Big Bear Modal Alternatives Analysis

Final Report

Prepared for:

SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

SANBAG

Inland Valley Development Agency

Prepared by:

InfraConsult

In association with:

Cambridge Systematics, Inc.
Sharon Greene + Associates
URS Corporation

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EXECUTIVE SUMMARY

ES.1 Background

Society is increasingly recognizing the need for man to live in balance with the environment, using the earth's natural assets in ways that will sustain a high-quality living standard over time without depleting essential resources. Planners of future transportation can contribute to a sustainable culture by developing systems that provide mobility with less reliance on fossil fuels, increased use of renewable sources, less disruption of the natural environment, and fewer emissions of pollutants and greenhouse gases. In few places around Southern California are these issues more relevant than in the mountain travel corridor between the Los Angeles Basin and the communities around Big Bear Lake.

Located high in the San Bernardino National Forest, the Big Bear Valley is both an active community and a popular recreation destination throughout the year. Primary access to Big Bear from the San Bernardino Valley and the greater Los Angeles metropolitan area is limited to three state highway routes through National Forest land, with just two lanes of capacity through most of the mountain areas. These routes have been increasingly plagued by a number of challenges that inhibit safe and convenient travel. Sections with steep grades, frequent switchback curves, limited sight distance, and slow-moving vehicles can make these roads a challenging drive under even the best of conditions. During winter snow storms, when travel demand is at its peak, travel is especially arduous due to icy conditions, chain requirements, and all-too-frequent traffic incidents. Access to the mountains has been affected by road closures for extended periods due to heavy snow, earth movement covering or undermining the road, and wildfire.

Without improvements to the system, traffic and maintenance-related problems can be expected to worsen. Weekend traffic congestion on the state highways can be expected to increase, resulting in longer periods of congestion during peak times. As traffic volumes and congestion levels increase, collision rates also typically increase. As the roadway and drainage system continues to age and deteriorate, road closures are likely to become more frequent and longer.

In addition, the future potential of the Big Bear Valley is constrained by the access limitations imposed by the highway system. No significant improvements to the roadway system are currently programmed or planned due to public sector financial constraints and the substantial environmental impact that would be associated with any major roadway capacity project in the mountains.

Various types of roadway-based strategies have been suggested to help address the system's capacity deficiencies. Each approach would increase capacity, improve roadway operations and safety, or make better use of existing capacity, but all have significant financial, environmental, or community impact issues that make them unsatisfactory approaches to addressing the long-term access needs.

On the other hand, adding capacity by developing an alternative (non-roadway) transportation mode offers advantages that a roadway improvement could not:

- An alternative system could provide convenient mountain access with minimal or no auto driving for people throughout the greater Los Angeles metropolitan area via a connection to Metrolink in San Bernardino.
- An alternative system would enable the mountains to accommodate more users for skiing, snow play, and summer recreation without the need to expand roads or parking areas.

- An alternative system could be developed along a different alignment than the existing roadway system. Therefore it might be usable during an emergency (such as wildfire or earthquake) for evacuating people or bringing in emergency personnel and equipment even if the roadways were shut down.
- An alternative system would be operable after a major snowstorm or during other types of road closures, so people and goods could move up and down the mountain even if one or all of the key mountain access roads are closed.
- The new system itself would be a tourist attraction, providing additional ridership and revenue, and providing an economic boost to areas where stations are located.
- For some types of goods, an alternative system might provide a cheaper and more efficient means of shipment to the mountain communities.

In addition, an alternative mode would likely be a more environmentally friendly alternative than road improvements.

- It would have a smaller environmental "footprint" than roads, so it would be expected to have less impact on the lands it passes through.
- It would emit fewer vehicular and greenhouse gas emissions than carrying the same number of people in autos and other vehicles.
- It would operate using a "greener" energy source (likely electricity) than the internal combustion engine.
- It would provide opportunities for transit-oriented development near mountain stations, making it possible for people to live and work and travel without need for a car.

Because of these factors, the Cities of Big Bear Lake, San Bernardino, and Highland, and the County of San Bernardino have partnered with the region's transportation planning agencies (the San Bernardino Associated Governments, the Southern California Association of Governments, and Caltrans) and the Inland Valley Development Agency to explore the feasibility of non-roadway alternatives for future transportation of people and goods between the San Bernardino and Big Bear Valleys. This study, and a similar effort completed in 1996, explores the feasibility of developing a non-roadway mountain transportation alternative, based on the recognition that a prosperous future in the Big Bear Valley depends upon the Southern California Region's ability to take advantage of the four-season recreational assets of the San Bernardino Mountains.

ES.2 Opportunities and Constraints

Demographics

The full-time population in Big Bear is forecast to grow slowly, so visitors and part-time residents represent the demographic groups with the most future growth potential. In the City of Big Bear Lake, over 70% of the housing units are not occupied year-round and serve either as second homes or seasonal rentals; in the surrounding unincorporated areas, the percentage is approximately 50%.

Travel Conditions

Traffic congestion and road closure problems combine to indicate a clear need for additional transportation capacity to accommodate future growth in travel to and from the mountains. An

alternative transportation system is an attractive alternative to adding roadway capacity because it could:

- Provide transportation of people and goods in all kinds of weather;
- Provide an alternative mode and/or route of access during an emergency;
- Have a smaller environmental "footprint" than building new roads or widening existing roads; and
- Facilitate expanded recreation opportunities in the mountains without proportional expansion of roadway and parking capacity.

Moving People with an Alternative System

The following are important factors to consider when implementing alternative methods to transport people:

Competitiveness with auto travel: To be able to attract significant numbers of riders, the new system would need to provide an overall travel time that is competitive with auto travel. This will be a determining factor in the selection of appropriate technologies.

Convenience of transporting personal belongings: To be attractive for carrying leisure travelers (weekend visitors to the mountains) or recreational trips (skiers, snow play visitors, and summer recreation visitors), the system will need to have a convenient process for loading and unloading personal belongings such as luggage and ski equipment. Since much of the corridor travel involves leisure or recreational trips, for the system to be successful it will need to conveniently serve this user group.

Distribution of people and goods: The system for distributing people (and their belongings) at the mountain end of the trip will be an important factor in attracting riders. While some destinations may be within walking distance of the stations, many destinations are dispersed throughout the mountains, so planning for an alternative system will need to include consideration of methods for moving people between the stations and their ultimate destinations. Likewise, a convenient and efficient method of moving freight from stations to its destination will be important for capturing a portion of the goods movement market.

Physical Factors

The following are important physical factors to consider:

Grades: The rapid elevation changes encountered in the mountains dictate that an alternative transportation system use a technology than can safely negotiate steep grades.

Environmental factors: When evaluating potential alignments, several environmental factors should be considered, and avoided to the extent possible, including potential landslide areas, earthquake fault zones, potential liquefaction areas, high fire hazard areas, flood plains, water courses, species habitat, and cultural resources.

Station locations: Communities to be served with stations should be selected to provide accessibility to the developed mountain communities and activity centers in the corridor; ideally, therefore, mountain

stations would be located in Running Springs, Snow Valley, and Big Bear Lake (the Village area and the China Gardens/Interlaken area). Valley stations should provide park-and-ride opportunities, potential for goods movement transfers, and connections to public transportation. Stations in Highland, at San Bernardino International Airport, and at the proposed downtown Metrolink station would serve these functions.

Right of Way Issues

Coordination and consultation with the US Forest Service will be essential for the project to be successfully implemented.

Land Acquisition will likely be necessary in the developed mountain areas, where potential station sites may be located. In the San Bernardino Valley portion of the corridor, considerations for property acquisition or operating easements will also influence project viability.

ES.3 Technologies

The study identified and evaluated the range of available technological alternatives that could provide passenger and freight service from the San Bernardino Valley to Big Bear Valley. These included:

- Aerial ropeway systems with self-propelled vehicles
- Cable-propelled systems
- Suspended monorails
- Cog railways
- Funicular railways
- Air travel

Various alignments incorporating these technologies were examined in the 1996 Study to service a wide range of topographical characteristics from level grade urbanized areas to mountainous steep-grade terrain. This analysis updated the technology review performed in the 1996 Study, and sought out the latest technological advances by establishing contact with manufacturers of fixed-guideway transit systems to identify contemporary applications that would be relevant to the Big Bear corridor.

Route Length: One of the most significant challenges is the scale of the proposed Big Bear project. Most of the existing aerial transportation systems are much shorter in length/distance than the 35+/- mile system being contemplated for Big Bear. In fact, the longest elevated ropeway system that the project team was able to identify is in Sweden and is approximately nine miles in length.

Topography: Another challenge of the Big Bear project is the steep mountain grades. Preliminary alignments include areas with grades exceeding 20%, and both at-grade and aerial systems have the capability of operating at this level of incline. However, for optimal passenger comfort and operations, systems are typically designed for no more than an 8% grade. After review of the Big Bear conceptual system needs, lengths and gradients, and discussions with representatives from Dopplemayr LLC, the analysis concluded that aerial ropeway systems are best suited for shorter distances, and developing and operating a 30+ mile systems using aerial ropeway technology is not recommended.

Freight Capabilities: Research has revealed that most areas rely on trucking for freight hauling to mountain destinations, with fixed-guideway systems limited to passenger travel. All of the systems

evaluated have the potential to carry freight, with varying capacities. Cog rail systems offer good freight capacity and capabilities. Self-propelled aerial ropeway technology has the capability but is unproven, while the elevated monorail and aerial cable propelled systems have limited cargo hauling capacity.

Travel Speeds: Cable propelled ropeway systems have limited speed capability, and vehicles would need to transfer between rope systems several times over the length of the corridor, so this technology could not be at all competitive with automobile travel. Elevated monorail and self-propelled ropeway technology have the potential for competitive speeds, but there have been no installations of these technologies in a corridor this long to demonstrate their capability. Cog rail operates at competitive speeds over long distances through the Alps.

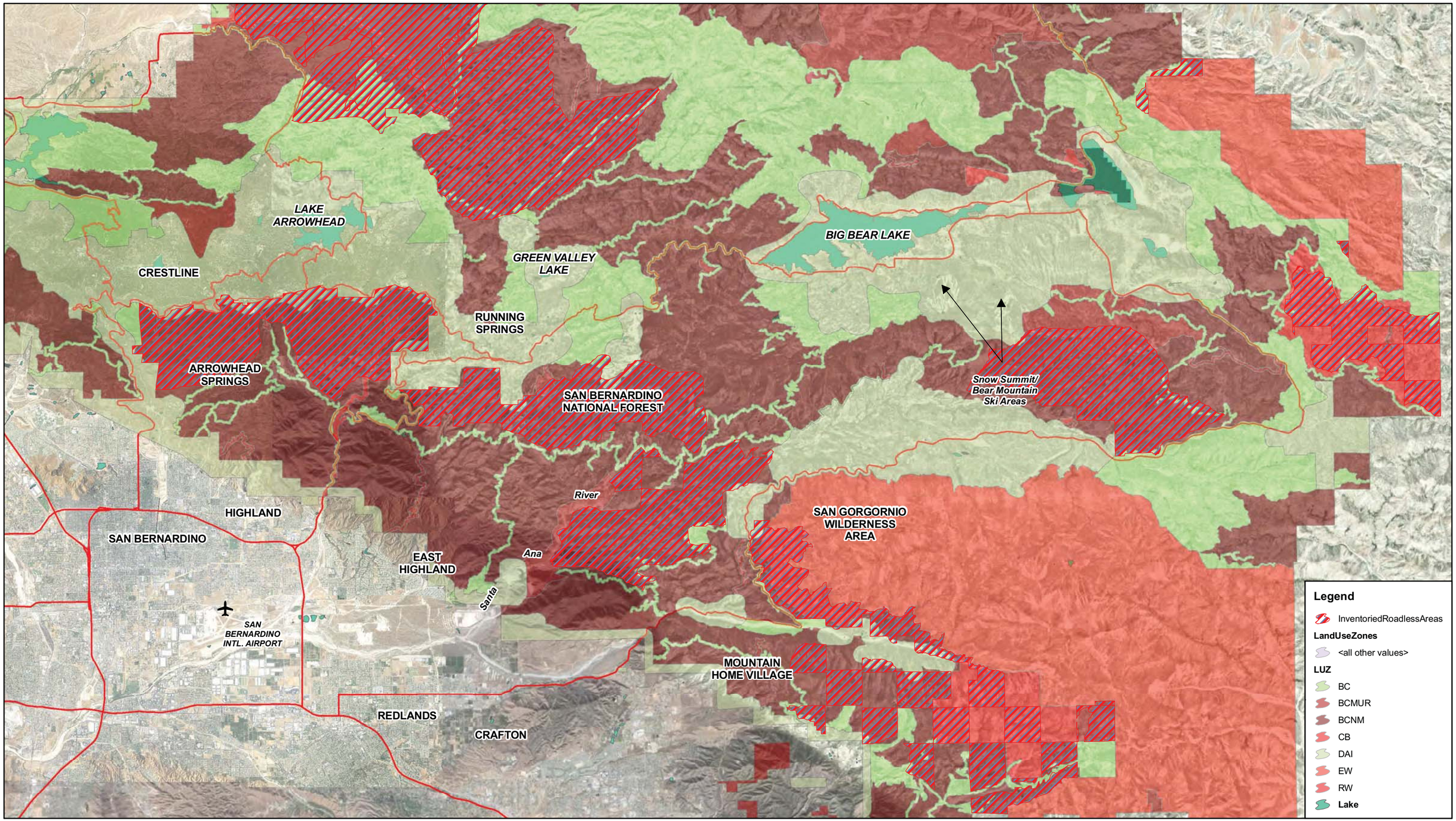
Technology Recommendation: Only the cog rail technology, which has demonstrated abilities to operate long distances through steep mountain terrain and inclement weather, is recommended to be carried forward for additional analysis and system planning.

ES.4 Alignment Alternatives

The 1996 study evaluated a number of potential alignment options through the mountain portion of the corridor from Highland to Big Bear Lake. Consultations with local US Forest Service representatives brought out the fact that the nine alternative alignments studied in 1996 pass through National Forest areas designated as incompatible with transportation uses. USFS representatives have indicated that, while it would be possible to obtain approval for a new transportation system through these areas, it would involve an extensive review and approval process within the Forest Service.

Because the National Forest land use conflicts could represent a significant impediment to the original nine alignments, the study team and Technical Advisory Committee (TAC) identified additional alignments that would eliminate or minimize corridor intrusion into roadless and non-motorized areas. Using the Forest Service mapping of compatible land use areas (shown in green colors in Figure ES.1) and non-compatible areas (shown in browns and reds), the study team and TAC identified six alternative corridors for further study, with potential variations in four of the six corridors. The alternative corridors (shown in Figure ES.2) are numbered from 1 to 6 from west to east. With variations, a total of 13 alignment alternatives were carried forward into the evaluation of system alternatives.

Figure ES.1 - USFS Land Uses



Source: USGS National Hydrography Dataset

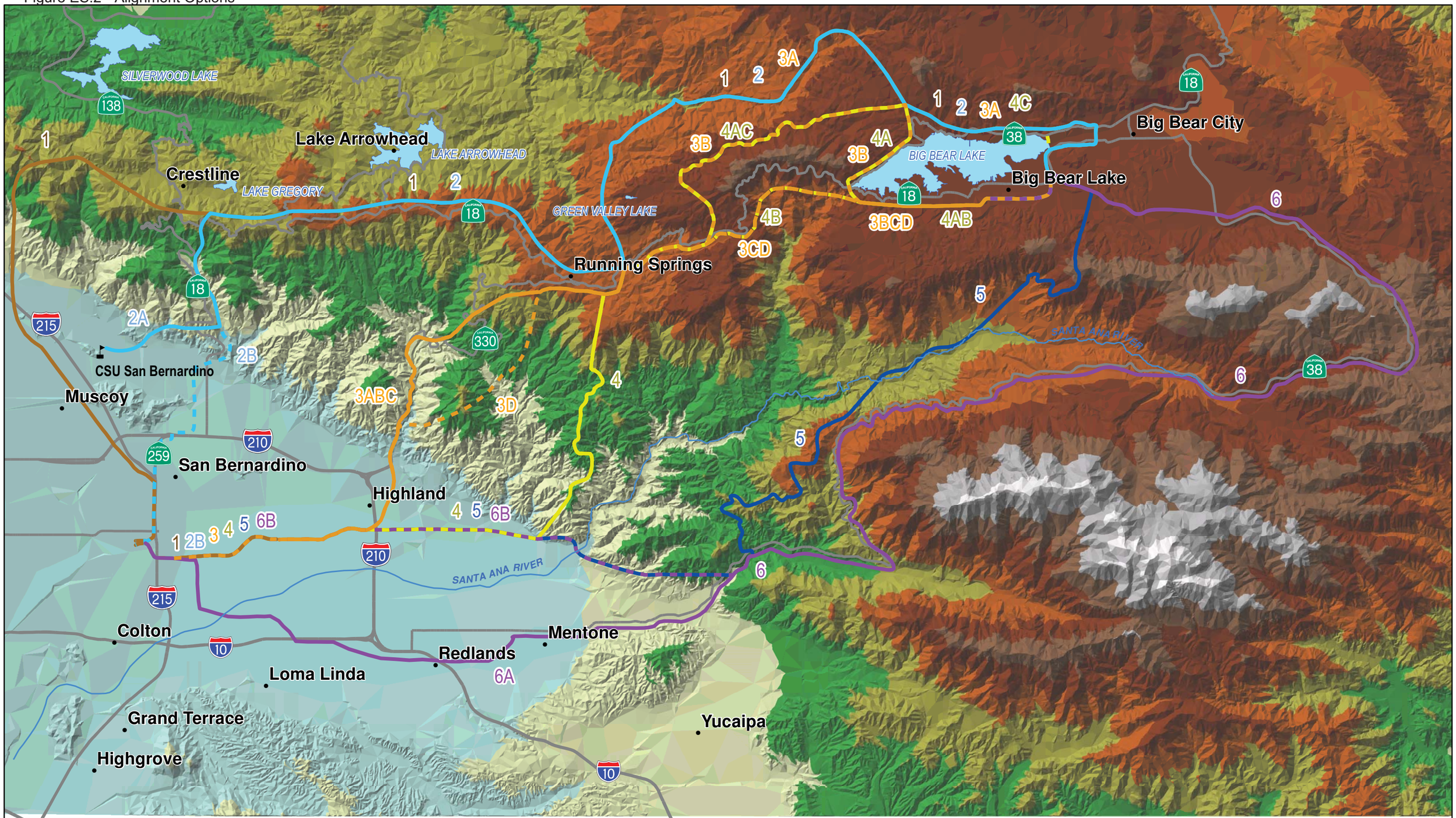
0 1.25 2.5 5 Miles

1 in = 3 miles

Big Bear Modal Alternatives 2010

USFS Roadless Areas
USFS Land Use Zone (LUZ)
Green: transportation allowed
Red: transportation not allowed

Figure ES.2 - Alignment Options



Legend

CSU San Bernardino **Alignment**

1, 2A, 2B, 3A, 3B, 3C, 3D, 4A, 4B, 4C, 5, 6A, 6B

N

0 1 2 4 Miles

Alignment Study

July 2011

URS

ES.5 Evaluation Results

The evaluation analyzed each of the 13 system alternatives in regard to capital costs, annual operating costs, total travel time from San Bernardino to Big Bear Lake, portion of the alignment requiring cog rail operation (greater than 8% slope), estimated annual ridership and passenger revenue, estimated weekly tonnage of goods movement and annual freight revenue, the portion of the alignment crossing roadless or non-motorized areas of the National Forest, the portion crossing sensitive habitat areas, and the portion crossing geologically unstable areas. To provide a snapshot of the magnitude and range of results, Table ES.1 depicts the performance results of the alternatives with the best and worst performance for each criterion. Table ES.2 summarizes the results for each criterion and each of the 13 alternatives.

Table ES.1 - Range of Performance Results

Criterion	Best Alternative Result	Worst Alternative Result
Length of Alignment	30 miles	58 miles
Capital Cost (2011 $)	$2.8 – 5.0 billion	$5.2 – 9.6 billion
Annual Operating Cost	$11.8 million	$13.8 million
Total travel time	72 minutes	114 minutes
Cog rail operation	0 miles (of 54 total miles)	7.5 miles (of 37 total miles)
Estimated 2035 annual passengers Annual passenger revenue	981,000 $16.5 million	575,000 $9.6 million
Weekly goods movement Annual freight revenue (high rate freight strategy)	870 tons $6.7 million	525 tons $5.5 million
Roadless & non-motorized areas: Distance across Distance adjacent to	 0 miles (of 57 miles total) 0.6 miles (of 32 miles total)	 9.2 miles (of 32 miles total) 17.9 miles (of 54 miles total)
Distance across sensitive habitat areas	0.5 miles (of 40 total miles)	5.2 miles (of 41 total miles)
Distance across Very High Landslide Risk areas	2.0 miles (of 51 total miles)	22.6 miles (of 54 total miles)

Table ES.2
Big Bear Modal Alternatives Analysis
Evaluation Results Summary Matrix

Alternative	1	2A	2B	3A	3B	3C (original Alt. 3)	3D (original Alt. 4)	4A	4B (original Alt. 5)	4C	5	6A	6B
Description													
Corridor	Devore	Waterman	Waterman	Highland/ SR-330	Highland/ SR-330	Highland/ SR-330	Highland/ SR-330	East Highland	East Highland	East Highland	Radford Camp Rd.	SR-38	SR-38
Route		To CSUSB	To SR-210	Via City Creek, 2W03, Division	Via City Creek, 2N13, BB Dam	Via City Creek, Arctic Circle	Via Plunge Creek, Arctic Circle	Via 2N13, BB Dam	Via Arctic Circle	Via 2N13, Division		Via Redlands	Via East Highland
Alignment Length (miles)	57	42	51	41	39	31	30	40	32	39	37	58	54
# of Stations	7	5	8	6	7	7	7	7	7	7	5	5	6
Stations/Communities Served	SB Intl. Airport Downtown SB SB Metrolink Crestline Running Springs Big Bear China Garden Big Bear Village	CSU San Bernardino Crestline Running Springs Big Bear China Garden Big Bear Village	SB Intl. Airport Downtown SB SB Metrolink SB E St./SR-210 Crestline Running Springs Big Bear China Garden Big Bear Village	Downtown SB SB Intl. Airport Highland SR-330 Running Springs Big Bear China Garden Big Bear Village	Downtown SB SB Intl. Airport Highland SR-330 Running Springs Snow Valley Big Bear Village Big Bear China Garden	Downtown SB SB Intl. Airport Highland SR-330 Running Springs Snow Valley Big Bear Village Big Bear China Garden	Downtown SB SB Intl. Airport Highland SR-330 Running Springs Snow Valley Big Bear Village Big Bear China Garden	Downtown SB SB Intl. Airport Highland Greenspot Running Springs Snow Valley Big Bear Village Big Bear China Garden	Downtown SB SB Intl. Airport Highland Greenspot Running Springs Snow Valley Big Bear Village Big Bear China Garden	Downtown SB SB Intl. Airport Highland Greenspot Running Springs Snow Valley Big Bear Village Big Bear China Garden	Downtown SB SB Intl. Airport Highland Greenspot Big Bear Village Big Bear China Garden	Downtown SB [intermediate stops] Redlands Angelus Oaks Big Bear China Garden Big Bear Village	Downtown SB SB Intl. Airport Highland Greenspot Angelus Oaks Big Bear China Garden Big Bear Village
Total One-Way Travel Time end to end (min)	114	90	106	92	94	73	72	93	78	91	85	114	114
Average speed (mph)	30	28	29	27	25	25	25	26	25	26	26	31	28
Steep Slopes Requiring Cog Rail (miles, slope > 8%)													
8-14%	0.0	0.0	0.0	0.0	2.5	0.0	6.0	2.5	0.0	2.5	7.5	0.0	0.0
14-25%	3.5	2.0	2.0	2.5	2.5	2.5	0.0	2.5	2.5	2.5	0.0	0.0	0.0
Capital Costs ($ millions)													
Low estimate	$5,225	$4,140	$4,685	$3,860	$3,610	$2,810	$2,760	$3,685	$2,885	$3,535	$3,170	$5,345	$5,120
High estimate	$9,600	$8,100	$8,600	$7,200	$6,700	$5,100	$5,000	$6,600	$5,000	$6,300	$5,200	$9,400	$9,100
Annual Operating Costs ($ millions)													
Rail system	$13.8	$12.0	$13.8	$13.6	$13.6	$11.8	$11.8	$13.6	$11.8	$13.6	$12.0	$13.8	$13.8
Feeder bus system	$4.7	$4.7	$4.7	$4.2	$4.9	$4.9	$4.9	$4.9	$4.9	$4.9	$2.7	$3.3	$3.3
TOTAL ANNUAL O&M	$18.5	$16.7	$18.5	$17.8	$18.5	$16.7	$16.7	$18.5	$16.7	$18.5	$14.6	$17.1	$17.1
Estimated Annual Ridership, 2035 (valley-mountain riders)	756,000	704,000	818,000	769,000	855,000	981,000	981,000	855,000	981,000	855,000	641,000	575,000	575,000
Estimated Annual Revenue, 2035 (in millions of 2010 $)	$11.5	$10.7	$12.5	$12.9	$14.3	$16.5	$16.5	$14.3	$16.5	$14.3	$10.8	$9.6	$9.6
Estimated Weekly Tonnage of Goods Movement, 2035													
Low-Rate Strategy	2,230	1,487	2,230	1,515	1,515	1,515	1,515	1,515	1,515	1,515	1,335	1,415	1,415
High-Rate Strategy	870	580	870	595	595	595	595	595	595	595	525	555	555
Estimated Annual Value of Goods Movement, 2035 (in millions of 2010 $)													
Low-Rate Strategy	$3.4	$2.3	$3.4	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.9	$2.8	$2.8	$2.8
High-Rate Strategy	$6.7	$4.5	$6.7	$5.8	$5.8	$5.8	$5.8	$5.8	$5.8	$5.8	$5.5	$5.6	$5.6
Portion of Alignment Crossing or Between Roadless or Non-Motorized Areas (miles)													
Crosses Roadless or Non-Motorized Areas	0.0	0.0	0.0	0.6	0.6	3.9	8.3	5.9	9.2	5.9	1.1	0.9	0.9
Alignment Between Roadless or Non-Motorized Areas	5.0	5.0	5.0	8.0	7.4	3.6	0.9	4.4	0.6	4.4	9.8	17.9	17.9
Portion of Alignment Crossing Critical Habitat Areas (miles)	1.4	1.6	1.7	5.2	3.9	4.0	1.7	0.5	0.6	0.5	1.3	1.7	2.1
Portion of Alignment Crossing Geologically Unstable Areas (miles)													
Very High Landslide Risk	4.1	2.1	2.0	5.5	6.8	7.4	8.8	8.0	8.5	6.3	14.2	21.8	22.6
High Landslide Risk	31.1	31.1	30.3	19.1	20.1	11.7	7.1	19.2	10.8	18.0	8.8	11.6	11.1

Table ES.3 presents a graphic comparison of the results, using a color scale to show the relative performance of each alternative for each criterion. Alternatives receiving a blue dot have the best performance for that criterion, those receiving a red dot have the poorest performance for that criterion, and the intermediate color scale (from green to yellow to orange) indicates decreasing level of performance relative to the other alternatives.

Table ES.3 – Qualitative Summary Evaluation of Alternatives

	ALTERNATIVE												
CRITERIA	1	2A	2B	3A	3B	3C	3D	4A	4B	4C	5A	6A	6B
Capital Costs	🔴	🟠	🟠	🟡	🟢	🔵	🔵	🟢	🔵	🟢	🔵	🔴	🔴
O&M Costs	🔴	🟡	🔴	🟠	🔴	🟡	🟡	🔴	🟡	🔴	🔵	🟡	🟡
Steep Slopes	🟡	🟢	🟢	🟢	🟠	🟢	🟠	🟠	🟢	🟠	🔴	🔵	🔵
Communities Served	🟢	🟠	🟢	🟢	🔵	🔵	🔵	🔵	🔵	🔵	🔴	🟡	🟡
Travel Time	🔴	🟡	🟠	🟡	🟡	🔵	🔵	🟡	🔵	🟡	🟢	🔴	🔴
Ridership & Revenue	🟡	🟤	🟡	🟡	🟢	🔵	🔵	🟢	🔵	🟢	🟠	🔴	🔴
Goods & Revenue	🔵	🔴	🔵	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟡	🟡
Land Use Compatibility	🔵	🔵	🔵	🟡	🟢	🟢	🟠	🟡	🟡	🟡	🔴	🔴	🔴
Critical Habitat	🟢	🟢	🟢	🔴	🟠	🟠	🟢	🔵	🔵	🔵	🟢	🟢	🟡
Landslide Risk	🔵	🔵	🔵	🔵	🟢	🟡	🟢	🟡	🟡	🔵	🟠	🔴	🔴

🔵 = best 🟢 = good 🟡 = average 🟠 = poor 🔴 = worst

ES.6 Financial Analysis

The financial analysis considers the financial requirements of the project (capital and operating costs) and evaluates possible funding and financing scenarios to determine how much of project costs can be covered by project revenues (passenger fares and freight fees), how much revenue could be generated from new sources of funding (excluding government grants), how project financing terms will affect the overall financial picture, and how much would still be required in government grants if the other funding sources are insufficient to cover the entire cost.

The financial analysis starts with definition of a baseline scenario. The baseline scenario assumes that a medium-length (approximately 37 miles) system alternative is to be built, with capital and operating unit costs at the higher end of the cost range ($6 billion in capital costs and $18.5 million in annual operating costs). Operating revenues are $20.1 million annually in 2035, a surplus of $1.6 million over the annual

operating costs. (This assumed system for the financial analysis is generally comparable to Alternative 4C in the evaluation of alternatives.) No new non-grant revenue sources are adopted, and traditional tax-exempt bonds are used for project capital financing. In this Baseline scenario, the annual revenue stream needed to cover debt service is $478 million, so with an operating surplus of just $1.6 million the annual revenue gap is $476 million. To fill this gap, almost $6 billion of public sector grants would be needed.

To test the financial implications of different revenue and financing scenarios, three alternative scenarios were analyzed with varying cost, revenue, and financing assumptions applied to the same assumed 37-mile system. Table ES.4 summarizes the assumptions in the four scenarios.

Table ES.4 - Cost and Revenue Estimates Applied to Each Financial Scenario

Financial Scenario	Baseline	#1	#2	#3
Scenario Description	**Base Case**	**Least Optimistic Case**	**Mid-Range Case**	**Most Optimistic Case**
Capital Cost	$6.0 billion	$6.2 billion	$4.7 billion	$3.1 billion
Net Annual Operating Income	$1.6 million	$14.0 million	$29.8 million	$62.6 million
Potential New Revenue Sources	None	$24.5 million	$44.0 million	$63.5 million

In Scenario #1 ("Least Optimistic Case") the capital and operating costs were held at the higher end of the cost range; passenger and freight revenues were assumed to be higher than the baseline scenario due to higher system usage attributable to increased energy costs; total capital costs were increased to pay for additional vehicles to provide reduced headways; a low level estimate of new revenue sources was included; and financing with traditional tax-exempt bonds was assumed. (New revenue sources could include things like a portion of mountain road tolls, a benefit assessment district, a fee on lodging or recreation area use, or a portion of a countywide vehicle license fee.)

In Scenario #3 ("Most Optimistic Case") a set of optimal assumptions was applied: capital costs were assumed to be at the low end of the unit cost range, hourly operating costs are the average for light rail in the US rather than the high end, passenger ridership was assumed to be 17.5% of corridor travelers, freight revenues were based on carrying all the corridor's package freight as a result of air quality and energy factors, a high level of new revenue sources was included, and financing was assumed with zero-interest bond financing based on the "America Fast Forward" transit financing proposal being proposed to Congress by the Los Angeles County MTA.

Scenario #2 ("Mid-Range Case") represents a mid-range capital cost and revenue scenario between #1 and #3, financed with traditional tax-exempt bonds.

Table ES.5 summarizes the results of the financial analysis. Of the four scenarios, only the Most Optimistic Case Scenario could be fully funded without public sector grants, assuming a low-end cost scenario, the highest passenger and freight revenue scenarios, the highest rates for supplementary revenue sources, and the lowest interest rates on bonding. For all other scenarios, the annual shortfall needed to finance additional bond proceeds is projected to range from $301 million per year to $459 million per year, which indicates that a substantial public sector grant ($3.8 – 6 billion) would be needed in all scenarios except the Most Optimistic Case.

Table ES.5 - Calculation of Annual Funding Gap/Surplus

Scenario	Base	#1	#2	#3
Scenario Description	**Base Case**	**Least Optimistic Case**	**Mid-Range Case**	**Most Optimistic Case**
Assumed Alignment Length	37 miles	37 miles	37 miles	37 miles
Capital Cost ($2011, millions)	$6,000.0	$6,250.0	$4,710.0	$3,070.0
Financing Method	traditional tax-exempt	traditional tax-exempt	traditional tax-exempt	QTIBs 0% interest
Annual revenue stream needed to cover debt svc	($477.7)	($497.6)	($375.0)	($107.4)
Passenger and Freight Revenues	$1.6	$14.0	$29.8	$62.6
New revenue sources	$0.0	$24.5	$44.0	$63.5
Total available annual revenue sources available for debt svc	$1.6	$38.5	$73.8	$126.1
Annual revenue (gap)/surplus	**($476.1)**	**($459.1)**	**($301.2)**	**$18.8**
Bonding Capacity of Total Available Revenue Sources	$20.1	$483.9	$926.8	$3,606.7
Additional Public Funding/Capital Cost Reductions Needed or (Bonding Capacity Surplus)	$5,980.0	$5,766.1	$3,783.2	($536.7)

The key findings of the financial analysis are as follows:

- The high capital cost and the project financing cost (assuming traditional tax-exempt debt) are the most significant financial impediments to financing a feasible project.
- The project could generate an operating surplus under the following conditions:
    - the corridor alignment follows one of the shorter or medium length routes;

    - the system includes stations that provide: a direct connection to Metrolink, convenient transloading for goods movement, a convenient park and ride lot at the base of the mountains, and intermediate stations in the mountain area (such as Running Springs and Snow Valley);
    - the system's hourly operating costs are toward the middle or lower end of the cost range for light rail systems in the United States; and
    - the system operation includes a package shipping operation that can successfully attract an adequate share of the market.
- Other additional sources of revenue (besides passenger fares and freight revenue) will be needed in order to have a sufficient revenue stream to pay for capital costs through bond financing. Various types of new revenue sources are possible, though relatively few could generate sufficient ongoing revenue to meaningfully contribute to debt payments for a project of this magnitude. For those sources that are capable of generating a significant revenue stream, support from the public and elected officials will be required to achieve their adoption.
- Even with very optimistic assumptions regarding operating revenues and additional revenue sources, the project's financial viability depends on getting either low interest bond financing or a multi-billion dollar government grant to help defray the capital costs.

For the project to be financially feasible without requiring significant government grants:

- The estimated capital cost will need to be toward the lower end of the range estimated in this study. More detailed study will be needed to identify an alignment that: follows a reasonably direct routing between San Bernardino and Big Bear Lake, has relatively limited need for elevated segments or structures, avoids environmentally sensitive areas, and minimizes right-of-way costs.
- Operating revenues will need to be maximized. A significantly higher-than-typical passenger mode share will need to be captured because of factors like substantial increases in fuel prices or extended road closures in the mountains. A very high level of freight movement activity will need to be captured because of factors like substantial increases in fuel prices, extended road closures in the mountains, or vehicle technology requirements that limit trucks' ability to climb mountain grades.
- Substantial new sources of funds will be needed to help defray capital costs.
- Very low interest bond financing will need to be secured for most of the project's capital cost.

ES.7 Key Findings

This section highlights the study's key findings that will significantly affect/determine the desirability and feasibility of implementing an alternative mode in this corridor and the conditions under which it would be feasible.

Transportation System Constraints

1. The mountain highway routes that provide access to the Big Bear Valley experience traffic congestion on weekends throughout the year, and experience high levels of congestion for extended periods of time on holiday weekends and winter weekends with good snow conditions.
2. The mountain access roads are increasingly vulnerable to closure or restriction because of adverse weather, traffic accidents, rockfall, landslides, or wildfire.
3. These impediments to mountain access act as constraints to growth and development in the Big Bear Valley, and to the Southern California Region's ability to take advantage of the mountain area's four-season recreational assets.
4. The feasibility of adding significant capacity to existing highways or constructing a new road facility is doubtful because of both environmental and financial constraints.
5. A non-roadway transportation alternative could increase transportation system capacity, reduce traffic congestion, operate in adverse weather or when roads are closed, and help accommodate long-term growth in mountain area population and visitation, and would likely have less environmental impact than road improvements that would provide comparable system capacity.

Technology Issues

6. Only one non-roadway transportation technology currently exists and has demonstrated in commercial operation its capability to safely transport large numbers of people across the kinds of distances and the steep terrain encountered in this corridor at speeds and costs that are competitive with automobile travel (and could therefore attract significant numbers of riders). For these reasons, the current preferred feasible technology for this corridor is light rail technology with a rack (cog) system that can engage on steep slopes.
7. Self-propelled aerial ropeway technology has shown the potential to have competitive operating characteristics with a lower initial capital cost, but has only been built and operated on a limited basis and is not currently in commercial operation.

Corridor Alignment Considerations

8. Certain alignment and station options are important to the success of the system and to best achieve the purpose and need:
   a) a reasonably direct alignment between San Bernardino and Big Bear Lake, because a long alignment would substantially increase the project's capital cost and the overall travel time, which would make the system less attractive to potential riders and reduce operating revenues;
   b) an alignment that serves intermediate mountain communities such as Running Springs and Snow Valley, because it would increase ridership and revenue and would substantially increase the number of travelers for whom an alternative system could be a viable travel option;
   c) a station with direct connection to Metrolink, to provide convenient transit access to Big Bear Lake from much of the greater Los Angeles metropolitan area;
   d) valley and mountain stations that provide convenient transloading for goods movement, so the system can compete effectively in the freight shipping market; and
   e) a convenient station/park-and-ride lot at the base of the mountains, to attract auto users that prefer not to navigate the mountain roads.
9. More detailed engineering studies will need to be undertaken in order to confirm feasible alignments. In particular, detailed study will be needed to find alignments that avoid sensitive

habitat areas, minimize needs for environmental mitigation, and are not unreasonably subject to landslide risk.

10. Much of the corridor will pass through the San Bernardino National Forest. Regardless of the specific alignment selected, it will traverse areas currently designated as incompatible with a new transportation system, since extensive areas of the National Forest have been designated to remain roadless or as appropriate only for non-motorized transportation. US Forest Service representatives have indicated that an extensive review and approval process within the Forest Service would be required to obtain approval for a change to accommodate a new transportation system through these areas.

Financial Considerations

11. For the project to be financially feasible:
    a) The estimated capital cost will need to be toward the lower end of the range estimated in this study. More detailed study will be needed to identify an alignment that: follows a reasonably direct routing between San Bernardino and Big Bear Lake, has relatively limited need for elevated segments or structures, avoids environmentally sensitive areas, and minimizes right-of-way costs.
    b) Operating revenues will need to be maximized. Changing conditions in the coming years are expected to lead to increasing interest in, and demand for, and alternative transportation mode to the mountains; these include increasing fuel prices, environmental regulations that affect vehicle technology (limiting the ability of trucks to ascend steep grades), and more frequent mountain road closures. These factors could enable a new transportation system to capture a significantly higher-than-typical passenger mode share and a high level of freight movement activity in the corridor, and generate a substantial positive stream of net operating revenue.
    c) Substantial new revenue sources will be needed at the local or regional level to provide a reliable funding stream so the project sponsor can issue long-term bonds to satisfy the upfront capital needs.
    d) Very low interest bond financing will need to be secured for most of the project's capital cost.
    e) If all of the above factors do not materialize, substantial supplemental sources of traditional grant funding will likely be necessary to help defray capital costs in addition to any new revenue sources implemented at the local and/or regional level to support the project.

ES.8 Recommendations

In short, the analysis has found that an alternative transportation system would be a good solution to help address future transportation needs between the San Bernardino Valley and Big Bear Lake; however, the system's technical and financial feasibility depends on the convergence of a number of political, financial, and operational conditions. Changing circumstances associated with energy costs, fuel sources, vehicle technology, air quality regulation, and transportation project funding and financing could create a situation in which an alternative transportation mode would be financially feasible. The following recommendations for further action are designed to increase understanding about the evolving status of circumstances that would be necessary for the project's success, while developing more specific information about system alignments, technologies, and operations that could help define a specific project proposal that is consistent with the requirements for success.

Next Steps

A. Outreach

1. Conduct a dialogue with the corridor's key elected officials and opinion leaders to determine the current level of interest in, and support for, the project.
2. Conduct an ongoing dialogue with the US Forest Service to develop a better mutual understanding of future transportation needs through the San Bernardino National Forest and how to serve them.
3. Work with USFS staff to develop a description of the requirements and process that would be involved in order for the Forest Service to be able to approve an alternative transportation system through the San Bernardino National Forest.
4. Monitor the progress of legislation in Congress that could present opportunities for grant funding.
5. Monitor the progress of the Fast Forward America legislation in Congress, and identify the potential and conditions for zero- or very-low interest financing for this project.
6. Monitor technological progress toward commercial operation of high-speed, high-capacity transportation technologies that can travel long distances and traverse steep grades through the mountains at overall speeds competitive with automobile travel.
7. Explore the potential to enter into a project development agreement with a light rail vehicle or other equipment manufacturer who may be interested in bringing its technology to market and may be willing to co-fund a Major Investment Study.
8. Conduct a dialogue with other resort access corridors that face similar transportation access challenges (Sacramento - Lake Tahoe, CA; Salt Lake City - Cottonwood Canyons UT; and Denver - Rocky Mountain Resorts, CO). Identify common issues and explore possibilities for benefits from cooperation.

B. Project Phasing/Early Action Opportunities

1. Evaluate potential project phasing to ascertain the viability of developing a first phase of the project before the entire system.
2. Identify potential early action projects that could serve as initial steps toward a new mountain access system.

C. Cost and Revenue Refinement

1. Undertake a conceptual engineering study or Major Investment Study to determine the location and cost of alignment alternatives that serve intermediate mountain communities, avoid sensitive habitat and minimize environmental mitigation, and avoid unnecessary risk of landslides.
2. Develop a better understanding of the geotechnical issues, constraints, and risks involved with developing a cog rail system through the corridors identified as alternatives for Alignments 3 and 4, for the purpose of helping to identify a lower-risk alignment that follows a relatively direct route from San Bernardino to Big Bear Lake.
3. Develop refined estimates of potential ridership and farebox revenues, as well as potential freight shipments and revenue.
4. Develop a more refined concept for passenger access to and from the mountain stations in the system. Identify an operational concept that is well suited to the access and distribution needs of potential passengers, as well as estimates of capital costs, operations and maintenance costs, and potential revenues.
5. Develop a more specific understanding of current goods movement activity through the corridor, including the types and volumes of commodities being carried and how the goods are distributed to mountain destinations.

6. Develop a more refined concept of how a cog rail system could serve the mountain corridor's goods movement needs effectively and efficiently. Include determination of types of goods to be carried, feasible and effective operational strategies, and a concept for distributing goods from mountain stations to their destinations.
7. Evaluate the potential ridership and farebox revenue within catchment areas of the corridor (i.e., trips between valley stations and between mountain stations), including potential increases if more stations are added to the alignment.
8. Investigate the reasons for differences in hourly operating costs for light rail systems in the United States, and develop a refined operating cost scenario for a light rail/cog rail system in the San Bernardino – Big Bear Lake corridor.

1. INTRODUCTION

1.1 Background of Project

Southern California is known for an excellent quality of life and the ability to "surf in the morning, ski in the afternoon." In fact, there is no better example of this than going from Los Angeles beaches to Big Bear Valley's ski slopes. As more people have begun to discover the region as a place to live, work and play, the problems associated with big cities have begun to overwhelm the areas surrounding Los Angeles, including air pollution, traffic congestion, road safety, and limited access. The usual solution to problems such as these is to widen roads, expand public transit options and limit growth. However, the usual solutions aren't always the best solutions, which is especially so in the case of Big Bear.

Located in the San Bernardino National Forest, the Big Bear Valley is both a thriving community and a popular recreation destination throughout the seasons. Access from the San Bernardino Valley and greater Los Angeles metropolitan area is limited to mostly two-lane state highways through National Forest land, and further expansion of these roads is unlikely. SR-18, SR-38 and SR-330 wind their way through mountainous terrain and scenic vistas, and part of SR-38 has been designated a state scenic highway. Currently, over 50% of traffic from the Los Angeles Basin to Big Bear Valley utilizes SR-18. Challenging grades, frequent switchback curves, and limited sight distance make this road a challenging drive under the best of conditions; during the frequent snow storms in the winter months, when demand for access is at its peak, travel along this route can be arduous as well as dangerous. Weather, peak season travel, goods movement, air quality, and environmental concerns are all issues adding to the need for an alternative transportation mode into and out of the Big Bear Valley.

Over the past decade, growth in the region has continued in both permanent residents and seasonal visitors. As a result, more vehicles are traversing the winding access roads than ever before, including an increased number of trucks. Congestion and seasonal road blockages caused by winter conditions have resulted in the mountain communities expressing an interest in potential partnerships with SCAG and SANBAG to address the issues of mountain community accessibility for both people and goods.

1.2 Location, Character of Study Area

The Big Bear study area is located within the County of San Bernardino, which lies in the northeast portion of Southern California. San Bernardino County is bounded by Riverside County to the south, Los Angeles County to the southwest, Kern County to the northwest and Inyo County to the north. The Big Bear Valley is a four-season mountain recreation area with proximity to the nearly 20 million people residing in Southern California. Figure 1.1 below illustrates the study area.

Figure 1.1 – Big Bear Vicinity Map

There are three distinct segments of the study area. These three segments reflect the vast differences in the natural, physical, and socio-economic conditions of the corridor. The following paragraphs summarize the character of each of the three segments.

San Bernardino Valley – Portions of the Cities of San Bernardino, Highland and Redlands, as well as the community of East Highland, are located in this segment of the study area. This portion of the study area is generally urbanized and has grown at a rapid pace over the past two decades. One of the most significant transportation improvements to San Bernardino is the Metrolink commuter rail line between Los Angeles and San Bernardino. This is the most heavily traveled line in the Metrolink system. In addition, the San Bernardino International Airport Authority has completed construction of a passenger terminal on the western portion of the former Norton Air Force Base for the San Bernardino International Airport.

San Bernardino National Forest – The center portion of the study area encompasses several mountain communities, including Running Springs, Arrowbear, and Snow Valley, which includes a ski resort. Lake Arrowhead, which is also a popular destination and residential community, lies approximately five miles to the northwest of Running Springs. This portion of the study area lies within the San Bernardino National Forest service boundaries, and with the exception of certain land areas under County of San Bernardino jurisdiction, is primarily under the jurisdiction of the United States Forest Service (USFS), which is part of the federal Department of Agriculture.

Big Bear Mountain Recreation Area – The upper portion of the study area contains the City of Big Bear Lake, as well as the unincorporated area of San Bernardino County known as Big Bear City. The north shore of Big Bear Lake is largely under the jurisdiction of the USFS. Bear Mountain and Snow Summit are the major ski resorts in the area.

1.3 Rationale for Studying a Non-Roadway Transportation Mode

This study explores the feasibility of non-roadway alternatives for the future transportation of people and goods between the San Bernardino and Big Bear valleys. This analysis, and a similar effort undertaken about 15 years ago, recognizes that growth and development in the Big Bear Valley, as well as the Southern California Region's ability to take advantage of its four-season recreational assets, are constrained by the capacity limitations of its conventional mountain highway access routes and their vulnerability to closure or restriction because of adverse weather, severe accidents, rockfall, and wildfire. The feasibility of adding significant capacity to existing highways or constructing a new road facility is doubtful because of both environmental and financial constraints. For these and other reasons noted below, the concept of a non-road alternative to the highways for transport of people and goods is attractive if its feasibility can be demonstrated.

The 1996 analysis identified alternative technologies capable of providing access to Big Bear and corridors compatible with those technologies. In the intervening years, the continued growth of Big Bear and the greater Southern California region, as well as maturation of transit connections to the San Bernardino Valley from Los Angeles and Orange Counties, suggest that the potential market for the proposed modal alternative is markedly larger now than in the 1990s. At the same time, the cost to implement such a transport facility is almost certainly higher. These are among the issues and tradeoffs to be considered in assessing the feasibility of a new mode to Big Bear.

The existing transportation system between San Bernardino and Big Bear Lake faces several problems/challenges:

- Traffic congestion: The key mountain access roads (SR-330 and SR-18 from Running Springs to Big Bear) regularly experience traffic congestion due to the volume of traffic during peak hours. On typical winter and summer weekends, the roads are congested inbound (to the mountains) on Friday afternoon and Saturday morning, and outbound on Saturday and Sunday afternoon. Peak weekends (with good snow conditions or holiday crowds) are highly congested for several hours.
- Safety: The mountain access roads experience collision rates that are 1.5 to 2 times the rates on similar highways around the state.
- Road closures: Because of maintenance needs and emergency closures (landslides and wild fires), the primary mountain access roads are sometimes totally shut down for extended periods of time. Historical data show that they are closed for these reasons between 5-10% of the days in a given year, and the closure of SR-330 for several months beginning in December 2010 is a recent example of the potential for long-term closures. In addition, the roads are closed occasionally by traffic accidents and major snow storms – storm closures can sometimes last for several days, as they did during the winter of 2010. After any significant snowfall, traffic operations are substantially hindered by drivers needing to install and drive with chains.
- Public transportation: Service currently consists of 2-3 bus trips per day between Big Bear Lake and San Bernardino (three round trips per day on weekdays, two on weekends). Funding is very constrained, especially for bus operations, so significant expansion of capacity would not be

possible without a new source of funding. In addition, bus transit is subject to the same challenges (above) that plague vehicle traffic.

The future of Big Bear depends on the transportation system:

- The future potential of the Big Bear Valley is constrained by the access limitations imposed by the highway system. Without a significant upgrade or enhancement of the mountain access system, new development is therefore likely to be modest and incremental.
- Current forecasts estimate fairly modest growth, with the number of housing units in the City of Big Bear Lake projected to increase by 31% over the next 25 years and employment by 23%.
- In the absence of any factors that would significantly change travel patterns or mountain visitation patterns, these forecasts indicate that current traffic volumes can be expected to grow by 25-30% by the Year 2035.

No significant improvements to the roadway system are currently programmed or planned. Without improvements, existing problems can be expected to worsen:

- With this amount of growth, weekend traffic congestion on SR-330 and SR-18 can be anticipated to increase, so there would be longer periods of congestion during peak times. Other than Friday afternoon, weekday volumes would not typically be high enough to cause recurring congestion.
- As traffic volumes and congestion levels increase, collision rates also typically increase. Without physical improvement of roadway geometrics, the high collision rates might get worse.
- As the roadway and drainage system continues to age and deteriorate, road closures are likely to become more frequent and longer.

Various types of roadway-based strategies have been suggested to help address the system's existing capacity deficiencies. Each approach would increase capacity, improve roadway operations and safety, or make better use of existing capacity, but all have significant shortcomings that make them unsatisfactory approaches to addressing the corridor's long-term needs. The benefits and shortcomings of the four roadway-based strategies are outlined below:

1. Achieve better utilization of available road capacity to/from Big Bear via SR-38 and SR-18E.
   Benefits: These two routes have available capacity when SR-330 and SR-18 become congested, and some drivers already use them as alternate travel routes between the San Bernardino Valley and Big Bear even though the normal driving time is about 30 minutes longer.
   Shortcomings: SR-38 and SR-18E are not convenient routes for trips to intermediate destinations (such as Running Springs, Arrowbear, and Snow Valley) which attract almost half the traffic using SR-330.

2. Add passing lanes; realign existing roads. This improvement would enhance highway operations by adding passing lanes where possible to SR-330 and SR-18 and realign the "13 curves" section of SR-18 between Running Springs and Snow Valley. In 1996 the construction cost of these improvements was estimated to be $50 to $53 million.
   Benefits: This level of improvement:
   - Would improve traffic operations in the corridor, enabling cars to pass slow-moving vehicles on many of the grades, and increasing travel speeds in the critical bottleneck area between Running Springs and Snow Valley, thereby increasing the number of vehicles that could pass through this area during periods of congestion.

- Would probably reduce accident rates in areas realigned or improved, but would not address the high accident rates in unimproved areas.

Shortcomings: This level of improvement would not increase the capacity of the system. Even with the addition of passing lanes and elimination of the critical bottleneck, the roadway system capacity would still be constrained to the capacity of two-lane mountain roads on SR-330 and on SR-18 between Running Springs and Big Bear.

3. Widen the existing roads (SR-330 and SR-18) to provide additional capacity.
   Benefits: This option would increase the carrying capacity of the mountain access roadways.
   Shortcomings: This option was not evaluated in the 1996 study, and is impractical for a number of reasons:
   - To provide appropriate geometrics so that the roads would carry four lanes of traffic, especially when snow is on the ground and piled at the side of the road, would require significant realignments of road segments as well as widening to a greater width than is typical for a four-lane arterial.
   - Through the developed communities, the widening would likely affect many homes and businesses. Through undeveloped areas, the widening would affect the forest areas adjacent to the road.
   - Widening would cost at least as much, probably more, than adding the same capacity by building a new two-lane road on a new alignment (Approach #4).
   - Unless the roadway is reconstructed, widening would not address the major repair and maintenance needs that increasingly affect the existing mountain roads.
   - Widening would not reduce the high collision rates, and would possibly worsen them unless the existing geometrics were substantially improved at the same time.

4. Build a new two-lane road through the front range of the mountains. The 1996 study identified a potential alignment for such a road, and assumed that it would be operated essentially as a one-way pair with SR-330 and SR-18 from Highland to the Big Bear Dam.
   Benefits: This option would increase the carrying capacity of the mountain access roadways.
   Shortcomings: The additional capacity through the corridor would come at a substantial cost (monetary and environmental):
   - The 1996 study estimated that constructing a new road would entail a capital cost comparable to that estimated for a cog rail system.
   - The new road would have a very significant impact on the environment, with a 40-foot wide roadway in an 84-foot wide right-of-way along a 20-mile corridor from Highland to the Big Bear Dam.
   - If the two roads (the old road and the new road) were to be operated as a one-way pair for operating efficiency, there would need to be crossover road connections developed so that drivers would not be forced to drive long distances out of their way if their destination is adjacent to the opposite roadway. Conversely, if the two roads were operated as individual roads with two-way traffic there would be less capacity, and traffic operations would be much less efficient.

Adding capacity by developing an alternative (non-roadway) transportation mode has advantages that a roadway improvement could not offer:

- An alternative system would provide convenient mountain access with minimal or no auto driving for people throughout the greater Los Angeles metropolitan area via a connection to Metrolink in San Bernardino.

- An alternative system would enable the mountains to accommodate more users traveling for skiing and snow play without the need to expand roads or parking areas.
- An alternative system would be developed along a different alignment than the existing roadway system. Therefore, the system might be usable during an emergency (such as wildfire or earthquake) for evacuating people or for bringing in emergency personnel and equipment, even if the roadways needed to be closed.
- An alternative system would be operable after a major snowstorm or during other types of road closures, allowing people and goods to move up and down the mountain regardless of whether or not the key mountain access roads are closed. The new system itself would be a tourist attraction (somewhat like the Palm Springs Aerial Tramway – a nice ride through a scenic area), providing additional ridership and revenue, and providing an economic boost to areas with stations, particularly to downtown San Bernardino.
- For some types of goods, an alternative system might provide a cheaper and more efficient means of shipment to the mountain communities.

An alternative mode would likely be a more environmentally friendly alternative than road improvements.

- It would have a smaller environmental "footprint" than roads, so it would be expected to have less impact on the lands it passes through. A cog rail right-of-way would be 15 feet wide for a single track and 30 feet wide in areas that require double-tracking; rope-propelled systems would impact the ground only where towers, switching facilities or cable drive and return buildings, and stations are constructed.
- It would emit fewer vehicular and greenhouse gas emissions than carrying the same number of people in autos and other vehicles.
- It would operate using a "greener" energy source (likely electricity) than the internal combustion engine.
- It would provide opportunities for transit-oriented development near mountain stations, making it possible for some people to live and work and travel without need for a car.

An alternative mode is more likely to be implementable than new road capacity (either a new road or widening existing roads) because:

- It would likely attract more public support because of its lesser environmental impact.
- It offers greater potential for attracting the needed funding (for construction, operations, and maintenance), since an alternative mode has greater potential for attracting private investment through a public private partnership.

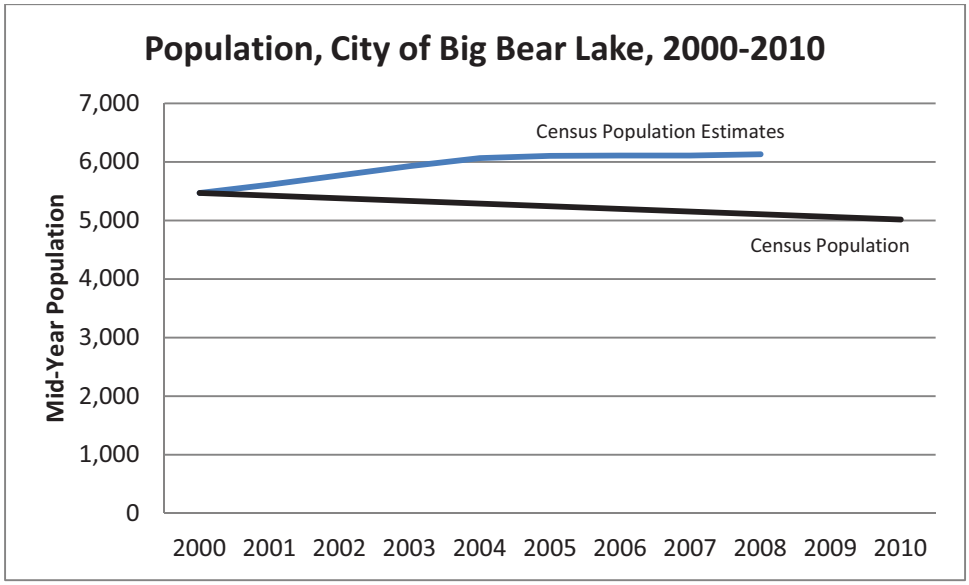
2. BACKGROUND CONDITIONS

2.1 Demographics

2.1.1 Population and Housing

According to the 2000 US Census Bureau, the population of the City of Big Bear Lake was 5,438 persons. As shown in Figure 2.1, the Census Bureau estimated that the population grew through 2004 and then leveled off to reach just over 6,100 persons in 2008. The overall compound annual growth rate (CAGR) was 1.71% for that 8-year period. Just before this report was prepared, the Census Bureau's official 2010 data were published, showing that the city's population had actually decreased to 5,019 since 2000.

Figure 2.1 – City of Big Bear Lake Population, 2000 - 2008



2.1.2 Housing Units

The San Bernardino Associated Governments (SANBAG) provided housing and employment data by traffic zone for Big Bear Lake and surrounding areas of San Bernardino County for 2008 existing conditions and 2035 forecasts. Housing units were divided into single family units and multi-family units. Employment was broken down into Retail and Non Retail employees.

Figure 2.2 illustrates existing and future housing units by type for the City of Big Bear Lake and for the adjacent areas of San Bernardino County. These are occupied year-round, and do not include second homes or seasonal rentals. The chart shows that there are many more housing units in the county areas (green bar) than in the city (blue bar); also that there are many more single-family than multi-family units in both the city and county areas. New housing growth up to year 2035 in the city is forecasted to continue to be in single family homes, but in the adjacent county new multi-family units will predominate.

Figure 2.2 – Comparison of Single and Multi-family Housing Units

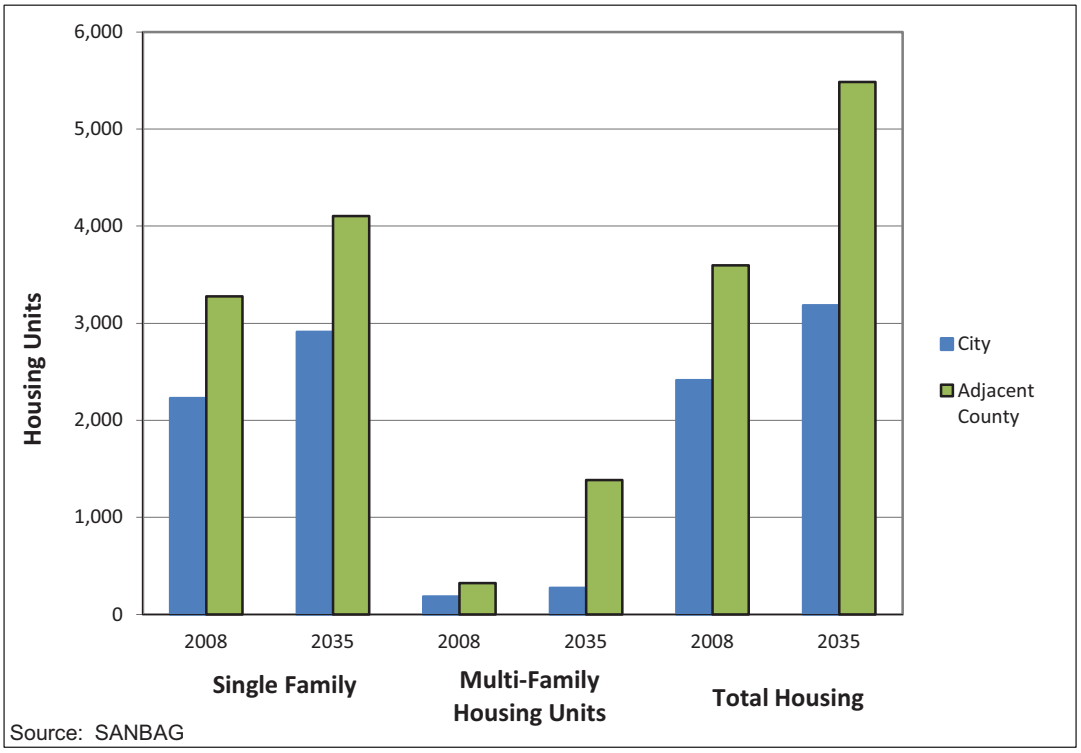


Table 2.1 lists 2008 and projected 2035 housing units, occupied and total, and total employment for the City of Big Bear Lake. Although this does not include the adjacent areas of the county, the city limits were chosen to provide a sound comparison with US Census data. According to the Census, there were 2,343 occupied units and 8,705 total units in Big Bear Lake in 2000. This translates into a ratio of 3.72 total-to-occupied dwelling units, and an average vacancy rate of 73% reflecting the large number of second homes and rental units in the ski resort area. This ratio was used to estimate total housing units for the 2035 forecast year.

Table 2.2 shows similar information for the entire Big Bear Valley, including the city and adjacent portions of the county.

Table 2.1 – Estimated Housing Units and Employment, 2008 and 2035, City of Big Bear Lake

Year	Occupied Housing Units	Total Housing Units	Population	Total Employment
2008	2,412	8,961	6,234	6,015
2035	3,185	11,833	8,365	7,295
CAGR*	1.04%	1.035%	1.095%	0.717%
*CAGR: Compounded Annual Growth Rate				

Table 2.2 – Estimated Housing Units and Employment 2008 and 2035 in Big Bear Valley (City of Big Bear Lake and Adjacent Unincorporated Areas)

Year	Occupied Housing Units	Total Employment
2008	3,597	7,402
2035	5,484	9,034
CAGR*	1.58%	0.74%
*CAGR: Compounded Annual Growth Rate		

2.1.3 Employment

Employment data were provided by SANBAG for the base year 2008 and a forecast year 2035. As indicated in Tables 2.1 and 2.2, there are approximately 6,015 jobs in the City of Big Bear Lake with a total of 10,717 jobs in the Big Bear Valley region. Going forward, citywide employment is expected to grow at 0.7% per year to 7,295 employees by 2035, and the valley is forecasted to grow to 9,034 jobs.

2.1.4 Big Bear Tax Receipts

Sales and use taxes are a measure of economic activity in an area and can additionally be a strong indicator for total traffic generation. Figure 2.3 illustrates the trend in general sales taxes in the City of Big Bear Lake for 2002-2009. Sales tax revenues grew from 2002 to 2005, but have declined at a rate of 7% per year since then. Figure 2.4 illustrates the trend in the Transient Occupancy Tax receipts for the City of Big Bear Lake, which has grown at an average rate of 5.9% per year. In November 2008, Voters passed Measure Y which increased the tax from 6% to 8%, to be implemented in two steps – in January 2009 it was increased to 7% and in January 2010 it was increased to 8%.

Tax receipts are available by quarter and are illustrated in Figure 2.5 below. The greatest variation is in the Transient Occupancy Tax, which changes from 35% in the first quarter to 14% in the second quarter. This quarterly variation may prove useful as a surrogate for estimating seasonal variations in traffic to and from Big Bear.

Figure 2.3 – Sales Tax Trend for City of Big Bear Lake, 2002 -2009

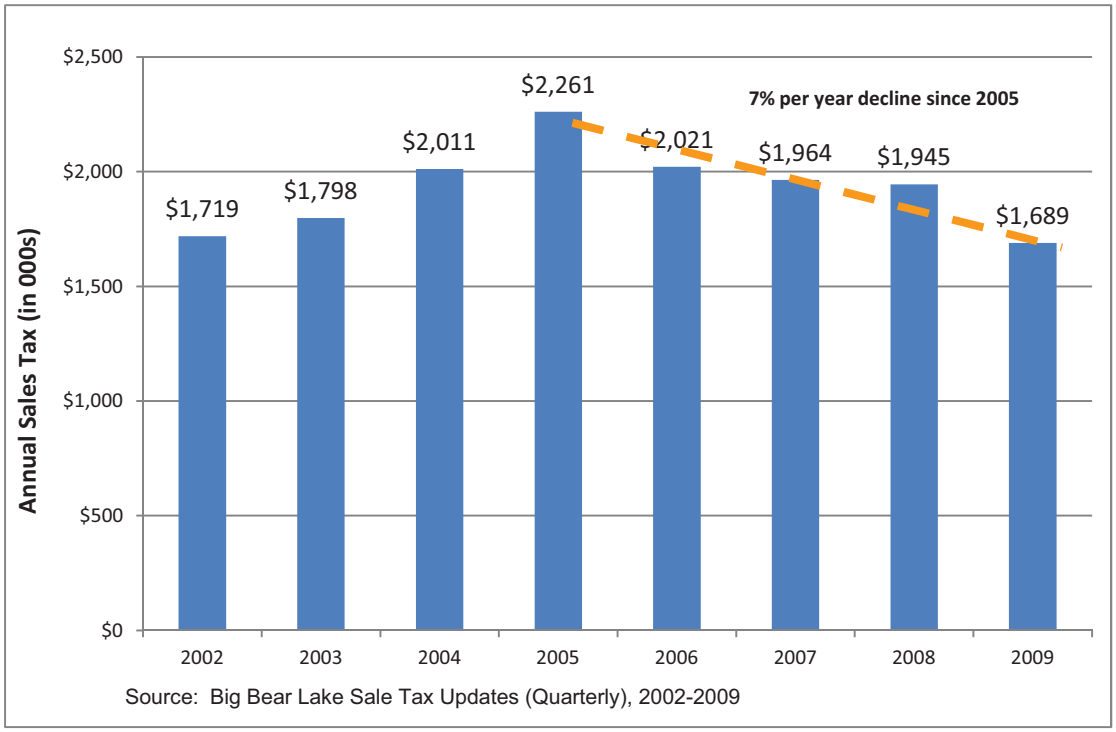


Figure 2.4 – Transient Occupancy Tax Trend, 2003 - 2009

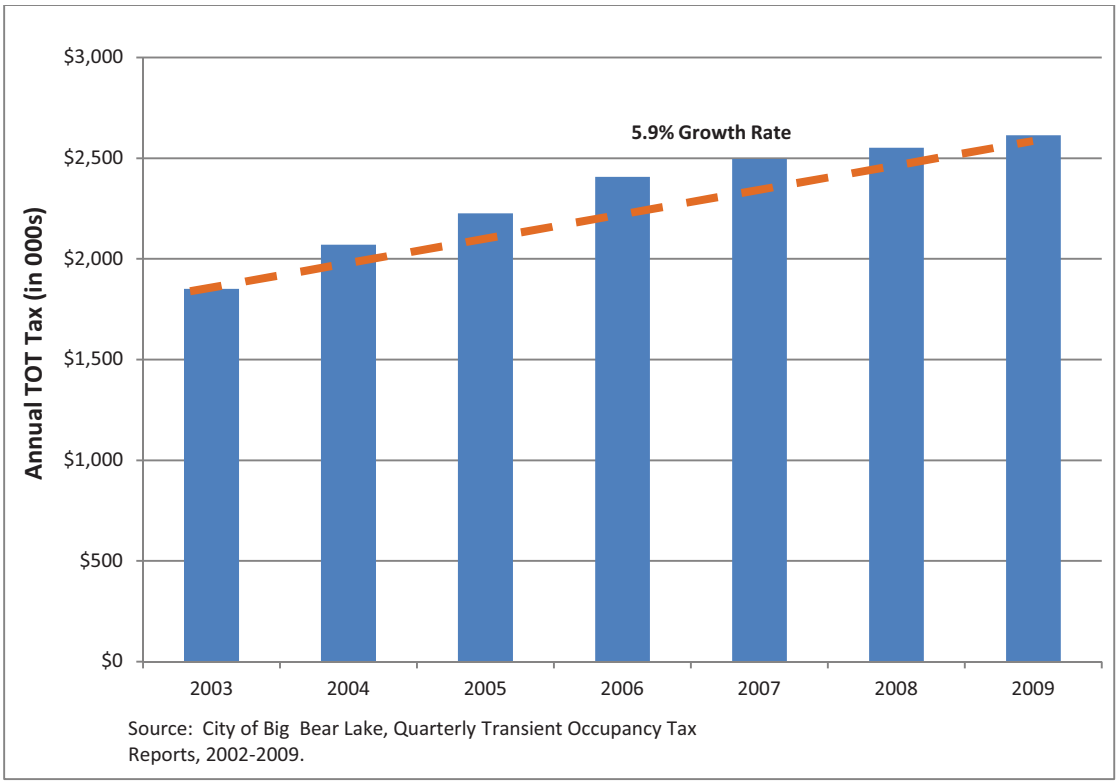
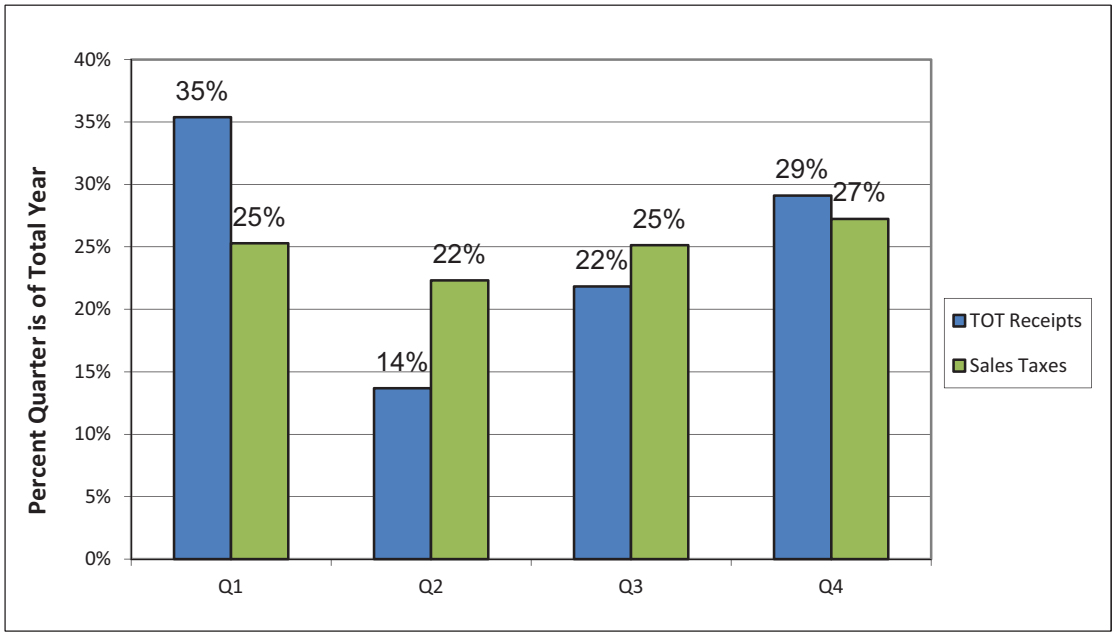


Figure 2.5 – Seasonal Variations in Tax Receipts



2.2 Existing Roadway System

2.2.1 Existing Streets and Highways

There are four two-lane state highways which provide access to the City of Big Bear Lake and the surrounding recreational and residential areas. In January 2011, SR-330 closed due to weather-related damage. Today, the route remains closed while Caltrans makes emergency repairs, placing a heavier congestion burden on the alternate routes. Including the temporarily-closed SR-330, the existing access routes are:

- SR-18 (W) from the west and south, also serving Snow Valley, Arrowbear, Running Springs, Lake Arrowhead, Crestline, and San Bernardino
- SR-18 (E) from the north and east toward Victorville and Lucerne Valley
- SR-38 from the south and east from Mentone and Redlands as well as I-10
- SR-330 from the south and west from Highland and San Bernardino; SR-330 joins SR-18 west of Big Bear Lake in Running Springs

These routes and other key roadways in the Big Bear area are shown earlier in Figure 1.1. This map also presents 2008 Average Annual Daily Traffic volumes (AADT) on selected road segments.

Table 2.3 lists key road segments on State Routes 18, 38, and 330 in the study area. Segments are classified by their number of lanes and terrain they pass through. Current (2008 AADT) traffic volumes from Caltrans Traffic Counts data files[9] are shown by segment for peak month and typical peak hour.

[9] Caltrans 2008 traffic counts, available at: http://traffic-counts.dot.ca.gov/

More than 75% of traffic to the Big Bear Lake area uses SR-18/330 from the Westside (San Bernardino and beyond); traffic on SR-18 from the north and east (Lucerne Valley) accounts for only 18% of Big Bear daily traffic. SR-18 serves 12,600 AADT to/from Big Bear Lake east of Big Bear Dam, or 57% of the daily total of 22,000 AADT. SR-38 at the Santa Ana River Bridge carries 3,800 AADT, and SR-18 (E) carries 5,600 AADT, or 26% of the total Big Bear traffic.

SR-18 connects with SR-330 at Running Springs where SR-330 carries 12,700 AADT west of Running Springs. East of Running Springs the combined SR-18/330 volume is 12,600 AADT implying that Running Springs and other developments along SR-330 generate about 8,600 AADT.

Table 2.3 – Existing Roadway Conditions and Traffic Volumes

Facility/Segment	Facility Type	Peak Month ADT	Peak Hour Traffic
State Route 18			
San Bernardino, SR 30 to 40th Street	4 Lane Highway	31,000	2,500
40th Street to Crestline, SR 138	4 Lane Highway	18,500	1,650
Crestline, SR 138 to Lake Arrowhead, SR 173	2 Lane Mountain Highway	12,700	1,600
Lake Arrowhead, SR 173 to Running Springs, SR 330	2 Lane Mountain Highway	8,500	1,100
Running Springs, SR 330 to Big Bear Dam	2 Lane Mountain Highway	12,600	1,550
Big Bear Dam to Mill Creek Road	2 Lane Mountain Highway	11,900	1,250
Mill creek Road to Pine Knot Avenue	2 Lane Roadway	13,700	1,650
Pine Knot Avenue to Stanfield Cutoff	4 Lane Major Road	32,500	4,000
Stanfield Cutoff to North Shore Drive	2 Lane Roadway	21,000	2,550
North Shore Drive to Lucerne Valley, SR 247	2 Lane Rolling Highway	5,600	520
State Route 38			
Redlands, I-10 to Orange Street	2 Lane Roadway	16,800	1,550
Orange Street to SBNF Boundary	2 Lane Rolling Highway	14,600	1,500
SBNF Boundary to Santa Ana River bridge	2 Lane Mountain Highway	3,750	590
Santa Ana River bridge to Greenspot Road	2 Lane Mountain Highway	8,800	1,200
Greenspot Road to Greenway Drive	2 Lane Roadway	16,800	1,500
Greenway Drive to Big Bear Dam	2 Lane Roadway	3,800	540
State Route 330			
San Bernardino, SR 30 to Running Springs, SR 18	2 Lane Mountain Highway	12,700	1,500

The driving time on the SR-18/330 between Big Bear Lake and San Bernardino is reported to take about 45 minutes. However, in bad weather this route becomes so slow and congested that the SR-38 route becomes the shorter time access.

Although it carries more than half of the Big Bear traffic, "Caltrans considers this route [SR-18/SR-330] to be the least favorable route because of substantial grades, winding curves, unsafe sight distance restrictions, and its susceptibility to land and rock slides."[10]

2.2.2 Traffic Congestion on Big Bear Access Routes

As will be discussed later in more detail, traffic volumes vary widely on State Routes 18, 38, and 330 in terms of time of day, directional split, average weekday or average weekend, and season of the year. During peak times, the trip from Big Bear to San Bernardino can stretch to two hours from the typical 45-minute off-peak driving time. Traffic engineers have developed a measure called Level of Service (LOS) to objectively measure congestion and delay on highways and at intersections. For two lane rural highways, LOS is more dependent on physical characteristics (e.g., slope, available passing sight distance, lane and shoulder width, etc.) than on strictly traffic volumes. LOS ranges from LOS A (free flow) to LOS F (start-and-stop conditions, long delays).

The two-way hourly capacities in Table 2.4 are based on the 2000 Highway Capacity Manual, and the volume-to-capacity (v/c) ratios are consistent with those applied in the 1996 Big Bear Access Study[11]. The table shows LOS values in terms of facility type, terrain, and volume-to-capacity ratio (v/c).

Table 2.4 – Roadway Level of Service Standards

Facility Type	Capacity (VPH)	A	B	C	D	E
4 Lane Highway	5600	0.07	0.19	0.35	0.53	0.92
2 Lane Mountain Highway	3200	0.02	0.12	0.20	0.37	0.82
2 Lane Rolling Highway	3200	0.10	0.23	0.39	0.57	0.94
2 Lane Roadway	1600	0.40	0.60	0.80	0.90	1.00
4 Lane Major Road	3200	0.40	0.60	0.80	0.90	1.00

As shown in Table 2.5, most segments of SR-18 and SR-330 are at LOS E of LOS F using typical peak hour volumes reported by Caltrans. Most of these segments will operate at LOS F during Average Weekends during the winter month ski season and holiday periods (e.g., July 4th) during the summer season. LOS E and LOS F conditions are generally termed as "unacceptable" by most motorists and they will divert to parallel routes if there are reasonable alternatives. At some point, the overall congestion becomes so great as to discourage discretionary trips such as those for recreational activities.

[10] Ibid, page 14
[11] Ibid, page 16.

Table 2.5 – Level of Service

Facility/Segment	Facility Type	Peak Month ADT	Peak Hour Traffic	Capacity	v/c Ratio	2008 LOS
State Route 18						
San Bernardion, SR 30 to 40th Street	4 Lane Highway	31,000	2,500	5600	0.45	C
40th Street to Crestline, SR 138	4 Lane Highway	18,500	1,650	5600	0.29	C
Crestline, SR 138 to Lake Arrowhead, SR 173	2 Lane Mountain Highway	12,700	1,600	3200	0.50	E
Lake Arrowhead, SR 173 to Running Springs, SR 330	2 Lane Mountain Highway	8,500	1,100	3200	0.34	D
Running Springs, SR 330 to Big Bear Dam	2 Lane Mountain Highway	12,600	1,550	3200	0.48	E
Big Bear Dam to Mill Creek Road	2 Lane Mountain Highway	11,900	1,250	3200	0.39	E
Mill creek Road to Pine Knot Avenue	2 Lane Roadway	13,700	1,650	1600	1.03	F
Pine Knot Avenue to Stanfield Cutoff	4 Lane Major Road	32,500	4,000	3200	1.25	F
Stanfield Cutoff to North Shore Drive	2 Lane Roadway	21,000	2,550	1600	1.59	F
North Shore Drive to Lucerne Valley, SR 247	2 Lane Rolling Highway	5,600	520	3200	0.16	C
State Route 38						
Redlands, I-10 to Orange Street	2 Lane Roadway	16,800	1,550	1600	0.97	E
Orange Street to SBNF Boundary	2 Lane Rolling Highway	14,600	1,500	3200	0.47	D
SBNF Boundary to Santa Ana River bridge	2 Lane Mountain Highway	3,750	590	3200	0.18	C
Santa Ana River bridge to Greenspot Road	2 Lane Mountain Highway	8,800	1,200	3200	0.38	E
Greenspot Road to Greenway Drive	2 Lane Roadway	16,800	1,500	1600	0.94	F
Greenway Drive to Big Bear Dam	2 Lane Roadway	3,800	540	1600	0.34	C
State Route 330						
San Bernardino, SR 30 to Running Springs, SR 18	2 Lane Mountain Highway	12,700	1,500	3200	0.47	E

2.3 Transit System

This section describes existing transit services in the Big Bear Lake area and those providing connections to potential riders to other parts of the region. The Mountain Area Regional Transit Authority (MARTA) provides Dial-a-Ride, local fixed route transit services within Big Bear Valley, and Off-the-Mountain (OTM) connections to San Bernardino. MARTA also provides the Crestline and Lake Arrowhead communities with similar services. In San Bernardino, MARTA connects with the Metrolink commuter rail service and Omnitrans bus routes.

2.3.1 MARTA

MARTA operates two local fixed routes within Big Bear: Route #1 (See Figure 2.6) operates between Boulder Bay and Erwin Lake from 6:15 AM to 5:30 PM on average weekdays and 8:30 AM to 5:30 PM on average weekends. Hourly service is provided on both average weekdays and average weekends. Route #1A (See Figure 2.7) operates between Mountain Meadows and Gold Mountain with hourly headways from 10 AM to 3 PM average weekdays only. Fares are $1.50 per trip ($0.75 for seniors) on each route.

MARTA also provides local fixed route service in the Crestline/Lake Arrowhead area. RIM Route #2, shown in Figure 2.8, runs between Lake Arrowhead Village and the Valley of Enchantment with hourly headways Monday through Friday only. RIM Route #4 (See Figure 2.9) provides service between the Mountain Community Hospital and Running Springs, also with hourly headways Monday through Friday only. The fare is $1.00 per zone.

MARTA's Big Bear Valley Off-the-Mountain (OTM) route connects Big Bear Lake with the Metrolink rail service and Omnitrans bus routes in downtown San Bernardino. (See Figure 2.10) The route makes three runs on Weekdays and two runs on Weekends. The fare is $10.00. MARTA provides similar OTM service from Lake Arrowhead to San Bernardino shown in Figure 3.7. On Weekdays, there are 4 round-trips between 5:30 AM and 8:10 PM; there are only two round trips on weekends. Both routes provide regional connections to Metrolink, Greyhound and Omnitrans.

MARTA's Dial-a-Ride (DAR) service is available for seniors, disabled persons, and anyone living more than 1/4 mile beyond the MARTA fixed route. DAR service is a shared ride system: DAR passengers may be picked up or dropped off while a vehicle is in route to another passenger pick-up. DAR connects with MARTA's fixed route at various stops within Big Bear Valley. The fare is $5.00 for regular passengers and $2.50 for Senior/Disabled passengers.

Figure 2.6 – Big Bear Valley Fixed Route #1

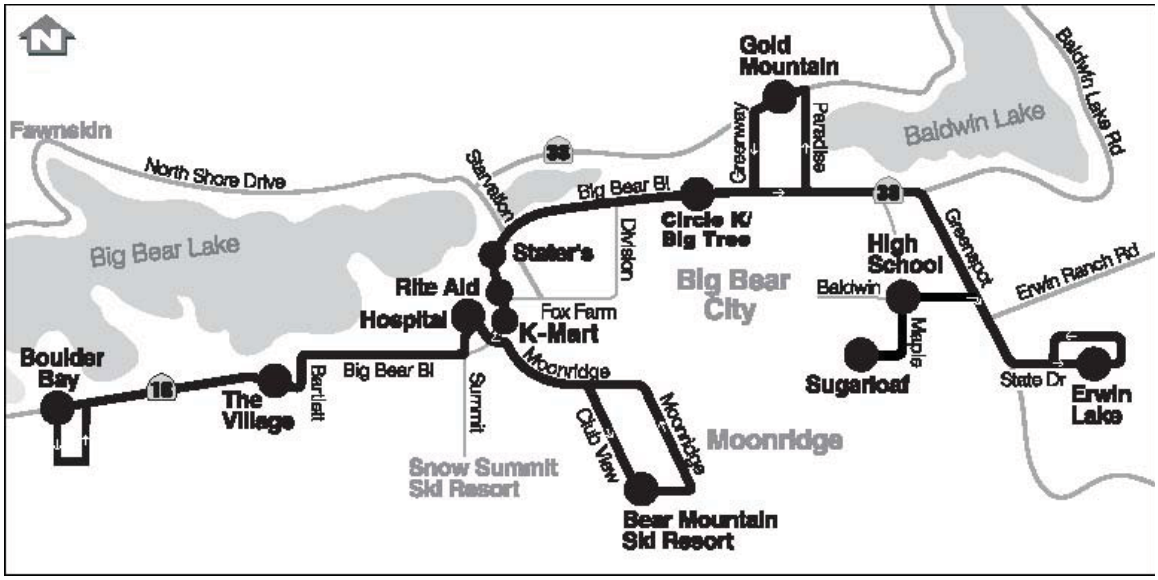


Figure 2.7 – Big Bear Valley Fixed Route #1A

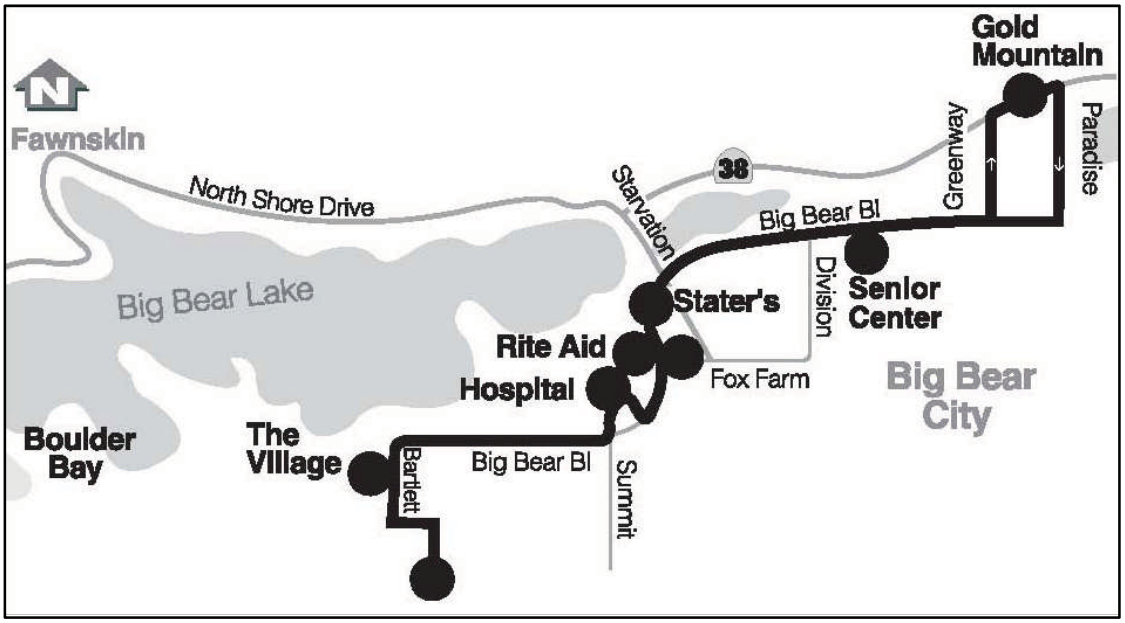


Figure 2.8 – RIM Fixed Route #2

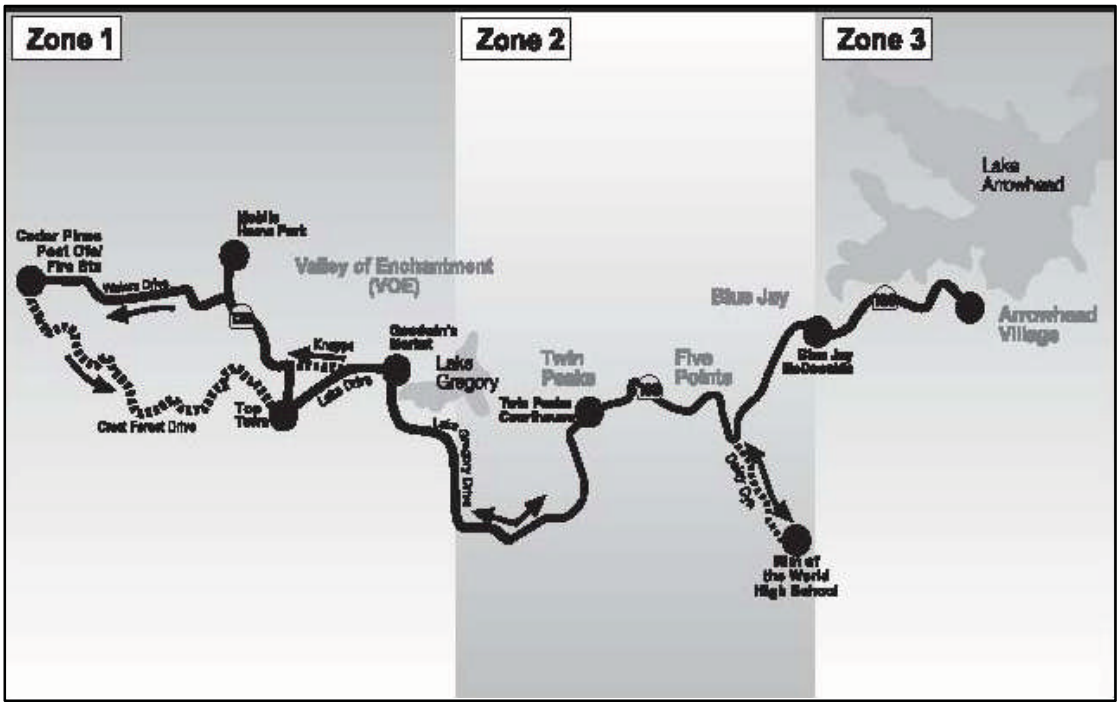


Figure 2.9 – RIM Fixed Route #4

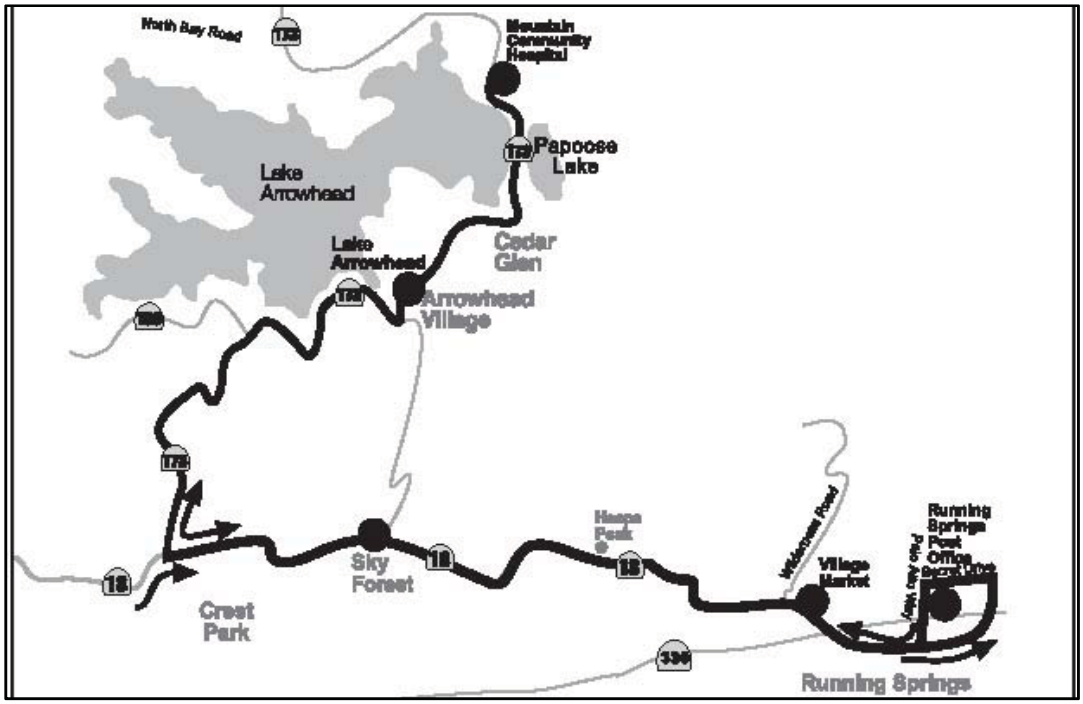


Figure 2.10 – Big Bear Valley Off The Mountain Route (OTM)

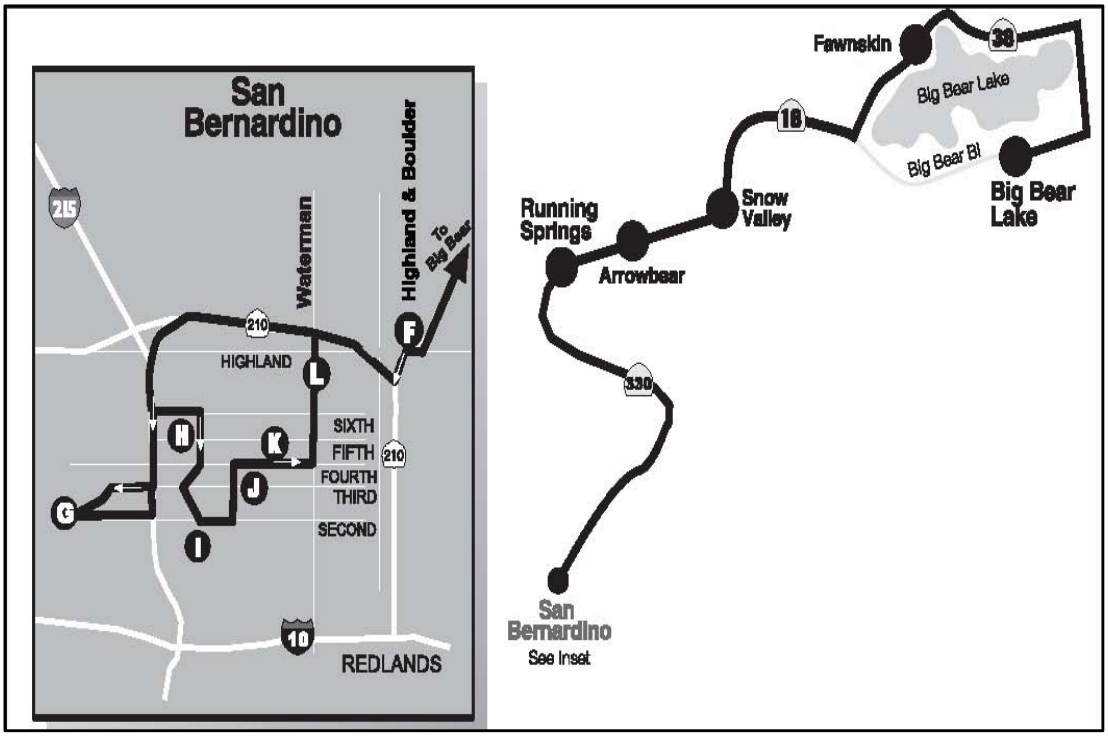
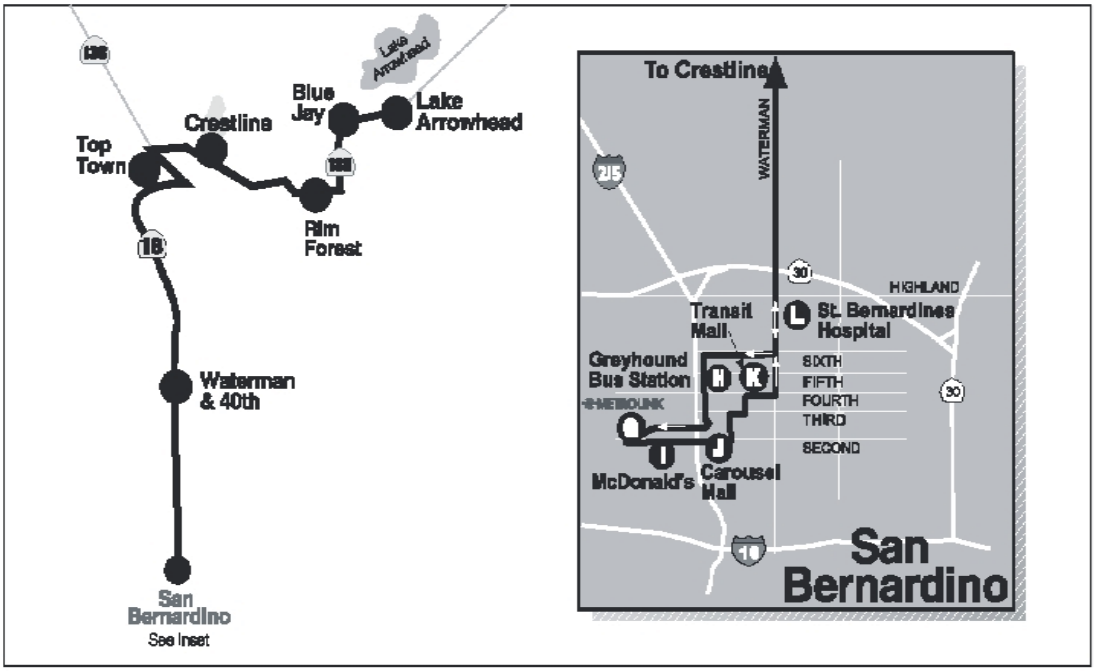


Figure 2.11 – RIM Off-the-Mountain Route

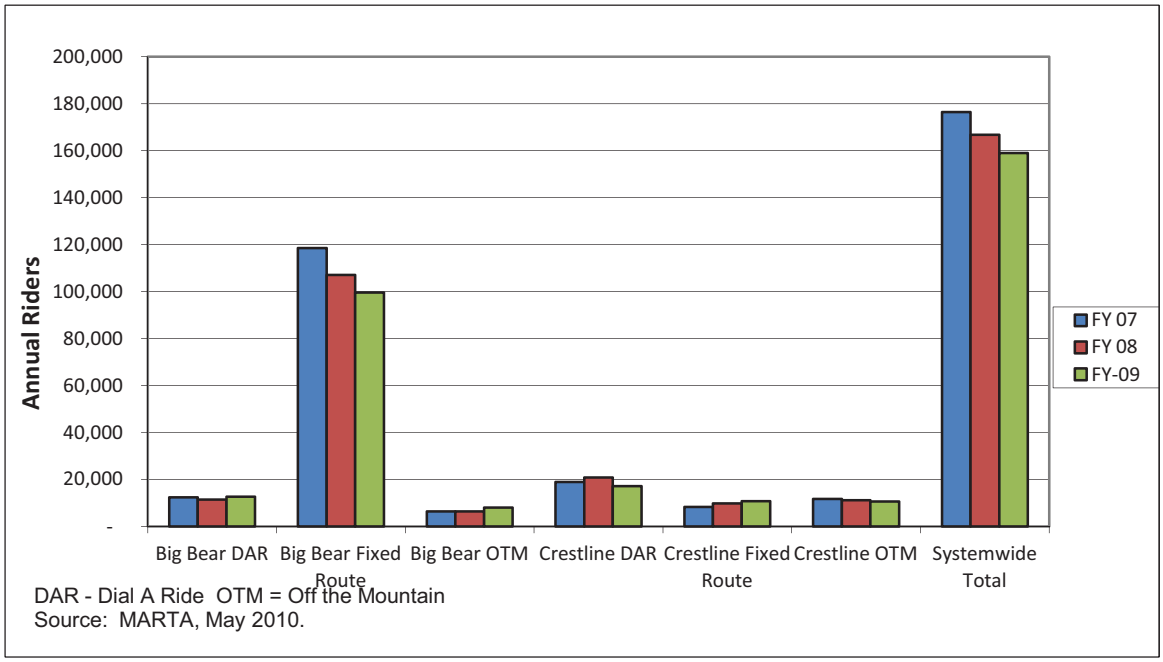


As shown in Table 2.6, ridership on most MARTA services has been declining in recent years. Overall, system ridership fell by 6% in FY 2008 and 5% in FY 2009. Only the Big Bear OTM and Crestline Local Fixed Route services showed ridership gains in FY 2009. These trends are illustrated in Figure 2.12.

Table 2.6 – MARTA Ridership Data 2007 - 2009

Route Group	FY-07	FY-08	% Increase/ Decrease	FY-09	% Increase/ Decrease
Big Bear DAR	12,420	11,453	-8%	12,670	11%
Big Bear Fixed Route	118,552	107,046	-10%	99,618	-7%
Big Bear OTM	6,496	6,403	-1%	8,037	26%
Crestline DAR	18,911	20,817	10%	17,169	-18%
Crestline Fixed Route	8,352	9,805	17%	10,786	10%
Crestline OTM	11,729	11,133	-5%	10,632	-5%
System-wide Total	**176,460**	**166,657**	**3%**	**158,912**	**17%**

Figure 2.12 – MARTA Annual Ridership by Route, FY 2007 - 2009



Figures 2.13 and 2.14 illustrate monthly ridership for the Big Bear Valley Off-the-Mountain and Local Fixed Routes, respectively. These graphs reinforce the annual trends in Table 2.4. OTM ridership peaks consistently in December, and it shows that ridership was higher in FY 2008-09 than it had been in previous years. Figure 3.10 illustrates how local fixed route ridership peaks each year in January and has overall declined since FY 2006-07.

Figure 2.13 – Monthly Ridership on Big Bear Valley OTM Route

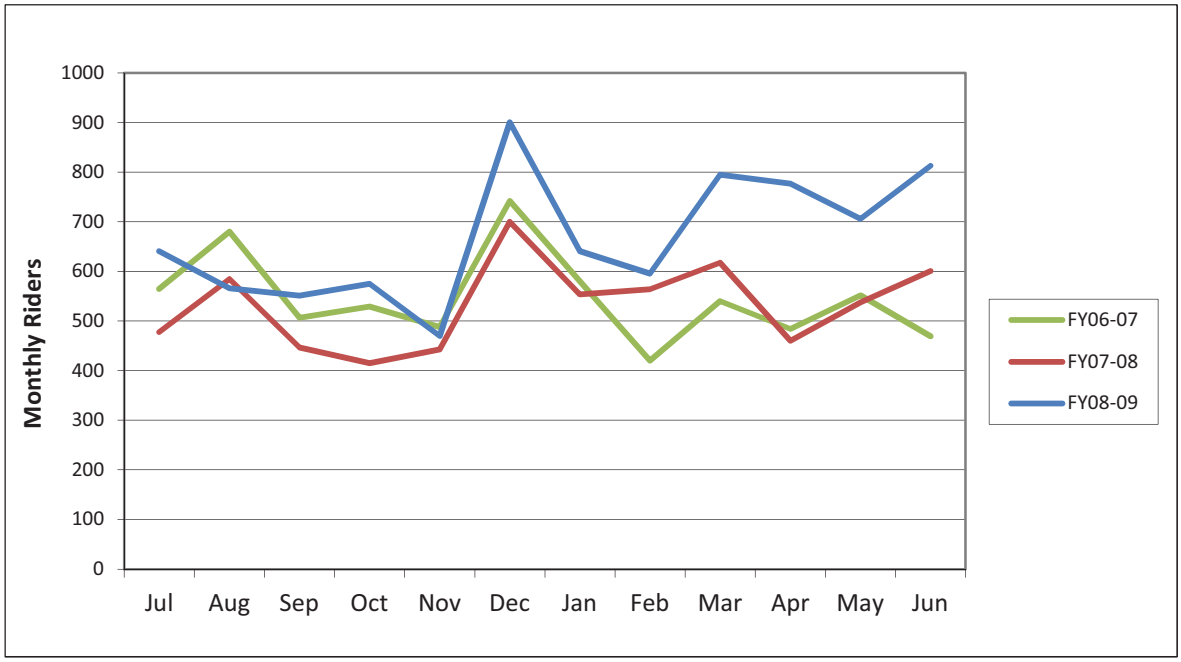
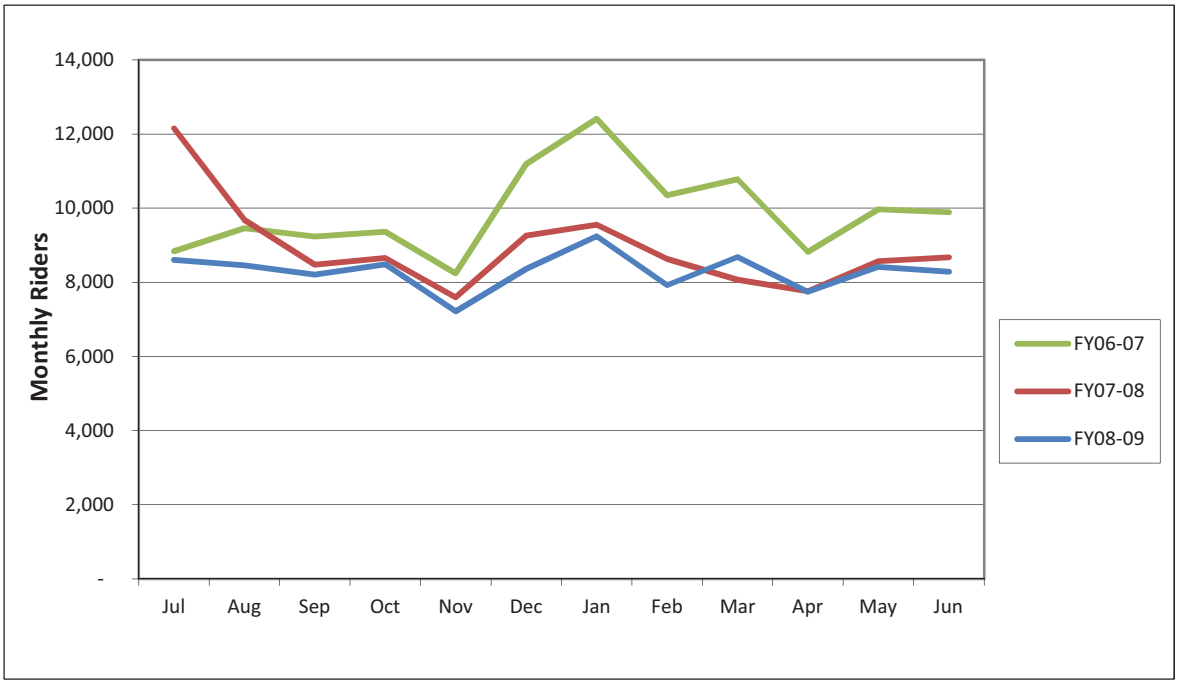


Figure 2.14 – Monthly Ridership on Big Bear Valley Local Fixed Route Services



2.4 Travel Patterns

2.4.1 Origin-Destination Patterns

No origin-destination studies have been performed in the Big Bear study area since the 1992 study described in the 1996 BRW Big Bear Alternative Access Study. The winter survey conducted at Snow Summit, Bear Mountain, and the Big Bear Visitors' Bureau (results reported in Section 4.6) yielded the following distribution of home locations:

Table 2.7 – Percentage of Respondents Surveyed from Origin-Destinations

Home Location	% of Respondents
Los Angeles County	34%
Orange County	23%
Inland Empire (incl. desert)	10%
San Bernardino Mountains	8%
San Diego County	19%
Ventura/Santa Barbara Counties	3%
Rest of United States	2%
Foreign	1%

2.4.2 Key Travel Generators

The following are the key traffic generators in the Big Bear Study Area:

City of Big Bear Lake
- Bear Mountain Ski Area
- Snow Summit Ski Area
- The Village (downtown)
- Interlaken (commercial area)

Unincorporated mountain communities
- Big Bear City (unincorporated)
- Running Springs
- Snow Valley Ski Area

City of Highland
San Manuel Indian Reservation and Casino
City of San Bernardino
- Downtown San Bernardino (including planned Metrolink station)
- San Bernardino International Airport

The three ski areas are the major travel attractions during the winter months. Although actual traffic counts for these generators are not available, ticket sales combined with average vehicle occupancies can be used to approximate average weekday and average weekend day vehicle trips. These are shown in Table 2.8.

Table 2.8 – Estimated Traffic Volumes at Big Bear Ski Areas

	2009 Weekday			2009 Weekend Day		
Ski Area	Ticket Sales	Occupancy	Estimated Daily Traffic	Ticket Sales	Occupancy	Estimated Daily Traffic
Bear Mountain	1,000	1.49	700	5,000	1.88	1,700
Snow Summit	1,500	1.49	1,000	7,000	1.88	3,700

2.4.3 Trends in Daily Traffic Volumes

Estimates of Annual Average Daily Traffic are available from Caltrans Traffic Data Branch (on the Web at traffic-counts.dot.ca.gov) for many road segments in the Big Bear area. Table 2.9 summarizes counts at selected locations for 2008 (the latest year available) from the Caltrans data and presents the results of traffic counts taken in the summer of 2009 for the City of Big Bear Lake.

Table 2.9 – Big Bear Traffic Count Summary for 2008 and Summer 2009

	2008 Traffic Data			Summer 2009 Traffic Counts			
Location	Peak Hour	Peak Month	Annual ADT	Weekday Peak Hour	Weekday ADT	Weekend Peak Hour	Weekend ADT
SR-18 East of SR-38 (at Dam)	520	5,600	5,400	586	6,761	1,075	10,077
SR-18 East of SR-330	1,550	12,600	10,300	1,021	12,846	1,521	16,400
SR-18 East of Pine Knot Ave.	4,100	33,500	31,500	1,707	20,788	2,199	27,804
SR-18 East of Blue Jay Rd.	870	7,600	6,200	661	7,755	1,175	11,534
SR-18 East of Mill Creek Rd.	1,050	10,000	8,200	977	11,802	1,477	16,630
SR-18 North of Paine Rd.	1,350	12,600	10,300	1,115	13,314	1,372	17,226
SR-18 East of Moonridge Rd.	4,000	32,500	30,500	1,984	24,296	2,444	29,728
SR-18 East of Stanfield Cut-Off	2,550	21,000	19,700	1,529	19,466	1,564	21,384
SR-18 North of SR-38	520	5,600	5,400	408	4,664	551	5,914
SR-18 North of Holcomb Valley Rd.	230	2,550	2,450	n/a	n/a	n/a	n/a
SR-38 East of SR-18	1,500	16,800	16,000	1,447	17,701	1,502	18,688

The 2008 Caltrans AADTs and the actual traffic counts in 2009 are relatively consistent, with the exception of SR-18 east of Pine Knot Avenue. This location was estimated at 31,500 AADT in 2008 but only 20,800 AADT for an average weekday in the summer of 2009. This discrepancy may be due to the exact location of the traffic counters in 2009. This location has seen continuous growth of 6.5% per year in the Caltrans traffic counts since 1999, and the trend seems well established to support the higher volume as shown in Figure 2.15. The trend also reflects a growing internalization of trips in Big Bear as more local retail and service opportunities are offered.

Figure 2.15 – AADT on SR-18E of Pine Knot Avenue, 1992 – 2007

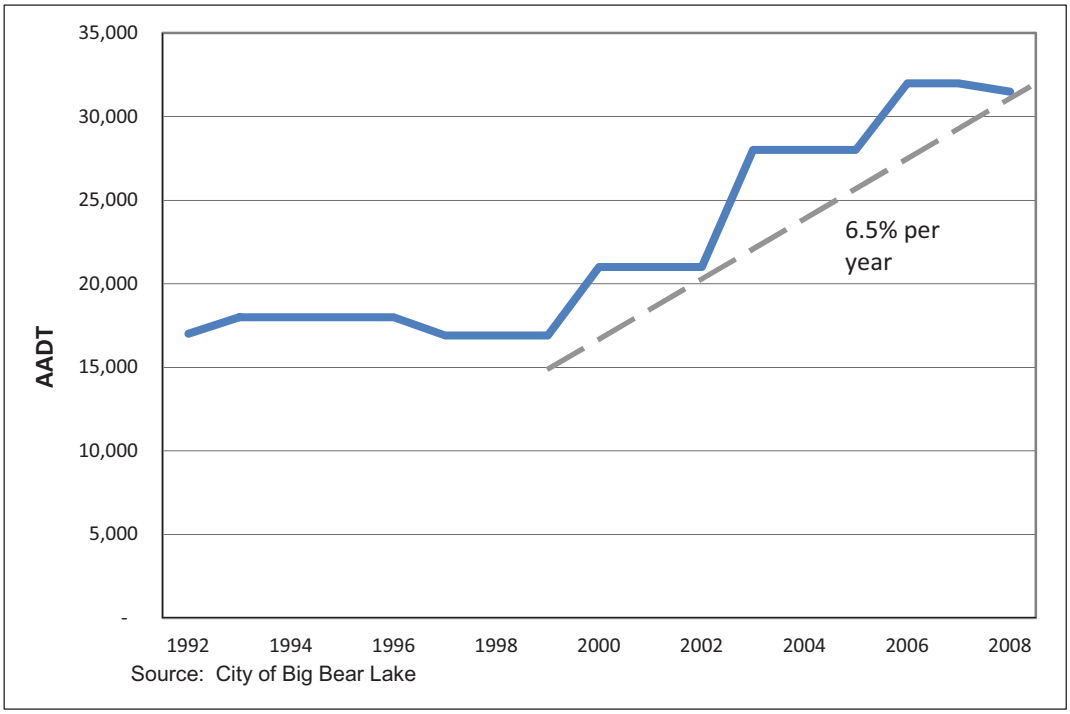


Figure 2.16 illustrates long-term trends on Big Bear access routes: SR-18, SR-18E, SR-38, and SR-330. There was a jump in traffic on SR-18 from 1994 to 1996, but traffic declined back to the long-term trend after 1997. Traffic on all four routes has been relatively constant or even declined slightly since 2000.

Figure 2.16 – AADT on Access Routes to Big Bear Lake

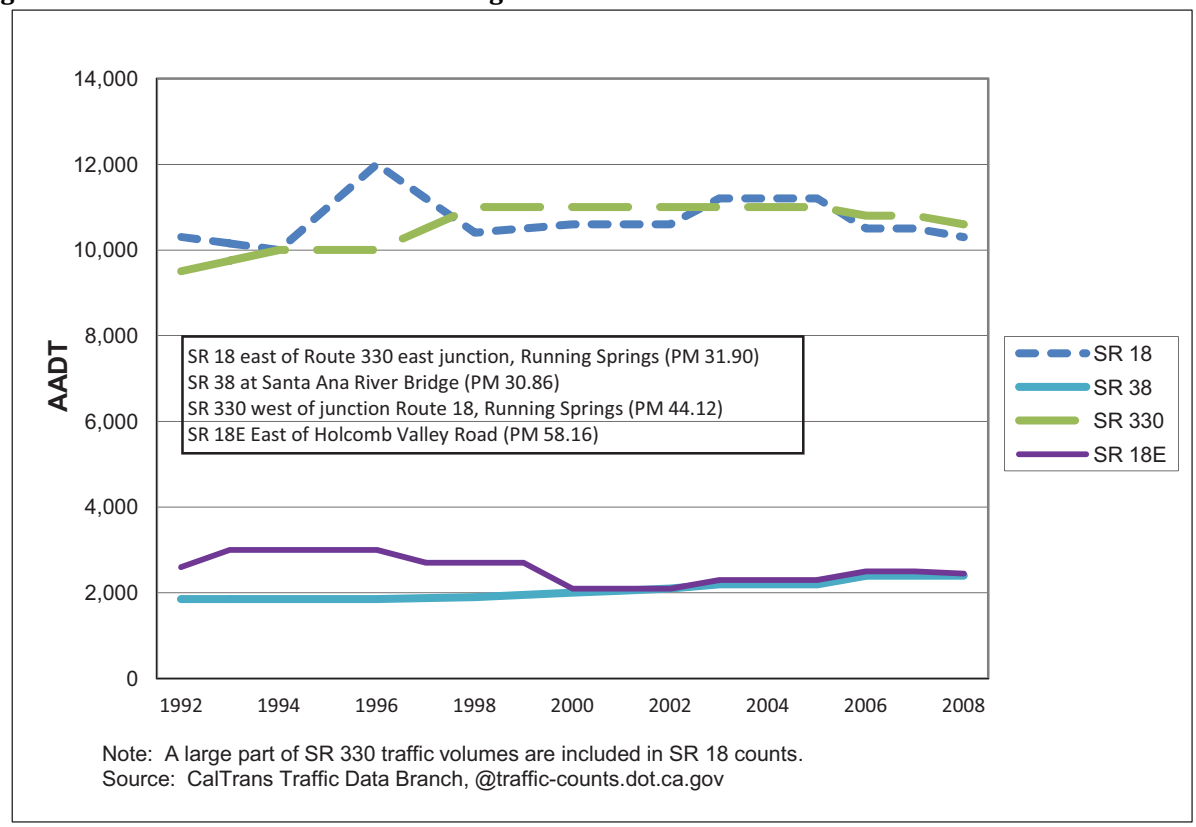
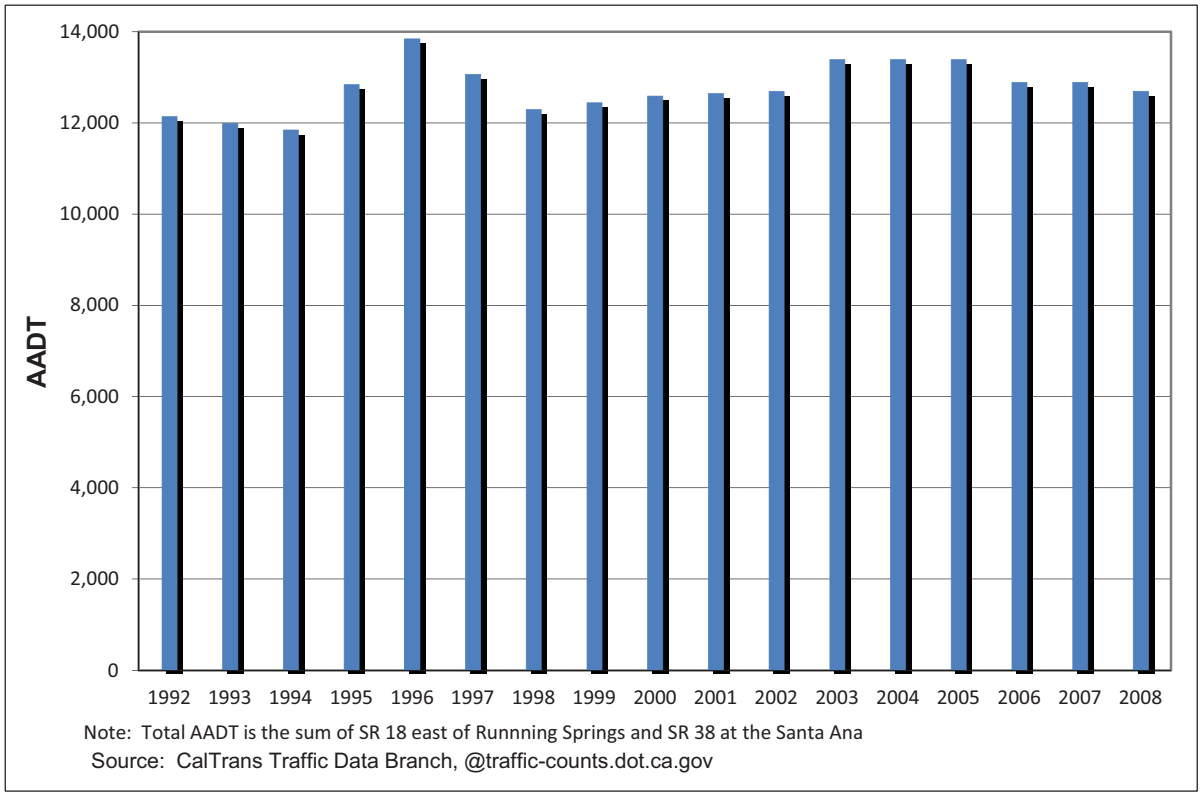


Figure 2.17 summarizes Caltrans counts on the Westside access routes: SR-18 east of Running Springs and SR-38 at the Santa Ana River Bridge. The combined totals show a cyclical pattern with traffic volumes rising from 1994-96, declining 1996-1998, rising again to a peak in 2004, and declining since then. Based on these data, 1996 was the peak year for traffic to and from Big Bear Lake.

Figure 2.17 – Total AADT on Westside Access Routes, 1992 - 2007

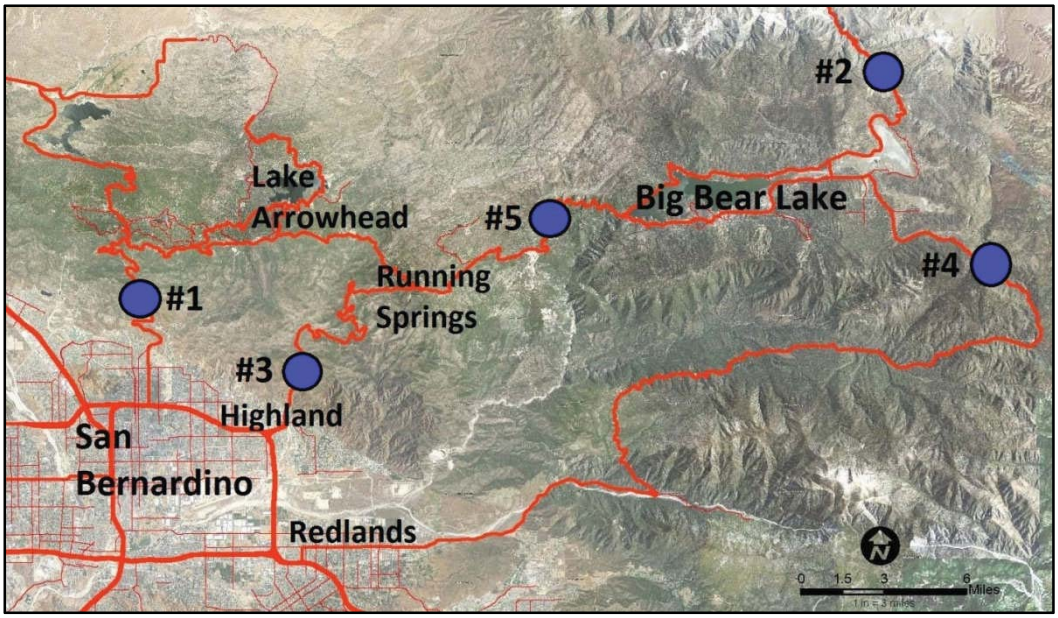


2.4.4 Project Traffic Counts

Winter 2010 traffic counts were undertaken at five locations during the week of Saturday, March 13, through Friday, March 19, 2010. The locations were (see Figure 2.18):

1. SR-18 between Old Waterman Canyon Road & SR-138
2. SR-18E between Camp Rock Road & Baldwin Lake Road
3. SR-330 between Highland Avenue and Live Oak Drive
4. SR-38 between Heart Bar Campground turnoff & Lake Wood Drive
5. SR-18 between Snow Valley Ski Area and the Big Bear Dam

Figure 2.18 – Locations for 2010 Traffic Counts



Note: count locations shown are approximate.

The count on SR-330 (#3) was interrupted by a construction closure that took effect on Wednesday afternoon and continued beyond the end of the counts. Therefore the only complete counts were for Saturday through Tuesday. The counters on SR-18 east of Snow Valley (#5) were lost due to snow plowing, so no data were obtained for this location. Traffic count data can be found in Appendix A.

Additional traffic counts were conducted at all five locations from Wednesday, June 16, through Tuesday, June 23, 2010. The locations included the four March locations referenced above plus SR-18 between Snow Valley Ski Area and SR-38. Detailed results from each count period are provided below.

March Traffic Counts

Daily Traffic Variations

Daily traffic variations on SR-18, SR-38, SR-330, and SR-18E are shown in Figures 2.19 through 2.22, respectively. Where the data are available, these charts show that Friday is the peak traffic day since it combined both the daily commuters and the Average Weekend vacationers.

Figure 2.19 – Daily Traffic on SR-18, March 2010

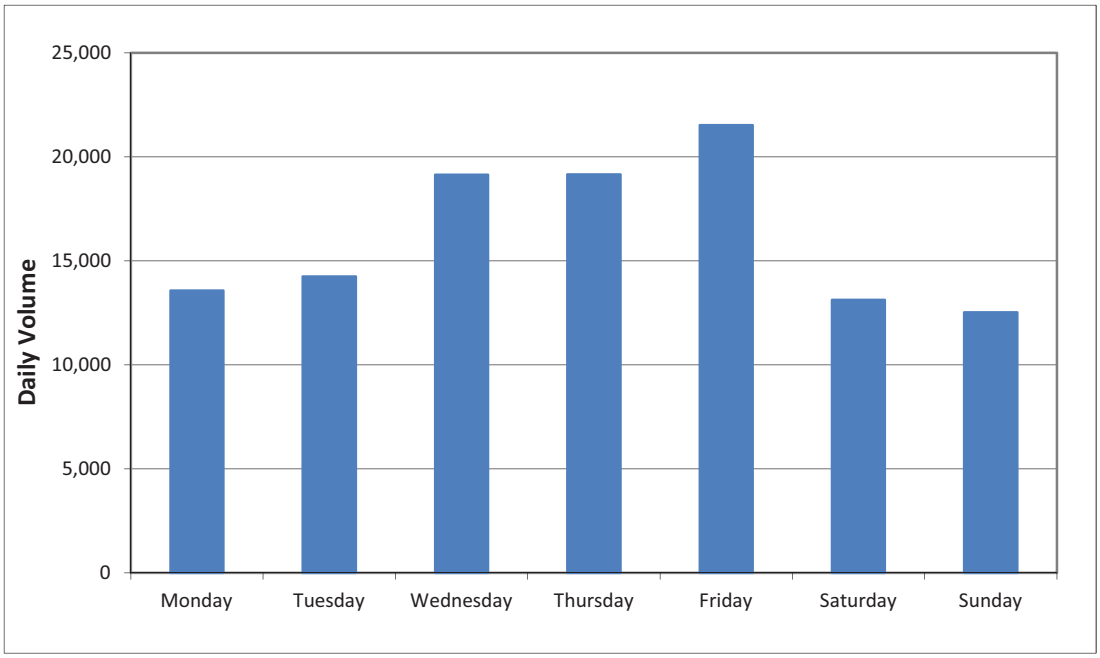


Figure 2.20 – Daily Traffic on SR-38, March 2010

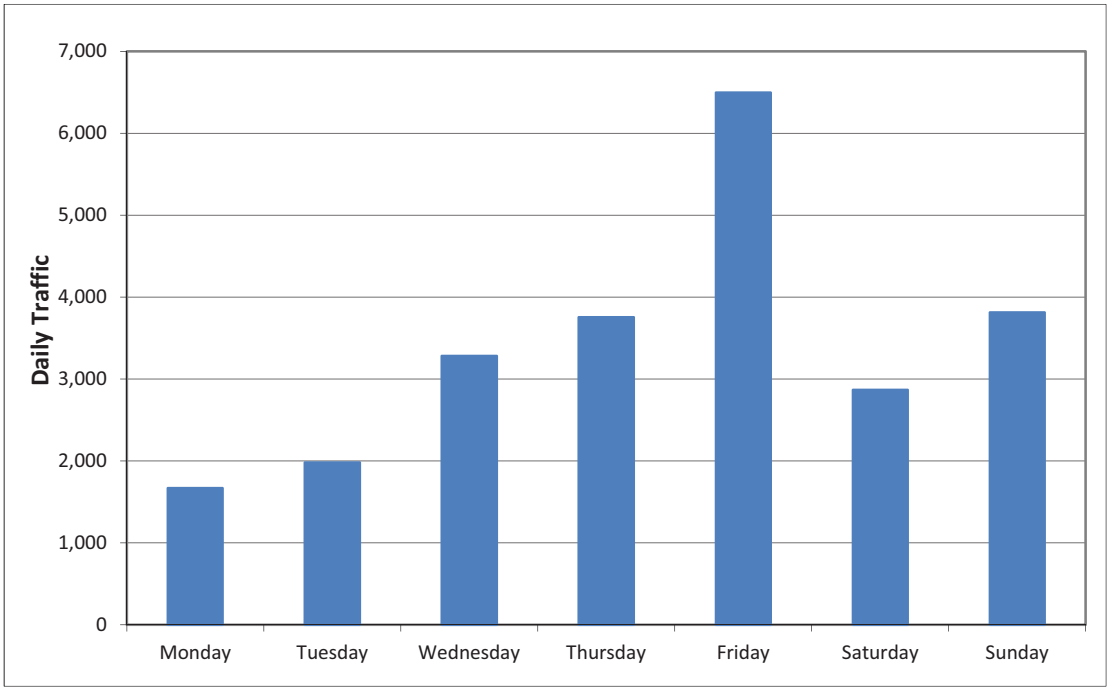


Figure 2.21 – Daily Traffic on SR-330, March 2010

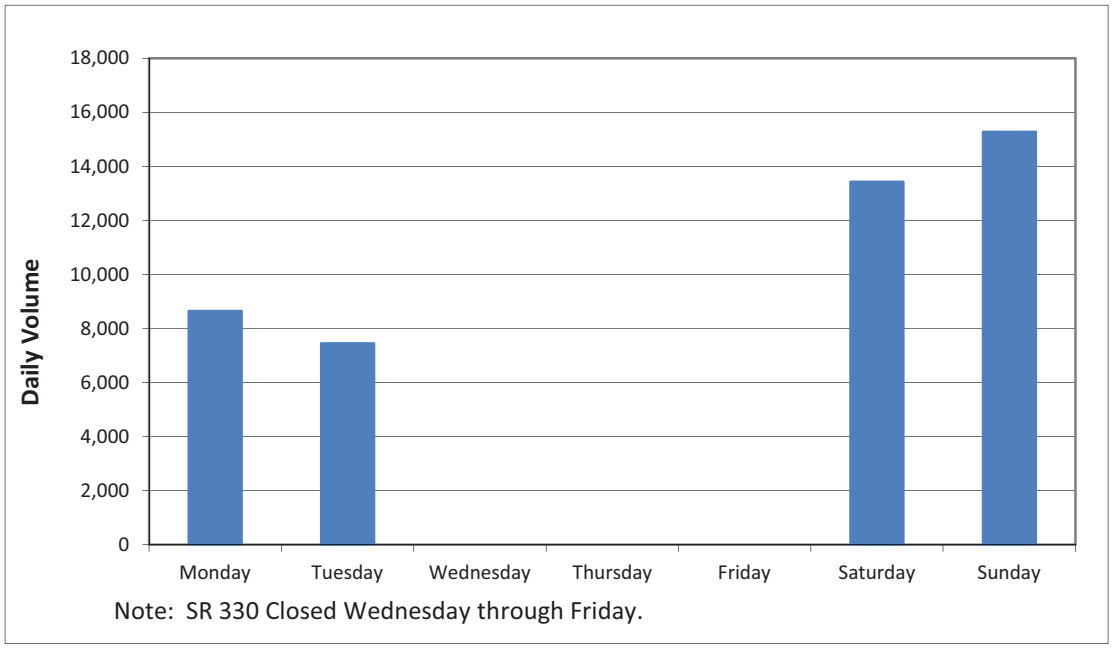
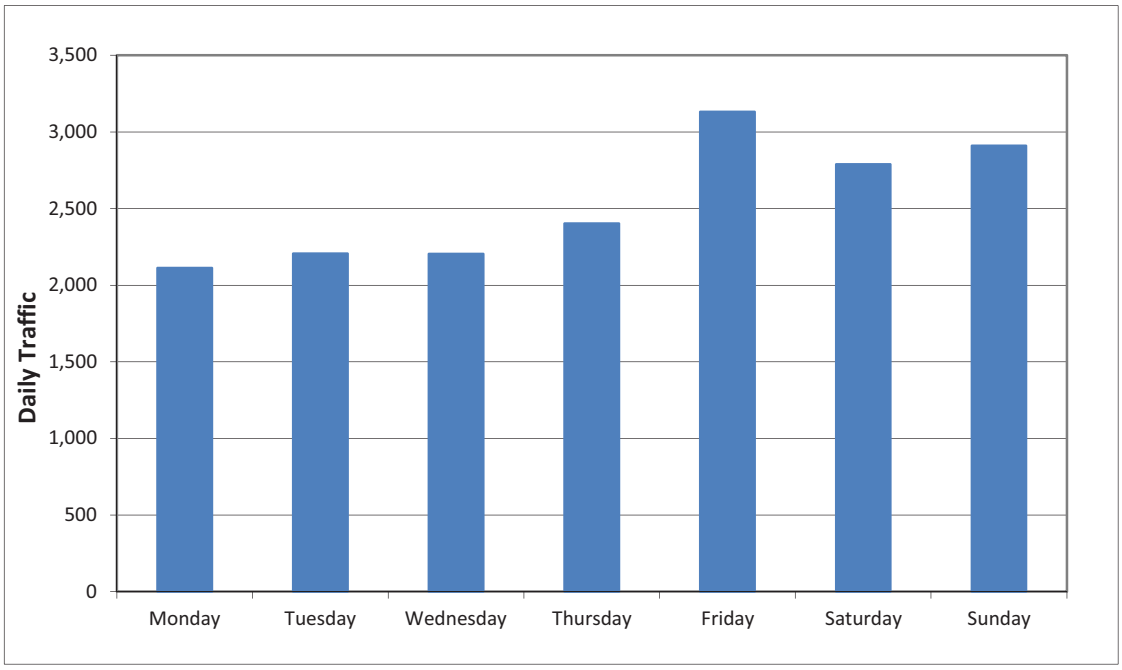


Figure 2.22 – Daily Traffic on SR-18E, March 2010



Hourly Traffic Volumes

Figures 2.23 through 2.30 present hourly traffic volumes for March average weekdays and March average weekend days for the Big Bear Lake access routes. In Figure 2.23, SR-18 shows a typical peaking pattern of high outbound traffic in the AM and peak inbound traffic in the PM for an average weekday. The average weekend pattern shown in Figure 2.24 is similar but without the sharp peaks between inbound and outbound; traffic is steadier in both directions.

Figure 2.23 – Hourly Traffic on SR-18 March Average Weekday

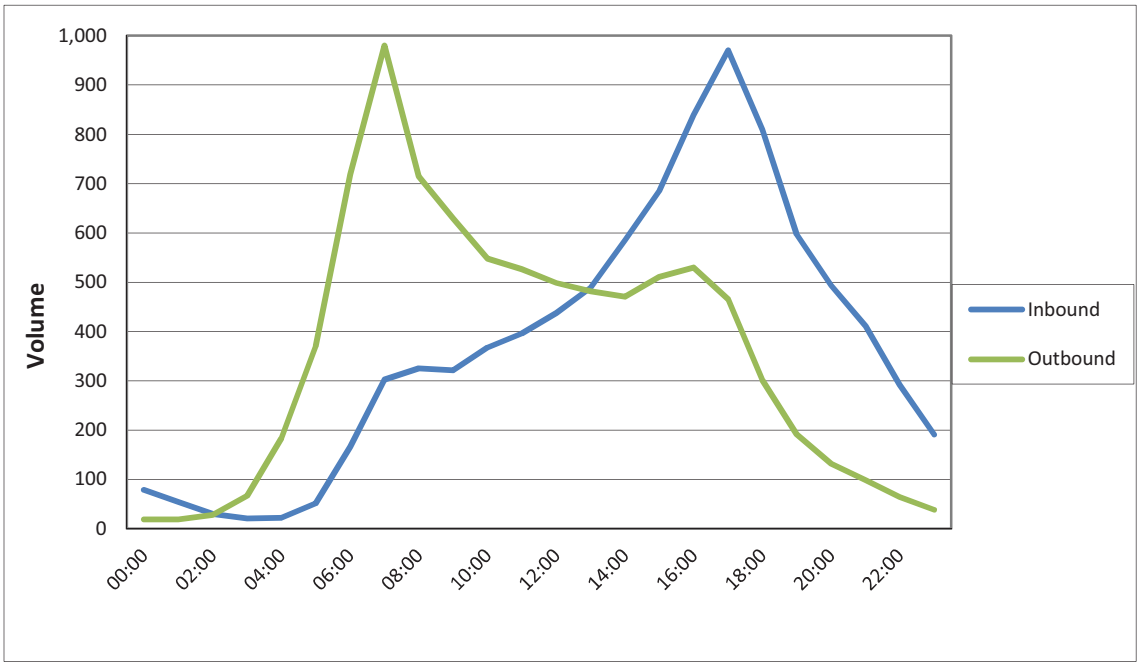
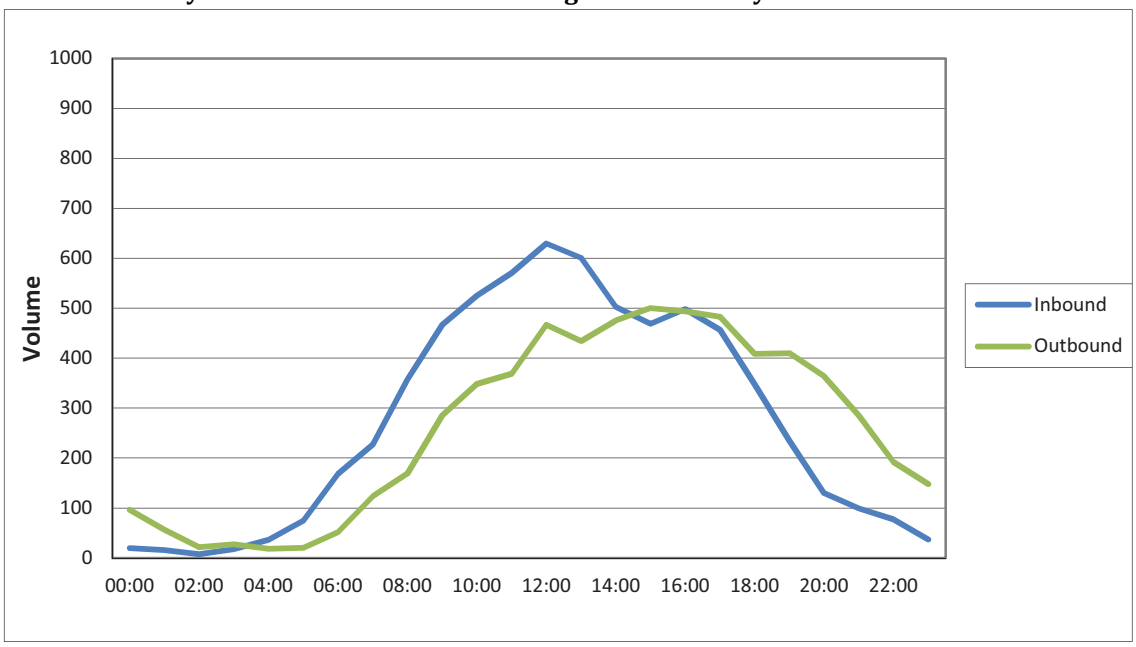


Figure 2.24 – Hourly Traffic on SR-18 March Average Weekend Day



As shown in Figure 2.25, there is little difference between inbound and outbound patterns on SR-38, but the total volumes are much lower than those on SR-18. Figure 2.26 shows the average weekend patterns on SR-38, where there is a significant outbound peak in the afternoon.

Like SR-38, there little difference between inbound and outbound average weekday volumes on SR-330 (Figure 2.27), but the average weekend patterns are typical of a recreation area with a peak inbound in the morning and a peak outbound in the afternoon.

As shown in Figures 2.23 and 2.24, the directional patterns on SR-18E are similar to those on SR-330 but the volumes are much lower.

Figure 2.25 – Hourly Traffic on SR-38 March Average Weekday

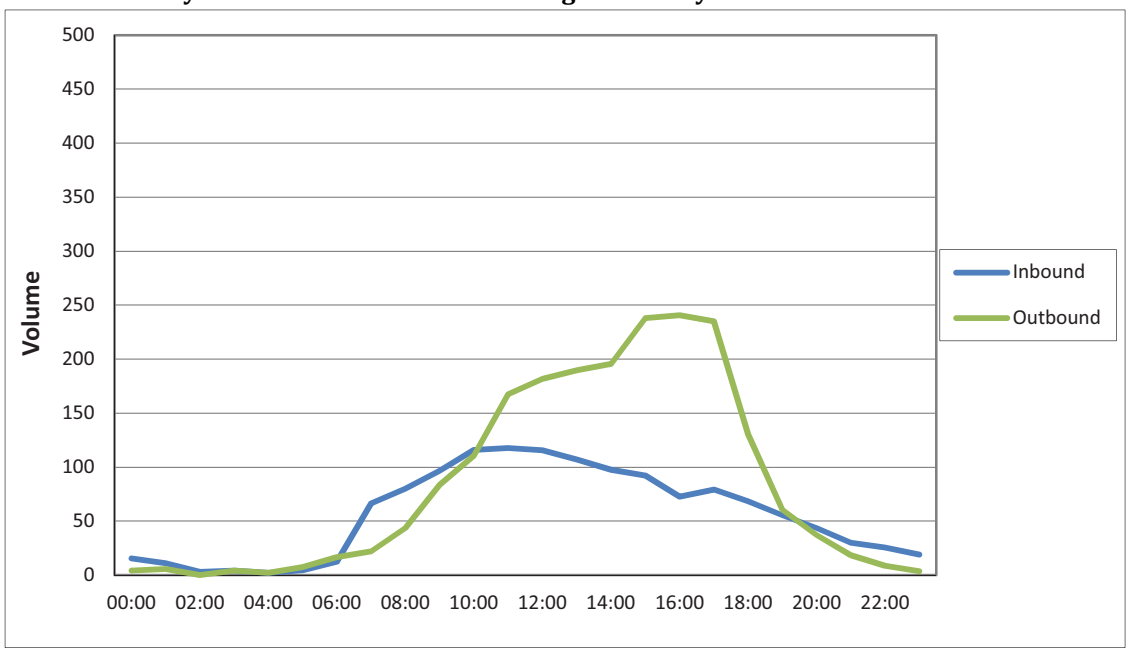


Figure 2.26 – Hourly Traffic on SR 38 March Average Weekend Day

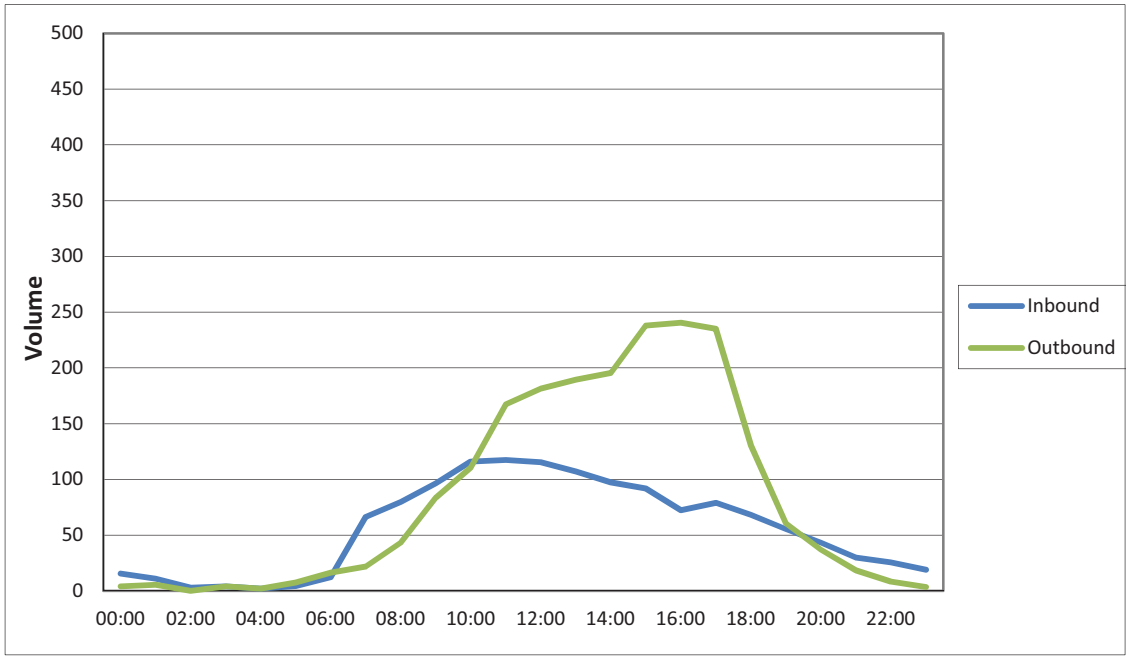


Figure 2.27 – Hourly Traffic on SR-330 March Average Weekday

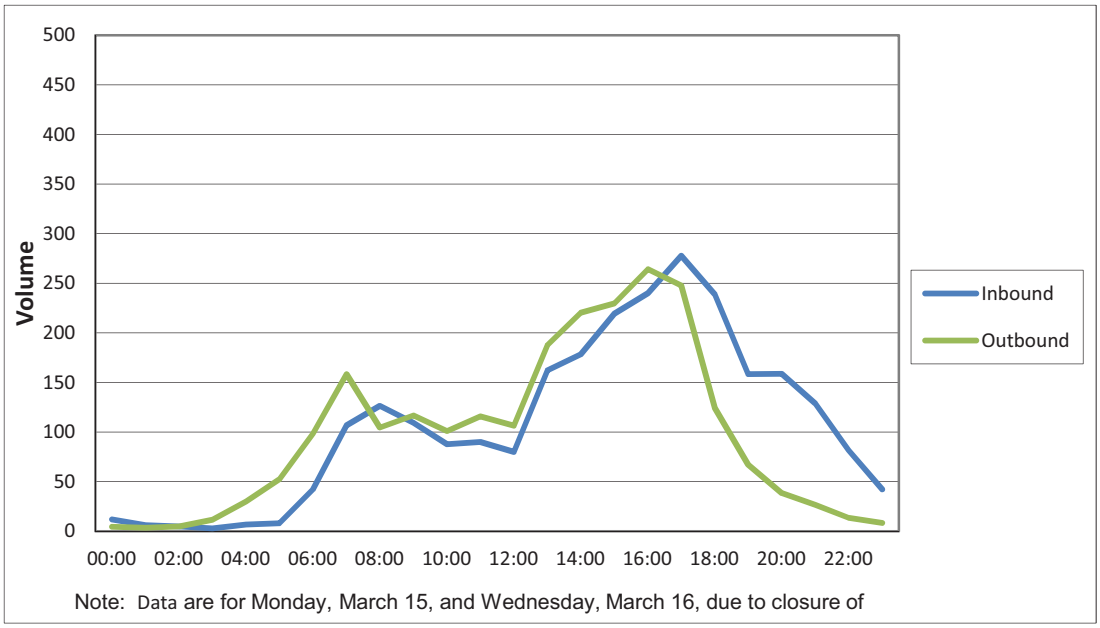


Figure 2.28 – Hourly Traffic on SR-330 March Average Weekend Day

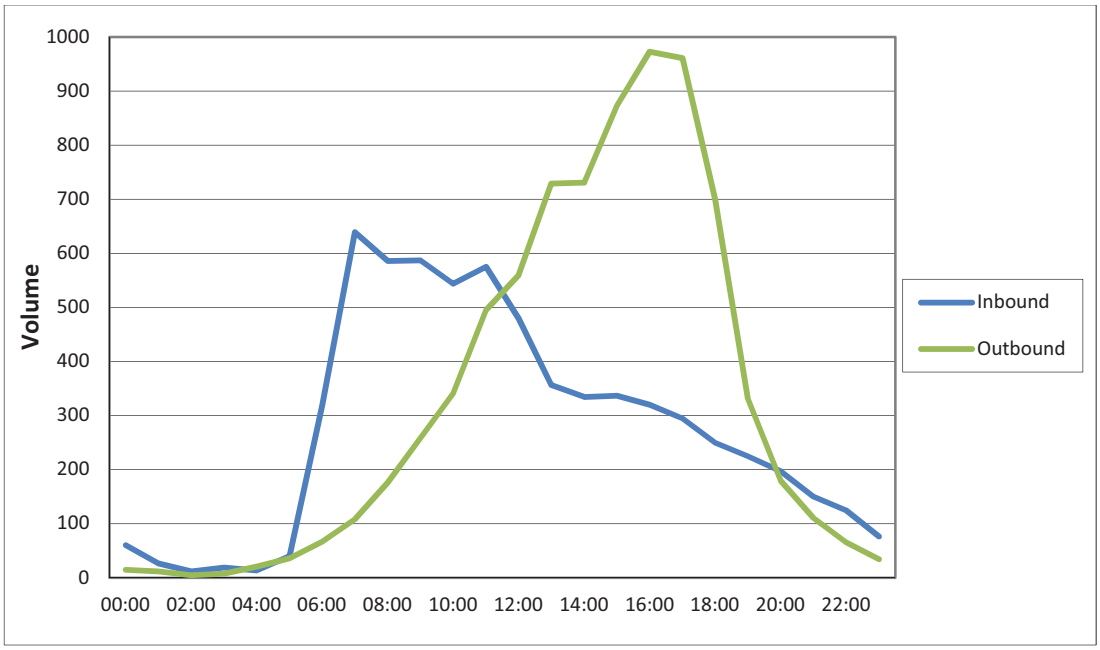


Figure 2.29 – Hourly Traffic on SR-18E March Average Weekday

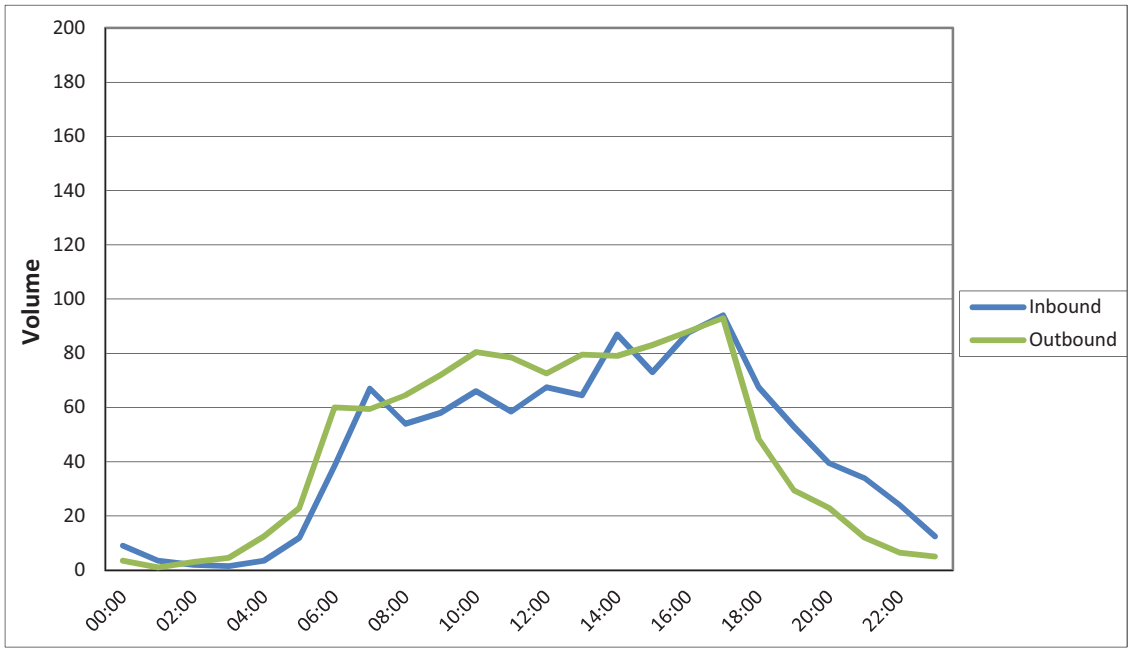
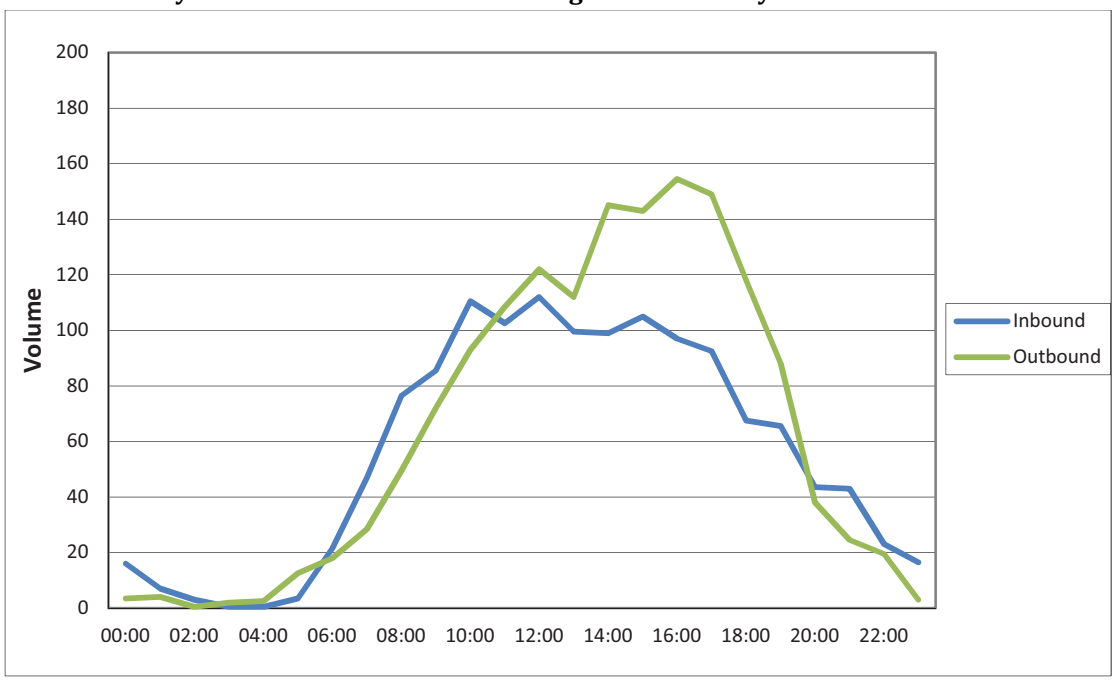


Figure 2.30 – Hourly Traffic on SR-18E March Average Weekend Day



Appendix B includes charts showing directional hourly traffic volumes by day of week for each of the traffic count locations.

June Traffic Counts

Daily traffic variations are shown in Figures 2.31 through 2.35. These graphs compare June counts with March counts – Figure 2.31 shows the combined ADT on the four routes up the mountain, and the following four charts show the volumes on each individual route. Overall, the June counts are higher than the March counts, except for Sunday. The March closure of SR-330 for much of the counting period resulted in mostly higher March counts on the individual routes.

Figure 2.31 – Total Daily Traffic on all four Mountain Access Roads (SR-18, SR-18E, SR-330, SR-38)

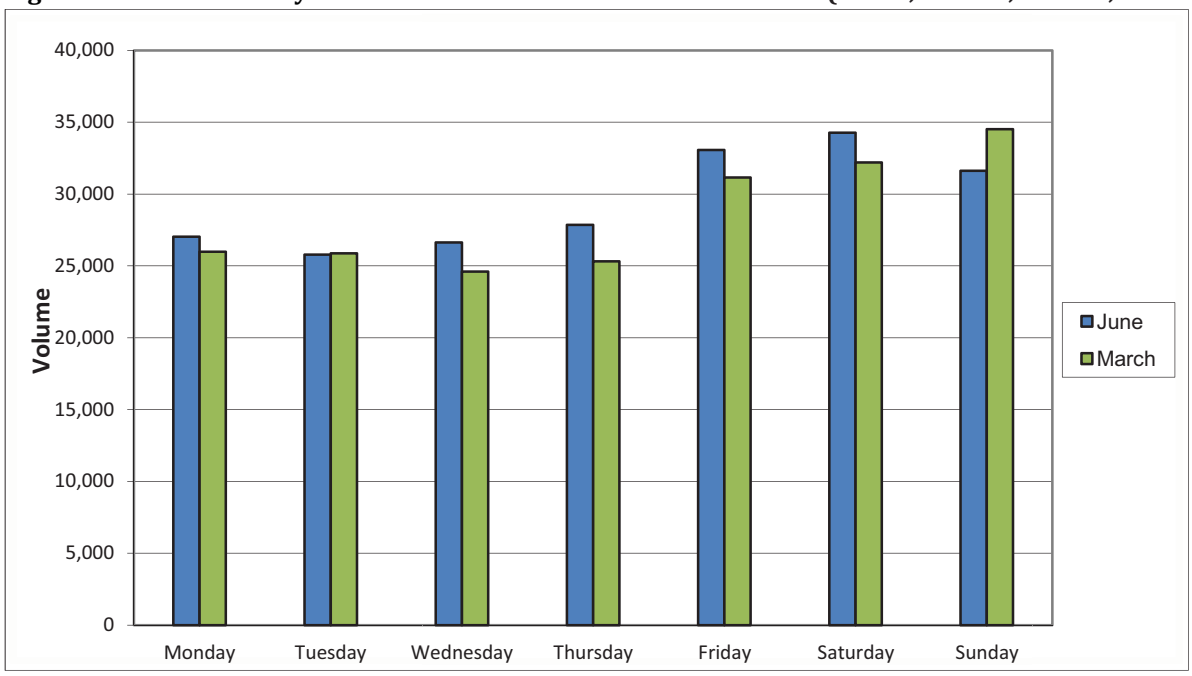


Figure 2.32 – Daily Traffic on SR-18 south of SR-138, June 2010

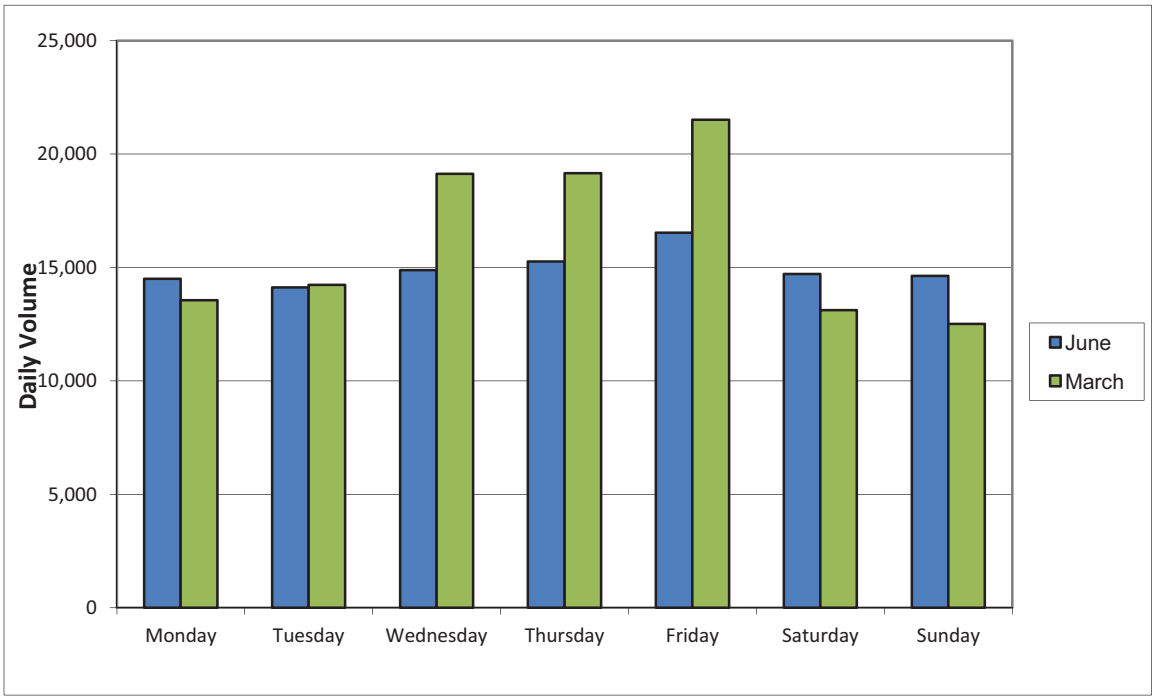


Figure 2.33 – Daily Traffic on SR-38, June 2010

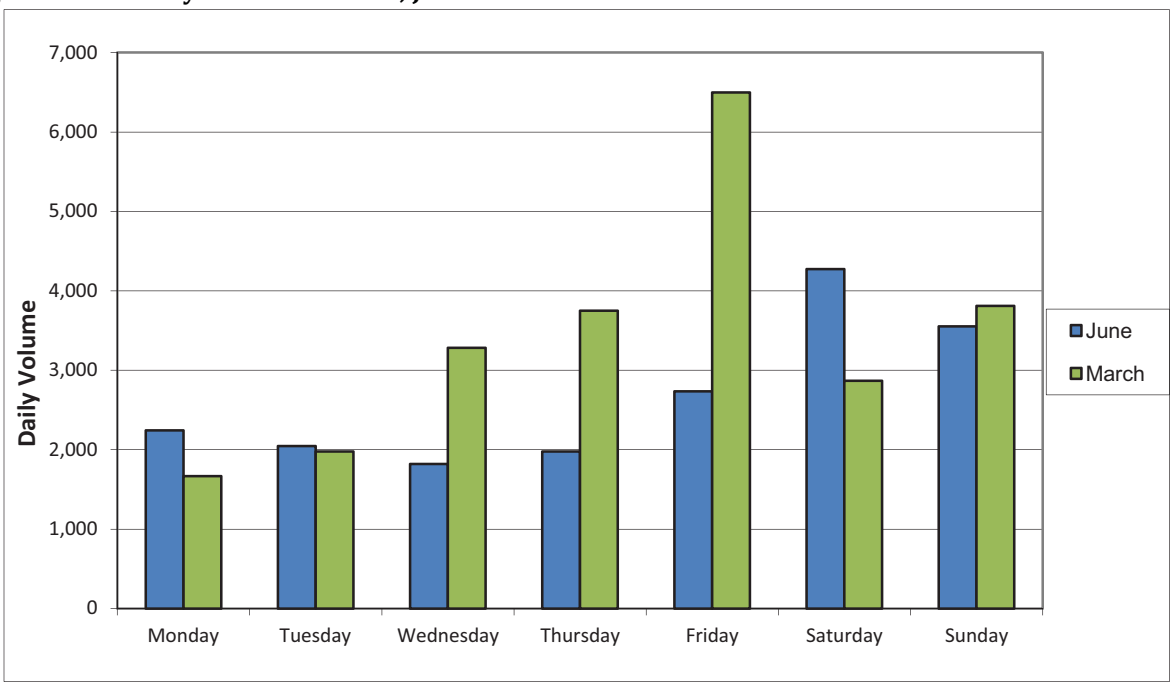


Figure 2.34 – Daily Traffic on SR-330, June 2010

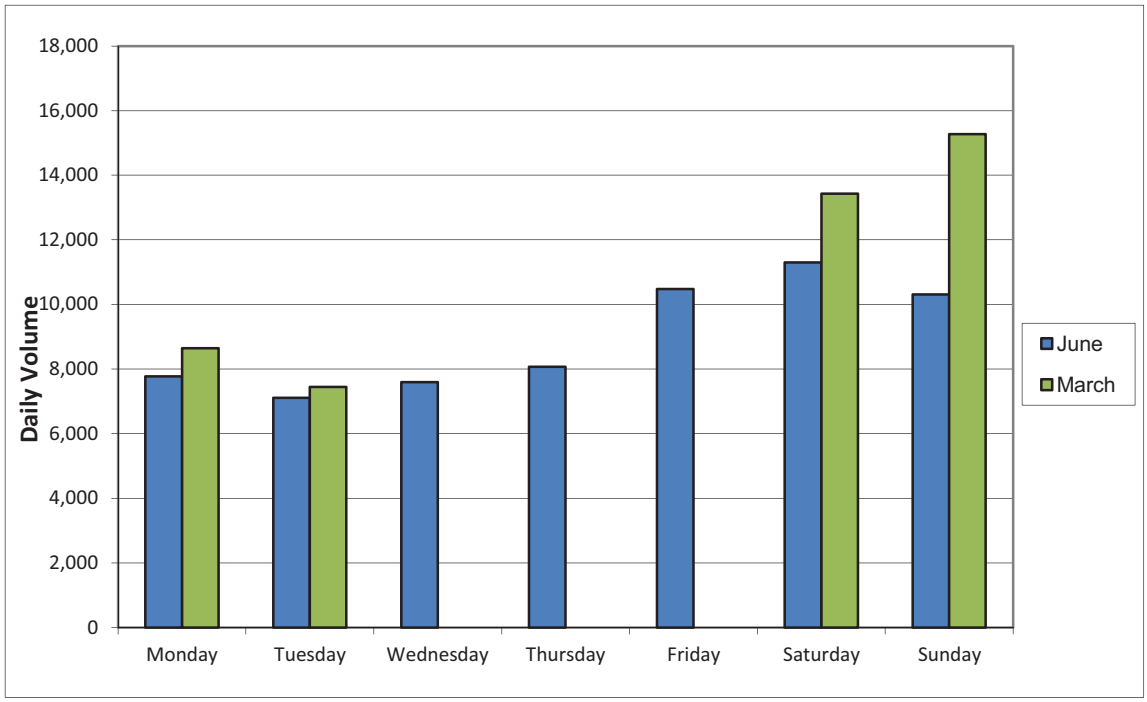
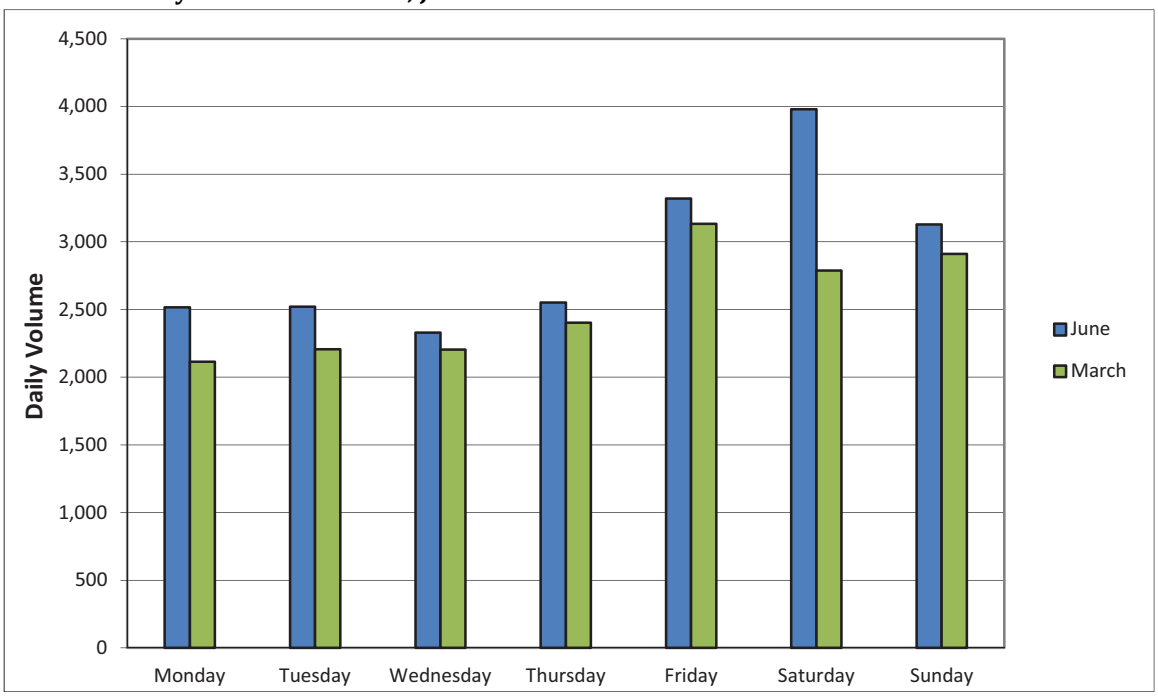


Figure 2.35 – Daily Traffic on SR-18E, June 2010



Hourly Traffic Volumes

Figures 2.36 through 2.46 show hourly traffic volumes for June average weekday and June average weekend days for the five count location

Figure 2.36 – Hourly Traffic on SR-18 south of SR-138 on an Average June Weekday

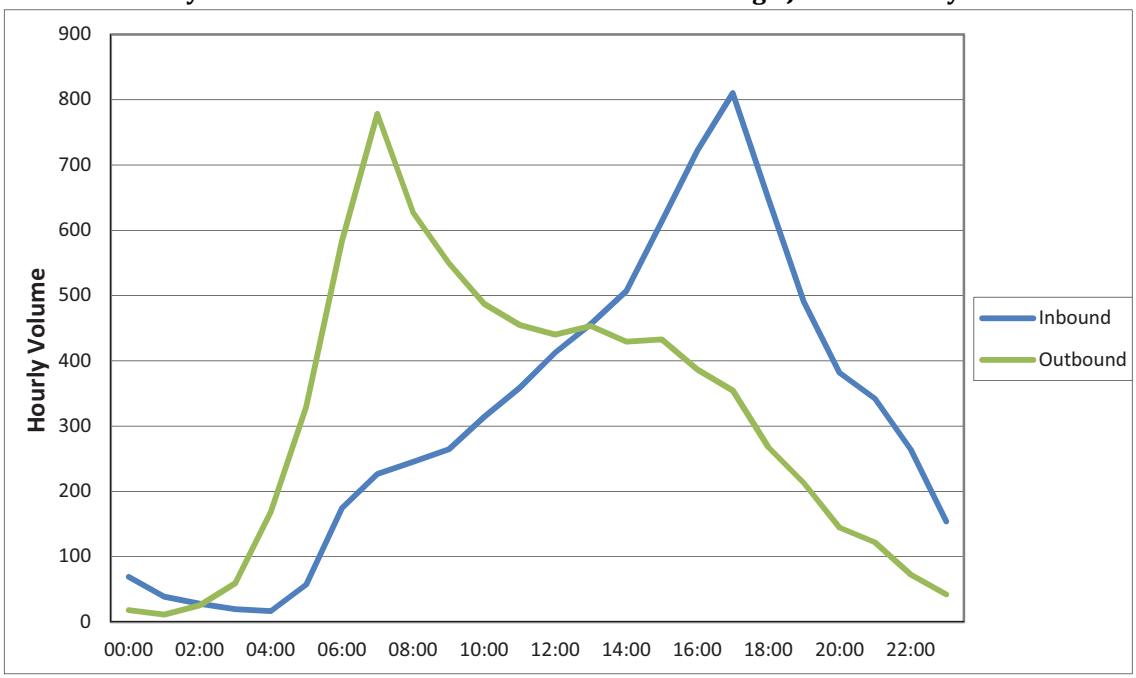


Figure 2.37 – Hourly Traffic on SR-18 south of SR-138 on an Average June Weekend Day

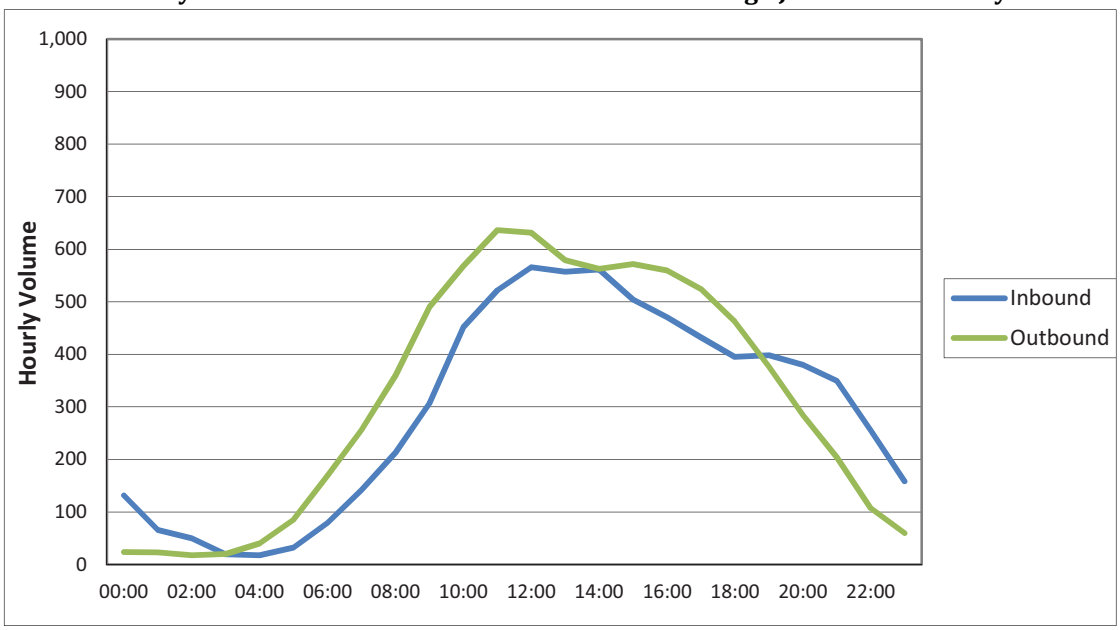


Figure 2.38 – Hourly Traffic on SR-18 east of Snow Valley on an Average June Weekday

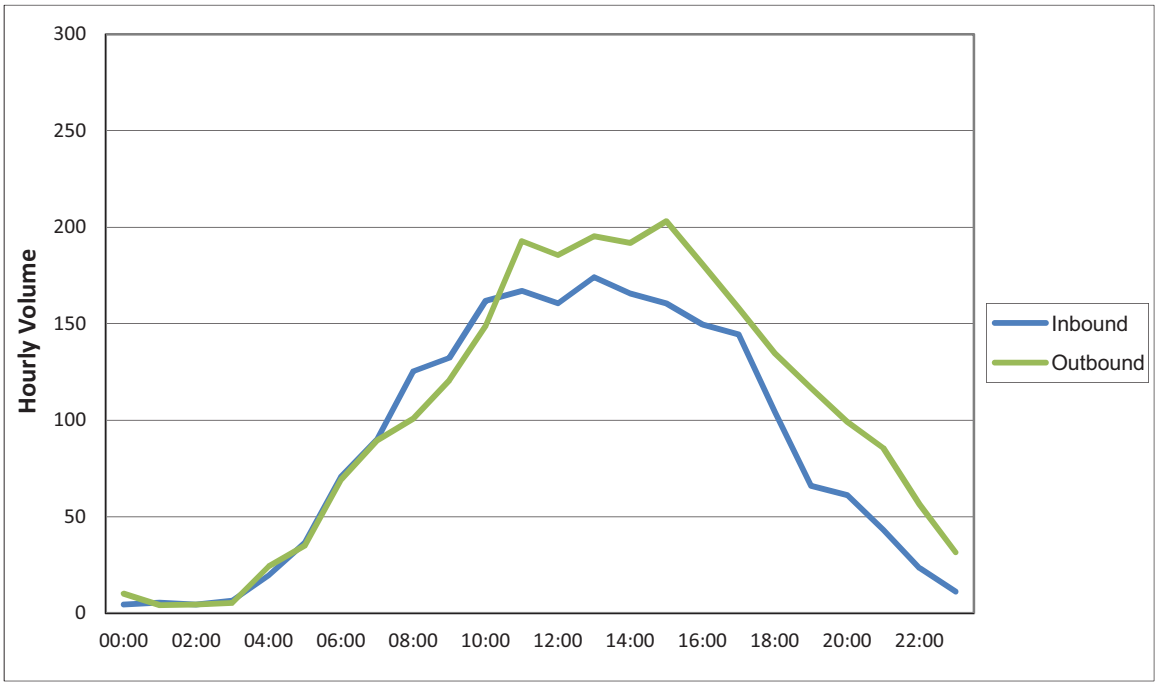


Figure 2.39 – Hourly Traffic on SR-18 east of Snow Valley on an Average June Weekend day

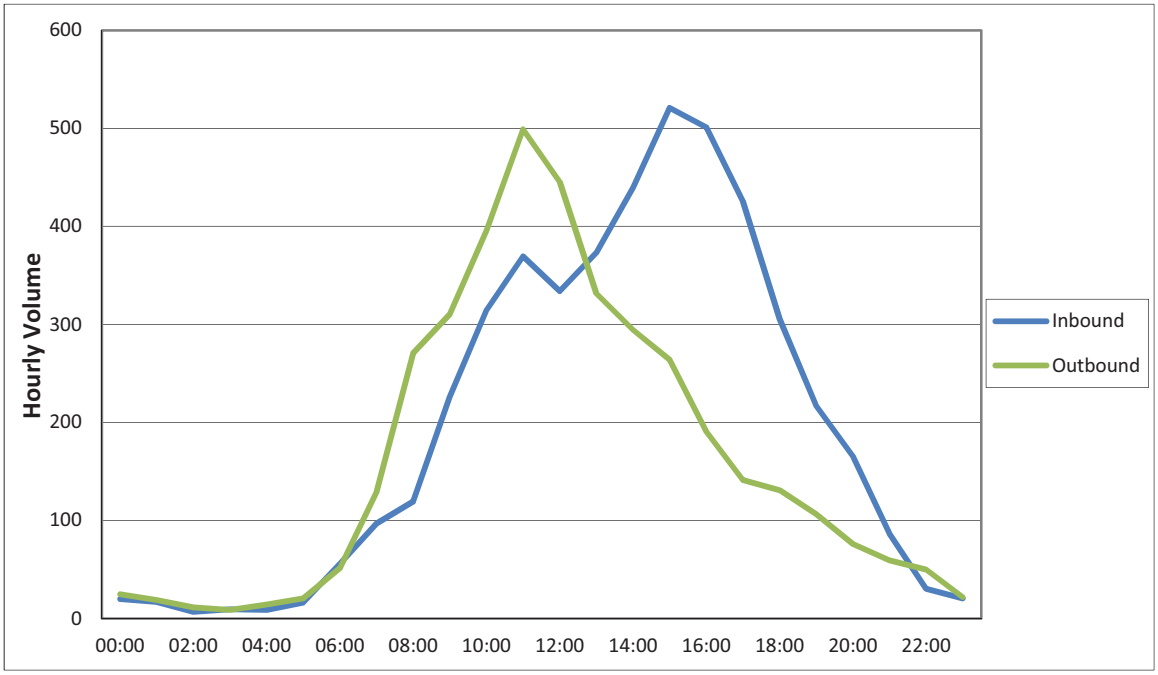


Figure 2.40 – Hourly Traffic on SR-38 June Average Weekday

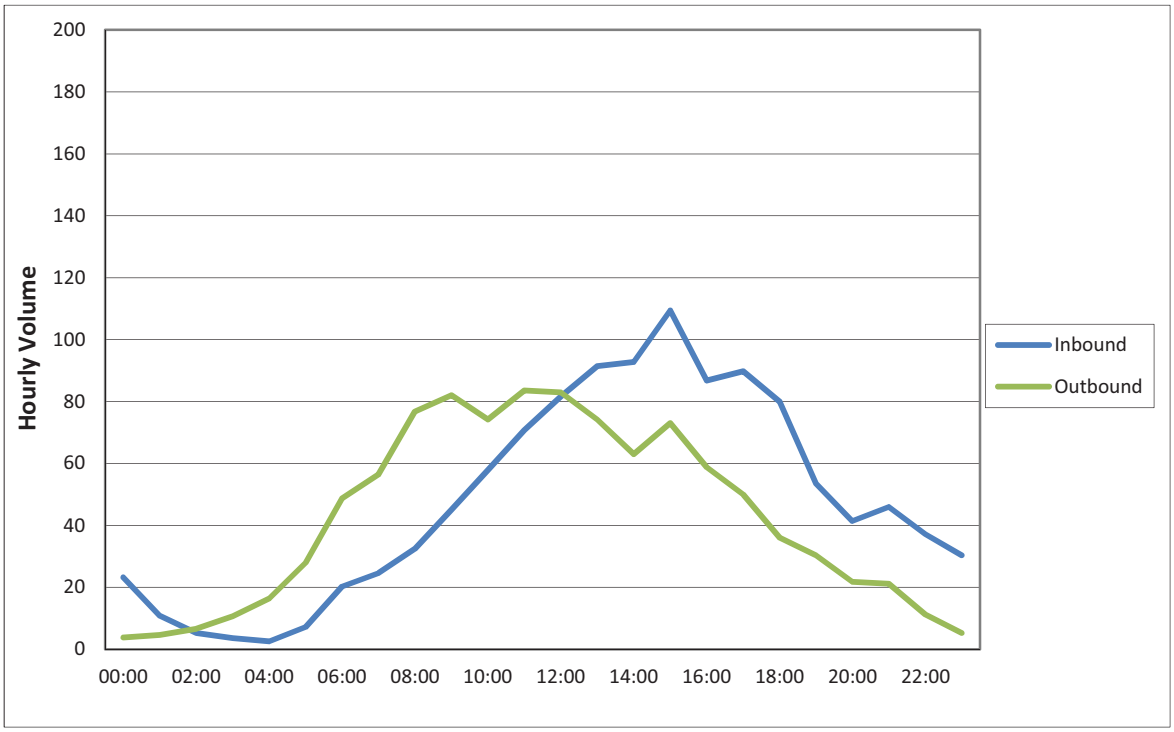


Figure 2.41 – Hourly Traffic on SR-38 June Average Weekend day

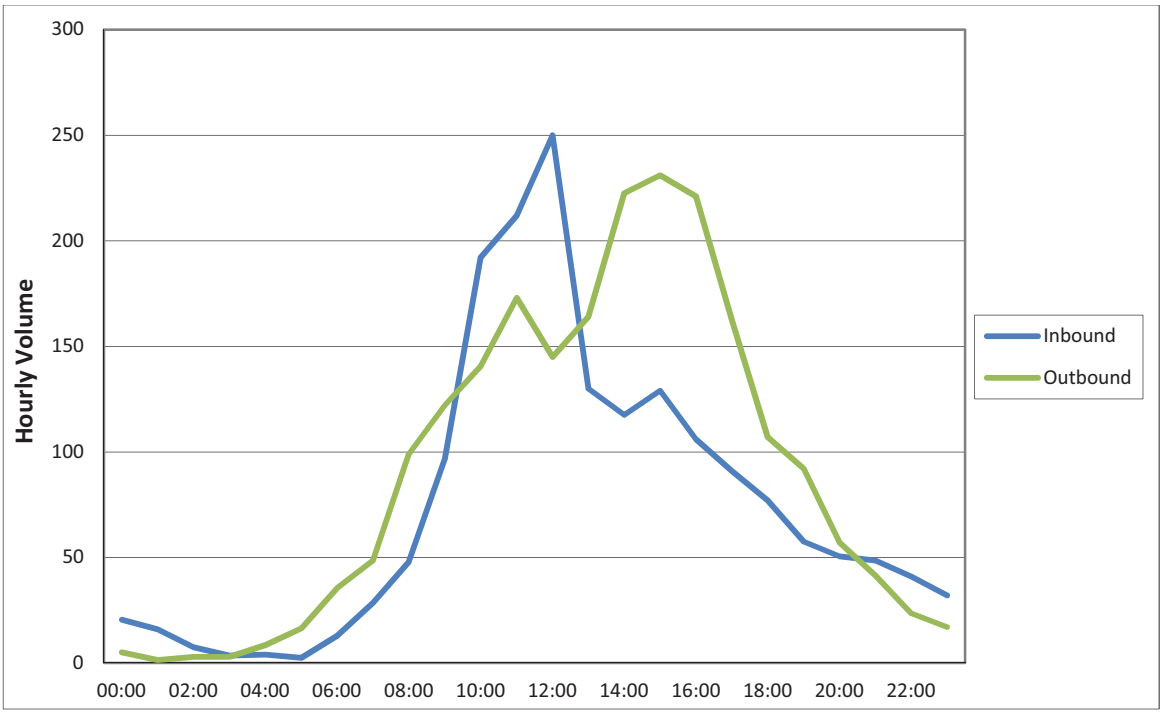


Figure 2.42 – Hourly Traffic on SR-330 June Average Weekday

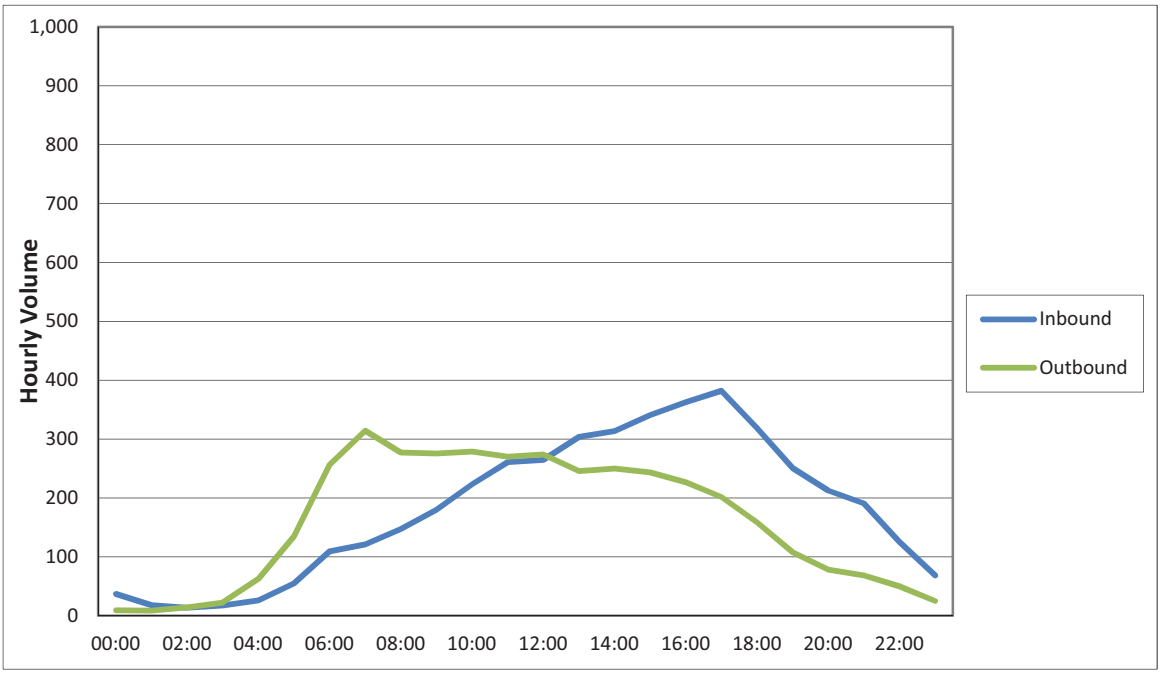


Figure 2.43 – Hourly Traffic on SR-330 June Average Weekend Day

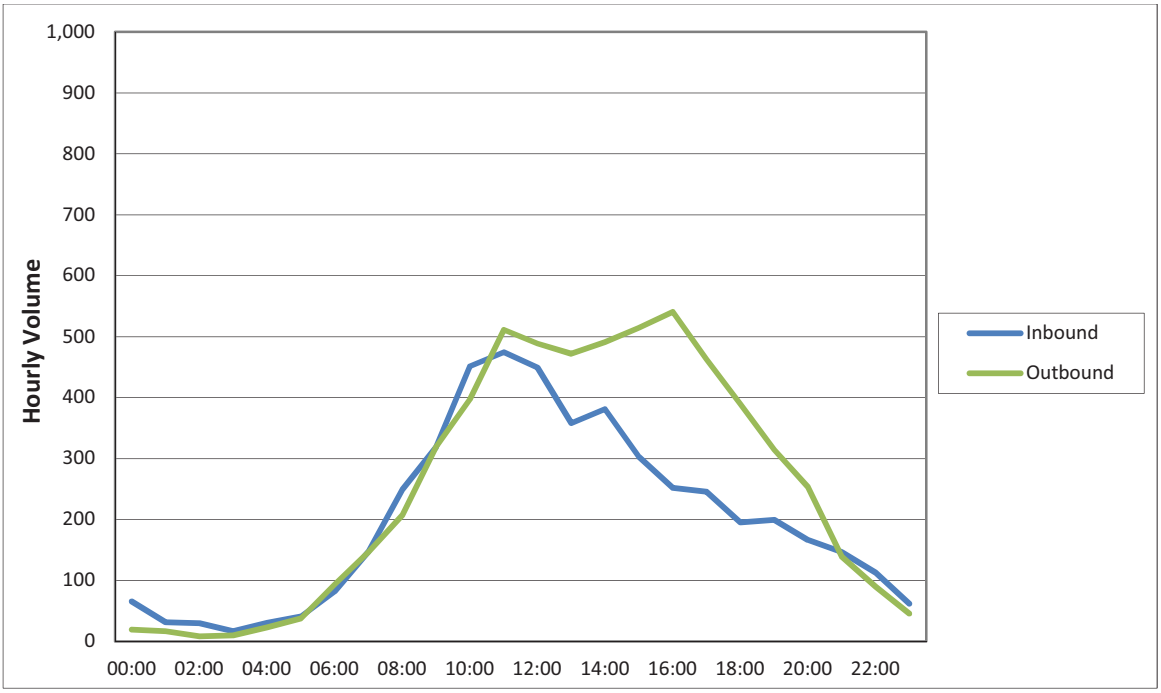


Figure 2.44 – Hourly Traffic on SR-18E June Average Weekday

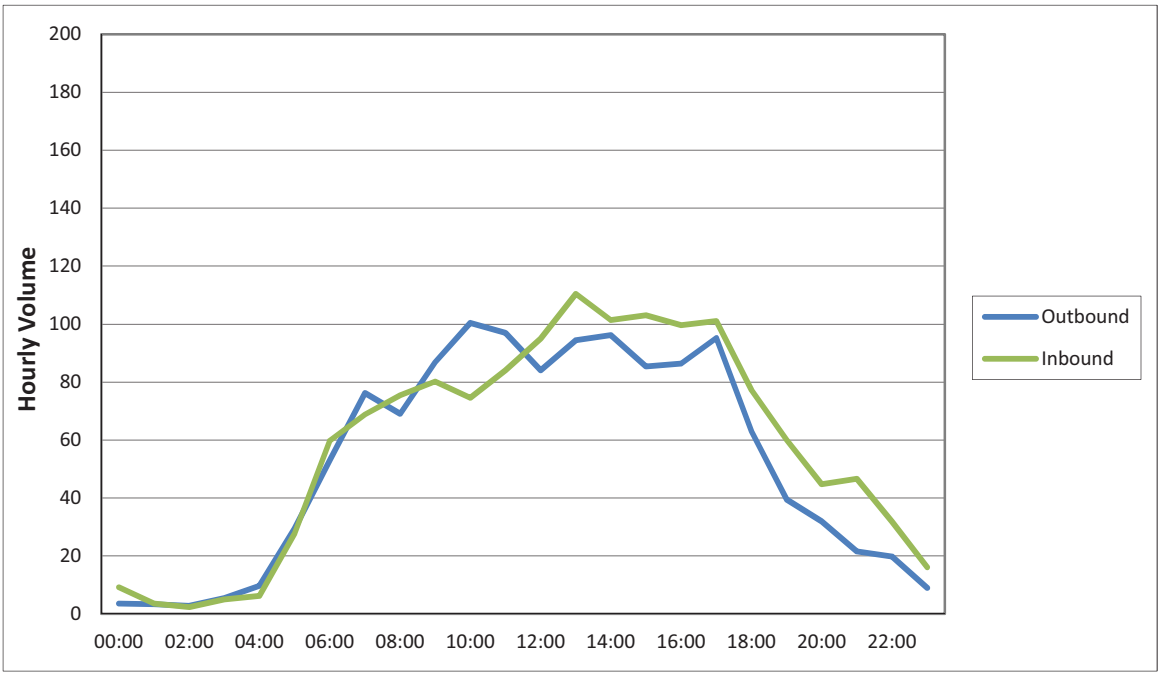
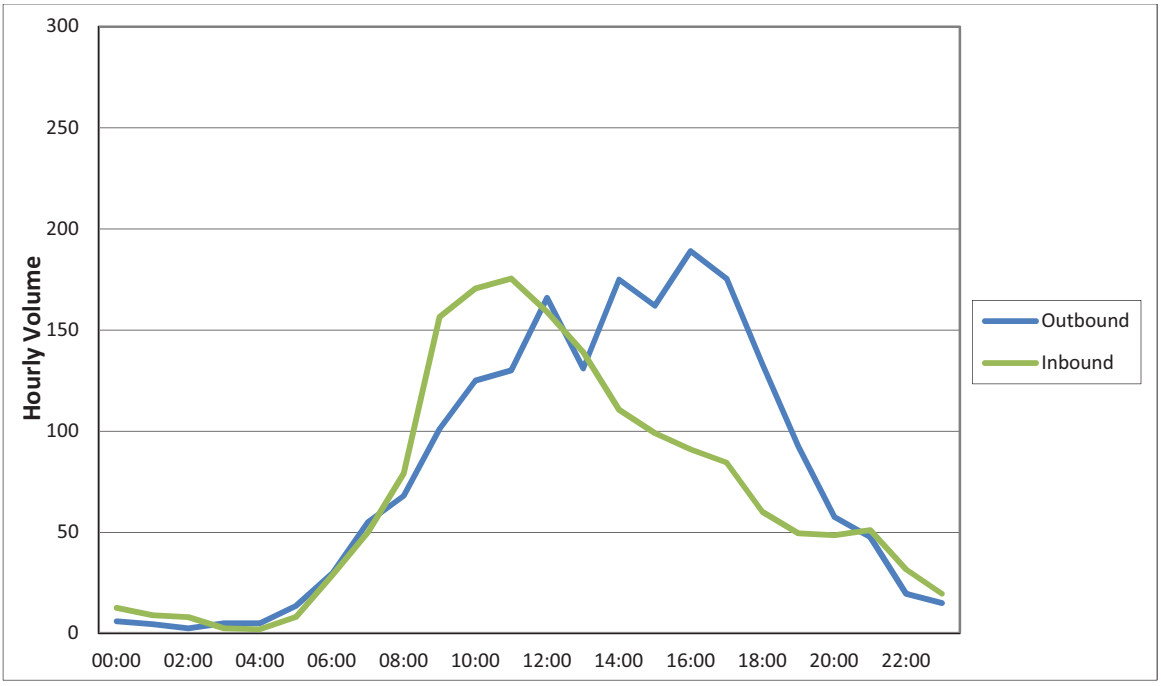


Figure 2.45 – Hourly Traffic on SR-18E June Average Weekend day



Hourly Traffic Summaries
Appendix B includes charts showing directional hourly traffic volumes by day of week for each of the traffic count locations.

August Traffic Counts

In early August, additional traffic counts were conducted to supplement the summer counts collected in June and to determine whether the June counts reflected typical summer traffic volumes. The August counts were collected from Thursday August 5 through Monday August 9 at four of the locations counted in March and June:

- SR-18 West between San Bernardino and Crestline
- SR-330 between Highland and Running Springs
- SR-38 between the Santa Ana River Bridge and Big Bear City; and
- SR-18 between Snow Valley and Big Bear Dam

The charts below compare the total daily volumes at these locations by day of the week in March, June, and August.

The August volumes are generally somewhat higher than the June volumes, except that the Saturday volumes were higher in June than in August.

The summer volumes were generally slightly higher than the March volumes, except for the weekend counts on SR-330 because of the good spring skiing conditions when the March counts were collected. (Note: The Wed/Thurs/Fri volumes in March on SR-18W and SR-38 were higher than the June and August volumes because SR-330 was closed for repairs on those days in March and the traffic that would normally use SR-330 used those two roads instead.)

Figure 2.46 – SR-18: San Bernardino to Crestline

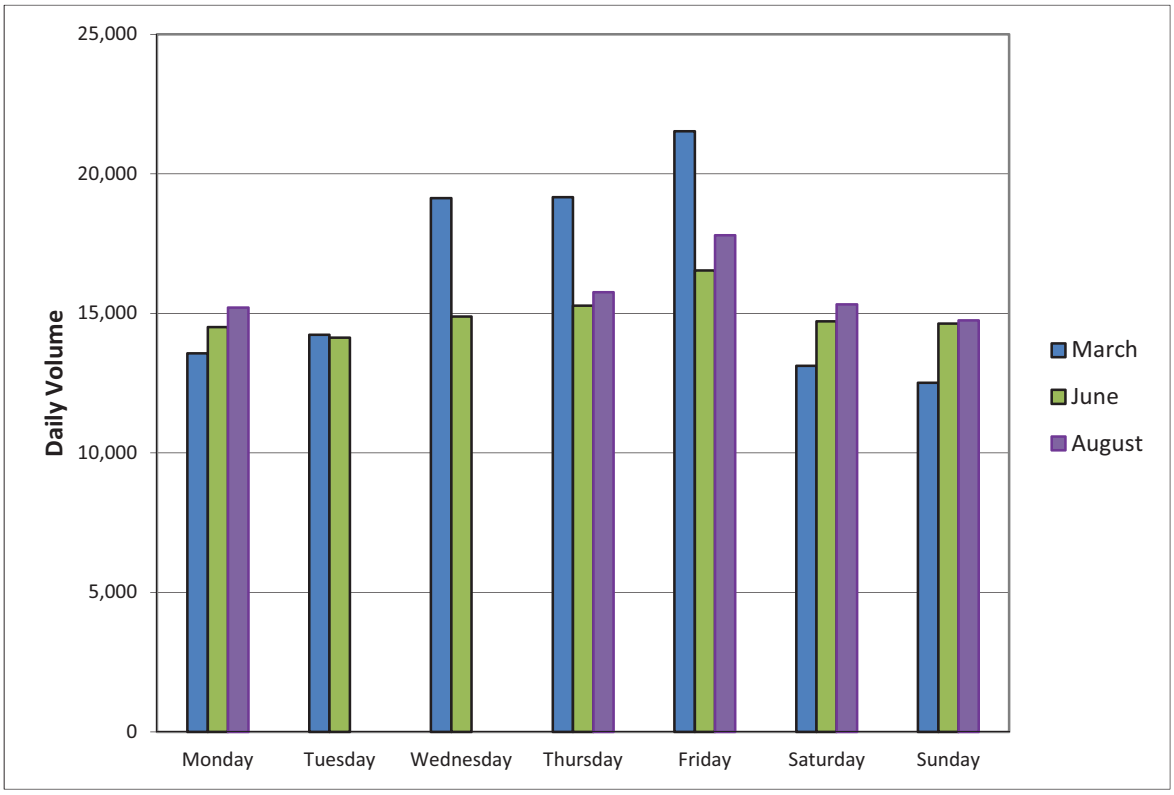


Figure 2.47 - SR-330: Highland to Running Springs

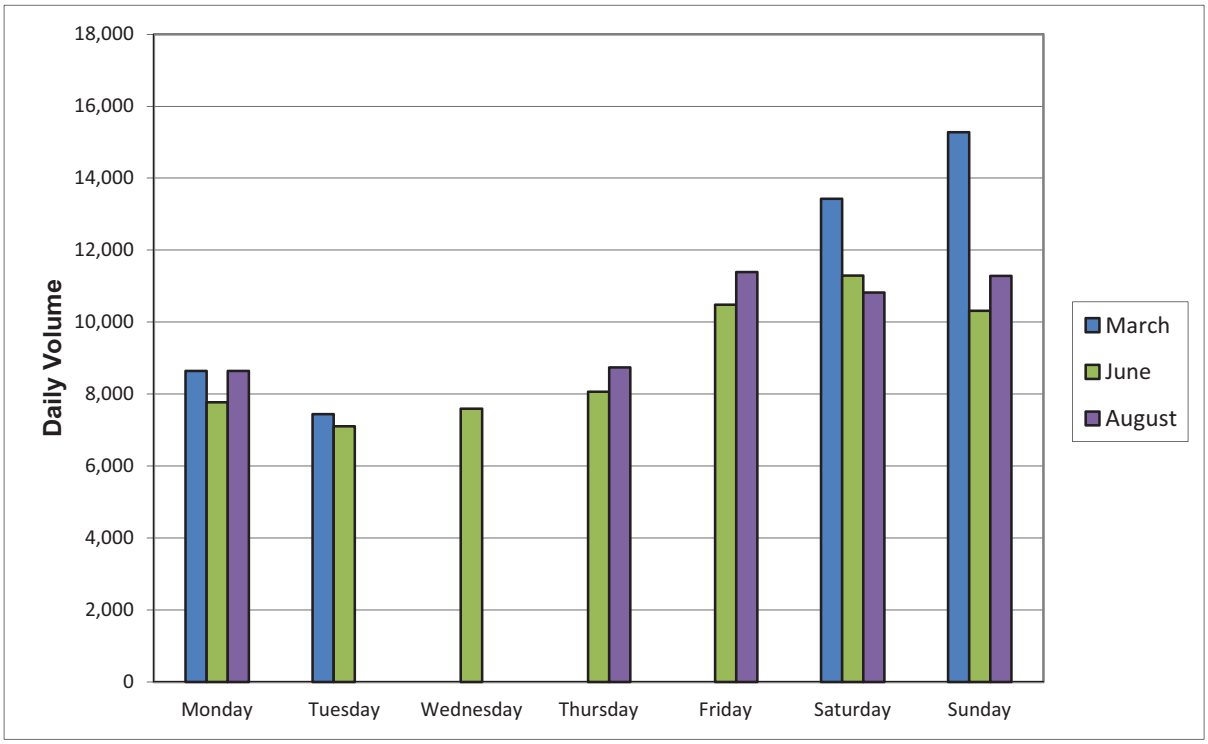


Figure 2.48 - SR-38: Santa Ana River to Big Bear City

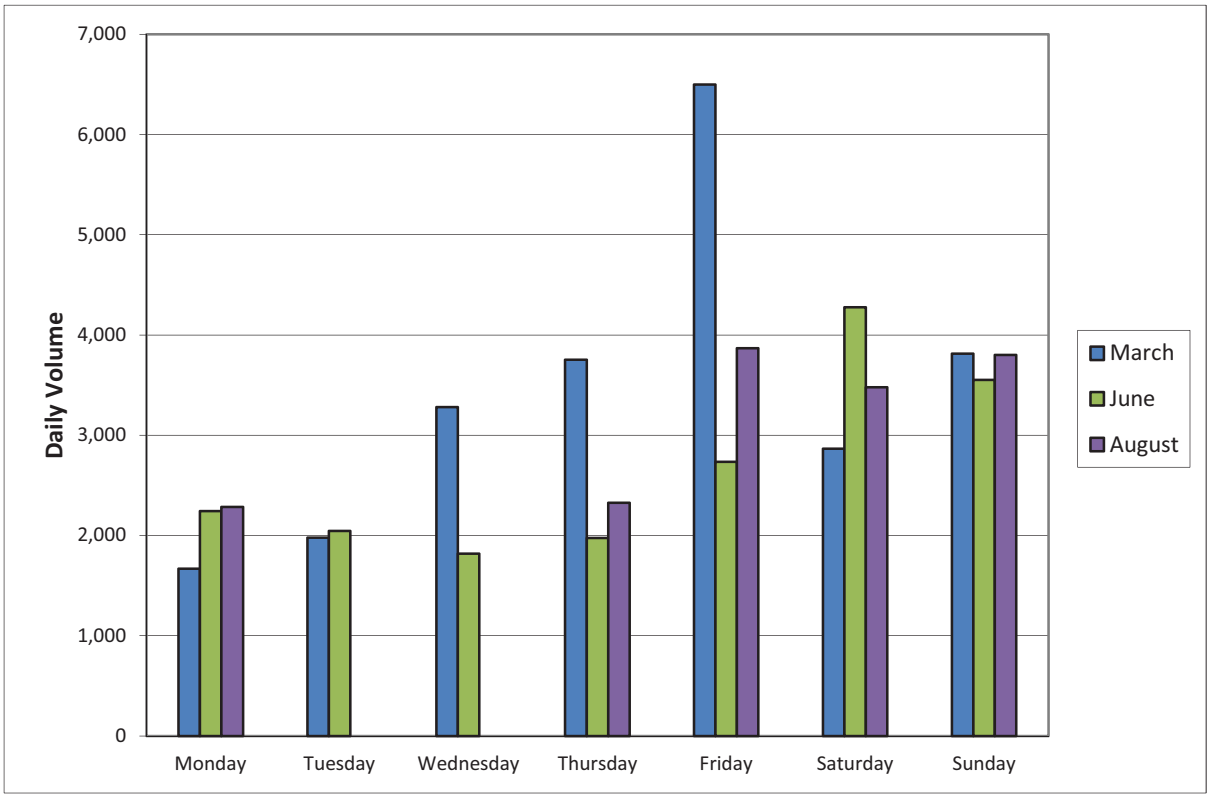
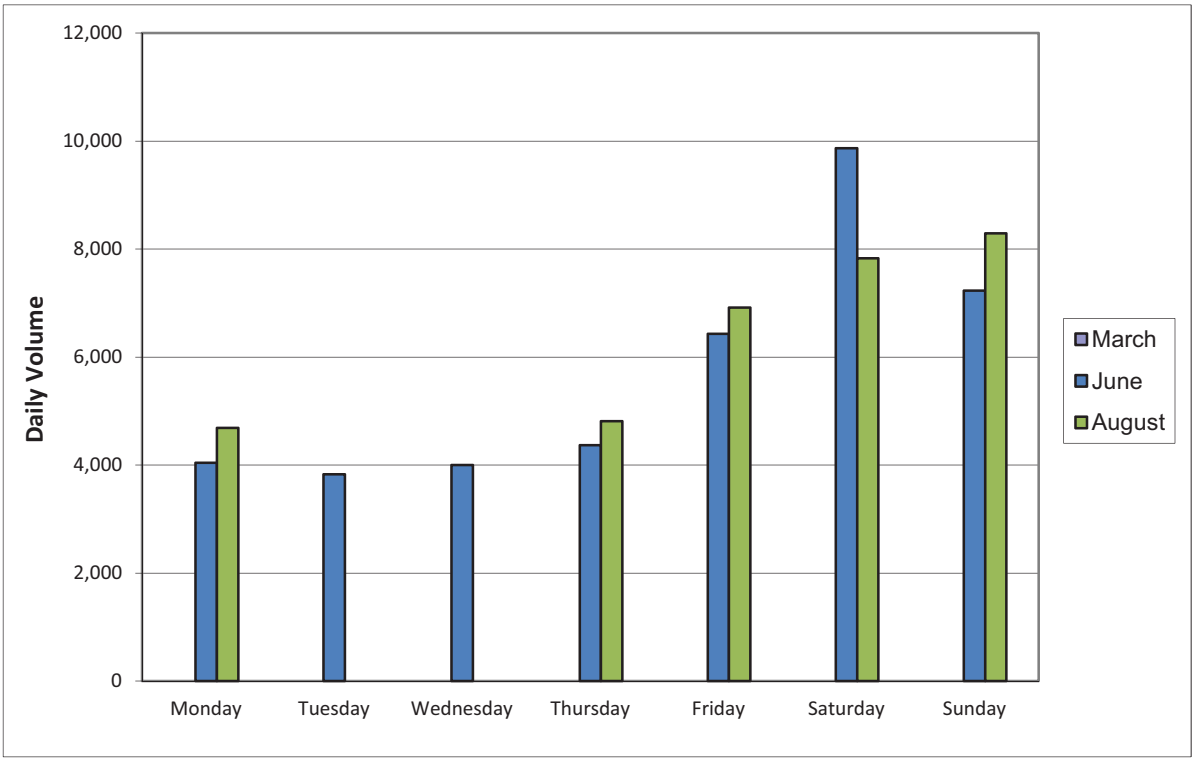


Figure 2.49 – SR-18: Snow Valley to Big Bear Dam



Vehicle Occupancy Patterns

Vehicle occupancy counts were taken on SR-18 on Wednesday, April 7, and on SR-38 on Friday afternoon, April 2, and Saturday morning, April 3. Table 2.10 shows the average occupancies for each of the count periods by direction. Saturday morning inbound has the highest occupancy at 1.96 persons per vehicle; Saturday afternoon outbound has the second highest at 1.86 persons per vehicle. This is consistent with the recreational nature of the Big Bear area.

Figures 2.50 through 2.53 show vehicle occupancy by time of day for each time period and location.

Table 2.10 - Average Vehicle Occupancies

		Persons per Vehicle	
Location	Time Period	Inbound	Outbound
SR-18	Wednesday Morning	1.43	1.26
SR-18	Wednesday Afternoon	1.27	1.55
SR-38	Friday Afternoon	1.8	1.8
SR-38	Saturday Morning	1.96	1.86

Figure 2.50 - SR-18 Vehicle Occupancies, Wednesday Morning

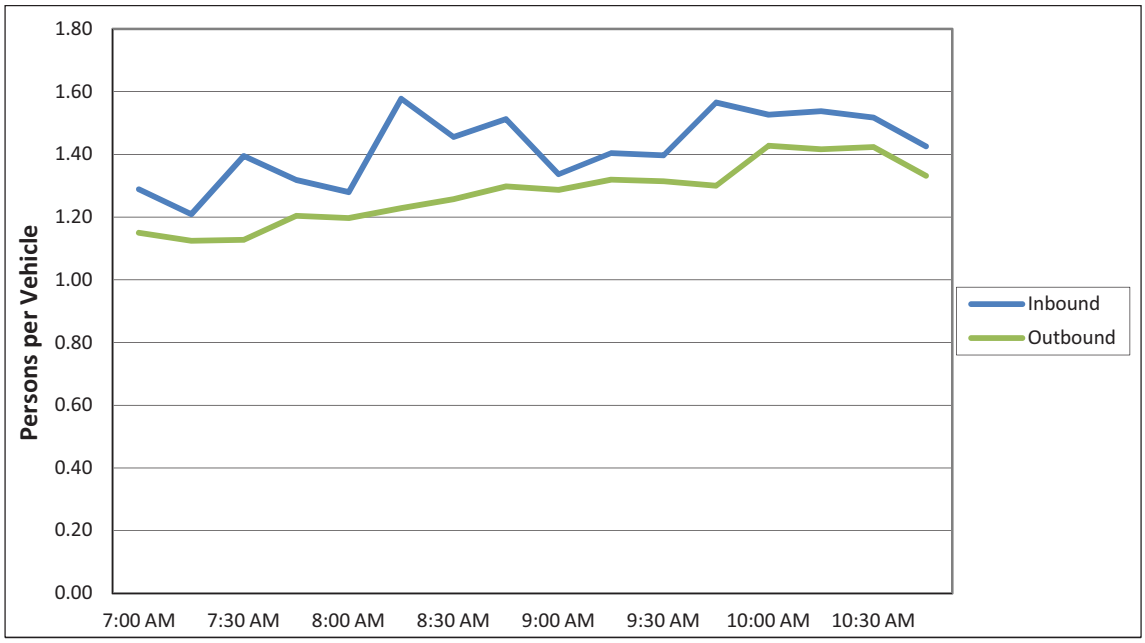


Figure 2.51 - SR-18 Vehicle Occupancies, Wednesday Afternoon

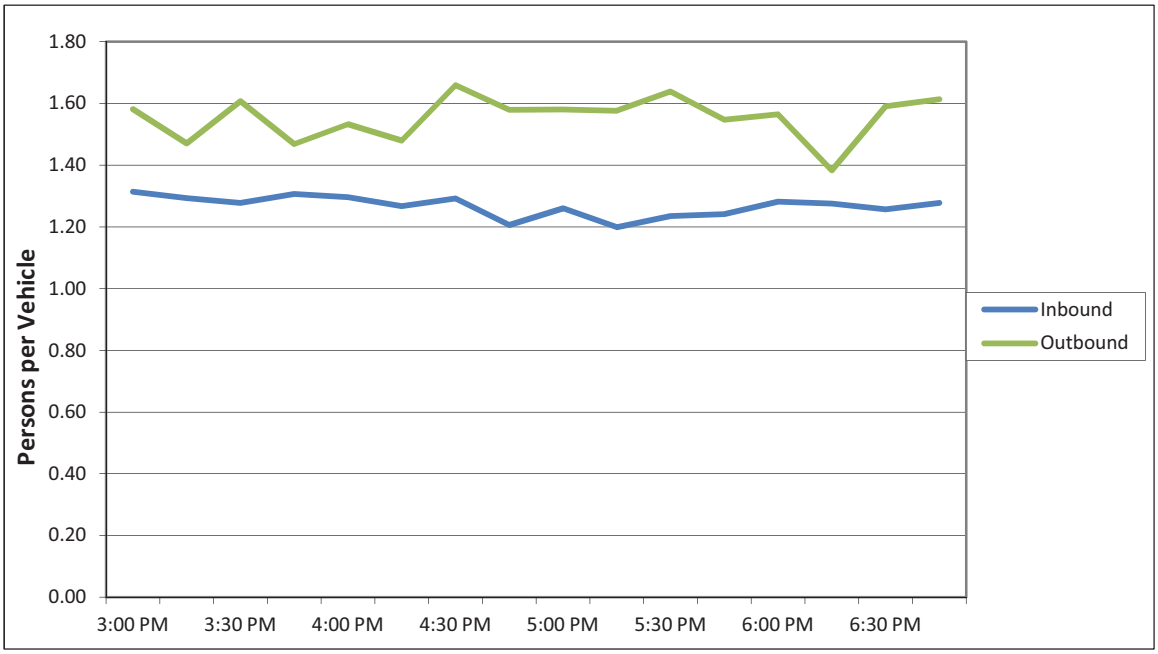


Figure 2.52 - SR-38 Vehicle Occupancies, Friday Afternoon

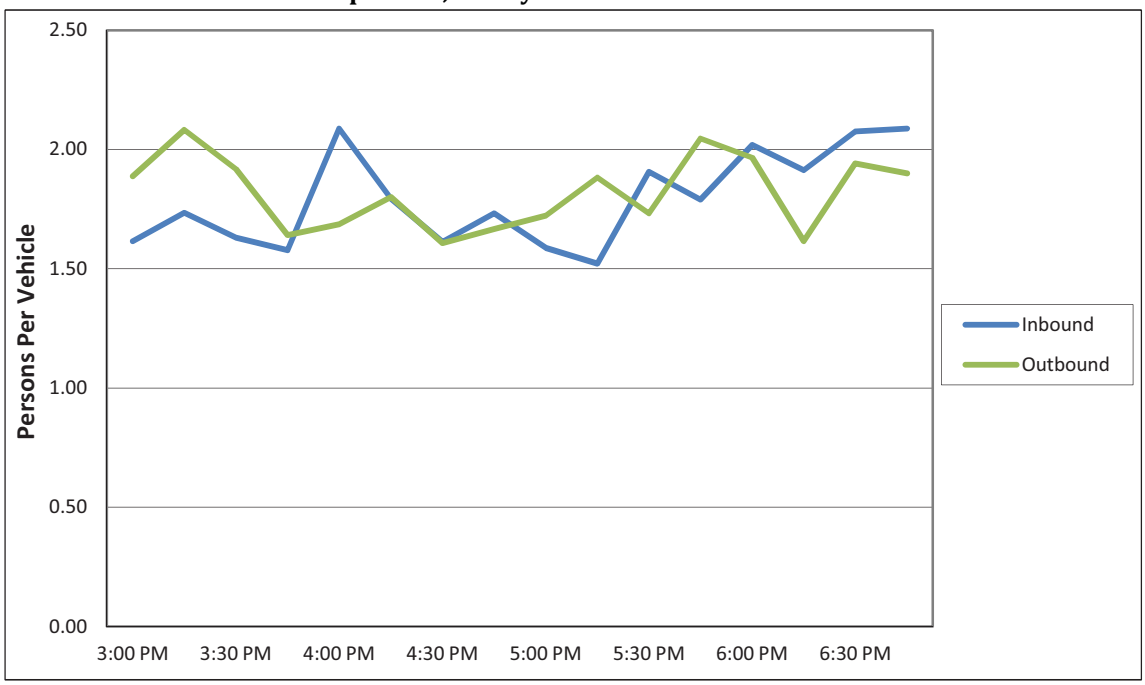
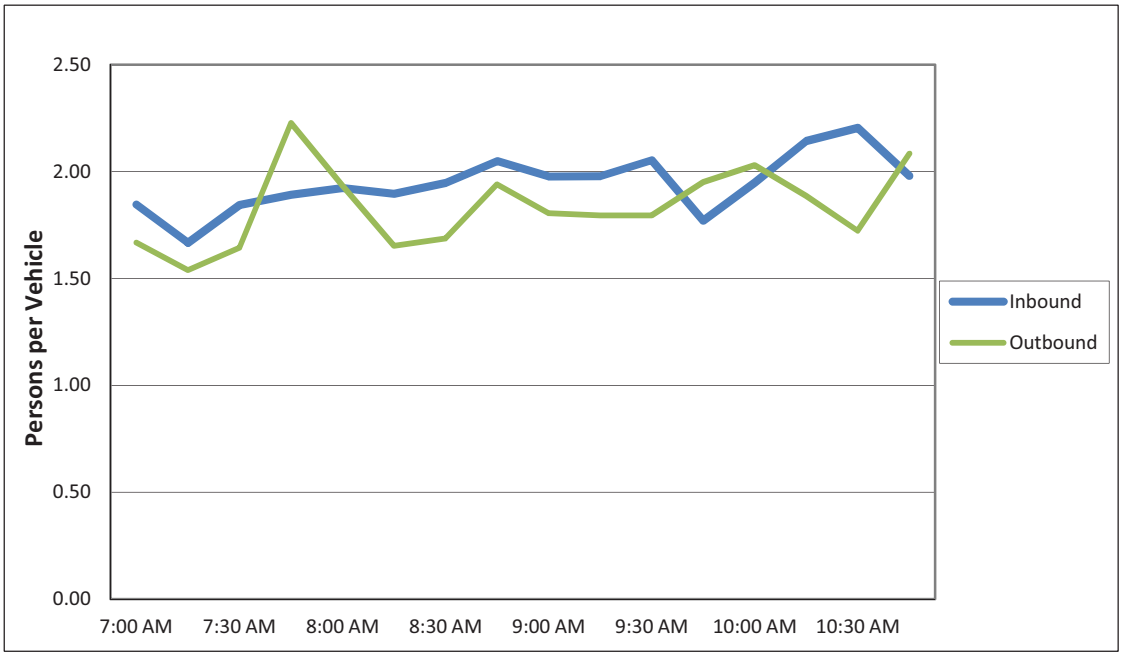


Figure 2.53 - SR-38 Vehicle Occupancies, Saturday Morning



2.4.5 Accidents and Safety Issues

Table 2.11 – Collision Rates on Mountain Access Roads, 2007-09

	From:	To:	Actual			Average			Ration (Actual/Average)		
Highway	Road	Road	Fatal	F+I	Total	Fatal	F+I	Total	Fatal	F+I	Total
SR-18	Sierra Way (San Bernardino)	SR-138 (Crestline)	0.065	0.48	1.03	0.013	0.32	0.79	5.00	1.50	1.30
	SR-138 (Crestline)	SR-330 (Running Springs)	0.064	0.99	2.16	0.028	0.45	0.99	2.29	2.20	2.18
	SR-330 (Running Springs)	SR-38 (Big Bear Dam)	0.045	1.07	2.56	0.029	0.49	1.08	1.55	2.18	2.37
	SR-38 (Big Bear Dam)	SR-38 (Big Bear City)	0	0.63	1.67	0.019	0.59	1.46	0.00	1.07	1.14
	SR-38 (Big Bear City)	Marble Canyon Rd (Lucerne Valley)	0.040	1.00	2.02	0.04	0.82	1.66	1.00	1.22	1.22
SR-38	SR-18 (Big Bear Dam)	SR-18 (Big Bear City)	0.034	1.20	2.26	0.033	0.69	1.56	1.03	1.74	1.45
	SR-18 (Big Bear City)	Santa Ana River Bridge	0.008	0.59	1.13	0.026	0.44	1.00	0.31	1.34	1.13
	Santa Ana River Bridge	Bryant Street (Mentone)	0.085	1.24	2.18	0.042	0.85	1.69	2.02	1.46	1.29
SR-330	SR-210 (Highland	SR-18 (Running Springs)	0.029	0.6	1.25	0.022	0.37	0.87	1.32	1.62	1.44

Table 2.11 presents a summary of 2007-09 collision rates on selected roadway segments leading to Big Bear. The values are collisions per million vehicles traversing the segment over the three-year period.

The table shows actual collision experience on the identified segments, the statewide average rates for similar roads, and the ratio of actual to average rates for the selected period.

Almost all segments had collision rates significantly higher than the statewide average (based on a criteria ratio >1.25) (see Appendix D). Fatal collisions are the most critical category due to the impact of loss of life, followed by fatal+injury collisions. As Table 2.11 shows, three segments of SR-18 each had fatal, fatal+injury, and total collision rate significantly higher than the state average:

- SR-18 from San Bernardino to Crestline
- SR-18 from Crestline to Running Springs
- SR-18 from Running Springs to Big Bear Dam.

Generally lower collision rates and lower ratios in all categories were observed on two segments of SR-18:

- From Big Bear Dam through the City of Big Bear Lake into Big Bear City; and
- From Big Bear City toward the Lucerne Valley.

For SR-38, all segments in the study area had higher than average collision rates, and the section from the Santa Ana River Bridge to Mentone has an observed fatality rate more than twice the statewide average. SR-330 from SR-210 to SR-18 had collision rates higher than the statewide average with ratios from 1.32 to 1.66 times the average collision rates.

2.4.6 Road Closures

Road closures are an important impediment to travel between San Bernardino and Big Bear Lake. When one of the access roads must be closed, people and goods must make their trip via a longer and more circuitous route, or they may be totally precluded from reaching their destination for a period of time if other access roads are closed as well. A listing of road closures can be found in Appendix E.

Closures can be caused by several different things:

- Landslides can occur without notice and close roads for days at time. (This is a particular problem on SR-330.)
- Repairs and maintenance of the roadway infrastructure sometimes requires closures that last for weeks. Two recent examples include the closure of SR-330 for several weeks during the spring of 2010 to repair a failing culvert and the months-long closure of SR-330 starting in December 2010 caused by heavy rains undermining a portion of the roadway.
- Accidents on the narrow, winding mountain roads sometimes require closure of a lane or the entire roadway, which can last for hours.
- Heavy snowfall can close the roads for hours or even days, as it did in the winter of 2010. Even when the roads are opened, the requirement for vehicles to use chains in snowy and icy conditions significantly disrupts traffic operations.

Caltrans was able to research the history of emergency-related closures of SR-330 for use in this study. The records show that SR-330 has had four emergency closures over the past ten years – three involving emergency storm water repairs and one related to wildfire in the area. Each closure lasted between one and two months. Based on this information, Caltrans concludes that SR-330 has been closed an average of eighteen days per year for emergency situations, or about 5% of the time. This does not include

closures for routine landslides, scheduled maintenance, accidents, or snowfall (for which closure data are not available). The closures are summarized in Table 2.12 and Figure 2.54.

Table 2.12 - State Route 18 & 330 Road Closures (2005-2010)

State Route	Year	Duration of Closure
18	2005	246d 12h
18	2006	7d 20h
18	2007	38d 11h
18	2009	7d 15h
18	2010	5d 21h
Average percentage of closure for 5 year period (2005-2010) 16%		
330	2005	8d
330	2006	43d 8h
330	2007	12d
330	2009	5d 12h
330	2010	55d 18h
Average percentage of closure for 5 year period (2005-2010) 7%		

Figure 2.54 - Vicinity Map with Road Closures

2.4.7 Sewer Usage

Data on sewer usage was obtained from the City of Big Bear Lake as an additional source of data on seasonality patterns. The available data include monthly usage within the City of Big Bear Lake (CBBL) and the unincorporated Big Bear City Community Services District (BBCCSD). Figure 2.55 shows the CBBL monthly flows from 2000 through March 2010. Figure 2.56 shows the BBCCSD monthly flows for the same period. Both parts of the Big Bear Valley experience a substantial peak in flows during the winter months, with the peak times corresponding to periods of heavier snowfall (and visitor levels) in the mountains. Summer flows (July and August) exceed spring and fall flows, but are substantially less than the peak winter flows.

Figure 2.55 - CBBL Monthly Sewage Flows

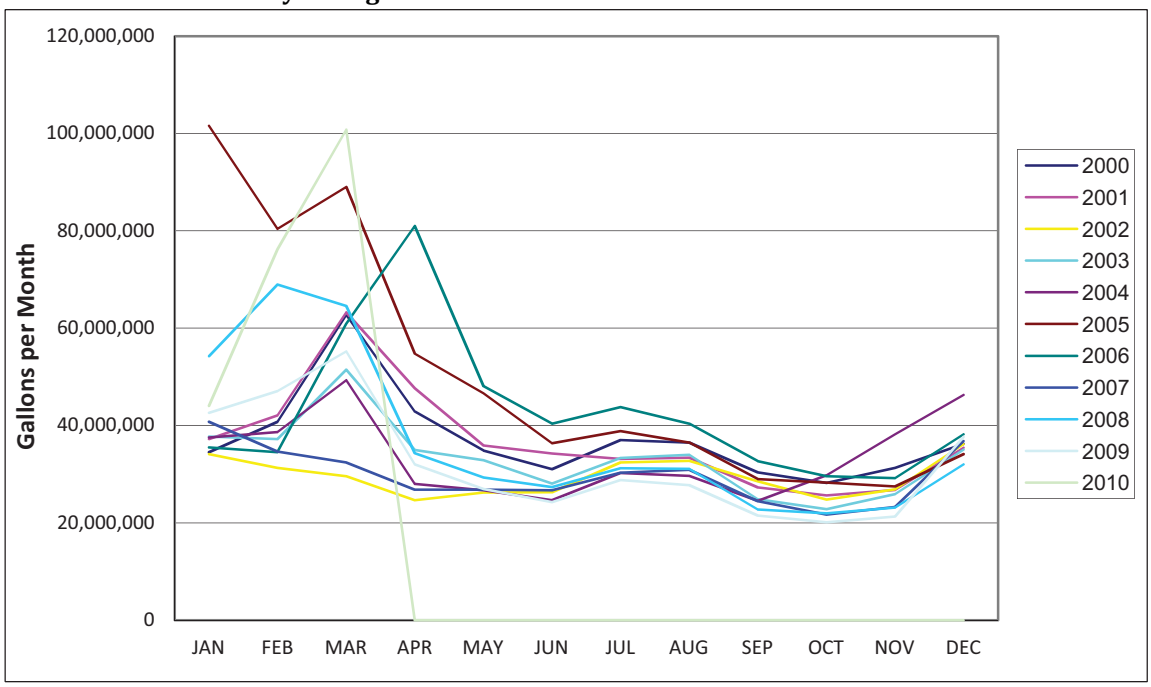


Figure 2.56 - BBCCSD Monthly Sewage Flows

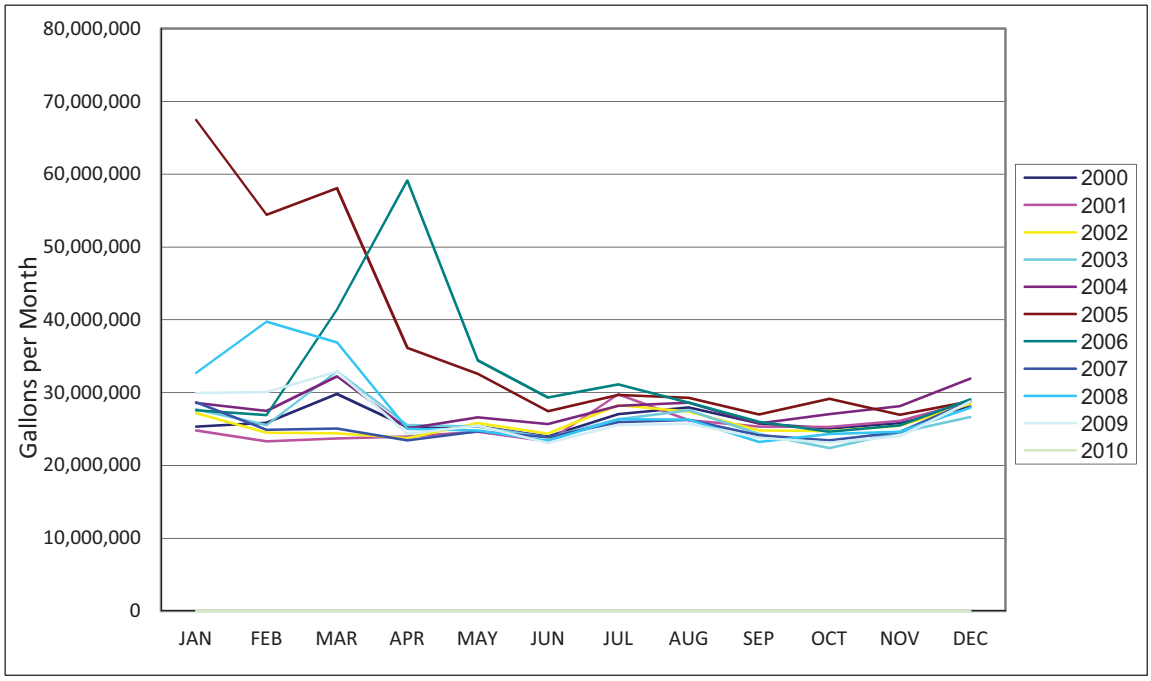
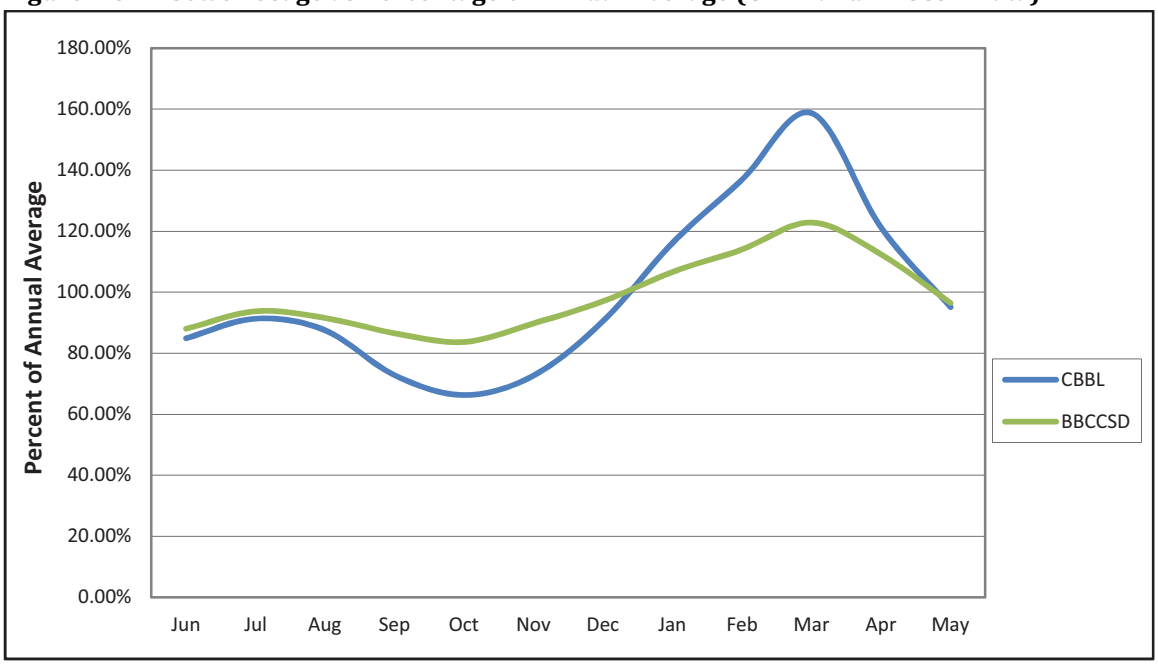


Figure 2.57 shows sewer usage by month as a percentage of the annual average. When averaged out in this manner, the sewer usage data peaks in March. Flows are above the average in the winter/early spring months of January through April. For the remaining months of the year, sewage flows are below the monthly average.

Figure 2.57 - Sewer Usage as Percentage of Annual Average (CBBL and BBCCSD Data)



2.4.8 Wind Conditions

For an aerial technology such as a gondola, high winds could be a factor in determining system operability, so available wind speed data was assembled from the website of the National Weather Service. Data were obtained from two observation stations in the front range area of the San Bernardino Mountains, though not within the study corridor. From these data, the number of days with observed wind speeds exceeding 40 miles per hour (the typical threshold for shutting down gondola operations in ski areas) was noted. Table 2.13 summarizes the results of this analysis, which indicates that high wind speeds occur on a very small percentage of the days for which data are available.

Table 2.13 – Wind Conditions

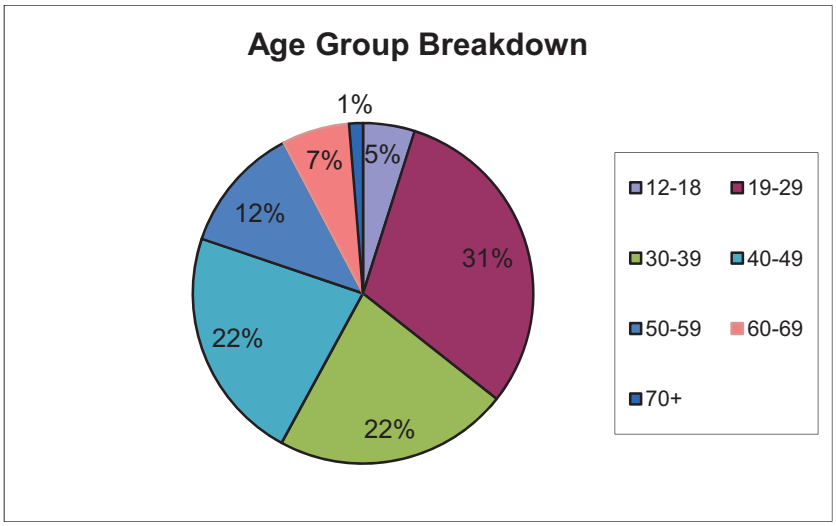
	San Sevaine Peak				Yucaipa Ridge			
	34d 12' 49" N, 117d 29' 58" W; elev 5651'				34d 03' 46" N, 116d 53' 33" W; elev 9020			
	4 miles west of 15/215 Devore interchange				2.5 miles ENE of Oak Glen; 1/3 mile west of Little San Gorgonio Peak			
	# of Days with observations	Dates with observations	# of Days with wind speed recorded over 40 mph	%	# of Days with observations	Dates with observations	# of Days with wind speed recorded over 40 mph	%
1998	287	3/18 - 12/31	3	1.00%	--	--	--	
1999	355	1/1 - 12/31	7	2.00%	--	--	--	
2000	364	1/1 - 12/31	4	1.10%	--	--	--	
2001	294	1/1 - 10/23; 12/30 - 12/31	1	0.30%	121	8/15 - 12/21	0	0.00%
2002	323	1/1 - 10/25; 12/5 - 12/31	1	0.30%	191	5/17 - 11/25	0	0.00%
2003	209	1/1 - 3/19; 8/22 - 12/31	1	0.50%	194	6/12 - 12/31	0	0.00%
2004	323	1/1 - 7/17; 8/28-12/31	9	2.80%	49	1/1 - 2/20	0	0.00%
2005	364	1/1 - 12/31	2	0.50%	0	--	--	
2006	244	1/1 - 6/1; 6/12 - 6/14; 7/30 - 7/31; 9/27 - 12/31	2	0.80%	325	2/10 - 12/31	0	0.00%
2007	364	1/1 - 12/31	0	0.00%	359	1/1 - 12/31	1	0.30%
2008	366	1/1 - 12/31	1	0.30%	359	1/1 - 12/31	6	1.70%
2009	362	1/1 - 12/31	0	0.00%	363	1/1 - 12/31	5	1.40%
2010	153	1/1 - 6/3	0	0.00%	145	1/1 - 6/3	0	0.00%
TOTAL	4008		31	0.80%	2106		12	0.60%

2.4.9 Winter Survey

A survey was developed and administered in Big Bear Lake to provide some indication of potential user preference information to help with the forecasts of potential ridership. The survey was distributed by the Snow Summit and Bear Mountain ski resorts and by the Big Bear Visitors' Bureau. A total of 541 survey responses were received – 298 from Snow Summit, 197 from Bear Mountain, and 46 from the Visitors' Bureau. (The survey form is included as Appendix F to this report.) The responses are summarized below.

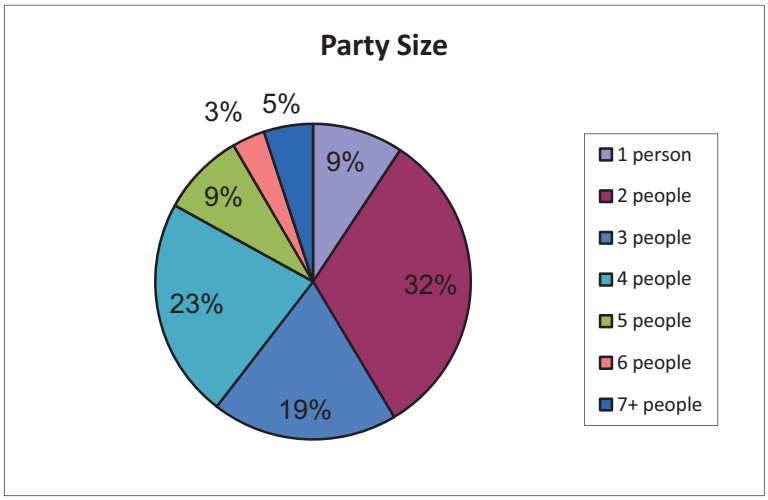
Three-fourths of the survey respondents were in the age range of 19-49, with 32% between the ages of 19 and 29, 22% between the ages of 30 and 39, and 22% between the ages of 40 and 49 (see Figure 2.58).

Figure 2.58 - Age of Survey Respondents



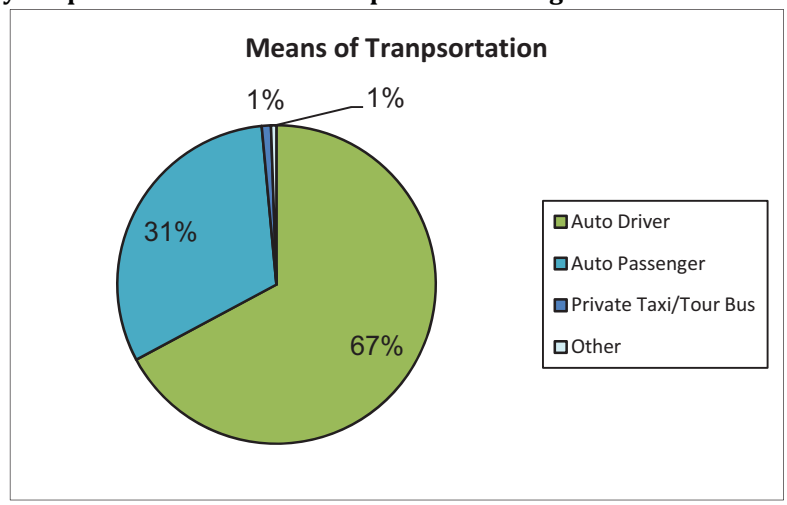
Three-fourths of the respondents were in parties of two, three or four, with 32% in parties of two, 19% in parties of three, and 23% in parties of four (Figure 2.59).

Figure 2.59 - Size of Survey Respondents' Parties



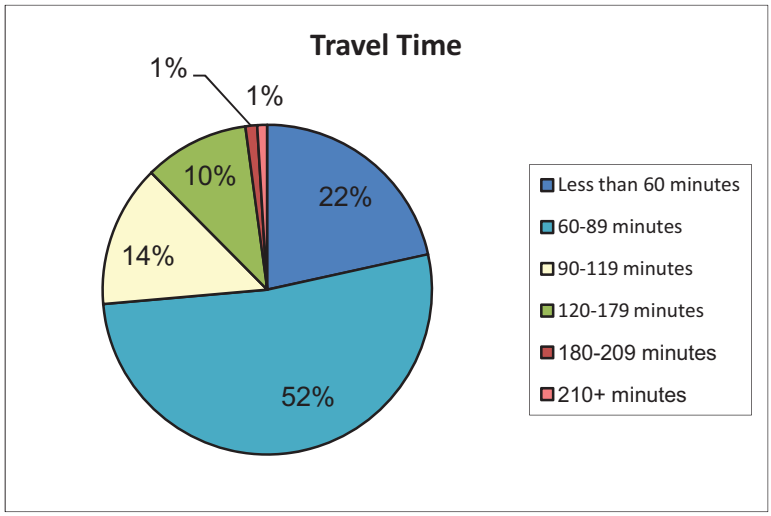
Almost all (98%) of the survey respondents traveled to Big Bear either as an auto driver or a passenger. Two-thirds of the respondents were drivers and 31% were passengers (Figure 2.60).

Figure 2.60 - Survey Respondents' Mode of Transportation to Big Bear



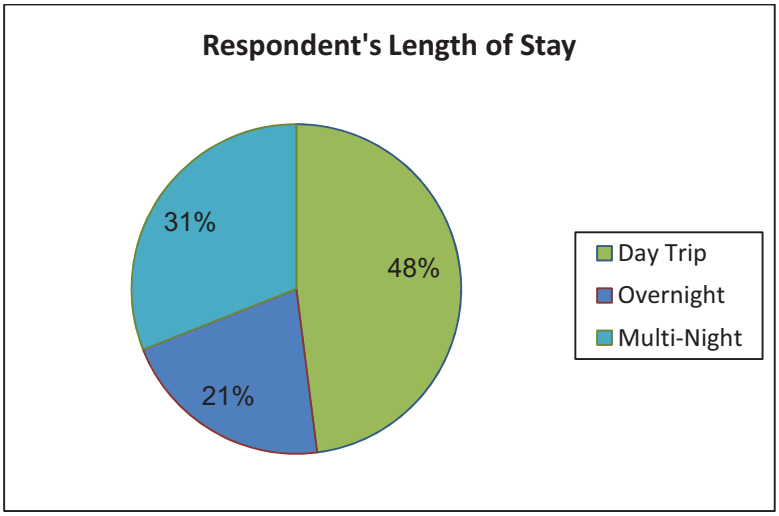
About half the survey respondents reported a travel time from San Bernardino to Big Bear of between an hour and 90 minutes. About a quarter of the respondents reported a travel time over 90 minutes (Figure 2.61).

Figure 2.61 - Survey Respondents' Travel Time from San Bernardino to Big Bear



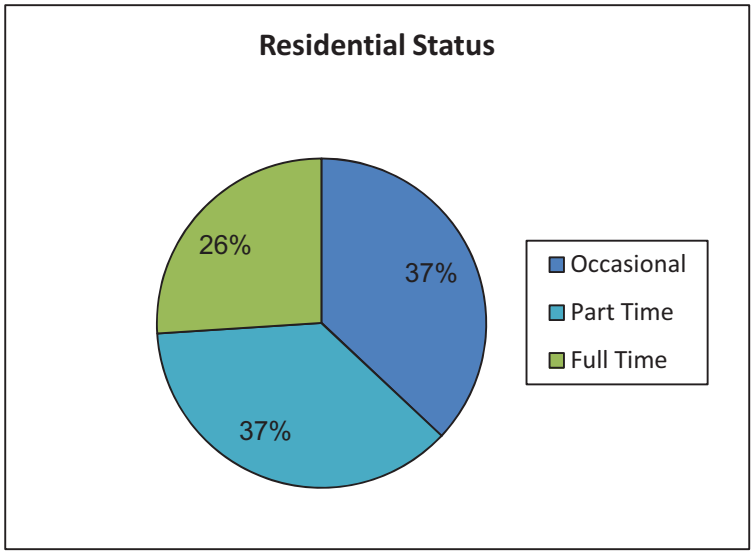
Visitors to the mountains comprised 86% of the survey respondents. Of these, about half (48%) were making a day trip, 21% were overnight visitors, and 31% were staying multiple nights (Figure 2.62).

Figure 2.62 - Survey Respondents' Length of Stay in Mountains



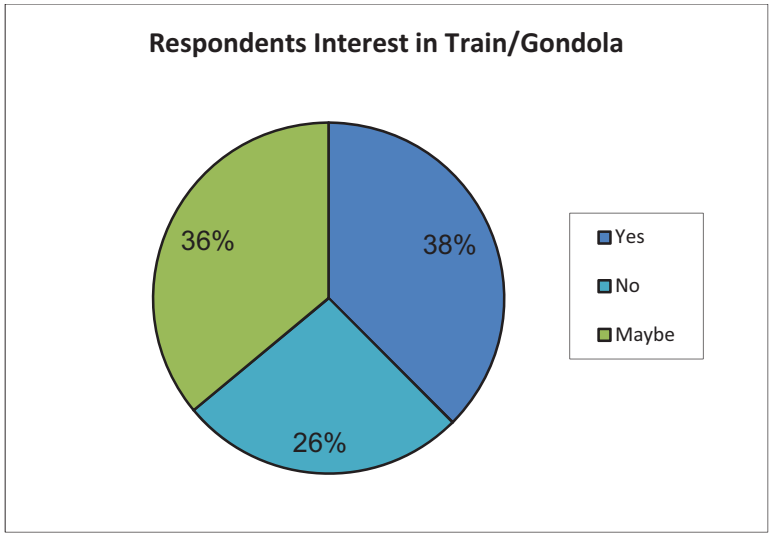
Additionally, 29% of the respondents reported that they have a home in the mountains. Of these, 26% are full-time residents of the mountains, 37% are part-time residents, and 37% are "occasional" residents.

Figure 2.63 - Survey Respondents with a Mountain Residence



Respondents were asked if they would have considered riding a train or gondola if it had been available for the trip to Big Bear instead of driving. Almost two-thirds of the respondents said "Yes" or "Maybe" (Figure 2.64)

Figure 2.64 - Survey Respondents' Interest in Train or Gondola as Transportation to Big Bear



The respondents who expressed possible interest were then asked if they would have ridden the train or gondola if the travel time was the same as driving (Figure 2.65), 30 minutes longer than driving (Figure 2.66), or 60 minutes longer than driving (Figure 2.67). With the same travel time, almost all of the respondents were still interested. With a travel time from San Bernardino 30 minutes longer than driving, about two-thirds were still interested; with a travel time 60 minutes longer than driving, only 28% were interested.

Figure 2.65 - Survey Respondents' Interest if Travel Time same as Auto

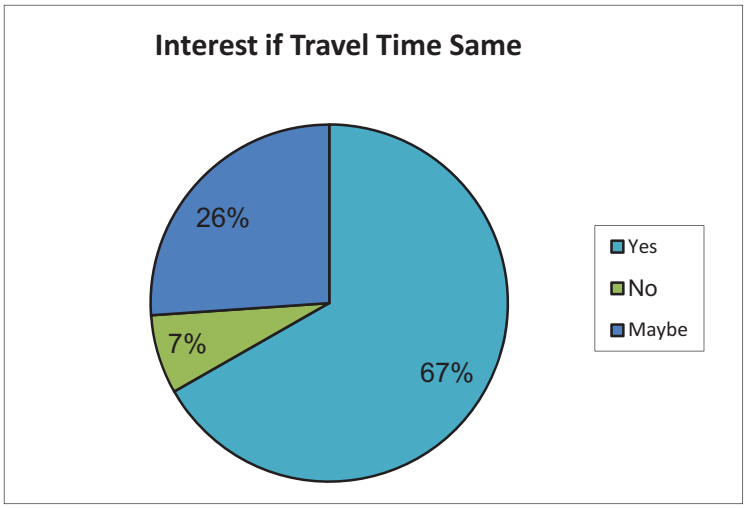


Figure 2.66 - Survey Respondents' Interest if Travel Time 30 minutes longer

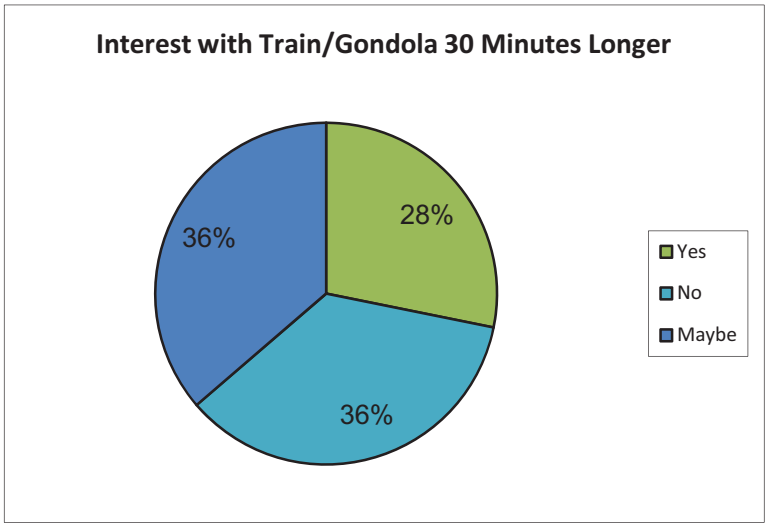
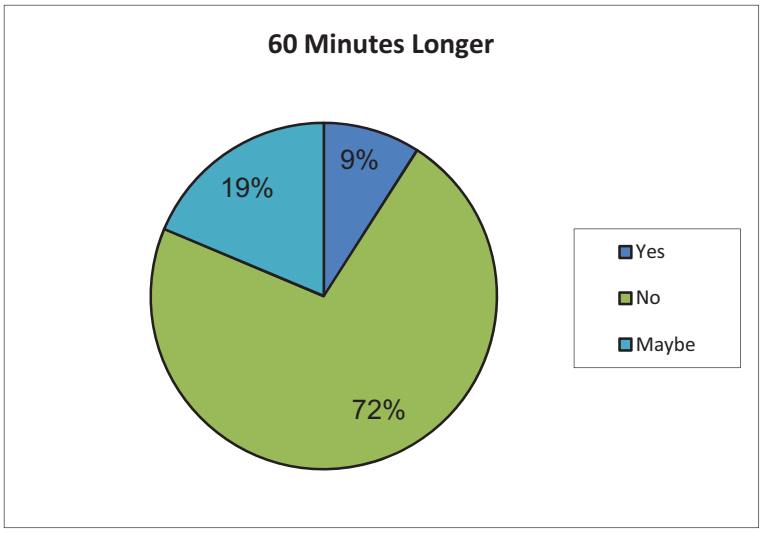


Figure 2.67 - Survey Respondents' Interest if Travel Time 60 minutes longer



The respondents who expressed possible interest were then asked if they would have ridden the train or gondola if the round trip fare was $40 (Figure 2.68), $60 (Figure 2.69), or $80 (Figure 2.70). With a $40 fare, almost three-fourths were still interested, but this level dropped to 28% with a fare of $60 and 11% with a fare of $80.

Figure 2.68 - Survey Respondents' Interest if round trip fare = $40

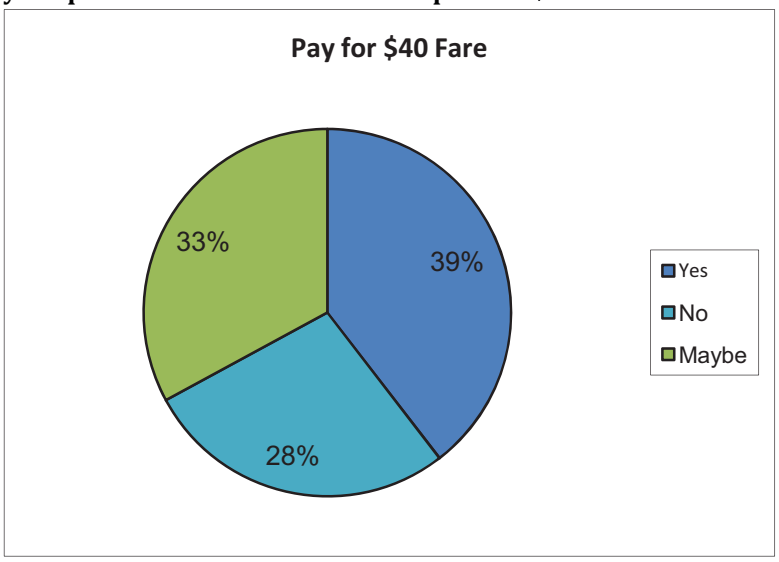


Figure 2.69 - Survey Respondents' Interest if Round Trip Fare = $60

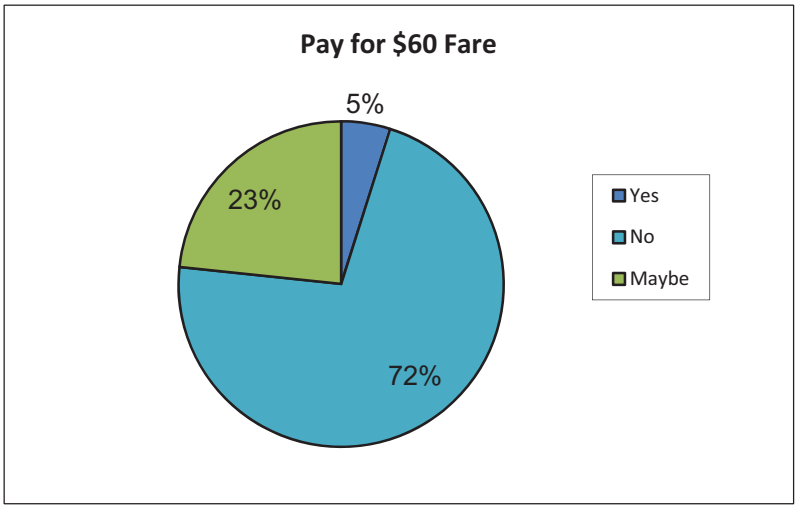
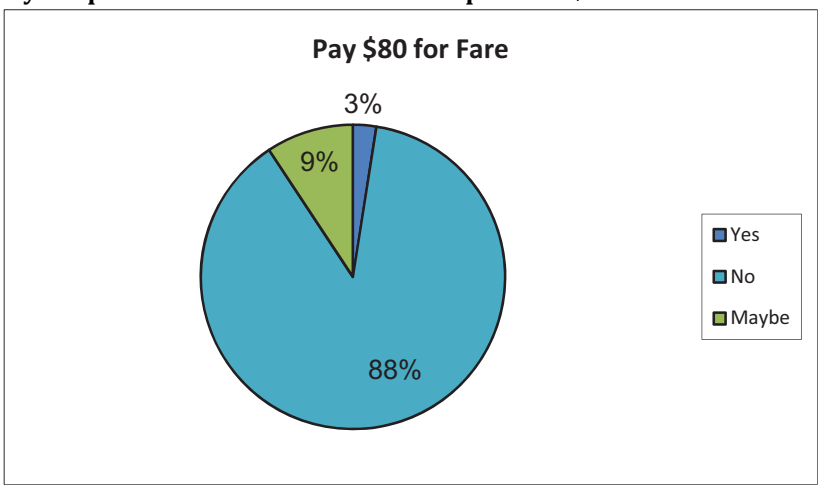


Figure 2.70 - Survey Respondents' Interest if Round Trip Fare = $80



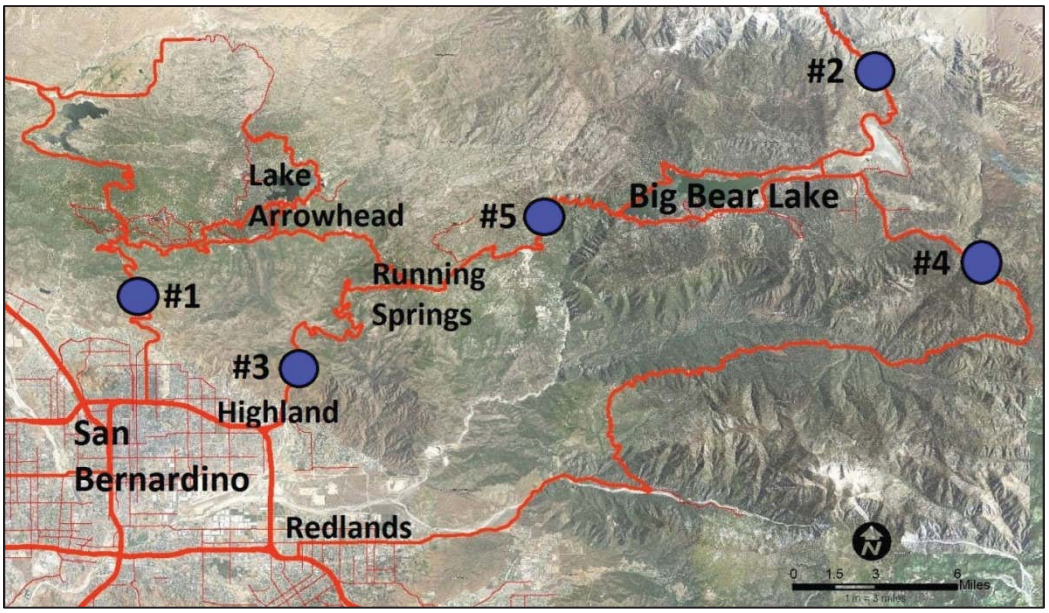
2.5 Shipping and Freight Movement

This section summarizes current freight traffic traveling to and from the Big Bear Mountain Recreation Area. The objective is to present a picture of the number of trucks and types of commodities traveling to and from the Big Bear area, along with more specific information relating to their logistics, such as time of travel, day of the week, and direction. Data for this section was gathered through traffic counts collected over a week-long period in March of 2010, and supplemented with manual truck counts that included more detailed description of the vehicles and their commodities. For purposes of this analysis, the generic term "truck" refers to vehicles of FHWA Class 5 and up.

2.5.1 Data Collection

Data was collected at five locations on the regional roadways used for travel between the Los Angeles Basin and the Big Bear mountain resort area, as illustrated in Figure 2.89. Pneumatic Road Tube Counters were used at each of the four locations to collect directional data by vehicle type, while manual truck counts were done at sites 3, 4, and 5. These locations cover all the major roadways leading to and from the Big Bear area.

Figure 2.71 - Data Collection Locations



Note: Counter locations are approximate

The 24 hour tube counters were employed for a week-long period from Saturday, March 13 through Friday, March 19. The data collected included motorcycles, passenger cars, light and heavy trucks, and buses in both directions.

The manual counts were done over three days, with one day for each of the three locations. Table 2.14 below shows the schedule for data collection at each of the locations. The AM and PM periods consisted of 4 hours, from 7 to 11 AM and from 3 to 7 PM. This data includes the type of heavy vehicle traveling (including buses) as well as the type of commodity that they were carrying. The data also included information on whether the vehicle was loaded or empty.

Table 2.14 - Manual Count Schedule

Counter #	Location	Day	Date	AM	PM
3	SR-330 bet. Highland Ave & Live Oak Dr	Friday	12-Mar		X
4	SR-38 bet. Lakewood & Heart Bar Campground	Saturday	20-Mar	X	
5	SR-18 bet. Snow Valley Ski Area& SR-38	Wednesday	24-Mar	X	X

2.5.2 Traffic Summary by Day

Figures 2.72-2.75 illustrate the truck traffic traversing Counters 1-4 throughout the week. The first counter location (near the intersection of State Routes 18 and 138) has the heaviest amount of traffic, registering over 1,100 heavy trucks and nearly 7 thousand light trucks over the 7 day period. Counter 3, located at SR-330 near Highland, was the second busiest with nearly 3,500 trucks. It should be noted

that this road was closed from Wednesday-Friday during that week, which resulted in lower traffic numbers. Without the closure the total count would be roughly 2,000 trucks higher (these trucks likely were rerouted through one of the other counters). These two counters are located along are the two primary highways connecting the Big Bear area to San Bernardino and Los Angeles. Counters 2 and 4 are located on the eastern part of the Recreation Area and see much lower amounts of traffic, with each registering close to 2,000 trucks over the week, out of which 85% were 2-axle light trucks.

Overall, Friday is the busiest day of traffic for trucks with 21% of the traffic (excluding counter 3), which highlights the region's nature as a Recreational Area mostly busy during the weekends. Thursday (17%) and Wednesday (16%) are the second and third busiest days. The rest of the week sees 11-12 % of the traffic per day. See Figure 2.76 for a combined illustration of truck traffic by day and location.

Figure 2.72 - Truck Traffic by Day on SR-18 (location #1)

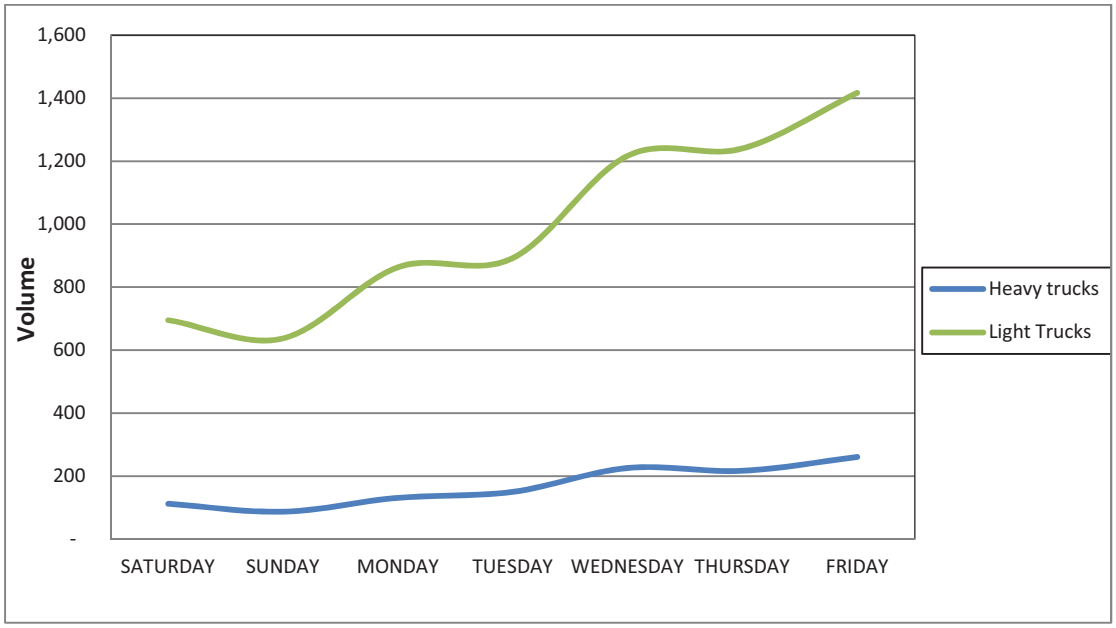


Figure 2.73 - Truck Traffic by Day on SR-18E (location #2)

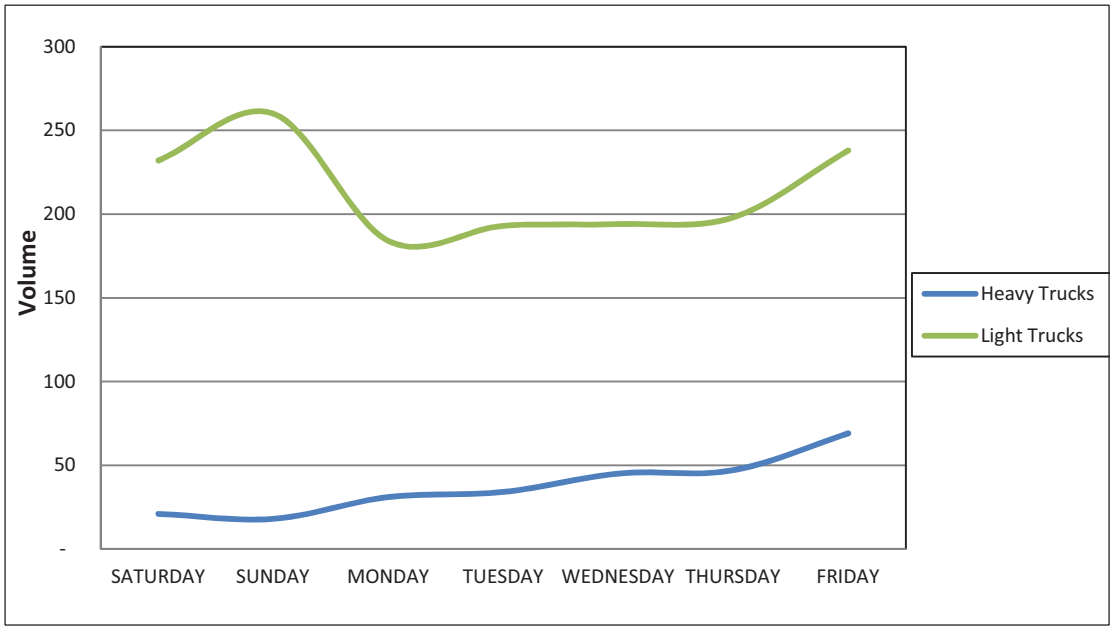
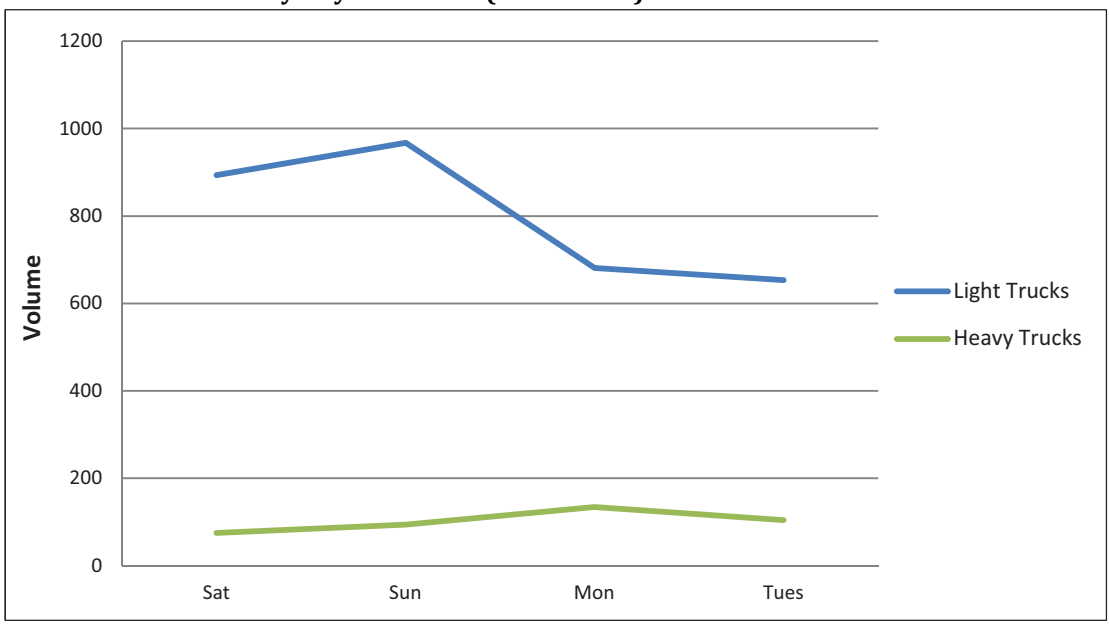


Figure 2.74 - Truck Traffic by Day on SR-330 (location #3)



Note: On Wednesday-Friday no data was collected due to road closure.

Figure 2.75 – Truck Traffic by Day on SR-38 (location #4)

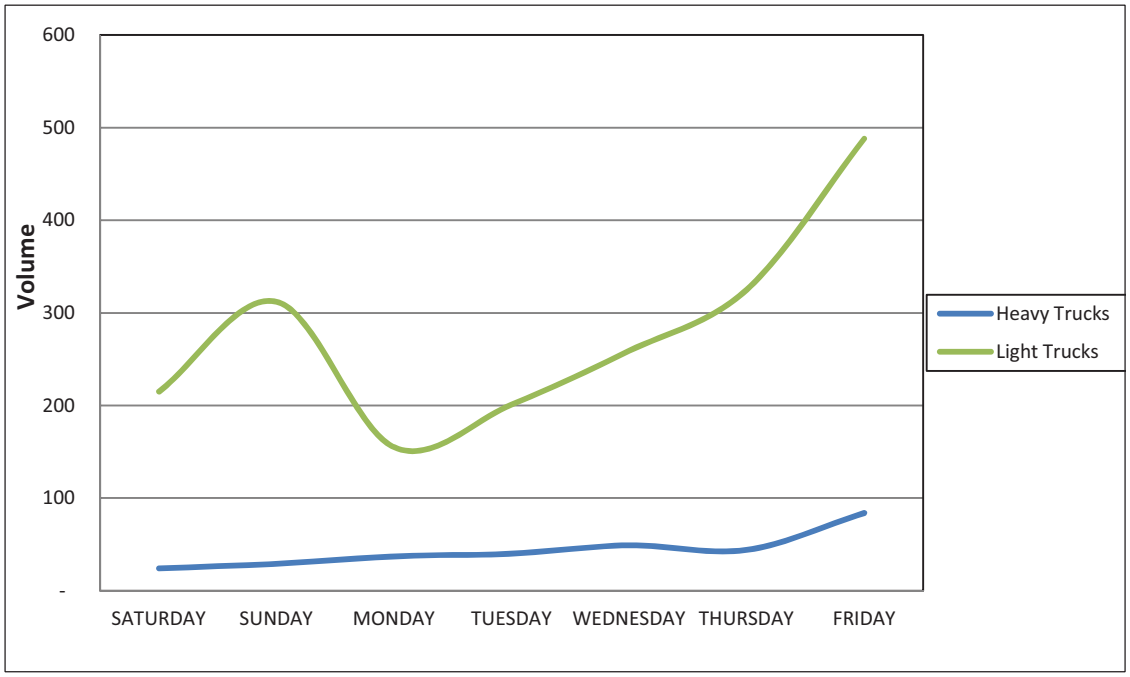
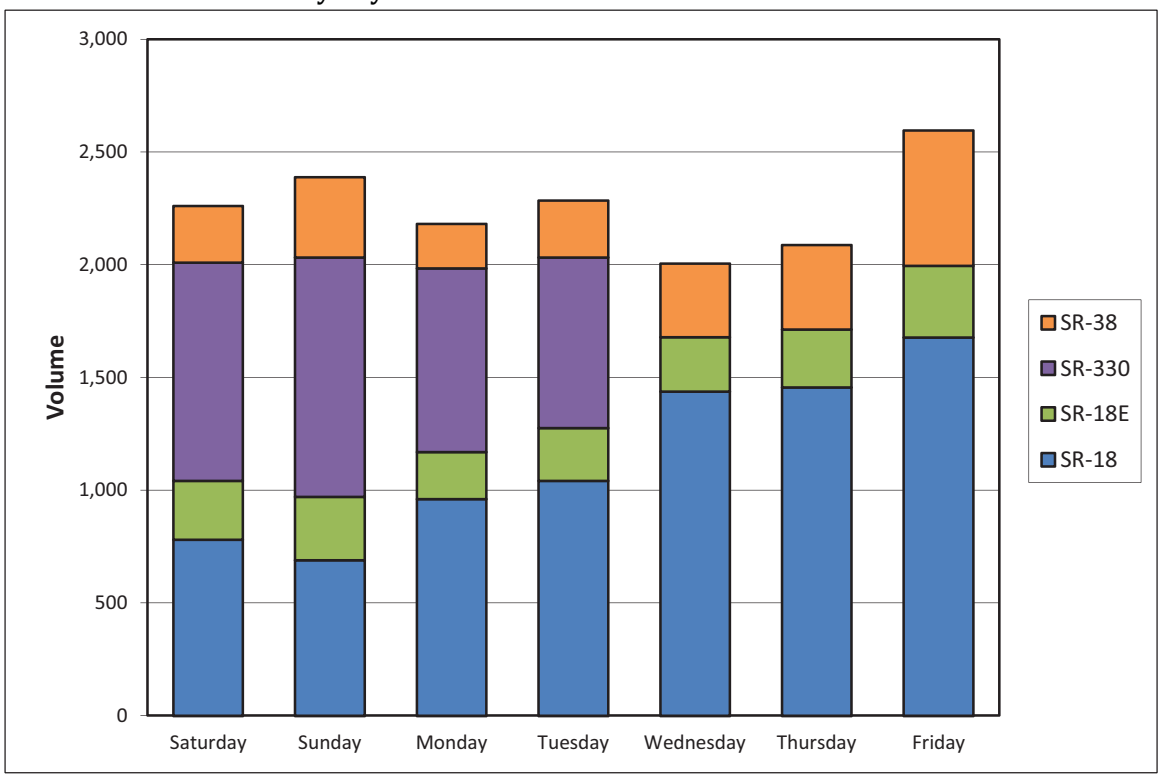


Figure 2.76 – Truck Traffic by Day at All Count Locations

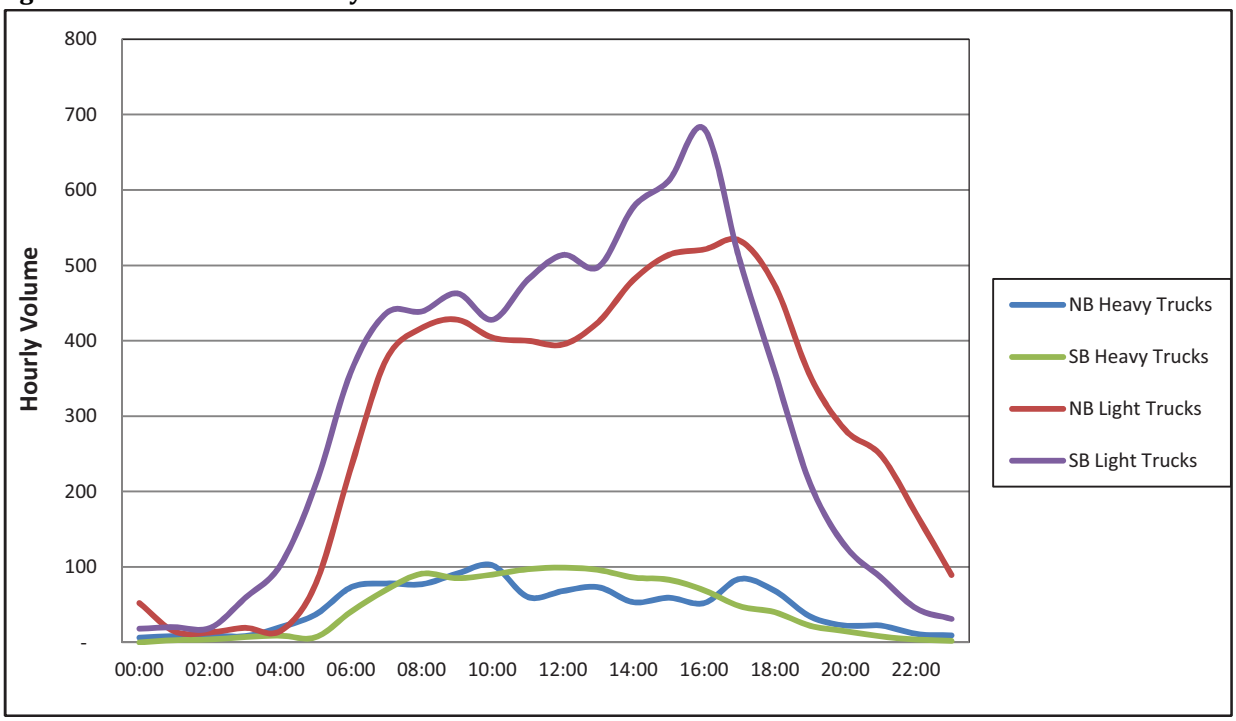


Note: On Wednesday-Friday no data was collected on SR-330 due to road closure.

2.5.3 Traffic Summary by Time of Travel

As Figure 2.77 illustrates, truck traffic starts to pick up at around 6 AM, with over 700 trucks traveling to and from the region. By 7 AM traffic reaches over 1,000 trucks per hour, and it gradually rises until it peaks at nearly 1,300 trucks at 4 PM, when it starts gradually declining until 5-6 PM and drops sharply thereafter. Southbound moves (down from the mountains) slightly exceed Northbound moves (up into the mountains) from the start of the day until 5PM. After this NB flows are higher by over 150 trucks per hour.

Figure 2.77 – Truck Traffic by Hour and Direction: Total of All Count Locations

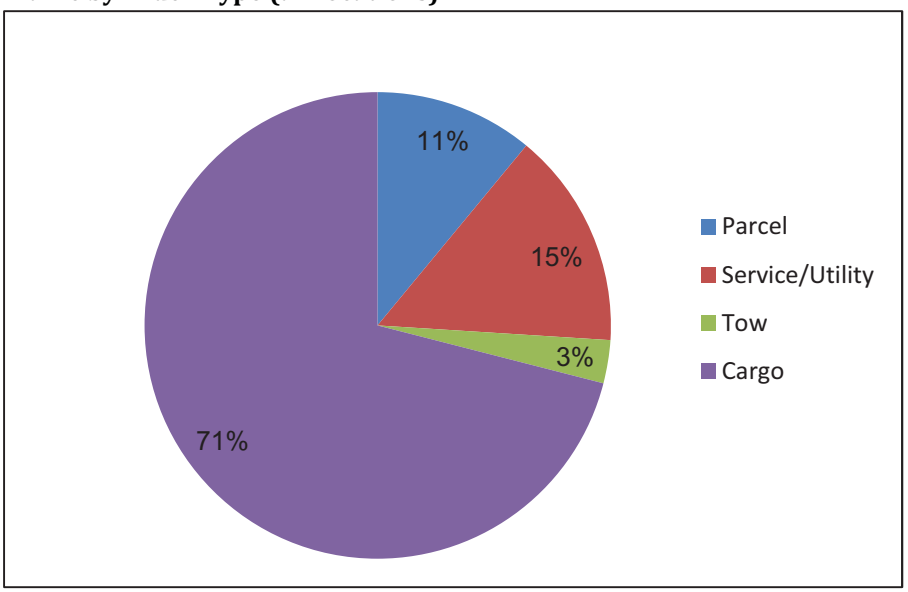


2.5.4 Traffic Summary by Commodity

The data from the tube counts summarized above is useful to understand the flow of truck units into and out of the region, however it does not include information about the type of cargo being transported. The data also do not differentiate between service and cargo trucks, and even within cargo trucks whether they are empty or loaded. To help fill these gaps, the study team conducted the manual counts at Stations 3, 4, and 5. This section summarizes the findings from these counts.

Observations were made for all heavy vehicles, including buses, which are not taken into account in this section. As shown in Figure 2.78, cargo trucks are the primary source of heavy vehicle traffic to and from the region, accounting for over 70% of flows. Service vehicles and parcel trucks accounted for 15% and 11% of observations respectively, while tow trucks made up the remaining 3%.

Figure 2.78 – Traffic by Truck Type (all locations)



The top commodities transported by cargo trucks include food and liquor, waste, home improvement goods, construction materials, and fuel. However empty trucks registered as the highest individual "commodity" type with approximately 1/3 of all observations. A summary by commodity is shown in Table 2.15 below; it should be noted however that this excludes unknown commodities, which made up almost half of all cargo truck observations.

Table 2.15 – Top Commodities Transported by Cargo Trucks

Commodity	% Share
Empty	34%
Food & Liquor	20%
Waste	14%
Home Improvement Goods	7%
Construction	5%
Fuel	3%
All Other	*17%*

Service and utility trucks consisted primarily of smaller vehicles, such as pickup and panel trucks, being used by mainly by construction, plumbing, roofing, and electrical companies/contractors. Parcel trucks were evenly split between UPS and FedEx.

2.6 Topographic and Geological Conditions

2.6.1 Introduction

The 1996 Big Bear study evaluated the project area's geologic and topographic conditions to assist in the selection of candidate corridors to deliver the most feasible all-weather, high capacity, non-auto transportation mode to the Big Bear area. In re-examining the project, the goal was to evaluate and validate the 1996 Study findings on geologic constrains and update the information using GIS technology to reflect any changed conditions since 1996. A series of GIS maps have been developed to aid in the analysis and provide a clear picture of the exiting environment for the alternatives analysis. The technical analysis complied geotechnical data on the following features and risks compiled from a variety of sources:

A. landslide risk,
B. earthquake faults,
C. liquefaction zones,
D. fire hazards,
E. flood plains, and
F. rivers/streams/waterways

The 1996 Study identified landslides as the primary geologic hazard in the project area, given the steep mountainous terrain. The prior report also identified a series of earthquake faults traversing the area, including the San Andreas Fault, which runs through the San Gorgonio Pass between the San Bernardino and San Jacinto mountains along the southern base of the San Bernardino Mountains. There have been periodic earthquakes in the area along the San Andreas and the other faults which bisect the study area.

Some key changes in existing conditions include:

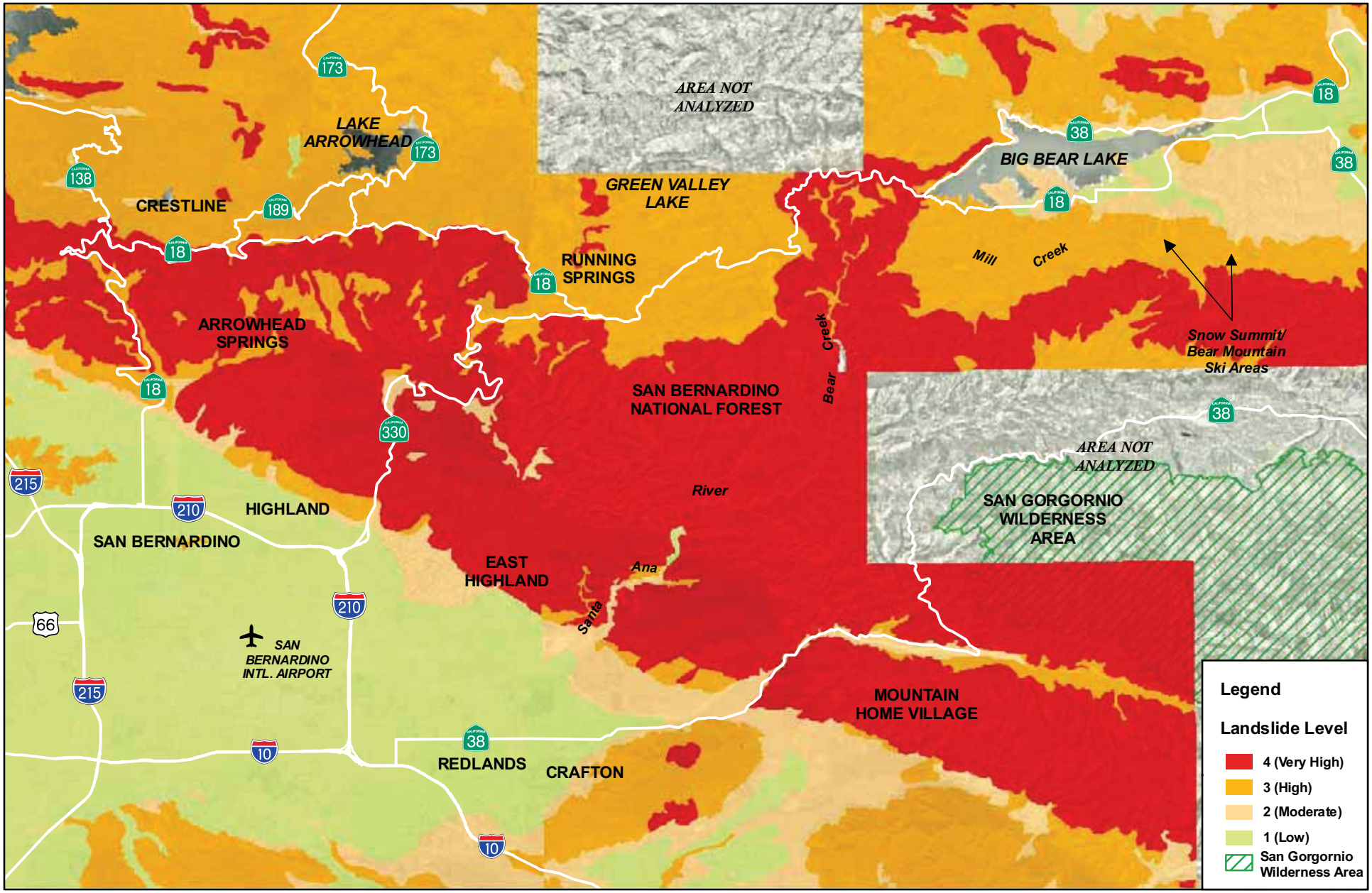
- further refinements in fault line definition throughout the project area;
- an assessment of wild fire hazards within the project area; and
- construction of the Seven Oaks dam facility in the Santa Ana River canyon.

The dam was completed in 1999 and is located approximately 3.5 miles northeast of the Redlands Municipal Airport providing flood control management for the Santa Ana River.

2.6.2 Landslide Risk

The project area is characterized by a mix of landslide risks. Not surprisingly, in the urbanized area of the San Bernardino valley, there is little risk of landslide. However, as the elevation rises to the north east, travelling toward Big Bear, the landslide risk categorized as high or very high encompasses nearly 100% of the mountain corridor analysis area. Figure 2.79 illustrates the levels of landslide risk as measured by the California Department of Conservation throughout the project area.

Figure 2.79 - Landslide Risk



Source: State of California Department of Conservation

0 1.5 3 6 Miles

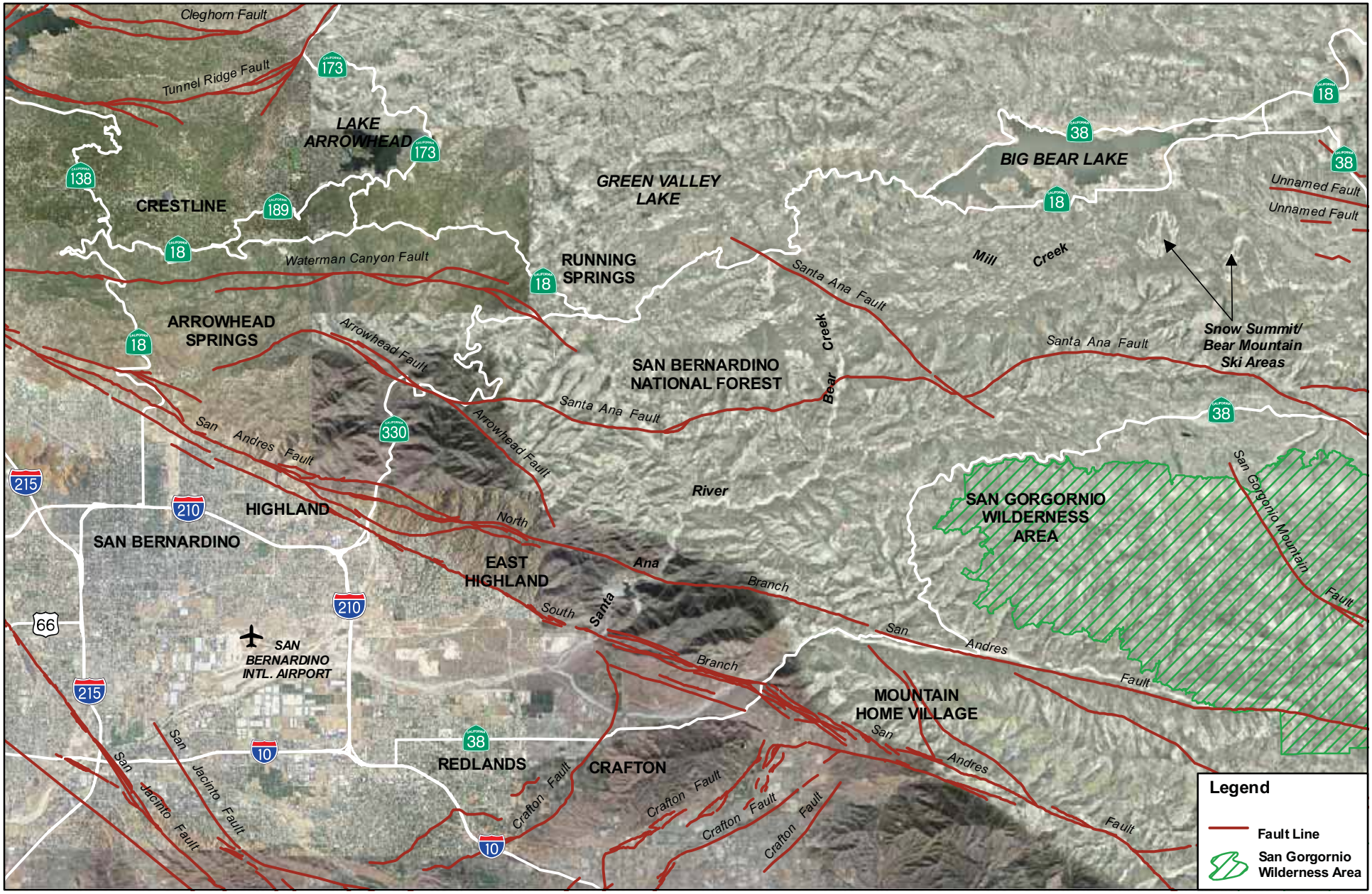
1 in = 3 miles

Big Bear Modal Alternatives 2010

2.6.3 Earthquake Faults

Seismic activity is common throughout the project area. Figure 2.80 identifies a series of earthquake faults traversing the area, including the San Andreas Fault, which runs through the San Gorgonio Pass between the San Bernardino and San Jacinto mountains along the southern base of the San Bernardino Mountains. There have been sporadic earthquakes in the area along the San Andreas, the Santa Ana, and the Waterman Canyon faults which bisect the study area.

Figure 2.80 - Earthquake Risk



Source: USGS Earthquake Hazard Program

0 1.5 3 6 Miles

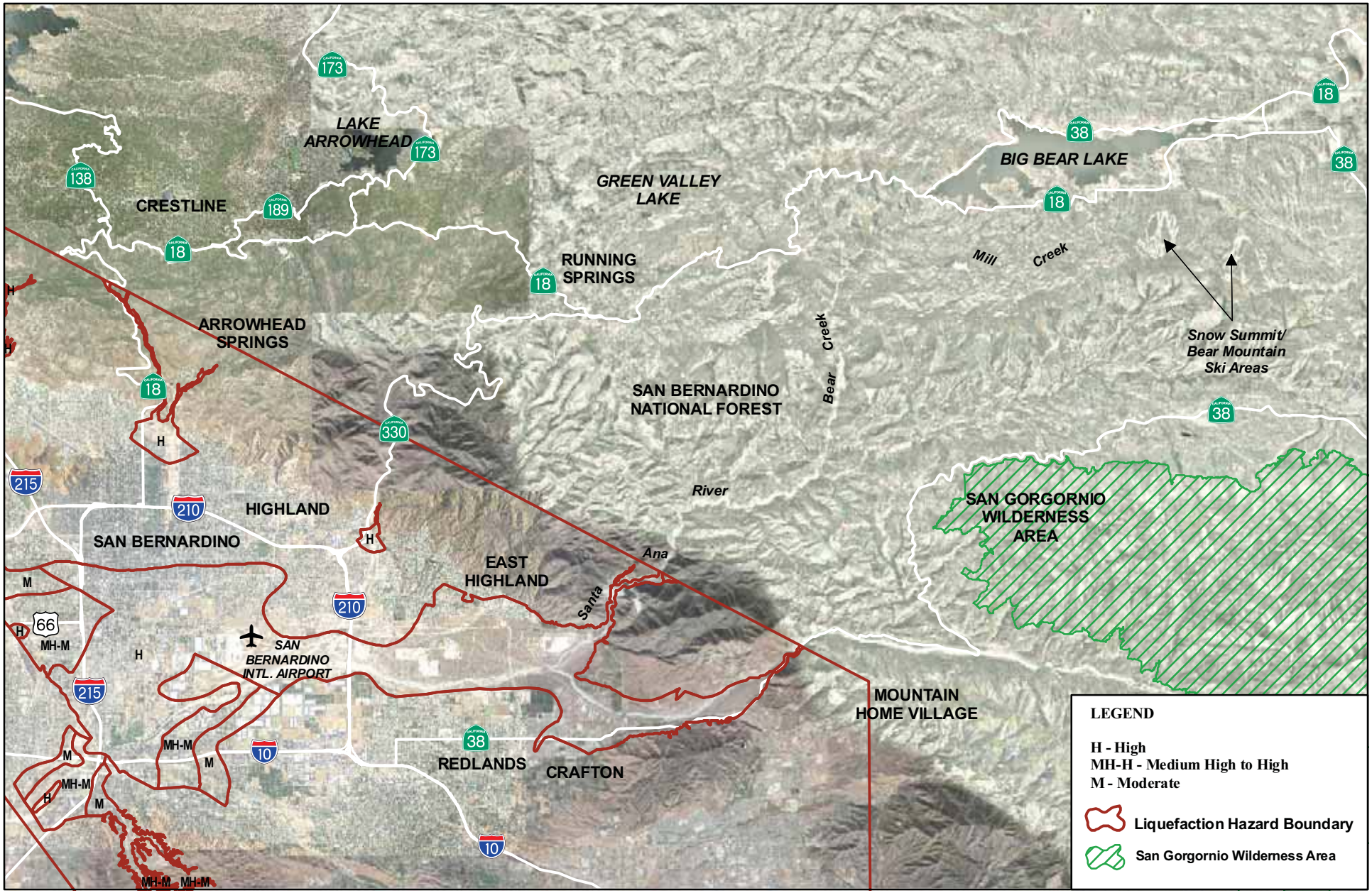
1 in = 3 miles

Big Bear Modal Alternatives 2010

2.6.4 Liquefaction Risk Areas

Liquefaction is often associated with earthquake risk. Liquefaction occurs when soil stability, strength and stiffness is reduced by earthquake shaking, and is typically associated with saturated soils and areas in alluvial streambeds. With liquefaction, the strength of the soil decreases and the ability of a soil deposit to support structural foundations is marginalized. In the San Bernardino valley area, the liquefaction risks are highest through the Santa Ana River area, including the east-west potential corridor from Highland to the San Bernardino airport and east to the I-215 freeway as represented in Figure 2.81.

Figure 2.81 - Liquefaction Risk Areas



Source: State of California Department of Conservation

0 1.5 3 6 Miles

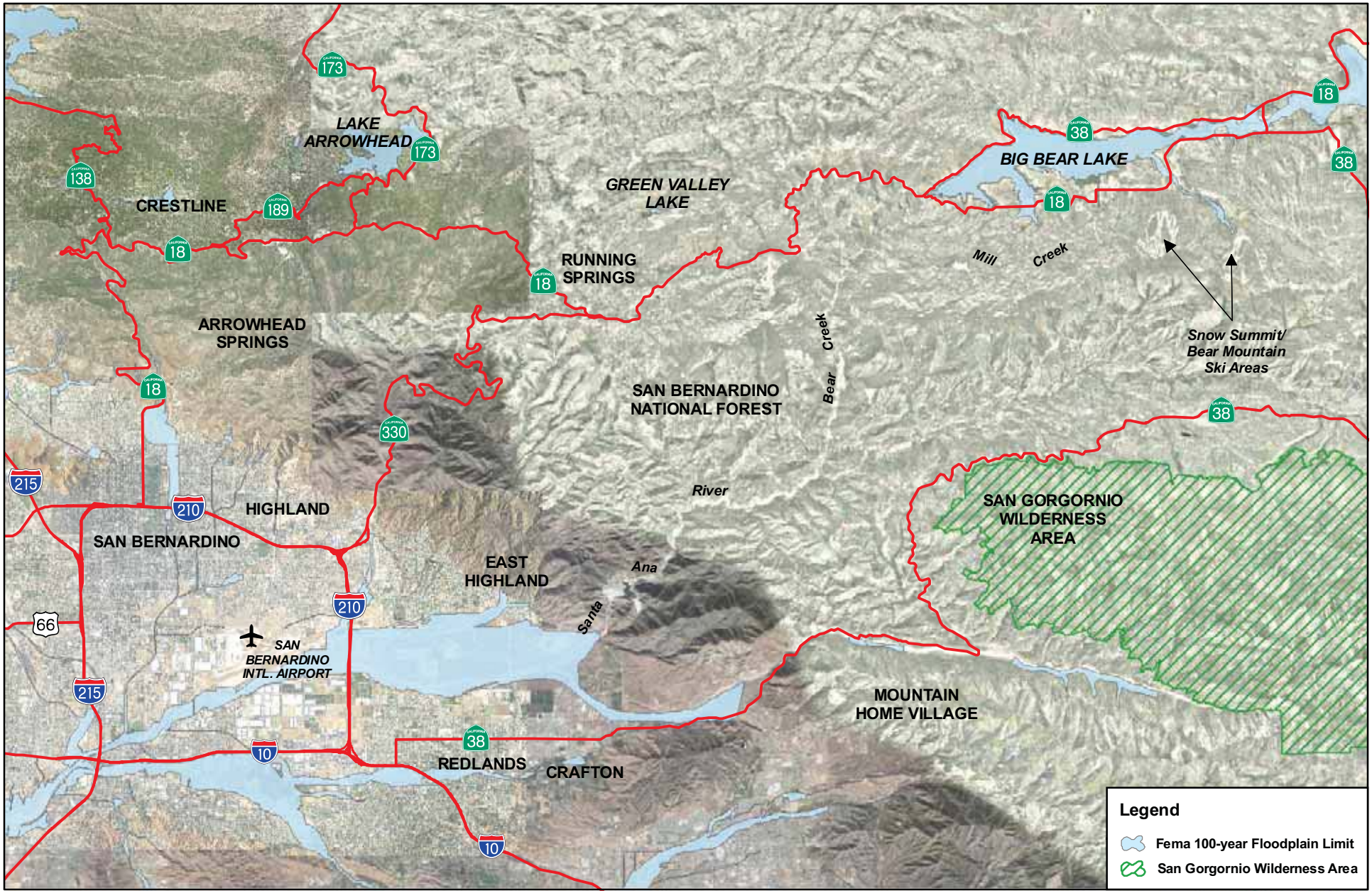
1 in = 3 miles

Big Bear Modal Alternatives 2010

2.6.5 Flood Plains

Figure 2.82 depicts the flood plain zones with the project study area. There's little risk associated with encroachment in flood plain for the mountain corridor area, with the majority of the flooding potential in the San Bernardino valley, with a particular high intensity area located at the base of the Santa Ana River. The Seven Oaks dam is located within the Santa Ana River flood plain zone.

Figure 2.82 - Flood Plains



Source: Flood Insurance, Maps, and Information (FEMA)

0 1.5 3 6 Miles

1 in = 3 miles

Big Bear Modal Alternatives 2010

2.6.6 Rivers, Streams and Waterways

The Big Bear Lake and the Santa Ana River are the key watersheds in the project study area. Bear Creek is the major drainage system, flowing southerly to the Santa Ana River. In the 1996 Study, five other major and minor drainages were noted in discussions with the US Forest Service. Figure 2.83 depicts the USGS survey of all water features in the project area, rivers, streams and waterways. When considering alternative corridors, crossing streams and rivers will have impacts on riparian habitats and species which may be located in the area, and on system design, construction and cost.