FINAL REPORT
CLINE DAHLE CAPACITY STUDY

University of Utah Metropolitan Research Center

Prepared for Summit County Economic Development

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Metropolitan Research Center

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Prepared under the direction and funding of
Summit County Economic Development

A team at the University of Utah, headed by Dr. Reid Ewing, Prof. Brenda Scheer, and Dr. Kathryn Terzano, was hired by Summit County to evaluate a nearly 30-acre parcel for potential development. The Cline-Dahle parcel is located between the Summit Business Center and Jeremy Ranch Elementary School off Rasmussen Road, allowing for connections to transit and trail systems. The property's location and characteristics make it potentially developable for workforce or affordable housing, transportation facilities (a park-and-ride lot or transit center), and other community uses.

Interest in acquiring the parcel grew with the realization that Summit County's employment growth had outpaced affordable housing, especially for public- and service-sector workers. As a result, a significant proportion of Summit County's workforce commutes into the region—which presents a financial burden to the workers and also exacerbates traffic-related issues such as congestion and the associated environmental consequences.

The University of Utah team's goal was to develop a program and layout studies for the Cline-Dahle parcel with four different scenarios, and to test these by modeling the resultant transportation effects. This goal was accomplished in phases, beginning with a review of the existing documents made available by Summit County and other sources. This phase included gathering, mapping, and analyzing 1) land use, zoning, traffic, public facilities, utilities, transit, topography, drainage, soils, vegetation, Phase I ESA, and access to the site, 2) reviewing housing surveys in Summit County, employment mix, and travel model origin/destination matrices, 3) reviewing the housing demand and supply report, and 4) transportation studies. The outcome of this phase was a report, with maps, on the physical site limitations and an initial range of programmatic options.

The second phase of the project was the case study phase. A list of case studies was developed based on similar resort/transit/housing accommodations in North America. The sites selected were examples of "transit-oriented development" -- that is, projects that are planned to be high density and nearby to public transportation. Two members of the University of Utah team accompanied stakeholders and representatives from Summit County on the case study site visits to Portland (Oregon), Seattle (Washington), and Whistler (British Columbia). The three cities offered a variety of design and density examples.

The third phase involved a scenario analysis. A range of uses and density parameters for preliminary analysis was prepared, based on case study lessons and data from the County and others. Next, designers worked to develop an analysis of the capacity of this particular site, based of the land constraints and density that might support transit. The scenarios developed look at the capacity of the site and are not intended as master plans. Four options of housing, parking, open space and other uses were developed, ranging in density, scale and open space, with estimates of units, parking and square footage.

The final phase of the study was the modeling of the transportation impact for each of the options. This included a projection of vehicle trips, mode shares, parking demands, and vehicle miles traveled (for air quality analysis), based on the ITE Trip Generation Manual, and, alternatively, the mixed-use development methodology of Ewing, et. al., along with Summit County's regional travel model. The transportation analysis also include an impact analysis to the Jeremy Ranch interchanges (pre- and post-roundabout installations) to be built in the future. One caution about this impact analysis is that it was based on 2040 population projections provided by the State of Utah. Summit County has argued that these projections are very aggressive, since the County has not seen the type of growth projected. Slower growth would lead to less traffic impacts of the development.

CASE STUDIES

Between Tuesday, October 11th and Friday, October 14th, 2016, representatives from the University of Utah, Summit County, and local stakeholders participated in a transit-oriented development (TOD) study tour in the Portland (Oregon) metro area, the Seattle (Washington) metro area, and Whistler (British Columbia). Seven projects were visited.

The purpose of the case study site visits was to experience representative mixed use developments and gather information about their financing, residents, and transportation opportunities. Mixed use development that are designed appropriately can create a cohesive community, with public spaces that are designed to encourage walking and interaction of residents. The architecture is designed in low to mid-rise residential types, including townhouses, and multi-level apartment blocks, some with ground floor restaurant or other commercial space. We were interested in defining the qualities that made these places attractive and welcoming. Since the buildable land on the Cline-Dahle site is 19 acres, we also looked at the relative size and capacity of the projects.

Orenco Station features a mix of housing, walkable retail and services, transit, and open space.

Portland Metro Area

The group met with John Southgate of the Oregon Metro TOD Steering Committee. Mr. Southgate discussed the history of TODs in the Portland area and the challenges that developers face when undertaking TOD projects. Mr. Southgate fielded questions from the groups about the logistics of TODs including a recommendation for the County to control the land.

Orenco Station

The first site visit was to Orenco Station (6111 – 6221 NE Cornell Rd, Hillsboro, Oregon).

Orenco is an award-winning, master-planned, mixed-use development located approximately 15 miles west of Portland. It was developed on 209 acres of open land, starting in 1979. Orenco Station includes a MAX light-rail station as well as retail, office, and over 1800 residential units. Residential density varies from 25 units per acre to over 100 units per acre near the Station itself, which are the most recent projects. Most of the projects are condominium, but an affordable housing project is under construction. The development is just south, and walking distance from, a large Intel campus.

The Orenco Station's variety of architecture, mix of uses and pleasant, walkable open spaces and landscaped streets were a design inspiration.

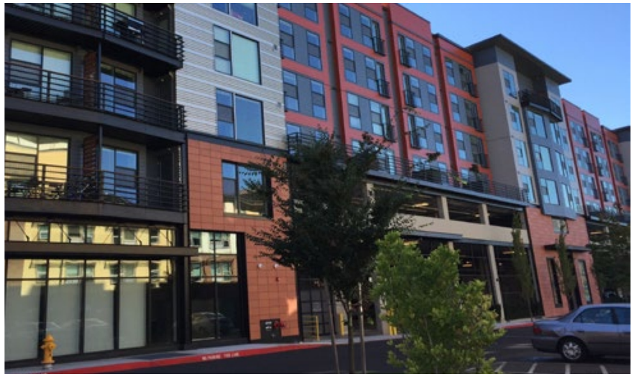
Orenco Station- Block Group Data

- **Median HH Income = $74,844**
- **HH Density/Acre = 10.9 HHs**
- **Housing costs as a % of Income = 29%**
- **Transportation costs as a % of Income = 19%**
- **Housing and Transportation costs as a % of Income = 48%**
- **Annual Greenhouse Gas Per Household/Auto Use = 6.49 Tonnes**
- **% of workers that ride transit = 9.0%**
- **Average vehicle miles traveled per household = 17,601**
- **Walkscore (0-100) = 71**

Source: Center for Neighborhood Technology/Census Block Group Data and Walkscore.com

Town Center at Orenco train station

Streetscape along the main drive in Orenco Station



Vector Apartments, with ground floor retail and parking

The Rise

The Rise (4545 SW Angel Avenue, Beaverton, Oregon), will be completed in 2017. The Rise is a small, .9 acre development within walking distance of a MAX light-rail station, with 87 market-rate apartments and 2,400 SF of retail space. The buildings are three and four stories with a density of 96 dwelling units per acre. There are 65 parking spaces. The project was intended to support the redevelopment of Beaverton's historic Old Town.

Rendering of the Rise.

The Rise - Block Group Data

- **Median HH Income = $44,356**
- **HH Density/Acre = 8.95 HHs**
- **Housing costs as a % of Income = 24%**
- **Transportation costs as a % of Income = 18%**
- **Housing and Transportation costs as a % of Income = 42%**
- **Annual Greenhouse Gas Per Household/Auto Use = 6.13Tonnes**
- **% of workers that ride transit = 12%**
- **Average vehicle miles traveled per household = 16,185**
- **Walkscore (0-100) = 95**

Source: Center for Neighborhood Technology/Census Block Group Data and Walkscore.com

The Rise has buildings at various heights.

Center Commons

Center Commons (5900 NE Hoyt Street, Portland, Oregon), was completed in 2000. It is located on a 4.9-acre site about a five-minute walk from a MAX light-rail station.

Center Commons is a TOD with 56 market-rate apartments, 60 affordable family units, and 172 units of senior affordable housing, spread over four apartment buildings and 26 townhouses. It does not have any commercial space aside from an on-site day care facility. Parking includes 101 structured parking spaces and 91 surface parking spaces.

Of the various site visits by the group, Center Commons was the TOD with the lowest average household income.

Townhouse units at Center Commons.

Center Commons - Block Group Data

- **Median HH Income = $25,144**
- **HH Density/Acre = 25.53 HHs**
- **Housing costs as a % of Income = 22%**
- **Transportation costs as a % of Income = 17%**
- **Housing and Transportation costs as a % of Income = 39%**
- **Annual Greenhouse Gas Per Household/ Auto Use = 5.25 Tonnes**
- **% of workers that ride transit =19%**
- **Average vehicle miles traveled per household = 15,213**
- **Walkscore (0-100) = 69**

Source: Center for Neighborhood Technology/Census Block Group Data and Walkscore.com

Multi-family affordable units at Center Commons, with playground.

Seattle Metro Area

The group toured two TODs as well as a “micro-apartment” building in Seattle. The group also met with Bob Knox, the Construction Manager for Imagine Housing.

The Village at Overlake Station

The Village at Overlake Station (2580 152nd Avenue NE, Redmond, Washington) is a suburban TOD with bus transit and a park-and-ride area. It is located on county-owned land, making this development of particular initial interest to the group.

The development consists of 308 affordable housing units in buildings up to five stories. Parking consists of 536 shared resident and park-and-ride parking spaces. There are 0.6 spaces per unit, in part because every resident receives a free bus pass.

Like most Mixed use projects, Overlake Station has well designed open spaces.

Village at Overlake Station - Block Group Data

- **Median HH Income = $49,432**
- **HH Density/Acre = 25.53 HHs**
- **Housing costs as a % of Income = 22%**
- **Transportation costs as a % of Income = 16%**
- **Housing and Transportation costs as a % of Income = 38%**
- **Annual Greenhouse Gas Per Household/Auto Use = 5.51Tonnes**
- **% of workers that ride transit = 5%**
- **Average vehicle miles traveled per household = 16,695**
- **Walkscore (0-100) = 72**

Source: Center for Neighborhood Technology/Census Block Group Data and Walkscore.com

The bus station (left) on the lower level of the project, which is on a hillside with excellent views (right).

Alder Flats

Micro apartments are small but have good common areas.

The group toured the Alder Flats micro-apartment building (220 10th Avenue, Seattle, WA). Opened in 2009, Alder Flats is a seven-story building with 46 micro-apartment units (with galley kitchenettes), a common kitchen area on the first floor, and a rooftop BBQ grill area. The building also features bike storage. There is no parking on site. The floor plans include micro flats, some with lofts, ranging between 200 and 375 SF. It is located in an urban area of Seattle.

Alder Flats is in an older neighborhood of Seattle.

Alder Flats - Block Group Data

- **Median HH Income = $34,018**
- **HH Density/Acre = 36.45 HHs**
- **Housing costs as a % of Income = 23%**
- **Transportation costs as a % of Income = 12%**
- **Housing and Transportation costs as a % of Income = 35%**
- **Annual Greenhouse Gas Per Household/Auto Use = 2.99 Tonnes**
- **% of workers that ride transit =19%**
- **Average vehicle miles traveled per household = 12,613**
- **Walkscore (0-100) = 92**

Source: Center for Neighborhood Technology/Census Block Group Data and Walkscore.com

The common kitchen at Alder Flats is frequently used by residents to entertain.

South Kirkland

South Kirkland Park-and-Ride TOD (10610 NE 38th Place, Kirkland, Washington) is on a 6.97-acre site and includes residential buildings with ground-floor commercial space. It was completed in 2014.

South Kirkland's parking includes 530 structured parking spaces for King County Metro as well as 323 park-and-ride surface parking spaces. South Kirkland was developed on the site of an existing bus park-and-ride lot owned by King County and that straddled the cities of Kirkland and Bellevue.

The residential component includes 181 market-rate units in a mixed-use retail/residential building as well as 58 affordable housing units (developed by Imagine Housing). The market-rate apartments are in a separate building from the affordable housing units.

South Kirkland boasts a community room (above), a common lounge, geothermal heating, on-site support services, and a roof deck.

South Kirkland - Block Group Data

- **Median HH Income = $115,156**
- **HH Density/Acre = 11.07 HHs**
- **Housing costs as a % of Income =40%**
- **Transportation costs as a % of Income = 16%**
- **Housing and Transportation costs as a % of Income = 56%**
- **Annual Greenhouse Gas Per Household/ Auto Use = 6.37 Tonnes**
- **% of workers that ride transit = 6%**
- **Average vehicle miles traveled per household = 16,703**
- **Walkscore (0-100) = 27**

Source: Center for Neighborhood Technology/Census Block Group Data and Walkscore.com

View from the parking garage. The affordable housing is on the right and market rate is on the left.

A park and ride garage is adjacent to the residential projects in South Kirkland. It is served by frequent bus service.

Whistler, B.C.

Whistler is a mountain resort north of Vancouver, B.C. It was selected for touring because it has pioneered construction of affordable and workforce housing, much of it served by bus transit. The group met with Allison Winkle (Whistler Housing Administrator), Melissa Laidlaw (Whistler Senior Planner), and Emma DalSanto (Transportation Demand Management [TDM] Coordinator for Whistler). Ms. Winkle and Ms. Laidlaw provided a walking tour of Cheakamus Crossing and Ms. DalSanto met with the group to discuss the Whistler transit system, including its Staff Housing Pilot Project.

Significantly, DalSanto noted that a free, shuttle served, remote park and ride lot intended for skiers had not been nearly as successful as they had hoped. Inexpensive lots nearer to the Village and to the lifts drew most of the visitors.

Cheakamus Crossing

Cheakamus Crossing is a 56-acre development south of Whistler's Olympic Village. In Whistler, "workforce housing" can mean residents with moderate and even high incomes. Development planning began in 2005, and while the majority of the development has been completed since 2010, additional buildings continue to be under construction. To purchase a home at Cheakamus Crossing, the potential buyer needs to be on the Whistler Housing Authority Waitlist and to have specifically selected Cheakamus Crossing as a desired development.

Cheakamus Crossing helps serve the municipality's continuing goal of at least 75% of the workforce living within Whistler's boundaries. A bus system connects Cheakamus Crossing to other developments and the Olympic Village. Cheakamus Crossing, at present, includes a 101-bed youth hostel and seven projects:

A townhouse development in Cheakamus Crossing, surrounded by pine forest.

Townhouses with a contemporary touch at Whistler.

(above) Central open space surrounded by mid rise apartment buildings..

Cheakumus Crossing has multiple projects.

•The Chiyakmesh, a 55-unit, Whistler Housing Authority rental building,
•The Falls, a 33-unit, employee-restricted apartment condominium,
•The Springs, a 34-unit, employee-restricted apartment condominium,
•The Heights, a 27-unit, employee-restricted townhouse development,
•The Rise, a 60-unit, employee-restricted townhouse development,
•The Terrace, a 27-unit, employee-restricted townhouse development, and
•Whitewater, a 40-unit, employee-restricted townhouse development.

Whistler Data

•Whistler has a permanent population of almost 10,000

•The median household income is $65,757 (C)

• Cheakamus Crossing is home tomore than 800 residents, a Hostel and the Whistler Athlete Centre

• Strong mix of housing product types

• The project is located 6.3 miles from Whistler Village core area

• Bus begins service at approximately 5:30am. Annually, Whistler bus service serves 2.5 million riders

• Youth hostel was specifically designed as part of a workforce housing village

•Walkscore is 27 out of 100

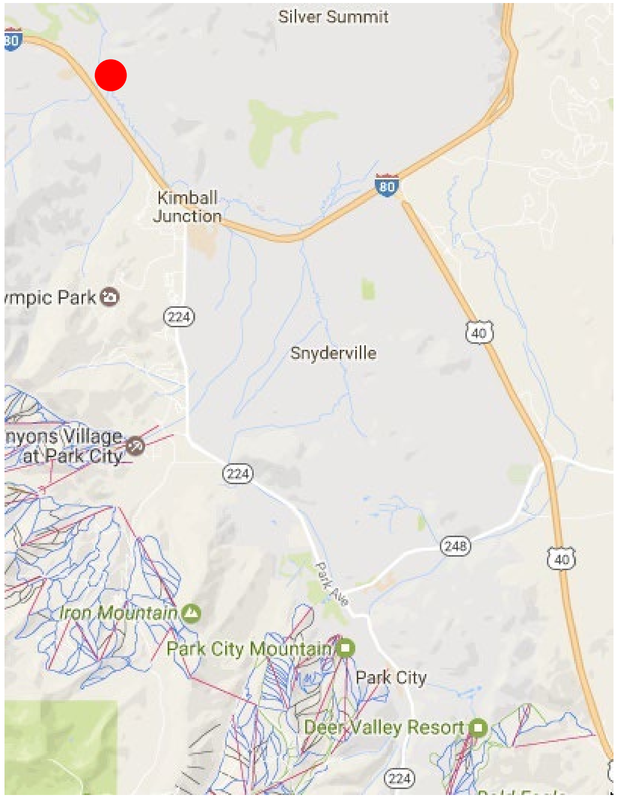
Source: Walkscore.com, Canada Statistics

Apartment Building in Cheakamus Crossing.

Youth Hostel has 101 beds and a cafe on the ground floor.

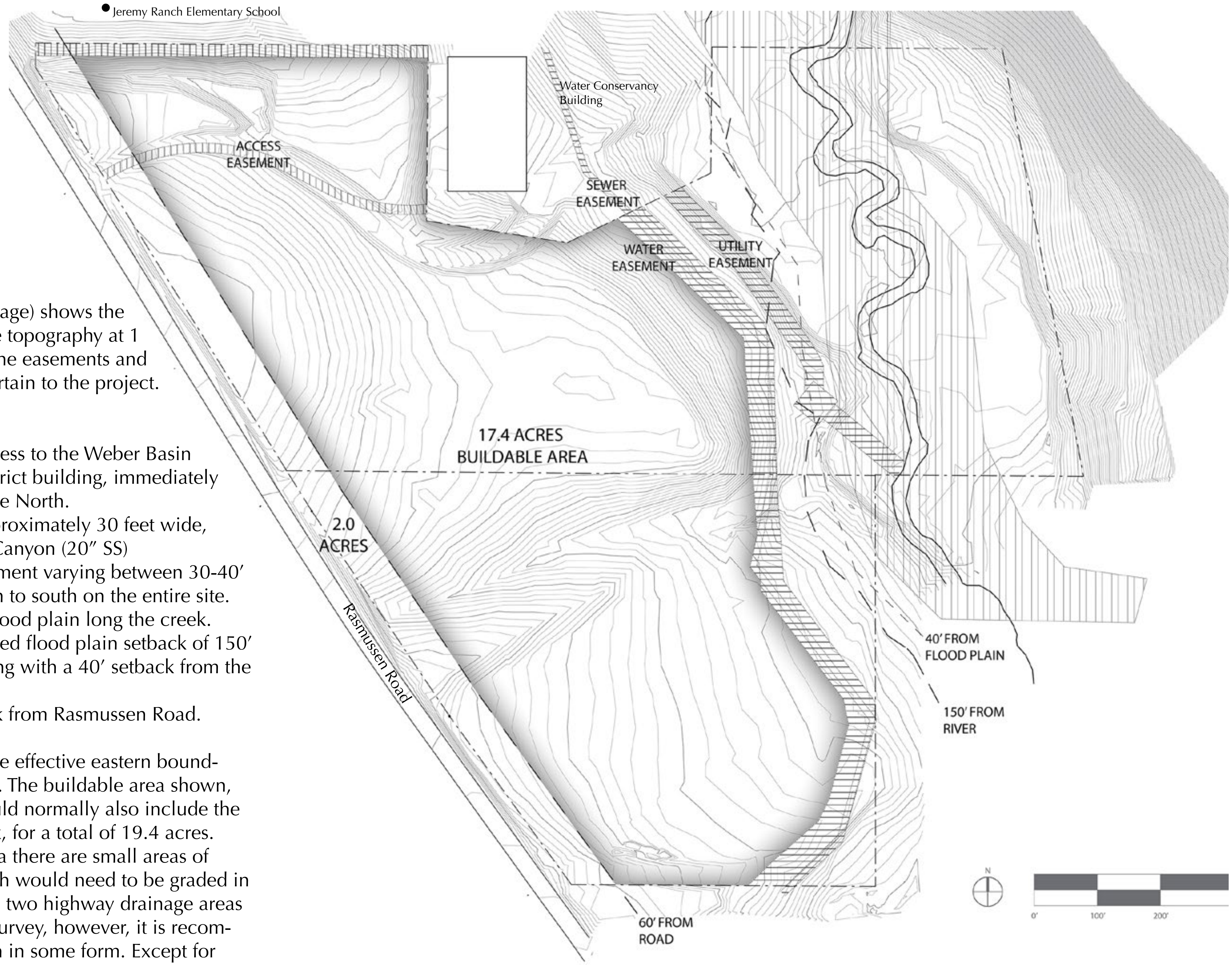
SITE ANALYSIS

The Cline-Dahle property is located in Summit County, adjacent to the Jeremy Ranch Elementary School and I-80. It is served only by the highway access road, also known as Rasmussen Road (see key map). On the south side of the site is a small shopping center. The two parcels of the property include about 29.6 acres of land. There is a stream running though the north-east of the property (East Canyon Creek), and steep elevation on the eastern side beyond the stream. The site is bare of significant vegetation east of the creek, and has previously been graded to account for run-off from I-80.



Location map - site is the red dot.

Key map: Located in the Jeremy Ranch area of Summit County, along I-80. The site is outlined in red.



The site survey (on this page) shows the boundary of the site, the topography at 1 foot intervals and all of the easements and other boundaries that pertain to the project. These include:

1. An easement road access to the Weber Basin Water Conservancy District building, immediately adjacent to the site on the North.
2. A utility easement approximately 30 feet wide, running parallel to East Canyon (20" SS)
3. A separate water easement varying between 30-40' wide, running from north to south on the entire site.
4. A FEMA determined flood plain long the creek.
5. Summit County required flood plain setback of 150' from the river, overlapping with a 40' setback from the flood plain (wetlands).
6. A 60' required setback from Rasmussen Road.

The water easement is the effective eastern boundary of the buildable area. The buildable area shown, which is 17.4 acres, would normally also include the Rasmussen Road setback, for a total of 19.4 acres. Within the buildable area there are small areas of steep slope > 10%, which would need to be graded in order to be built on. The two highway drainage areas are not recorded in the survey, however, it is recommended that they remain in some form. Except for these drainages, the buildable part of the site is mostly gently sloping.

View of the hills and creek looking east from the middle of the site.

View of the site (in red), looking south toward I-80 from the Jeremy Ranch Subdivsion.

Within the site, the views to the east are particularly desirable, including the creek and its associated wetlands, and the adjacent foothills (see photo above). We also examined the view into the site from locations in Jeremy Ranch and across the highway in the foothills. From across the highway, it may not be easy to see the site's development, because of the highway as foreground, and the distance from houses up the hill. From Jeremy Ranch, the site development would block the view of the highway, and in many locations it would be hidden by the hills.

The site location is an opportunity to provide affordable and workforce housing, as long as that housing is dense enough to support transit of some kind (shuttles or buses) to employment. Because the site is not adjacent to single family residences, and is located where commercial development already occurs (to the south), it may be more appropriate for multi-family. The Jeremy Ranch Elementary School, which can be easily connected by a pedestrian path, is also a bonus for families with children or school employees. The commercial development on the south, Quarry Village, could also benefit from residential development on the site. Finally, the site is highly visible from the highway, increasing its marketing potential.

The site is convenient for travelers from Salt Lake City and is relatively close to employment centers like Park City, the resorts (Deer Valley, Canyons, and Park City Mountain). It is very close to Kimball Junction (Exit 145 on I-80), in fact there is a bike trail paralleling Rasmussen Road that could provide transportation. The affordable housing component will require transportation choices to be convenient.

Summit County has home values far beyond the price that people with modest incomes can afford. Workforce housing, that is, the housing available for teachers, policemen, restaurant employees, resort employees, and so on, is in very short supply. The Consolidated Housing Plan prepared by the Mountainland Association of Governments in 2015 estimated the County's need in excess of 1,000 units.

SITE SCENARIOS

The site scenarios were prepared by Professor Brenda Scheer, FAIA, FAICP, with the assumption that the county was interested in developing the site as a mixed-use transit oriented development. The four site scenarios demonstrate the capacity of the site for housing, given the limitations (easements, flood plain, etc) found on the site. All of the scenarios are dense (30 units per acre and greater) compared to much of Summit County. They all show parking ratios per unit and per square foot of retail that is less than most current suburban standards. This density is not uncommon for transit oriented developments that were visited, as well as the TODs that have been studied by the Metropolitan Research Center. In all scenarios there are “park and ride” spaces that can serve as overflow for housing and retail, as well as parkand ride for area employees.

Projects with this density have sevearl advantages: First, a site of this size has the opportunity to create a walkable community that includes a mix of uses, residential choices, open space, and a small town center to focus the community’s activities. Newer enclaves like this are becoming more and more common across the country and they attract people looking for a lifestyle that is more small village than suburban subdivision. Many of the sites we visited offer this style of living. In a transit-oriented development (TOD), cars and parking take a back seat to useable sidewalks and tree-lined streets, with buildings that enclose the streets and open spaces. (See “site visit” for images and descriptions of relevant examples). Many different uses can be accommodated there, which means that some people do not need to get in their cars to make a short errand or even go to work. The design of the buildings emphasizes the way they relate to the street, including entrance and facade design and minimal setbacks. Parking is usually hidden behind or on under buildings.

Second, a higher density of development, even if built over time in phases, can help to substantially relieve the shortage of affordable and workforce housing in Summit County.

Third, a higher density of development can be served by transit. Being a “transit oriented development” means that frequent transit access is provided, in this case, buses or shuttles to resorts and other employment areas. The more people there are to use the transit, the more reasonable it is to provide it. More people riding transit can keep car traffic down (see “Transportation Analysis”) at important intersections that might otherwise be shortly overwhelmed.

Finally, to a degree, higher density is less expensive to build per unit, because the land and infrastructure costs are distributed over more units. Higher density projects have a mix of unit types from small studios to townhouses, which provides more choices and more price points for the workforce population.

The following scenarios represent just four options that might be built on this site. They are not meant to constitute a master plan or any guidance for future development. Their main purpose is to examine the capacity of the site and to illustrate how the project might have a “transit oriented development” site arrangement, with multiple uses, unit choice, walkability, a town center, transit stops, and responsiveness to the view.

Sidewalk at the mixed use Orenco Station.

Example of Orenco Station apartment blocks in a walkable community in Portland. Buildings sit next to the sidewalk.

Orenco Station has an attractive public open space.

OPTION ONE

Option one has residential buildings on the north side of the site, near the school, and a three level parking garage on the south, designated for park and ride. Employees traveling from outside the county could park here and be shuttled to their destination. These two parts of the project would connect via foot/bike path. The parking garage is “wrapped” on two sides with apartment buildings. There are two residential-building types: apartment buildings with parking on the first level and townhouses. There is also a hostel, which might serve more transient visitors.

The buildings of the “town center “ shown in red, have commercial uses on the ground floor and residential use above, with parking in the lower level. The Option One tables (next page) describe two scenarios, one in which the apartments are three stories tall plus the ground floor, and one in which the buildings are four stories tall plus the ground floor. The ground floor is typically a parking podium, as shown in the photo below.

The parking podium is well disguised in this walkable project in Phoenix.

OPTION 1A Apartments 3+ floors

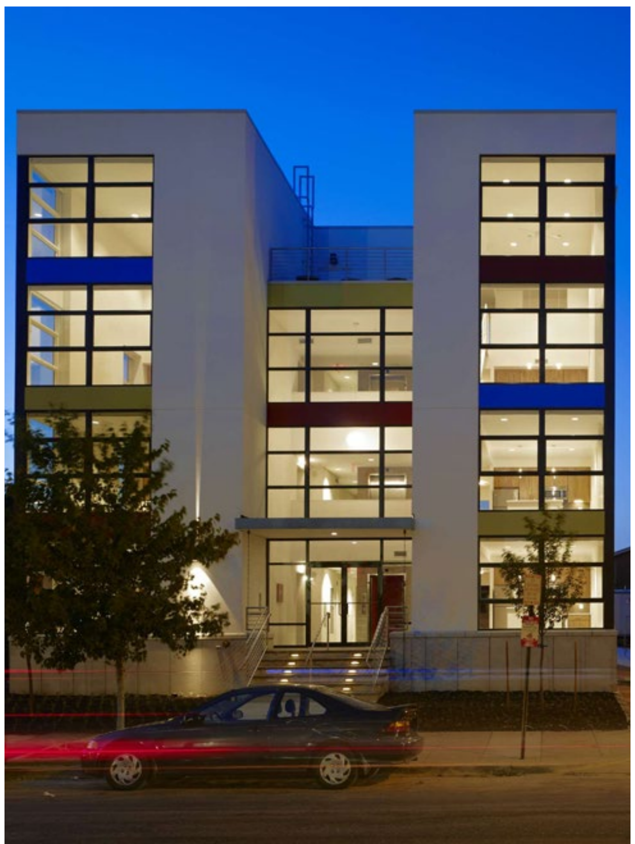
BLDG TYPE	FLOORS	UNITS	PARKING RATIO	PARKING *
Townhouse	2.5	45	1.0	45
1 Bedroom	3	283	.9	255
2 Bedroom	3	90	1.2	108
STUDIO	4	200	.5	100
HOSTEL	4	80 PER	.25	20
3-Bedroom	4	16	1.5	24
NON-RESIDENTIAL		10000 SF		
PARK and RIDE				557
TOTAL		634 + HOSTEL		1,109

OPTION 1A Apartments 4+ floors

BLDG TYPE	FLOORS	UNITS	PARKING RATIO	PARKING *
Townhouse	2.5	45	1.0	45
1Bedroom	4	377	.9	339
2 Bedroom	4	120	1.2	144
STUDIO	4	200	.5	100
HOSTEL	4	80 PER	0	0
3 Bedroom	4	16	1.5	24
NON-RESIDENTIAL		10000 SF		
PARK and RIDE				557
TOTAL		758 + HOSTEL		1,209

OPTION TWO

Option two uses the north part of the site for a town center, where transit would pick up residents and park and ride users. The park and ride lot garage would be connected with a short path to the town center, allowing visitors to shop. Townhouses line the main street through the project, which would be tree-lined and pedestrian friendly. The remaining buildings are apartments with parking on the podium level. Two small buildings provide small studio apartments and are one floor taller than the apartment blocks.



Contemporary style studio lofts.

OPTION 2A apartments 3+ floors

BLDG TYPE	FLOORS	UNITS	PARKING RATIO	PARKING
Townhouse	3	35	1.2	43
1 Bedroom	3	399	.9	359
2 Bedroom	3	98	1.2	118
STUDIO	4	84	.5	42
HOSTEL	4	80 PER	0	0
NON-RESIDENTIAL		15,000 SF		50
PARK and RIDE				182
TOTAL		616 + HOSTEL		794

OPTION 2B apartments 4+ floors

BLDG TYPE	FLOORS	UNITS	PARKING RATIO	PARKING
Townhouse	3	35	1.2	43
1 Bedroom	4	630	.9	567
2 Bedroom	4	130	1.2	156
STUDIO	5	112	.5	56
HOSTEL	4	80 PER	0	0
NON-RESIDENTIAL		15,000 SF		50
PARK and RIDE				182
TOTAL		907		1,054

EXAMPLE SQUARE FOOTAGE FOR TOWN CENTER NON-RESIDENTIAL SPACE

COFFEE HOUSE	1,000
GYM	3,000
DAY CARE	5,000
CONVENIENCE STORE	1,000
SPORTS BAR	3,000
OFFICE	2,000
TOTAL	15,000

OPTION THREE

Option 3 provides a central street connecting the north and south parts of the site. The town center is located on this street, at the edge of the buildable land. Commercial uses there could capture the view of the creek and hillsides. Townhouses line the open space in the central part of the site, with apartment blocks and some studio buildings organized to line the central street. Parking lots generally serve the residents but can also be used for park and ride. Parking lots are concealed from internal view by buildings.

In the tables on the next page, Option 3A has three floors plus parking, while Option 3B has two floors plus parking.

Townhouses near Whistler, in British Columbia, Canada

OPTION 3A Apartments 3+ floors

BLDG TYPE	FLOORS	UNITS	PARKING RATIO	PARKING
Townhouse	3	36	1.0	36
1 Bedroom	3	300	.9	270
2 Bedroom	3	240	1.2	288
STUDIO	3	168	.5	84
NON-RESIDENTIAL	19,000 SF			50
PARK and RIDE				340
TOTAL		744		1,068

OPTION 3B Apartments 2+ floors

BLDG TYPE	FLOORS	UNITS	PARKING RATIO	PARKING
Townhouse	2	36	1.0	36
1 Bedroom	2	200	.9	180
2 Bedroom	1	160	1.2	192
STUDIO	2	112	.5	56
NON-RESIDENTIAL	19,000 SF			50
PARK and RIDE				340
TOTAL		508		854

EXAMPLE SQUARE FOOTAGE FOR TOWN CENTER NON-RESIDENTIAL SPACE

COFFEE HOUSE	2,200
RECREATION	5,600
DAY CARE	2,800
CONVENIENCE STORE	2,100
SPORTS BAR	3,600
OFFICE	2,700
TOTAL	19,000

OPTION FOUR

Option 4 resembles Option 3 in many respects, however, it is planned to be higher density by building the apartment buildings at least one floor taller. Some of the north part of the site is given over to parking lots and two soccer fields, anticipated to be connected by pathway to the elementary school. The parking will help relieve the school drop-off traffic and serve soccer in the spring and summer. It can also be used in the winter for park and ride.

Option 4A has housing that is planned to be four floors plus parking, while 4B is the same with five floors on the apartments. A photo of housing with five floors over a parking podium is below.

Five floors of apartments over a parking deck, with garden space on top of the parking deck (South Kirkland).

OPTION 4A Apartments 4+ floors

BLDG TYPE	FLOORS	UNITS	PARKING
Townhouse	3	18	18
1 Bedroom	4	368	331
2 Bedroom	4	148	178
STUDIO	3	224	112
NON-RESIDENTIAL	19,000 SF		50
PARK and RIDE			268
SOCCER FIELDS		2	
TOTAL		758	957

OPTION 4B Apartments 5+ floors

BLDG TYPE	FLOORS	UNITS	PARKING
Townhouse	3	18	36
1 Bedroom	5	541	467
2 Bedroom	5	220	264
STUDIO	3	350	175
NON-RESIDENTIAL	19,000 SF		50
PARK and RIDE			268
SOCCER FIELDS		2	
TOTAL		1,129	1,280

Example Uses for Town Center,

COFFEE HOUSE	2,200
RECREATION	5,600
DAY CARE	2,800
CONVENIENCE STORE	2,100
SPORTS BAR	3,600
OFFICE	2,700
TOTAL	19,000

Town Center in Whistler, BC has attractive foliage.

TRANSPORTATION ANALYSIS

In order to understand the transportation and traffic impacts of the various options, vehicle trips in and out of the potential development were calculated on a daily and peak hour basis. These vehicle trips were then distributed to the regional road network.
The ITE (Institute for Transportation Engineers) provides trip generation rates based on specific uses and residential units. These are not as accurate for a mixed use development, since they are based on almost every trip being made by car, which is not as true in a denser mixed use development.

Vehicle Trip Generation

Using methodology first introduced by Ewing et al. (2010) and refined by Tian et al. (2015) , the Metropolitan Research Center at the University of Utah estimated the total vehicle trips generated by the different development scenarios for the Cline Dahle site in Summit County. The MRC has collected a database of 412 MXDs (mixed-use developments or mixed-use districts) in 13 diverse regions of the U.S. Examples from the Salt Lake region include Gateway, City Creek Center, Trolley Square, 9th and 9th, Commons at Sugarhouse, Magna Main Street, Quarry Bend, and Daybreak. These are developments that capture some trips internally (both origin and destination lie within the MXD), generate walk trips to and from the development, and generate transit trips to and from the development (bike trips also, but in very small numbers). All of these tend to reduce or discount the number of external automobile trips generated by the MXD.
The methodology pioneered by the MRC, referred to as the EPA methodology since EPA was the funding source, starts with standard suburban vehicle trip generation rates from the ITE Trip Generation Manual and then discounts successively for internal capture of trips, external walking and external transit use. For this project, we estimated new equations for internal capture, external walking and external transit use using data for the 412 MXDs in the MRC database.
For each scenario, ITE trip rates are applied to development totals in dwelling units and floor area in 1,000 square feet to obtain total vehicle trips for standard suburban developments of the same size. For example, for Option 4A, the trip generation calculation is shown in Table 1.

Table 1. Option 4A Trip Generation Example

land uses			unit or sf	parking	daily trips	am peak	pm peak	ITE land use type
Residential	Townhouse	3	18	18	105	8	9	230 townhouse
	1 Bedroom	4	368	331	1,827	155	221	220 apartment
	2 Bedroom	4	148	178	1,225	104	148	220 apartment
	Studio	4	224	112	741	63	90	220 apartment
	subTOTAL		**758**	**639**	**3,898**	**329**	**468**	
Commercial uses	coffee		2,200		1,941	238	90	936 coffee/donut shop
	recreation		5,600		922	39	99	492 health/fitness club
	day care		2,800		207	34	35	565 day care center
	convenience		2,100		717	65	73	852 convenience market
	sports bar		3,600		490	4	41	925 drinking place
	office		2,700		31	5	5	715 single tenant office
	subTOTAL		**19,000**	50	4,309	386	341	
Soccer fields			2		143	2	35	488 soccer complex
Subtotal for development			758 / 19,000	689	8,350	717	844	
Park-and-ride			--	268	509	127	127	
Total			**758 / 19,000**	**957**	**8,859**	**845**	**972**	

Ewing, R., Greenwald, M., Zhang, M., Walters, J., Feldman, M., Cervero, R., & Thomas, J. (2010). Traffic generated by mixed-use developments—six-region study using consistent built environmental measures. Journal of Urban Planning and Development, 137(3), 248-261.

Tian, G., Ewing, R., White, A., Hamidi, S., Walters, J., Goates, J. P., & Joyce, A. (2015). Traffic Generated by Mixed-Use Developments: Thirteen-Region Study Using Consistent Measures of Built Environment. Transportation Research Record: Journal of the Transportation Research Board, (2500), 116-124.

Independent Variables

The independent variables used in our models are: "area" is the buildable area of the site in square miles.

"actden" is activity density, which equals (population + employment)/area. *Population was calculated based on the assumption of: 1 = studio, 1.5 = one-bedroom, 2.5 = two-bedroom, 4 = three-bedroom, 2.5 = Townhouse 2br; 4 = Townhouse 3br. Employment was calculated based on ITE Trip Generation Manual values.*

"jobpop" is job-population balance, which equals 1 – [ABS(employment – 0.2*population) / (employment + 0.2*population)]. *Jobs and population are assumed to be balanced when there is one job for every five residents. In our earlier work, a ratio of 1:5 was found to maximize internal capture in MXDs. Job-population balance is the variable used in our earlier modeling work to represent the concept of jobs-housing balance. It is a better measure of jobs-housing balance than jobs/housing units because it accounts for household size.*

"empmile" is the number of employees within one mile of the boundary of the development, not including employment within the development. *The employment within the surrounding area came from the Longitudinal Employer-Household Dynamics data at the block level.*

"vehcaplow" is the vehicles per capita for the Low Parking assumption.
"vehcaphigh" is the vehicles per capita for the High Parking assumption.
Two different assumptions were made for each option, with respect to resident parking. The Low Parking assumption was consistent with Professor Brenda Scheer's parking space allocations (0.5 = studio, 0.9 = one-bedroom, 1.2 = two-bedroom, 1.5 = three-bedroom, 1 = Townhouse; 1.2 = Townhouse with three-bedroom). The High Parking assumption was consistent with the County's parking standards (1 = studio, 1 = one-bedroom, 2 = two-bedroom, 2.5 = three-bedroom, 2 = Townhouse; 2.5 = Townhouse with three-bedroom). This only affects the values of one variable, vehcap. The different values are shown in Table 2. Vehicle ownership is a key variable in trip generation analysis, which has significant effects on internal capture, external walking, and external transit use.

Variable Values

Values of the independent variables for each development scenario are show in Table 2.

Best-Fit Equations

The best-fit equation for the internal capture rate is:

internal share of trips = -0.06 + 0.037*ln area + 0.026*ln actden + 0.011*ln jobpop – 0.078*ln vehcap (1)

where the internal share of trips is the fraction of trips that stay within the development, and all variables are as defined above. This equation suggests that the internal capture rate increases with the area of a site, with the density of development, and with the balance of jobs to residents, and decreases with vehicle ownership. All relationships are consistent with theory and with prior literature (Ewing et al. 2010 and Tian et al. 2015).

All variables in this equation are statistically significant at the 0.01 level or beyond, a high level of statistical significance that suggests there is less than one chance in 100 that these relationships are due to chance. The R2 for this equation is 0.22, which means

Table 2. Values of Independent Variable for Different Development Scenarios

	area	actden	jobpop	empmile	vehcaplow	vehcaphigh
Option 1A	0.027	38,474	0.18	1,057	0.54	0.77
Option 1B	0.027	46,418	0.15	1,057	0.52	0.76
Option 2A	0.027	40,423	0.25	1,057	0.53	0.72
Option 2B	0.027	57,122	0.18	1,057	0.54	0.72
Option 3A	0.027	49,361	0.23	1,057	0.52	0.78
Option 3B	0.027	34,428	0.32	1,057	0.51	0.78
Option 3C	0.027	64,294	0.18	1,057	0.52	0.78
Option 4A	0.027	45,057	0.25	1,057	0.54	0.78
Option 4B	0.027	65,876	0.18	1,057	0.55	0.78

that the independent variables explain 22 percent of the variation in the internal capture rate across the 412 MXDs in our database.

The best-fit equation for external walking is:

walk share of external trips = -0.481 – 0.029*ln area + 0.031*ln actden + 0.009*ln jobpop + 0.021*ln empmile – 0.133* ln vehcap (2)

where the walk share of external trips is the fraction of external trips that are made by walking, and all other variables are as defined above. This equation suggests that the external walking decreases with the area of a site, increases with the density of development, increases with the balance of jobs to residents, increases with the number of jobs (employment) within one mile of the site boundary, and decreases with vehicle ownership. All relationships are consistent with theory and with prior literature.

All variables in this equation are statistically significant at the 0.01 level or beyond, a high level of statistical significance. The R2 for this equation is 0.45, which means that the independent variables explain 45 percent of the variation in the fraction of external trips by walking across the 412 MXDs in our database.

The best-fit equation for external transit use is:

transit share of external trips = -0.286 – 0.009*ln area + 0.022*ln actden + 0.010*ln empmile – 0.092*ln vehcap (3)

where the transit share of external trips is the fraction of external trips that are made by transit, and all other variables are as defined above. This equation suggests that external transit use decreases with the area of a site, increases with the density of development, increases with number of employees within one mile of the site boundary, and decreases with vehicle ownership. All relationships are consistent with theory and with prior literature.

All variables in this equation are statistically significant at the 0.01 level or beyond, except the variable ln empmile, which is significant at the 0.011 level. The R2 for this equation is 0.32, which means that the independent variables explain 32 percent of the variation in the fraction of external transit trips across the 412 MXDs in our database.

Internal Capture Estimate

To estimate internal capture, external walking, and external transit, we substituted values of the independent variables for each scenario into the equations above. The values, by scenario, are shown in Table 2.

The resulting vehicle trip reductions for the different scenarios are shown in Table 3. The reduction is the combination of estimated percentage of internal capture, estimated percentage of external trips by walking, and estimated percentage of external trips by transit. Here we use the Option 4A Low Parking assumption as an example.

From the equation (1):

internal share of trips = mean of internal capture + 0.037 * (ln area of this site – mean of ln area of 412 MXDs) + 0.026 * (ln actden of this site – mean of ln actden of 412 MXDs) + 0.011 * (ln jobpop of this site – mean of ln jobpop of 412 MXDs) – 0.078 * (ln vehcap of this site – mean of ln vehcap of 412 MXDs)

The mean values of these variables come from our database of 412 MXDs. Substituting values into the

Table 3. Total Reduction for Different Development Scenarios

	internal share of trips		external trips				total reduction	
			walk share		transit share			
	low	high	low	high	low	high	low	high
Option 1A	11.4%	8.5%	16.9%	12.0%	10.5%	7.1%	35.7%	26.0%
Option 1B	11.8%	8.9%	17.6%	12.6%	11.1%	7.6%	37.1%	27.4%
Option 2A	12.1%	9.6%	17.6%	13.4%	10.8%	7.9%	37.0%	28.9%
Option 2B	12.4%	10.2%	18.1%	14.3%	11.3%	8.7%	38.1%	30.8%
Option 3A	12.6%	9.4%	18.3%	12.9%	11.3%	7.6%	38.5%	27.9%
Option 3B	12.1%	8.8%	17.6%	12.0%	10.6%	6.8%	36.9%	26.0%
Option 3C	13.0%	9.8%	18.9%	13.5%	11.9%	8.1%	39.7%	29.3%
Option 4A	12.2%	9.3%	17.7%	12.7%	10.8%	7.4%	37.2%	27.6%
Option 4B	12.6%	9.9%	18.3%	13.6%	11.5%	8.2%	38.6%	29.5%

equation above, we obtain the following for Option 4A:

internal share of trips = 0.122 or 12.2%

The internal share of trips depends on the area of the site, the activity density of development on the site, the job-population balance of development on the site, and the vehicles per capita of residents of the development. The internal capture rate for Option 4A is slightly above the average for the 412 MXDs in our sample, despite the much smaller site area. This is due to the higher than average proposed density and the lower than average vehicle ownership per capita of Option 4A.

External Walking Estimate

From the equation (2):

walk share of external trips = mean share of external walk trips – 0.029 * (ln area of this site – mean of ln area of 412 MXDs) + 0.031 * (ln actden of this site – mean of ln actden of 412 MXDs) + 0.009 * (ln jobpop of this site – mean of ln jobpop of 412 MXDs) + 0.021 * (ln empmile of this site – mean of ln empmile of 412 MXDs) – 0.133 * (ln vehcap of this site – mean of ln vehcap of 412 MXDs)

The mean values of these variables come from our database of 412 MXDs. Substituting values into the equation above, we obtain the following for Option 4A:

walk share of external trips = 0.177 or 17.7%

The walk share of external trips depends on the area of the site, the activity density of development on the site, the job-population balance of development on the site, the number of employees within one mile of the development, and the vehicles per capita of residents of the development. The walk share of external trips for Option 4A is above the average for the 412 MXDs in our sample, despite the much smaller site area and the smaller number of employees within on mile of the development. This is due to the higher than average proposed density and the lower than average vehicle ownership per capita of Option 4A.

Table 4. Daily Vehicle Trips for Development Options

		Low Parking		High Parking		Daily vehicle Trips of Park and Ride
	ITE Estimation	Reduction %	Net Trips	Reduction %	Net Trips	
Option 1A	5,790	35.7%	3,725	26.0%	4,284	1,058
Option 1B	6,505	37.1%	4,091	27.4%	4,725	1,058
Option 2A	6,178	37.0%	3,892	28.9%	4,391	346
Option 2B	7,683	38.1%	4,755	30.8%	5,315	346
Option 3A	8,549	38.5%	5,256	27.9%	6,160	647
Option 3B	7,205	36.9%	4,547	26.0%	5,333	647
Option 3C	9,893	39.7%	5,961	29.3%	6,990	647
Option 4A	8,350	37.2%	5,245	27.6%	6,046	509
Option 4B	10,021	38.6%	6,154	29.5%	7,062	509

External Transit Estimate

From the equation (3):

transit share of external trips = mean share of external transit – 0.009 * (ln area of this site – mean of ln area of 412 MXDs) + 0.022 * (ln actden of this site – mean of ln actden of 412 MXDs) + 0.010 * (ln empmile of this site – mean of ln empmile of 412 MXDs) – 0.092 * (ln vehcap of this site – mean of ln vehcap of 412 MXDs)

The mean values of these variables come from our database of 412 MXDs. Substituting values into the equation above, we obtain the following for Option 4A:

transit share of external trips = 0.108 or 10.8%.

The transit share of external trips depends on the area of the site, the activity density of development on the site, the number of employees within one mile of the development, and the vehicles per capita of residents of the development. The transit share of external trips for Option 4A is above the average for the 412 MXDs in our sample, despite the much smaller site area and the smaller number of employees within on mile of the development. This is due to the higher than average proposed density and the lower than average vehicle ownership per capita of Option 4A.

AM and PM peak hour totals are shown in Tables 5 and 6.

Table 5	AM Peak Hour Vehicle Trips of the Development					AM Peak hour Trips of Park and Ride
		Low Parking		High Parking		
	ITE Estimation	Reduction %	Net Trips	Reduction %	Net Trips	
Option 1A	545	35.7%	351	26.0%	403	265
Option 1B	605	37.1%	381	27.4%	439	265
Option 2A	539	37.0%	340	28.9%	383	86
Option 2B	666	38.1%	412	30.8%	461	86
Option 3A	743	38.5%	457	27.9%	535	162
Option 3B	630	36.9%	398	26.0%	466	162
Option 3C	857	39.7%	516	29.3%	605	162
Option 4A	718	37.2%	451	27.6%	520	127
Option 4B	876	38.6%	538	29.5%	617	127

Table 6	PM Peak Hour Vehicle Trips of the Development					PM Peak hour Trips of Park and Ride
		Low Parking		High Parking		
	ITE Estimation	Reduction	Net Trips	Reduction	Net Trips	
Option 1A	620	35.7%	399	26.0%	459	265
Option 1B	706	37.1%	444	27.4%	513	265
Option 2A	631	37.0%	398	28.9%	448	86
Option 2B	813	38.1%	503	30.8%	562	86
Option 3A	847	38.5%	521	27.9%	610	162
Option 3B	685	36.9%	432	26.0%	507	162
Option 3C	1,009	39.7%	608	29.3%	713	162
Option 4A	845	37.2%	531	27.6%	612	127
Option 4B	1,071	38.6%	658	29.5%	755	127

Net Vehicle Trips

In sum, the total reduction in ITE vehicle trips for Option 4A is 37.2% (0.122 + (1-0.122)*(0.177+0.108)). This is higher than the average trip reduction for the 412 MXDs in our sample, 22.4%. This is due to the higher than average density and the lower than average vehicle ownership per capita of Option 4A. The reductions for each development scenario are shown in Table 3.

The resulting daily vehicle trip totals for the different development scenarios are shown in Table 4.

Conclusion

The PM (afternoon) peak hour trip generation by the Cline Dahle site is of greatest interest to us, since the PM peak hour is the most congested time of day at and near the Jeremy Ranch interchange. The smallest number of PM peak hour trips generated is for Option 2A with the Low Parking assumption, which amounts to 398 development-related vehicle trips and 86 park-and-ride-related vehicle trips, for a total of 484 vehicle trips. The largest number of PM peak hour trips generated is for Option 4B with the High Parking assumption, which amounts to 755 development-related vehicle trips and 127 park-and-ride-related vehicle trips, for a total of 882 vehicle trips.

For all options on the Cline Dahle site, the estimated reductions in ITE vehicle trips range from 26.0% to 39.7%. This is higher than the average vehicle trip reduction for the 412 MXDs in our sample, 22.4%. This is due to the higher than average density and the lower than average vehicle ownership per capita of all options. For all options, the activity density ranges from 34,428 to 65,876 per square mile and the vehicle ownership per capita ranges from 0.51 to 0.78 vehicles per person. For the 412 MXDs in our sample, the average activity density is 18,362 per square mile and the average vehicle ownership per capita is 0.85. We also acknowledge one limitation of the estimations of vehicle trip reduction, which is the lack of transit service variables in the models. The availability of transit service influences the total reduction, especially the external mode choices. In the 412 MXDs in our sample, there are 62% of households living within ¼ mile of a transit stop. The transit stop density is about 78 stops per square mile and 23.6 percent of regional jobs can be reached within 30 minutes by public transportation. Comparable figures are not available for the Cline Dahle site.

Another possible limitation relates to the Low Parking scenarios. These assume very low parking ratios compared to the suburban standards assumed in the High Parking scenarios and taken from the Summit County code. One might question whether the low ratios are realistic. In our professional judgment, they are realistic but only if other aspects of the development deviate from suburban norms to be far more urban.

We know from our studies of TODs around the U.S. that low parking demands don't just happen but have to be fostered by policies that make parking optional for residents. Some of the policies we would recommend in order to reduce parking demands include:

- high quality transit service to the site, particularly in terms of frequency of service, reliability of service, hours of operation, and comfort and convenience;
- unbundling of parking costs for residents, meaning that they have to pay for individual parking spaces if they want them separate from their rents;
- provision of parking "cash out" for employees, where those who do not drive to work receive a monthly cash payment equivalent to the value of a free parking space for those who drive to work;
- provision of travel demand management services for employees, including flexible work hours and compressed work weeks.

Vehicle Trip Distribution

The Utah Department of Transportation (UDOT) recently completed an interchange analysis for the Jeremy Ranch I-80 interchange in Summit County. The interchange analysis evaluated several options to improve traffic operations at the interchange. The preferred option was a pair of large roundabouts at the interchange, as shown in Figure 1.

A traffic impact analysis requires that vehicle trips coming to or going from the development site be distributed to the surrounding roadways. That is, the 398 vehicle trips generated during the pm peak hour under Option 2A, Low Parking assumption, have to be assigned to the local and regional road network. So do the 755 vehicle trips generated during the pm peak hour under Option 4B, High Parking assumption.

We cite these two examples, in particular, because they are the lowest and highest trip generation numbers of any options studied. Hence we selected the extreme values for the two runs. Note that by convention, our analysis focuses on the PM peak hour (not am peak or daily) because the PM peak hour is ordinarily the time of maximum congestion.

Also note that these vehicle trip numbers include trips inbound to the development and outbound from the development. The numbers indicated above are the sums of the two. This also requires us to make assumptions in our trip distribution.

This distribution of vehicle trips is inherently subjective, but should be reasonable. Our trip distribution assumptions for the trips generated by the development are shown in Table 7. For example in Figure 2, for Option 2A during the pm peak hour, we assumed that 70 percent of the total trips (279 trips) were inbound and 30 percent (119 trips) were outbound. Further, of the outbound trips, we assumed that 70

Figure 1. Proposed roundabout intersection

percent (84 trips) turn right onto Rassmussen northbound and 30 percent (35 trips) turn left onto Rassmussen southbound. Only the northbound trips are of interest to us in the traffic impact study since only those load on the Jeremy Ranch interchange.

All of these northbound trips (84 trips) enter the proposed north roundabout. Of the total trips entering the north RAB, none are assumed to take the first exit onto Homestead northbound, 25 percent (21 trips) are assumed to the second exit onto I-80 westbound, and the remaining 75 percent (63 trips) would take the third exit onto Homestead southbound. Of the trips entering the south RAB (roundabout), none are assumed to take the first exit onto Kilby westbound, 30 percent (19 trips) are assumed to the second exit onto Pinebrook southbound, none are assumed to take the third exit onto Kilby eastbound, and the remaining 70 percent (44 trips) would take the fourth exit onto I-80 eastbound.

Of the inbound trips, we assumed that 70 percent (195 trips) come from the north on Rassmussen and turn left into the development, while 30 percent (84 trips) come from the south on Rassmussen and turn right into the development. Only the southbound trips are of interest to us in this traffic impact study because only they affect the performance of the Jeremy Ranch interchange.

All of these southbound trips (195 trips) funnel through the proposed north RAB. Of the total trips entering the north RAB, 30 percent (59 trips) are assumed to come from the east on I-80 and take the 1st exit onto Rassmussen and 70 percent (137 trips) are assumed to come from the south on Homestead and take the first exit onto Rassmussen. Of the trips coming from the south on Homestead, 60 percent (82 trips) are assumed to enter the south RAB from I-80 eastbound and take the third exit onto Homestead, 20 percent (27 trips) are assumed to enter the south RAB from Pinebrook northbound and take the second exit onto Homestead, and 20 percent (27 trips) are assumed to enter the south RAB from Kilby westbound and take the first exit onto Homestead. (Table 7).

For the distribution of trips generated by the park-and-ride facility during the pm peak hour, we assumed that all of them (86 trips for Option 2A) turn right out of development on Rassmussen, enter the north RAB, and take the second exit onto I-80 west.

The same logic applies to our analysis of the high volume scenario (Option 4B, High Parking assumption). Trips are distributed in the same percentages for the different movements.

Traffic Simulation

Table 7. Trip Distribution for the PM Peak Hour Vehicle Generated by the development	Alternative 2A (low parking)	Alternative 4B (high parking)
Total Trips Generated	***398***	***755***
Outbound		
Outbound total	119	229
turn right out of development onto Rassmussen northbound	84	159
enter north RAB and take 2nd exit onto I-80 westbound	21	40
enter north RAB and take 3rd exit onto RAB Homestead southbound	63	119
enter south RAB and take 2nd exit onto Pinebrook southbound	19	40
enter south RAB and take 4th exit onto I-80 eastbound	44	83
Inbound		
Inbound total	279	528
turn left into development (from Rassmussen north)	195	370
enter north RAB from east/I-80 and take 1st exit on Rassmussen north	59	111
enter north RAB from south/Homestead south and take 1st exit onto Rassmussen north	137	259
enter south RAB from I-80 eastbound and take 3rd exit onto Homestead northbound	82	155
enter south RAB from Pinebrook northbound and take 2nd exit onto Homestead northbound	27	52
enter south RAB from Kilby westbound and take 1st exit onto Homestead northbound	27	52

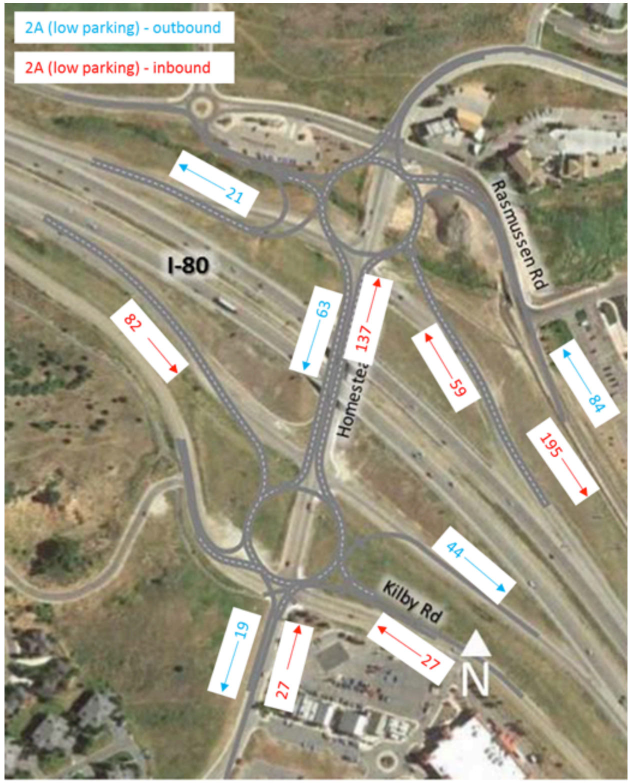


Figure 2. Trip distribution

Using the traffic projections supplied for the Cline Dahle site, Ryan Hales of Hales Engineering ran simulations for the proposed interchange design at the Jeremy Ranch interchange. The proposed design would replace the current standard diamond interchange with traffic signal control with two roundabouts, one to the north for westbound traffic on I-80, the other to the south for eastbound traffic.

The simulations were performed with VISSIM, a state-of-practice and state-of-the art (take descriptive language off the VISSIM website). Hales Engineering requested the VISSIM model that was used to evaluate the preferred interchange option. UDOT provided a future 2040 PM VISSIM model of the planned roundabout interchange. It was assumed that the VISSIM model had already been calibrated and tested by the UDOT interchange evaluation project, therefore no additional changes were made to the model.

Future 2040 PM Background LOS Results

Using VISSIM, and following the Highway Capacity Manual (HCM) 2010 methodology, the evening peak hour level of service (LOS) was computed for each study intersection. The results of this analysis are reported in Figure 3. Multiple runs of VISSIM were used to provide a statistical evaluation of the interaction between the intersections. These results serve as a baseline condition for the impact analysis of the proposed development during future (2040) conditions. The 2040 background volumes, to which development-related traffic is added, come from UDOT and assume dramatic growth in Summit County population toward the end of the period. Given existing zoning and other constraints, Summit County planners question whether growth like this is realistic.

As a result of this worst-case scenario for background traffic, the analyses that follow represent the worst

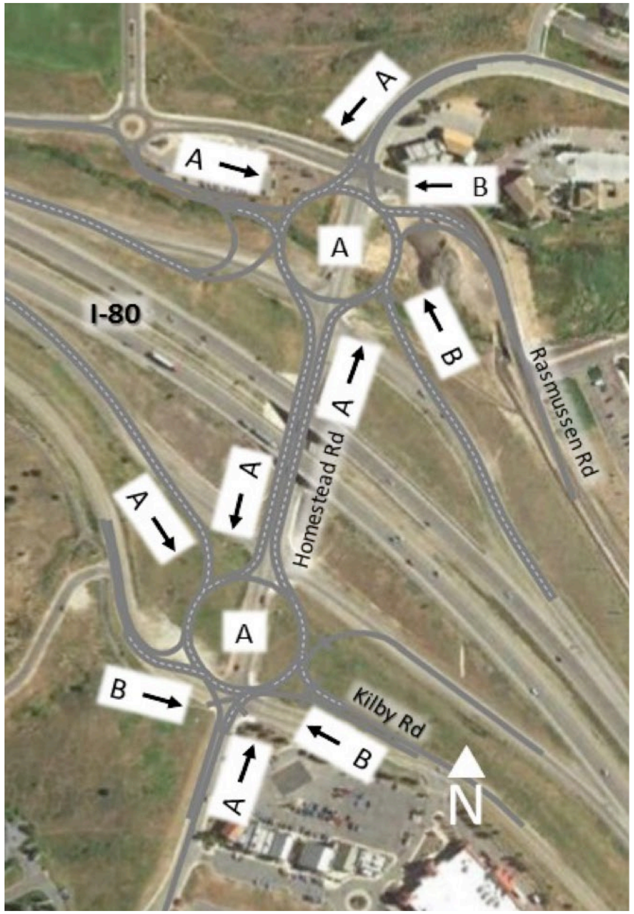


Figure 3. Future 2040 Background Level of Service

case for traffic congestion at the Jeremy Ranch interchange.

As shown in Figure 3, both study intersections are anticipated to operate at LOS A during the evening peak hour.

Trip generation and distribution for the proposed project was calculated in the previous sections. The traffic assignment was completed for two scenarios: a Low Parking scenario, and a High Parking scenario. The provided traffic assignment for the project was as follows:

Low Parking Scenario:
- **PM Peak Hour** **398 Total Trips**
  - o **Entering** **279 Trips**
  - o **Exiting** **119 Trips**
- **Park & Ride Trips** **86 Trips**

High Parking Scenario:
- **PM Peak Hour** **755 Total Trips**
  - o **Entering** **528 Trips**
  - o **Exiting** **226 Trips**
- **Park & Ride Trips** **127 Trips**

Using the traffic assignment values shown above, the future 2040 p.m. plus project scenarios were analyzed.

Future 2040 PM Plus Project Low Parking Scenario LOS Results

Using VISSIM, and following the Highway Capacity Manual (HCM) 2010 methodology, the evening peak hour LOS was computed for each study intersection. The results of this analysis are reported in Figure 4. Multiple runs of VISSIM were used to provide a statistical evaluation of the interaction between the intersections. These results serve as a comparison for the impact analysis of the proposed development during future (2040) conditions. As shown in Figure 4, the Rasmussen roundabout is anticipated to operate at level of service C during the p.m. peak hour in 2040, with all approaches operating at LOS D or better. The Kilby roundabout is anticipated to operate at level of service B during the PM peak hour in 2040, with all approaches operating at LOS C or better. The maximum queue expected is on the westbound I-80 off-ramp with a maximum queue of almost 500 feet.

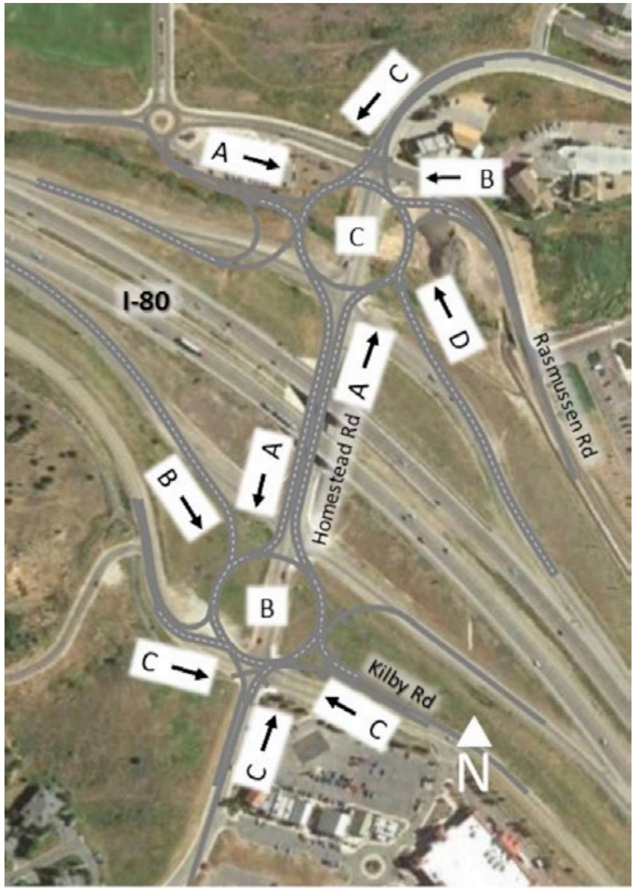


Figure 4: Future 2040 Plus Project Low Parking Level of Service

Future 2040 PM Plus Project High Parking Scenario LOS Results

Using VISSIM, and following the Highway Capacity Manual (HCM) 2010 methodology, the evening peak hour LOS was computed for each study intersection. The results of this analysis are reported in Figure 5. Multiple runs of VISSIM were used to provide a statistical evaluation of the interaction between the intersections. These results serve as a comparison for the impact analysis of the proposed development during future (2040) conditions.

As shown in Figure 5, the Rasmussen roundabout is anticipated to operate at level of service F during the p.m. peak hour in 2040 with the "High Parking" traffic added. The westbound I-80 off-ramp is anticipated to operate at LOS F, and is anticipated to have a maximum queue of almost 900 feet (average of 680 feet). The Kilby roundabout is anticipated to operate at level of service C during the p.m. peak hour in 2040. However, the Kilby Road entry into the roundabout is anticipated to operate at level of service F, with a maximum queue of 400 feet (average 120 feet) during the p.m. peak hour.

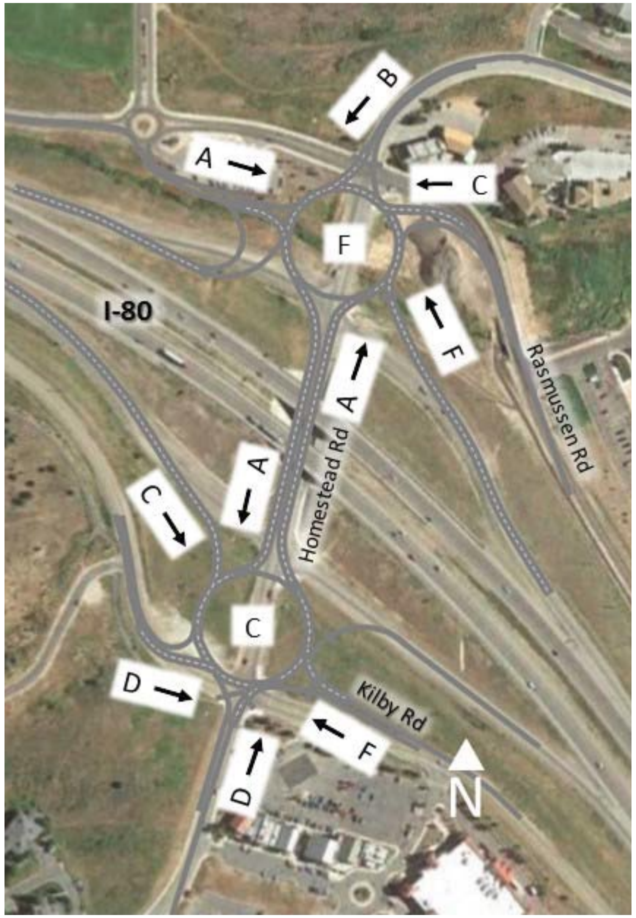


Figure 5. Future 2040 Plus Project High Parking Level of Service

Traffic Impact

The "Low Parking" scenario appears to operate at acceptable levels of service, and reasonable queuing at the roundabouts. However, the "High Parking" scenario is anticipated to push the Rasmussen roundabout to LOS F, with extensive delay and queuing at the westbound I-80 off-ramp. This scenario is not recommended, as potential queuing onto mainline I-80 can create unsafe conditions where speed differentials are greatest, e.g., stopped vehicles on the ramp next to free-flowing traffic on I-80.

In addition, it is recommended that a separate left-turn deceleration lane on Rasmussen Road be provided at the project access for either scenario. This will improve traffic operations and safety on Rasmussen Road.

CONCLUSION

The site capacity study for the Cline-Dahle site looked at eight different density options, with four different site plan configurations. These options were designed to provide a compact, mixed use neighborhood where the expected number of trips by car are reduced, the amount of parking is reduced and the quality of life is increased through design of infrastructure, open space and walkability. The number of units varies with each, as does the amount of park and ride spaces provided.

In this study, our recommendation is that the Cline Dahle site is an appropriate location to build affordable and workforce housing. In a high income community like Summit County, this kind of housing allows local employees in ski resorts, shopping centers, restaurants, schools, and government services to live in the area where they work. Increased density means that more people can be accommodated, and that increase in transit service becomes more practical.

The layouts of the options are for illustration and calculation of traffic impacts, but they also demonstrate that parking, open space and housing units can be attractively accommodated on the site at densities that can support alternative transportation modes like walking, biking, and transit. On the site, each plan option dedicates more than 45% of the land to natural open space. In addition, there are more intensely used open spaces intended for recreation, parks, playgrounds, and paths.

We are certain that the site can be developed with at least 600 units, 15,000 SF of commercial and at least 180 park and ride spaces (see Option 2A) without unacceptable traffic impacts. In general, the more park and ride spaces there are, the more traffic will be generated in the afternoon that impacts congestion. So trade-offs between housing and commercial vs park and ride could be considered.

This site, which is owned by Summit County, has much to offer that makes a compact community feasible: convenient bicycle routes, a nearby elementary school, scenic beauty, convenient highway access, and high visibility for park and ride. As the County moves forward, each development proposal will need to evaluated for design, housing mix, walkability, and transit potential, as well as traffic impacts.