West Vail Interchange

ALTERNATIVES ANALYSIS
Problem Definition and Existing Conditions
Alternative Solutions Analysis

Prepared for:

Town of Vail

Prepared by:

MK CENTENNIAL
CENTENNIAL ENGINEERING, INC.

MK Centennial
15000 W. 64th Avenue
P.O. Drawer 1307
Arvada, Colorado 80001

West Vail Interchange

ALTERNATIVES ANALYSIS
Problem Definition and Existing Conditions
Alternative Solutions Analysis

Prepared for:

Town of Vail

Prepared by:

MK CENTENNIAL
CENTENNIAL ENGINEERING, INC.

MK Centennial
15000 W. 64th Avenue
P.O. Drawer 1307
Arvada, Colorado 80001

Table of Contents

List of Figures & Tables

Introduction

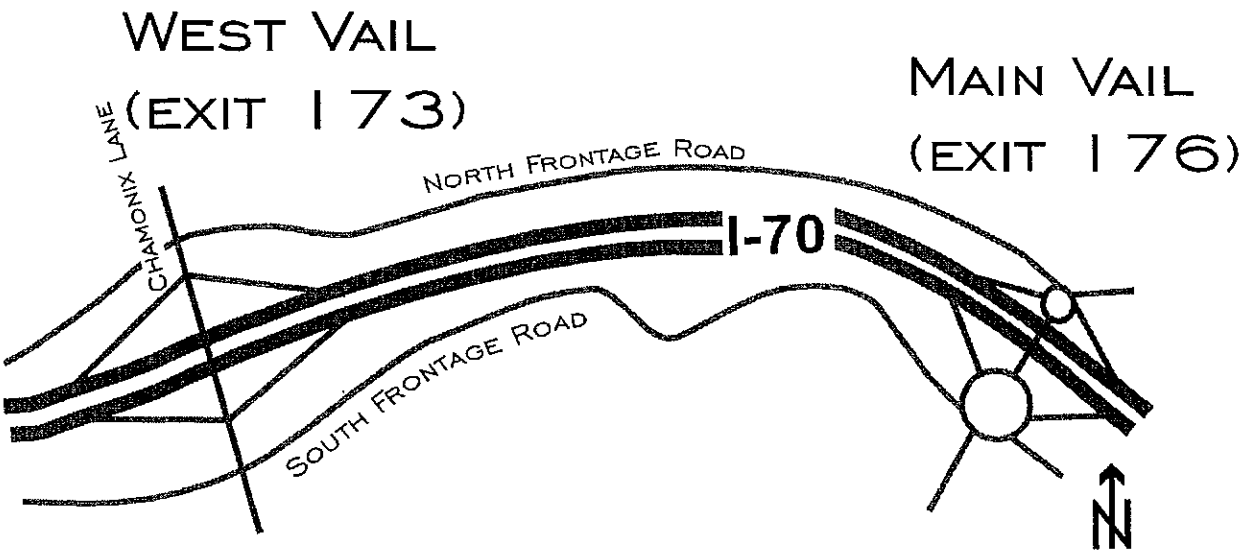
In March of 1996 the Town of Vail conducted a town survey asking citizens to identify and rank existing problems within the Vail Valley. The survey returns indicated that poor traffic conditions at the West Vail Interchange as the number one perceived problem in the Vail Valley.

MK Centennial was hired to work with Town of Vail staff to perform a technical analysis of the alternative interchange solutions and to conduct a public involvement process to achieve informed public consent for proceeding forward with the selected alternative.

Existing Conditions

The West Vail interchange provides access to I-70 from both the north and south frontage roads as well as Chamonix Lane in West Vail, see figure 1. Both the north and south intersections at the interchange are stop sign controlled with single lane entrances from all directions.

Figure 1



The interchange experiences significant congestion and delays throughout the entire day particularly during the height of the winter/summer tourist seasons. The north side of the interchange experiences total entering volumes for both the frontage road and the ramps in excess of 1400 vehicles during the winter AM peak hour and 2300 vehicles during the winter PM peak hour. The south side of the interchange experiences total entering

volumes for both the frontage road and the ramps in excess of 1550 vehicles during the winter AM peak hour and 1950 vehicles during the winter PM peak hour. Detailed turning movement counts of the West Vail interchange for summer and winter peaks can be found in the Appendix A of this report.

Congestion Issues

Generally the four intersections operate with severe delays and congestion during the peak hours. The heaviest vehicle movements are those exiting from the I-70 eastbound off ramp and those heading I-70 westbound and southbound from the North Frontage Road. These heavy vehicle movements not only cause congestion throughout the entire interchange, they often indirectly cause back-ups along eastbound I-70, as existing vehicles are blocked from departing the off ramp by queues on Chamonix Lane, and quickly build into ramp queues of sufficient length to spill back onto the interstate itself.

The back-ups along the North Frontage Road limit access to the stores and businesses along it. The large number of closely spaced access drives on the North Frontage Road creates side friction which adds to the congestion and delays along the North Frontage Road and increases the potential for rear-end and right angle accidents.

The spacing between the four intersections of the interchange is quite close, leaving very little room for queuing vehicles. Therefore when vehicles do begin to queue and stack up, the entire interchange can quickly become gridlocked. Lengthy queues build very quickly on all approaches, and traffic slowly grinds through the interchange. When the interchange becomes this congested the drivers tend to lose patience, ignore the posted stop signs and accept unsafe cross street gaps in traffic, which compounds the accident potential of the interchange.

A large portion of the traffic utilizing the West Vail interchange is commuter traffic from the west. This pattern of greater levels of traffic coming from the west is indicative of the growth further down the Eagle River Valley along the western slope. As growth throughout the valley continues, commuter traffic from the west will continue to grow and the congestion problems at the West Vail interchange can be expected to worsen. According to Vail Associates, nearly 40% of the skiers arrive at the Eagle Airport, most of which would use the West Vail Interchange to get to the slopes.

Vehicular Circulation and Intersection Signage

The location and placement of the stop signs is another problem. Due to space limitations the signs are not installed at standard location and/or height. Vehicles at all approaches are required to stop except for those vehicles driving under the I-70 underpass. Tourists

and other drivers unfamiliar to the area are often confused and believe all directions are stopping and proceed at unsafe gaps in front of vehicles that are not stopping. A number of the stop signs are also posted at a low height which makes them difficult to see due to the presence of other vehicles blocking the driver's line of sight. This confusion often results in drivers inadvertently or intentionally ignoring the stop signs.

Access

The West Vail interchange not only provides access to I-70 and West Vail homes and businesses it also provides a north/south access across the I-70 barrier connecting the north and south sides of Vail. As there are only three north/south connections along I-70 throughout Vail the majority of the north south traffic on the west side of town must use Chamonix Lane to cross I-70. A similar condition holds true for both pedestrian and bicycle traffic. When one of the primary north/south connections in Vail is unusable by both vehicles and pedestrians because of congestion and delays, it limits the access and, therefore, the economic vitality of the entire community.

Safety Issues

There are actually three separate safety issues affecting in the West Vail interchange; safety at the intersections, safety on the I-70 corridor and ramps, and safety of pedestrians and bicyclists.

Traffic moving through the intersections is traveling at slow speeds and all traffic is required to stop, therefore the accidents at the intersections are generally fairly minor and involve limited property damage, only minor injury and no fatalities. The interchange complex maintains inadequate sight distances for several lanes of turning traffic. For example it is difficult for drivers to see past the I-70 bridge structure when making turns off of the I-70 ramps. The safety of the interchange is indeed compromised by these factors.

Higher speed accidents caused by back-ups onto the interstate due to excess congestion on the ramps can have more serious effects in terms of both property damage and injury. Recent accident data for I-70 is recorded in table 1.

Table 1. West Vail / I-70 Accidents

Accident Type	1993	1992	1991	1990
PDO (Property Damage Only)	40	31	39	14
Injury	12	7	13	6
Fatal	0	0	0	0

Data is for both directions on I-70 at the West Vail Interchange.

A third critical safety issue relates to pedestrians and bicyclists. Pedestrians and bicyclists have no clear pathway to traverse the West Vail interchange and often cross I-70 at-grade just east of the existing West Vail interchange. There are a number of worn paths where pedestrians continuously cross the interstate at-grade. There have been 2 pedestrian/vehicle fatalities at these locations.

Aesthetics

The aesthetics of the interchange are an important issue due to the resort nature of the Vail community. Unfortunately the West Vail interchange does not aesthetically reflect a world class entry or gateway into the Town of Vail.

Pavement Surface

The mountainous nature of the local climate (i.e. frequent and plentiful snowfall) have made the interchange difficult to maintain, as evidenced by the abundance of potholes, pavement cracks, sand and cinders - particularly in winter months.

Level of Service Analysis

The need for improvements on roadways and at intersections is estimated by determining how traffic operates under capacity restraints. Unsignalized intersections can be analyzed using procedures outlined in the 1985 and 1994 Highway Capacity Manual (Transportation Research Board Special Report 209). A level of service "grade" is assigned based on the traffic versus capacity of the intersection. The minimum acceptable Level of Service for an intersection is assumed to be Level of Service D for most urban conditions. Level of Service D indicates tolerable driving conditions with minor delays. Level of Service A, B, and C all represent acceptable traffic conditions. Level of Service E represents a condition

approaching the capacity of an intersection or roadway and is the common peak hour condition in most urban areas. At Level of Service F an intersection is operating with excessive delay and congestion, and improvements to the intersection or roadway are required.

Based on the peak hour counts and under current conditions (stop sign control) the interchange functions at a Level of Service F for all intersections, frontage roads and ramps. Intersection counts and detailed Level of Service analysis can be found in the Appendix A of this report.

Public Process

A public process was used to verify the existing problem, establish a set of criteria by which alternative solutions could be measured, and help determine the best solution to the West Vail interchange problem.

Figure 2. Outline of Public Process (all dates refer to 1996)

WEST VAIL INTERCHANGE EXCHANGE

STEP 1 JUNE

LISTEN TRACK AND ORGANIZE INTERCHANGE PROBLEMS

TOWN OF VAIL SURVEY - MARCH
WEST VAIL INTERCHANGE SURVEY - MAY

FOCUS GROUPS - JUNE 3,4,5
IDENTIFIED THE PROBLEM AND GENERATED POTENTIAL SOLUTIONS

PUBLIC WORKSHOPS - JUNE 6, 10
VERIFIED PROBLEM, GENERATED CRITERIA AND MORE POTENTIAL SOLUTIONS

ORIGIN AND DESTINATION STUDY - JUNE 26, 27

OPEN HOUSE - JUNE 27, 28
DESCRIBED PROBLEM, CRITERIA, AND SOLUTIONS GENERATED. RECEIVED ADDITIONAL SOLUTIONS AND COMMENTS.

STEP 2 JULY

DEVELOP OPTIONS

TOWN COUNCIL WORK SESSION - JULY 9
DISCUSSION OF EXISTING PROBLEM, POTENTIAL SOLUTIONS AND ORIGIN AND DESTINATION STUDY.

STEP 3 MID-JULY

REVIEW AND SELECT ALTERNATIVE SOLUTIONS

OPEN HOUSE - JULY 17, 18
ALL SOLUTIONS TESTED FOR FATAL FLAWS. SELECTED TOP REMAINING ALTERNATIVES FOR FURTHER ANALYSIS.

STEP 4 AUGUST

REFINE ALTERNATIVES

PUBLIC MEETING - AUGUST 21, 22
REDUCED NUMBER OF ALTERNATIVES TO THREE AND GATHERED PUBLIC INPUT TO SELECT FINAL ALTERNATIVE

STEP 5 SEPTEMBER

SELECT FINAL ALTERNATIVE BY TOWN COUNCIL

TOWN COUNCIL WORK SESSION - SEPTEMBER 3
PRESENT FINAL ALTERNATIVE

PRELIMINARY DESIGN- OCTOBER 1

Prior to initiating the public process the Town of Vail staff drafted a set of project ground rules. These rules were not only intended to set goals but also to establish cohesiveness between the project itself and the community. The project ground rules were presented to the public for information and approval.

Figure 3. Public Process Ground Rules

PROJECT GROUND RULES

1. All ideas for solutions will be considered.
2. Design solutions will not compromise SAFETY and must accommodate long-term TRAFFIC VOLUMES.
3. The TOWN OF VAIL (TOV) will be the lead agency in project initiation; in accordance with the Town Charter, the Town Council will make the final decision on the project and budget.
4. The TOV will seek the maximum contributions from all funding sources.
5. Depending on the amount of funding received for this project, other capital projects may be delayed.
6. The project will be designed to professional design standards and regulatory requirements.
7. Access in West Vail, to and from, the interstate will be maintained.
8. The Town Council and staff will strongly consider recurring preferences expressed by all people involved.

The first set of meetings held were limited focus groups only, consisting of informal group discussions. The citizens invited to attend the meetings were area residents and business owners who used the West Vail interchange daily. The project ground rules, problem statement, and goals and objectives were presented to the focus group

attendees for their input and approval (focus group meeting minutes are found in Appendix B of this report).

After taking input at the focus group meetings the project ground rules, problem statement, and goals and objectives were refined to reflect the input received. This information was then taken to public workshop sessions where the documents were further refined, (public workshop meeting minutes are found in the appendix of this report).

The focus group meetings and the input received at the public workshops yielded the official problem statement, defining the existing problem at the West Vail interchange and the goals and objectives of the project.

Figure 4. Public Process Problem Statement

PROBLEM STATEMENT

At the West Vail interchange, users feel unsafe, and experience significant congestion and delays.

- On the eastbound off-ramp, there are large backups of cars onto the interstate which creates a high speed safety problem.
- There are poor lines of sight, causing drivers to take unnecessary risks when making routine turns.
- The congestion at the intersections with ramps and frontage roads has a negative impact.
- Neighborhoods and businesses are affected by congestion.
- There are no safe walkways or pathways to accommodate the pedestrian and bicycle traffic along either the roadways or underneath the overpass.
- Aesthetically, the intersection does not reflect a world class entry into the community.

Vail would be irresponsible if we did not take the lead in correcting these problems, using both short and long term solutions.

Figure 5. Public Process Goals and Objectives

GOALS AND OBJECTIVES

GOAL

- Develop the best solution to existing safety and congestion problems.

OBJECTIVES

- **SAFETY**
  - Vehicles
  - Pedestrians
  - Bicycles
- **DELAYS/CONGESTION**
- **ENVIRONMENTAL CONCERNS**
- **INFORMATION/SIGNAGE**
- **BUSINESS ACCESS**
- **AESTHETICS**

Summary of Focus group Meetings (June 3,4,5, 1996)

Groups of approximately ten people met the Town of Vail staff and MK Centennial

representatives. They were given a description of the project and presented with a public involvement approach and schedule for the project. The groups agreed with the public involvement approach and schedule that the Town of Vail was taking with this project. The rest of the meeting focused on defining the problem, setting some criteria, and generating alternative solutions.

Problem

Problems at the interchange were discussed and members of the each group generally agreed with the problem statement as it read. There were some minor changes made to the sentence structure.

Criteria

The group engaged in a discussion of how the alternatives should be judged or ranked and tried to determine the most important set of criteria by which to accomplish this ranking. The following list of criteria is in no particular ranking. The group had difficulty in determining which criteria should be the most important. After some discussion it was decided that the criteria were all so interrelated that they cannot be accurately ranked. For instance if the congestion is relieved then safety will be improved as a result.

Solutions

There was general discussion about possible solutions. A list of all the solutions generated by each group can be found in the meeting minutes in Appendix B. Some of the more predominant solutions involved the following:

- Moving the I-70 ramps
- Signals
- Roundabouts
- Pedestrian and bicycle facilities

Summary of Public Workshops (June 6,10, 1996)

The public workshops served mainly to "kick off" the public process. Most people who attended the workshop did so primarily to attain information about the project and the public process. There were some solutions generated which are listed in Appendix B.

Questions asked at the workshop were primarily concerning the projects scope. Some of the questions raised follow:

- Is there enough room at the interchange for a roundabout?
- Will the improvements from this project be short or long term?
- What will happen to the traffic during the construction phase of the project?

Criteria

Through this process of meetings a draft list of criteria by which to rank the alternative solutions was created.

Transportation Capacity
Reduces delay by providing increases in capacity for:
Ramps
Intersections
Frontage Roads
Provides capacity for future demand

Safety
Reduces intersection conflicts
Reduces accident rate
Provides for adequate sight distances
Reduces ramp/freeway flow conflicts
Meets engineering standards
Improves bicycle/pedestrian safety

Pedestrian/Bicycle
Provides adequate areas to walk and bicycle along both frontage roads
Provides adequate areas to allow pedestrians and bicycles to cross I-70
Reduces conflicts between vehicles and pedestrians and bicycles

Access
Improves access to commercial and residential areas
Reduces conflicting movements to commercial and residential area
Maintains interstate access at West Vail site

Environmental Considerations
Requires little or no environmental mitigation with respect to:

Visual	Noise	Flora and Fauna
Air quality	Gore Creek	Wildlife

Usability
Is easy to maneuver and makes efficient use of informational signing and other means for providing clear direction of use.

Aesthetic
Solution allows for aesthetic improvements and additions as secondary element

Financial considerations
Requires short- or long-term funding capability and ability to carry out construction during a short- or long-term period

Solutions

A list of all of the solutions generated by the public process was also established for further analysis.

1. **Traffic signals or ramp metering**
2. **Relocation of on and off ramps to I-70**
3. **New interchange between Main and West Vail**
4. **New ramps to South Frontage Rd. at Sandstone**
5. **One large roundabout under I-70**
6. **Two double lane roundabouts**
7. **Two single lane roundabouts**
8. **New ramps and underpass between Main and West Vail**
9. **New underpass one way loop to West Vail**
10. **Additional over/underpass connection (ie. Simba Run)**
11. **Intersection improvements (free flow right turns)**
12. **Widen ramps to two lanes**
13. **Widen frontage roads**
14. **Pedestrian/bicycle over/underpass east of West Vail interchange**
15. **Variable message signs to redirect traffic**
16. **Extend North Frontage Rd. to Dowd Junction**
17. **Bury the interstate and build roundabout on top**
18. **Gondola across the interstate for pedestrian traffic**
19. **New interchange/alternative access for Vail day skiers**
20. **Encourage alternative modes by providing improved facilities**
21. **Additional off ramps for car pools and buses**
22. **Interconnect the parking lots of North Frontage Rd businesses**
23. **Direct connection from North Frontage Rd. to westbound I-70 ramp**
24. **One way frontage roads to restrict access**

Origin and Destination Study (June26,27, 1997)

One other need that was uncovered at the focus group and public workshop meetings was the need for more north-south access across the interstate. There was a school of thought that emerged from these initial meetings suggesting that an additional north-south access would alleviate the congestion at the West Vail interchange. The belief was that by taking a significant portion of traffic that was traveling north-south only and not utilizing the interstate away from the interchange the congestion at the interchange would be relieved.

An origin and destination study was completed to determine if in fact there was a significant number of north-south trips utilizing the west Vail interchange but not the interstate ramps. The specific results from the study can be found in Appendix C of this report.

Information Learned from the Traffic Counts and Origin/Destination Studies

The Winter counts are from 1994, the summer counts are from 1996

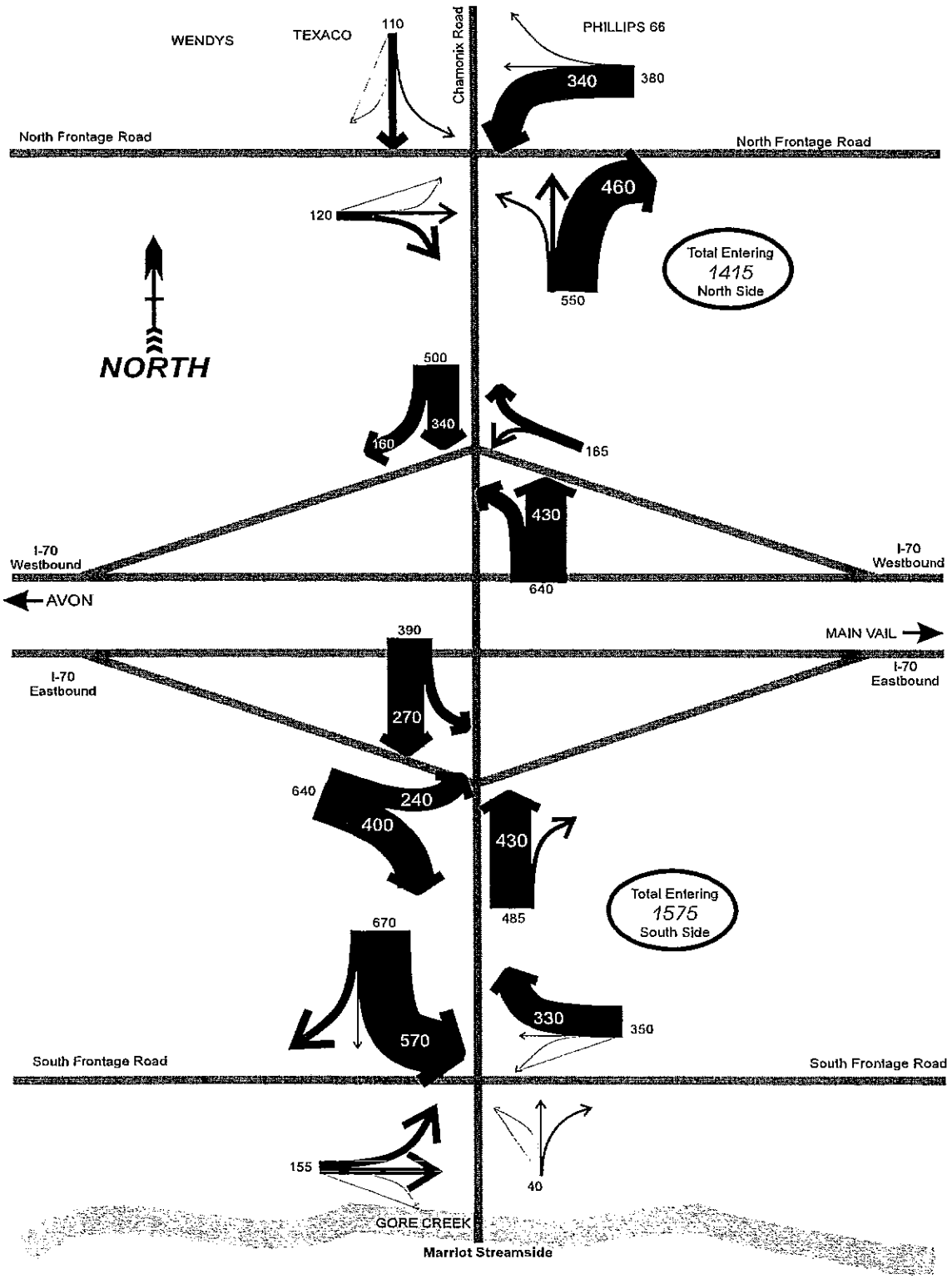
- **The breakout of rush hour trip types at the West Vail interchange are as follows:**
  - **About 60% are work oriented trips**
  - **10% are shopping**
  - **10% are recreation**
  - **20% are personal, service, and other**
- **The winter rush hour traffic is 25%-30% higher than summer traffic.**
- **There appears to have been a shift of local traffic away from the West Vail interchange since the opening of the Main Vail roundabouts.**
- **Although some local traffic has shifted away from West Vail, some traffic has replaced it, using the West Vail interchange to get to and from I-70.**
- **About 15% of the traffic from the North Frontage Road is detouring behind the shopping area and approaching the interchange from Chamonix.**
- **The predominant traffic movement at the West Vail interchange is going between West I-70 (Avon, etc.) and the North and South Frontage Roads**
- **Even with the opening of the Main Vail roundabouts, there is still about 15% of traffic using the West Vail interchange to reach Vail Village and Lionshead.**
- **75% of traffic at West Vail are Single Occupant Vehicles.**
- **Compared to the large roundabout at Main Vail, both of the intersections at West Vail carry about 70% of the Main Vail traffic volume. The volumes are reversed from Main Vail, with more traffic on the north side than south.**

Appendix A

Peak Hour of Morning Traffic, Existing Winter

(Prior to opening of Main Vail Roundabouts, includes Vail Commons)
Width of arrows indicates relative traffic volume making that movement

Black numbers indicates total volume on intersection approach
White numbers within arrows are volumes for that specific turning movement

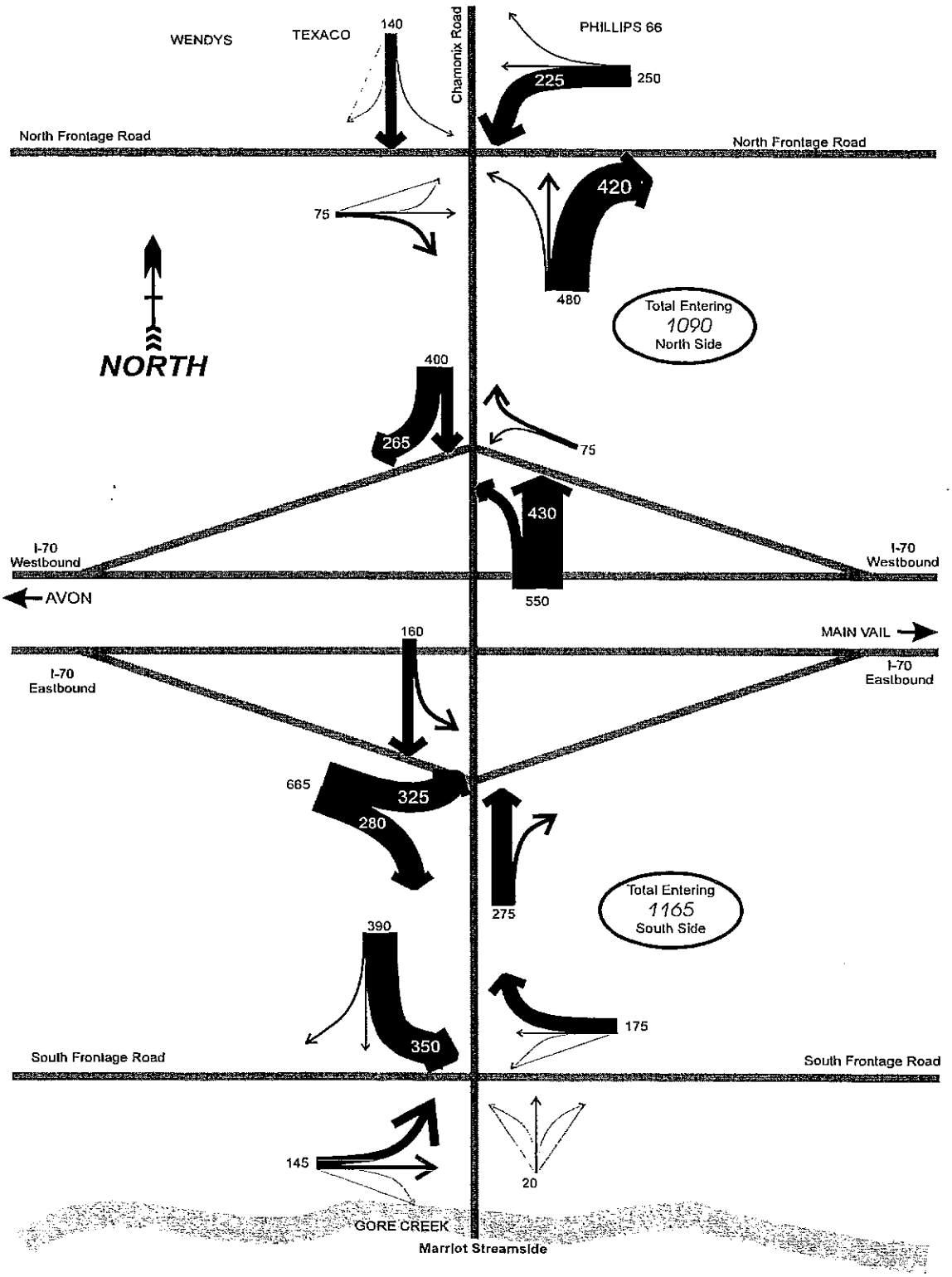


Peak Hour of Morning Traffic, Existing Summer

Width of arrows indicates relative traffic volume making that movement

Black numbers indicates total volume on intersection approach

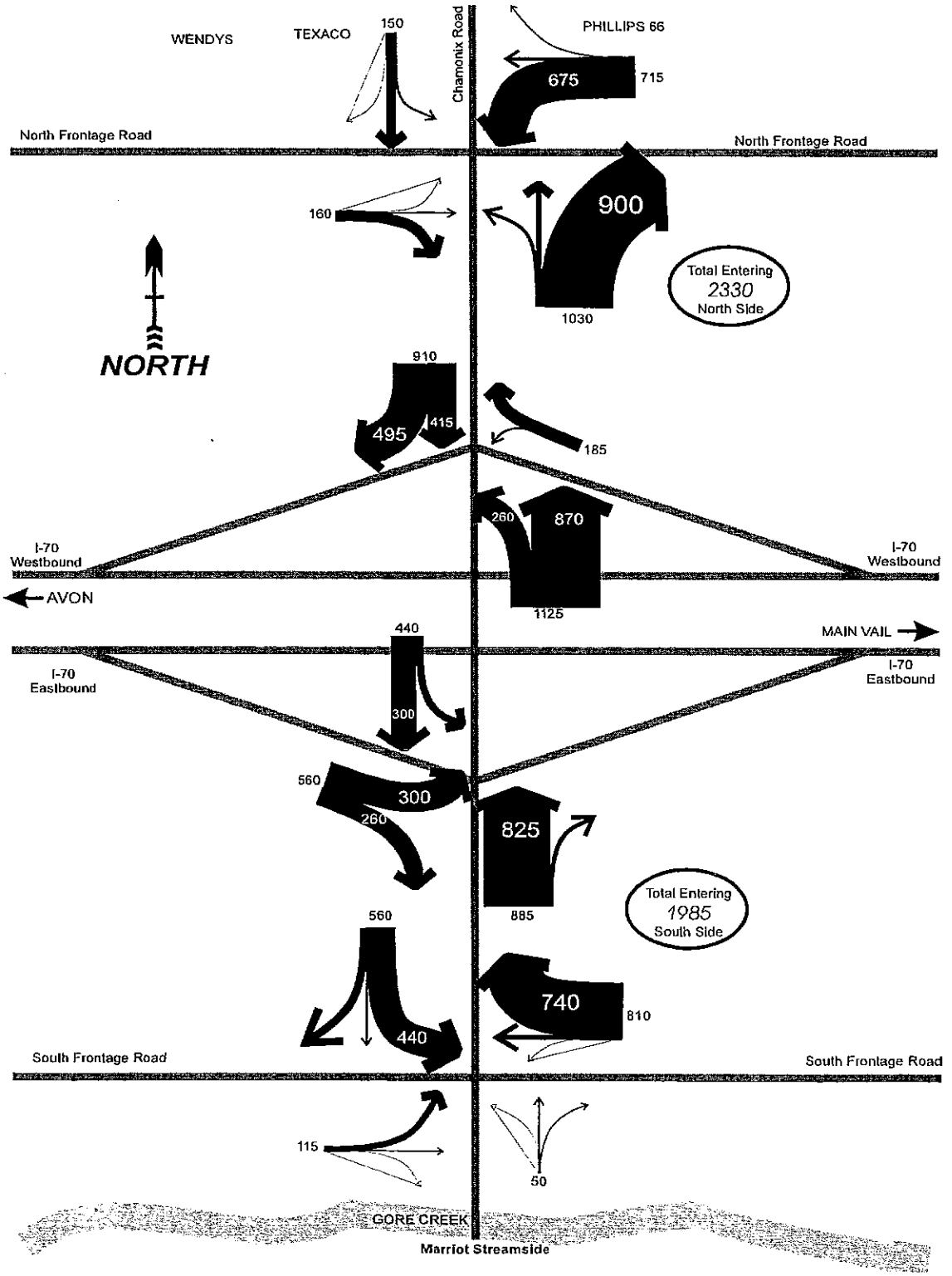
White numbers within arrows are volumes for that specific turning movement



Peak Hour of Evening Traffic, Existing Winter

(Prior to opening of Main Vail Roundabouts, includes Vail Commons)
Width of arrows indicates relative traffic volume making that movement

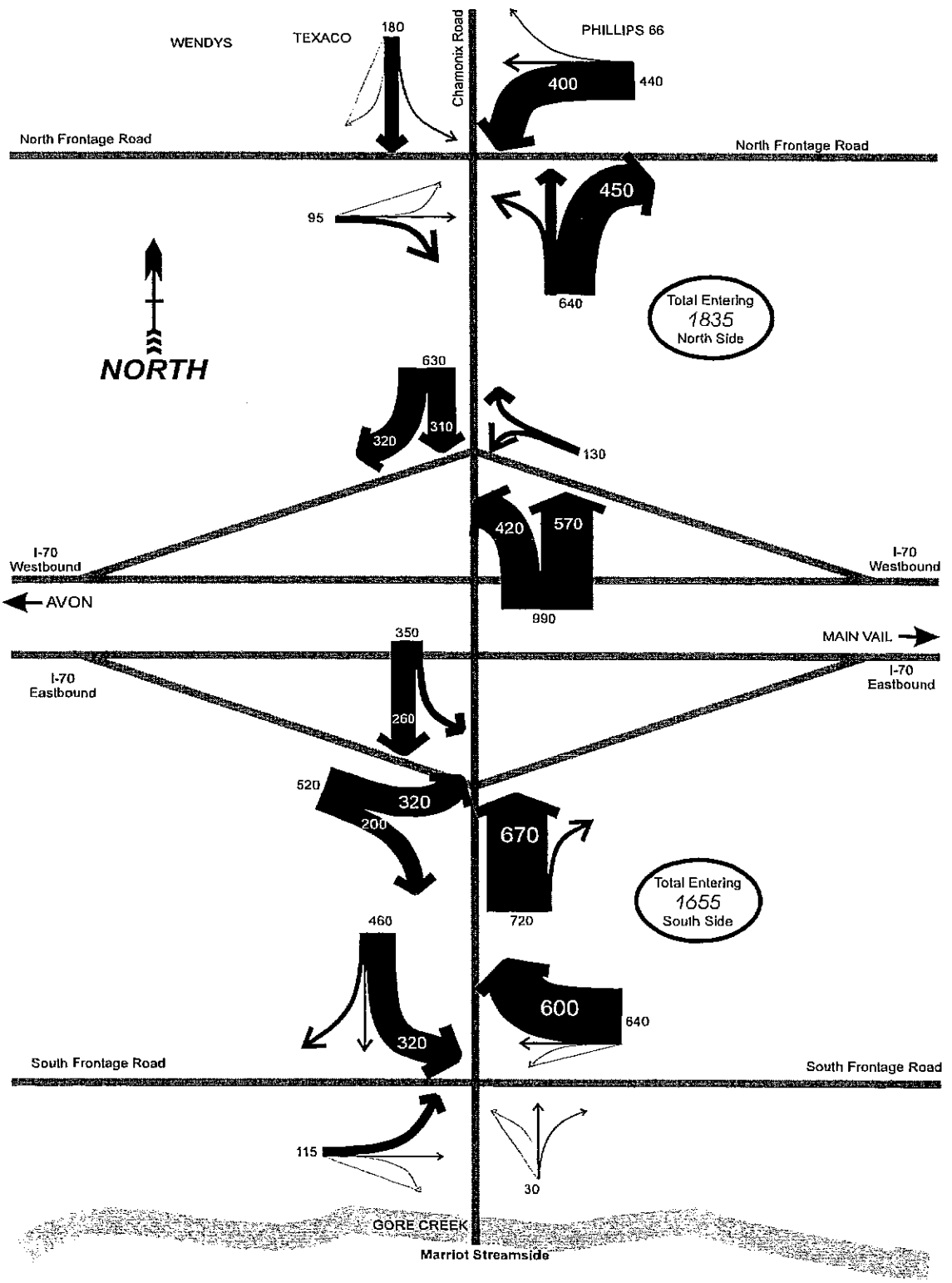
Black numbers indicates total volume on intersection approach
White numbers within arrows are volumes for that specific turning movement



Peak Hour of Evening Traffic, Existing Summer

Width of arrows indicates relative traffic volume making that movement

Black numbers indicates total volume on intersection approach
White numbers within arrows are volumes for that specific turning movement



Appendix B

Focus Group Meeting Minutes

Subject: West Vail Interchange

Date Held: June 3, 1996

The Meeting was opened by the Town of Vail. The focus group was welcomed and given a brief description of the process.

The public involvement process and the meeting schedule for the summer was detailed to the focus group.

June:	Establish Criteria - through public process
July:	Develop Alternatives
July-Sept:	Analyze and Evaluate Criteria
Sept-Oct.:	Determine Preferred Alternative

The group agreed with the schedule and public involvement approach.

The group read over the problem statement prepared by the Town of Vail (TOV) and all members of the focus group agreed with the problem statement as it read (enclosed).

There was some discussion of possible solutions to the West Vail Interchange problem. There was a question about when the improvements could be implemented. Therefore, some of the solutions recommended were for the short-term (1-2 years). The suggestions for west Vail interchange alternatives follow:

- Ramp metering - A signal to control flow of vehicles onto the Interstate, as a short-term solution.

- Pedestrian/Bicycle Overpass - This was recommended as a way to provide alternatives to automobile driving through the interchange by area residents and guests.

- Relocation of the on and off ramps to the interstate - The close proximity of the ramps adds to the congestion problem.

- Roundabout - There was agreement that the roundabout at the main Vail entrance was a success and if a roundabout could fit it should be considered. There was

a great deal of concern over whether or not a roundabout would fit.

- Restricted access via one way frontage roads in combination with a simba run connection.

After these alternatives were discussed Larry brought the discussion back to the problem. By better understanding the problem TOV will be best able to solve the problem. The discussion of the problem follows:

- Site problems
- Closeness of ramps
- Too many traffic conflicts exist
- Confusing signage - not always clear who has the right-of-way
- Traffic congestion
- Safety of pedestrian and bicycle traffic
- Lack of enforcement for traffic violations
- Stop signs are misplaced - too high

Because of the close proximity of possible turns, a turn signal does not accurately indicate where someone is going to turn.

- Interchange stripping is unclear and fades too quickly
- The placement of the stop signs is not conventional and confuses people
- There are no turn lanes under I-70
- Too many people use the West Vail Interchange to access Vail proper

Criteria

The group engaged in a discussion of how the alternatives should be judged or ranked and tried to determine the most important set of criteria by which to accomplish this ranking. The following list of criteria is in no particular ranking. The group had difficulty in determining which criteria should be the most important. After some discussion it was decided that the criteria were all so interrelated that they cannot be accurately ranked. For instance if the congestion is relieved then safety will be improved as a result.

- Safety

- Congestion/Delay
- Aesthetics
- Neighborhood characteristics
- Traffic Speeds
- Cost
- Ability to accommodate build out traffic

Additional Discussion

The group would like TOV to look at a short term solution (1-2 years) and a 10 year solution and a 20 year solution.

There were also a number of questions that the group would like to have answered concerning the availability of right-of-way and the amount needed for a roundabout.

The next step in the public process will be a series of public meetings. These meetings will be the vehicle used to solicit the alternatives to be critically analyzed by the TOV and MK Centennial.

Meeting Schedule

Date:	Thursday June 6th	**Date:**	Monday June 10th
Location:	Dancing Bear	**Location:**	Stephens Park
Time:	7:45 a.m. - 9 a.m.	**Time:**	5:15 p.m. - 6:30 p.m.

Focus Group Meeting Minutes

Subject: West Vail Interchange

Date Held: June 4, 1996

The Meeting was opened by the Town of Vail. The focus group was welcomed and given a brief description of the process.

The public involvement process and the meeting schedule for the summer was detailed to the focus group.

June:	Establish Criteria - through public process of listening, tracking and organizing the interchange problems
July:	Develop Alternatives
July-Sept:	Analyze and Evaluate Criteria
Sept-Oct.:	Determine Preferred Alternative

The group agreed with the schedule and public involvement approach.

The group read over the problem statement prepared by the Town of Vail (TOV) and the focus group attendees made comments about the west Vail interchange problem. The focus group generally agreed with the TOV problem statement as it read (enclosed).

COMMENTS:

- The Left turn onto EB ramps is a problem, the left turn movement needs a separate left turn lane.
- There is currently no separate access for bicycle and pedestrian traffic. This is a problem.
- Visibility is a problem when vehicles are trying to turn.
- The lack of crosswalks is part of the pedestrian problem.
- The entire interchange area is dangerous and unsafe.
- The congestion and delays make the intersection unsafe, because they lead to the frustration that makes people impatient and causes accidents.
- There are currently too many individual accesses to the businesses along the north frontage road. The parking lots need to be interconnected so that people do not need to get back out on the frontage road to get to shops which are next to each other.
- Aesthetics need to be improved.

- There are additional safety concerns about people trying to avoid the intersections most challenging movements and changing lanes.

Larry brought the discussion back to the problem. By better understanding the problem TOV will be best able to solve the problem. The focus groups discussion of what makes this intersection a problem follows:

- At the WB S. Frontage Road people don't stop at the stop sign and jam up the intersection
- Ramps are too tight and close
- Turning into the businesses along the Frontage Road is difficult
- Confusing signage - not always clear who has the right-of-way
- Lack of Visibility
- Unfriendly from a tourist's perspective
- Lack of enforcement for traffic violations
- Stop signs are misplaced and hard to see

Criteria

The group engaged in a discussion of how the alternatives should be judged or ranked and tried to determine the most important set of criteria by which to accomplish this ranking. The following list of criteria is in no particular ranking. The group had difficulty in determining which criteria should be the most important. After some discussion it was decided that the criteria were all so interrelated that they cannot be accurately ranked. For instance if the congestion is relieved then safety will be improved as a result.

- Safety
- Congestion/Delay
- Information and signage
- Access to businesses
- Aesthetics
- Environmental concerns - creek
- Ability to accommodate long term growth

Solutions

There was some discussion of possible solutions to the West Vail Interchange problem. Focus group members had some questions about the time frame for solutions and the ability to phase the solutions. Some of the solutions recommended were for the short-term (1-2 years). The suggestions for west Vail interchange alternatives follow:

- Ramp metering - A signal to control flow of vehicles onto the Interstate, as a short-term solution.
- Provide an alternative access for Vail day skiers.
- Pedestrian/Bicycle Overpass - This was recommended as a way to provide alternatives to automobile driving through the interchange by area residents and guests.
- Additional connections without ramps under I-70 to help connect north and south Vail.
- Extension of the north Frontage Road to Dowd Junction - This was recommended as a way to provide an alternative to driving the interstate from the west.
- Relocation of the on and off ramps to the interstate - The close proximity of the ramps adds to the congestion problem.
- Roundabout - There was agreement that the roundabout at the main Vail entrance was a success and if a roundabout could fit it should be considered. There was a great deal of concern over whether or not a roundabout would fit.
- Elevated roundabout.
- Widen area under the interstate and have one big roundabout.

Additional Discussion

The group would like TOV to look at a short term solution (1-2 years) and a final solution.

The solution should be phased to help alleviate the problem while keeping adequate access.

Public transit should be promoted.

Meeting Schedule

Date:	Thursday June 6th	**Date:**	Monday June 10th
Location:	Dancing Bear	**Location:**	Stephens Park
Time:	7:45 a.m. - 9 a.m.	**Time:**	5:15 p.m. - 6:30 p.m.

Focus Group Meeting Minutes

Subject: West Vail Interchange

Date Held: June 5, 1996

The Meeting was opened by the Town of Vail. The focus group was welcomed and given a brief description of the process.

The public involvement process and the meeting schedule for the summer was detailed to the focus group.

June:	Establish Criteria - through public process by listening, tracking, and organizing interchange problems
July:	Develop Alternatives
July-Sept:	Analyze and Evaluate Criteria
Sept-Oct.:	Determine Preferred Alternative

The group agreed with the schedule and public involvement approach.

The group read over the problem statement prepared by the Town of Vail (TOV) and the attendees of the focus group made comments on how the problem statement could be altered to more accurately represent the problem. Initial TOV problem statement enclosed.

COMMENTS:

- Elaborate the safety concerns in the initial statement then separate out the other points.
- General comments about the sentence structure of the problem

Larry brought the discussion back to the problem. By better understanding the problem TOV will be best able to solve the problem. The focus groups discussion of what makes this intersection a problem follows:

- Congestion, getting off of the EB ramps is hell
- People do not alternate at stop signs
- Traffic flow is non-existent
- Confusing signage - not always clear who has the right-of-way
- Lack of Visibility

- Pot holes
- Lack of enforcement for traffic violations
- Pedestrians and bicyclists need separate access

Criteria

The group engaged in a discussion of how the alternatives should be judged or ranked and tried to determine the most important set of criteria by which to accomplish this ranking. The following list of criteria is in no particular ranking. The group had difficulty in determining which criteria should be the most important. After some discussion it was decided that the criteria were all so interrelated that they cannot be accurately ranked. For instance if the congestion is relieved then safety will be improved as a result.

- Safety
- Congestion/Delay
- Information and signage
- Access to businesses
- Aesthetics
- Environmental concerns - creek
- Ability to accommodate long term growth
- Budget
- Time frame

Solutions

There was some discussion of possible solutions to the West Vail Interchange problem. The solutions recommended were both short and long term solutions. The general consensus of the focus group was that something needed to be done in the near future and a final solution needed to be pursued for the future, 10-20 year time frame. The suggestions for west Vail interchange alternatives follow:

- Ramp metering - A signal to control flow of vehicles onto the Interstate, as a short-term solution.

- Widen under I-70.

- Pedestrian/Bicycle Overpass over I-70 - This was recommended as a way to provide alternatives to automobile driving through the interchange by area residents and guests.

- Additional merge and turn lanes every direction - to make it clear where people intend to go..

- Make the interstate ramps access prior to the intersection for right turns.

- Relocation of the on and off ramps to the interstate - The close proximity of the ramps adds to the congestion problem.

- Roundabout - There was agreement that the roundabout at the main Vail entrance was a success and if a roundabout could fit it should be considered. There was a great deal of concern over whether or not a roundabout would fit.

- Simba run underpass to accommodate the Vail north-south traffic not using the interstate.

- Widen the Frontage Roads.

- Use variable message signs to inform driving public which interchange to use, west of central.

Additional Discussion

The group would like TOV to conduct an origin and destination study to determine the major traffic movements at the intersection.

Meeting Schedule

Date:	Thursday June 6th	**Date:**	Monday June 10th
Location:	Dancing Bear	**Location:**	Stephens Park
Time:	7:45 a.m. - 9 a.m.	**Time:**	5:15 p.m. - 6:30 p.m.

Public Workshop Minutes

Subject: West Vail Interchange

Date Held: June 6 &10, 1996

The Public Workshops were given by the Town of Vail to assess the citizens perception of the west Vail interchange problem and to take comments to help develop the criteria and alternatives that the TOV should consider.

The concerns and ideas expressed at the public workshop:

The existing interchange configuration is confusing and not properly signed.

TOV should consider a large oval shaped roundabout for the entire interchange - perhaps elevated.

Extend the Frontage Road connection to Dowd Junction

Construct and over or underpass at Cascade

In conjunction with the improvement to the West Vail Interchange - also construct the Simba Run underpass.

Roundabouts similar to main Vail entrance

Traffic signals are a simple solution and have no more negative aesthetic impact than all the signs necessary for a roundabout.

Consider a right turn yield rather than a full stop

Pedestrian and bicycle overpass

Bury the Interstate at the West Interchange location.

Place a "Please Alternate" sign at the stop signs.

Add another interchange between West Vail and Main Vail

Construct smaller roundabouts than the ones at main Vail

Construct a half diamond interchange between West and Main Vail interchanges

Connect the parking lots of the businesses along the North Frontage Road

Change the speed limits on the frontage roads to discourage use of west Vail interchange and encourage use of main Vail roundabouts

Add left turn lanes to the existing configuration

Questions raised at the public workshop

Is there enough room for a roundabout?

Will the improvements be phased, short term and long range?

What will happen to the traffic during the construction of the preferred solution?

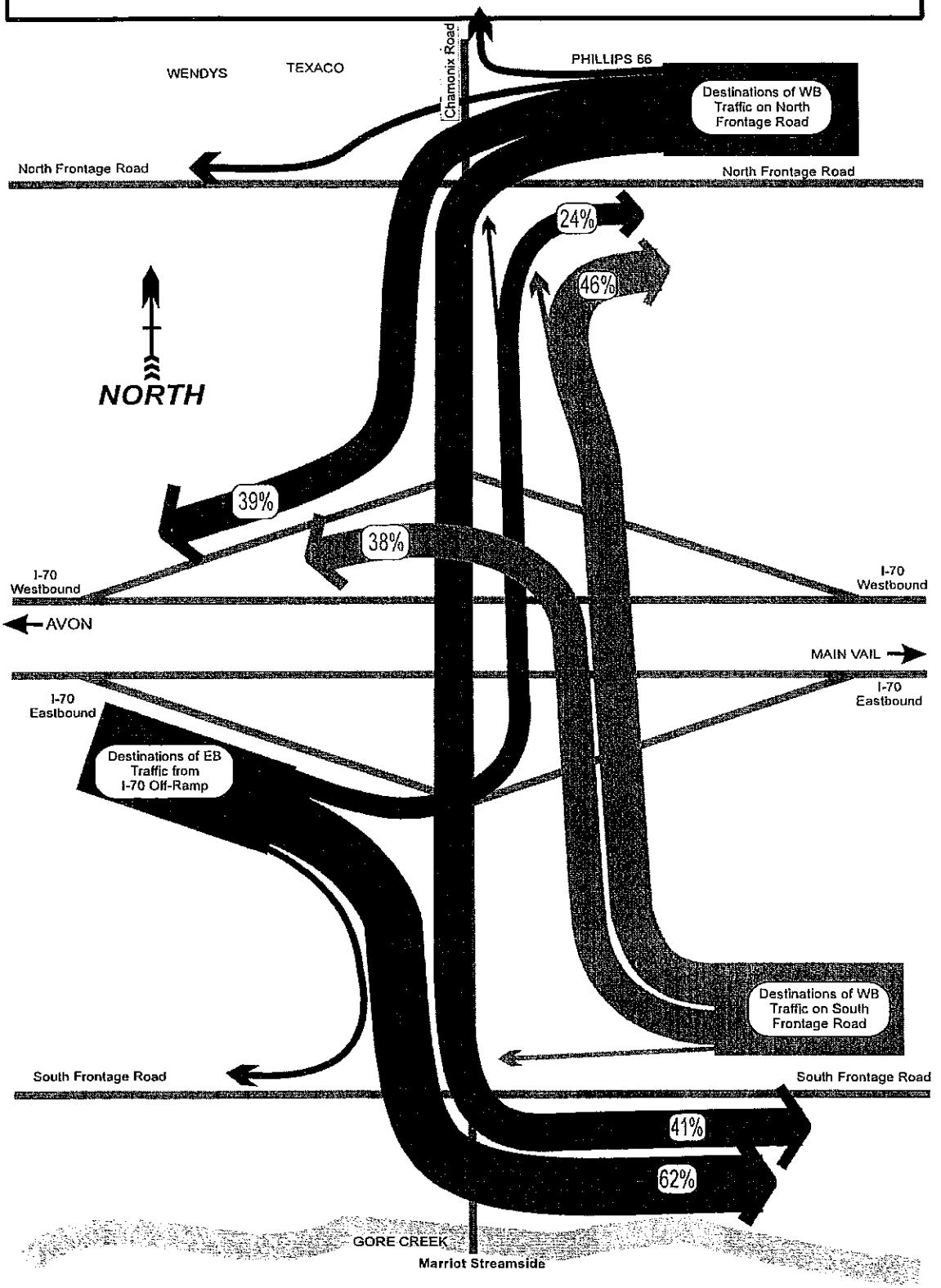
Meeting Schedule

Date:	Thursday June 27th	**Date:**	Friday June 28th
Location:	West Vail Lodge	**Location:**	West Vail Lodge
Time:	4 p.m. - 7 p.m.	**Time:**	7:30a.m. - 10:30 a.m.

Appendix C

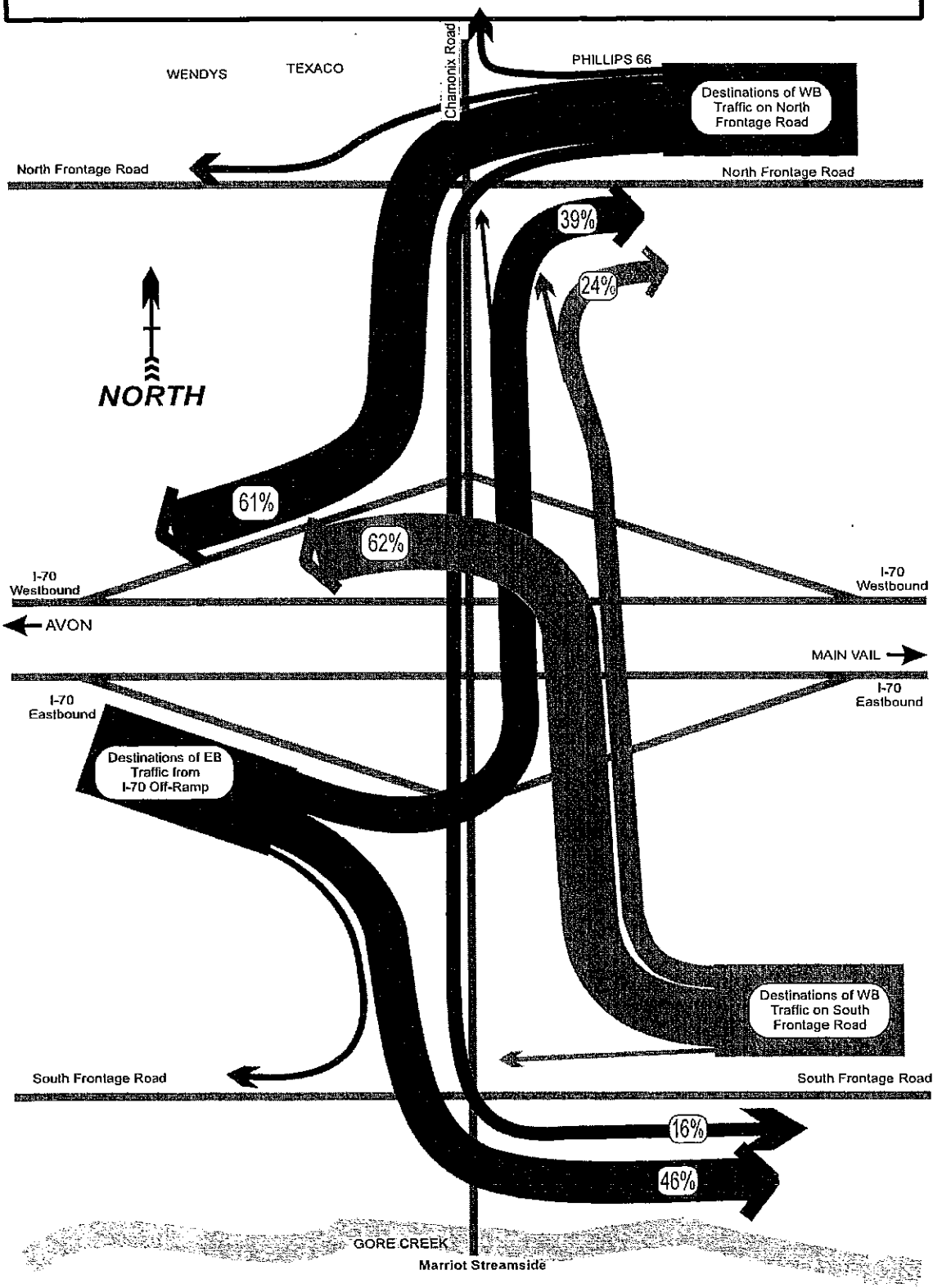
Destinations of Morning Traffic, Existing Winter

Movements below 10% of the total traffic are not labeled, so percentages may not add to 100%



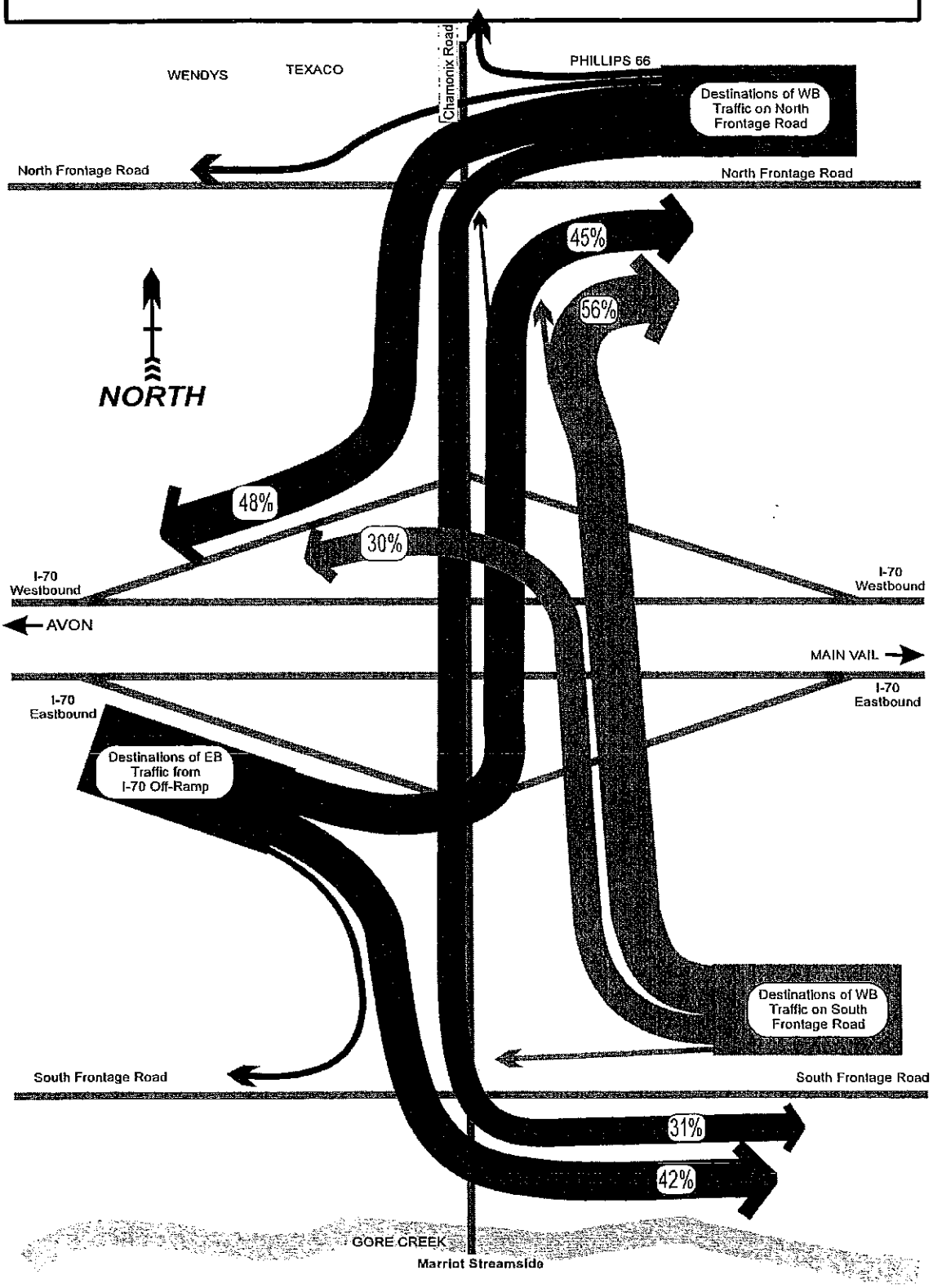
Destinations of Morning Traffic, Existing Summer

Movements below 10% of the total traffic are not labeled, so percentages may not add to 100%



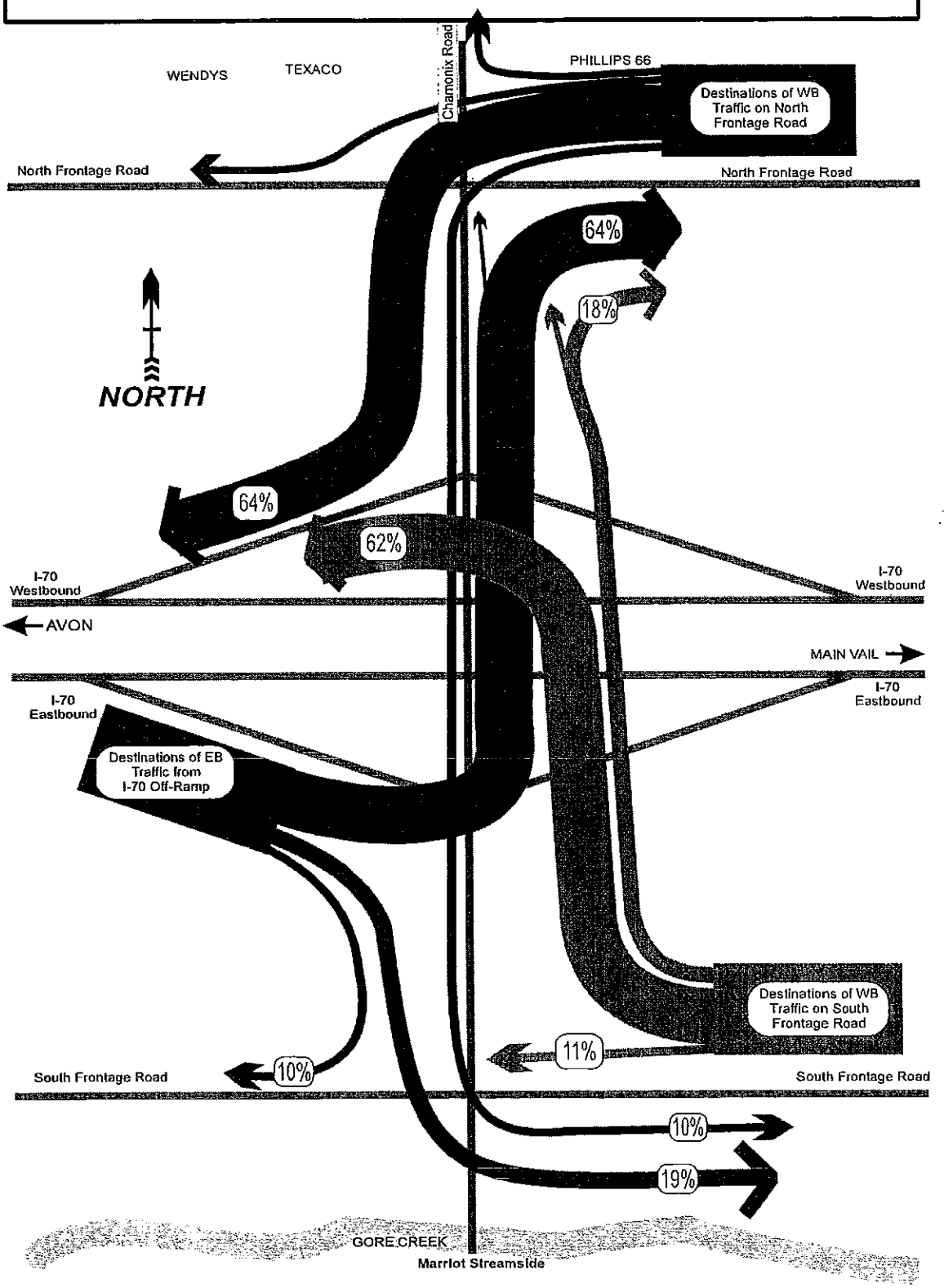
Destinations of Evening Traffic, Existing Winter

Movements below 10% of the total traffic are not labeled, so percentages may not add to 100%



Destinations of Evening Traffic, Existing Summer

Movements below 10% of the total traffic are not labeled, so percentages may not add to 100%



Alternative Solutions Analysis

Table of Contents

List of Figures

Alternatives Analysis

The West Vail interchange project began with a series of public meetings. Through these meetings existing problems were defined and validated, a set of criteria by which to rank alternative solutions was created, and a list of possible alternative solutions was developed. The list of alternative solutions, the process by which the alternative solutions were analyzed, and the final recommended solution are described within this report.

Alternative Solutions

The following list of alternative solutions was developed through a combination of public input and analysis by the project team. Each alternative is illustrated and described in the figures following this section.

1. **Traffic signals and/or ramp metering**
2. **Relocation of on and off ramps to I-70**
3. **New interchange between Main Vail interchange and West Vail**
4. **New ramps to South Frontage Rd. at Sandstone**
5. **One large roundabout under I-70 intersecting all four crossing streets**
6. **Two double lane roundabouts**
7. **Two single lane roundabouts**
8. **New ramps and underpass between Main Vail interchange and West Vail**
9. **New underpass and one way loop to West Vail**
10. **Additional over/underpass connection (ie. Simba Run)**
11. **Intersection improvements (free flow right turns)**
12. **Widen ramps to two lanes**
13. **Widen frontage roads**
14. **Pedestrian/bicycle over/underpass east of West Vail interchange**
15. **Variable message signs to redirect traffic**
16. **Extend North Frontage Rd. to Dowd Junction**
17. **the interstate and build roundabout on top**
18. **Gondola across the interstate for pedestrian traffic**
19. **New interchange/alternative access for Vail day skiers**
20. **Encourage alternative modes by providing improved facilities**
21. **Additional off ramps for car pools and buses**
22. **Interconnect the parking lots of North Frontage Rd businesses**
23. **Direct connection from North Frontage Rd. to westbound I-70 ramp**
24. **One way frontage roads to restrict access**

Process

After collecting the list of possible alternatives from the public, each alternative was run through a fatal flaw analysis. The results from that analysis were brought back to the public for further discussion and input. More in-depth cost and engineering analysis were conducted on the remaining alternatives, and brought to the public for their final input which resulted in the final recommendation.

Fatal Flaw Analysis

As part of the public involvement process the project team agreed to consider all of the alternatives recommended. A list of all alternative solutions was compiled and each alternative solution was analyzed to determine if it met with the project givens, goals and objectives; namely:

- Improves safety of the intersection by reducing intersection conflicts or improving sight distances;
- Reduces delays and congestion at the interchange by meeting, at a minimum, the existing traffic capacity requirements; and
- Economically feasible and constructable alternative.

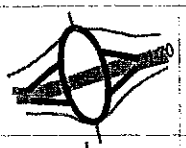
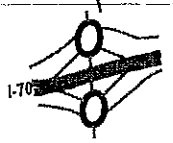
Each of the 24 alternatives, shown in Figure 1, was tested against the project givens, goals and objectives. Those alternatives that did not meet these criteria were identified as fatally flawed and were eliminated from further consideration as a stand alone alternative.

A number of the eliminated (fatally flawed) alternatives were suggested for solving other problems, mostly dealing with the north-south access issue for pedestrians, bicycles, and vehicles. Most of these alternatives can also be considered as an addition to one of the alternatives that did meet project givens. For example, the Simba Run connection (alternative 10) did not pass the fatal flaw test, because it did not address the interchange issues. However Simba Run could still be combined with one of the alternative solutions that did pass the fatal flaw test such as roundabouts.

The charts (Figure 1) on the following three pages detail the fatal flaw analysis, noting the reasoning behind each decision. The "Go" alternatives will be carried forward for further analysis, the "No-Go" alternatives will be dropped from the study at this time, although elements of the "*No-Go*" alternatives may be considered as possible additions to the "Go" alternatives.

~~FIGURE 1~~
PAGE 1 OF 4

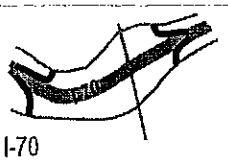
Go/No-Go Analysis

ALTERNATIVES:	'GO	NO-GO	*NO-GO*	COMMENTS:
One large roundabout under I-70 	X			Relative Cost $$$$$ Large roundabout alternative provides adequate capacity for future growth. This alternative would require the building of additional I-70 bridges.
Double lane roundabouts 	X			Relative Cost $$ This alternative would provide excess capacity for the interchange. The engineering of a two lane roundabout on the south side of I-70 would require a larger bridge over Gore Creek.
Single lane roundabouts 	X			Relative Cost $$ Single lane roundabout would not provide adequate capacity for future growth unless combined with an additional under/ overpass. Single lanes roundabout on south side would operate under capacity during heavy peaks, but would not accommodate long-term future growth.
New Ramps and undercrossing between Main and West Vail 			X	Relative Cost $$$ Variations possible, this option provides ramps for the heavy traffic movement to and from west I-70 (Avon, etc.). An under-crossing would be necessary for the reverse peak movements. Engineering issues with adding a ramp on the North Side.
New underpass one way loop 	X			Relative Cost $$$$ This alternative provides adequate traffic capacity. It requires significant out-of-direction travel for many low volume local movements. Difficult intersection geometry is required which may confuse drivers.

NO-GO = THESE ALTERNATIVES STILL REQUIRE AN IMPROVEMENT TO THE WEST VAIL INTERCHANGE, BUT ARE NO LONGER INDEPENDANTLY UNDER CONSIDERATION

FIGURE 1
PAGE 2 OF 4

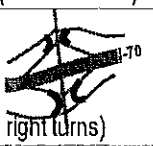
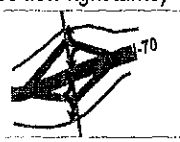
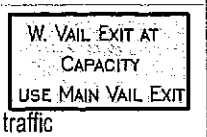
Go/No-Go Analysis

ALTERNATIVES:	GO	NO-GO	*NO-GO*	COMMENTS:
 Traffic Signals or Ramp metering	X			Relative Cost $ Traffic signals allow the intersections' major movements to flow, while restricting the flow of minor movements. This would generate the capacity necessary for current interchange functions. Intersection delay may improve slightly.
 Relocation of on and off ramps to I-70	X			Relative Cost $$$ Relocating the ramps would reduce conflicts and thus increase capacity, to meet current traffic demands. Future demand may be met by intersection improvments such as roundabouts or signals.
 New Interchange between Main and West Vail			X	Relative Cost **$$$$$** Variations possible, this option would reduce traffic at West Vail and provide a new crossing of I-70. There still need to be intersection safety improvements at West Vail, and there are engineering issues in fitting a new interchange in the narrow corridor.
 New ramps on south side at Red Sandstone			X	Relative Cost $$ This option would help to lower traffic levels at the south side of the W. Vail interchange in the AM peak. This option does not help PM traffic since there is no connection to westbound I-70. **This alternative may be combined with additional West Vail interchange improvements.**

NO-GO = THESE ALTERNATIVES STILL REQUIRE AN IMPROVEMENT TO THE WEST VAIL INTERCHANGE, BUT ARE NO LONGER INDEPENDANTLY UNDER CONSIDERATION

FIGURE 1
PAGE 3 OF 4

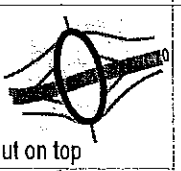
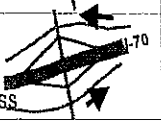
Go/No-Go Analysis

ALTERNATIVES:	GO	NO-GO	*NO-GO*	COMMENTS:
 Additional over/underpass connections (ie. Simba Run)			X	Alone this alternative will not provide the needed capacity. **This alternative may be combined with additional interchange improvements.**
 Intersection Improvments (ie. free flow right turns)			X	These improvements help capacity and storage for mostly minor traffic movements and alone will not have adequate traffic capacity. **This alternative may be combined with additional interchange improvements.**
 Widen ramps to two lanes			X	The width of the ramps has little to do with the capacity of the intersections, therefore this solution alone does not increase capacity. **This alternative may be combined with additional interchange improvements.**
Widen frontage roads			X	The capacity constraint is the interchange itself, not the frontage roads. **This alternative must be combined with an interchange improvement**
 Pedestrian/Bicycle over/underpass (Locations vary)			X	Alone this alternative will not provide the needed capacity. **This alternative may be combined with additional interchange improvements.**
 Variable message signs to redirect traffic			X	Alone this alternative will not provide the needed capacity, or reduce conflicts or improve traffic control. **This alternative may be combined with additional interchange improvements.**

NO-GO = THESE ALTERNATIVES ALSO REQUIRE AN IMPROVEMENT TO THE WEST VAIL INTERCHANGE. THEY ARE NO LONGER INDEPENDANTLY UNDER CONSIDERATION.

FIGURE 1
PAGE 4 OF 4

Go/No-Go Analysis

ALTERNATIVES:	GO	NO-GO	*NO-GO*	COMMENTS:
Extend North Frontage Road to Dowd Junction			X	Alone this alternative will not provide the needed capacity, Dowd Jct. has capacity constraints, and traffic is still forced through the West Vail Interchange. **This alternative may be combined with additional interchange improvements.**
 Bury the interstate and build roundabout on top			X	This alternative provides the needed capacity for long-term growth. There are engineering and financial constraints that do not make this a reasonable short-term solution for the interchange.
 Gondola across the interstate			X	Alone this alternative will not provide the needed capacity. **This alternative may be combined with additional interchange improvements.**
New Interchange/Alternative access for Vail day skiers			X	Adding an interchange is a possible long-termsolution. Alone, most of these alternatives will not provide the needed capacity increase or improve safety at the West Vail interchange. **These alternatives may be combined with additional interchange improvements to enhance all aspects of transportation in Vail.**
Encourage alternative modes by providing better facilities			X	
Additional off ramp for car pools and buses			X	
Interconnect parking lots of Vail Commons businesses			X	
Previously Recommended Alternative Direct Frontage-Ramp connection, relocate part of North Frontage Road 		X		This alternative does not solve the sight distance constraints, and many of the conflicting movments still exist, and is therefore not a safety improvement. There is also limited capacity for existing or future growth.
 One way frontage roads to restrict access		X		Alone this alternative will not provide the needed capacity. This alternative would lead to a significant increase in out-of-direction travel.

NO-GO = THESE ALTERNATIVES ALSO REQUIRE AN IMPROVEMENT TO THE WEST VAIL INTERCHANGE. THEY ARE NO LONGER INDEPENDANTLY UNDER CONSIDERATION

At least six of the 24 alternatives had no fatal flaw and were carried forward to undergo more detailed analysis including the "project criteria" established by public input for the project. These six alternatives were shown and described in detail to the public in an open house format on July 17th and 18th. Public input given at this open house was considered in the continuing analysis.

Refining of Alternatives

The six remaining alternatives were further refined for analysis by the project team. The original alternative solutions generated by the public and project team were very general and not specific in terms of geometry or design and location. For example an alternative solution that needed to be refined was relocating the interstate ramps. There are four ramps at the current interchange and a number of possible ways to relocate these existing ramps. The project team conducted traffic circulation and capacity analysis to determine the affect of moving each ramp and the best location for the ramps, east or west of the interchange. A detailed analysis of possible locations for each ramp was then conducted, see Appendix 2A, taking into account the minimum turn radius necessary for the ramps and the topography of the area. The project team then analyzed only the best of all possible ramp relocating alternatives. The same process was used to determine the best design and locations for the other alternatives as well.

Each of the refined alternatives was then analyzed in terms of capacity and cost. Capacity was measured utilizing the Highway Capacity Manual and Rodel (for roundabouts). Cost estimates at this stage were based on a conceptual design and were used primarily to give a picture of the relative cost differences between alternatives (Appendix 2A)

In order to compare the alternatives in a comprehensive manner the capacity numbers on the following chart (Figure 2) represent the ability of the alternative to handle current (winter 1994) traffic volumes. The number 1 represents the capacity necessary to handle current traffic volumes, any number less than 1 indicates that the alternative does not have the capacity to accommodate existing traffic. A number greater than one indicates that the alternative has excess capacity to the magnitude of the difference between the number and 1. For example an alternative with a capacity level of 1.5 would allow for an increase in traffic of fifty percent over existing volumes.

The alternatives are presented here in three categories:

- Existing Layout with Laneage Improvements
- Moving the Interstate Ramps
- Roundabouts

For both the existing layout with laneage improvements and moving the interstate ramps capacity analysis were conducted for both stop sign and signal traffic control. Both the north and south intersections at the interchange were analyzed for all of the alternatives. The results of this analysis was than brought to the public for review and comment on August 21st and 22nd.

Three Categories of improvements

Existing Layout with Laneage Improvements - These alternatives under stop sign control would not provide enough capacity to the interchange to accommodate existing traffic. Under signal control the interchange could accommodate existing traffic, but would not be able to accommodate an increase in traffic volume. These alternatives do however represent the least costly short-term approach to improving the interchange.

Signal control with the construction of additional lanes for turns represents the best alternative for this category of improvements. This option would provide some increase in capacity at limited expense.

Moving the Interstate Ramps - Moving the interstate ramps did not provide the excess capacity that was predicted. Because the West Vail interchange is a north-south connector and the majority of the traffic using the interchange is utilizing the interstate ramps, most of the traffic would still have to travel through the interchange and signals would be necessary to create any excess capacity. Moving the interstate ramps also represents the most costly option.

Moving the off ramps only represents the best alternative for this category of improvements (assumes signalization). This option would provide the most increased capacity for the least expense in this category.

Roundabouts - Roundabouts in all forms considered would provide the greatest increase in capacity for the interchange. The cost for roundabout options is moderate, in between the cost of signals and moving interstate ramps.

Two lane roundabouts on the north and south side of the interchange represents the best alternative for this category, providing the highest increase in capacity.

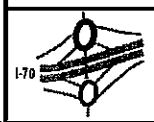
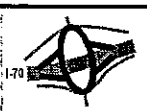
Analysis of Three Top Alternatives

The one best alternative from each category was chosen to be analyzed using the criteria generated through the public process (Figure 3). The best alternative from each category

FIGURE 2

Refined "Go" Alternativews Based on July 17th & 18th Open House

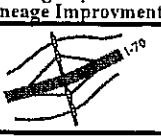
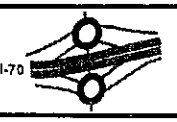
		Existing Layout with Laneage Improvments			Move Freeway Ramps *			
								
		Stop Sign Control	Signal Control (Preferred Alternative)	Comp Plan Layout	Move Off Ramps Only (Preferred Alternative)	Move On Off Ramps	Move On/Off Ramps East	Add West Side Ramps
Capacity Stop Signs	North	0.8		0.9	0.85	0.85	0.85	0.9
	South	0.7		0.7	0.7	0.7	0.75	0.8
Capacity Signals	North		1.0	1.4	1.5	1.5	1.5	1.6
	South		1.0	1.0	1.25	1.2	1.2	1.25
Construction Cost in millions		$1.7	$2.0	$4.6 assumes signalization	$7.1 assumes signalization	$10.1 assumes signalization	$6.8 assumes signalization	$14.8 assumes signalization

		Roundabouts			
					
		1 Lane South/2 North	2 Lanes North & South (Preferred Alternative)	One Large Roundabout	Speedway
Capacity Roundabout	North	2.46	2.46	2.22	** This alternative was reviewed and could not be built due to the grades needed on the North Frontage Rd. and the turnaround access.
	South	1.0	1.56	1.3	
Construction Cost in millions		$3.0	$5.4	$11.7	

* Note: Ramp combinations shown here are the best of all the possible ramp relocating alternatives

numbers indicate capacity:
1 = at capacity (operates with congestion and delays)
less than 1= the intersection is beyond its capacity (failing)
greater than 1 = excess capacity (minimal to no delays)

FIGURE 3 A Comparison of The Three Best Alternative Solutions

		Existing Layout with Laneage Improvments	Move Freeway Ramps	Roundabouts
				
		Signal Control	Move Off Ramps Only	2 Lanes South & North
Capacity* Roundabout	North			2.46
	South			1.56
Signals	North	1.0	1.5	
	South	1.0	1.25	
Construction Cost in millions		$2.0	$7.1 assumes signalization	$5.4
Safety				
Intersection Conflicts		-	0	+
Accident Rate		0	0	+
Adequate Sight distances		0	+	0
Ramp/Freeway Conflicts		0	+	+
Meets engineering Standards		yes	yes	yes
Ped/Bike Safety		0	0	0
Ped/Bike Treatments				
Frontage Roads		+	-	+
Crossing I-70		0	0	0
Vehicle ped/bike Conflicts		+	0	+
Creekside Opportunities		0	0	+
Access				
Commercial & Residential		0	-	0
Maintain I-70 Access		yes	yes	yes
Environmental				
Visual		- -	- -	+
Noise		0	0	0
Air Quality		-	-	0
Gore Creek		0	0	-
Water Quality		0	0	0
Visual		0	0	-
Aesthetics		- -	- -	+
Constructability/Timing		+	-	0
Construction Impacts		0	-	-
Gore Creek		0	0	-
Residential		0	-	0
Commercial		0	-	-
Approvals				
CDOT		+	-	+
FHWA		+	-	+
Dept. od Wildlife/Army Corps		+	0	0

+ Meets and exceeds stated criteria, affects positively

0 Does not have a positive or negative affect

- Does not meet stated criteria, affects negatively

- - Major negative impact

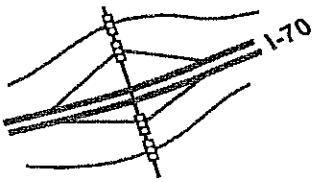
*numbers indicate capacity
1 = at capacity (intersection operates with congestion and delays)
less than 1= the intersection is beyond its capacity (failing)
greater than 1 = excess capacity (minimal to no delays)

Providing a connection of the North and South Frontage Roads at Simba Run would increase the capacity of the West Vail Interchange by approximately 7-8% and would cost approximately $6 million.

was chosen based on capacity and cost. The criteria issues were addressed by deciding whether the affect of the proposed alternative would be positive (+), negative (-), or neutral (o). Because some of the criteria issues cannot be quantified, and are subject to individual interpretation, the decisions as to wether the effect would be positive, negative, or neutral was decided upon by the entire project team and reflects no one individual bias. The results of this analysis were presented to the public at the August 21st and 22nd public meeting. Comments and questions by the public were incorporated into the final decision. Comments from the public at this meeting were strongly in favor of two lane roundabouts (Figure 4).

Figure 4. Public Comments on Top Three Alternatives

Intersection Improvements and Signals

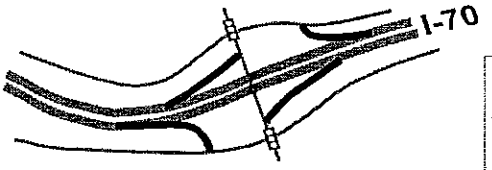


"NOT ENOUGH INCREASE IN CAPACITY TO PLAN FOR THE FUTURE"

REQUIREMENTS:
- LANE IMPROVEMENTS
- FRONTAGE ROAD IMPROVEMENTS
- SIGNALS AT FOUR INTERSECTIONS
- PEDESTRIAN IMPROVEMENTS

CAPACITY : N INTERSECTION = 1
S INTERSECTION = 1
(MEETS EXISTING CAPACITY DEMANDED DURING WINTER PEAK)
COST : $2.0 MILLION

Moving Off-Ramps Only

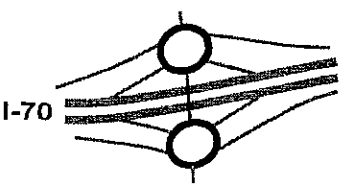


"NOT COST EFFICIENT. ESPECIALLY DISAPOINTING THAT IT WOULD ALSO REQUIRE SIGNALIZATION TO GAIN THE NEEDED CAPACITY"

REQUIREMENTS:
- LANE IMPROVEMENTS
- FRONTAGE ROAD IMPROVEMENTS
- SIGNALS AT TWO INTERSECTIONS
- EXTENSIVE GRADING
- RETAINING WALLS
- PEDESTRIAN IMPROVEMENTS

CAPACITY : N INTERSECTION = 1.50
S INTERSECTION = 1.25
(PROVIDES EXCESS CAPACITY: 50% AT N, 25% AT S)
COST : $7.1 MILLION

Roundabouts - Two Lane Design



"THIS SOLUTION IS THE MOST EFFICIENT MEANS TO SOLVE THE MOST PROBLEMS FOR BOTH NOW AND INTO THE FUTURE"

REQUIREMENTS:
- BRIDGE
- FRONTAGE ROAD IMPROVEMENTS
- RETAINING WALLS
- PEDESTRIAN IMPROVEMENTS

CAPACITY : N INTERSECTION = 2.46
S INTERSECTION = 1.56
(PROVIDES EXCESS CAPACITY: 146% AT N, 56% AT S)
COST : $5.4 MILLION

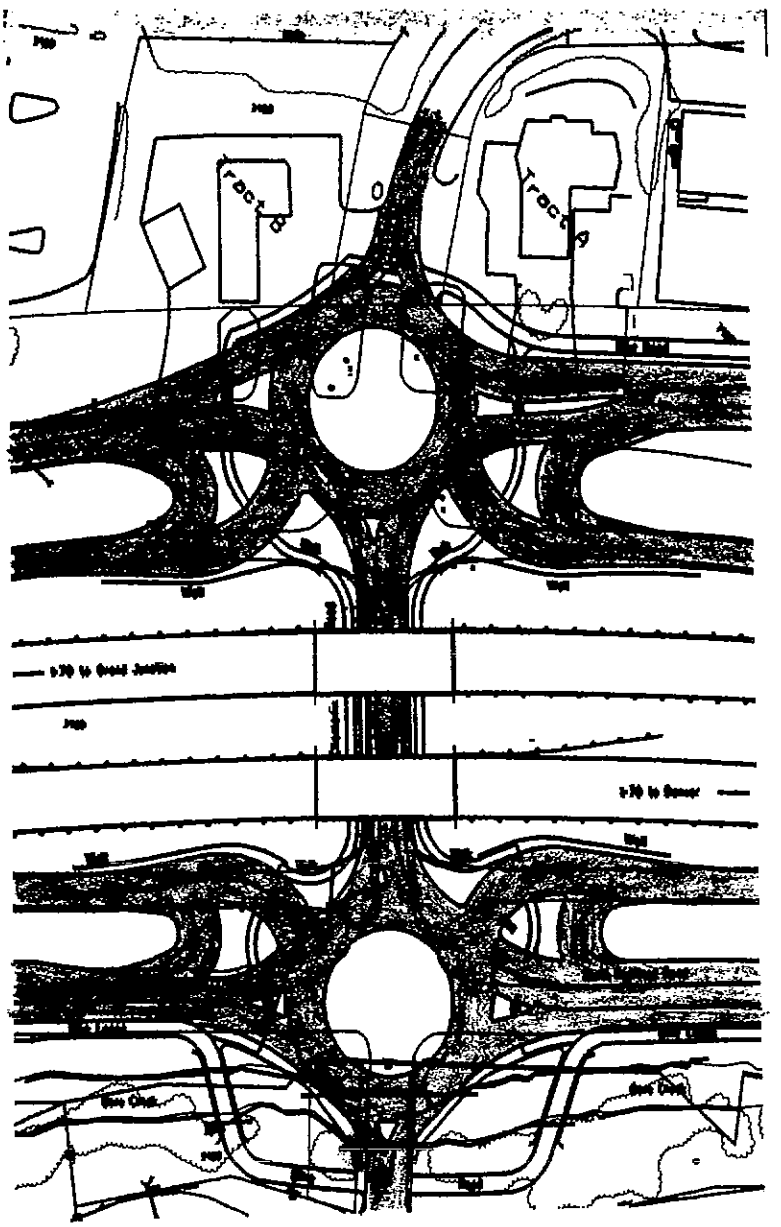
numbers indicate capacity:
1 = at capacity (operates with congestion and delays)
less than 1= the intersection is beyond its capacity (failing)
greater than 1 = excess capacity (minimal to no delays)

Recommendations

The final recommendation for the West Vail interchange is two lane roundabouts on the north and south side of the interchange.

Two lane roundabouts were determined to provide the greatest increase in capacity for the lowest relative cost as well as increasing safety, access, and aesthetics. The roundabout solution will also accommodate growth in and environmentally friendly manner.

Figure 5. Preliminary design of Two Lane Roundabout



Appendix 2A

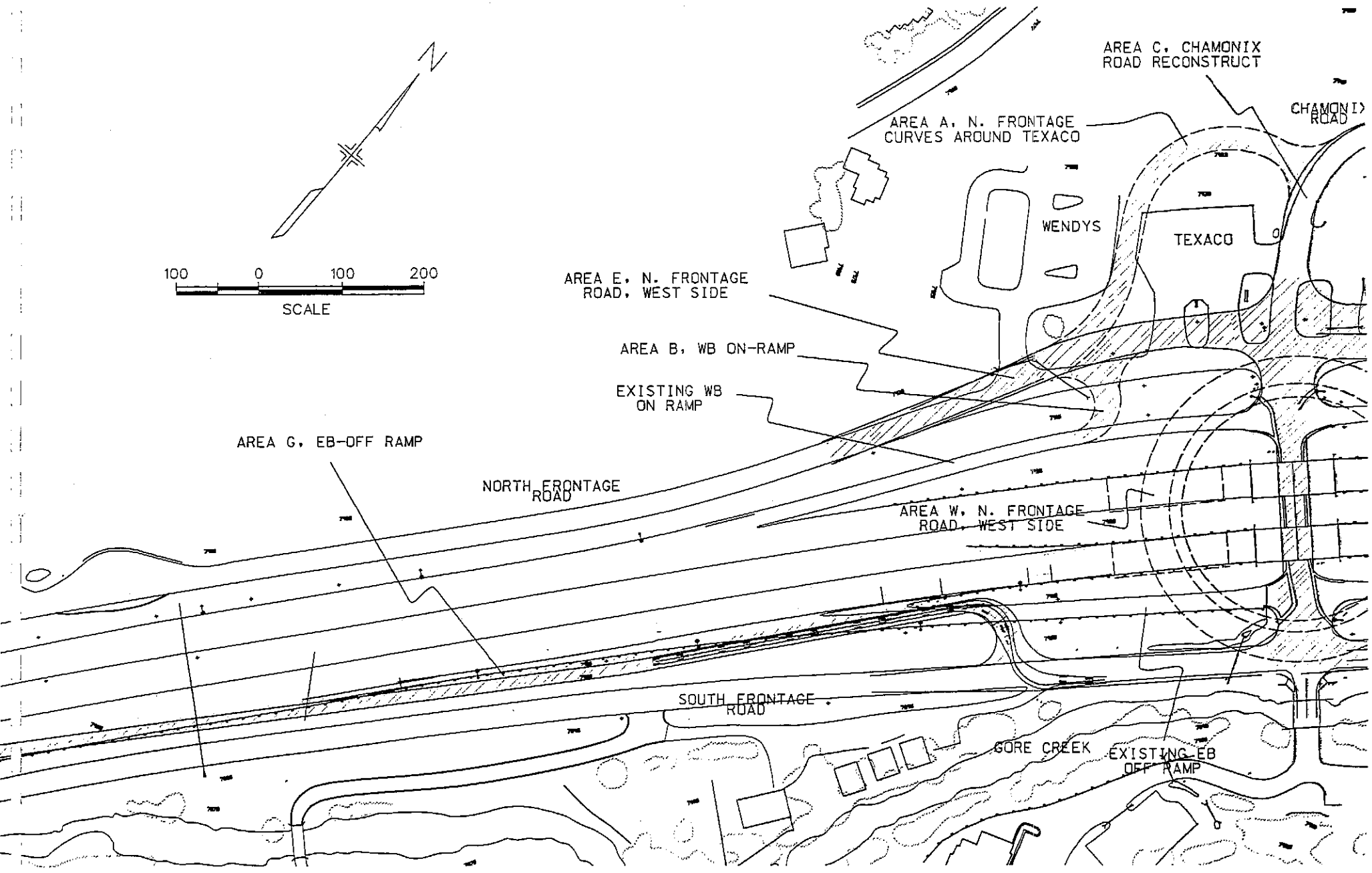
Table 1

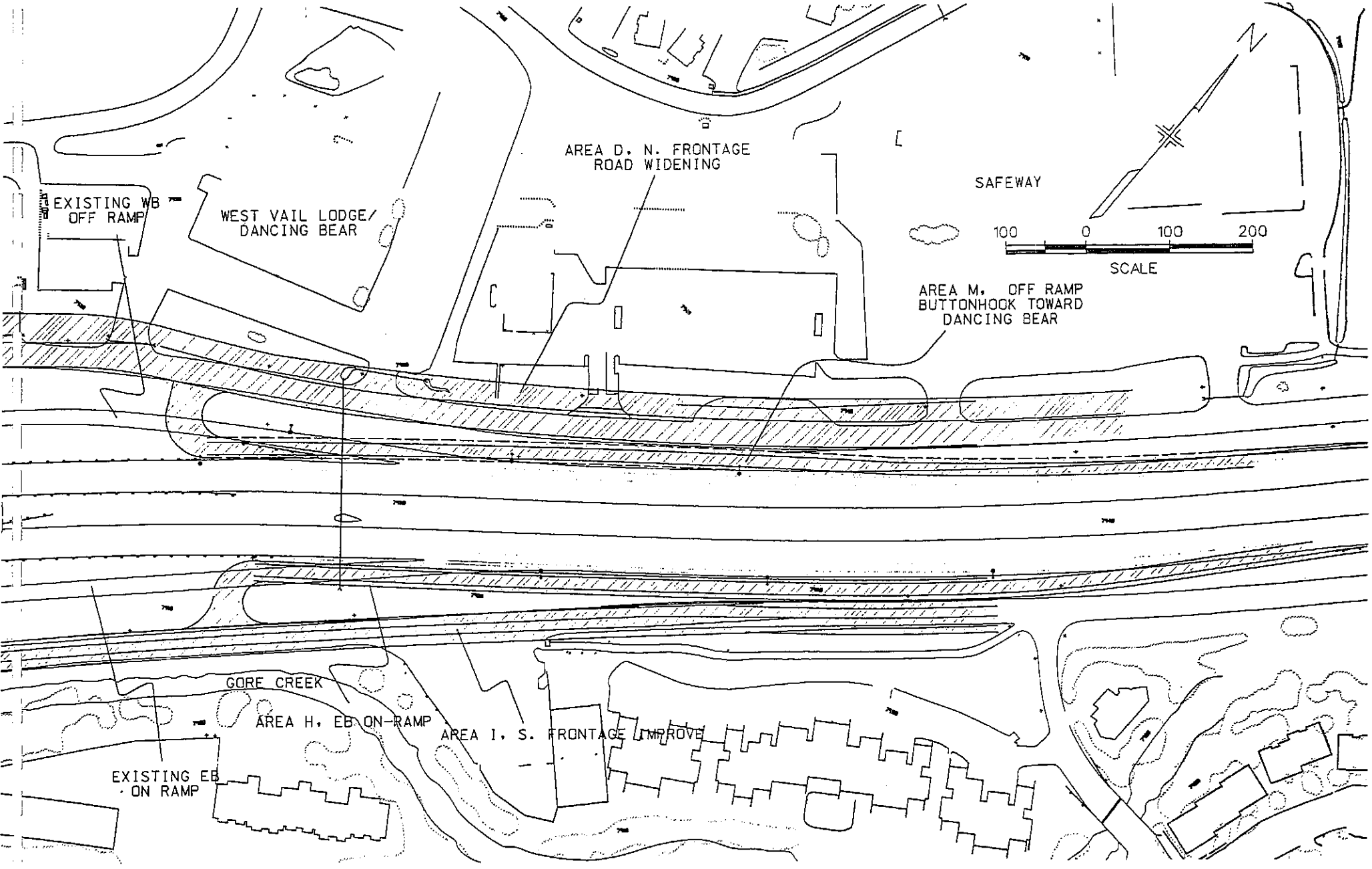
Cost Estimates for Vail

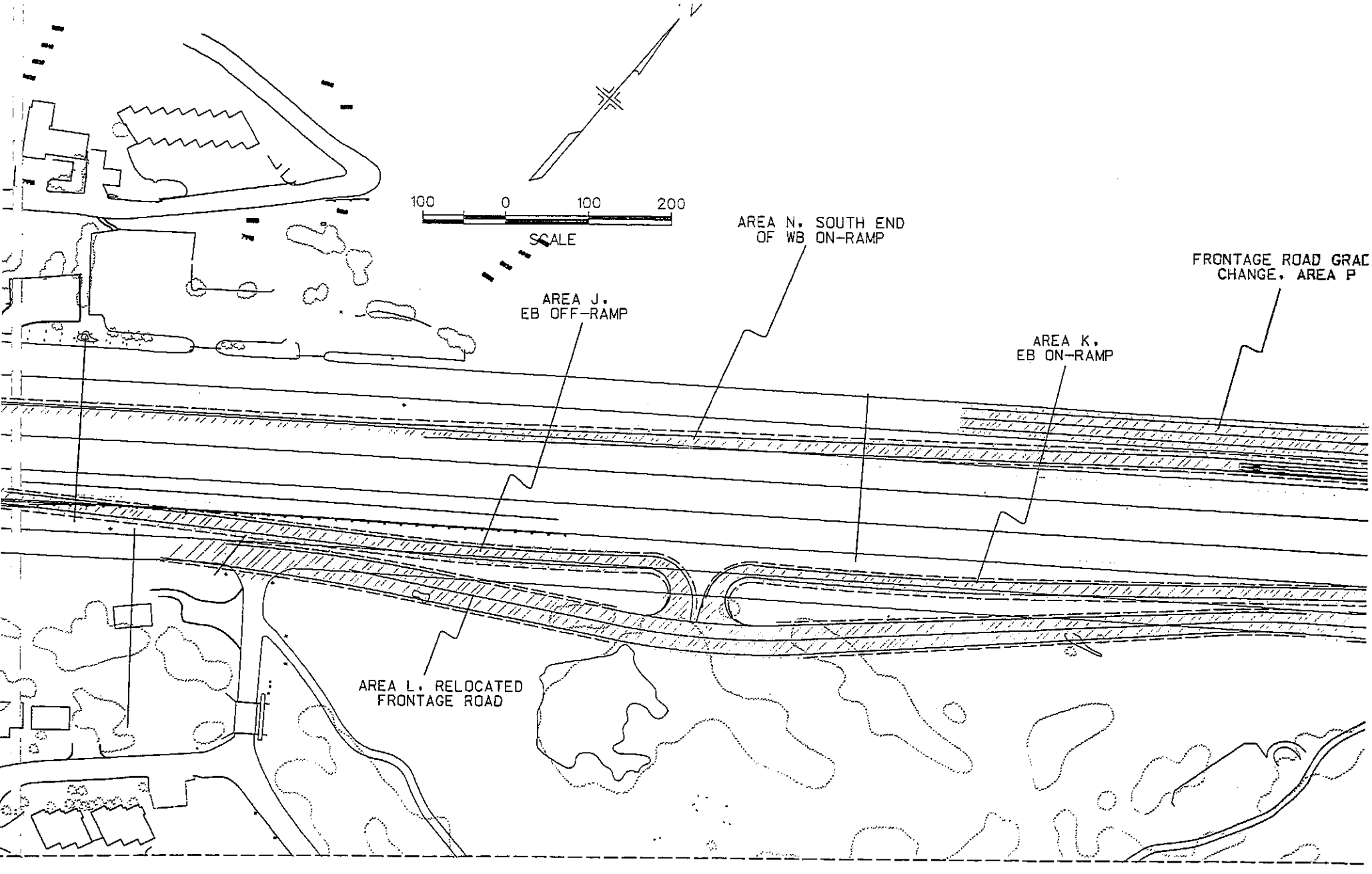
		Unit Cost	Area A North Frontage Road curves around Texaco		Area B WB On-ramp #1		Area C Chamonix Road		Area D North Frontage Road Widening		Area E North Frontage Road widened, moved north on west side of interchange		Area F Widen EB off ramp to 2 lanes at intersection	
Earthwork														
Cut			2,200		200									
Fill			100		400									
Cut (Balanced)	Cu. Yd.	$6	100	$600	200	$1,200	3,000	$18,000	0	$0	0	$0	0	$0
Fill (Balanced)	Cu. Yd.	$6	100	$600	200	$1,200	3,000	$18,000	0	$0	0	$0	0	$0
Fill/Cut (Borrow/Haul)	Cu. Yd.	$12	2,100	$25,200	1,000	$12,000	0	$0	4,000	$48,000	0	$0	1,200	$14,400
Roadway														
Remove Existing Pavement	Sq. Yd.	$4	3,220	$12,880	1,450	$5,800	0	$0	2,800	$11,200	3,220	$12,880	0	$0
Install New Pavement	Sq. Yd.	$25	2,720	$68,000	1,840	$46,000	500	$12,500	4,000	$100,000	2,280	$57,000	550	$13,750
Overlay Existing Pavement	Sq. Yd.	$5			2,500	$12,500	2,410	$12,050	0				1,600	$8,000
Sidewalk (w/Curb & Gutter)	Ln. Ft.	$45	800	$36,000	0	$0	1,000	$45,000	625	$28,125	550	$24,750	100	$4,500
Curb & Gutter (Edge, Median)	Ln. Ft.	$20	800	$16,000	0	$0	630	$12,600	625	$12,500	550	$11,000	200	$4,000
Guardrail														
Type 3	Ln. Ft.	$15	500	$7,500	0	$0	0	$0	0	$0	0	$0	600	$9,000
Type 4	Ln. Ft.	$40	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Bridge Construction														
New Bridge	Sq. Ft.	$200	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Retaining Wall (Assume CIP)														
0-5 feet	Ln. Ft.	$350	0	$0	0	$0	800	$280,000	0	$0	0	$0	0	$0
5-10 feet	Ln. Ft.	$600	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
10-15 feet	Ln. Ft.	$900	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
15-20 feet	Ln. Ft.	$1,300	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
20-25 feet	Ln. Ft.	$1,900	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Drainage	Ln.Ft.	$100	200	$20,000	100	$10,000	300	$30,000	300	$30,000	0	$0	200	$20,000
Signals	L.S.	$150,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Lighting	Each	$12,000	8	$96,000	2	$24,000	4	$48,000	6	$72,000	0	$0	2	$24,000
Signing/Striping	Ln. Ft.	$20	500	$10,000	660	$13,200	1,000	$20,000	625	$12,500	550	$11,000	200	$4,000
CONSTRUCTION SUBTOTAL				$292,780		$125,900		$498,150		$314,325		$116,630		$101,650
Other Utility Relocations (5%)		5.0%		$14,639		$6,295		$24,808		$15,716		$5,832		$5,083
Mobilization (5%)		5.0%		$14,639		$6,295		$24,808		$15,716		$5,832		$5,083
Contingency (20%)		20.0%		$58,556		$25,180		$99,230		$62,865		$23,326		$20,330
Engineering/Permits (20%)		20.0%		$58,556		$25,180		$99,230		$62,865		$23,326		$20,330
Construction Engineering (10%)		10.0%		$29,278		$12,590		$49,615		$31,433		$11,663		$10,165
Construction Traffic Control (10%)		10.0%		$29,278		$12,590		$49,615		$31,433		$11,663		$10,165
Rignt of Way	*Lump Sum*			$0		$0		$0		$0		$0		$0
Landscaping ($100,000 to $1,000,000)	*Lump Sum*	*$500,000*												
Signals (Add $300,000 for two intersects.)	*Lump Sum*	*$300,000*												
PROJECT TOTAL				$497,726		$214,030		$843,455		$534,353		$198,271		$172,805

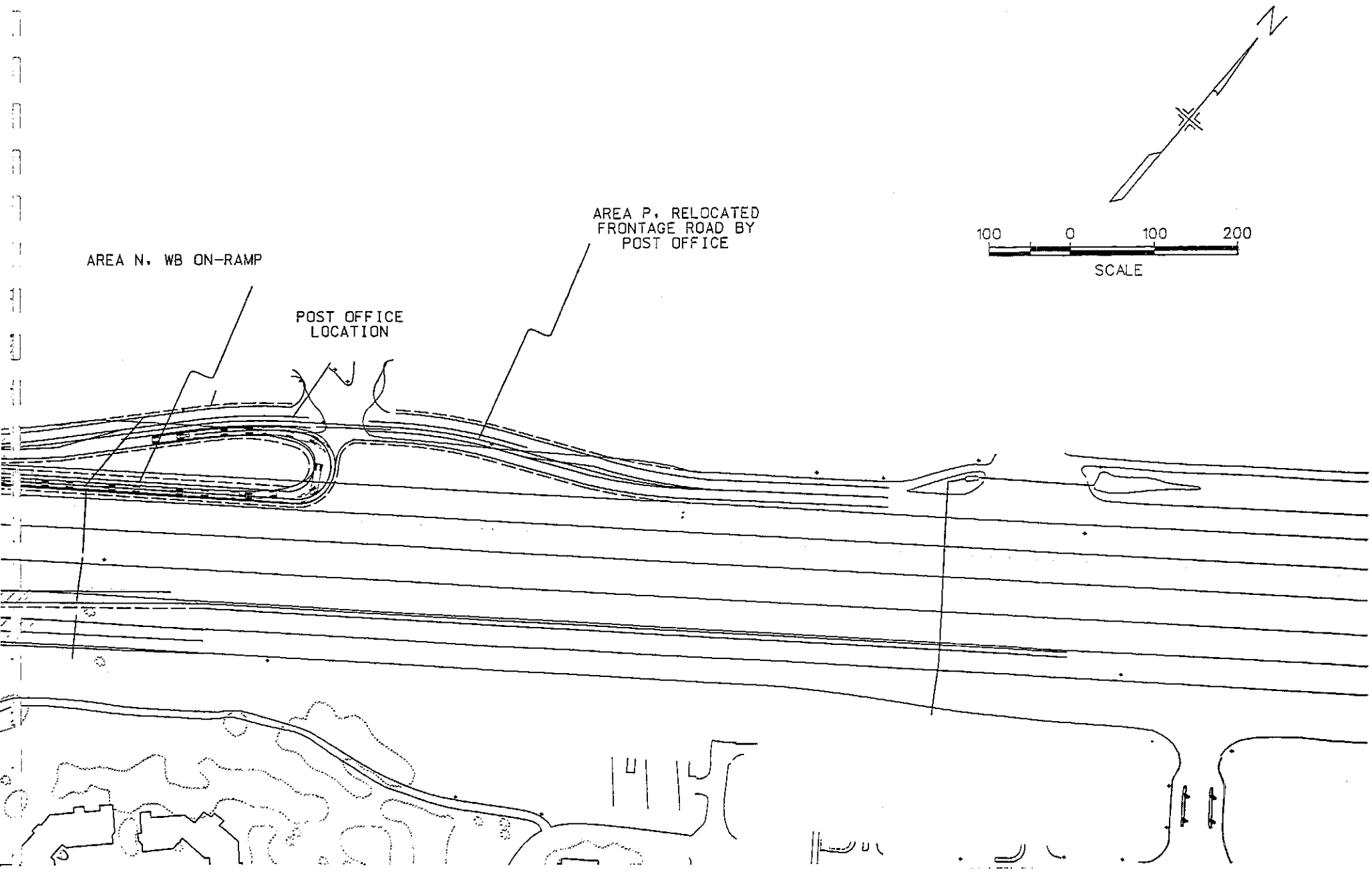
Table 1

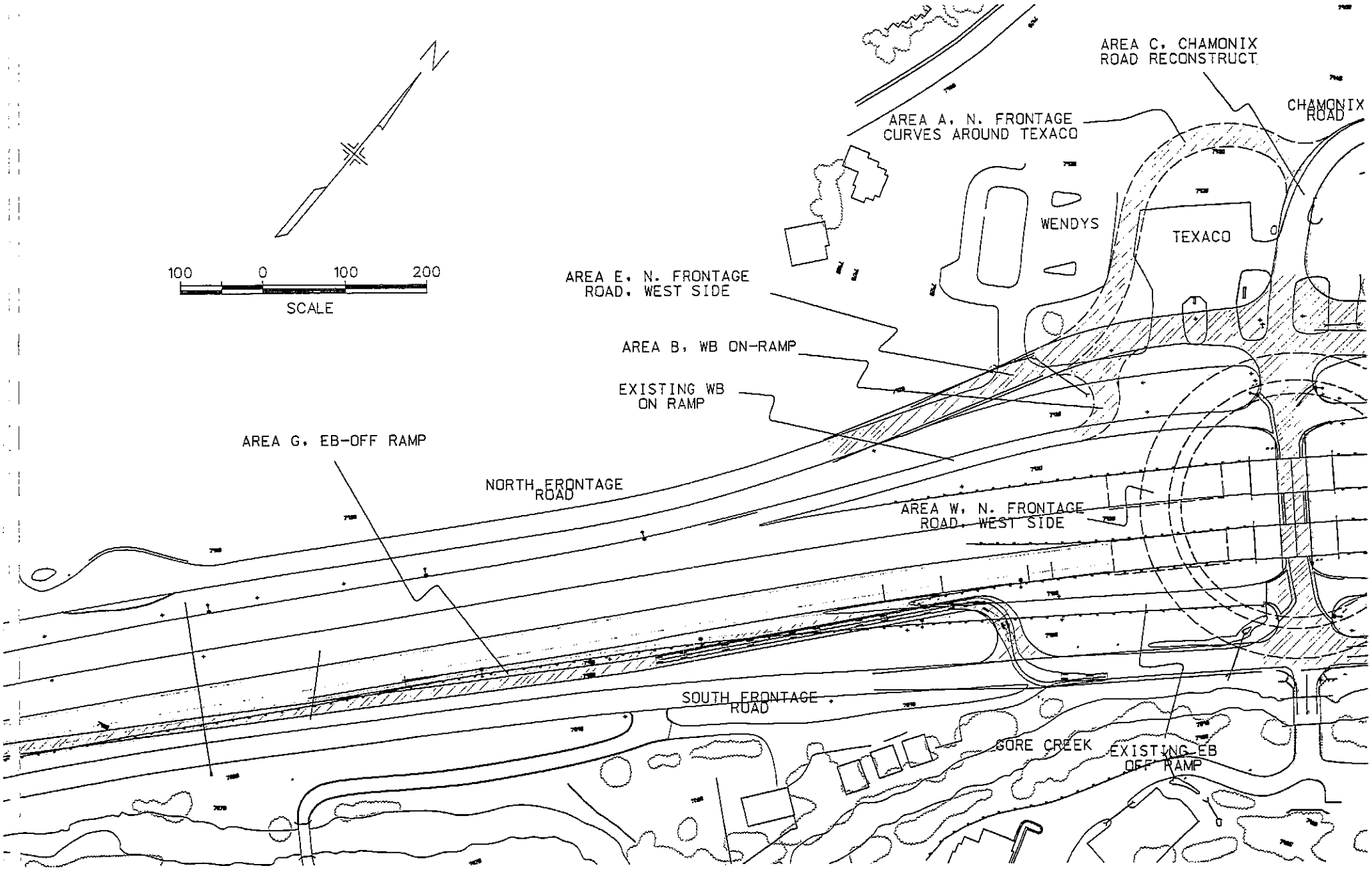
		Unit Cost	Area G EB Off-ramp on west side of Chamonix		Area H EB On-ramp just east of Chamonix		Area I South Frontage Road		Area J EB Off Ramp into Park Area, Buttonhook		Area K EB On Ramp from Park Area		Area L Frontage Road relocated for J and K	
Earthwork														
Cut			6,000		4,500				0		2,200		8,500	
Fill			2,100		2,900				12,000		5,200		13,000	
Cut (Balanced)	Cu. Yd.	$6	2,100	$12,600	2,900	$17,400	0	$0	0	$0	2,200	$13,200	8,500	$51,000
Fill (Balanced)	Cu. Yd.	$6	2,100	$12,600	2,900	$17,400	0	$0	0	$0	2,200	$13,200	8,500	$51,000
Fill/Cut (Borrow/Haul)	Cu. Yd.	$12	3,900	$46,800	1,600	$19,200	0	$0	12,000	$144,000	3,000	$36,000	4,500	$54,000
Roadway														
Remove Existing Pavement	Sq. Yd.	$4	1,590	$6,360	1,560	$6,240	2,000	$8,000	3,580	$14,320	3,700	$14,800	0	$0
Install New Pavement	Sq. Yd.	$25	3,300	$82,500	4,200	$105,000	3,450	$86,250	2,540	$63,500	3,550	$88,750	7,000	$175,000
Overlay Existing Pavement	Sq. Yd.	$5	1,340	$6,700	0	$0	3,000	$15,000	0	$0	0		500	$2,500
Sidewalk (w/Curb & Gutter)	Ln. Ft.	$45	0	$0	0	$0	1,500	$67,500	0	$0	0	$0	1,200	$54,000
Curb & Gutter (Edge, Median)	Ln. Ft.	$20	1,000	$20,000	0	$0	1,500	$30,000	0	$0	0	$0	800	$16,000
Guardrail														
Type 3	Ln. Ft.	$15	1,000	$15,000	1,200	$18,000	0	$0	1,000	$15,000	1,500	$22,500	0	$0
Type 4	Ln. Ft.	$40	2,000	$80,000	2,000	$80,000	0	$0	500	$20,000	500	$20,000	0	$0
Bridge Construction														
New Bridge	Sq. Ft.	$200	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Retaining Wall (Assume CIP)														
0-5 feet	Ln. Ft.	$350	240	$84,000	1,240	$434,000	0	$0	0	$0	200	$70,000	0	$0
5-10 feet	Ln. Ft.	$600	260	$156,000	200	$120,000	0	$0	500	$300,000	0	$0	0	$0
10-15 feet	Ln. Ft.	$900	760	$684,000	180	$162,000	0	$0	0	$0	0	$0	0	$0
15-20 feet	Ln. Ft.	$1,300	580	$754,000	100	$130,000	0	$0	0	$0	0	$0	0	$0
20-25 feet	Ln. Ft.	$1,900							0	$0	0	$0	0	$0
Drainage	Ln.Ft.	$100	100	$10,000	100	$10,000	100	$10,000	200	$20,000	200	$20,000	500	$50,000
Signals	L.S.	$150,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Lighting	Each	$12,000	6	$72,000	6	$72,000	0	$0	6	$72,000	6	$72,000	4	$48,000
Signing/Striping	Ln. Ft.	$20	2,000	$40,000	1,450	$29,000	1,500	$30,000	2,000	$40,000	800	$16,000	1,500	$30,000
CONSTRUCTION SUBTOTAL				$2,082,560		$1,220,240		$246,750		$688,820		$386,450		$531,500
Other Utility Relocations (5%)		5.0%		$104,128		$61,012		$12,338		$34,441		$19,323		$26,575
Mobilization (5%)		5.0%		$104,128		$61,012		$12,338		$34,441		$19,323		$26,575
Contingency (20%)		20.0%		$416,512		$244,048		$49,350		$137,764		$77,290		$106,300
Engineering/Permits (20%)		20.0%		$416,512		$244,048		$49,350		$137,764		$77,290		$106,300
Construction Engineering (10%)		10.0%		$208,256		$122,024		$24,675		$68,882		$38,645		$53,150
Construction Traffic Control (10%)		10.0%		$208,256		$122,024		$24,675		$68,882		$38,645		$53,150
Rignt of Way	*Lump Sum*			$0		$0		$0		$0		$0		$0
Landscaping ($100,000 to $1,000,000)	*Lump Sum*	*$500,000*												
Signals (Add $300,000 for two intersects.)	*Lump Sum*	*$300,000*												
PROJECT TOTAL				$3,540,352		$2,074,408		$419,475		$1,170,994		$656,965		$903,550

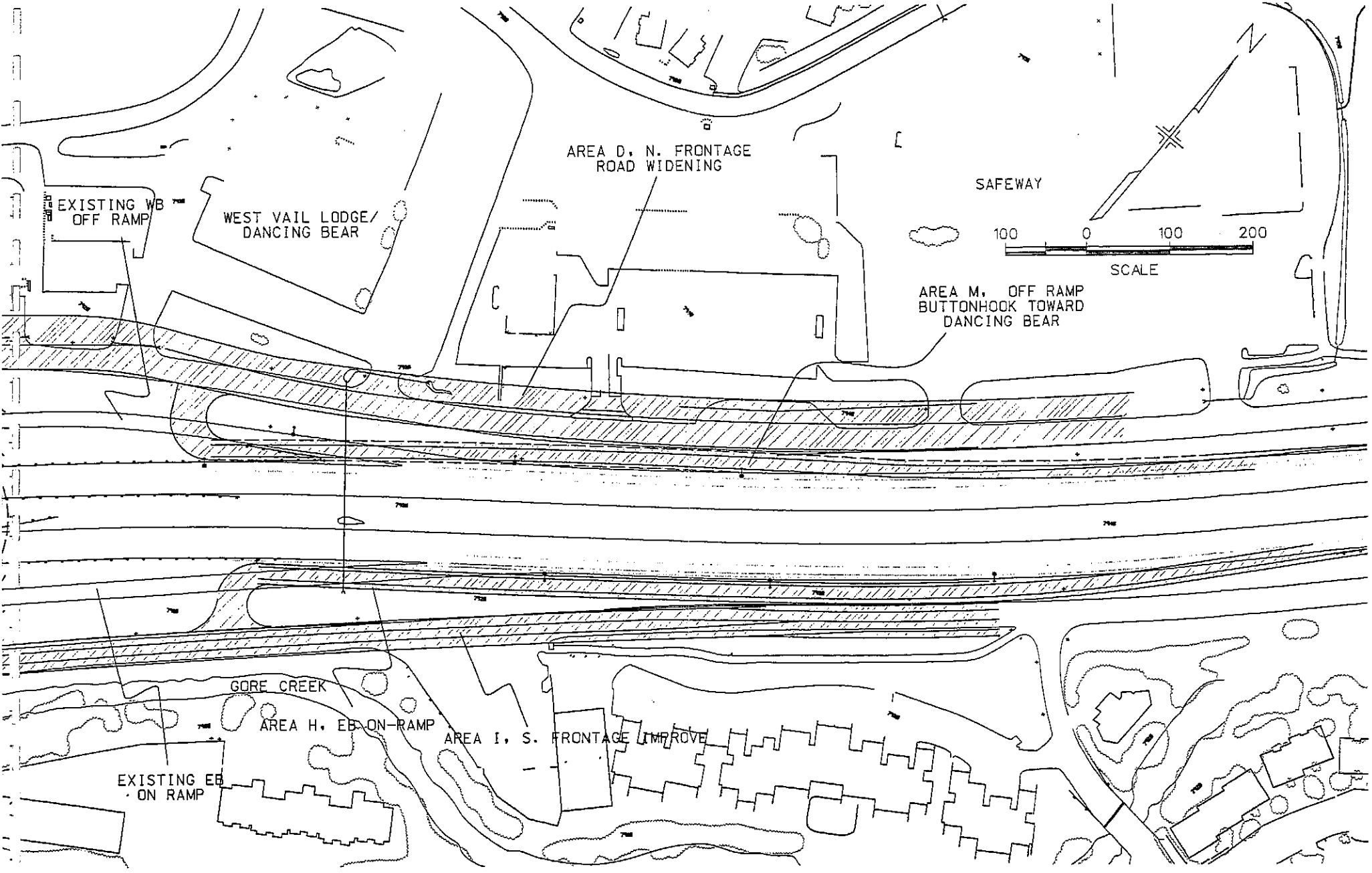

N
100 0 100 200
SCALE
AREA C, CHAMONIX ROAD RECONSTRUCT
CHAMONIX ROAD
AREA A, N. FRONTAGE CURVES AROUND TEXACO
WENDYS
TEXACO
AREA E, N. FRONTAGE ROAD, WEST SIDE
AREA B, WB ON-RAMP
EXISTING WB ON RAMP
AREA G, EB-OFF RAMP
NORTH FRONTAGE ROAD
AREA W, N. FRONTAGE ROAD, WEST SIDE
SOUTH FRONTAGE ROAD
GORE CREEK
EXISTING EB OFF RAMP

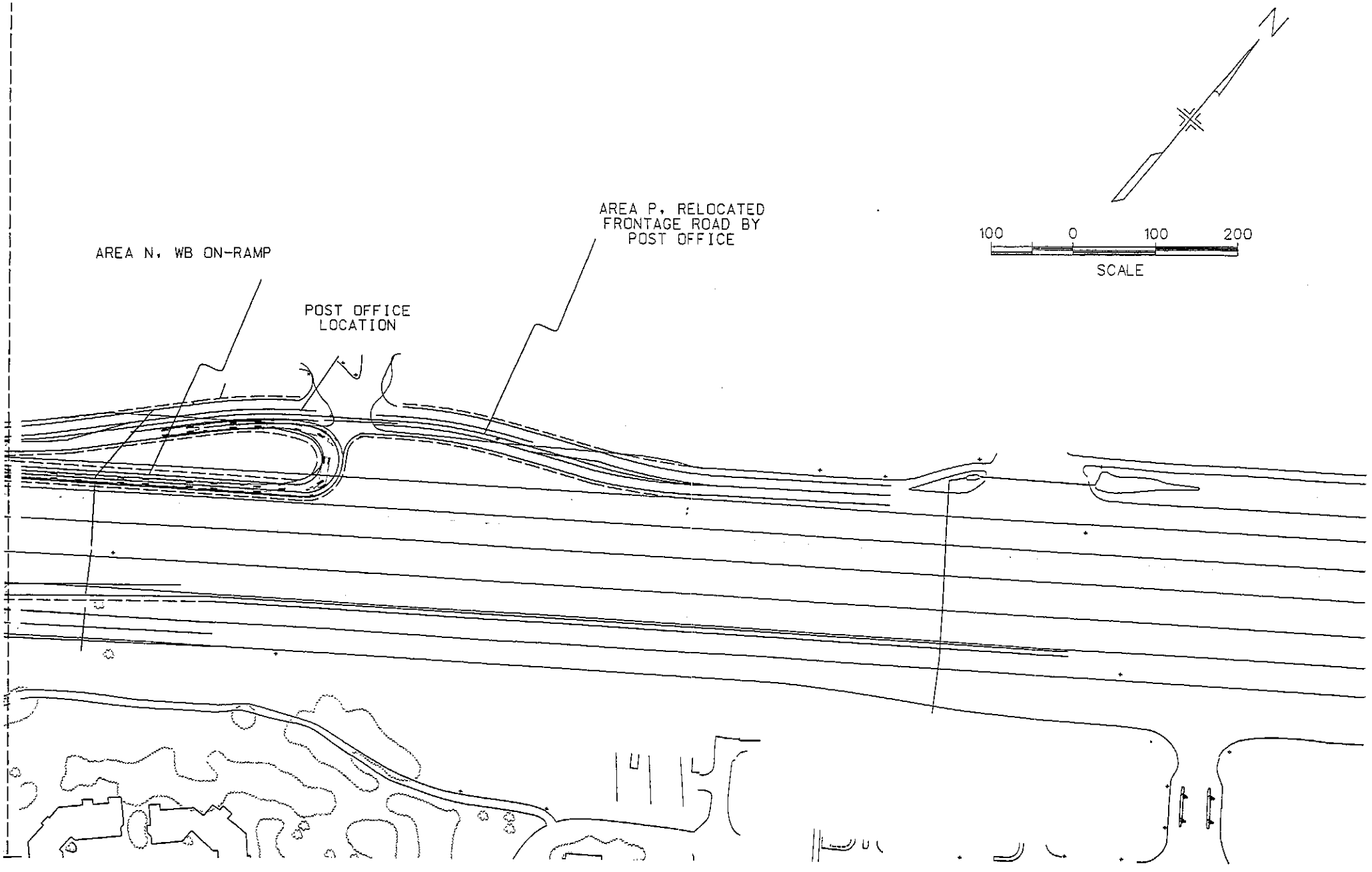

EXISTING WB
OFF RAMP
WEST VAIL LODGE/
DANCING BEAR
AREA D. N. FRONTAGE
ROAD WIDENING
SAFEWAY
N
100
0
100
200
SCALE
AREA M. OFF RAMP
BUTTONHOOK TOWARD
DANCING BEAR
GORE CREEK
AREA H. EB ON-RAMP
AREA I. S. FRONTAGE IMPROVE
EXISTING EB
ON RAMP

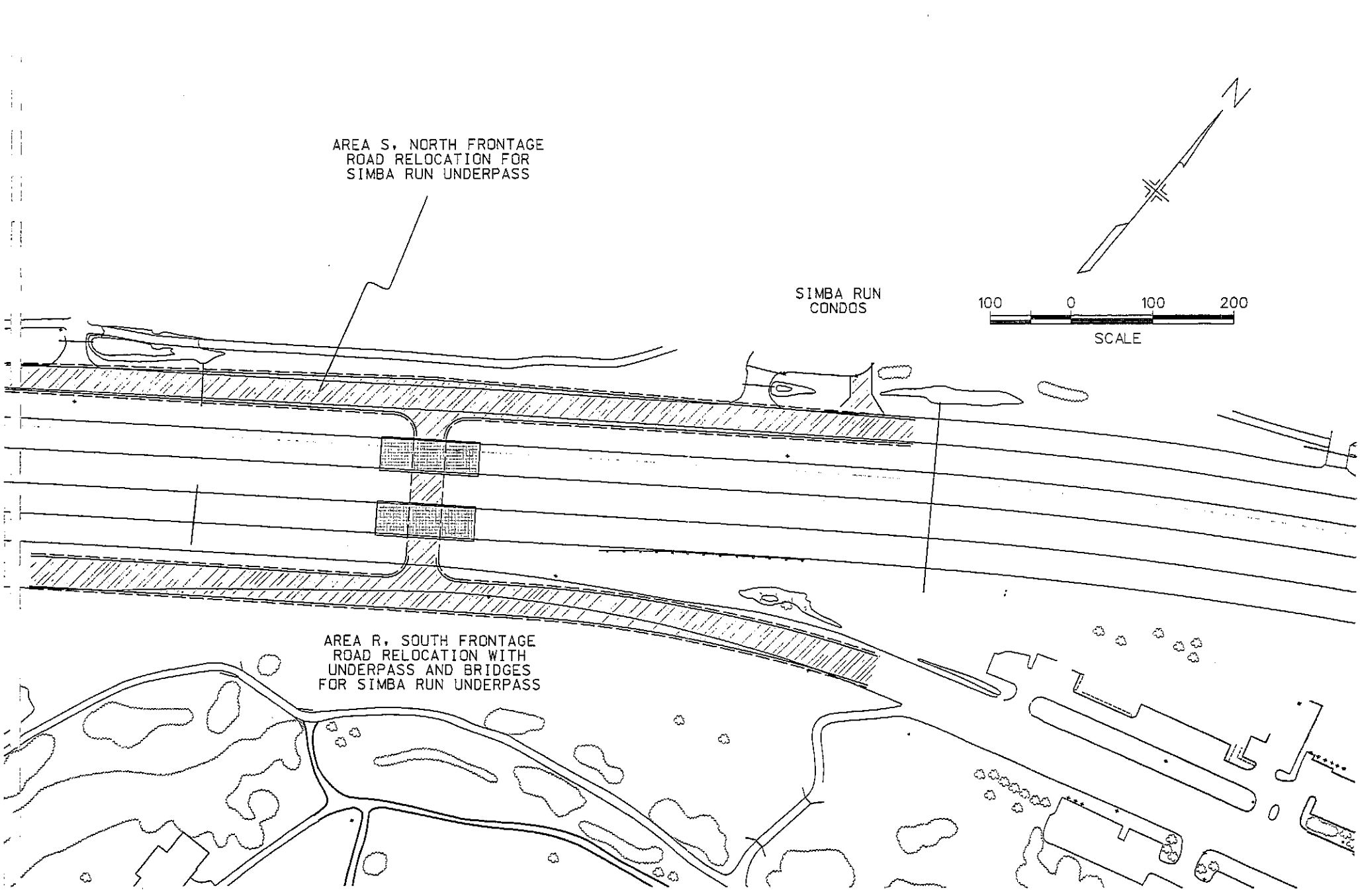

100 0 100 200
SCALE
AREA J.
EB OFF-RAMP
AREA N. SOUTH END
OF WB ON-RAMP
AREA K.
EB ON-RAMP
FRONTAGE ROAD GRAD
CHANGE. AREA P
AREA L. RELOCATED
FRONTAGE ROAD

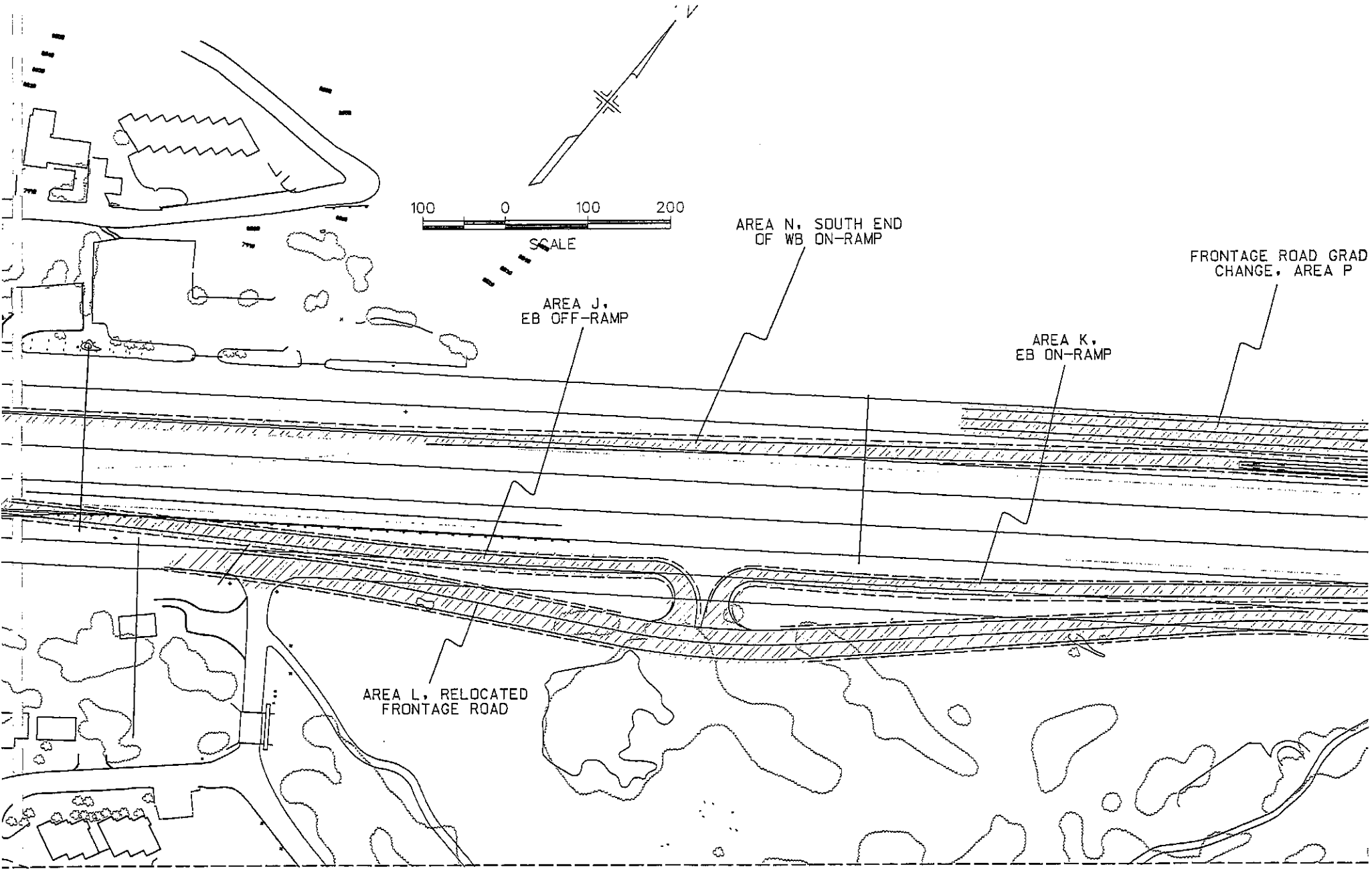

AREA N, WB ON-RAMP
POST OFFICE LOCATION
AREA P, RELOCATED FRONTAGE ROAD BY POST OFFICE
N
100
0
100
200
SCALE


AREA C, CHAMONIX
ROAD RECONSTRUCT
CHAMONIX
ROAD
AREA A, N. FRONTAGE
CURVES AROUND TEXACO
WENDYS
TEXACO
100 0 100 200
SCALE
AREA E, N. FRONTAGE
ROAD, WEST SIDE
AREA B, WB ON-RAMP
EXISTING WB
ON RAMP
AREA G, EB-OFF RAMP
NORTH FRONTAGE
ROAD
AREA W, N. FRONTAGE
ROAD, WEST SIDE
SOUTH FRONTAGE
ROAD
GORE CREEK
EXISTING EB
OFF RAMP


AREA D, N. FRONTAGE
ROAD WIDENING
EXISTING WB
OFF RAMP
WEST VAIL LODGE/
DANCING BEAR
SAFEWAY
100 0 100 200
SCALE
AREA M, OFF RAMP
BUTTONHOOK TOWARD
DANCING BEAR
GORE CREEK
AREA H, EB ON-RAMP
AREA I, S. FRONTAGE IMPROVE
EXISTING EB
ON RAMP


AREA N, WB ON-RAMP
POST OFFICE LOCATION
AREA P, RELOCATED FRONTAGE ROAD BY POST OFFICE
N
100 0 100 200
SCALE


AREA S, NORTH FRONTAGE
ROAD RELOCATION FOR
SIMBA RUN UNDERPASS
SIMBA RUN
CONDOS
N
100
0
100
200
SCALE
AREA R, SOUTH FRONTAGE
ROAD RELOCATION WITH
UNDERPASS AND BRIDGES
FOR SIMBA RUN UNDERPASS


100 0 100 200
SCALE
AREA J,
EB OFF-RAMP
AREA N, SOUTH END
OF WB ON-RAMP
AREA K,
EB ON-RAMP
FRONTAGE ROAD GRAD
CHANGE, AREA P
AREA L, RELOCATED
FRONTAGE ROAD