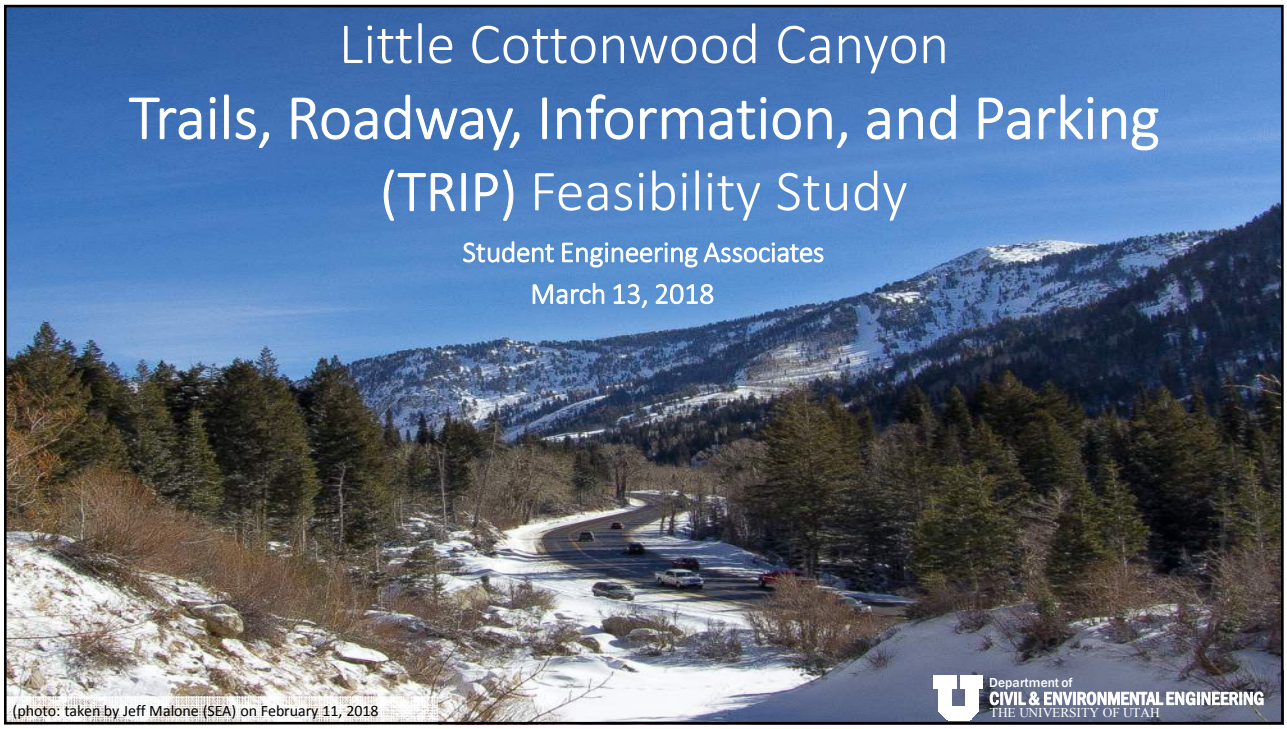
Little Cottonwood Canyon
Trails, Roadway, Information, and Parking (TRIP) Feasibility Study

Student Engineering Associates

March 13, 2018



(photo: taken by Jeff Malone (SEA) on February 11, 2018

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WHO WE ARE

- Student Engineering Associates (SEA)
- Civil and Environmental Engineering Undergraduate
- On behalf of Granite Community Council

(photo: taken by Jeff Malone (SEA) on February 11, 2018

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RESIDENTIAL PERSPECTIVE

Common Complaints

Traffic Congestion Affects Daily Life

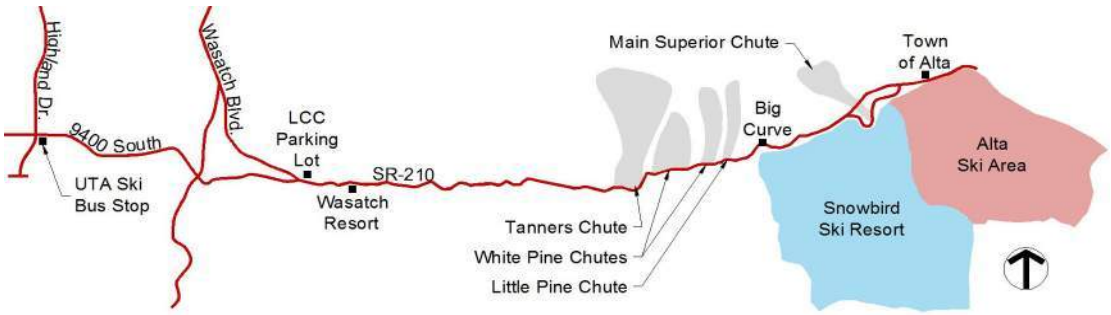
- Neighborhood exits blocked
- Students miss school
- Emergency vehicle lack of mobility

Popular Community Solutions

- Increase carpooling
- More Park & Ride locations
- Incentivize mass transit/carpooling

(image source: obtained from appendices of Cottonwoods Transportation Recommendations)

TRANSPORTATION NETWORK



(image source: developed by Savanah Whitaker (SEA) with insight from David Eckhoff, PhD, PE)

EXISTING CONDITIONS

Winter Season
- Peak traffic and hazardous roads

Avalanche Control
- Artillery and Gazex®
- Road closure

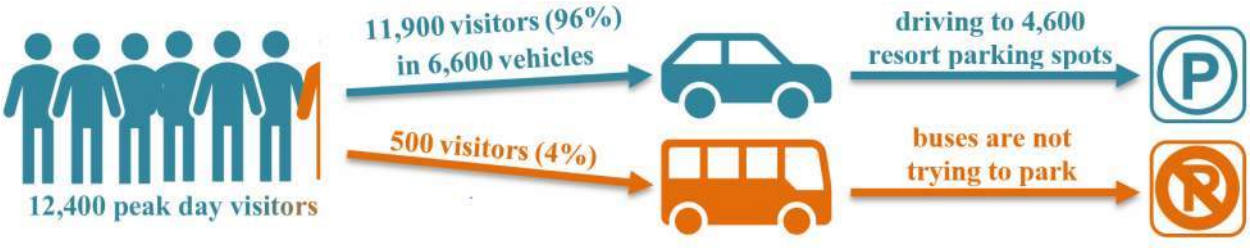
Resort Exits
- Require manned traffic control

Bike/Foot Traffic
- Shoulder parking reduces right-of-way
- Safety

(image source: obtained from appendices of Cottonwoods Transportation Recommendations)

EXISTING CONDITIONS

- Increase in visitors
- Average ridership of 1.8 ppl/veh
- ~25% of in-canyon parking is illegal



(image source: figure created by Savanah Whitaker (SEA) with data from Mountain Accord)

VISION STATEMENT

Our vision is for Little Cottonwood Canyon to remain a captivating destination where people of diverse interests and hobbies can safely experience Utah's Wasatch Mountains, while preserving the health and vitality of the Canyon and its surrounding communities.

Bringing transportation diversity, information, and safety to LCC

BRAINSTORMING

- At the mouth of Big Cottonwood Canyon land north of the existing parking lot could be developed to provide "500" more spots.
- Increasing the number of buses up the canyon, having some buses stop at specific resorts to reduce travel time
- As an alternative to cars or traditional buses John Thomas suggested using smaller shuttle buses or Uber-type service. He shard the idea of shuttle vans with a trailer to hold gear and equipment.
- Other additional parking was considered at the swamp lot or along 9400 south at an existing park and ride lot.
- Expansion of parking at the mouth of Little Cottonwood Canyon, with improved bus pickup and drop off locations
- Construction of a queue for cars to wait in at the mouth of Little Cottonwood Canyon to hold cars during temporary canyon closures, while maintaining vehicles place in line
- Incentivize carpooling through tolling based on current number of vehicles in already [illegible] number of [illegible] the vehicle
- Building a light rail or personal rapid transit to the top of the canyon
- Construction of an overhead gondola to carry visitors from the mouth of [illegible]
- Autonomous vehicles and shuttles
- Snow sheds/barriers at prevalent avalanche locations to prevent canyon closures during avalanche operations
- Heated pavement under the snow sheds and possibly the whole length of the canyon to decrease ice build up and improve safety
- Designated location at the mouth of the canyon for chains to be put on tires and for officers to turn cars away that were not adequately prepared for snowy conditions.
- Gazex or other onsite avalanche control devices
- Better parking at trail heads in the canyon
- Enforcement of illegal parking laws

over 30 concepts

- Designated bike/pedestrian lanes running the length of the canyon to improve safety and comfort while recreating.
- Problems with traffic also generate because of specific curves within the canyon, single lane in both directions for much of the canyon, and entries into the ski resorts.
- Straighten out the "Big Curve" through cut/fill or a bridge to reduce cars dramatically reducing speeds
- Reconfiguration of entry intersections at resorts to provide better sight to drivers
- Tunnels leaving the resorts that would travel under the road and merge with the down hill traffic to reduce left turns.
- [illegible] the length of the canyon that could alternate direction of traffic flow when needed
- [illegible] ust below Entry 1, as it causes a pinch point during high traffic volumes.
- [illegible] ts in the canyon that significantly reduce speeds of some vehicles
- [illegible] e-decker road
- A[illegible] ohn Thomas presented us with, was to incorporate smart technology into the canyon.
- C[illegible] th information about parking availability, weather conditions, carpooling opportunities, road closures, etc.
- Signs along the road sharing information about parking and other conditions.
- Equipping bicyclists and runners with electronic trackers that gave drivers a heads up of who was around the next bend.
- Updating trailheads with smart kiosks that would provide information about wildlife, recreational opportunities, and canyon preservation tips.
- Tolling system at mouth of canyon that would rely on infrared scanners instead of person to person contact
- Other ideas were generated to simply improve the quality of visitors experience while in the canyon.
- Better restrooms with running water at trail heads
- Visitor center hosting exhibits and concessions to visitors waiting for the next bus.

CHOOSEN FOR FEASIBILITY STUDY

Transportation Systems

- Gondola
- Autonomous Vehicle Network
- Multimodal Transportation Hub

Roadway Improvements

- Avalanche Mitigation
- Resort Exits
- Big Curve Realignment

Bike and Pedestrian Path

(photo: taken by Jeff Malone (SEA) on February 11, 2018

RANKING CRITERIA

Safety..... 30%
- Ability to increase safety

Serviceability/Mobility..... 25%
- Meets performance goals
- Provides level of comfort & reliability

Environmental Impact.....20%
- Creates minimal impact from construction & operations

Affordability.....15%
- Estimated capital costs are within budget

Aesthetics..... 10%
- Ability to incorporate into surroundings and community

TRANSPORTATION SYSTEMS

Gondola – *Thomas Buhler*

Autonomous Vehicle Network – *Moriah Gamache*

Multimodal Transportation Hub – *Nick Summerhays*

GONDOLA

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GONDOLA

Performance

- 3S Detachable Gondola System
  - 5,500 persons/hour/direction
  - Independent & redundant safety features
  - 19 mph top speed
  - Comfortable carriages
  - Sizes vary, up to 35 passengers

GONDOLA

Constraints

- Environmental
  - Aesthetics
  - Wildlife
- Constructability
  - Mountainous Terrain → Cost Increase
- Social
  - Public Engagement
  - Construction Access

GONDOLA

Constraints

- Economic
  - ≈ $100M
  - ROW & Easements
  - Operation & Maintenance
- Political
  - External funding
  - Wilderness Area Proximity

GONDOLA

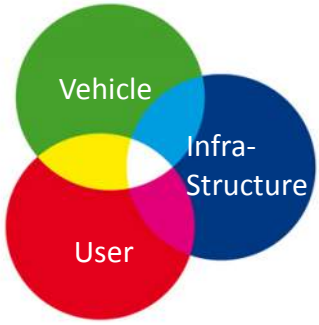
Evaluation

- Safety
- Serviceability/Mobility
- Environmental Impact
- Affordability
- Aesthetics

AUTONOMOUS VEHICLE NETWORK (AVN)

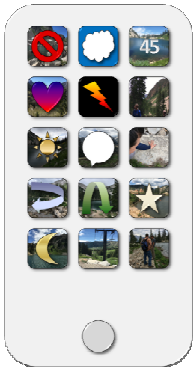
SMART System

Sustainable
Methods to
Achieve
Ridership
Targets

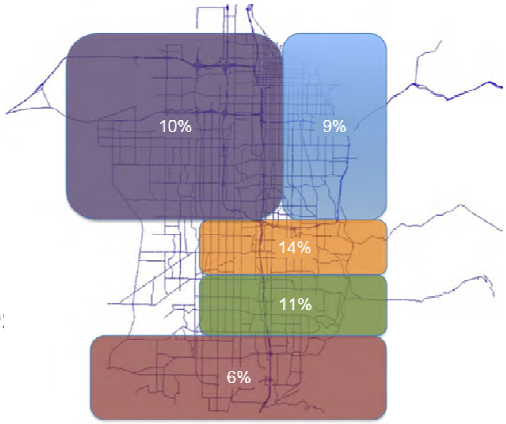


AUTONOMOUS VEHICLE NETWORK (AVN)

User Interface



- ☼ Weather
- 👍 Road conditions
- ☺ Activities
- ↪ Directions
- ⑩ Parking availability
- 🕓 Nearby shuttle vehicles & wait times

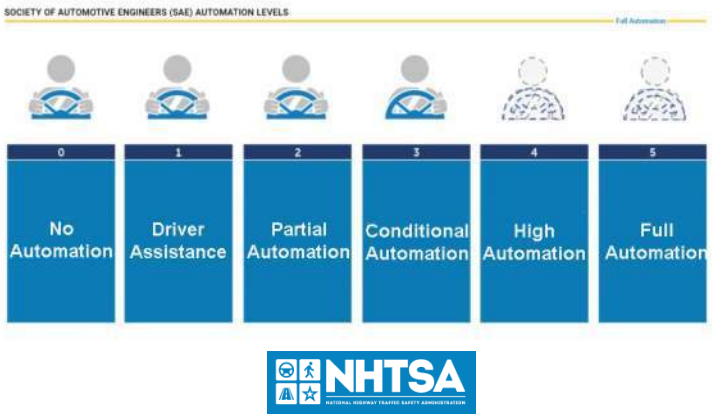


traveling from HOME for RECREATION (50%)

(image source: modified images from Mountain Accord report)

AUTONOMOUS VEHICLE NETWORK (AVN)

Vehicle Specifications



AUTONOMOUS VEHICLE NETWORK (AVN)

Constraints

- Technology
  - Until vehicles are retrofitted with autonomous technology, the UTA vanpool could subsidize the fleet while the enterprise could drive the vehicles

AUTONOMOUS VEHICLE NETWORK (AVN)

Safety

"94% *of serious crashes are due to human error."*

NHTSA

AUTONOMOUS VEHICLE NETWORK (AVN)

Evaluation

- Safety
- Environmental Impact
- Aesthetics

- Serviceability/Mobility
- Affordability

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MULTIMODAL TRANSPORTATION HUB

Attractive and Smart Multimodal Hub

MULTIMODAL TRANSPORTATION HUB

Hub Performance Goals

- Increase parking
- Maximize ridership
- Reduce congestion

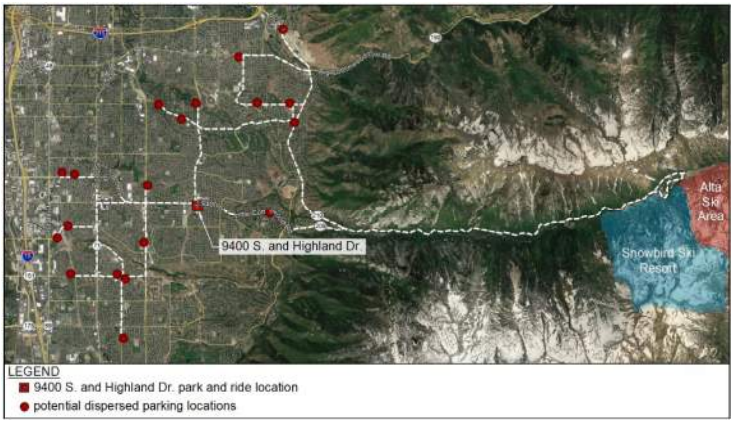
Hub Features

- Information Sharing
- Retail stores

MULTIMODAL TRANSPORTATION HUB

Parking: System Overview

- In canyon
  - No significant traffic increase
- Out of canyon
  - Centralized
    - Hubs
  - Distributed system
    - Integrated later in larger dispersed system



MULTIMODAL TRANSPORTATION HUB

Potential Location

- 9400 South and Highland Dr.

Attractive Features

- Capacity
  - 300-350 veh/level
- Accessibility
- UTA owned land
- Commercial area

MULTIMODAL TRANSPORTATION HUB

Constraints

- Environmental
  - Low impact
- Maintenance
  - Minimal

MULTIMODAL TRANSPORTATION HUB

Cost Estimate

- 3 – levels $18-23 million
  - Materials
  - Labor

Other Cost

- Maintenance cost
- Commercial real estate
  - Generates revenue

MULTIMODAL TRANSPORTATION HUB

Evaluation

- Cost
  - Public/private partnerships
- Serviceability
  - Accommodate users
- Environmental Impact
  - Emissions
- Safety
  - Reduces congestion

- Safety
- Environmental Impact
- Aesthetics

- Serviceability/Mobility
- Affordability

ROADWAY IMPROVEMENTS

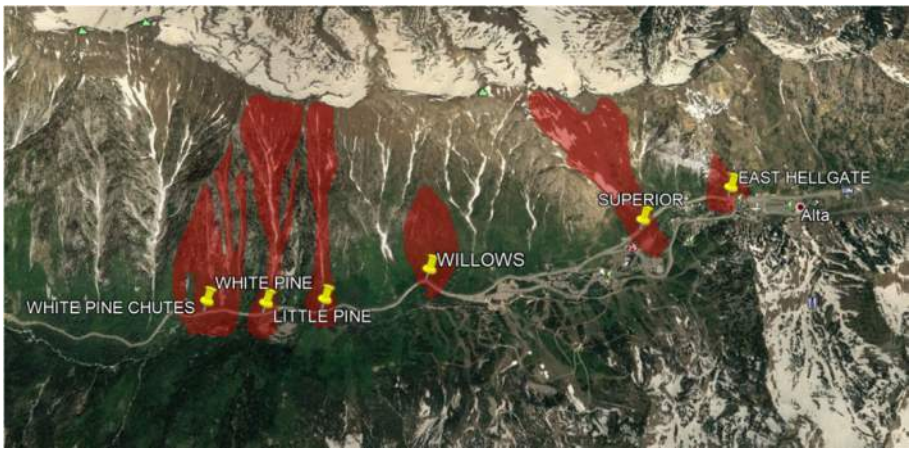
Avalanche Mitigation – *Bryce Ferguson*

Resort Exits – *Bryan Luu*

Big Curve Realignment – *Hui Wang*

SAFETY

AVALANCHE MITIGATION (SNOW SHEDS)



SAFETY

AVALANCHE MITIGATION (SNOW SHEDS)

Performance

- Withstand forces from avalanche
- Mitigate closures from snow removal
- Will not disrupt flow of traffic
- Act as a wildlife crossing

SAFETY

AVALANCHE MITIGATION (SNOW SHEDS)

Constraints

- Operations
  - Ice melt system
  - Drainage
  - Lighting
  - Fencing and vegetation
- Environmental
  - Wildlife crossing
  - Construction within footprint of SR-210

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SAFETY

AVALANCHE MITIGATION (SNOW SHEDS)

Cost Estimate

- ≈ $67 million for highest priority chutes
- ≈ $119 million for all chutes
- Cost may be reduced using corrugated steel culvert (TBD)

Chute	Cost (Million)	Priority
Superior	$17	Low
East Hellgate	$21	Low
White Pine	$16	High
White Pine Chutes	$34	High
Little Pine	$17	High
Willows	$14	Low

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SAFETY

AVALANCHE MITIGATION (SNOW SHEDS)

Evaluation

- Safety improved in event of avalanche
- Reduces closure times due to avalanches
- Mitigates snow removal on roads
- Improves traffic flow

- Safety
- Serviceability/Mobility
- Environmental Impact

- Affordability
- Aesthetics

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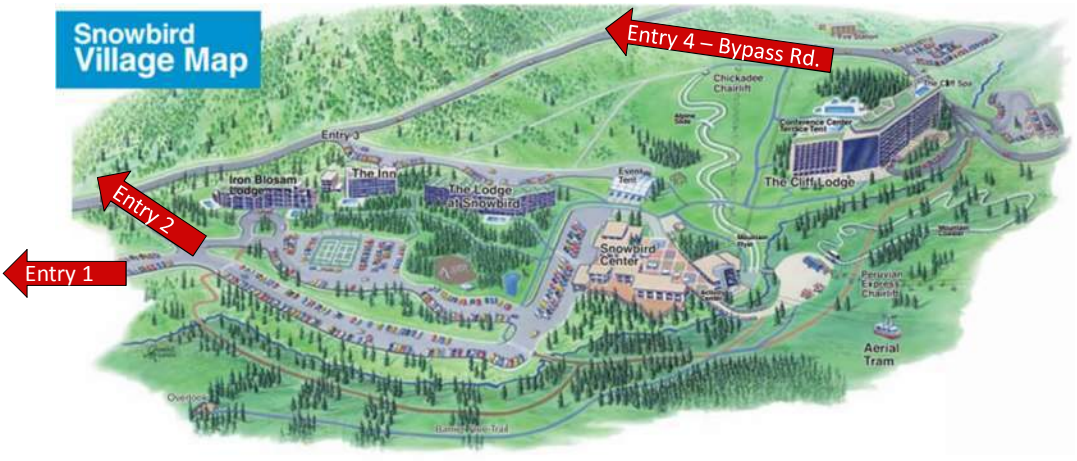
OPERATIONS

RESORT EXITS



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OPERATIONS

RESORT EXITS

Performance

- Allow traffic to **merge** from resort exits
- Reduce potential accidents
- **Improve traffic flow** in both directions

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OPERATIONS

RESORT EXITS
Constraints

Constraints

- Maintenance
  - Snow and ice removal
- Environmental
  - Emissions reduced from lowered congestion at each entry point
- Stakeholder Input
  - Granite Community Council and UDOT interested
- Cost Estimate
  - ≈ $4.8 Million

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OPERATIONS

RESORT EXITS

Evaluation

- Beneficial for traffic efficiencies and safety
- Easier merging = more traffic movement throughout the Canyon
- Reduce congestion
- Safety improved with fewer car accidents

- Safety
- Serviceability/Mobility
- Aesthetics

- Environmental Impact
- Affordability

OPERATIONS

THE BIG CURVE REALIGNMENT

Location

- SR-210, west of the first Snowbird entrance

Existing Condition

- Two-lane merging at Big Curve
- 24 vehicle accidents during 4-year period

OPERATIONS

THE BIG CURVE REALIGNMENT

Performance Goals

- Eliminate down canyon pinch point
- Improve traffic efficiency
- Safer merging
- Reduce traffic accidents

OPERATIONS

THE BIG CURVE REALIGNMENT

Constraints

- Environment
  - Forest and aquatic life
- Stakeholder input
  - UDOT
- Cost
  - ≈ $8-$12 Million

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OPERATIONS

THE BIG CURVE REALIGNMENT

Evaluation

- Improve traffic efficiency and safety
- Less congestion at peak hour
- Help move emergency vehicles

- Safety
- Serviceability/Mobility
- Affordability
- Aesthetics

- Environmental Impact

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BIKE AND PEDESTRIAN PATH

Route 1: Separated Path Old Quarry Rd

Route 2: Roadside SR-210

Kenzie Osguthorpe

Jeff Malone

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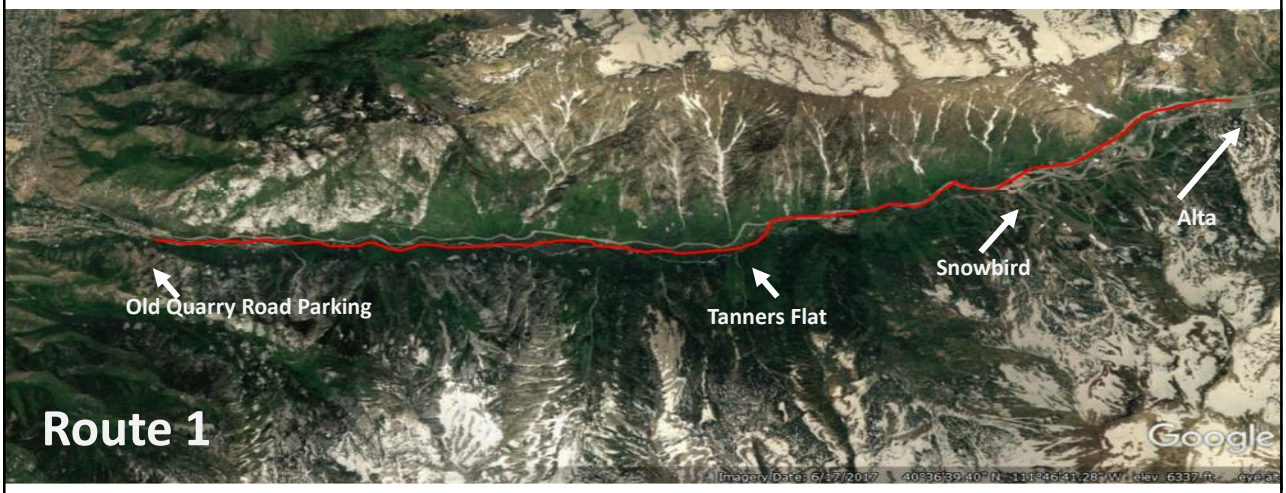
SAFETY

BIKE & PEDESTRIAN PATH



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SAFETY

BIKE & PEDESTRIAN PATH

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SAFETY

BIKE & PEDESTRIAN PATH

Route 1

- Along Old Quarry road to Little Cottonwood Trail to SR-210
- Removes bikers and pedestrians from much of SR-210
- Facilitates uphill road bikers along with uphill/downhill mountain bikers and pedestrians

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SAFETY

BIKE & PEDESTRIAN PATH

Constraints

- Environmental
- Maintenance
- Utilities
- Cost

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SAFETY

BIKE & PEDESTRIAN PATH

Cost Estimate

- Parley Canyon Trail Feasibility Study
- Recommended by American Association of State Highway and Transportation Officials (AASHTO)
- Total Cost: ≈ $13 Million

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SAFETY

BIKE & PEDESTRIAN PATH

Evaluation

- Within budget
- Multi-user friendly
- Moderate environment disturbance
- Reduction of pedestrian-vehicular conflicts
- Elimination of non-designated trails

- Safety
- Serviceability/Mobility
- Affordability
- Aesthetics
- Environmental Impact

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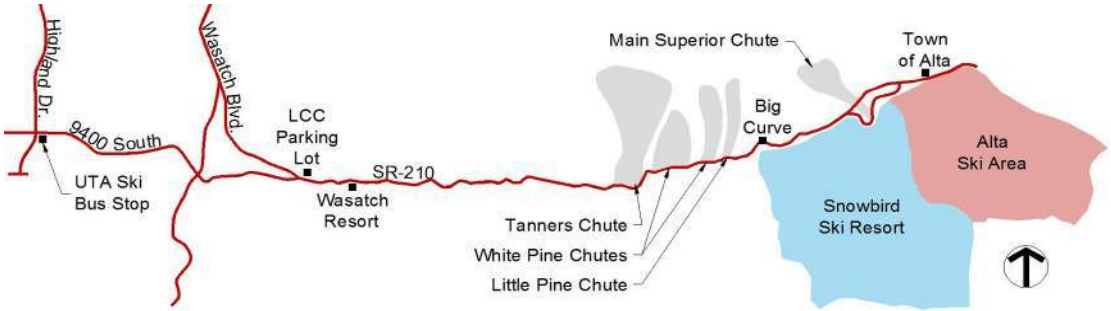
CONCLUSION: NETWORK REVIEW



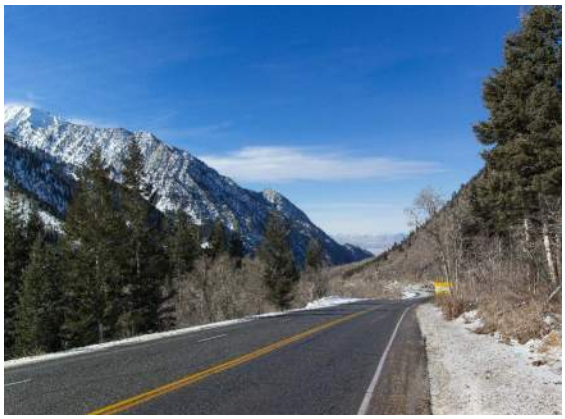
(image source: developed by Savanah Whitaker (SEA) with insight from David Eckhoff, PhD, PE)

RECOMMENDATIONS

Smart Transportation Network
reduce congestion
- Communication/Information System
- Automated Vehicle Technology
- Distributed Parking Nodes

Roadway Improvements
enhance safety & reduce congestion
- Avalanche Control
- Merging Realignment

Essential Feature
enhance safety
- Separated & Paved Trail



(photo: taken by Jeff Malone (SEA) on February 11, 2018

Thank you

WE APPRECIATE YOUR FEEDBACK