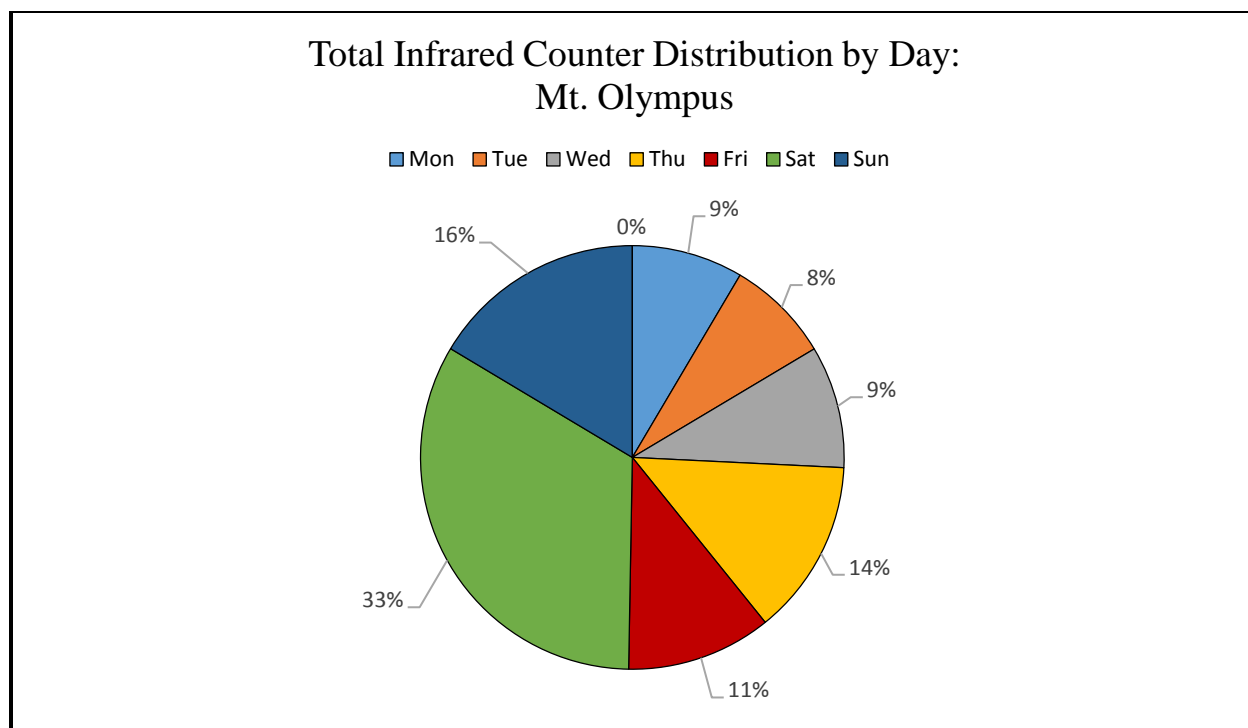


Figure 15: Total Counter Distribution by Day

Counter Data:

Site Name	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Daily Averages	19.9	18.5	21.75	31.35	25.5	77.65	38.25

Figure 15 shows the daily averages of readings from an installed infrared counter on the Mount Olympus trail. Both of the weekend daily readings showed the highest percentages of readings; Saturday, 33%, and Sunday, 16%, accounting for nearly half of the average weekly hikers. Understanding that one-third of visitors use the Mount Olympus trail on Saturdays provides insight for managers interested in dispersing visitor impacts across the weekly calendar.

Mount Olympus Summary:

From the data above, the Mount Olympus trail is a highly traveled hike in the Wasatch Front during the summer. This trail had a high number of group encounters throughout the entire trail, though there remained a relatively increased number of encounters along the first mile of the trail. Mount Olympus is a prominent peak above the city, and along with Lake Blanche, is listed in many hiking guidebooks about the city and the Wasatch Range. Mount Olympus trail has a ranking of 1.3 on the opportunity class scale, which is due to the high amount of people using the trail. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.2.2 – Neff’s Canyon:

Located near the Olympus Cove neighborhood, east of Holladay in the Salt Lake Valley, Neff’s Canyon is frequented by many families from the surrounding neighborhoods, as well as many dog owners, as much of the trail is outside of designated watershed boundaries. To reach the top of Neff’s Canyon, one must hike 6.2 miles (round trip) and 2,982 vertical feet. The first part of the trail ascends to a broad clearing, where there is creek access, shady play space for young people, and a rope swing. This clearing also provides additional trail access to other parts of the Mount Olympus Wilderness. Neff’s Canyon is a highly trafficked area, although it is ranked as a 1.2 on the opportunity class scale.

Table 12: Neff’s Canyon Weekday Encounters

<i>Monitoring Area: Neff’s Canyon</i>	<i>Weekday: TOTAL</i>				<i>Weekday: WILDERNESS</i>		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encounters	# of Traveling Encounters
7/25/2016	0	10	19	3.1	0	1	2
8/19/2016	0	7	7	1.1	0	0	0
8/21/2016	0	7	13	2.1	0	2	3
9/7/2016	0	9	12	1.9	0	1	1
9/12/2016	0	8	9	1.4	0	1	1
Total	0	41	60	9.6	0	5	7

Table 12 shows the number of campsites, traveling encounters, and group encounters seen during the five weekday monitoring sessions. As shown within the data, researchers documented a total of 60 traveling encounters, 7 within wilderness boundaries, over the five days, which is an average of 12 total traveling encounters, and 1.4 encounters within wilderness boundaries per monitoring period.

Table 13: Neff’s Canyon Weekend Encounters

<i>Monitoring Area: Neff’s Canyon</i>	<i>Weekend: TOTAL</i>				<i>Weekend: WILDERNESS</i>		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encounters	# of Traveling Encounters
6/4/2016	0	30	52	8.4	0	0	0
6/12/2016	0	31	70	11.3	0	0	0
7/16/2016	0	15	30	4.8	0	2	3
8/15/2016	0	8	10	1.6	0	0	0
8/27/2016	0	17	36	5.8	0	3	5
Total	0	101	198	6.4	0	5	8

Table 13 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data, researchers documented a total

of 198 traveling encounters, 8 within wilderness boundaries, over the five days, which is an average of 39.6 total traveling encounters, and 1.6 encounters within wilderness boundaries per monitoring period.

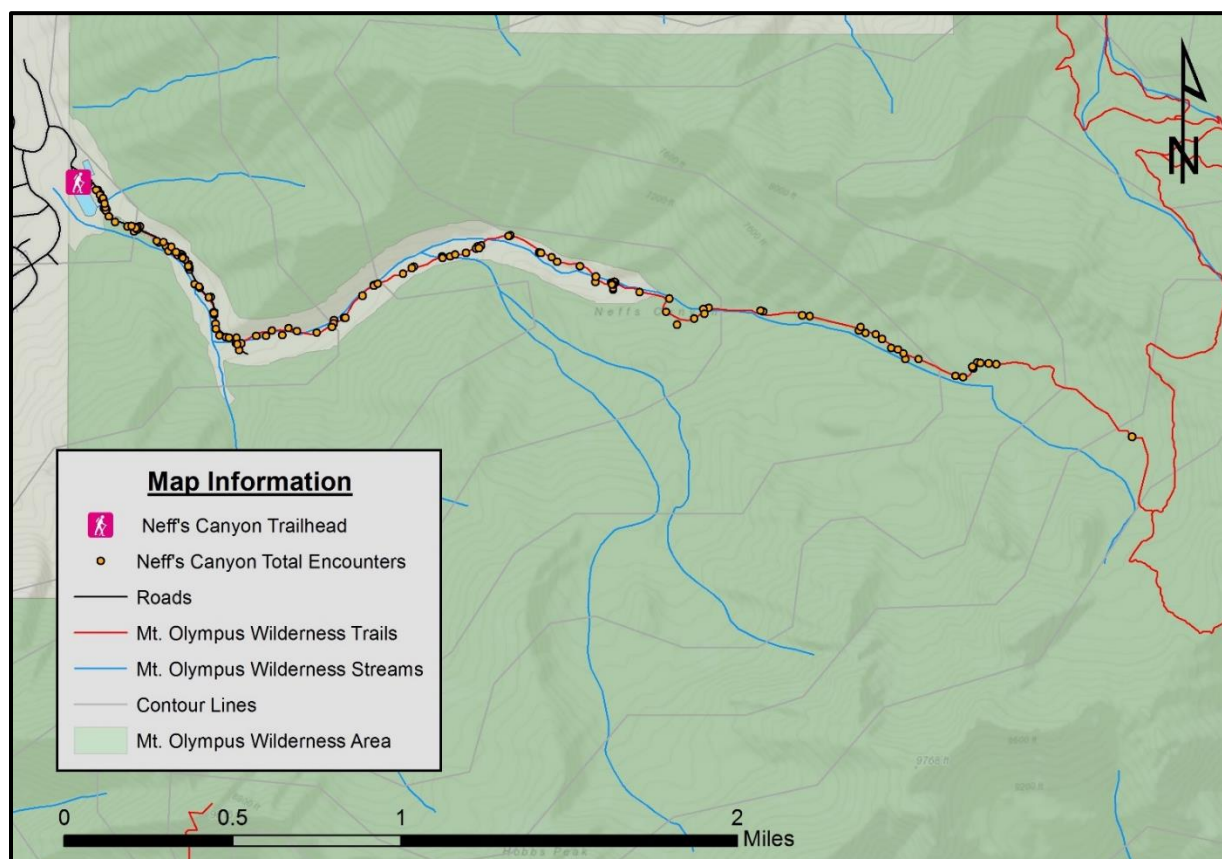


Figure 16: Neff's Canyon Total Trail Group Encounters

Figure 16 shows the total group encounters ($N = 142$) for Neff's Canyon trail over the course of the study period. The amount of encounters along the trail is medium to high along the entire trail. The majority of the group encounters occur outside of the Mount Olympus Wilderness boundary, within the first 1 to 2 miles, as displayed on the map.

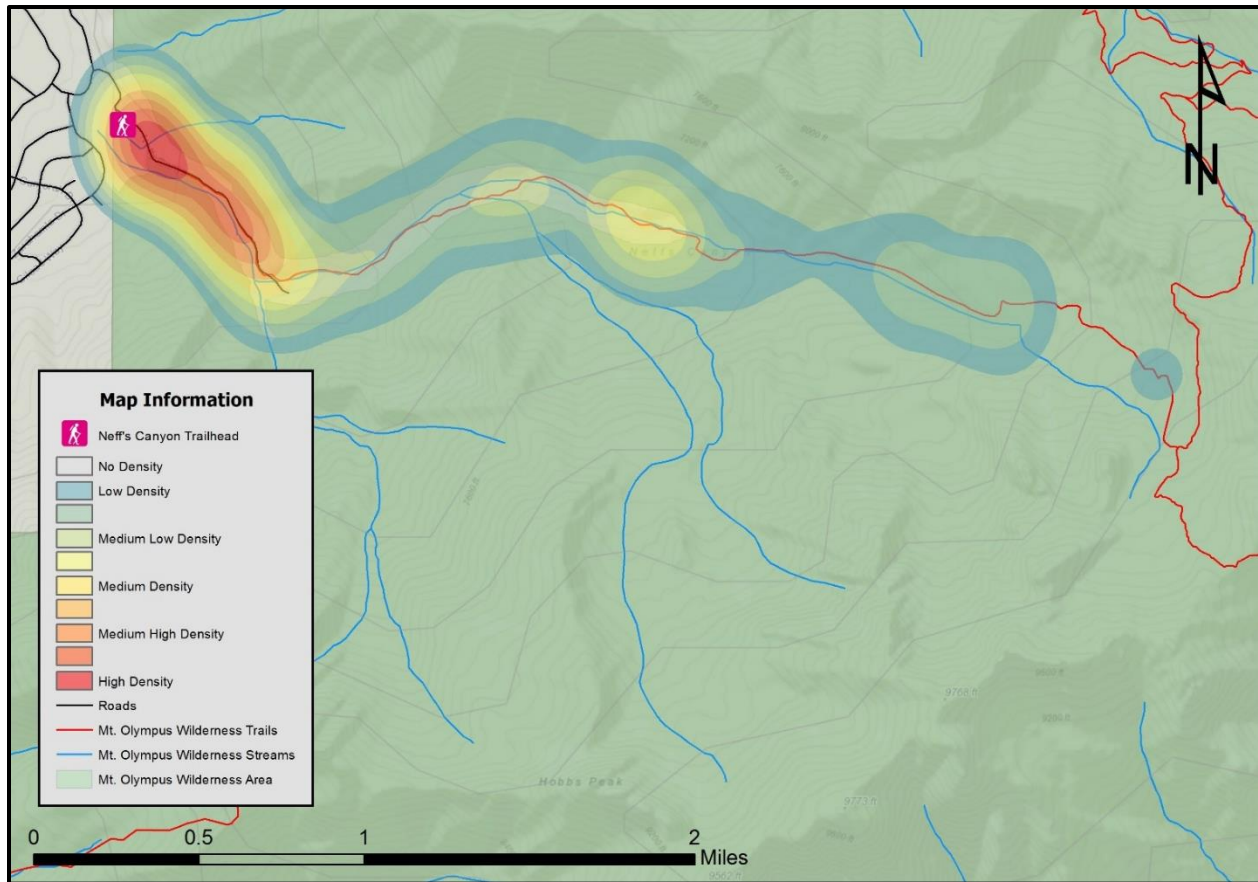


Figure 17: Heat Map of Total Group Encounter Locations on Neff's Canyon Trail

Figure 17 shows density of the total group encounter locations on Neff's Canyon trail. Red areas are high encounter areas, yellow is medium encounter areas, and blue are low encounter areas. This map shows that there are medium to high amount of encounters throughout the entire trail, though the majority of encounters occur within the first mile of the trail. There are also multiple informal social trails in the first quarter mile of this monitoring area. Dogs and young people populated much of the flat area within the first mile of the trail.

Neff's Canyon Summary:

From the data above, Neff's Canyon is a well-traveled hike in the Wasatch Front during the summer season. This trail had some of the most consistent numbers of encounters due to the ability to bring dogs on this hike. This trail was ranked as a 1.2 on the opportunity class scale, with this data illustrating that due to the amount of people and dogs on the trail throughout the duration of the project, there were substantial visitor encounters. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.2.3 – Butler Fork:

Located 8 miles up Big Cottonwood Canyon Road (UT-190), Butler Fork to Baker Pass is a hike that allows one to access both Mount Raymond and Gobblers Knob, two prominent peaks within the Wasatch Range. To reach Baker Pass, one must hike 7.3 miles (round trip) and gain 2,890 vertical feet. Parking for this trail regularly exceeds designated spaces along the road. This hike is ranked at a 1.2 on the opportunity class scale probably due to the medium to low amount of encounters using the trail.

Table 14: Butler Fork Weekday Encounters

Monitoring Area: Butler Fork	Weekday: TOTAL				Weekday: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/24/2016	0	7	11	1.5	0	7	11
7/4/2016	0	14	59	8.2	0	14	59
7/19/2016	0	3	6	0.8	0	3	6
8/31/2016	0	7	9	1.3	0	6	7
9/13/2016	0	5	3	0.5	0	2	3
Total	0	36	88	2.5	0	32	86

Table 14 shows the number of campsites, traveling encounters, and group encounters seen during the five weekday monitoring sessions. As shown within the data, researchers documented a total of 88 traveling encounters, 86 of which occurred within wilderness boundaries, over the five days, which is an average of 17.6 total traveling encounters, and 17.2 encounters within wilderness boundaries per monitoring period.

Table 15: Butler Fork Weekend Encounters

Monitoring Area: Butler Fork	Weekend: TOTAL				Weekend: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
7/17/2016	0	13	36	5.0	0	13	36
7/24/2016	0	9	15	2.1	0	8	13
8/7/2016	0	8	15	2.1	0	6	11
8/13/2016	0	7	15	2.1	0	6	13
8/27/2016	0	8	15	2.1	0	8	15
Total	0	45	96	2.7	0	41	90

Table 15 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data, researchers documented a total of 96 traveling encounters, 90 of which occurred within wilderness boundaries over the five days, which is an average of 19.2 total traveling encounters, and 18 encounters within wilderness boundaries per monitoring period.

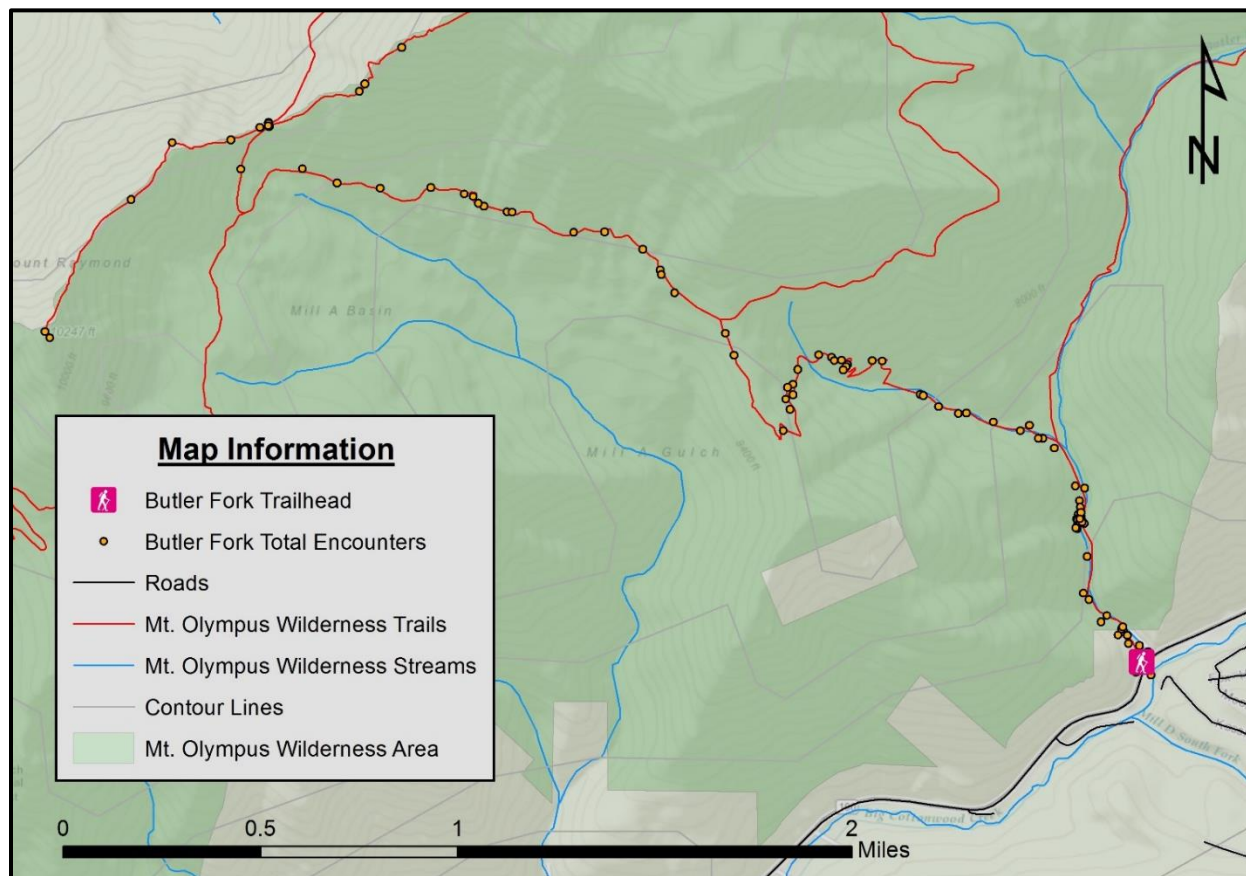


Figure 18: Butler Fork Trail Total Group Encounters

Figure 18 shows the total group encounters ($N = 81$) for Butler Fork trail over the course of the study period. The amount of encounters is spread out along most of the trail. The majority of the group encounters occur within the Mount Olympus Wilderness boundary, as displayed on the map.

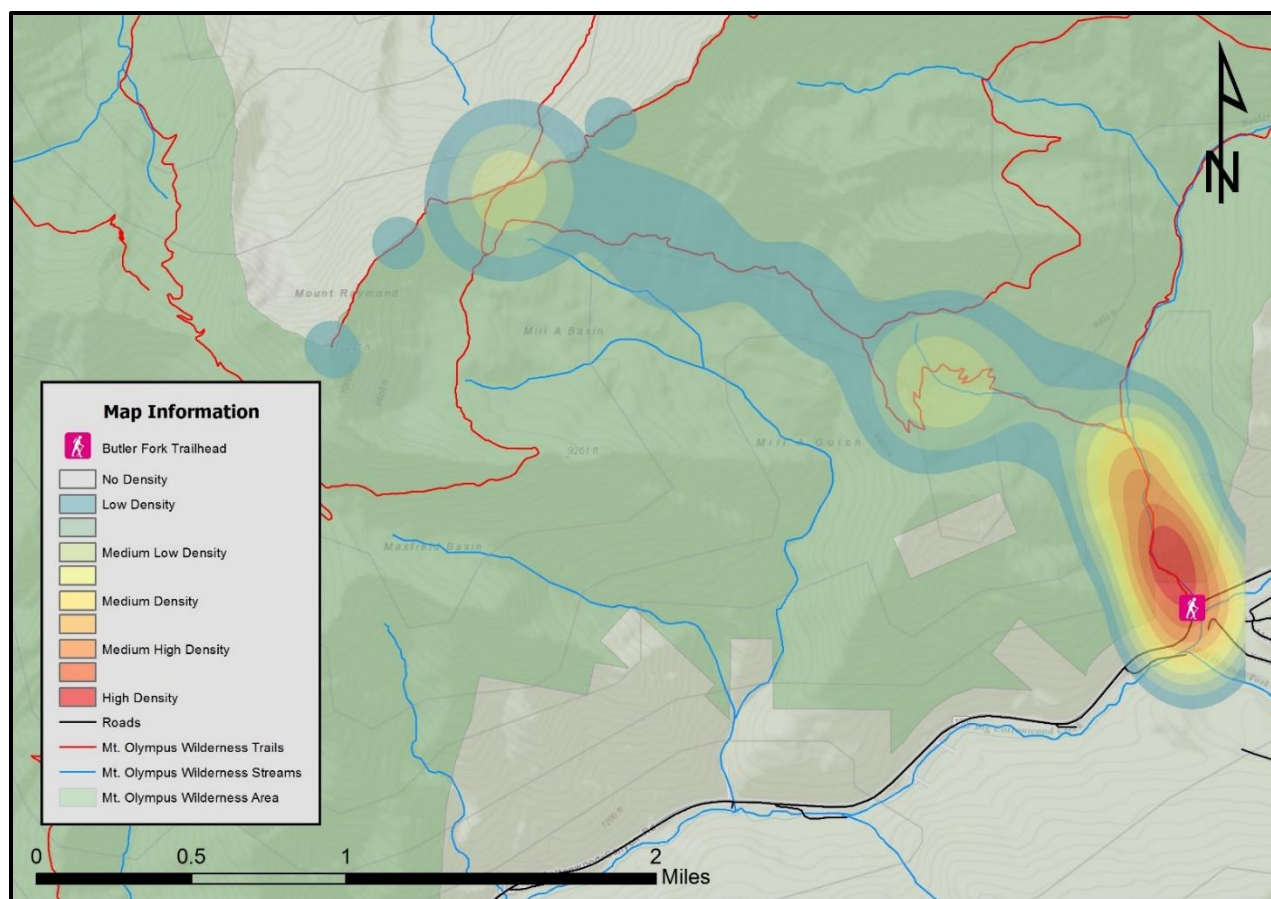


Figure 19: Heat Map of Total Group Encounter Locations on Butler Fork Trail

Figure 19 shows density of the total group encounter locations on Butler Fork trail. Red areas are high encounter areas, yellow is medium encounter areas, and blue are low encounter areas. This map shows that there was a high amount of encounters within the first mile of the trail, though there is medium density spread out along almost the entire trail. There were increased concentrations of encounters along flat sections of the trail, where natural benches provide resting areas and views of Big Cottonwood Canyon and Little Cottonwood Canyon and peaks of the Wasatch Range. Another congregation point includes Baker Pass, which is a stopping point for hikers on their way to Dog Lake, Gobbler's Knob, Mount Raymond, or connecting Mill Creek Canyon and Big Cottonwood Canyon.

Butler Fork Summary:

From the data above, Butler Fork is a consistently traveled hike in the Wasatch Front during the summer season. This trail had some of the most even distribution of encounters out of the nine sampling areas. Butler Fork differs from many of the other monitoring areas of this study in that it has a relatively high degree of connectivity to other existing trails and trail networks, rather than being an exclusively out-and-back trail. Butler Fork trail was ranked as a 1.2 on the opportunity class scale, however it might have been expected to be higher due to the amount of encounters found during any given day. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.3 – Deseret Peak Wilderness:

The Deseret Peak Wilderness Area in the Uinta-Wasatch-Cache National Forest is located 52 miles to the west of Salt Lake City, and this area contains two different monitoring areas for this study: Deseret Peak Loop Trail and Mill Fork Trail. These trails are found within the Stansbury Range; while the Stansbury Mountains are disconnected from the more populated Wasatch Range, they are geologically similar as being uplifts in the Basin and Range feature of the intermountain west. The Deseret Peak Wilderness Area has less group encounters and traveling encounters than the other wilderness areas in this study. This noted decrease in encounters is most likely due to there being only two monitoring areas and its distance from the urban population center of Salt Lake City.

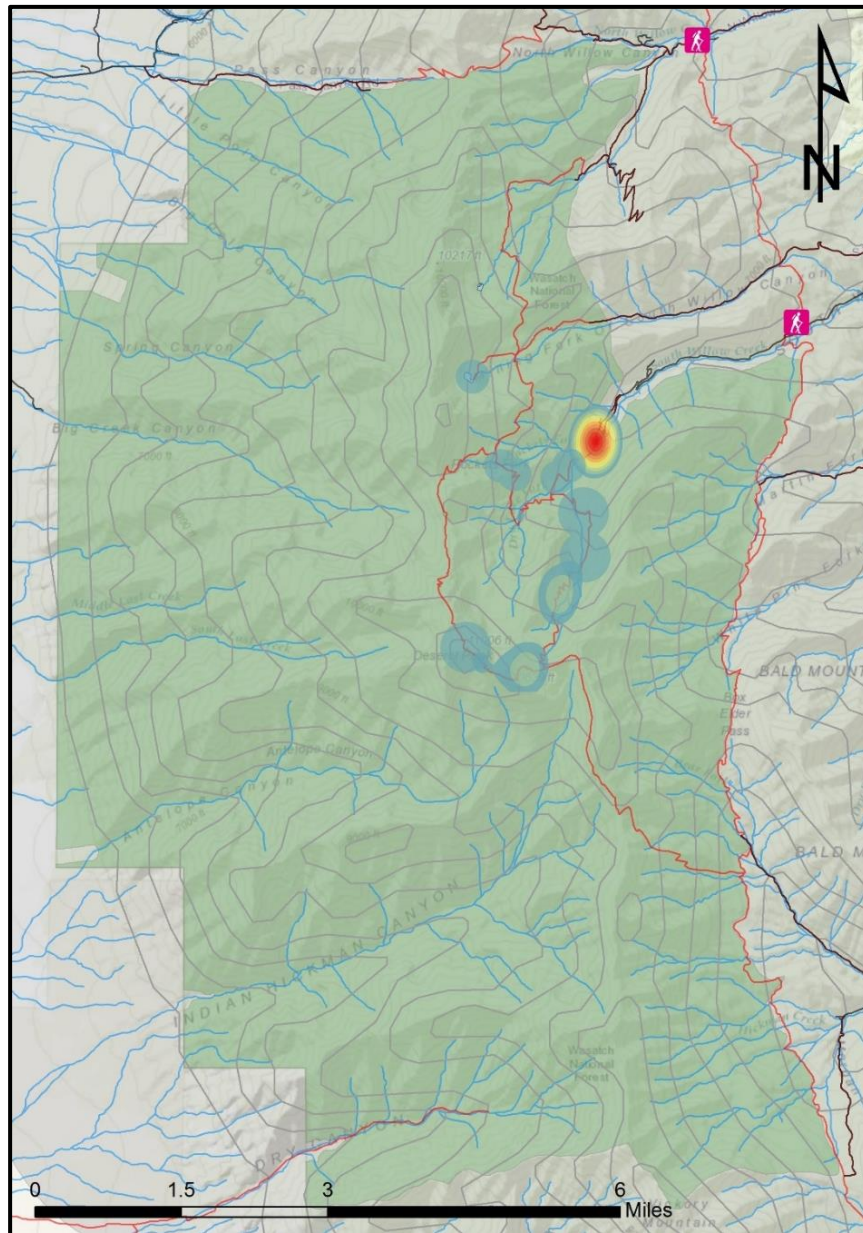


Figure 20: Heat Map of Total Group Encounter Locations of Deseret Peak Wilderness

Figure 20 shows the relative density for all the monitoring areas within the Deseret Peak Wilderness. The areas with large heat displays had more encounters than the areas with smaller heat displays. (Note: Both the Deseret Peak Trail and the Mill Fork Trail heat displays overlap at the origins of the trails.)

5.3.1 – Deseret Peak Loop Trail:

Located 52 miles from Salt Lake City, the Deseret Peak Loop Trail allows access to the summit of an 11,000-foot peak, with a continuous but moderate climb to the summit. In addition to hikers, this trail is somewhat popular with late-season skiers and snowboarders. The Deseret Peak Loop Trail is 9.2 miles and 4,032 vertical feet. Deseret Peak has a low amount of encounters, probably due to the distance from Salt Lake City. This trail was initially rated as a 1.3 on the wilderness opportunity class scale, which is surprising considering the low amount of encounters and relative isolation of this trail.

Table 16: Deseret Peak Weekday Encounters

Monitoring Area: Deseret Peak	Weekday: TOTAL				Weekday: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/14/2016	0	3	11	1.2	0	3	11
6/20/2016	0	1	3	0.3	0	1	3
7/7/2016	0	2	3	0.3	0	2	3
7/26/2016	0	0	0	0.0	0	0	0
7/29/2016	0	5	15	1.6	0	5	15
Total	0	11	32	0.7	0	11	32

Table 16 shows the number of campsites, traveling encounters, and group encounters seen during the five weekday monitoring sessions. As shown within the data, researchers documented a total of 32 traveling encounters, 32 of which occurred within wilderness boundaries, over the five days, which is an average of 6.4 total traveling encounters and 6.4 encounters within wilderness boundaries per monitoring period.

Table 17: Deseret Peak Weekend Encounters

Monitoring Area: Deseret Peak	Weekend: TOTAL				Weekend: WILDERNESS		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
6/25/2016	0	9	48	5.2	0	9	48
7/3/2016	0	8	15	1.6	0	8	15
7/30/2016	0	10	19	2.1	0	9	17
9/4/2016	0	11	32	3.5	0	11	32
9/5/2016	0	12	56	6.1	0	12	56
Total	0	50	170	3.7	0	49	168

Table 17 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data, researchers documented a total of 170 traveling encounters, 168 of which occurred within wilderness boundaries, over the five days, which is an average of 34 total traveling encounters and 33.6 encounters within wilderness boundaries per monitoring period.

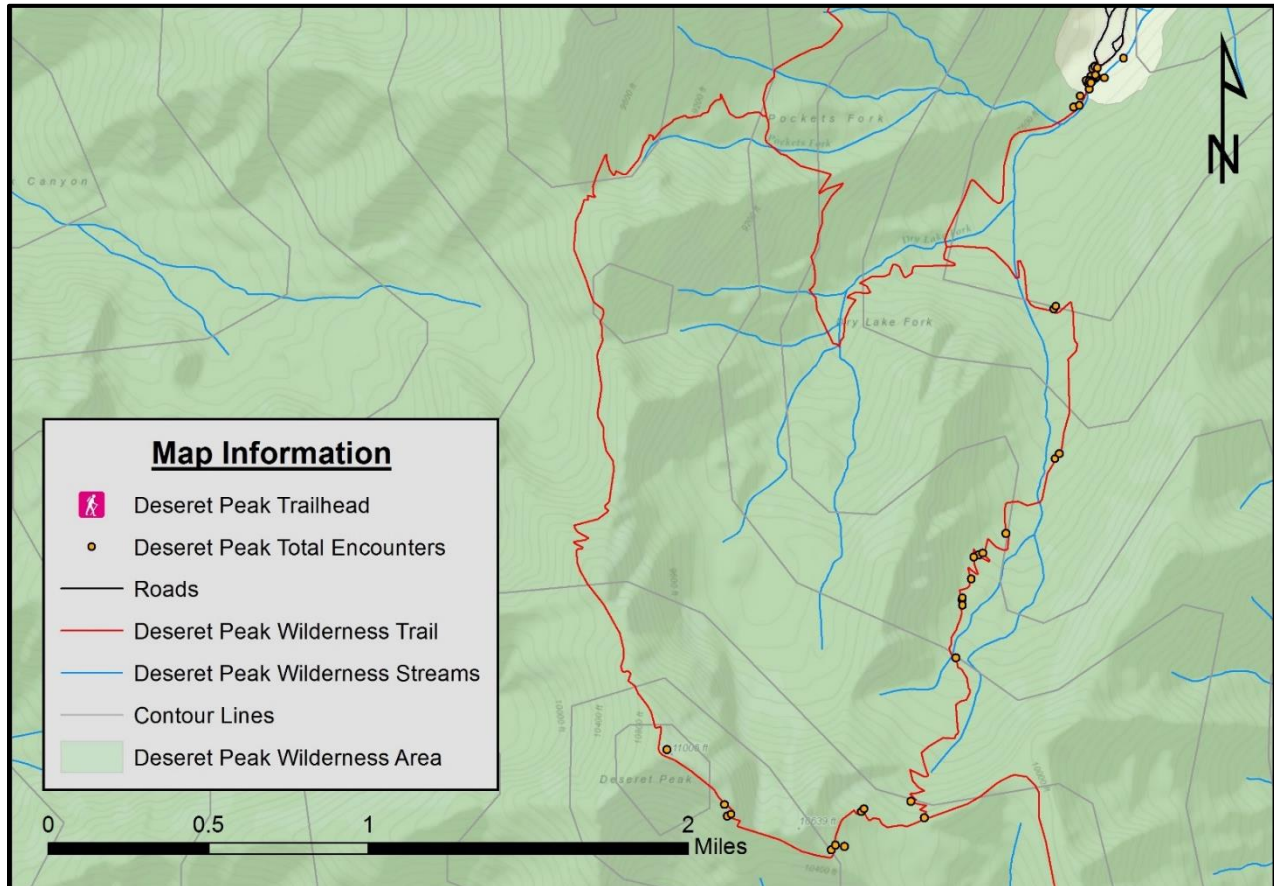


Figure 21: Deseret Peak Total Trail Group Encounters

Figure 21 shows the total group encounters ($N = 61$) for Deseret Peak trail over the course of the study period. The number of encounters along the trail is mostly dispersed, indicating that these encountered groups were typically large in size. The majority of the group encounters occur within close proximity to the trailhead, as displayed on the map.

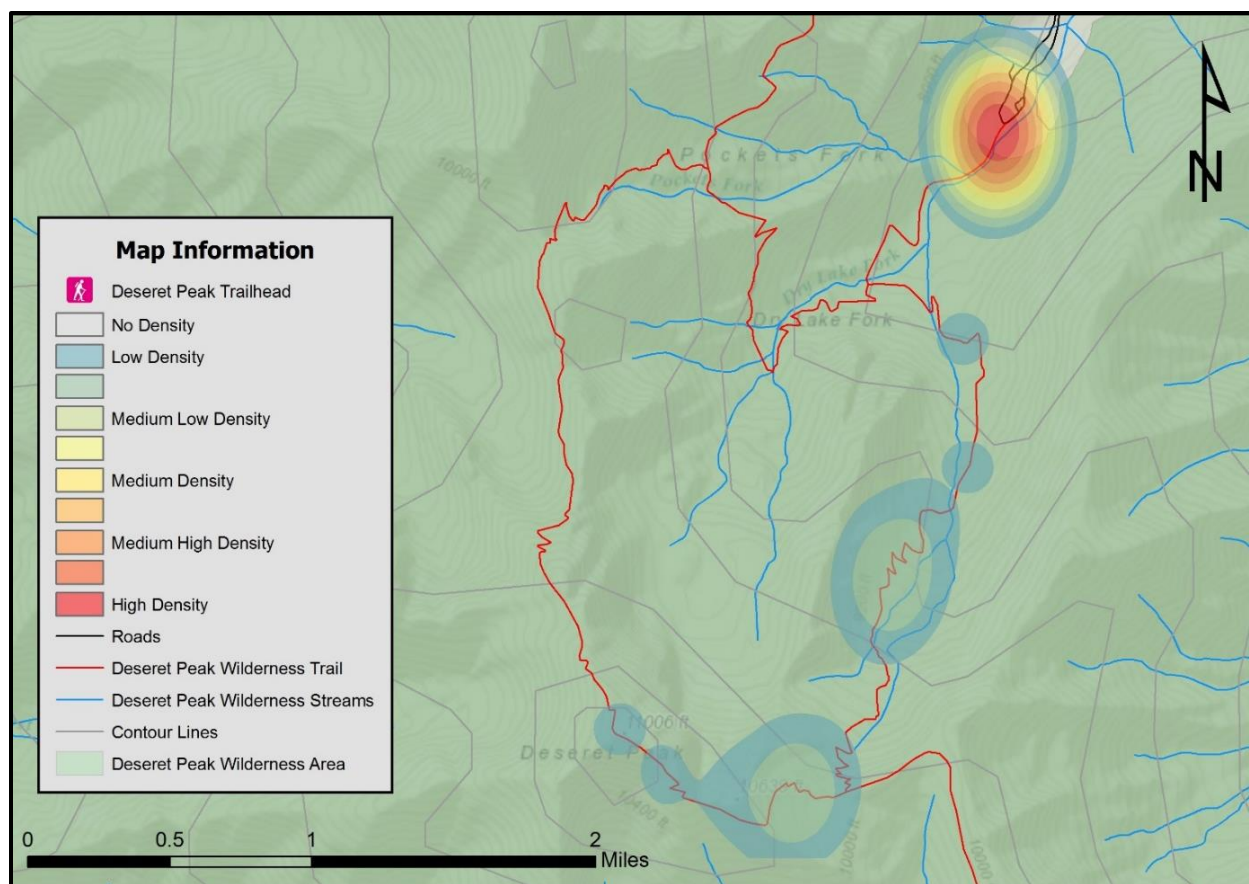


Figure 22: Heat Map of Total Group Encounter Locations on Deseret Peak Trail

Figure 22 shows density of the total group encounter locations on the Deseret Peak Loop Trail. Red areas are high encounter areas, yellow is medium encounter areas, and blue are low encounter areas. This map shows that there was a high amount of encounters within the first mile of the trail and medium amount of encounters throughout the rest of the trail. Most hikers were heading to the summit of Deseret Peak, though there were also substantial amounts of people in the first mile along the creek, which is also relatively close to the nearby USFS campground. Early season hikes also included individuals carrying skis and snowboards to the summit.

Deseret Peak Summary:

From the data above, Deseret Peak Loop Trail is a consistently moderately traveled hike in the Stansbury Range during the summer season. This trail had moderate numbers of group encounters but only on an out-and-back route. As seen in the data, no visitor encounters occurred on the “loop” section of the hike. This trail was ranked as a 1.2 on the opportunity class scale due to the low amount of people frequenting the trail and area, and this ranking seemed to hold through the duration of the project. Like the other monitoring areas, this trail showed substantially increased visitor encounters on weekend dates.

5.3.2 – Mill Fork:

Located 52 miles from Salt Lake City, Mill Fork allows for a fairly moderate hike to South Willow Lake in the Deseret Peak Wilderness Area of the Stansbury Range. This trail is 7 miles roundtrip, accounting for only 1,786ft vertical feet, the monitoring area with the least elevation gain in this study. Mill Fork has a consistently low amount of encounters, probably due to its distance from Salt Lake City, and the relative draw of the nearby Deseret Peak Loop Trail, which goes to the summit of Deseret Peak. This trail was rated as a 1.2 on the opportunity class scale, which is probably accurate due to the low amount of encounters and isolation.

Table 18: Mill Fork Weekday Encounters

<i>Monitoring Area: Mill Fork</i>	<i>Weekday: TOTAL</i>				<i>Weekday: WILDERNESS</i>		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
7/18/2016	0	1	1	0.1	0	1	1
8/12/2016	0	6	10	1.4	0	2	3
8/24/2016	0	0	0	0.0	0	0	0
8/26/2016	0	3	4	0.6	0	2	4
9/6/2016	0	3	3	0.4	0	2	3
Total	0	13	18	0.5	0	7	11

Table 18 shows the number of campsites, traveling encounters, and group encounters seen during the five weekday monitoring sessions. As shown within the data, researchers documented a total of 18 traveling encounters, 11 of which occurred within wilderness boundaries, over the five days, which is an average of 3.6 total traveling encounters and 2.2 encounters within wilderness boundaries per monitoring period.

Table 19: Heat Map of Total Group Encounter Locations on Mill Fork Trail

<i>Monitoring Area: Mill Fork</i>	<i>Weekend: TOTAL</i>				<i>Weekend: WILDERNESS</i>		
DATES	# of Campsites	# of Groups Encountered	# of Traveling Encounters	# of Traveling Encounters per mile	# of Campsites	# of Groups Encountered	# of Traveling Encounters
7/2/2016	0	4	14	2.0	0	3	11
8/14/2016	0	0	0	0.0	0	0	0
8/21/2016	0	6	9	1.3	0	4	9
8/28/2016	0	2	6	0.9	0	1	6
9/2/2016	0	3	6	0.9	0	2	6
Total	0	15	35	1	0	10	32

Table 19 shows the number of campsites, traveling encounters, and group encounters seen during the five weekend monitoring sessions. As shown within the data, researchers documented a total of 35 traveling encounters, 32 of which occurred within wilderness boundaries, over the five days, which is an average of 7 total traveling encounters and 6.4 encounters within wilderness boundaries per monitoring period. It should be noted that Mill Fork had the lowest number of encounters – both weekday and weekend – from any of the nine monitoring areas assessed in this study.

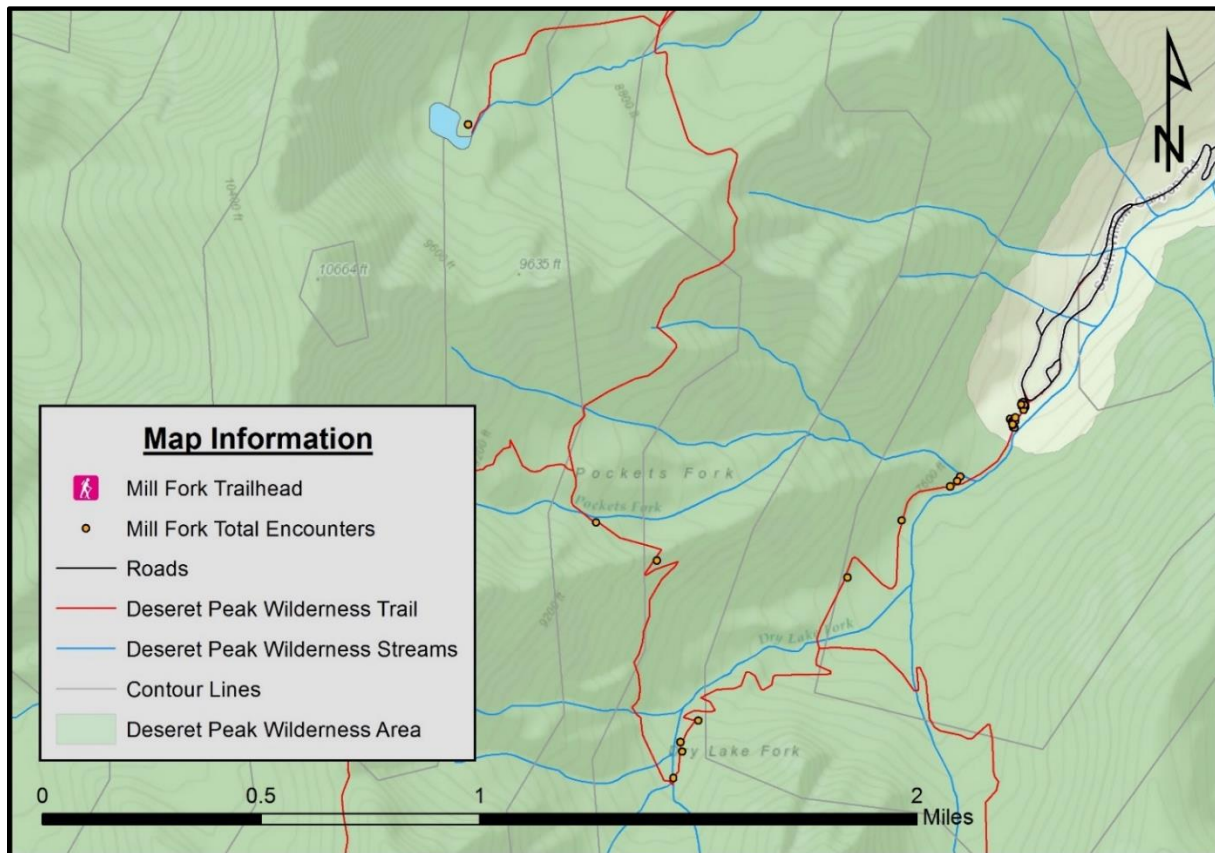


Figure 23: Mill Fork Total Trail Group Encounters

Figure 23 shows the total group encounters ($N = 28$) for Mill Fork Trail over the course of the study period. The number of group encounters along the trail is mostly dispersed, indicating that many of these groups were large in size. The majority of the group encounters occur within close proximity to the trailhead, as displayed on the map. While this is a sparsely visited trail, most visitor encounters occurred near the trailhead, and there were a substantial number of visitors on horseback.

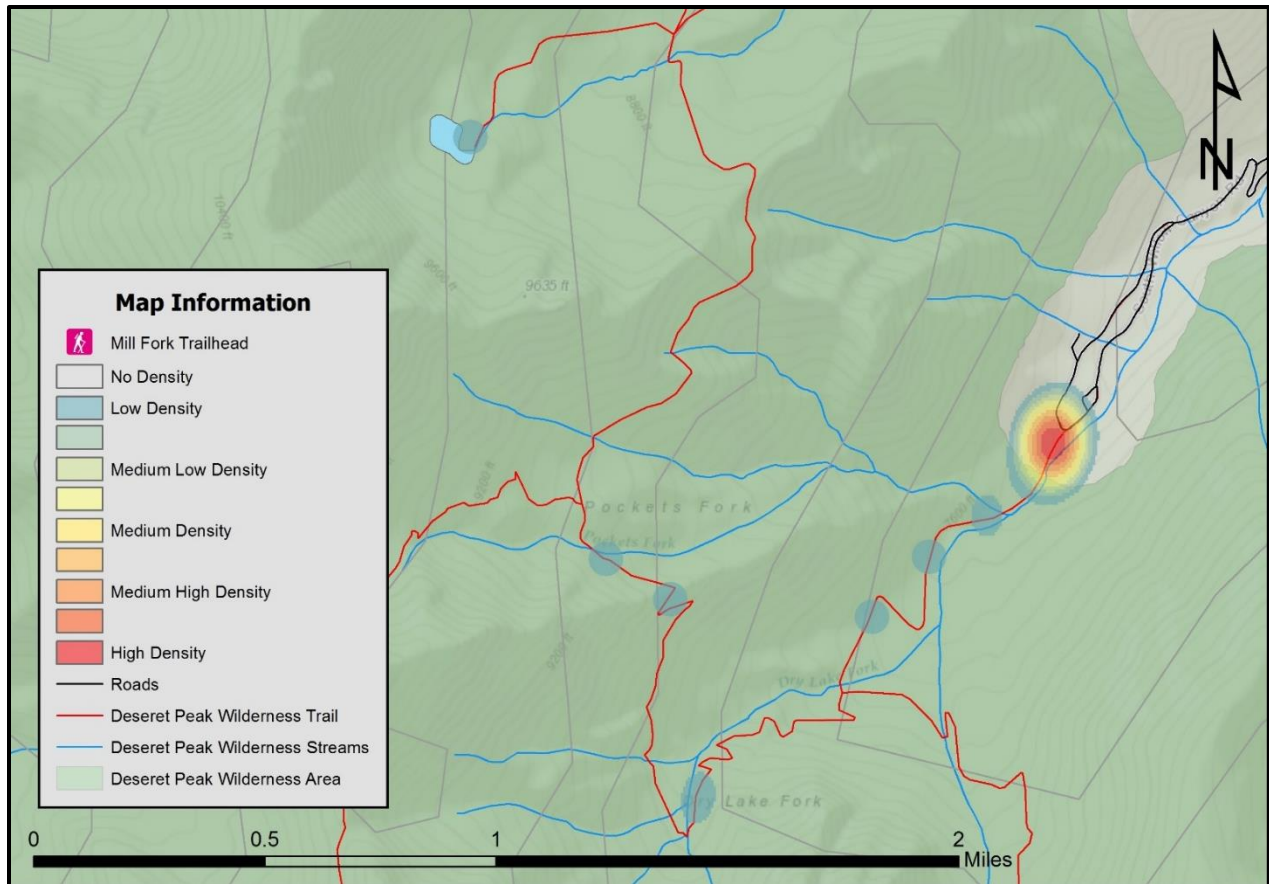


Figure 24: Heat Map of Total Group Encounter Locations on Mill Fork Trail

Figure 24 shows the relative density of the total group encounter locations on the Mill Fork Trail. Red areas are high encounter areas, yellow is medium encounter areas, and blue are low encounter areas. This map shows that there was a high amount of encounters within the first mile of the trail and low amount of encounters throughout the rest of the trail.

Mill Fork Summary:

From the data above, the Mill Fork Trail is a consistently lightly traveled hike in the Stansbury Range during the summer season. This trail had low numbers of group encounters. This trail was ranked as a 1.2 on the opportunity class scale due to the low amount of people frequenting the trail and area, and this ranking seemed to hold through the duration of the project. Like the other monitoring areas, this trail showed increased visitor encounters on weekend dates, though only slightly due to the overall low number of documented visitor encounters.

6.0 – Recommendations:

Visitor encounters were assessed in three wilderness areas (Twin Peaks Wilderness, Mount Olympus Wilderness, and Deseret Peak Wilderness) on the following nine monitoring areas (trails): Lake Blanche, Broads Fork, Cardiff Pass, Ferguson Canyon, Mount Olympus, Neff's Canyon, Butler Fork, Deseret Peak Loop, and Mill Fork. Data and analyses from the nine monitoring areas demonstrate that visitor use in the Twin Peaks, Mount Olympus, and Deseret Peaks Wilderness Areas in the Salt Lake Ranger District of the Uinta-Wasatch-Cache National Forest across the summer season is highly variable. Infrared trail counters were deployed on Lake Blanche, Broads Fork, and Mount Olympus trails. Trail counters indicated that Broads Fork and Mount Olympus trails each averaged approximately 200 visitors per week, while Lake Blanche averaged more than 600 visitors per week. These counts correspond with our researcher-documented trail encounter data, supporting the validity of both metrics. Popular trails such as Lake Blanche (in Twin Peaks Wilderness) and Mount Olympus (in Mount Olympus Wilderness) have consistently high use (determined from infrared counter data) and high visitor encounters (determined by researcher field counts). However, other trails, both geographically nearby (i.e., Broads Fork, Butler Fork) and distant (i.e., Mill Fork), have much less documented use and visitor encounters. In addition to the high variability between trails within wilderness areas, there is also variability across time; trail use and encounters were consistently higher during weekend and holiday periods than during the week. Data show that in many monitoring areas, the number of vehicles in parking areas and the number of visitors using trails may exceed the intended capacity of these areas.

While campsites observed throughout the three wilderness areas were infrequent, the number of groups encountered were 429 groups in Twin Peaks Wilderness, 304 groups in Mount Olympus Wilderness, and 77 groups in Deseret Peak Wilderness. This total of 810 groups accounted for encounters with a total of 2,462 visitors to the wilderness areas. Of the nine monitoring areas, Lake Blanche in the Twin Peaks Wilderness had the most visitor encounters (1,041 visitor encounters in 290 groups), while Mill Fork in the Deseret Peaks Wilderness had the fewest visitor encounters (43 visitor encounters in 17 groups). In addition to these metrics of encounters with visitors in wilderness areas, researchers were also able to document overall encounters in monitoring areas, including those encounters outside of designated wilderness areas. Our research indicates that approximately 25% more groups and visitors were encountered in monitoring areas outside of wilderness boundaries, usually near trailheads, parking areas, and along the initial stretches of trail.

The Salt Lake Ranger District may likely need to continue steps designed to mitigate overuse and disperse increased numbers of recreationists that are expected with further population growth and recreational demand along the Wasatch Front. Some minor management modifications in existing wilderness classification schemes may enable some of the monitoring areas to better represent actual visitor use tendencies and encounter likelihoods during high use seasons. Based off the collected data and spatial analyses, it is recommended that the Salt Lake Ranger District of the Uinta-Wasatch-Cache National Forest make the following changes to the wilderness opportunity classification to the following trails:

- Broads Fork (in Twin Peaks Wilderness) could be changed from opportunity class 1.2 to 1.1, given its usage, likelihood for visitor encounters, and degree of human modification. Visitors can reasonably expect opportunities for solitude in this area.

- Mill Fork (in Deseret Peak Wilderness) could be changed from opportunity class 1.3/1.2 to 1.1, given its usage and likelihood for visitor encounters. Visitors can reasonably expect opportunities for solitude in this area.
- Deseret Peak Loop (in Deseret Peak Wilderness) could be changed from opportunity class 1.3 to 1.2, given its usage and the likelihood for visitor encounters. Of particular note on this trail is the opportunity to support visitor use of the “loop,” where visitor encounters on the northern ridge portion of the loop are currently unlikely.
- Cardiff Pass (near the Twin Peaks Wilderness) could be considered for future wilderness area expansion, as this area provides much of the characteristics of wilderness, including excellent opportunities for solitude.

This report recommends that these findings be used to update the existing 2003 Uinta-Wasatch-Cache Forest Plan so that managers can best distribute visitors according to a matrix of resource availability, expected population geographies, and visitor interest.

In addition to these recommendations, some general conclusions can be drawn from collected and analyzed data. There is a differential amount of solitude within the Salt Lake Ranger District’s wilderness areas, with many visitor encounters concentrated on Lake Blanche and Mount Olympus trails. Other trails with higher visitor encounters include Ferguson Canyon, Deseret Peak Loop, and Butler Fork. Meanwhile, other trails within those same wilderness areas see far fewer encounters, such as Neff’s Canyon, Mill Fork, and Cardiff Pass. In sum, substantially more visitors are encountered in Mount Olympus Wilderness and Twin Peaks Wilderness than in Deseret Peak Wilderness. These conclusions align with the spatial proximity of these wilderness areas to the metropolitan and urban core of the Salt Lake Valley, with a high population concentration. Additionally, Salt Lake Valley residents show a cultural propensity to participate in various forms of unconfined outdoor recreation. The combination of increased population with cultural affinity for outdoor recreation indicates increasing pressures on a variety of nearby protected areas, including wilderness areas managed by the USFS. Data in this report show that is unlikely that visitors can expect to gain a sense of solitude along Lake Blanche and Mount Olympus trails, though they may find solitude in other locations within the Twin Peaks Wilderness area and the Mount Olympus Wilderness area.

Finally, as many of these wilderness areas and trails also experience high use in non-summer seasons, there is a need for continued monitoring through an extension of this project to account for visitor use during winter and spring months, when the Uinta-Wasatch-Cache National Forest is thought to experience increased visitor use with snow-based recreation. A combination of infrared trail counters and field-based, GPS-enabled encounter documentation would contribute to data in this report to provide a more comprehensive examination of opportunities for solitude in the three wilderness areas of the Salt Lake Ranger District of the Uinta-Wasatch-Cache National Forest. Winter use, winter use type, and winter encounters are likely substantial, though different, than summer season statistics, but would further inform managerial decisions and imperatives.