DENVER WATER

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Denver, CO 80204-3412
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denverwater.org

May 3, 2021

Mr. Ben Pearlman and Ms. Summer Frederick
1325 Pearl Street
Boulder, CO 80302

Re: **Draft Traffic Management Plan for the Gross Reservoir Expansion, Gross Reservoir Hydroelectric Project (FERC Project No. 2035)**

Dear Mr. Pearlman and Ms. Frederick,

Per Article 425 of the Federal Energy Regulatory Commission Order Amending License and Extending License Term (FERC Order) dated July 16, 2020, and United States Forest Service (USFS) 4(e) Conditions 10, 26, and 27, as applicable, Denver Water is submitting this draft Traffic Management Plan for the Gross Reservoir Expansion Project (May 3, 2021) for your agency's review. This plan includes all requirements indicated by the FERC Order and USFS 4(e) conditions.

The deadline for your agency's comments on this plan is **June 2, 2021**. Denver Water requests agencies submit their comments using the attached template.

Please submit your agency's comments to Ms. Melissa Brasfield, Communications Specialist, Gross Reservoir Expansion Project (grossreservoir@denverwater.org).

Denver Water will consider all agency comments received by the deadline and update the plan as necessary. The final plan will be submitted to FERC, per Article 425, for review and approval on or before July 16, 2021.

If you have any questions, please reach out to project staff at 303-628-6348 or grossreservoir@denverwater.org. Thank you again to you and your colleagues for your feedback on Denver Water's draft Traffic Management Plan for the Gross Reservoir Expansion Project.

Sincerely,

Jeff Martin, P.E.
Gross Reservoir Expansion Program Manager

cc: File
Enclosures

Denver Water

Gross Reservoir Hydroelectric Project
FERC Project No. 2035

TRAFFIC MANAGEMENT PLAN

DRAFT May 3, 2021

Prepared by:

DENVER WATER

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Glossary

AADT	Average Annual Daily Traffic
BMP	Best Management Practice
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CR	County Road
Denver Water	Board of Water Commissioners for the City and County of Denver
EIS	Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FERC Order	License Amendment
FS	Forest Service Road
GRE Project	Gross Reservoir Expansion Project
LOS	Level Of Service
MHT	Methods of Handling Traffic
MUTCD	Manual on Uniform Traffic Control Devices
RCC	Roller Compacted Concrete
SH	State Highway
TCP	Traffic Control Plan
TIS	Traffic Impact Study
TMP	Traffic Management Plan
UPRR	Union Pacific Railroad
US	U.S. Highway
USFS	U.S. Forest Service

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1 Introduction

1.1 Scope and Content of the Traffic Management Plan

The Gross Reservoir Expansion Project (GRE Project) is located on South Boulder Creek in Boulder County, Colorado, and in the Arapaho-Roosevelt National Forest. The objective of the GRE Project is to raise the existing Gross Dam by 131 feet to a height of 471 feet, increasing the storage capacity from approximately 42,000 acre-feet to about 119,000 acre-feet.

On July 16, 2020, the Federal Energy Regulatory Commission (FERC) issued an order amending the existing license (FERC Order) for Project No. 2035 (Gross Reservoir Hydroelectric Project) to raise the dam, enlarge the reservoir, extend the license to year 2051, increase the capacity of the generators, and modify the project boundary. The amended license includes conditions that, among others, require the Board of Water Commissioners for the City and County of Denver (Denver Water) to start and complete construction of the raised dam by July 16, 2022, and July 16, 2027, respectively, and to submit a revised Recreation Management Plan, a Tree Removal Plan, Quarry Operations and Reclamation Plans, and a Traffic Management Plan by July 16, 2021, for FERC approval. Excerpts from the FERC Order and amended license and conditions are provided in Appendix A. The purpose of this Traffic Management Plan (TMP) is to address the effects of the traffic associated with the construction of the GRE Project with measures to minimize the impacts of construction-related traffic on local traffic, residents, and visitors to the project area. The FERC requirements of this TMP are provided in Table 1 along with section numbers where this information can be found in this document.

Table 1:
FERC Requirements: Order Amending Hydropower License, Article 425 (July 16, 2020)

Requirements	Section of this Plan
(1) Measures to minimize the number of truck trips needed for project construction.	Section 6
(2) Measures to minimize the effects of construction-related traffic on local traffic patterns, residents, and visitors.	Section 6
(3) Measures to minimize noise, dust, and exhaust.	Section 9
(4) Measures to encourage and/or require the use of carpools for construction workers.	Section 6
(5) Proposed construction traffic routes, time-of-use, traffic control measures, and other restrictions.	Sections 2.1.1, 2.1.2, 4, and 7
(6) Measures to minimize and repair any road damage.	Section 8.6.1.
(7) Procedures for complying with county road regulations.	Sections 2.1.2 and 8.6.2.
Consistency with Forest Service 4(e) condition 10 (Road Maintenance Plan)	Section 8.6.1. The Road Maintenance Plan will be developed according to the schedule stated in FERC Order Article 422(a).

Requirements	Section of this Plan
Consistency with Forest Service 4(e) condition 26 (Pit Development & Reclamation Plan)	As described in Section 3.1.1, this plan accounts for operations associated with the Quarry Operation and Reclamation Plans required by FERC Article 424. Denver Water does not believe that a Pit Development & Reclamation Plan will be required because the quarry for the GRE Project will not be on U.S. Forest Service land.
Consistency with Forest Service 4(e) condition 27 (Tree Removal Plan)	Throughout this plan, Denver Water has addressed operations associated with the Tree Removal Plan required by FERC Article 423 and 4(e) condition 27.

Denver Water used the Boulder County Transportation Management Plan template as a starting point for developing this TMP. Some elements may differ slightly from the original template. Table 2 provides a list of the elements of the Boulder County template and the sections in this document that correspond to the template information.

Table 2:
Boulder County TMP Template Crosswalk

Boulder County Template Sections	Corresponding Sections in this TMP Document
Contents	Section 1.1
How to Use this TMP	Sections 2.0 and 2.1
Background Information	Section 3
Summary	Section 3
Project Description	Section 3
TMP Team — Roles and Responsibilities	Section 2.2
Existing Conditions	Sections 2.1 and 4
Project Information	Section 3.1
Work Zone Impact Assessment	Section 5
Work Zone Impact Management Strategies	Section 8
TMP Monitoring	Section 8.4

1.1.1 Agency Consultation

Article 425 requires Denver Water consult with the U.S. Forest Service (USFS), Colorado Department of Transportation (CDOT), Boulder County, Jefferson County, and Gilpin County in development of the plan. Denver Water initiated consultation with the USFS, CDOT, and Boulder County prior to issuance of the FERC Order due to the complexity of the plan and coordination needed to review planning roadway improvements. At the time of the pre-license consultation, Denver Water did not envision significant traffic patterns to occur on Gilpin and Jefferson county roadways. The GRE Project team was able to better understand and define traffic patterns related to both construction and tree removal activities, and both Gilpin and Jefferson counties were consulted prior to the formal TMP agency review period.

A summary of recent (2018 to present) consultation with local and regional agencies follows:

- **Colorado Department of Transportation**
  - July 9, 2019, Region 1 meeting to review permitting for State Highway (SH) 72 and Gross Dam Road.
  - February 22, 2018, CDOT Region 1 meeting to review SH 72 and Gross Dam Road Traffic Impact Study.
- **U.S. Forest Service, Boulder Ranger District**
  - April 8, 2021, annual consultation meeting.
  - February 5, 2020, annual consultation meeting.
  - October 1, 2019, draft 2019 Tree Removal Plan stakeholder meeting.
  - August 5, 2019, draft 2019 Tree Removal Plan stakeholder meeting.
- **Boulder County**
  - February 10, 2021, Boulder County, CDOT, and local jurisdictions teleconference regarding tree removal.
  - February 3, 2021, Boulder County Building Safety & Inspection Services Department teleconference regarding temporary and permanent facilities.
  - February 3, 2021, Boulder County Parks and Open Space Department teleconference regarding sensitive resource areas and related topics.
  - January 27, 2021, Boulder County Public Works, CDOT, and local jurisdictions teleconference regarding transportation issues.
  - May 4, 2018, meeting with Boulder County Transportation Department representatives.
  - March 18, 2018, meeting with Boulder County Transportation Department representatives.
- **Jefferson County**
  - February 10, 2021, teleconference regarding tree removal activities.
- **Gilpin County**
  - April 6, 2021, Gilpin County Commissioner and staff teleconference regarding Tree Removal Plan and transportation.
  - February 17, 2021, Gilpin County Commissioner and staff teleconference regard GRE Project overview.
  - February 10, 2021, Gilpin County, CDOT, and local jurisdictions teleconference regarding tree removal.

1.1.2 Public Outreach

In addition to the required agency consultation, Denver Water has put forth a public outreach campaign to inform and solicit feedback from neighboring communities and the public on many aspects of the GRE Project. Transportation activities and the effects to existing roadways and traffic patterns are a primary concern to neighboring communities and visitors. Denver Water started public outreach related to permitting efforts in 2003 with scoping as part of the Environmental Impact Statement (EIS) process. This outreach continued with public site visits and meetings in 2008 related to the FERC process. Additional public meetings were held in

2009 for the Draft EIS. Efforts to engage the community on a regular basis started in 2013 and continues today through project updates, community presentations and one-on-one virtual meetings staffed by a Denver Water project representative.

A summary of key outreach activities follows:

- 2003 — Scoping as part of the EIS process.
- 2008 – Site visit and public meetings for the FERC process.
- 2009 — Public comment meetings on the EIS process.
- 2011 – Public comment meetings for the U.S. Fish and Wildlife Mitigation Plan.
- 2013 — Intergovernmental Agreement public meetings with Boulder County.
- 2013 — Listening studies to inform a formal outreach program.
- 2016 — Availability sessions to gather information from local community.
- 2016 — Hired full time public outreach staff. Built a dedicated project website.
- 2017 — Built and opened an onsite Public Information Yurt to host office hours and events.
- 2018 — Updated project website to continue to share GRE Project information.
- 2019 — Conducted community survey to more than 2,100 residents surrounding Gross Reservoir.
- 2020 — Initiated online office hours due to COVID-19 limitations.
- 2021 — Continued online office hours and other outreach efforts.

Denver Water has considered public feedback from these outreach efforts in both the GRE Project design development and the development of the TMP.

Notable public feedback was incorporated into the design, and the TMP includes:

- Reduction of haul traffic by approximately 23,000 trips to the GRE Project site by producing all sand and gravel aggregate from an onsite quarry.
- Commitment to no project hauling while school buses are using SH 72 and adjoining roadways.
- Creation of a project staging area to manage GRE Project delivery truck traffic.
- Encouraging workforce carpooling efforts to reduce vehicle volumes associated with the GRE Project.
- Relocation of the onsite quarry to reduce visibility and decrease the quarry disturbance area above the new high water line.

2 Traffic Management Plan Overview

The TMP details the expected traffic patterns, volume, and transportation management strategies that will be used to manage and minimize construction related traffic effects.

The TMP comprises the following elements:

- General GRE Project background information.
- Construction-related traffic routes.
- Traffic impact minimization strategies.
- Traffic safety improvements.
- Work zone impact management strategies.
- Environmental mitigation and best management practices (BMPs).

Denver Water will review, update, and revise the TMP in the event of significant updated or changed conditions. Market conditions related to tree removal activities or other construction commodities (which cannot be known until closer to work starting in 2024 through 2026) may require adjustments to the approach for truck routes discussed in this plan.

2.1 Traffic Impact Studies and Traffic Control Plans

The TMP development considered completed engineering studies of the existing roadway systems and traffic safety during roadway improvements, and these are summarized below.

2.1.1 Traffic Impact Studies

A Traffic Impact Study (TIS)[1] was prepared in 2021 to support traffic safety design improvement decisions and to understand opportunities to reduce GRE Project related traffic.

2021 Stantec Traffic Impact Study

The 2021 TIS is included in Appendix B. The purpose of the Traffic Impact Study — 90% Design Memorandum, Interim Submittal was to determine the impacts of construction and tree removal traffic on the proposed access routes and access intersections. The TIS also determined whether mitigation is required for the access routes and intersections with SH 72 on the east side of the reservoir and SH 119 on the west side of Gross Reservoir. In addition, the TIS evaluated the traffic for tree removal operations and the impacts on the roads involved. The TIS also addressed the safety and mobility for the traveling public. The 2021 TIS (Appendix B) will be updated based on agency comments received and continued design progression.

Cement and Fly Ash Material Deliveries. The delivery of cement and fly ash, which is anticipated to commence in 2023, with the majority of and peak deliveries taking place in 2024 and 2025. According to the cement and fly ash haul study described in the 2021 TIS and the

[1] The Traffic Impact Study, an engineering study evaluating existing and proposed traffic upon an existing or proposed transportation system, is also known as a Traffic Impact Analysis.

current construction schedule, Denver Water estimates up to 7,200 tons (approximately 288 trucks) of cement and fly ash deliveries will be required every week during peak roller compacted concrete (RCC) production. The majority of RCC production will occur over two seasons in 2024 and 2025 with peak production each season lasting a couple of weeks. This volume of truck deliveries is considered a conservatively high estimate for the purposes of the TIS. The proposed single route for deliveries of cement and fly ash material was determined with previous study efforts (Engineering Solutions, 2014) and includes approximately 13 miles of travel on SH 72 between SH 93 and Gross Dam Road and approximately 4 miles of travel on Gross Dam Road. The highest impacts will occur during deliveries of cement and fly ash materials for Dam Raise construction (2023 to 2025). This analysis examines these traffic impacts, including mitigation of the intersection at SH 72 and Gross Dam Road and along Gross Dam Road.

Vegetation and Tree Removal. Limited vegetation and tree removal are expected to occur yearly during Site Development construction activities commencing in 2022. The removal of trees within the footprint of the raised reservoir area will be the last phase, with the largest volume of tree removal expected to take place between 2025 and 2026[2], as part of the Dam Raise work. The tree removal materials are planned to be transported away from the site using different routes from the east and west sides of the Gross Reservoir. Market conditions related to tree removal activities (which cannot be known until closer to work starting in 2024 through 2026) will be used to determine the final destination of biomass leaving the site. For tree removal from the east side of Gross Reservoir, transport trucks are planned to use the proposed routes for cement and fly ash material deliveries between SH 93 and Gross Dam Road via SH 72. For tree removal from the west side of Gross Reservoir, the proposed route includes approximately 3.2 miles of travel on Lazy Z Road (County Road [CR] 97E) to CR 132 and approximately 24 miles of travel on SH 119 between U.S. Highway (US) 6 and CR 132 to access I-70. Another proposed route is to the north on SH 119 from CR 132. No tree removal material transport trucks will occur on SH 72 between Gross Dam Road and CR 97. Transport of these materials will result in increased traffic on the west side access routes; however, the existing traffic volumes on these roadways is very low and impacts to the traveling public will not be significant. The TIS interim submittal (Appendix B) is based on information developed for the Tree Removal Plan dated March 2021.

Evaluated Roadways — Existing Conditions

SH 72 (Coal Creek Canyon Road) west of SH 93 is a rural, mountainous roadway that provides regional connectivity between the Denver metropolitan area on the east and SH 119 near the towns of Nederland and Rollinsville on the west. SH 72 near Gross Dam Road is a two-lane (one lane in each direction) paved 24-foot-wide section. Shoulders in the area of the study intersection include 2-foot paved shoulders, unpaved shoulders, or roadside ditched for

[2] The 2021 Draft Tree Removal Plan indicated that tree removal activities in the inundation area would take place in 2026 and 2027. This timeline has been updated and will be reflected in the final Tree Removal Plan.

stormwater. Gross Dam Road turn-off from SH 72 is 8.6 miles west from SH 93, and 3.9 miles south from Denver Water Headquarters (HQ) near 3817 Gross Dam Road. SH 72 has a grade that ranges from about 3% to about 8% from SH 93 to the intersection with Gross Dam Road. One of the steepest roadway segments on SH 72 within the study area is the 1/3 mile immediately leading up to Gross Dam Road with about 7.5% grade. The posted speed limit on SH 72 in the study area varies from 35 to 45 mph and is 40 mph near the Gross Dam Road access. SH 72 is classified as a Rural Highway in the CDOT State Highway Access Category Assignment Schedule. Colorado State Highways are designed for tractor trailer trucks and similar traffic. SH 72 is a school bus route and school buses travel and stop to pick up children on the roadway during the morning (7:00 AM – 8:30 AM) and the afternoon (3:00 PM – 4:30 PM). SH 72 passes under a railroad crossing bridge, 2.5 miles to the west of the intersection of SH 72 and SH 93, with a posted vertical clearance of 14 feet 9 inches in both directions. The roadway segment on SH 72 between Gross Dam Rad and SH 119 Road will not be used by trucks for the GRE Project. Historical average annual daily traffic (AADT) counts from 2015 to 2019 for SH 72 are listed below:

- SH 72 west of SH 93: 5,546 to 5,572.
- SH 72 west of Twin Spruce Road: 3,900 to 4,195.
- SH 72 northwest of Ranch Elsie Road: 2,900 to 3,071.
- SH 72 east of Indian Peak Road: 1,400 to 1,531.
- SH 72 east of SH 119 Junction: 880 to 1,425.

SH 119 is a 63.7-mile-long state highway in north central Colorado. SH 119 north of US 6 to CR 132 (Magnolia Road) is primarily classified as a rural, mountainous roadway. SH 119 provides regional connectivity between the towns of Golden, Black Hawk, Central City, and Idaho Springs on the south and Rollinsville and Nederland on the north. SH 119 continues northeast past Nederland towards the City of Boulder and Longmont. Near CR 132, SH 119 is a two-lane (one lane in each direction) paved 24-foot-wide section with 11-foot shoulders in each direction. The CR 132 turn-off from SH 119 is 23.8 miles north of US 6. The posted speed limit on SH 119 in the study area varies from 35 to 45 mph and is 45 mph near the CR 132 access. SH 119 has a grade that ranges from about 4% to about 6% from US 6 to CR 132. In the study area, SH 119 is classified as a Regional Highway (RA) in the CDOT State Highway Access Category Assignment Schedule. It should be noted that a portion of SH 119 is a designated State Scenic Byway. Colorado state highways are designed for tractor trailer trucks and similar traffic. To the north, SH 119 intersects with SH 72 in Nederland where SH 119 turns to the northeast enters the scenic Boulder Canyon, and City of Boulder. Historical AADTs from 2015 to 2019 for SH 119 are listed below:

- SH 119 NE/O SH 72 Junction — 2,657 to 3,560.
- SH 119 SW/O Tilden Street — 4,161 to 4,578.

Gross Dam Road is a two-lane (one lane in each direction) unpaved gravel road with continuity from SH 72 on the south to Flagstaff Road on the northeast side of Gross Reservoir. The posted speed limit on Gross Dam Road is 20 mph. However, based on previous studies and the AutoTurn analysis presented in the TIS, the steep grades, which range from about 2% to about 9%, and the tight switch back curves, will only allow for large trucks to travel at a maximum speed of about 10 mph unless substantial improvements are made to the roadway; even then, one-way flagging in several areas would be required under current conditions. Gross Dam Road provides access to the existing Gross Dam maintenance facilities and recreation areas and is used for local access by residents who live in the area. Gross Dam Road crosses the Union Pacific Railroad (UPRR) tracks approximately 2.2 miles north of SH 72. The railroad crossing is at grade and is equipped with railroad warning signs and flashing lights but no railroad gates. Gross Dam Road also provides access to the Walker Ranch Loop regional trail and the western portion of El Dorado State Park just northeast of the Railroad crossing. Additionally, Denver Water owns a portion of Gross Dam Road.

Crescent Park Drive is a two-lane (one lane in each direction) paved Jefferson County road with continuity from SH 72 on the south to Gross Dam Road on the north. Crescent Park Drive is generally used by traffic en route to Flagstaff Road and Gross Reservoir and by residents for local access. Traffic traveling west (from Denver) can use Crescent Park Drive to access Gross Dam Road. Crescent Park Drive will be utilized as an access route to the project until the new intersection at Gross Dam Road and SH 72 can be improved.

Flagstaff Road is a two-lane (one lane in each direction) paved road north of Gross Reservoir with continuity between Gross Reservoir and Boulder. Flagstaff Road will be restricted from commercial construction access as part of the GRE Project.

CR 132 (Magnolia Road) is a two-lane (one lane in each direction) unpaved gravel road with continuity from SH 119 on the west to cross SH 119 again in Boulder Canyon on the northeast. The posted speed limit on CR 132 is 30 mph. Towards the east, approximately 3 miles from SH 119, CR 132 intersects with Lazy Z Road, which is one of the access roads to the west side of Gross Reservoir. CR 132 is part of the proposed route for hauling tree removal materials from the west side of the reservoir as part of the GRE Project. The grade on CR 132 from SH 119 to Lazy Z Road ranges from about 4% to about 6%.

Lazy Z Road (CR 97E) is a two-lane (one lane in each direction) unpaved gravel road west of Gross Reservoir. Lazy Z Road provides connectivity between CR 132 and Gross Reservoir. Lazy Z Road is a narrow roadway, particularly for the first 1.5 miles west of Gross Reservoir, with a total roadway width of less than 15 feet. Lazy Z Road is part of the proposed route for hauling tree removal materials from the west side of Gross Reservoir as part of the GRE Project. Lazy Z Road has a grade ranging from about 3% to about 9% from CR 132 to Gross Reservoir.

Forest Service Road (FS 359) is an unpaved gravel road west of Gross Reservoir. FS 359 in an access road to the West Side of Gross Reservoir and provides connectivity from CR 68 on the west to Gross Reservoir on the east. FS 359 is a narrow roadway with a total width of less than

15 feet. FS 359 is part of the proposed route for hauling tree removal materials from the west side of Gross Reservoir as part of the GRE Project. Improvements to FS 359 will be required to accommodate access for logging equipment and haul trucks. FS 359 has a grade ranging from about 2% to about 9% from CR 68 to Gross Reservoir.

Construction-Generated Traffic

Construction traffic includes material delivery, workforce commuting, and tree removal hauling. Assuming all cement and fly ash delivery trucks and the entire workforce arrives at the site during the morning peak hour, 95 to 145 inbound passenger cars are estimated, a conservative assessment even during peak RCC placement periods. Assuming all cement and fly ash trucks arrive at the site in the early morning and are departing the site during the morning peak hour while the workforce is arriving, 50 to 101 inbound cars are estimated and 45 outbound cars are estimated. Estimates for the average number of tree removal trucks per day and per peak hour are provided in Table 3-2 of the TIS (Appendix B). Total construction traffic on the east access to the GRE Project jobsite in 2025 will consist of truck traffic delivering cement and fly ash, tree removal truck traffic, and traffic from construction workers commuting to and from the site.

Based on the TIS analysis of the two scenarios assumed in this study (including low and high variations for the workforce), the total peak hour construction traffic on the east side during 2025 is estimated to be:

- 101 to 152 inbound trips for one scenario and 50 to 101 inbound trips/51 outbound trips for another scenario during an AM peak hour.

Total construction traffic on the west access to the GRE jobsite in 2025 includes only tree removal truck traffic traveling to and from the site. Based on the analysis of the two scenarios assumed in the TIS, the average total construction traffic on the west side during 2025 is estimated to be:

- 12 inbound trips and 12 outbound trips during a peak hour.

Background Traffic, Future Traffic Projections, and Level Of Service (LOS). Peak construction activities are assumed to occur in year 2025, based on the current construction schedule. Future background traffic hourly volumes (without the GRE Project), including recreational traffic, for the east and west project sides are listed in the TIS (Appendix B, Tables 4-1 and 4-2). The 2025 future year total hourly traffic volumes accessing Gross Reservoir from the east were developed by adding the 2025 total peak hour construction traffic (including material delivery, workforce, and tree removal) to the 2025 hourly background volume. These hourly volumes are listed for the east and west project sides in the TIS (Appendix B, Tables 4-3 and 4-4). Level of service at the major intersections was analyzed in the TIS (Appendix B, Section 5.1). Based on the results, LOS reduction is not predicted for SH 72 and Gross Dam Road or at Gross Dam Road and Crescent Park Drive. Based on the 2025 background LOS predicted at SH 119/SH 72 and CR 132, the LOS is conservatively predicted to drop from LOS B to LOS C for outbound WB traffic with the GRE Project traffic.

The LOS analysis, as described in the TIS, which was completed for the segment of SH 72 on the proposed route, concluded that there will be minimal impact to the traffic on SH 72. SH 72 and SH 119 are designed to accommodate truck traffic, and the additional traffic from daily construction and tree removal activities on SH 72 east of Gross Dam Road and on SH 119 north of CR 132 will not cause significant delay. However, vehicles traveling on Gross Dam Road and CR 132 will experience delays due to the additional construction traffic. It is anticipated that vehicles traveling behind trucks will be delayed approximately 12 minutes as they travel this segment of Gross Dam Road. It is anticipated that vehicles traveling behind trucks will have an average delay of 25.5 minutes as they travel to/from Gross Reservoir on the west via FS 359, Lazy Z Road, and CR 132.

Mitigation. Based on the results of the TIS LOS analysis, mitigation measures are recommended for Gross Dam Road and the SH 72 and Gross Dam Road intersection (access to the east side of Gross Dam) during peak construction periods when workforce traffic is at its peak and RCC is being placed to allow for delivery of cement and fly ash materials.

2.1.2 Traffic Control Plans

Traffic Control Plans (TCPs) detail specific measures such as signage, barricades, and flagging operations required in or near roadway construction projects. Denver Water intends to implement at least four roadway improvement locations to create a safer flow of traffic to and from the project area. The roadway improvement locations planned at this time include:

- A new staging area access off SH 72 near the intersection of SH 93.
- A new intersection and access at the intersection of SH 72 and Gross Dam Road. A preferred traffic control scenario is provided in the TIS (Appendix B, Figure 7-4) for the relocated intersection.
- Roadway widenings along Gross Dam Road.
- Portions of FS 359 and Country Road (CR) 97E.

This TMP is not a traffic control plan. TCPs specific to each roadway improvement project will be developed by the contractor and approved by the regulatory agency responsible for the roadway. In this case, Boulder County oversees work located on Gross Dam Road (portion owned and maintained by Boulder County) and CDOT oversees work located on state highways. A list of anticipated TCPs to be developed by the contractor prior to the initiation of specific construction activities is provided in Appendix C.

2.2 Traffic Management Plan Roles and Responsibilities

This section identifies primary personnel involved in the GRE Project, their roles, and their responsibilities with regard to the TMP, and emergency contact information.

Contractor	Owner's Representative
TMP Implementation/Monitoring Managers	
Name/Title: Todd Orbus, Project Sponsor	Name/Title: Doug Raitt, Construction Manager
Contractor: Kiewit Barnard Joint Venture	Agency: Denver Water
Phone: (707) 439-7300 Ext. 7352	Phone:
Email: todd.orbus@kiewit.com	Email: douglas.raitt@denverwater.org
Roles and Responsibilities: Supervisor for Contractor of all onsite operations.	Roles and Responsibilities: Supervisor for Denver Water of all onsite construction project operations.
TMP Implementation Task Leaders	
Name/Title: TBD, Traffic Management Supervisor	Name/Title: TBD, Area Manager — Roadways
Contractor: Kiewit Barnard Joint Venture	Agency: Denver Water
Phone: TBD	Phone: TBD
Email: TBD	Email: TBD
Roles and Responsibilities: Supervisor for Contractor of all site traffic control and all public traffic operations.	Roles and Responsibilities: Supervisor for Denver Water of all traffic and roadway related operations.
Public Information — Liaison	
Name/Title: TBD, Public Information Representative	Name/Title: TBD, Public Information Representative
Contractor: Kiewit Barnard Joint Venture	Agency: Denver Water
Phone: TBD	Phone: TBD
Email: TBD	Email: TBD
Roles and Responsibilities: Provides contractor public information releases about traffic management, incidents and responds to public questions.	Roles and Responsibilities: Provides public statements about traffic management, incidents and responds to public questions.
Emergency Service Contacts	
Name/Title: TBD, Site Project Manager or Assigned Duty Officer	Name/Title: Denver Water 24-Hour Emergency Services
Contractor: Kiewit Barnard Joint Venture	Agency: Denver Water
Phone: TBD	Phone: 303-628-6801
Email: TBD	Email: TBD
Roles and Responsibilities: Onsite supervisor or designated duty officer for 24-hour response to emergency notification.	Roles and Responsibilities: 24-hour attended emergency notification center. Contacts duty representative with Denver Water for emergency response.

An emergency phone tree that provides current contact information for parties potentially involved in communications related to traffic management or incident response will be established and maintained by Denver Water or its contractor.

3 General Project Background Information

3.1 Project Description and Schedule

A general site plan including the major existing facilities at the GRE Project site is shown in Figure 1.

Elements of the GRE Project that affect local traffic and nearby communities include:

- Construction of roadway improvements along access routes to the GRE Project site.
- Delivery of construction equipment, materials, and supplies to the GRE Project site.
- Removal of tree clearing material to its final disposal destination.
- Arrival and departure of the commuting workforce.
- Scheduling of traffic to reduce impacts (avoid peak travel times and school bus schedules).

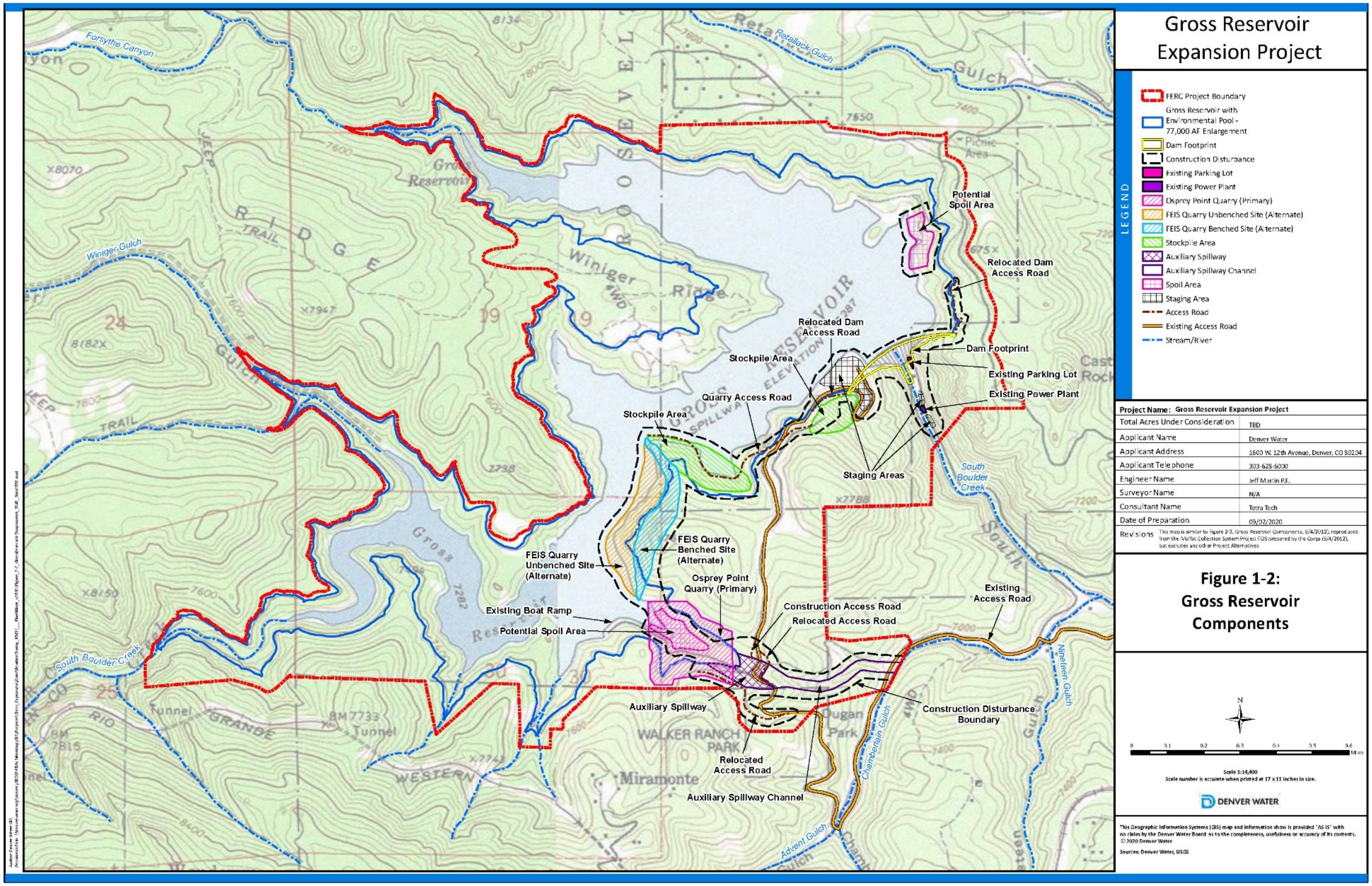

Figure 1: General Project Site Plan (Figure 1-2 from the Areas and Activities of State Interest (1041) Application)

3.1.1 Project Activity Schedule and Expected Construction-Related Traffic

GRE Project construction will occur between 2022 and 2027. Major activities supporting the execution of the GRE Project and the anticipated durations of each activity are shown in Table 3. A short description of each activity and the expected traffic type and pattern for each activity is presented below. Peak hour volumes for construction activities are addressed in the TIS (Appendix B) and summarized in Section 2.1.1.

Table 3:
Anticipated GRE Project Schedule Related to Offsite Traffic Generation

Activity/Year	2022 Year 1	2023 Year 2	2024 Year 3	2025 Year 4	2026 Year 5	2027 Year 6	2028 Year 7
Site mobilization							
Dam surface preparation, materials laboratory, and Grading for Temporary Facilities							
Quarrying operations							
Dam foundation excavation, preparation, and plant setup							
Dam raise activities — materials trucking							
Forestry activities/tree clearing in inundation area							
First fill							

Site Mobilization

Mobilization to the GRE Project site will occur in the first year of construction (2022). Major plant equipment for the concrete batch plant and aggregate processing plant, cranes, heavy earthwork equipment, and field offices will be transported to the GRE Project site as part of this activity. As Denver Water anticipates SH 72 and Gross Dam Road intersection improvements will be under construction during the site mobilization effort, mobilization equipment will be transported to the GRE Project site by SH 72, Crescent Park Drive, and Gross Dam Road. This mobilization activity will occur over several months and some equipment may require an oversized permit from CDOT and/or Jefferson County.

Permits for overweight and oversized vehicles will be acquired from both Boulder County and CDOT for movements made on state highways or county roads. Denver Water will provide information on truck and trailer weights to the appropriate jurisdiction when oversize or overweight permits are required. Although a conventional WB-50 style truck could be used for improvements on the east area roads, Denver Water will consider transport vehicle configurations as development of the west side access roads are evaluated. Trucks will be under weight limits and within height restrictions for designated haul routes. Denver Water will assume a maximum weight of 20 tons per truck with the appropriate number of axles and a maximum height of 14 feet 9 inches. The UPRR bridge on SH 72, which will be considered for the transport of large equipment, has a vertical clearance of 14 feet 9 inches and narrowed shoulders. Denver Water will identify routes to transport the necessary equipment to the GRE Project site given the restrictions in place along the route. Dust control measures including watering and tracking pads will be used during road construction to minimize fugitive dust.

Previously, Denver Water did not anticipate needing to use Crescent Park Drive for construction access. However, due to permitting delays for the improvements to the intersection of Gross Dam Road and SH 72 resulting from Boulder County's refusal to review design drawings and authorize a CDOT Access Permit application, Crescent Park Drive must now be considered as an initial access route. Crescent Park Drive will be used for some vehicle access prior to and during construction of improvements at the intersection of Gross Dam Road and SH 72. Traffic levels along Crescent Park Drive will be evaluated and the geometry of the Crescent Park Drive and SH 72 intersection will be evaluated for potential truck turning movements in coordination with Jefferson County and CDOT. The weight limitations and vertical clearance restrictions for overhead power and communication lines will also be considered. As soon as the improvements are complete at Gross Dam Road and SH 72 construction truck traffic will be rerouted to avoid Crescent Park Drive.

Dam Surface Preparation, Materials Laboratory, Quarry Development, Early Dam Foundation Excavation and Grading for Temporary Facilities

The dam surface preparation, materials laboratory construction, and grading for temporary facilities will be among the first construction activities at the GRE Project site in 2022. Installation of erosion control features will be an early activity in preparation of ground-disturbing activities. Clearing of trees in the quarry, staging areas, and haul roads will occur during this period as well. Earthwork and rock blasting will follow the clearing. Processing of biomass and transport offsite of timber and wood chips will occur at this time. Early crushing operations of excavated rock materials will begin. Dam surface preparation equipment will be mobilized, as well as the associated water treatment plant equipment. Supply and fuel deliveries will be initiated to support construction activities and construction worker traffic will begin during this phase. Dust control measures including watering and tracking pads will be used during road construction to minimize fugitive dust.

Dam Foundation Excavation Operations and Quarry Operations

Dam foundation excavation will continue throughout most of 2023. Daytime and nighttime drilling will be required and periodic traffic for the commuting workforce and supply deliveries for this operation will continue through the period. Daytime quarry operations and aggregate processing will also continue. The commuting workforce as well as delivery of fuel, supplies, and explosives will continue through the year. Excavation of the dam foundation will require the transport of spoils from below the dam along Gross Dam Road onsite to disposal areas within the dam work zone. Traffic controls will be put in place to accommodate local access on Denver Water-controlled portions of Gross Dam Road during this operation. Deliveries of materials to the jobsite including ready-mix concrete are anticipated until the onsite batch plants are functional. Dust control measures including watering and tracking pads will be used during road construction to minimize fugitive dust.

Dam Concrete Placement and Quarry Operations

In April 2024, the dam concrete placement will begin once environmental conditions allow. Concrete placement will take place primarily at night; the commuting workforce will be split between day and night shifts. Cement and fly ash deliveries will take place during the day according to a schedule that minimizes disruption to local traffic and the community. Deliveries of fuel, materials, and supplies, including explosives, will continue throughout the year to support quarry and concrete batch plant operations. It is anticipated that, during this peak construction phase, Denver Water will institute busing of a portion of the commuting workforce to reduce the number of vehicles traveling to the jobsite. Dust control measures including watering and tracking pads will be used during road construction to minimize fugitive dust.

Dam concrete placement will likely be suspended for the season in late November 2024 as overnight temperatures fall below freezing. Construction operations will transition to a maintenance mode during the fall and winter until conditions warm in the spring. The same dam concrete placement schedule will be followed in 2025 until the dam height reaches the top of RCC just below the crest elevation by the end of the season in November.

Reservoir Perimeter Tree Removal Operations

Procurement of the reservoir tree removal contractor is planned for 2024 to allow the contractor to mobilize in 2025. Initial tree removal operations around the reservoir perimeter will begin with the improvement of access roads and staging areas on the west side of the reservoir. Earthmoving equipment and trucks will be mobilized and aggregate materials will be used to stabilize temporary road surfaces. Dust control measures including watering and tracking pads will be used during road construction to minimize fugitive dust.

Tree removal will begin on the west side of the reservoir once access has been completed. Tree and biomass collection and processing will continue through the season. Helicopter logging will begin once sufficient product is ready for transport. Offsite transport will begin after processing starts. The final locations and haul routes will be determined in 2024, during the procurement process, as the current market conditions are understood at that time. Market conditions will dictate the amount of material that can be repurposed for energy or reuse. Material not suitable for alternative uses will be transported to landfills for disposal. Road reclamation activities will be completed after the removal of biomass from the area.

The reservoir tree clearing on the east side of the reservoir will begin in 2026 as dam construction operations begin to wind down. A similar approach to the west side tree removal operation will take place, although the quantity of material will be significantly less. After processing starts, offsite transport will begin to locations determined during the 2024 procurement process. As with operations on the west side, material not suitable for alternative uses will be transported to landfills for disposal. A few access improvements above the inundation level of Elevation 7406 are anticipated as site access routes developed for dam construction can be used for tree removal operations. Reclamation of road improvements will be completed after the removal of biomass from the area and in conjunction with overall site reclamation efforts.

Dam Crest Completion, Site Reclamation, Permanent Recreation, Site Reclamation, and Demobilization

The dam crest will be completed in 2026, following completion of the RCC placement. This work will include completion of the spillway crest, spillway bridge, dam crest roadway, crest barrier, control building, and dam abutment roadways. Other work that will be completed in 2026 and 2027 includes the construction of permanent recreation facilities, site reclamation, and plant and equipment demobilization. The commuting workforce will continue to travel to the site, but the volume will diminish as the workload is reduced. Delivery of fuel and supplies to complete the remaining work will continue during this phase. Transport equipment to remove plant and equipment will also be prevalent during this phase of work. Dust control measures including watering and tracking pads will be used during road construction to minimize fugitive dust.

4 Construction-Related Traffic Routes

This section addresses the roadways surrounding the GRE Project site that will be affected by the construction operations. Areas involved in construction include:

- Roadways along access routes to dam construction work zones or tree removal activities.
- Roadways on Denver Water property disturbed by dam construction.
- USFS property disturbed by support facilities and an expanded access road.

The roadways that will see active construction work zones, as well as construction traffic associated with the dam construction, are summarized in Table 4 and shown in Figures 2 and 3. Segment numbers in Table 4 correspond with the segment numbers shown in these figures.

Table 4:
Construction-Related Traffic Routes

Roadways						
Segment	**Roadway Element**	**Activity**	**Timing**	**Traffic Disruption Mitigation Measures**	**ROW Control**	**Coordination With**
Dam Raise Related Traffic Routes						
1	SH 72 (Coal Creek Canyon Road), SH 93 to Crescent Park Drive	Primary transportation route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Begin at start of site mobilization and continue through project completion.	Public Information Program: COTRIP Website Information, Gross Reservoir Project Website Updates, Local Agency Outreach. Traffic Control Devices: Variable Message Sign with Advisory, Contact Information Signage, Project Information Signage, Traffic Control Signage per the Methods of Handling Traffic (MHT). Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	CDOT	CDOT, Arvada, Jefferson County, Contractor, Denver Water
2	SH 72 (Coal Creek Canyon Road), Crescent Park Drive to Gross Dam Road	Primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Use this route after completion of new intersection at Gross Dam Road and SH 72.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	CDOT	CDOT, Jefferson County, Boulder County, Contractor, Denver Water
3	SH 72, Gross Dam Road to Pinecliffe	Not allowed as a haul route for equipment, materials, or supply deliveries to the GRE Project site due to vehicle length restrictions.	Not used.	Instruct all contactor personnel and vendors to not use this route for deliveries. Monitor compliance.	CDOT	CDOT, Contractor, Denver Water
4	Crescent Park Drive from SH 72 to Gross Dam Road	Early primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Use this route prior to completion of new intersection at Gross Dam Road and SH 72.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	Jefferson County	Jefferson County, Contractor, Denver Water
5	Gross Dam Road, SH 72 to Union Pacific Railroad Crossing	Primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Use this entire route after completion of new intersection at Gross Dam Road and SH 72. The segment west of Crescent Park Drive will be used after completion of the Gross Dam Road and SH 72 Intersection.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per Boulder County permit. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Boulder County	Boulder County, Contractor, Denver Water
6	Gross Dam Road, Union Pacific Railroad Crossing to Gross Reservoir Headquarters and Site Entrance	Primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Begin at start of site mobilization and continue through project completion.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Denver Water	Contractor, Denver Water, Boulder County
7	Gross Dam Road, Gross Reservoir Headquarters to Flagstaff Road	Secondary haul route for equipment, materials, and supply delivery to the north side of dam. Excavated material from dam foundation work to onsite spoil areas.	Begin at start of site mobilization and continue through project completion.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per Boulder County permit. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Denver Water	Contractor, Denver Water, Boulder County
8	Flagstaff Road, Gross Dam Road to City of Boulder	Not allowed as a haul route for equipment, materials, or supply deliveries to or from the GRE Project site due to vehicle length restrictions.	Not used.	Instruct all contactor personnel and vendors to not use this route for deliveries. Monitor compliance.	Boulder County	Boulder County, Denver Water

Roadways						
Segment	**Roadway Element**	**Activity**	**Timing**	**Traffic Disruption Mitigation Measures**	**ROW Control**	**Coordination With**
Tree Removal Related Traffic Routes						
Initial Phase Tree Removal						
1	SH 72 (Coal Creek Canyon Road), SH 93 to Crescent Park Drive	Primary transportation route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Begin at start of site mobilization and continue through project completion.	Public Information Program: COTRIP Website Information, Gross Reservoir Project Website Updates, Local Agency Outreach. Traffic Control Devices: Variable Message Sign with Advisory, Contact Information Signage, Project Information Signage, Traffic Control Signage per the MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	CDOT	CDOT, Arvada, Jefferson County, Contractor, Denver Water
4	Crescent Park Drive from SH 72 to Gross Dam Road	Early primary haul route for equipment access and initial phase of tree removal biomass truck haul.	Use this route prior to completion of new intersection at Gross Dam Road and SH 72	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	Jefferson County	Jefferson County, Contractor, Denver Water
5	Gross Dam Road, SH 72 to Union Pacific Railroad Crossing	Primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Use this entire route after completion of new intersection at Gross Dam Road and SH 72. The segment west of Crescent Park Drive will be used after completion of the Gross Dam Road and SH 72 Intersection.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per Boulder County permit. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Boulder County	Boulder County, Contractor, Denver Water
6	Gross Dam Road, Union Pacific Railroad Crossing to Gross Reservoir Headquarters and Site Entrance	Primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Begin at start of site mobilization and continue through project completion.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Boulder County	Boulder County, Contractor, Denver Water
Inundation Phase Tree Removal (West Side)						
9	FS 359 on National Forest Lands, Winiger Ridge access to DW property	On site traffic route for workers only. Public access to National Forest closed during tree removal west of reservoir. The route would be used for access of tree removal equipment, hauling activities, and removal of biomass.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per USFS permit. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	USFS	Contractor, Denver Water, USFS
10	CR 68 or CR 68J	Not allowed as a haul route for equipment, materials, or supply deliveries to or from the GRE Project site.	Not used.	Instruct all contactor personnel and vendors to not use this route for deliveries. Monitor compliance.	Boulder County	Boulder County, Denver Water
11	FS 359 to new connection to FS 97	Temporary improvement of haul route developed for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per USFS permit. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	USFS	Contractor, Denver Water, USFS
12	Lazy Z Road (CR 97E), from FS 97 to CR 132, Magnolia Drive	Haul route for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per Boulder County permit. Traffic Control Oversight: Tree Removal Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Boulder County	Boulder County, Tree Removal Contractor, Denver Water

Roadways						
Segment	**Roadway Element**	**Activity**	**Timing**	**Traffic Disruption Mitigation Measures**	**ROW Control**	**Coordination With**
13	CR 132, Magnolia Drive, from CR 97E southwest to SH 119	Haul route for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per Boulder County permit. Traffic Control Oversight: Tree Removal Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Boulder County	Boulder County, Tree Removal Contractor, Denver Water
14	CR 132, Magnolia Drive, from CR 97E northeast to SH 119	Not allowed as a haul route for equipment, materials, or supply deliveries to or from the GRE Project site due to vehicle length restrictions.	Not used.	Instruct all Tree Removal Contactor personnel and vendors to not use this route for deliveries. Monitor compliance.	Boulder County	Boulder County, Denver Water
15	CR 97 from CR 132, Magnolia Drive, to SH 72	Secondary Haul route for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion. Use this route if intersection at SH 119 and CR 132 turning movement is not allowed.	Traffic Control Devices: Signage per MHT, dust suppression per Gilpin County permit. Traffic Control Oversight: Tree Removal Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Boulder County	Boulder County, Tree Removal Contractor, Denver Water
16	SH 72 from CR 97 to SH 119	Secondary Haul route for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion. Use this route if intersection at SH 119 and CR 132 turning movement is not allowed.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Tree Removal Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	CDOT	CDOT, Boulder County, Gilpin County, Tree Removal Contractor, Denver Water
17	SH 119 to I-70, south from CR 132	Haul route for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Tree Removal Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	CDOT	CDOT, Boulder County, Gilpin County, Tree Removal Contractor, Denver Water
18	SH 119, north from CR 132	Haul route for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of west reservoir tree removal and continue through west reservoir tree removal project completion.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Tree Removal Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	CDOT	CDOT, Boulder County, Tree Removal Contractor, Denver Water
Inundation Phase Tree Removal (East Side)						
6	Gross Dam Road, Union Pacific Railroad Crossing to Gross Reservoir Headquarters and Site Entrance	Primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Begin at start of site mobilization and continue through project completion.	Traffic Control Devices: Signage per MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Denver Water	Contractor, Denver Water, Boulder County
5	Gross Dam Road, SH 72 to Union Pacific Railroad Crossing	Primary haul route for equipment, materials, and supply delivery to the GRE Project site. Primary route for commuting workforce.	Use this entire route after completion of new intersection at Gross Dam Road and SH 72. The segment west of Crescent Park Drive will be used after completion of the Gross Dam Road and SH 72 Intersection.	Traffic Control Devices: Signage per MHT, erosion controls and dust suppression per Boulder County permit. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations, Maintenance of surfacing, dust control.	Boulder County	Boulder County, Contractor, Denver Water
2	SH 72 (Coal Creek Canyon Road), Crescent Park Drive to Gross Dam Road	Haul route for equipment access and tree removal biomass truck haul.	Begin at start of mobilization of second phase of east reservoir tree removal and continue through east tree removal project completion.	Traffic Control Devices: Variable Message Sign with Advisory, Contact Information Signage, Project Information Signage, Traffic Control Signage per MHT. Traffic Control Oversight: Contractor-assigned Traffic Control Supervisor patrols, Denver Water oversight of traffic control operations.	CDOT	CDOT, Arvada, Jefferson County, Boulder County, Contractor, Denver Water

Figure 2: Local GRE Project Construction Routes

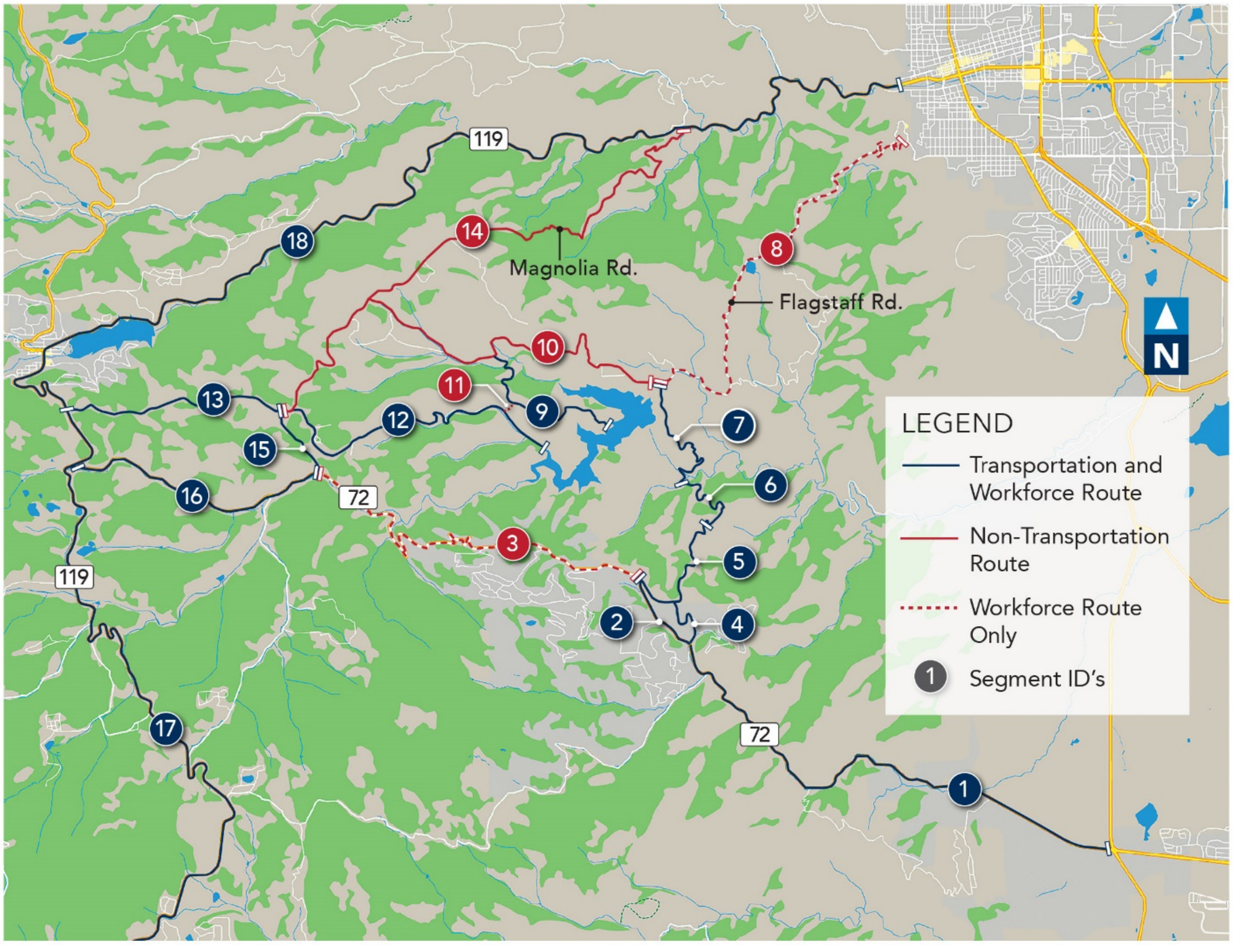

Figure 3: GRE Project Construction Routes

5 Work Zone Impact Assessment

The TIS (Appendix B) and Section 2.1.1 provide a discussion of peak hourly traffic and impacts to roadways during construction. Potential disruptions to the identified routes that are indicated for use during construction of both the roadways and the dam include:

- Traffic congestion due to material and supply deliveries as well as commuting workforce using dam access routes.
- Shoulder and lane closures due to temporary roadway construction on construction access routes.
- Local traffic detours during phases of roadway construction at the intersection of SH 72 and Gross Dam Road.
- Traffic congestion due to oversized loads that occasionally require slower speeds.
- Surface condition impacts to Gross Dam Road from additional truck traffic beyond current design standards.

Other considerations for work zone impacts include the following and are discussed below:

- School bus and bicycle traffic, which is being considered during TMP strategy development.
- Access for emergency first response vehicles and traffic incident responders will be a priority and maintained at all times.
- Debris on the roadway tracked from vehicles entering paved roadways will be addressed.
- Consideration of construction traffic movements during inclement weather will be addressed.

The roadways that will see active construction work zones, as well as construction traffic associated with the dam construction, are shown above in Figures 2 and 3.

6 Traffic Impact Minimization Strategies

Denver Water has identified minimization strategies related to traffic for the GRE Project. A brief description of these strategies is below. Additional strategies may be identified once the final design has been completed and traffic details are finalized.

- Onsite sand production: The planned onsite quarry at Osprey Point is designed to allow for the production of all aggregate materials onsite. This design capability will reduce truck traffic associated with the GRE Project by approximately 23,000 trucks.
- Worker busing and carpooling: During peak dam concrete placement, the contractor may require workers to commute to the work site by shuttle bus. During non-peak production times, workers will be encouraged to carpool to the GRE Project site to reduce the volume of vehicles traveling to the GRE Project site.
- SH 72/SH 93 staging area: Denver Water will develop a staging area on Denver Water property on the southwest side of the SH 93 and SH 72 intersection. This staging area will be used for the worker busing and carpooling described above. It will also be used as a check-in point for large truck deliveries heading to the GRE Project site.
- Managed fly ash and cement deliveries: The staging area described above will be used to receive trucks delivering materials and equipment to the GRE Project site, thereby allowing

the contractor to control the frequency of trucks traveling through the canyon to reduce congestion.

- Avoiding school bus and commuting times: For safety reasons, Denver Water has committed to not having truck traffic on the haul routes at the same time as school buses are traveling through the canyon during mornings and afternoons. This will ensure school buses are able to pick up and drop off children safely and ensure students are not delayed.
- No haul days: The contractor will have designated no haul days that will restrict deliveries of some construction materials like cement and fly ash. The intent is to reduce the disruption to local residents. The schedule for this will be developed once the permitting release dates and sources for materials have been confirmed and quantity requirements are finalized.
- Use of multiple routes for tree removal material: As detailed in the Tree Removal Plan, Denver Water has identified the volume and removal locations for trees around the reservoir. Denver Water has identified two main routes for the transport of trees offsite and to potential disposal locations. Multiple locations for processing and transport of tree material will reduce impacts to local residents.

7 Traffic Safety Improvements

A Roadway Key Improvements map is provided in the TIS (Appendix B, Figure 7-5) that shows the locations of some of the improvements listed below. The following improvements will be implemented for traffic safety during GRE Project construction activities:

- SH 72/SH 93 Staging Area (Figure 4). On offsite staging area will be constructed near the intersection of SH 72 and SH 93. The staging area is owned by Denver Water and an Access Permit from CDOT and a grading permit from the City of Arvada are necessary prior to developing the site. The staging area will allow the contractor to reduce traffic to the site by moving some site support functions offsite, coordinate shared worker transportation, and manage project deliveries. Turn lanes both into and out of the site will be considered by CDOT as part of the Access Permit process.
- SH 72 and Gross Dam Road Intersection (Figure 4; Appendix B, Figures 7-1, 7-2, and 7-3). The intersection at SH 72 and Gross Dam Road will be improved to accommodate the expected traffic vehicles and type (Figure 4). Denver Water worked with CDOT through the Access Permit process to evaluate several alternatives to move traffic through this intersection safely. Denver Water is proceeding with the design of the CDOT's preferred alternative, which includes moving the intersection to the east for better sight distances and vehicle turning clearances and adds a deceleration lane.
- Gross Dam Road Curve Widenings. Several curves along Gross Dam Road will be widened to accommodate two-way traffic for tractor trailer vehicles.
- Interconnect between FS 359 and FS 97EA section of an existing unimproved roadway will be constructed to connect FS 359 to FS 97E on National Forest System land. The roadway will be used to connect tree removal traffic to onsite roadways and to avoid less traveled and narrow public roadways.

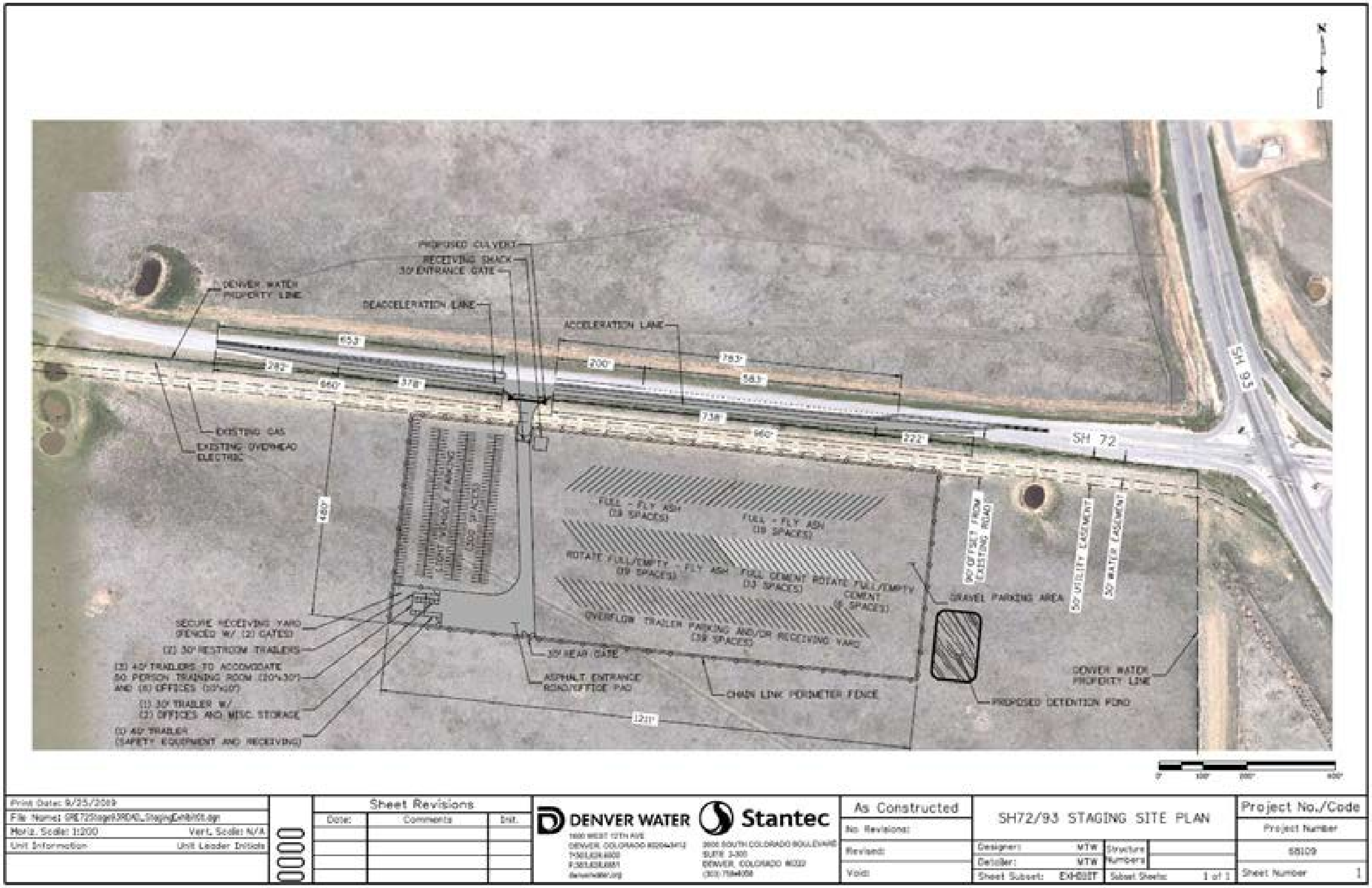

Figure 4: SH 72 and SH 93 Staging Area Concept

8 Work Zone Impact Management Strategies

Several approaches will be employed to minimize traffic delays; maintain or improve motorist, cyclist, pedestrian, and worker safety; and maintain access for businesses and residents. These are described in more detail, but they fall within the general categories of temporary traffic control, traffic operations, and public information and outreach. Generally, Denver Water's approach is to maintain continuous access through work zones with a minimum of delay and disruption while maximizing the safety of the public and construction workers.

8.1 Temporary Traffic Control

Temporary traffic control measures will be employed where construction work affects traffic on the adjacent roadway. Appendix C provides a list of specific TCPs that will be submitted to the respective jurisdictions whenever temporary traffic controls are proposed for implementation in the public right-of-way.

TCPs will be prepared by a qualified Traffic Control Supervisor. The contractor's superintendent and all others serving in a similar supervisory capacity shall have completed a CDOT-approved two-day Traffic Control Supervisor training as offered by the Colorado Contractor Association. The one-day Colorado Contractor Association Traffic Control Technician training, along with the two-day American Traffic Safety Services Association Traffic Control Supervisor training, will serve as an alternate. If the alternate is chosen, the contractor shall provide written evidence that at least an 80% score was achieved in both of the training classes. The certifications of completion or certifications of achievement for all appropriate staff shall be submitted to the appropriate jurisdiction engineer according to instructions agreed to with the agency.

Some specific strategies that will be employed for roadway construction include:

- Construction phasing/staging: This will be used on Gross Dam Road and at the SH 72 and Gross Dam Road intersection to maintain traffic through the work zone while completing the improvements. See Figures 5a through 5d for a representation of how staging (shown as phases in the figure) will be used at the Gross Dam Road and SH 72 intersection. A detailed TCP will be prepared for regulatory approval (based on the appropriate jurisdiction) for each phase of work. Figure 6 provides the routes identified for inundation area tree removal operations. Detailed plans will be developed once the biomass disposition is determined.
- Lane closures to provide worker safety: This strategy will be used on Gross Dam Road requiring the daytime closure of one existing traffic lane to accommodate work activities. Both lanes will be open at the end of the day's activities.
- Temporary roadway widenings of Gross Dam Road within the right-of-way may be used to allow local traffic through work zones during roadway work. The final alignment of the road will match the approved plans and erosion control will be put in place per the plans.
- Flagging will be used to control traffic through work zones that are adjacent to traffic.

- Concrete barriers will be used where practical to separate work zones and construction workers from open lanes of traffic.
- Any access blockage or closure to the public right-of-way or private driveways will be opened by the end of the workday. A minimum of 48 hours’ notice will be given to all property owners as well as the Boulder County Public Works Traffic Operations Engineer prior to any road or driveway blockage.

The following are temporary traffic control measures for both onsite and offsite roadways that may be used during construction:

- Full roadway closures: This strategy involves complete closure of a specific roadway for various time periods to minimize project impacts and improve worker safety by reducing traffic conflicts. Full closures may be brief (e.g., intermittent, off-peak), short-term (e.g., night, weekend), or long-term (e.g., continuous for the duration of the GRE Project). This approach will be used for some onsite access roads that have been used for public recreation access in the past. The roads that are now in the work zone will be closed during construction to keep public traffic away from active work zones.
- Temporary lane shifts or closures: Lane shifts or closures last for varying durations. They may be intermittent, off-peak, night, weekend, for a single project phase, or continuous for the duration of the GRE Project. Work zones that may involve this approach include shoulder widening on SH 72 at the Gross Dam Road intersection, roadway grading on Gross Dam Road at the SH 72 intersection, and various areas of curve widening north of Gross Dam Road.
- One-lane, two-way operation: One lane, two-way traffic control involves using one lane for both directions of traffic, allowing work activities to occur in the other lane that is closed. Work zones that may use this approach include roadway grading on Gross Dam Road at the SH 72 intersection and various areas with curve widening north of Gross Dam Road.
- Work hour restrictions for peak travel: This involves restricting work hours such that work that may impact traffic does not occur during periods of peak travel demand and congestion (e.g., peak hours, holidays, special events). Work zones that may incorporate this approach include shoulder widening on SH 72 at the Gross Dam Road intersection, roadway grading on Gross Dam Road at the SH 72 intersection and various areas with curve widening along Gross Dam Road. The work hours will be coordinated to minimize lane closures during peak commuting times and school bus pick up and drop off times.
- Offsite detours/use of alternate routes: This strategy involves re-routing some or all traffic off the roadway under construction and to other existing roadways. Public information systems and signage will be used to reduce traffic on SH 72 that could be diverted to other routes.
- Bicycle safety measures are included in the TIS (Appendix B, Section 7.5).
- Night work: Work is performed at night (end of evening peak period to beginning or morning peak period) to minimize work zone impacts on traffic and adjacent businesses. This approach will mainly involve scheduling work on the site for night shifts, reducing peak traffic volumes on SH 72 and Gross Dam Road. Daytime construction is planned for work directly on SH 72 and Gross Dam Road to minimize disruption to adjacent property owners.

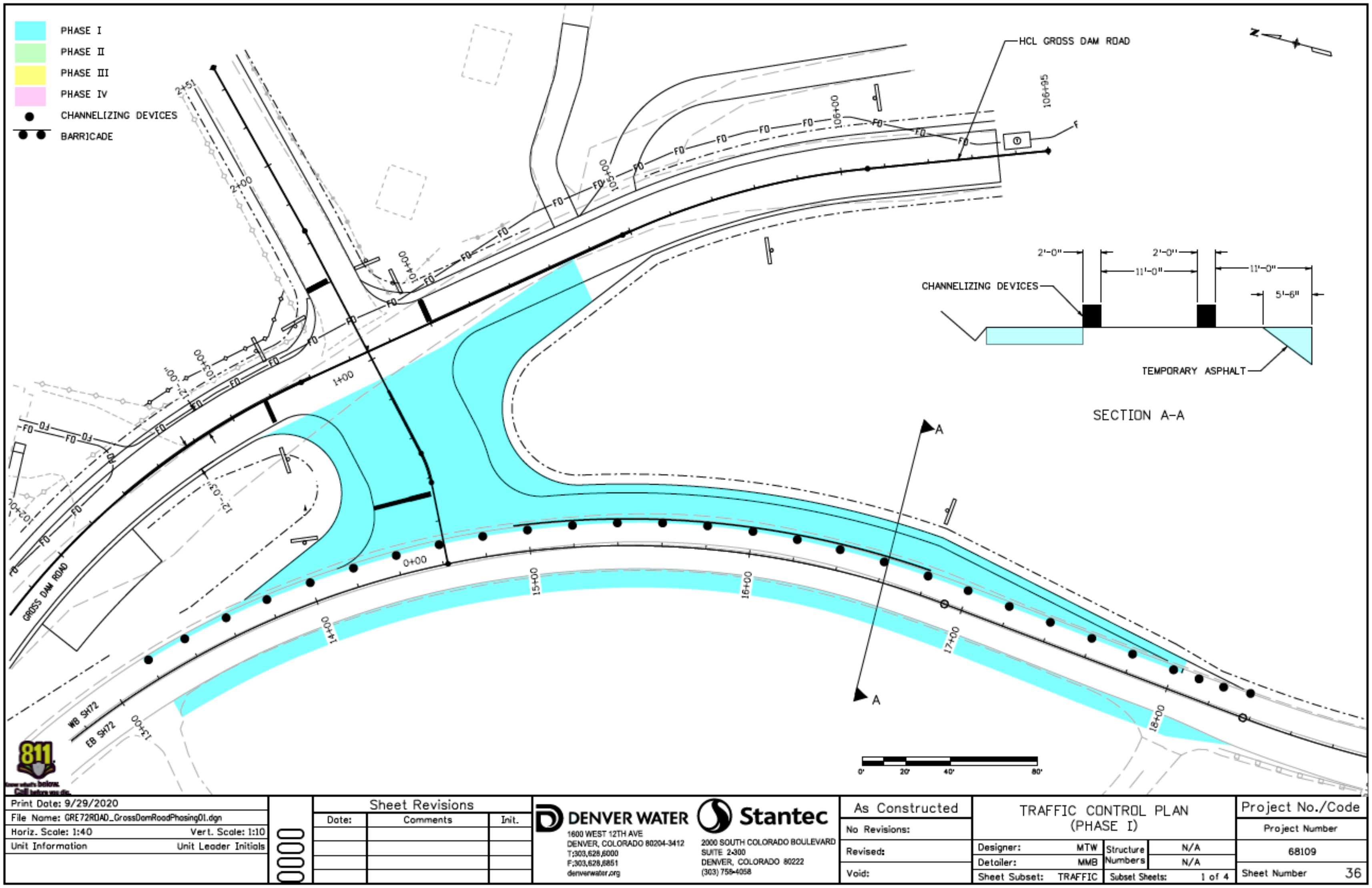

Figure 5a: Gross Dam Road and SH 72 Intersection — Phase I

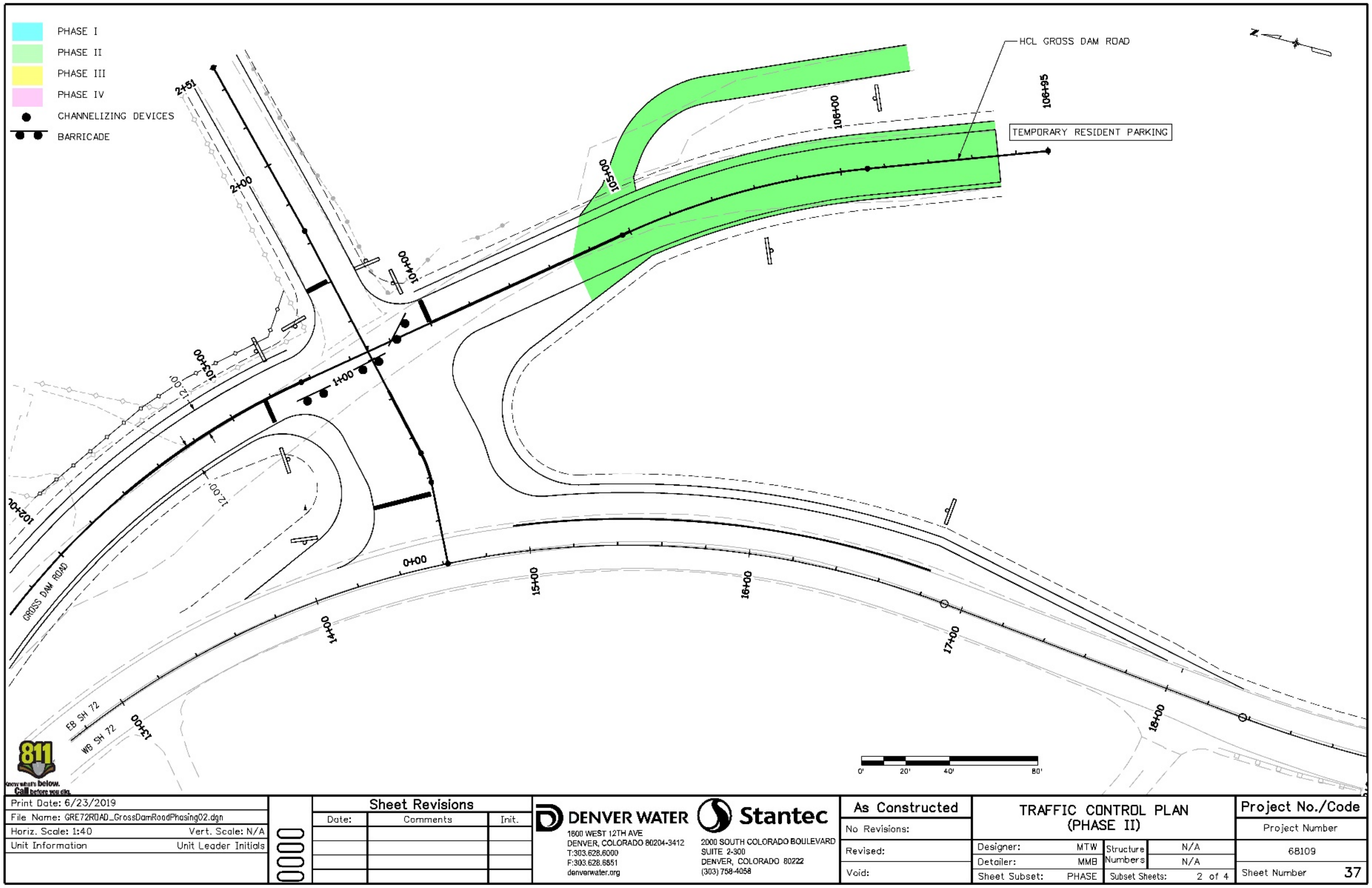

Figure 5b: Gross Dam Road and SH 72 Intersection — Phase II

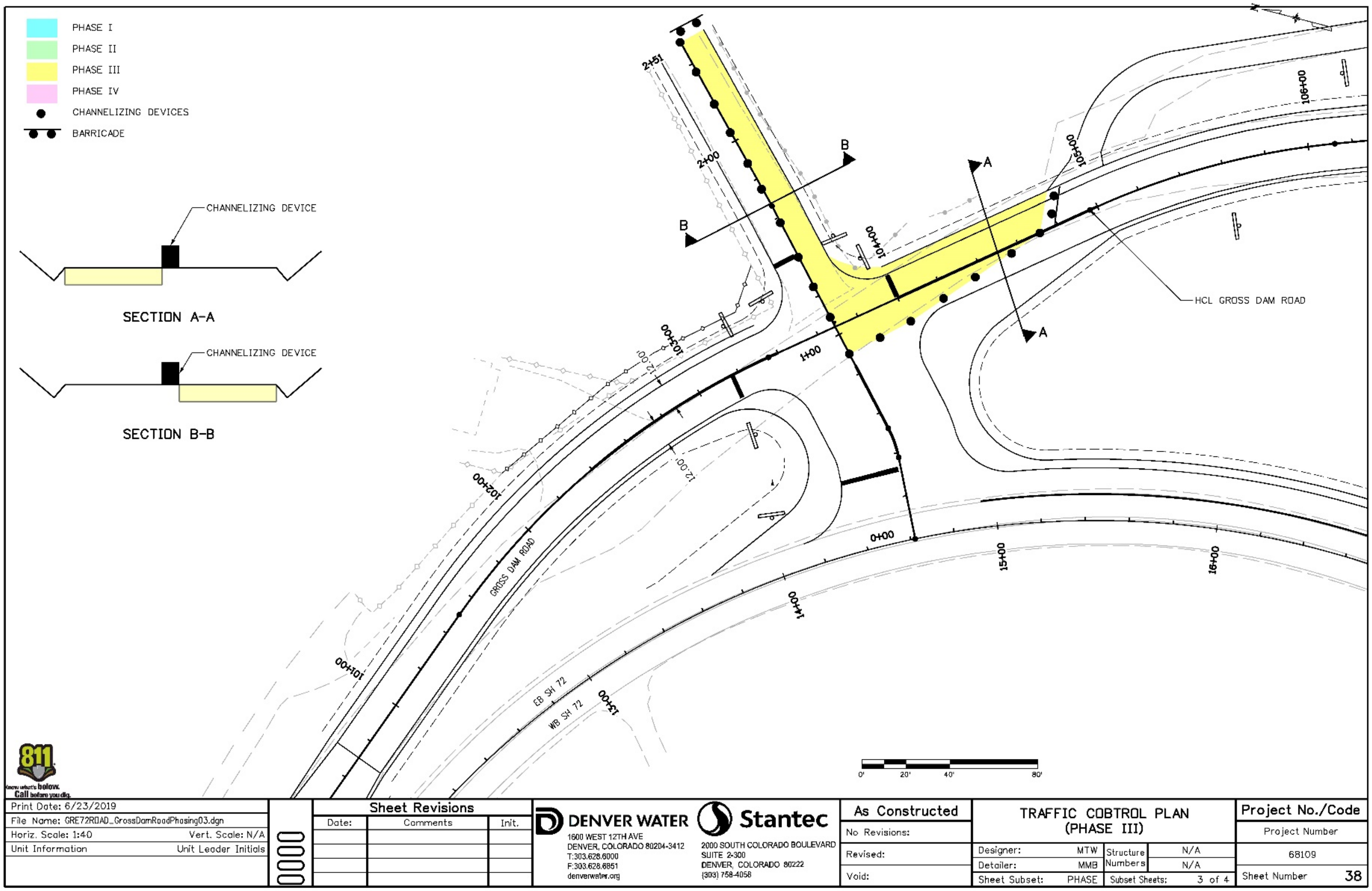

Figure 5c: Gross Dam Road and SH 72 Intersection — Phase III

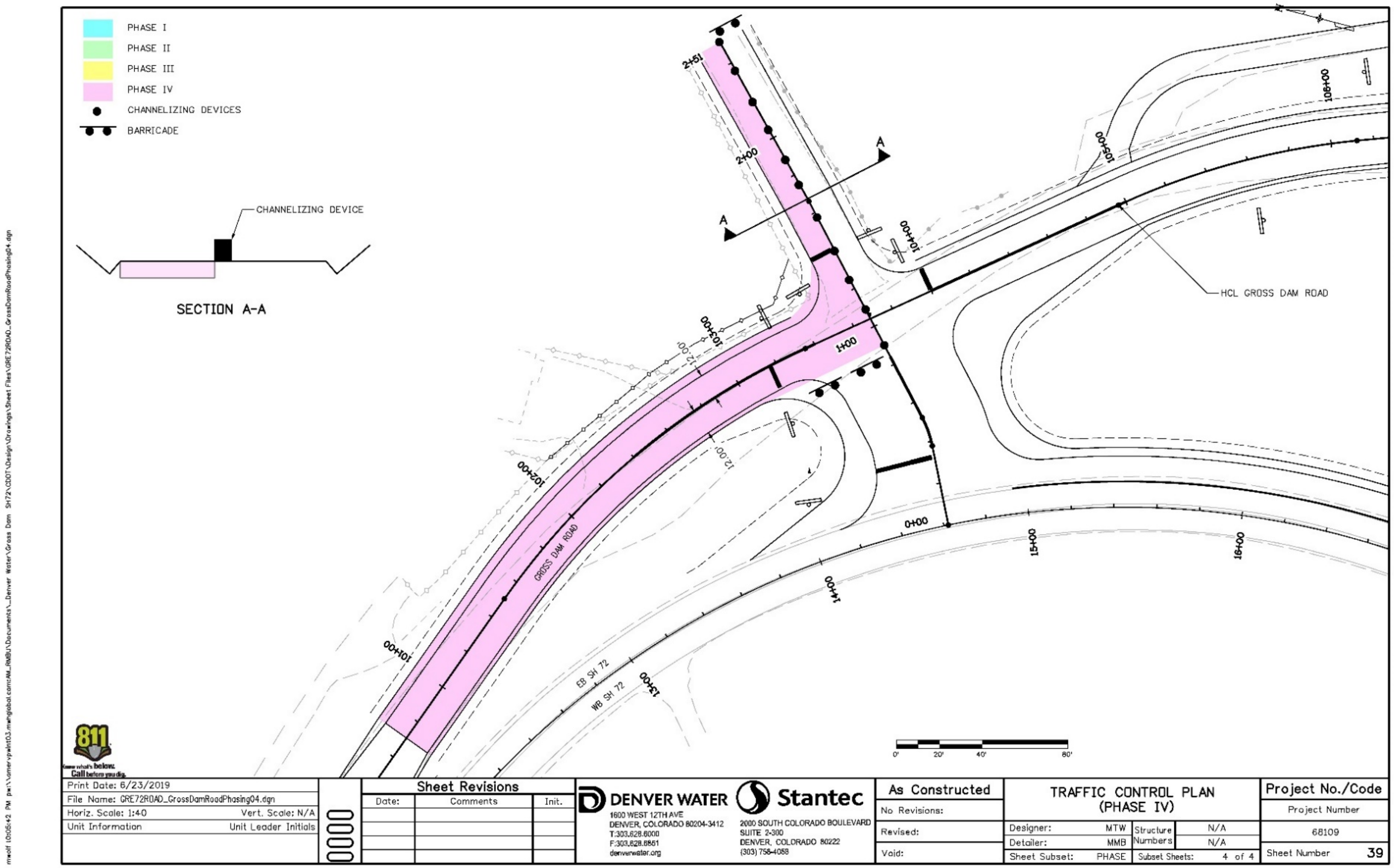

Figure 5d: Gross Dam Road and SH 72 Intersection — Phase IV

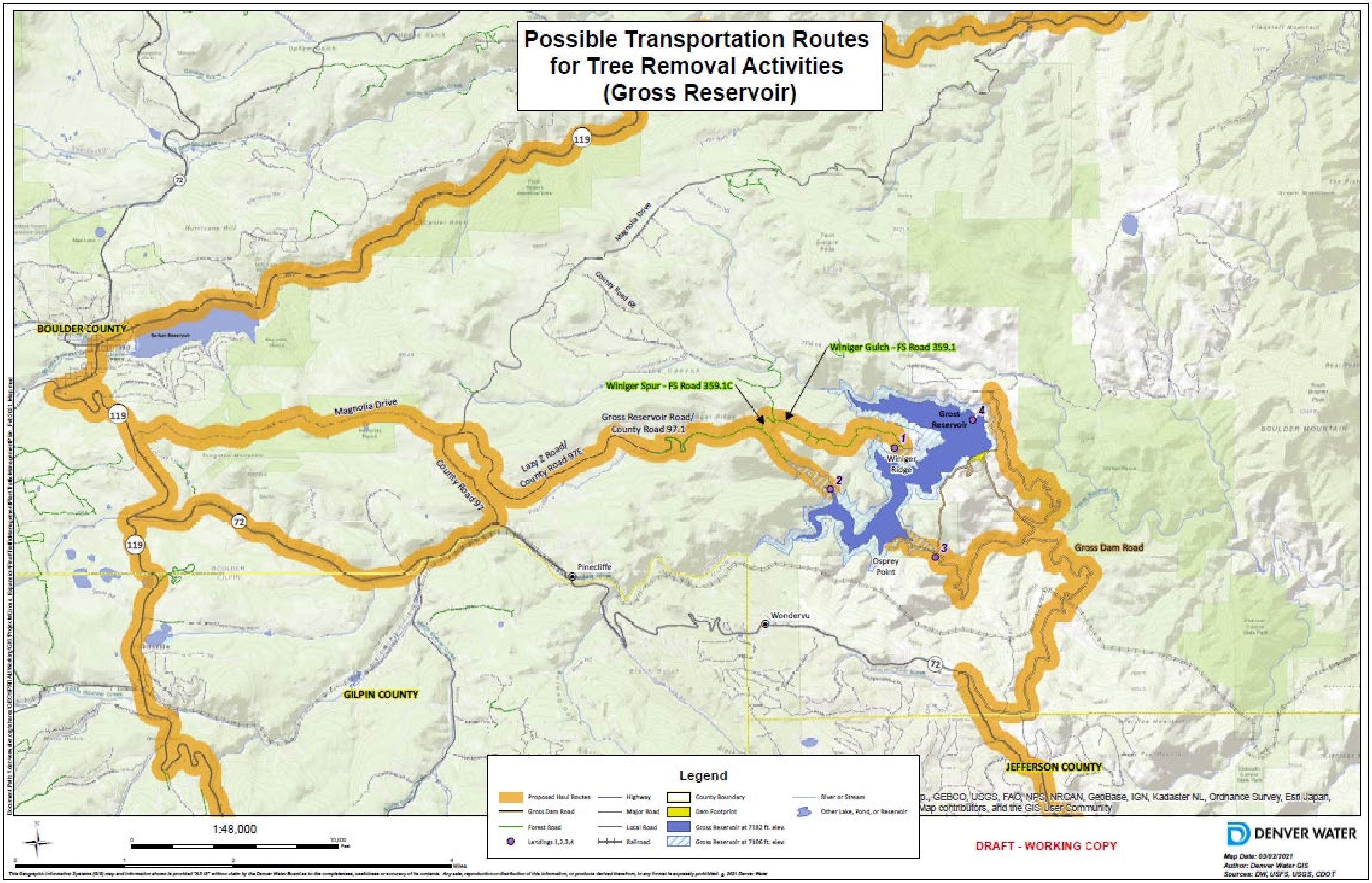

Figure 6: Tree Removal — Potential Haul Routes for Inundation Area Tree Removal

8.1.1 Traffic Control Devices

The contractor shall employ a certified Traffic Control Supervisor to develop project TCPs incorporating the Manual on Uniform Traffic Control Devices (MUTCD) standards, guidelines, and other information pertaining to installing, maintaining, and operating traffic control devices on streets and highways. Part 6 of the MUTCD, "Temporary Traffic Control," addresses safety, mobility, and constructability issues in work zones, and shall be used as a reference for all TCP's prepared for the project.

Traffic control devices and other safety devices used for work zones include:

- Temporary signs.
- Variable message signs.
- Arrow panels.
- Channelizing devices.
- Temporary pavement markings.
- Flaggers and uniformed traffic control officers.

8.1.2 Project Coordination, Contracting, and Innovative Construction Strategies

Project coordination strategies with the potential to improve mobility and reduce safety impacts of work zone activities include:

- Coordination with other projects: The contractor will coordinate with other agencies in the area to sequence and schedule work to minimize motorist delay and impacts to potentially affected businesses and communities. Known projects that may overlap with portions of the GRE Project and are being considered include:
    - CDOT's Floyd Hill project on I-70 that may impact routes contemplated for tree removal.
- Contracting strategies: These strategies will be used to streamline the contracting process to reduce the project duration and traffic impacts.

8.2 Traffic Operations

Transportation operation strategies and transportation system management will be used to mitigate work zone impacts. Strategies will include demand management, corridor/network management, work zone safety management strategies, and traffic/incident management and enforcement.

8.2.1 Demand Management Strategies

Demand management strategies include techniques that will reduce the volume of traffic traveling through the work zone such as diverting travelers to alternate modes of transit, shifting trips to off-peak hours, or shifting vehicles to alternate routes. These strategies include:

- Coordination with public and private transit service operators. Currently, no public transit routes operate in the planned GRE Project SH 72 corridor. If public or private transit routes resume along that corridor, Denver Water will coordinate with those operators.
- Commuting workforce ride sharing. A staging and parking area will be established early in the construction schedule near the intersection of SH 72 and SH 93 in the City of Arvada (see Figure 4). A parking area where commuting workers can ride share to the GRE Project site will be made available so the number of vehicles traveling to and from the site is reduced. The contractor will encourage ride sharing. Figure 4 provides an illustration of the staging area concept.
- Shuttle services. Denver Water has identified the potential for a shuttle buses between the staging area and the GRE Project site to transport workers onsite to reduce roadway vehicle counts. The contractor will encourage workforce participation in the busing program.

8.2.2 Corridor/Network Management Strategies

This category includes strategies to optimize traffic flow through the work zone corridor and adjacent roadways using various traffic operations techniques and technologies, including:

- Signal timing/coordination improvements: This will involve regular monitoring of the SH 93 and SH 72 intersection to monitor signal timing for traffic movements from SH 93 to SH 72 and for return movements. Signal timing may require adjustment as approved by CDOT based on observed traffic patterns.
- Turn restrictions: Restricting turn movements by some construction delivery trucks may be imposed by jurisdictions with permitting authority to increase roadway capacity, reduce potential congestion and delays, and improve safety. Restrictions may be applied during peak periods or all day. A specific restriction on semi-tractor trailer use of the Gross Dam Road and SH 72 intersection will be required until the new intersection is put in service. Restrictions may be applied during peak periods or all day.
- Parking restrictions: This strategy will be used to eliminate construction workforce parking where it might impair the flow of traffic. Any “No Parking” zones will consider local residents and businesses so as to not interfere with their access.
- Truck/heavy vehicle restrictions: This strategy will involve restricting construction material and supply deliveries during school bus operating times. Deliveries outside the 7 a.m. to 7 p.m. window will also be limited to only those necessary for ongoing operations.
- Coordination with adjacent construction site(s): This involves combining or coordinating projects within a specific corridor to minimize the combined impacts on the motoring public and community. Denver Water’s contractor will coordinate with CDOT and Boulder County to make sure there is no overlay of work zones or uncoordinated operations on SH 72. The contractor will coordinate with CDOT and Jefferson County regarding the staging area on SH 93. Any work on county roads in Boulder County, Gilpin County, Jefferson County or others will be coordinated with the respective agencies.
- Truck staging area. The staging area shown in Figure 4 will assist in managing truck traffic through the canyon. Acknowledging this route is the main in and out for residents in the

area, Denver Water will work to manage truck traffic to reduce disruptions and delays to those traveling through the canyon.

8.2.3 Work Zone Safety Management Strategies

This category includes devices, features, and management procedures used to address traffic safety concerns in work zones. Work zone safety management strategies for the GRE Project include:

- Speed limit reduction/variable speed limits: A reduced speed limit may be used in a TCP to improve traffic safety in a work zone and help protect workers. Speed limit reductions may be implemented through an entire work zone or solely in active work areas or adjacent to workers. Reduced speed limits may also be appropriate on detours where traffic volumes and conflicts are increased.
- Temporary traffic barrier: Temporary traffic barriers will be used to provide positive physical separation between travel lanes and the adjacent workspace.
- Bicycle safety measures are included in the TIS (Appendix B, Section 7.5).
- Warning lights: Various types of warning lights, as described in the MUTCD, will be used to alert drivers and pedestrians and draw attention to critical signs, channelizing devices, and other work zone features.
- TMP monitor/inspection team: Whenever temporary traffic control devices are installed in the public right-of-way, a qualified third-party inspector will monitor and inspect implementation and monitoring of the work zone transportation management strategies (see Section 8.4).

8.2.4 Traffic/Incident Management and Enforcement Strategies

This category includes various strategies to manage work zone traffic operations. Work zone traffic management strategies involve monitoring traffic conditions and adjusting traffic operations based on changing conditions. Some of those changing conditions involve traffic incidents, so this category includes management strategies that have specific applicability to those events. Strategies in this area include:

- Local detour routes: Advanced identification and approval/authorization of local detour routes will be provided to minimize disruption. Variable message signs will be used to make detour plans known in advance of the scheduled work.
- Incident/emergency management coordination: This strategy will provide a designated individual on the contractor’s team with overall responsibility for incident and emergency management. Responsibilities may include developing incident and/or emergency response plans, overseeing implementation and monitoring of the work zone management strategies, and overall management of incidents or emergencies.
- Incident/Emergency Response Plan: This involves developing a plan on incident response. The contractor will develop this plan, which will include roles and responsibilities, response agencies, processes/procedures, actions to take for various incident types and levels,

contact information, alternate routes, personnel and equipment information, staging area locations, and other information as appropriate for the specific GRE Project activity or phase. Meetings will be held with emergency response providers before work starts to ensure lines of communications are defined and clear.

- Cooperative police enforcement: Local law enforcement agencies will be informed of planned construction operations and alerted to operations that will have an influence on local traffic. Observations about traffic patterns and motorist behavior will be used to refine traffic control measures to ensure safe passage through work zones.

8.3 Public Information and Outreach

As previously discussed in Section 1.1.2, Denver Water has put forth a public outreach campaign to inform and solicit feedback from neighboring communities and the public on many aspects of the GRE Project beginning in 2003. The public information and outreach program, as related to transportation during construction, addresses the public awareness and motorist information strategies used for the GRE Project. The information program will inform the public of the overall purpose of the GRE Project. The program will also encourage changes in driver, cyclist, and pedestrian behavior during construction to help minimize congestion by informing the public of anticipated roadwork areas, possible delays, and schedules for increased truck traffic.

The public information campaign related specifically to traffic concerns will start prior to construction. This approach will make the public aware of the GRE Project and potential impacts prior to construction and inform them about construction status and TMP elements.

These strategies include both public awareness strategies and motorist information strategies described below.

8.3.1 Public Awareness Strategies

Public awareness strategies focus on educating and reaching out to the public, businesses, and the nearby community about construction transportation routes and work zones:

- Press releases/media alerts: This strategy will provide GRE Project-related information to the news media, affected businesses, and other affected or interested parties using print and digital media.
- Social Media: Outreach via social media, including Twitter and Facebook, will be used to provide real-time updates, including information on traffic conditions or incidents affecting traffic flow. Denver Water will both create content and partner with other agencies to share content across these platforms.
- Public information center: This facility has already been established at the Public Information Yurt located near the Gross Reservoir Headquarters building on Gross Dam Road. This facility is open periodically during the recreation season and contains scale model displays and literature describing the GRE Project and its potential impacts and describes available

alternatives to minimize the impacts. The availability and use of this facility may change during construction.

- Planned lane closure website: CDOT maintains an interactive web page (cotrip.org/map.htm#/default?RoadWorkAlertId=349611). GRE Project-specific lane closure information will be updated on this site through coordination with CDOT. Additional GRE Project updates will be found on a GRE Project-specific CDOT page. The web page will summarize planned lane closures, list the routes involved, and detail closure start and end dates, both in text and graphical form.
- GRE Project website: This website will provide traffic or travel information for the work zone online. The website will include both long-term static information and real-time interactive information.
- Project notifications to schools/businesses/emergency services: Public information staff will ensure stakeholders impacted by the project are notified in a timely manner through regular project notifications and updates, including dissemination of project schedules, MHTs, and traffic plans, upcoming work, and changes to traffic patterns. This will include local schools and school districts, local employers/businesses, and emergency services (fire, police, and ambulance) and will employ mechanisms such as email, phone messages, mailings, etc.
- Stakeholder outreach and partnerships: Throughout the duration of the GRE Project, staff will engage with local community groups and homeowners associations to ensure area residents are informed and kept up-to-date on project-related impacts.
- Visual information (videos, slides, presentations) for meetings or for web-based dissemination have been developed and will be used to facilitate the distribution of GRE Project information.

8.3.2 Motorist Information Strategies

These strategies provide current and real-time information to road users regarding the GRE Project work zones. Motorist information strategies include:

- Variable message signs: Portable message boards will be placed along roadways to notify road users of lane and road closures, work activities, incidents, potential work zone hazards, queues, slowed or stopped traffic ahead, travel time or delay information, and alternate routes in or around the work zone. Signs will be located before potential diversion points to give motorists an opportunity to divert to an alternate route or take other appropriate measures based on the information provided. These signs can also be used as an enforcement tool to inform drivers of speed limit reductions and enforcement activities in a work zone. The variable message sign equipment will be included in TCPs submitted for approval to the regulating agency.
- Temporary motorist information signs: Temporary conventional signs mounted in the ground, overhead, or on vehicles may also be used to provide information to guide motorists through work zones and warn of potential hazards. These signs will be included in TCPs submitted for approval to the regulating agency. Denver Water will coordinate with the Boulder County Community Planning & Permitting communications specialist for signage

and public information dissemination related to GRE Project timelines. Any signs located on National Forest System lands will be coordinated with the USFS.

8.4 TMP Monitoring

This section outlines the requirements for monitoring the work zones and the TMP, including who is responsible for monitoring tasks.

Monitoring the performance of the work zones and the TMP during construction is important to see if the predicted impacts closely resemble the actual conditions in the field and if the strategies in the TMP are managing impacts effectively.

Monitoring will consider both the performance of individual TMP strategies and overall performance of the work zone and work zone impact area during construction. The contractor's project management staff and TCP designer will monitor the work zones and TMP performance and, if necessary, make changes to the TMP. In addition, Denver Water will monitor the overall performance of the TMP and coordinate any necessary adjustments with the contractor and TCP designer. Any changes to work zones or the TMP will be consistent with the decisions made in the original TMP, will involve the TCP designer, and will be documented in the TMP. Changes will be submitted for approval to the regulating agency, as needed.

Appendix D provides the proposed organization chart for the TMP implementation and operation, including the role of the TCP. Project contract documents will specify the contractor TMP implementation responsibilities, and compliance documents will be kept in the project files.

Monitoring for oversight will include:

- Determining and documenting how strategies are being implemented and verifying that specified TMP elements are happening on schedule and in the manner planned.
- Identifying TMP performance monitoring processes and ensuring monitoring is carried out.
- Verifying work zone setup (via MHTs and daily traffic control supervisor diaries).
- Ensuring variable message signs, Highway Advisory Radio, and other media tools provide accurate and timely information to motorists, bicyclists, and pedestrians regarding lane closure times and other GRE Project information.
- Identifying approaches for performance of corrective actions when TMP strategies are not carried out or performance measures are not met.

8.5 TMP Performance Measures of Effectiveness

The effectiveness of the TMP will be monitored throughout the GRE Project. Specific observations about traffic related metrics will include:

Mobility

- Throughput volumes.
- Delay and travel time reliability.

- Queues.
- Safety.
- Vehicle accidents.
- Worker accidents.
- Speed reduction compliance.

Customer Satisfaction

- Work zone quality perceptions.
- Travel condition ratings through the work zone.
- Complaint frequency.

Agency and Contractor Productivity and Efficiency

- Percent of allowable days worked.
- Lane closure hours occurring outside of allowed work windows.
- Measurements of work completed.
- Average hours of work activities that adversely affect mobility or safety.

8.6 Additional Agency Coordination

8.6.1 Measures to Minimize and Repair Road Damage

For County Roads, Denver Water will arrange a preconstruction meeting with Boulder County Public Works and Boulder County Community Planning & Permitting staff prior to the commencement of construction activities. At this meeting, work hours, access points, snow removal in the construction zone, traffic management, traffic control, construction, and inspection schedules will be discussed.

Denver Water will include a GRE Project overseer, approved by Boulder County Public Works, to monitor and inspect the project and ensure compliance with Roadway Construction Permit conditions and all other county requirements specific to Boulder County's Public Works Department's issues and concerns. This overseer will be both independent of the primary construction contractor and project engineer and have the authority to alter, direct, and stop any activity that will result in adverse environmental or safety conditions or violate the conditions of the permit(s), county approval, or accepted construction standards. The GRE Project overseer/inspector shall provide reports to the GRE Project contractor, Denver Water, and Boulder County Public Works Department on a weekly basis during construction activity. Weekly reports will consist of a diary of observations throughout the construction process and progress. This overseer will be in addition to any other overseer required for the GRE Project.

Prior to GRE Project commencement, the contractor will photo document the conditions of all county roads that will be used during construction. All affected roadways will be restored to pre-project conditions or better. Photo documentation will be submitted to Boulder County Public Works Department prior to construction.

For USFS roads, as required by USFS 4(e) Condition 10, Denver Water will develop a Road Maintenance Plan according to the schedule provided in FERC Order Article 422(a) and will ensure consistency between that plan and this document.

8.6.1.1 Roadway Maintenance Operations

Road maintenance and road improvements will be undertaken and made whenever necessary to maintain the road in good operating condition at all times and to insure the provision of safe access by local residents, the traveling public, and emergency vehicles. Where not otherwise maintained by local agencies, roadways road shall be snowplowed so as to permit year round access. If Denver Water is made aware of emergency safety conditions on a public road, the necessary repairs be completed immediately.

Specific attention will be paid to maintaining proper cross slopes, drainage, and minimizing corrugation that develops on gravel roads during heavier haul periods. Supplemental gravel and spot repairs of potholes may be required when the subgrade becomes distressed. Materials will be stockpiled for both gravel and paved road repairs. A dedicated crew will be responsible for monitoring the condition of access roads and maintaining them in a safe operating condition.

8.6.2 Procedures for Complying with County Road Regulations

- Roadway Construction Permit: required for the permanent road improvements proposed in Boulder County rights-of-way. Denver Water will review the Boulder County Multimodal Transportation Standards and submit designs to apply for Roadway Construction Permits necessary to facilitate construction access to the site. The proposed improvements will be described in Design Documents prepared for the appropriate jurisdictions. Design Documents typically include Design Memoranda, Design Drawings, and Specifications. Elements of the design review process that ensure compliance with regulations include submission of 30%, 60%, 90% and For Construction Documents for jurisdiction review, comment submission, and subsequent approval. Specific elements of the designs will address compliance with roadway design standards, satisfactory sight distance, satisfactory drainage, and appropriate striping and signage. Any deviations from the standards that may be required due to the mountainous terrain or property interests that would be excessively harmed will be highlighted for jurisdiction concurrence and approval. When construction activity is parallel to Boulder County rights-of-way, Denver Water shall not use the rights-of-way for any construction-related activity including, but not limited to, stockpiling of material, staging construction materials, parking for workers or construction vehicles. Note that, among other things, hours of work are regulated by the Roadway Construction Permit.
- Oversize/Overweight Permit: weight restrictions may apply to heavy equipment traffic along adjacent roadways. If necessary, Denver Water will apply for Oversize/Overweight Permits from the appropriate jurisdictions. Denver Water will be responsible for repairing roads should there be any damage as identified by the Boulder County Engineer.
  CDOT Access Permits: The intersection of SH 72 and Gross Dam Road requires a CDOT Access Permit due to the volume of trucks entering/exiting the state highway at that location.

Denver Water met with CDOT representations in 2018 to review design alternatives. A preferred alternative was identified that includes a relocated and improved intersection. Denver Water has progressed design of the improved intersection and has shared preliminary design drawings with both CDOT and Boulder County for review and feedback. Boulder County has not provided feedback or comments on the designs provided to date. CDOT has informed Denver Water that, because Boulder County owns Gross Dam Road at its point of access to SH 72, Boulder County must provide its permission to submit the Access Permit for intersection improvements. Boulder County has informed Denver Water that it will not provide its permission to submit the Access Permit until Boulder County's Areas and Activities of State Interest (1041) Permitting process is complete. Denver Water has informed Boulder County that, unless this issue is resolved by August, Boulder County's refusal to authorize the Access Permit application will obstruct Denver Water's ability to begin the necessary property acquisitions in advance of construction, which would jeopardize the construction deadlines stated in FERC's order amending the hydropower license for the GRE Project. Additionally, this delay in the permitting process for improvements to the intersection of Gross Dam Road and SH 72 has resulted in the need for Denver Water to evaluate using Crescent Park Drive as an early construction access route.

A CDOT Access Permit is also required at the staging area of SH 72 close to SH 93. Denver Water has had preliminary discussions with CDOT on the staging area location and required access elements to include deceleration and turn lanes on SH 72. Because the staging area is located on Denver Water property in Jefferson County, Denver Water will be the applicant for the CDOT Access Permit at the staging area. Denver Water will work with CDOT beginning in 2021 to ensure the final design meets the requirements of the Access Permit and construction can begin on time.

8.6.3 Other Required Permits

Other permits that are necessary for construction include, but are not limited to, the following:

- Stormwater Quality Permit: Boulder County's water quality protection and municipal separate storm sewer system construction program requires a stormwater quality permit through the Colorado Department of Public Health and Environment (CDPHE) because the area of disturbance for the GRE Project exceeds 1 acre in size. Denver Water plans to submit the stormwater quality permit application with any building or grading permit applications in order to obtain the permit before commencing work on the GRE Project. This permit is also likely to be required for the staging area at SH 72 and SH 93.
- USFS Permits: Denver Water will apply for a permit to improve the interconnection between FS 359 and FS 97. Denver Water will coordinate with USFS to identify the appropriate permits to perform the roadway improvement. Coordination will begin in 2023 to allow for improvements to be completed prior to west side reservoir tree removal activities scheduled to begin in 2025. On April 8, 2021, Denver Water held its annual consultation meeting with

the USFS on GRE Project issues. Denver Water will continue to coordinate with USFS on all improvements on National Forest System lands.

- City of Arvada Permits: The staging area off SH 72 near SH 93 is located with the City of Arvada on Denver Water property. The development of this area will require various permits from the City of Arvada. Coordination has begun with the City of Arvada and will continue as design is completed for the area.

9 Environmental Mitigation Measures and Best Management Practices

9.1 Erosion and Water Quality

Denver Water's contractor will implement measures to control erosion, sedimentation, and fugitive dust during construction activities based on the grading and stormwater permits, access permits, Section 404 Permit for the GRE Project, and the Fugitive Dust Control Plan required by Boulder County, CDPHE, and CDOT prior to the initiation of construction activities. Denver Water or its contractor will acquire a State General Permit for Stormwater Discharges associated with construction activities. As required under this permit, Denver Water will prepare a Stormwater Management Plan that will specify BMPs and inspection requirements to reduce pollutants in stormwater runoff from the construction sites. BMPs will be used to address erosion control, materials stockpiling, dust control, revegetation, materials handling, and fuel containment. Prior to construction, Denver Water or its contractor will obtain and comply with the necessary CDPHE air quality permits, including developing a Fugitive Dust Control Plan. Crews also will follow USFS requirements on National Forest System lands and CDOT requirements on state highways.

Measures will be employed to minimize soil erosion and effects to water quality during construction activities. Dust suppression on gravel roads during hauling operations will include speed restrictions and application of water during high wind conditions. Denver Water will implement BMPs to prevent offsite sediment transport.

Per Condition 10 (Use of Roads on National Forest System lands) and Condition 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials) in the FERC Order, Denver Water will minimize impacts to roads on National Forest System lands through implementation of a new Road Management Plan. Denver Water will also repurpose or revegetate and reclaim National Forest System lands outside the inundation area with seed mixtures and mulch materials approved by the USFS according to Condition 28. Repurposed areas will be converted to parking areas or recreation facilities.

9.2 Lighting, Noise, and Odors

Downcast lighting will be used and shielding installed to prevent lighting glare being visible from offsite locations. Trucks used for construction activities will be appropriately equipped with mufflers to minimize noise and speed limits will be enforced. Where feasible, reduced volume backup alarms will be used for nighttime operations. Sound barriers will also be evaluated for effectiveness during nighttime operations. In addition, noxious odors will be minimized to meet local requirements.

9.3 Hazardous Materials

Contractors will be required to provide a Spill Prevention Plan and provide the necessary equipment for spills and containment onsite as a precautionary measure. Required fueling and maintenance operations monitoring for safety and spill prevention will be documented in the Spill Prevention Plan. If hazardous materials are stored on National Forest System lands, Denver Water will complete a Spill Prevention and Cleanup Plan for USFS approval prior to filing with FERC consistent with Condition 11 of the FERC Order.

9.4 Wildlife

Denver Water will follow requirements for protection of wildlife including avoiding nesting sites and consideration of winter elk habitat.

The Final EIS prepared by the U.S Army Corps of Engineers indicated the federally designated threatened Preble's meadow jumping mouse is not known or expected to be present at Gross Reservoir and is not likely to be adversely affected by the proposed construction and reservoir expansion activities. In addition, the U.S. Fish and Wildlife Service reviewed potential effects to the Preble's meadow jumping mouse and issued a Biological Opinion on December 6, 2013, that the GRE Project is not likely to affect the Preble's meadow jumping mouse.

Denver Water will work with the USFS and Colorado Parks and Wildlife to develop measures to minimize potential impacts to raptors and songbirds that occur during the raptor- and bird-related wildlife protection seasons. Further, Denver Water will work with these agencies to minimize potential impacts to elk during the winter.

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Appendix A:
FERC Order and Conditions

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The FERC Order contains specific elements to be addressed in the TMP. Article 425, Traffic Management Plan, is the primary article governing the TMP with additional requirements contained with the U.S. Forest Service (USFS) 4(e) Conditions 10, 26, and 27. Article 425 summarizes the purpose and requirements of the TMP.

Appendix A, From FERC Order Amending License and Extending License Term issued 7/16/20:

9.4.1.1 License Articles to be Added:

56. As discussed in the Final Supplemental EA, this order requires three new license articles to further protect the public and environmental resources affected by the amended project: (1) Article 423 requires additional logging-related traffic control measures to be added to the Tree Removal Plan required by Forest Service 4(e) condition 27; (2) Article 424 requires the licensee to refile its Quarry Operation Plan and its Quarry Reclamation Plan with additional measures to address quarry development, operation, reclamation, and mitigation; and (3) Article 425 requires the licensee to file a Traffic Control Plan with details for minimizing the effects of truck traffic, addressing road damage, meeting county road regulations, reducing disruptions to local traffic and transportation, and minimizing traffic-related noise, light, and obnoxious odors. The Traffic Control Plan must be consistent with traffic control measures required by Forest Service 4(e) conditions 10, 26, and 27 (Road Maintenance Plan, Pit Development and Reclamation Plan, and Tree Removal Plan, respectively).

425. Traffic Management Plan. Within one year of the date of this order, the licensee must file, for Commission approval, a Traffic Management Plan that includes measures to minimize the impacts of construction-related traffic on local traffic, residents, and visitors to the project area.

The Traffic Management Plan must include: (1) measures to minimize the number of truck trips needed for project construction; (2) measures to minimize the effects of construction-related traffic on local traffic patterns, residents, and visitors; (3) measures to minimize noise, dust, and exhaust; (4) measures to encourage and/or require the use of carpools for construction workers; (5) proposed construction traffic routes, time-of-use, traffic control measures, and other restrictions; (6) measures to minimize and repair any road damage; and (7) procedures for complying with county road regulations. The plan must be consistent with traffic control measures needed to comply with Forest Service 4(e) conditions 10, 26, and 27, as appropriate.

The licensee must prepare the plan after consultation with the U.S. Forest Service, Colorado Department of Transportation, Boulder County, Jefferson County, and Gilpin County. The licensee must include with the plan documentation of consultation, copies of comments and recommendations on the completed plan after it has been prepared and provided to the agencies and specific descriptions of how agency comments are accommodated by the plan. The licensee must allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the plan with the Commission. If the licensee does not adopt a recommendation, the filing must include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the plan. Implementation of the plan must not begin until the licensee is notified by the Commission that the plan is approved. Upon Commission approval, the licensee must implement the plan, including any changes required by the Commission.

From Appendix A of FERC Order Amending License and Extending License Term, Section 4(e) Conditions for Amendment of the Gross Reservoir Project License, U.S. Department of Agriculture, Forest Service, Filed March 27, 2017:

Condition No. 10 — Use of Roads on National Forest System Land (NEW CONDITION)

Roads inside FERC Project Boundary

The Licensee shall develop a Road Maintenance Plan for use, maintenance, reconstruction and relocation of roads used for Project purposes on NFS land within the FERC Project Boundary. This plan shall be developed in consultation with the Forest Service and is subject to Forest Service approval. The Plan shall be filed by Licensee with the Commission within two years of the effective date of the amended license. The Plan shall address costs for maintenance, reconstruction and relocation of National Forest System Roads ("NFSRs"). Licensee shall be responsible for a proportional share of the costs of maintenance, reconstruction, and relocation of NFS roads within the FERC Project boundary commensurate with use of NFS roads for Project operations, Project-related public recreation and other Project-related activities as a percentage of the total use of NFSRs within the FERC project boundary. The Plan shall also address road maintenance for non-NFSRs that are used or maintained by the Licensee for Project purposes on NFS land within the FERC Project Boundary. The non-NFSR Plan shall specify road maintenance and management standards that provide for traffic safety, minimize erosion, and minimize damage to natural resources. It shall also include BMPs as approved by the Forest Service. The Road Maintenance Plan filed with the Commission shall be updated as determined necessary by the Forest Service. All updates are subject to Forest Service review and approval.

Suitable authorization for NFSRs needed for specific construction activities authorized under this license amendment will be provided under Conditions 24, 26 and 27.

In the event a road requires maintenance, restoration, or reconstruction to accommodate Licensee's needs and that work is not identified in the approved Road Maintenance Plan or cost share agreement, Licensee shall perform such work at its own expense after obtaining prior approval and/or authorization from the Forest Service.

The road maintenance plan shall also include the following:

a. Current condition survey.
b. Map(s) at a scale to allow identification of specific routes or segments.
c. Forest Service assigned road numbers for NFSRs and Project road references for non-NFSRs used for reference on the maps, tables, and in the field.
d. GIS compatible files of GPS alignments of all roads used for Project access to be provided to the Forest Service.
e. Adequate signage, to be installed and maintained by Licensee at each road or route, identifying the NFSRs by Forest Service road number.

Licensee shall confine all vehicles being used for Project purposes on NFS land, including but not limited to administrative and transportation vehicles and construction and inspection equipment, to roads or specifically designed access routes, as identified in the Road Maintenance Plan described above. The Forest Service reserves the right to close any and all such routes on NFS land where resource damage is occurring or to require reconstruction/construction by Licensee to the extent needed to accommodate Licensee's use. The Forest Service understands the importance of access to the dam and agrees to provide advance notice of 30 days to Licensee prior to road closures, except in an emergency, in which case notice will be provided as soon as practicable.

Licensee shall maintain suitable crossings as required by the Forest Service for all roads and trails that intersect the right-of-way occupied by linear Project facilities (power line, penstock, ditch, and pipeline).

For roads on the west side of Gross Reservoir listed in Condition 30, a road maintenance plan shall only be required if the Licensee performs road maintenance in lieu of paying the Forest Service for Licensee's share of maintenance costs as required under Condition 30. Licensee shall continue to maintain the portions of Gross Dam Access Road and Miramonte Access Road that cross NFS land in Parcels 62 and 64 and provide access to the dam and Project-related facilities on the east side of Gross Reservoir, which the Licensee currently performs under the current license. This maintenance shall be covered in the Road Maintenance Plan as described above.

Roads outside FERC Project Boundary

For use of NFSRs or non-NFSR project access roads used or maintained by the Licensee on NFS land outside the FERC Project Boundary, Licensee shall obtain suitable road use authorizations from the Forest Service. Such authorizations shall require cost sharing for road maintenance and reconstruction commensurate with Licensee's use and project-related use of NFSRs. It shall also address road maintenance for non-NFSR project access roads. The authorizations shall specify road maintenance and management standards acceptable to the Forest Service that provide for traffic safety, minimize erosion, and minimize damage to natural resources.

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Appendix B:
Traffic Impact Study

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Gross Reservoir Expansion Project
Denver Water Project No. 19152
Stantec Project No. 224202091

TRAFFIC IMPACT STUDY
90% Design Memorandum
Interim Submittal

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Prepared by:

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Revision Sheet

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Sign-off Sheet

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EXECUTIVE SUMMARY

This document is submitted independently from the Basis of Design Memorandum for raising Gross Dam and should be considered part of the Gross Reservoir Expansion (GRE) Project.

This *Traffic Impact Study – 90% Design Memorandum (DM), Interim Submittal* document builds on two previous traffic studies:

1) *Report for Gross Reservoir Expansion Alternatives Analysis and Feasibility Study for Roadway Improvements*, by Michael Baker International (2015), and

2) *Gross Dam Reservoir Expansion Traffic Control Plan*, by Alliant Engineering (2015).

For the current assignment, the Design Engineer estimates show that the raising of Gross Dam would require approximately 800,000 cubic yards (CY) of roller-compacted concrete (RCC) throughout the construction phase, which considers two (2) years for the majority of RCC construction, with a placement schedule of RCC between the months of April and November. It is noted that the placement of RCC will not take place during the winter seasons in the two years of construction.

Cement and Fly Ash Material Deliveries

One of the main topics covered in this traffic study is the delivery of cement and fly ash, which is anticipated to commence in 2024, with the majority of deliveries taking place in 2025 and 2026.

According to the cement and fly ash haul study (Engineering Solutions, 2014) and the current construction schedule, Denver Water estimates up to 7,200 tons (approximately 288 trucks) of cement and fly ash deliveries will be required every week during peak RCC production. This volume of truck deliveries is considered a conservatively high estimate for the purposes of this GRE Traffic Impact Study.

The proposed single route for deliveries of cement and fly ash material was determined with previous study efforts (Engineering Solutions, 2014) and includes approximately 13 miles of travel on State Highway (SH) 72 between SH 93 and Gross Dam Road and approximately 4 miles of travel on Gross Dam Road. The previous and current traffic studies use SH 93 as a starting point for this work as this is the point where the larger multiple-lane roads change into a single lane in each direction.

In general, GRE construction activities will result in increased traffic on SH 72 between SH 93 and Gross Dam Road. The highest impacts will be during deliveries of cement and fly ash materials for Dam Raise construction (2024-2026). This analysis examines these traffic impacts, including improvements to the intersection at SH 72 & Gross Dam Road and along Gross Dam Road.

Vegetation and Tree Removal Trucking

The GRE Project will require clearing of vegetation and removal of trees within the area of the raised reservoir. Vegetation and tree clearing will contribute to the additional heavy-haul trucks on highways near the Gross Dam site. Limited vegetation and tree removal is expected to occur early in the construction schedule during Site Development construction activities. The removal of trees within the footprint of the raised reservoir area will be the last phase with the largest volume of tree removal expected to take place between 2026 and 2027, as part of the Dam Raise work. Trees that can be merchandised are planned to be transported to a vendor selected based on market conditions and the tree chipped residues are planned to be transported by truck to Republic Services Foothills Landfill on SH 93 south of SH 72.

The tree removal materials are planned to be transported away from the site using different routes from the east and west sides of the Gross Reservoir. For tree removal from the east side of the Gross Reservoir, transport trucks are planned to use the same proposed routes for cement and fly ash material deliveries between SH 93 and Gross Dam Rd via SH 72. For tree removal from the west side of the Gross Reservoir, the proposed route includes approximately 3.2 miles of travel on US Forest Service Road 359 and/or Lazy Z Road to County Road (CR) 132. The trucking route from CR 132 is still under discussion with multiple jurisdictions. There will be no tree removal material transport trucks on SH 72 between Gross Dam Rd and CR 97. Transport of these materials will result in increased traffic on the west side access routes, however, the existing traffic volumes on these roadways is very low and impacts to the traveling public will not be significant. It should be noted that Tree Removal Plan is in the process of being updated by Denver Water. This TIS interim submittal is based on information developed for the Tree Removal Plan dated March 2021.

Summary

The following conclusions and recommendations are based on the analysis presented in this DM:

1. Improvements are needed to safely accommodate the expected construction traffic at the SH 72 & Gross Dam Road intersection. It is recommended to relocate and reconstruct the existing SH 72 & Gross Dam Road intersection slightly east along SH 72 to provide better sight distance and turning radii into and out of the access intersection from SH 72. This will improve the safety and traffic operations at this intersection both short term (during construction) and long term.

2. Current analyses indicate that the daily truck traffic impacts to the SH 119 intersection with CR 132 are less than 10% on all approaches. In addition, site traffic is not triggering the need for turn lanes based on the requirements of the State Highway Access Code and all approaches are expected to operate at pre-construction Level of Service. Therefore, no mitigation is required or recommended for SH 119 or the SH 119 & CR 132 intersection.

3. Initial analyses of the additional traffic on Gross Dam Road indicate that the improvements can be accomplished with grading and drainage improvements like ditches/culverts, which

are not expected to greatly affect the footprint, condition, or feel of the roadways. Local access points (driveways) will be adjusted accordingly to meet existing and proposed conditions.

4. Strategic placement of warning signs and delineators along the site access route is recommended to make drivers aware that they are in a construction area. The number and placement of these signs shall be coordinated with Boulder County through traffic control plans as part of the FERC article 425 – Traffic Management Plan.

5. Additional analysis may be required to determine if CR 132 and Lazy Z Road, as well as any US Forest Service roads, along the access route to the west side of Gross Reservoir will require improvements to accommodate the trucks needed for tree removal operations during construction. Long-term safety improvements for both residents and visitors should also be considered.

(END OF SECTION)

ABBREVIATIONS

AADT	Average Annual Daily Traffic
AF	Acre-Foot / Acre-Feet
BOCO	Boulder County
CAGR	Compound Annual Growth Rate
CDOT	Colorado Department of Transportation
CSHP	Colorado State Highway Patrol
CR	County Road
CY / cy	Cubic Yards
DM	Design Memorandum
EB	Eastbound
El.	Elevation
FERC	Federal Energy Regulatory Commission
FS	Forest Service (Road)
FT	Foot / Feet
GDR	Gross Dam Road
GRE	Gross Reservoir Expansion (Project)
HCM	Highway Capacity Manual
HQ	(Denver Water) Headquarters (building at Gross Dam site)
JEFFCO	Jefferson County
LOS	Level of Service
NB	Northbound
RA	Regional Highway
RB	Rural Highway
RCC	Roller Compacted Concrete
SB	Southbound
SEO	(State of Colorado) State Engineer’s Office
SH	State Highway
TMC	Turning Movement Count
UPRR	Union Pacific Railroad
vph	Vehicles per Hour
WB	Westbound

1.0 INTRODUCTION

The Gross Reservoir Expansion (GRE) Project is located on South Boulder Creek in Boulder County (BOCO), Colorado, and in the Arapaho-Roosevelt National Forest. Gross Dam is a curved gravity structure with a height of 340 feet (FT) that was completed in 1954. The objective of the GRE Project is to raise the existing Gross Dam by 131 FT to a final height of 471 FT, increasing the storage capacity from approximately 42,000 acre-feet (AF) to about 119,000 AF.

Denver Water selected Stantec, including AECOM as a major subconsultant, to be the Design Engineer for the GRE Project, which includes investigation of the dam foundation and quarry, review of subsurface conditions, engineering analyses and design services, including development of design and construction documents for select elements of Site Development and Dam Raise.

1.1 GENERAL OVERVIEW

The current GRE schedule indicates that the peak of construction traffic will be due to cement and fly ash deliveries during Dam Raise construction taking place between 2024 and 2026 and reservoir perimeter tree removal operations that are expected to occur in 2025 and 2026.

1.2 SCOPE OF DESIGN MEMORANDUM

The purpose of this *Traffic Impact Study – 90% Design Memorandum (DM), Interim Submittal* is to determine the impacts of construction and tree removal traffic on the proposed access routes and access intersections. This plan determines if mitigation is required for the access routes and intersections with State Highway (SH) 72 on the east side of the reservoir (see **Figure 2-1**) and SH 119 on the west side of the reservoir (see **Figure 2-2**). Specifically, mitigation measures are recommended for Gross Dam Road and the SH 72 & Gross Dam Road intersection (access to the east side of Gross Dam) during peak construction periods when workforce traffic is at its peak and RCC is being placed to allow for delivery of cement and fly ash materials. In addition, this plan includes an evaluation of the traffic for tree removal operations and the Traffic Impacts of the roads involved. Finally, this plan addresses the safety and mobility for the traveling public that will be impacted.

(END OF SECTION)

2.0 ROADWAY AND TRAFFIC CONDITIONS

2.1 AREA ROADWAYS

The proposed primary routes for construction and tree removal traffic, including the delivery of cement and fly ash to the GRE project site and hauling tree removal materials from the GRE site, are illustrated on **Figure 2-1** and **Figure 2-2**.

As shown on **Figure 2-1**, workforce traffic and cement and fly ash truck trips will originate from the Denver metropolitan region and will enter SH 72 at the SH 93 intersection, travel west (uphill) on SH 72 to Gross Dam Road and then north on Gross Dam Road to access the GRE construction work areas. On the east side, tree removal material truck trips will originate from the east side of the Gross Reservoir area and will enter SH 72 at the Gross Dam Road intersection and travel east (downhill) to SH 93 to continue to either log processing facilities or to the landfill.

As shown on **Figure 2-2**, tree removal trucks loaded from the west side of Gross Reservoir, will egress either Forest Service (FS) Road 359 or Lazy Z Road. An access road from FS 359 to Lazy Z Road is planned to be reconstructed to allow all hauling tree removal trucks to access County Road (CR) 132 from Lazy Z Road. Trucks hauling to/from log processing facilities or the landfill will then travel from CR 132 on SH 119.

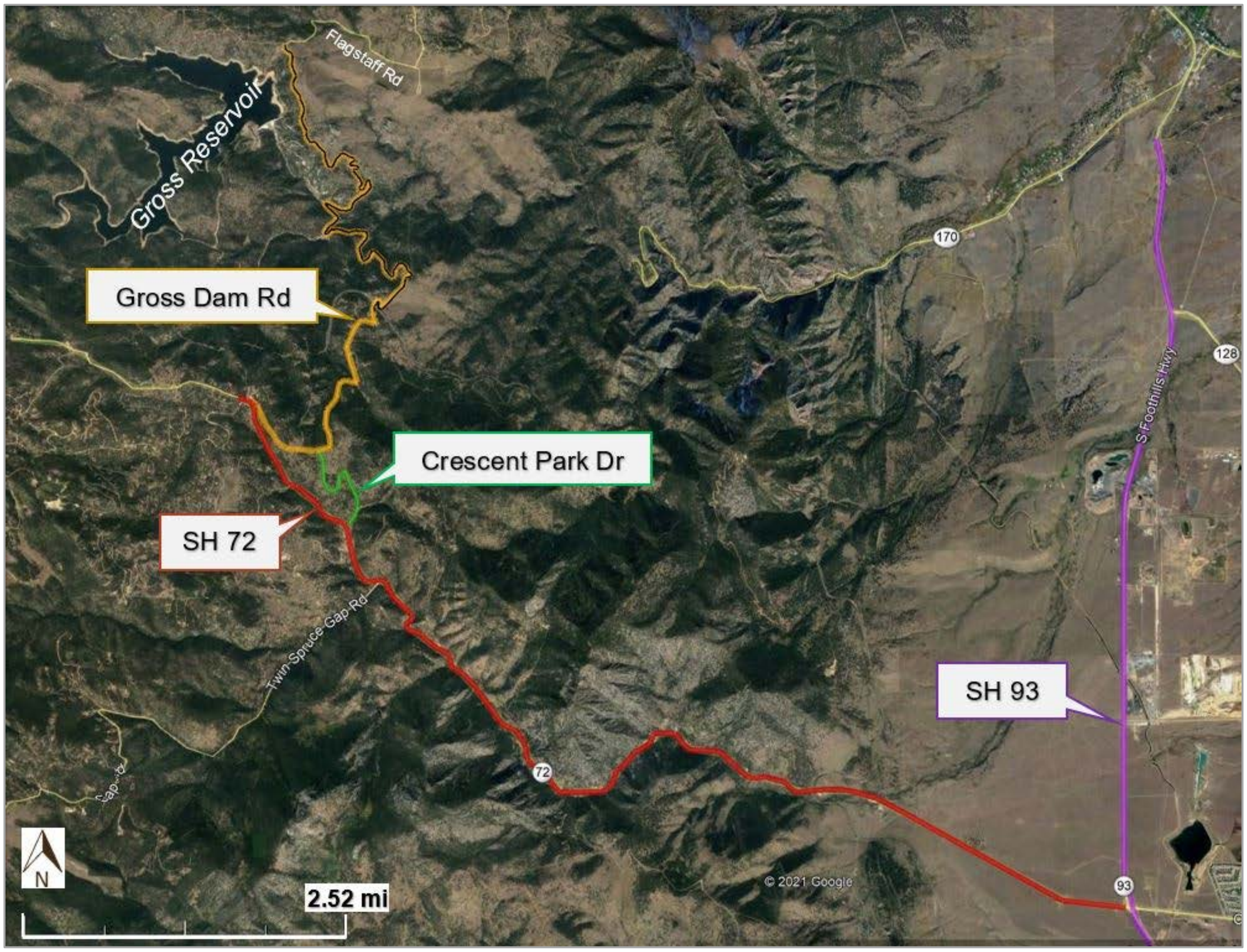


Figure 2-1. Proposed Site Access Haul Route – East Side (Material Delivery, Workforce, and Tree Removal)

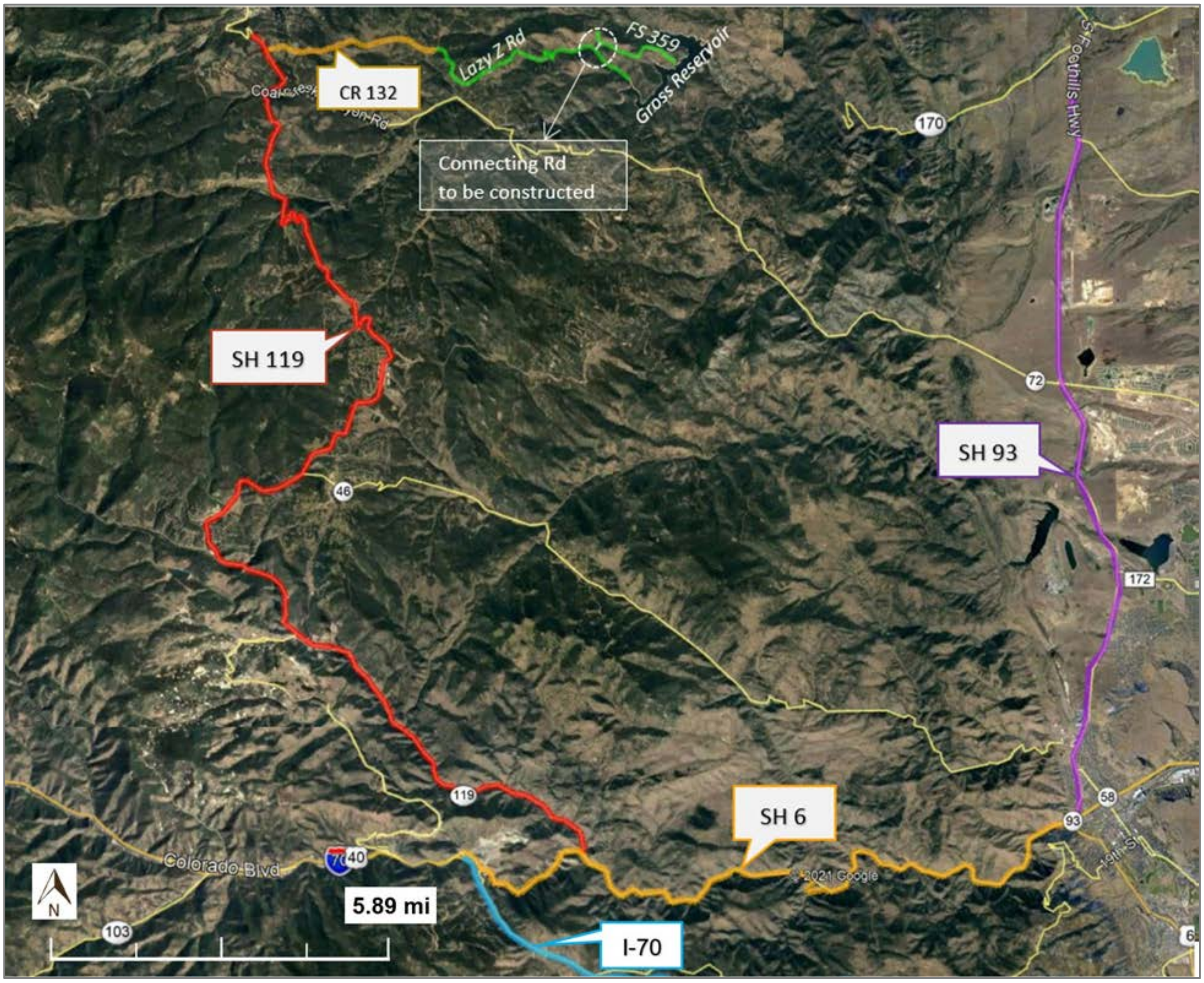


Figure 2-2. Proposed Site Access Route – West Side
(Tree Removal only)

The white link labeled “to be constructed” above refers to approx. 0.15 miles of roadway that is planned to be reconstructed to connect FS 359 to Lazy Z Road to allow for tree removal traffic to travel between these two roads.

The roadways evaluated in this study are described below:

- SH 72 (Coal Creek Canyon Road) west of SH 93 is a rural, mountainous roadway that provides regional connectivity between the Denver metropolitan area on the east and SH 119 near the towns of Nederland and Rollinsville on the west. SH 72 near Gross Dam Road is a 2-lane (one lane in each direction) paved 24-foot-wide section. Shoulders in the area of the study intersection include 2-foot paved shoulders, unpaved shoulders or roadside ditched for storm water (see picture of typical cross section in **Appendix A**). Gross Dam Road turn-off from SH 72 is 8.6 miles west from SH 93, and 3.9 miles south from Denver Water Headquarters (HQ) near 3817 Gross Dam Road. SH 72 has a grade that ranges from about 3% to about 8% from SH 93 to the intersection with Gross Dam Road. One of the steepest roadway segments on SH 72 within the study area is the 1/3 mile immediately leading up to Gross Dam Road with about 7.5% grade. The posted speed limit on SH 72 in the study area varies from 35 to 45 mph and is 40 mph near the Gross Dam Road access. SH 72 is classified as a Rural Highway (RB) in the Colorado Department of Transportation (CDOT) State Highway Access Category Assignment Schedule. Colorado State Highways are designed for tractor trailer trucks and similar traffic. SH 72 is a school bus route and school buses travel and stop to pick up children on the roadway during the morning (7:00 AM – 8:30 AM) and the afternoon (3:00 PM – 4:30 PM). SH 72 passes under a railroad crossing bridge, 2.5 miles to the west of the intersection of SH 72 & SH 93, with a posted vertical clearance of 14'-9" in both directions. The roadway segment on SH 72 between Gross Dam Road and CR 97will not be utilized by semi-trailer trucks for this project.

- SH 119 is a 63.7-mile long state highway in north central Colorado. SH 119 north of US 6 to CR 132 (Magnolia Road) is primarily classified as a rural, mountainous roadway. SH 119 provides regional connectivity between the towns of Golden and Idaho Spring on the south and Rollinsville and Nederland on the north. SH 119 continues northeast past Nederland towards the cities of Boulder and Longmont. Near CR 132, SH 119 is a 2-lane (one lane in each direction) paved 24-foot-wide section with 11-foot shoulders in each direction. The CR 132 turn-off from SH 119 is 23.8 miles north of US 6. The posted speed limit on SH 119 in the study area varies from 35 to 45 mph and is 45 mph near the CR 132 access. SH 119 has a grade that ranges from about 4% to about 6% from US 6 to CR 132. In the study area, SH 119 is classified as a Regional Highway (RA) in the CDOT State Highway Access Category Assignment Schedule. It should be noted that a portion of SH 119 is a designated State Scenic byway. Colorado State Highways are designed for tractor trailer trucks and similar traffic. To the north, SH 119 intersects with SH 72 in Nederland where SH 119 turns to the northeast enters the scenic Boulder Canyon, and city of Boulder.

- Gross Dam Road is a two-lane (one lane in each direction) unpaved gravel road with continuity from SH 72 on the south to Flagstaff Road on the northeast side of Gross Reservoir (see picture of typical cross section in **Appendix A**). The posted speed limit on Gross Dam Road is 20 mph. However, based on previous studies and the AutoTurn analysis presented in this report, the steep grades, that range from about 2% to about 9%, and tight switch back curves will only allow for large trucks to travel at a maximum speed of about 10 mph unless substantial improvements are made to the roadway and even then, one-way flagging in several areas would be required under current conditions. Gross Dam Road provides access to the existing Gross Dam maintenance facilities and recreation areas and is used for local access by residents who live in the area. Gross Dam Road crosses the Union Pacific Railroad (UPRR) tracks approximately 2.2 miles north of SH 72. The railroad crossing is at grade and is equipped with railroad warning signs and flashing lights but no railroad gates (see **Appendix A**). Gross Dam Road also provides access to the Walker Ranch Loop regional trail and the western portion of El Dorado State Park just northeast of the Railroad crossing. Additionally, Denver Water owns a portion of Gross Dam Road shown with black line on **Figure 2-1**.

- Crescent Park Drive is a two-lane (one lane in each direction) paved JEFFCO road with continuity from SH 72 on the south to Gross Dam Road on the north. Crescent Park Drive is generally used by traffic in route to Flagstaff Road, Gross Reservoir, and by residents for local access. Traffic traveling west (from Denver) can use Crescent Park Drive to access Gross Dam Road. Crescent Park Drive will be utilized as an access route to the site until the new intersection at Gross Dam Road and SH 72 can be improved.
- Flagstaff Road is a two-lane (one lane in each direction) paved road north of Gross Reservoir with continuity between Gross Reservoir and Boulder. Flagstaff Road will be restricted from commercial construction access as part of the GRE Project.
- CR 132 (Magnolia Road) is a two-lane (one lane in each direction) unpaved gravel road with continuity from SH 119 on the west to cross SH 119 again in Boulder Canyon on the northeast. The posted speed limit on CR 132 is 30 mph. Towards the east, approximately 3 miles from SH 119, CR 132 intersects with Lazy Z Road, which is one of the access roads to the west side of Gross Reservoir. CR 132 is part of the proposed route for hauling tree removal materials from the west side of the reservoir as part of the GRE Project. The grade on CR 132 from SH 119 to Lazy Z Road ranges from about 4% to about 6%.
- Lazy Z Road (CR 97E) is a two-lane (one lane in each direction) unpaved gravel road west of Gross Reservoir. Lazy Z Road provides connectivity between CR 132 and Gross Reservoir. Lazy Z Road is a narrow roadway, particularly for the first 1.5 miles west of Gross Reservoir, with a total roadway width of less than 15-feet. Lazy Z Road is part of the proposed route for hauling tree removal materials from the west side of Gross Reservoir as part of the GRE Project. Lazy Z Road has a grade ranging from about 3% to about 9% from CR 132 to Gross Reservoir.
- FS 359 is an unpaved gravel road west of Gross Reservoir. FS 359 in an access road to the West Side of Gross Reservoir and provides connectivity from CR 68 on the west to Gross Reservoir on the east. FS 359 is a narrow roadway with a total width of less than 15-feet. FS 359 is part of the proposed route for hauling tree removal materials from the west side of Gross Reservoir as part of the GRE Project. Improvements to FS 359 will be required to accommodate access for logging equipment and haul trucks. FS 359 has a grade ranging from about 2% to about 9% from CR 68 to Gross Reservoir.

2.2 AREA TRAFFIC VOLUMES

The location of CDOT traffic count stations along the SH 72 and SH 119 in the study area are illustrated on **Figure 2-3.** Historical average annual daily traffic (AADT) from 2015 to 2019 at these locations along each corridor are summarized in **Table 2-1** and are graphically illustrated on **Figure 2-4.** As shown in **Table 2-1**, average annual traffic growth rates of 3.5% have been assumed for SH 72 and SH 119 for this analysis. The annual growth rates are based on the calculated compound annual growth rate (CAGR) for the count stations nearest to the proposed access intersections.

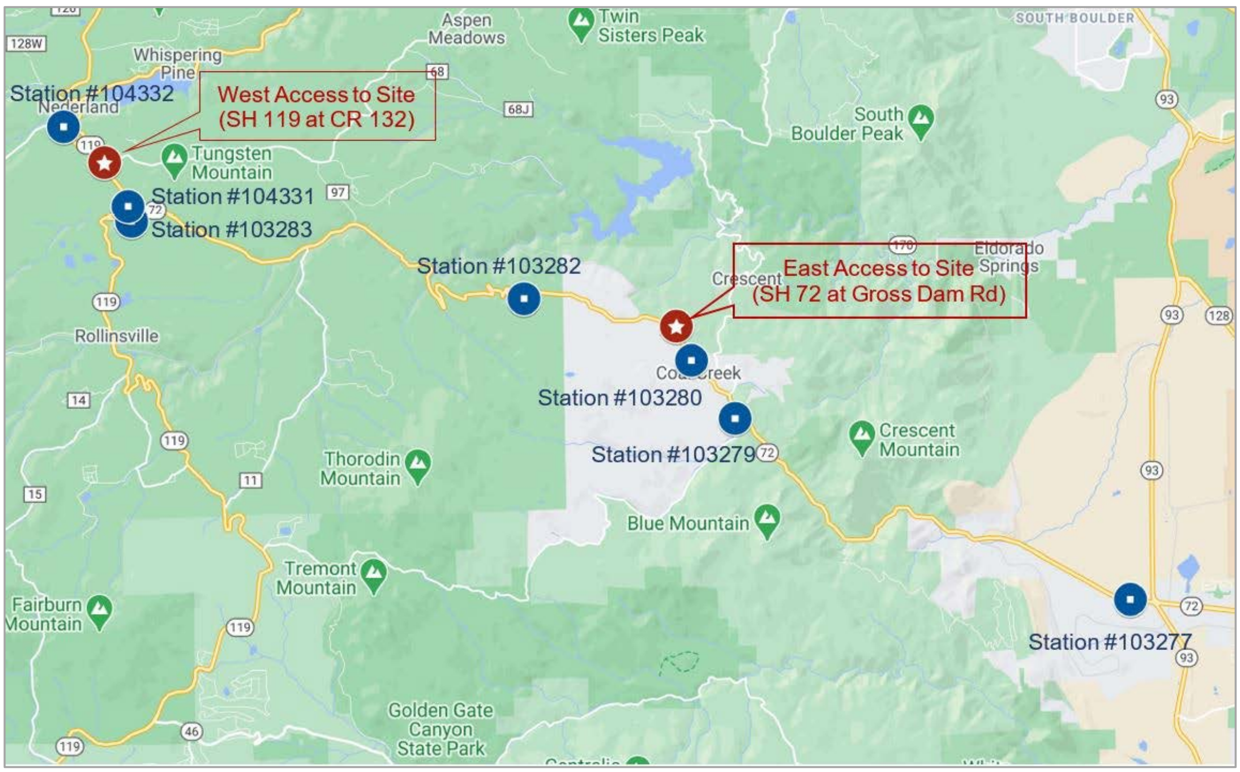


Figure 2-3. Count Stations along SH 72

Table 2-1. Historical AADT for SH 72 and SH 119

State Highway	Count Station ID	Location	2015	2016	2017	2018	2019	2015 - 2019 CAGR
SH 72	103277	SH 72 W/O SH 93	5,549	5,546	5,535	4,997	5,572	0.1%
	103279	SH 72 W/O Twin Spruce Rd	3,900	4,037	4,033	4,077	4,195	1.8%
	103280	SH 72 NW/O Ranch Elsie Rd	2,900	3,002	3,071	2,548	2,622	-2.5%
	103282	SH 72 E/O Indian Peak Rd	1,400	1,449	1,472	1,488	1,531	2.3%
	103283	SH 72 E/O SH 119 JCT	880	1,154	1,300	1,314	1,425	12.8%
SH 119	104331	SH 119 NE/O SH 72 JCT	2,657	3,276	3,351	3,388	3,560	7.6%
	104332	SH 119 SW/O Tilden St	4,161	4,307	4,406	4,449	4,578	2.4%
Average Compound Annual Growth Rate								**3.5%**

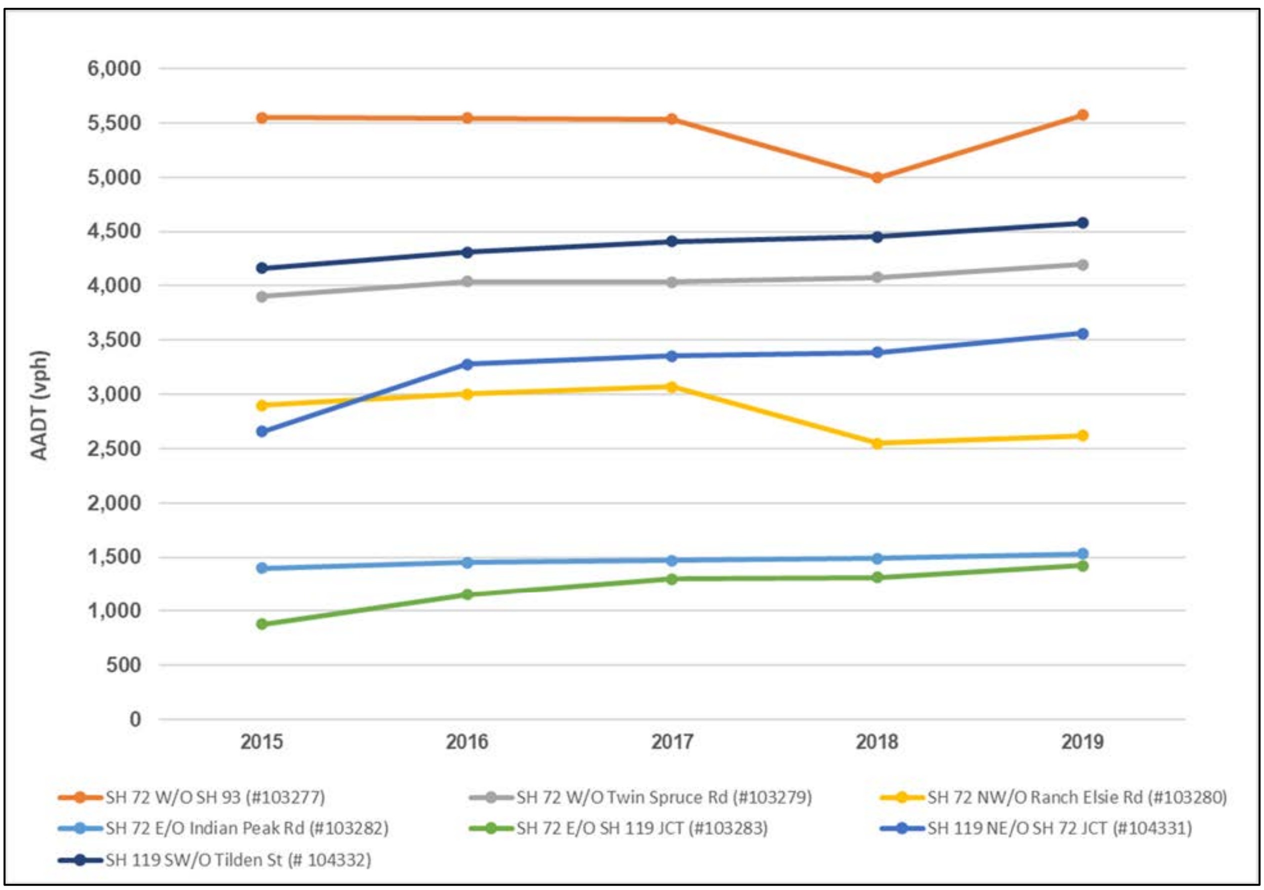


Figure 2-4. Historical AADT for SH 72 and SH 119

(END OF SECTION)

3.0 CONSTRUCTION GENERATED TRAFFIC

3.1 CEMENT AND FLY ASH MATERIAL DELIVERY AND TREE REMOVAL SCHEDULE

As previously stated, SH 72 is the primary project ingress and egress route that will be impacted by construction traffic. This highway is a designated school bus route, with school buses travelling and stopping along it in the morning (7:00 – 8:30 AM) and in the afternoon (3:00 – 4:30 PM).

Denver Water has unilaterally developed construction traffic restrictions to improve the safety of SH 72. Specifically, measures will be taken to avoid heavy truck traffic during school bus pick up and drop off times traveling on SH 72. Other assumptions related to the days per week and time windows are stated below:

- The memo prepared by Denver Water (see **Appendix B**) analyzing trip generation related to concrete production examines several scenarios for material delivery schedules. All scenarios are being considered, and, as a baseline criterion, a 4-day material delivery schedule is assumed with truck deliveries on Monday, Wednesday, Thursday, and Friday (weekends are prohibited).
- It should be noted that the baseline criterion to limit material delivery to a 4-day schedule was developed as a conservative assumption to evaluate the upper limit of number of trucks per day. However, it is expected that during times of peak RCC production, cement and fly ash deliveries could take place more frequently than 4 days per week, which would result in truck traffic volumes lower than those assumed for the purposes of this DM.

3.2 MATERIAL DELIVERY AND WORKFORCE GENERATED TRAFFIC

Material delivery and workforce traffic for this project will consist of truck traffic (of varying sizes, including 18-wheel and “low boy” delivery trucks) delivering material to the site and traffic from construction workers commuting to and from the site.

In cooperation with Denver Water, the Design Engineer developed a model to evaluate the RCC placement schedule, and the number of cement and fly ash delivery trucks throughout the duration of the project. The results of the model indicate that the number of trucks could range between two (2) and seven (7) trucks per hour depending on the stage of construction and other factors. For the purposes of this traffic impact study, the number of cement and fly ash trucks has been conservatively assumed to be 15 trucks per hour (during the peak hour) to account for unexpected bunching of trucks on the road.

The required construction workforce is expected to generate between 75 and 151 commuting worker vehicles per day shift, based on the latest construction evaluations prepared by Denver Water in coordination with the Construction Manager General Contractor (CM/GC). This range is based on input from the CM/GC and considers a combination of carpooling and busing during periods of peak construction activities. Considering the expected range of commuting worker vehicles per day shift, the traffic analysis was completed for both a “Low” and a “High” estimate, to provide a thorough review of the possible impacts. This range is expected to bracket the final estimate of construction workforce-generated trips, which will be developed by the CM/GC based on the final schedule and estimate of resources for construction of the GRE Project.

The timing for deliveries of cement and fly ash can easily be adjusted to accommodate the traffic restrictions established by Denver Water for the GRE Project, as well as critical commute times. The scheduled timing for truck deliveries will also take into account other traffic restrictions including those imposed by CDOT maintenance and Colorado State Highway Patrol (CSHP). It is anticipated that time windows early in the morning and later at night will be favored. However, for the purposes of this study, the hourly traffic volumes used are conservatively assumed to occur during a morning peak hour outside of school bus timing. In addition, 2025 and 2026 are assumed as the construction years, which correspond to the higher demand of RCC production based on the current schedule.

The following two scenarios are considered:

> <u>Material Delivery and Workforce Traffic, Scenario 1:</u> all cement and fly ash delivery trucks and the entire workforce arrives at the site during the morning peak hour. This is considered a conservative assessment even during peak RCC placement periods.

> <u>Material Delivery and Workforce Traffic, Scenario 2:</u> all cement and fly ash trucks arrive at the site in the early morning and are departing the site during the morning peak hour while the workforce is arriving.

Total peak hour material delivery and workforce trip generation is therefore estimated as:

> <u>Total Peak Hour Material Delivery and Workforce Traffic</u> = (# of trucks during the peak hour * passenger car equivalency factor) + (total # of commuting worker vehicles)

Assuming a 3.0 passenger car equivalency factor for trailer trucks (as required by CDOT) and accounting for the potential range in the expected number of commuting worker vehicles:

> **Scenario 1 Low: Total Peak Hour Material Delivery and Workforce Traffic** =
> (15 x 3) + (75 / 1.5) = **95** inbound passenger car equivalent trips.

> **Scenario 1 High: Total Peak Hour Material Delivery and Workforce Traffic** =
> (15 x 3) + (151 / 1.5) = **146** inbound passenger car equivalent trips.

> **Scenario 2 Low: Total Peak Hour Material Delivery and Workforce Traffic** =
> (15 x 3) = **45** outbound passenger car equivalent trips, and
> (75 / 1.5) = **50** inbound passenger car equivalent trips

Scenario 2 High: Total Peak Hour Material Delivery and Workforce Traffic =
(15 x 3) = **45** outbound passenger car equivalent trips, and
(151 / 1.5) = **101** inbound passenger car equivalent trips

3.3 TREE REMOVAL TRAFFIC

The clearing of vegetation and removal of trees associated with the GRE Project is planned to occur as described below. As stated in the Executive Summary, the Tree Removal Plan has been updated by Denver Water. The analysis herein is based on the 2019 Tree Removal Plan document, which was the latest version at the time of the Synchro analysis for this report. The final TIS will be revised to incorporate the updated Tree Removal Plan information.

3.3.1 Major Tree Removal Phases

- Phase 1: Site Development: Work includes clearing at the quarry and Gross Dam Road areas, as well as clearing to support roadway improvements, staging areas, and other site preparation activities.
- Phase 2: Dam Raise: Work includes clearing of the foundation for the dam raise construction.
- Phase 3: Reservoir Clearing: Work includes clearing from the footprint of the raised reservoir area between El. 7282 and El. 7406. (This is separate work from the Dam Raise construction.)
- Phase 4: Post-Construction: This work includes minor clearing of vegetation for the implementation of permanent recreation facilities. (This is separate work from the Dam Raise construction.)

Scheduling of the phases has been conservatively estimated as follows:

- Site Development and Dam Raise (Phases 1 & 2): Clearing primarily in 2022.
- Reservoir Clearing and Post-Construction (Phases 3 & 4) will involve the largest volume of tree removal traffic and is planned to occur in 2025 and 2026. Tree removal operations during this time will occur on both the east and west sides of the Gross Reservoir.

3.3.2 Tree Removal Operations Assumptions

The assumptions made by the Design Engineer in developing the tree clearing traffic analysis and the study presented in this DM are summarized below:

1) The quantities in the 2019 Tree Removal plans, including supplements, are the basis of the transportation values developed in the analysis.
2) 15% of tree waste is merchantable timber, distributed uniformly across the cleared area.

3) Merchantable timber disposition is very dependent on market conditions. As the schedule for reservoir perimeter tree removal approaches, the routing of merchantable tree logs will be presented to jurisdictions.

4) Residue wood is chipped and hauled to Republic Services Foothills Landfill off SH 93 in Golden, CO.

5) No semi-truck or trailer vehicles longer than 30 feet are allowed on CR 132 between west of CR 68 and SH 119.

6) Lazy Z Road and FS 359 are used as ingress and egress routes from the west side of Gross Reservoir.

7) Tree waste materials from the east side of the reservoir, including the north shore, will be hauled to the south and leave the site via Gross Dam Road and SH 72. No tree waste materials will be hauled on Flagstaff Road.

The proposed ingress and egress routes for tree removal trucks from the west side of Gross Reservoir, FS 359 and Lazy Z Road, are shown on **Figure 3-1**.

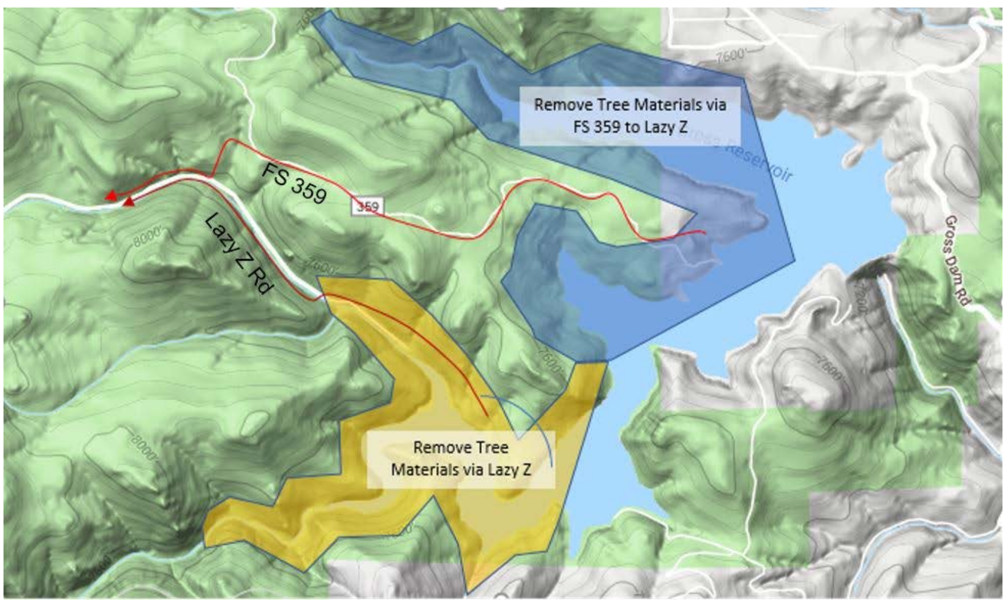


Figure 3-1. West Side Tree Removal Access Roads

The document *Tree Removal Plan – Transportation Analysis – Revision 2* (July 30, 2018) and subsequent clarification emails from Denver Water provided the required data regarding the total number of truckloads from each individual stand and the designated routes for tree removal materials. **Table 3-1** outlines the originating route of the truckloads in each phase. It also shows the total number of truckloads hauling merchandise versus chipped residue during each phase. The routes from the east and west sides of the Gross Reservoir are illustrated in the previous section in **Figure 2-1** and **Figure 2-2**.

Table 3-1. Total Project Number and Routes of Trucks in Tree Removal Plan

Phase	Route	# Merch Truckloads	# Chipped Residue Truckloads	Total # Trucks
1 & 2	East Side via Gross Dam Road (CR 77S)	44	246	290
3 & 4	East Side via Gross Dam Road (CR 77S)	99	548	647
	West Side via FS 359 and Lazy Z Road	110	608	718
	West Side via Lazy Z Road	109	607	716

3.3.3 Number of Tree Removal Truckloads

The average number of trucks per day and per peak hour hauling merchantable timber versus tree chipped residue for each phase are shown in **Table 3-2**. The assumptions made in developing the average number of trucks per day and per peak hour are summarized below.

- Due to interval breaks between chipping days and harvesting days, and recommendations from the Design Engineer, our analysis team took the conservative approach of considering one week of hauling per month during tree clearing operations.
- Tree removal trucking occurs 4 days per week (Monday, Wednesday, Thursday, and Saturday, or Friday if weekends are prohibited).
- 10% of the trucks will be on the road during the AM peak hour.

Table 3-2. Average Number of Tree Removal Trucks per Day and per Peak Hour

		# of Truck Trips per Day			# of Truck Trips per Peak Hour		
Phase	Route	Total	to North Merchants	to Landfill	Total	to North Merchants	to Landfill
1 & 2	East Side via Gross Dam Road (CR 77S)	25	4	21	3	1	3
3 & 4	East Side via Gross Dam Road (CR 77S)	17	3	14	2	1	2
	West Side via FS 359 and Lazy Z Road	18	3	16	2	1	2
	West Side via Lazy Z Road	18	3	16	2	1	2

Note: the average number of trucks are rounded up to the nearest whole number.

Table 3-2 shows that during Site Development (Phases 1 & 2), there will be a total average of 25 trucks per day per hauling week. Trucks will be delivering tree logs or chips only to/from the **east** side of the reservoir, utilizing the access along SH 72 and Gross Dam Road.

In 2025 and 2026 during Reservoir Clearing (Phases 3 & 4), there will be an average of 53 trucks per day per hauling week. 36 trucks will be delivering tree logs or chips to/from the **west** side of the reservoir, using SH 119 and CR 132, while 17 trucks will be delivering tree materials to/from the **<u>east</u>** side of the reservoir, using SH 72 and Gross Dam Road.

Based on the above analysis for the design year of 2026, the average number of tree removal trucks entering and/or exiting the site during the AM peak hour is estimated to be 2 trucks from the east side and 4 trucks from the west side of the reservoir.

For this preliminary analysis, two scenarios have been assumed during the AM peak hour for tree removal truck traffic:

> <u>Tree Removal, Scenario 1:</u> all tree removal trucks arrive at the site (east or west side) during the morning peak hour.

> <u>Tree Removal, Scenario 2:</u> all tree removal trucks exit the site (east or west side) during the morning peak hour.

Total peak hour tree removal trip generation is therefore estimated with the following formula:

> <u>Total Peak Hour Tree Removal Traffic</u> = (# of trucks during the peak hour * passenger car equivalency factor)

Assuming a 3.0 passenger car equivalency factor for trailer trucks (as required by CDOT), total peak hour tree removal trip scenarios for both accesses are as follows:

<u>East Side (via SH 72)</u>

Scenario 1: Total Peak Hour Tree Removal Traffic =
(2 x 3) = **6** inbound passenger car equivalent trips.

Scenario 2: Total Peak Hour Tree Removal Traffic =
(2 x 3) = **6** outbound passenger car equivalent trips.

<u>West Side (via SH 119)</u>

Scenario 1: Total Peak Hour Tree Removal Traffic =
(4 x 3) = **12** inbound passenger car equivalent trips.

Scenario 2: Total Peak Hour Tree Removal Traffic =
(4 x 3) = **12** outbound passenger car equivalent trips.

It should be noted that the average peak hour tree removal traffic values summarized above are based on conservative assumptions for the purposes of analyzing the Level of Service (LOS) and potential traffic impacts. However, actual tree removal traffic is expected to be well below these values for the majority of the construction phase of the GRE Project.

(END OF SECTION)

4.0 TRAFFIC VOLUME PROJECTIONS

This section presents the total generated construction traffic, design year background traffic, and total design year forecasted traffic for 2026. Volumes for each side (east and west) of the GRE Project site are discussed separately.

4.1 SITE GENERATED TRAFFIC

4.1.1 Total Construction Traffic (East Side)

Total construction traffic on the east access to the GRE jobsite in 2026 will consist of truck traffic delivering cement and fly ash, tree removal truck traffic, and traffic from construction workers commuting to and from the site. Based on our analysis of the two scenarios assumed in this study (including low and high variations for the workforce), the total peak hour construction traffic on the east side during 2026 is estimated to be:

Scenario 1 Low (Inbound Traffic):

= Peak Hour Material Delivery and Workforce Traffic + Peak Hour Tree Removal Traffic
= 95 inbound passenger car equivalent trips + 6 inbound passenger car equivalent trips
= **101 inbound** passenger car equivalent trips total.

Scenario 1 High (Inbound Traffic):

= Peak Hour Material Delivery and Workforce Traffic + Peak Hour Tree Removal Traffic
= 146 inbound passenger car equivalent trips + 6 inbound passenger car equivalent trips
= **152 inbound** passenger car equivalent trips total.

Scenario 2 Low (Inbound and Outbound Traffic):

= Peak Hour Material Delivery and Workforce Traffic + Peak Hour Tree Removal Traffic
= **50 inbound** passenger car equivalent trips total and
= 45 outbound passenger car equivalent trips + 6 outbound passenger car equivalent trips
= **51 outbound** passenger car equivalent trips total.

Scenario 2 High (Inbound and Outbound Traffic):

= Peak Hour Material Delivery and Workforce Traffic + Peak Hour Tree Removal Traffic
= **101 inbound** passenger car equivalent trips total and
= 45 outbound passenger car equivalent trips + 6 outbound passenger car equivalent trips
= **51 outbound** passenger car equivalent trips total.

Figure 4-1 and **Figure 4-2** on the following pages show year 2026 hourly site generated traffic volumes on the east side of Gross Reservoir for Scenario 1 and Scenario 2, respectively. Each figure includes both the low and high workforce variations, with the [High] values in brackets.

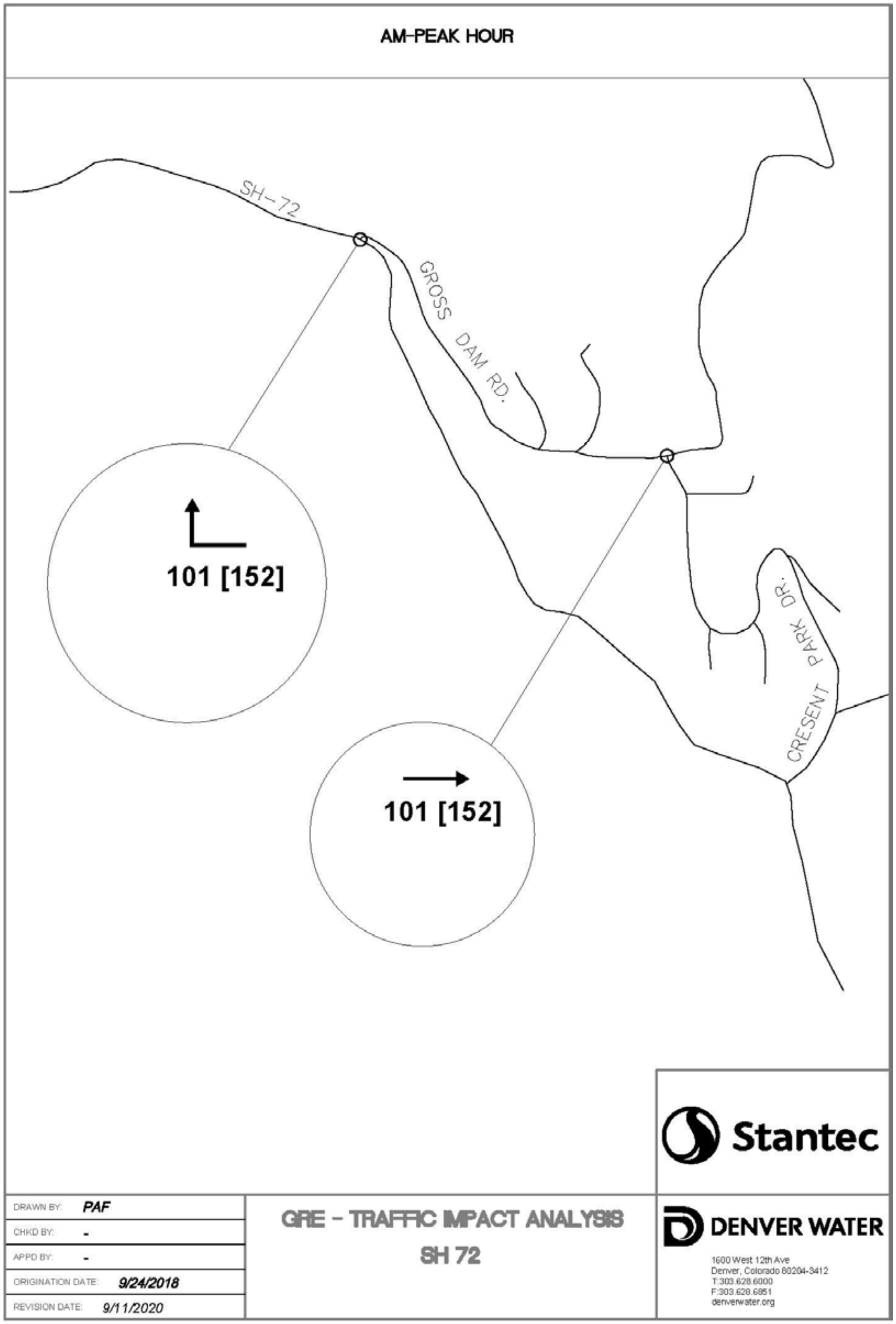


Figure 4-1. 2026 Hourly Site Generated Traffic – East Side Scenario 1 Low [High]

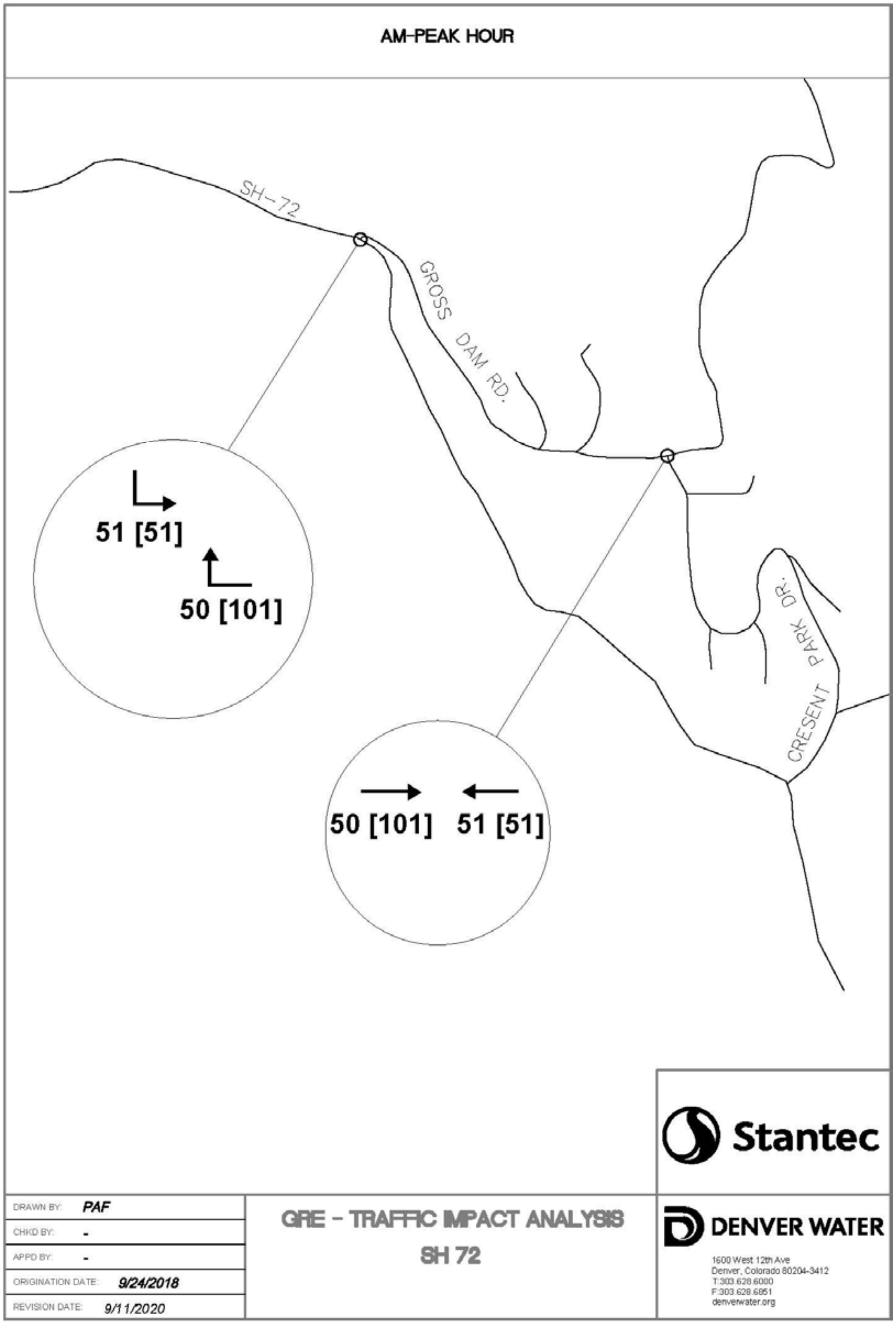


Figure 4-2. 2026 Hourly Site Generated Traffic – East Side Scenario 2 Low [High]

4.1.2 Total Construction Traffic (West Side)

Total construction traffic on the west access to the GRE jobsite in 2026 includes only tree removal truck traffic traveling to and from the site. Based on our analysis of the two scenarios assumed in this study, the average total construction traffic on the west side during 2026 is estimated to be:

Scenario 1 (Inbound Traffic):

= Peak Hour Tree Removal Traffic
= **12 inbound** passenger car equivalent trips total.

Scenario 2 (Outbound Traffic):

= Peak Hour Tree Removal Traffic
= **12 outbound** passenger car equivalent trips total.

Figure 4-3 and **Figure 4-4** on the following pages show year 2026 hourly site generated traffic volumes on the west side of Gross Reservoir for Scenario 1 and Scenario 2, respectively. As the construction workforce will not be using the west access to the site, there are no low or high variations for the west side volumes.

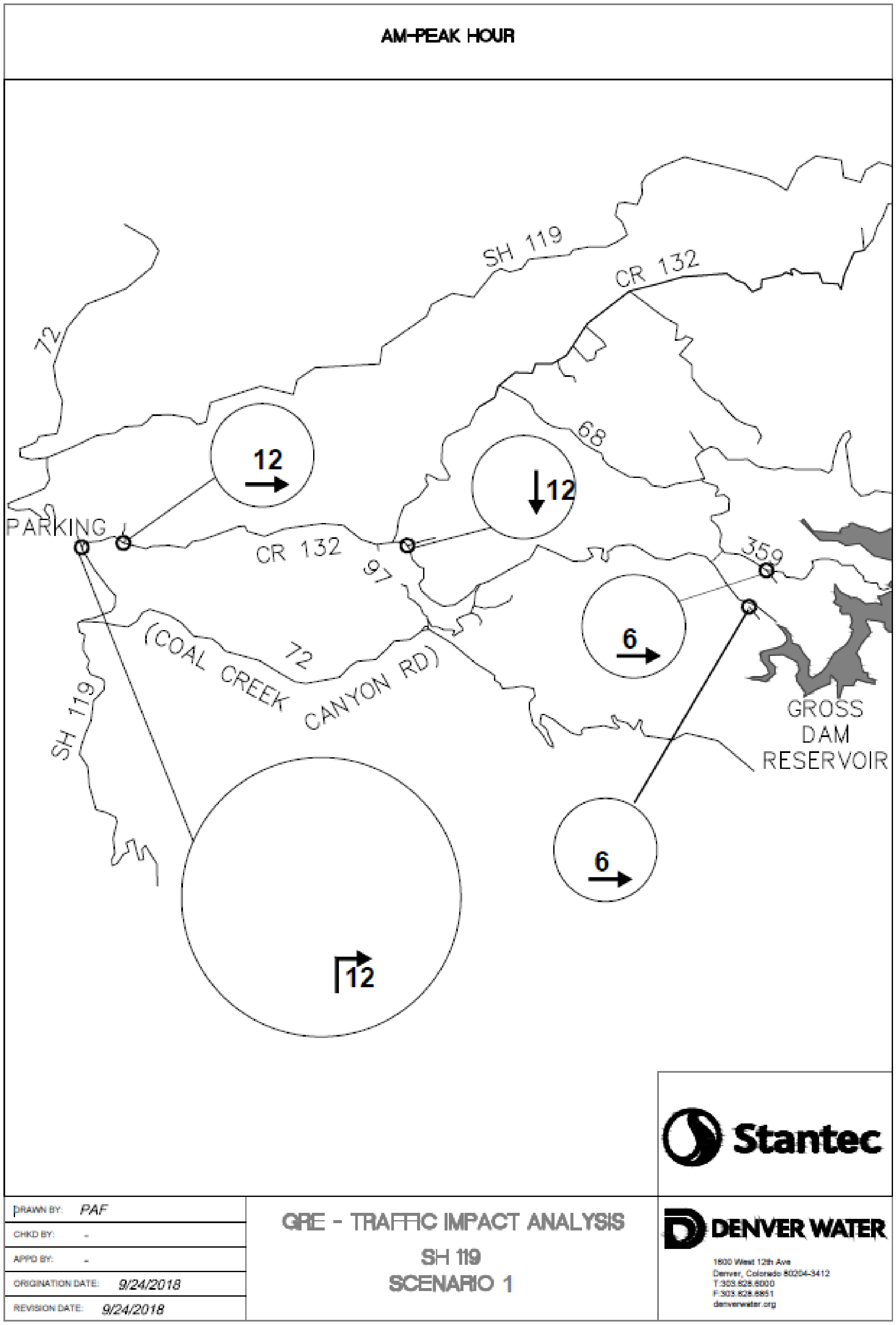


Figure 4-3. 2026 Hourly Site Generated Traffic – West Side Scenario 1

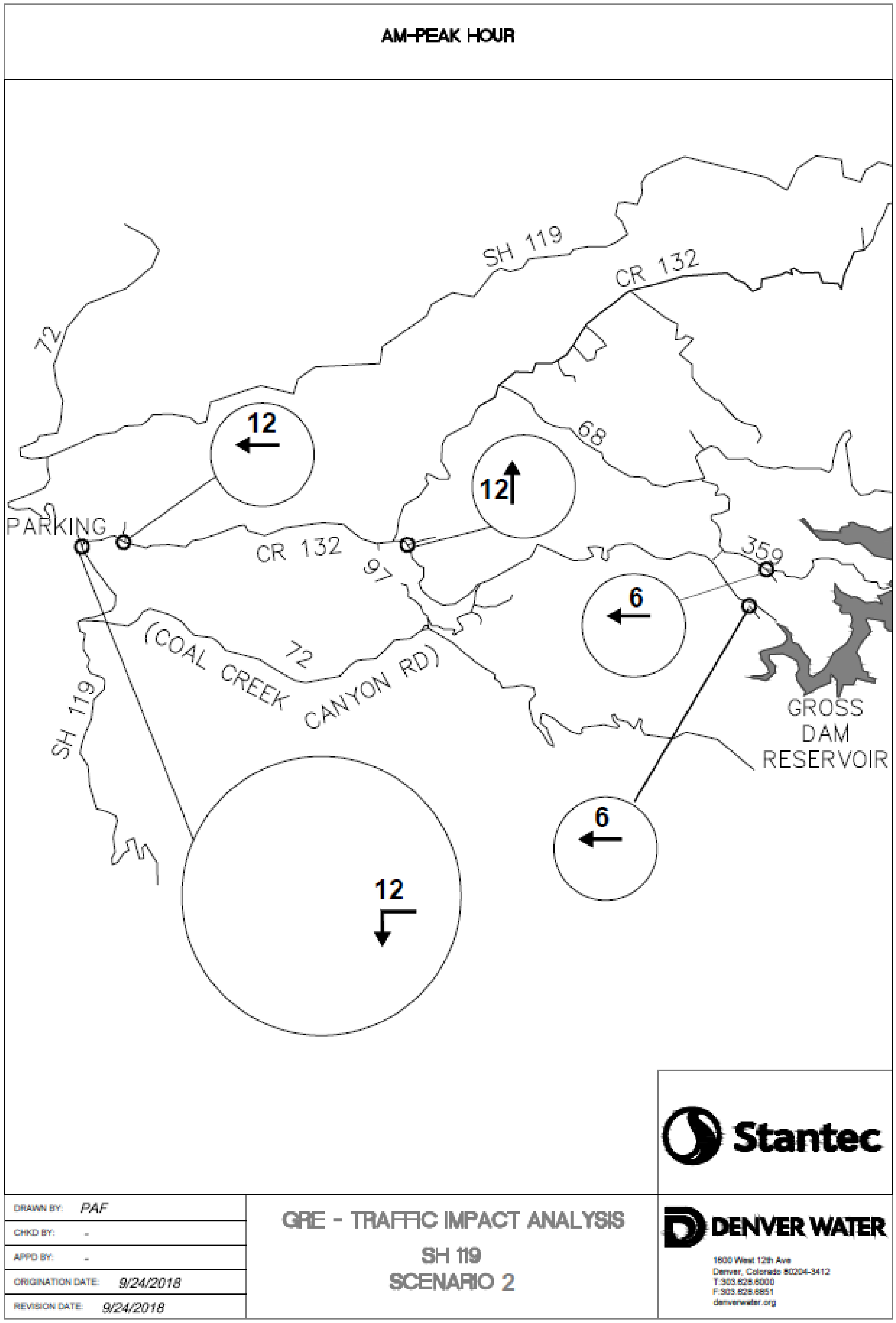


Figure 4-4. 2026 Hourly Site Generated Traffic – West Side Scenario 2

4.2 EXISTING AND FUTURE YEAR BACKGROUND TRAFFIC

4.2.1 Existing and Future Year Background Traffic (East Side)

Year 2015 traffic counts for the intersections at SH 72 & Gross Dam Road and Gross Dam Road & Crescent Park Drive were collected and summarized for the *Gross Dam Reservoir Expansion, Traffic Control Plan* report by Alliant Engineering (2015). The counts were collected during the AM peak period (9:00 – 11:00 AM) and the PM peak period (4:00 – 6:00 PM) on December 8, 2015 and December 9, 2015. The peak hour was determined for each intersection by taking the sum of all traffic movements per 15-minute period and finding the greatest consecutive four 15-minute periods.

Since these counts were conducted in December, most of the traffic traveling to and from the Gross Reservoir recreation area are not included. When developing the future year background traffic forecast, an additional 50 vehicles inbound and 15 vehicles outbound per hour were considered for the East side access to account for vehicles traveling to and from the recreation area. These numbers were estimated based on the size of the recreation parking area (58 spaces, as indicated in the Gross Reservoir Hydroelectric Project Final License Amendment Application) and the anecdotal survey conducted in March 2021.

The 2026 hourly background traffic volumes were developed by increasing the 2015 traffic by an annual growth rate of 3.5%, adding the recreational traffic, and rounding up to the nearest 5 to be conservative. The annual growth rate was based on the AADT data obtained from CDOT as discussed in **Section 2.2**.

The 2015 hourly traffic counts and 2026 hourly background traffic volumes for the east side are listed below in **Table 4-1** and are shown on **Figure 4-5** and **Figure 4-6** on the following pages.

Table 4-1. Existing and Future Background Hourly Traffic Volumes – East Side

Intersection	Movement	Existing Volume	Recreational Traffic (Estimate)	Future Background Traffic
SH 72 & Gross Dam Rd	WBL	1		5
	WBT	52		80
	WBR	0	50	50
	EBL	5		10
	EBT	87		130
	EBR	1		5
	SBL	2	15	20
	SBT	0		5
	SBR	3		5
	NBL	0		5
	NBT	0		5
	NBR	0		5
	Total	**151**	**65**	**325**
Gross Dam Rd & Crescent Park Dr	WBL	7		15
	WBT	1	15	20
	EBT	0	50	50
	EBR	1		5
	NBL	2		5
	NBR	6		10
	Total	**17**	**65**	**105**

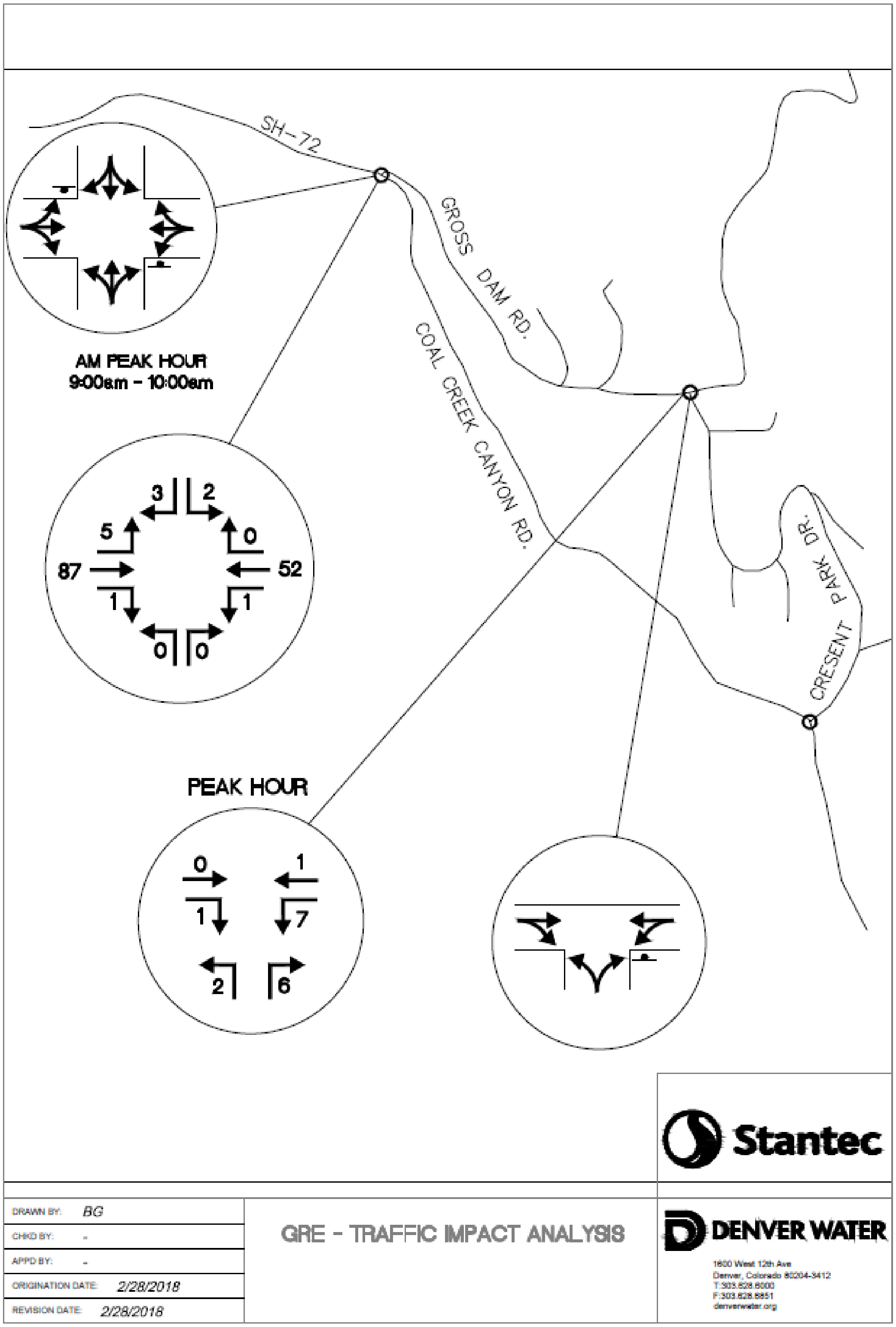
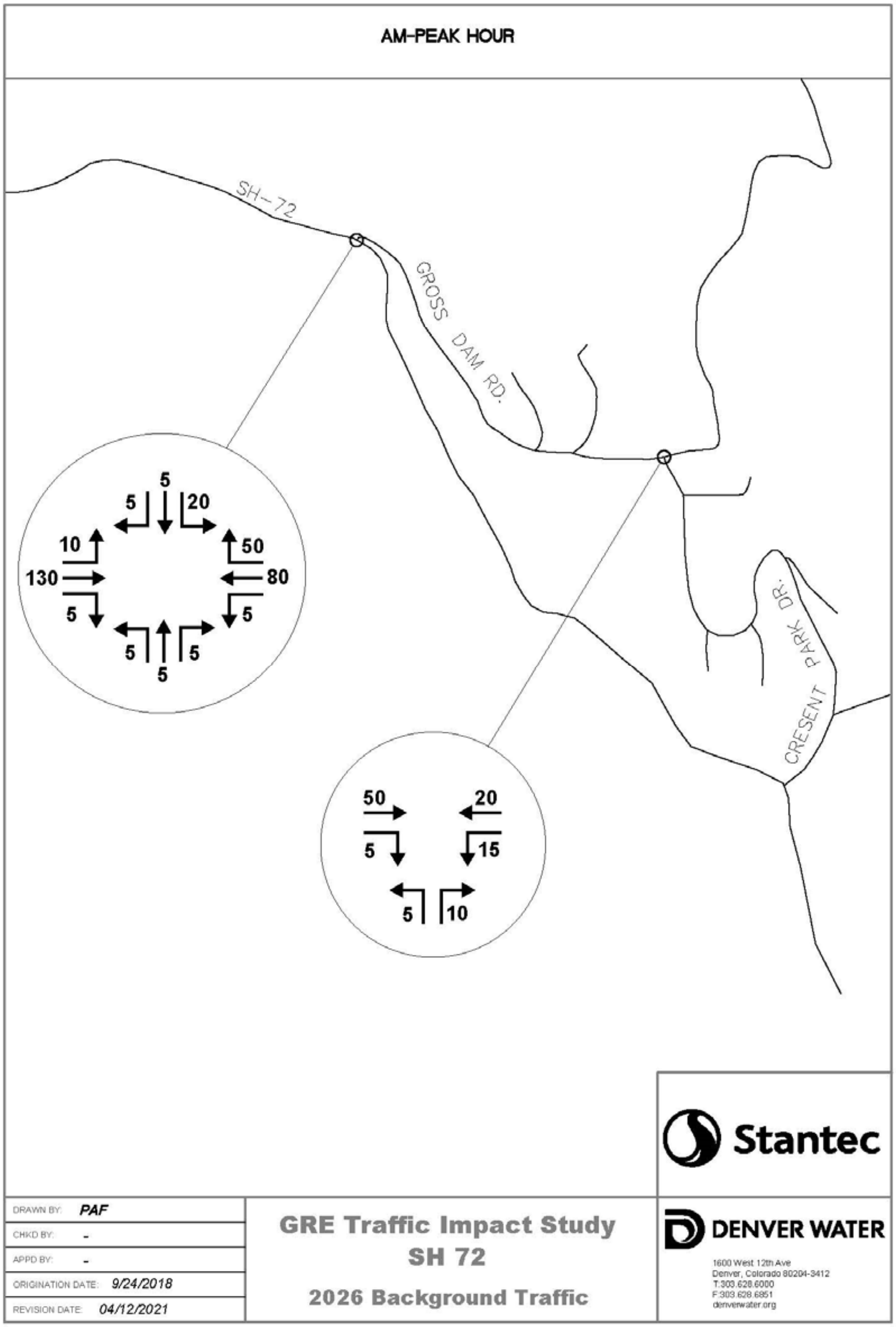


Figure 4-5. Existing (2015) Hourly Traffic Counts and Intersection Geometry – East Side



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2 **Figure 4-6. Future Background (2026) Hourly Traffic Volumes – East Side**

4.2.2 Existing and Future Year Background Traffic (West Side)

Turning movement counts (TMC) for the intersection at SH 119 & 132 and daily traffic counts along the west side access route were collected in 2018. The TMC was collected for both the AM peak period (9:00 – 11:00 AM) and the PM peak period (4:00 – 6:00 PM) on September 13, 2018. The peak hour was determined by taking the sum of all traffic movements per 15-minute period from the daily traffic counts and finding the greatest consecutive four 15-minute periods. Daily link counts were collected from Thursday, September 13, 2018 through Saturday, September 15, 2018. The link counts collected during the AM peak hour on Thursday, September 13, 2018 were used for this analysis. Year 2018 traffic count data is provided in **Appendix E**.

The 2026 hourly background traffic volumes were developed by increasing the 2018 traffic by an annual growth rate of 3.5% and rounding up to the nearest 5 to be conservative. The annual growth rate was based on the historical AADT data (2015-2019) obtained from CDOT as discussed in **Section 2.2**.

The 2018 hourly traffic counts and 2026 hourly background traffic volumes for the west side are listed below in **Table 4-2** and shown on **Figure 4-7** and **Figure 4-8** on the following pages.

Table 4-2. Existing and Future Background Hourly Traffic Volumes – West Side

Intersection	Movement	Existing Volume	Future Background Traffic
SH 119 & Magnolia Rd / CR 132	SBL	20	30
	SBT	125	165
	SBR	8	15
	NBL	6	10
	NBT	197	260
	NBR	1	5
	WBL	0	5
	WBT	0	5
	WBR	19	30
	EBL	4	10
	EBT	1	5
	EBR	1	5
	Total	**382**	**545**

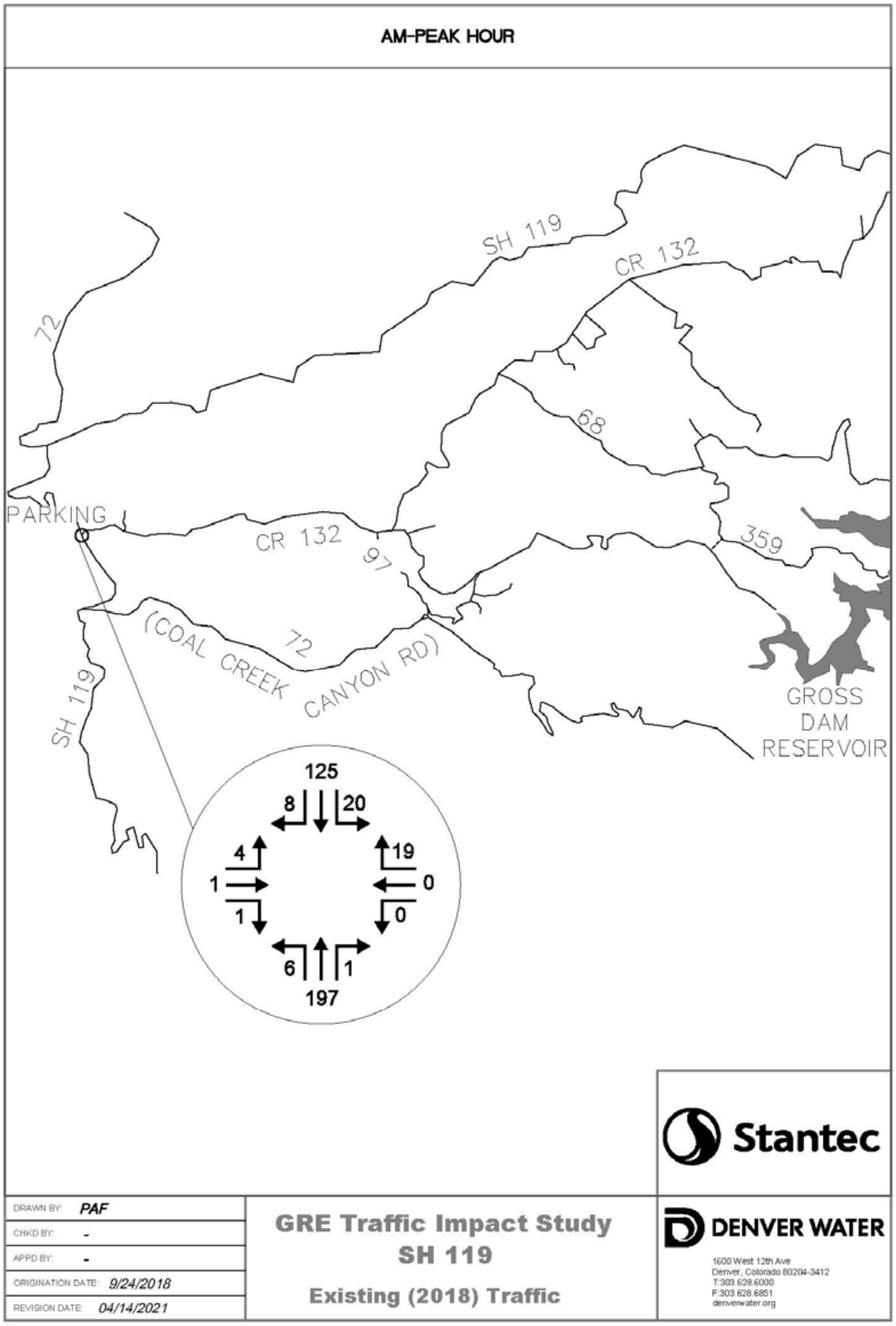

Figure 4-7. Existing (2018) Hourly Traffic Counts and Intersection Geometry – West Side

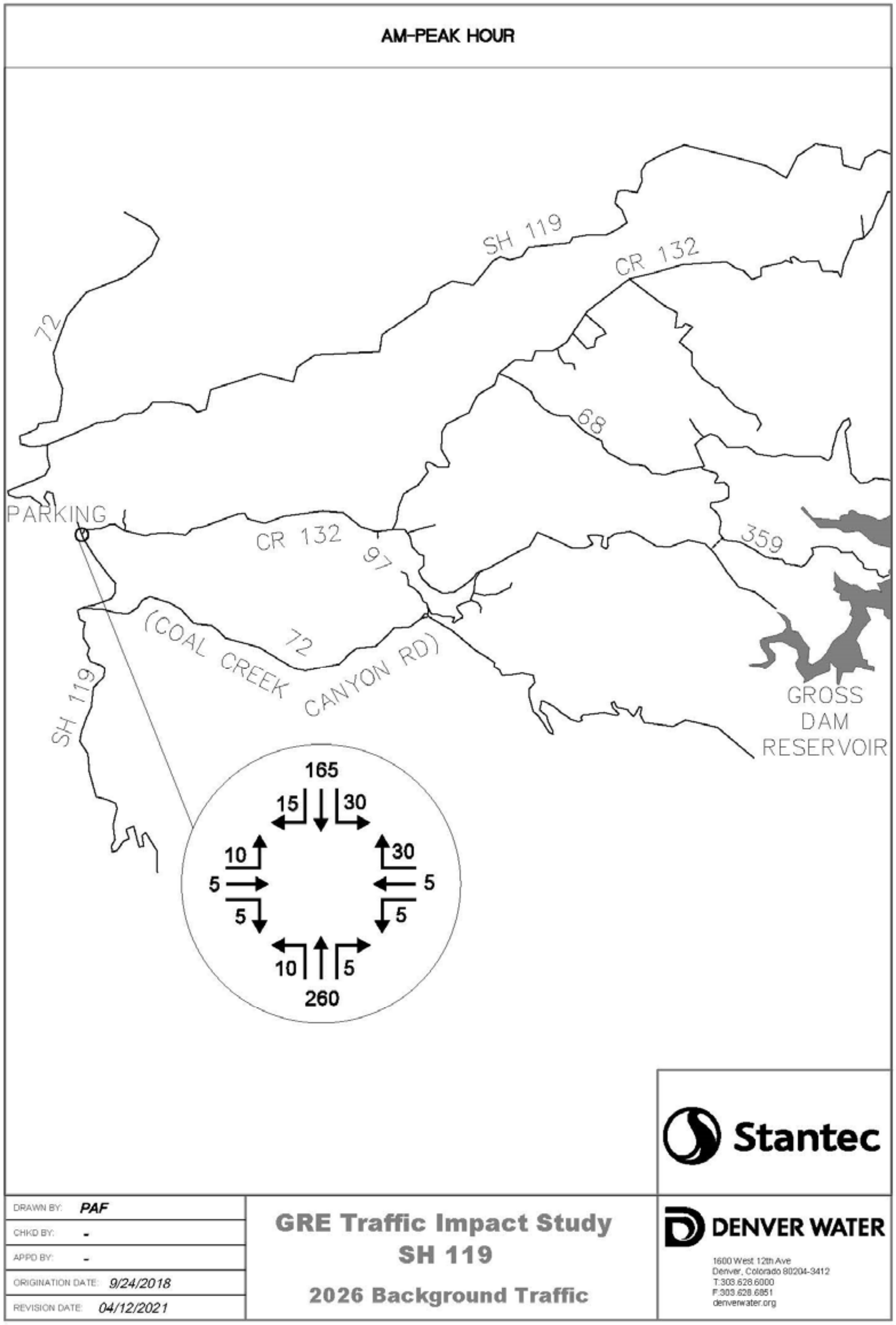

Figure 4-8. Future Background (2026) Hourly Traffic Volumes – West Side

4.3 TOTAL FUTURE YEAR TRAFFIC PROJECTION

4.3.1 Future Year Total Projected Traffic (East Side)

2026 future year total hourly traffic volumes accessing Gross Dam Reservoir from the east were developed by adding the 2026 total peak hour construction traffic (including material delivery, workforce, and tree removal) to the 2026 hourly background volume. This process was completed for both Scenario 1 and Scenario 2, including low and high variations based on estimated workforce for the east side access. The resulting volumes are listed below in **Table 4-3** and are illustrated on **Figure 4-9** and **Figure 4-10** on the following pages.

Table 4-3. Future Year Total Hourly Traffic Volumes – East Side

		Scenario 1 (Inbound Traffic)				Scenario 2 (Inbound and Outbound Traffic)			
		Low Workforce		High Workforce		Low Workforce		High Workforce	
Intersection	Movement	Total GRE Traffic	Future Total Traffic	Total GRE Traffic	Future Total Traffic	Total GRE Traffic	Future Total Traffic	Total GRE Traffic	Future Total Traffic
SH 72 & Gross Dam Rd	WBL		5		5		5		5
	WBT		80		80		80		80
	WBR	101	151	152	202	50	100	101	151
	EBL		10		10		10		10
	EBT		130		130		130		130
	EBR		5		5		5		5
	SBL	0	20	0	20	51	71	51	71
	SBT		5		5		5		5
	SBR		5		5		5		5
	NBL		5		5		5		5
	NBT		5		5		5		5
	NBR		5		5		5		5
	Total	**101**	**426**	**152**	**477**	**101**	**426**	**152**	**477**
Gross Dam Rd & Crescent Park Dr	WBL		15		15		15		15
	WBT	0	20	0	20	51	71	51	71
	EBT	101	151	152	202	50	100	101	151
	EBR		5		5		5		5
	NBL		5		5		5		5
	NBR		10		10		10		10
	Total	**101**	**206**	**152**	**257**	**101**	**206**	**152**	**257**

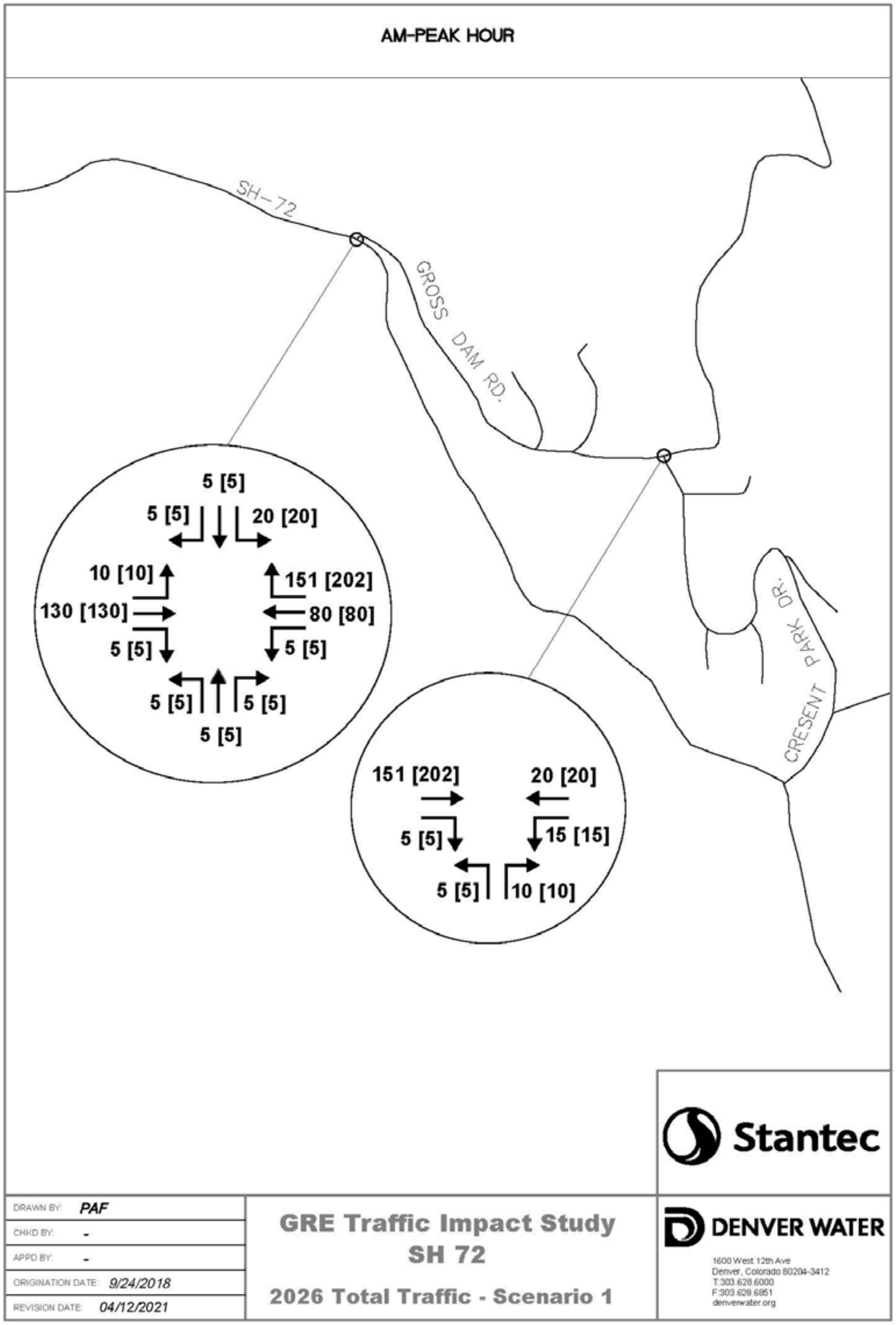

Figure 4-9. Future Year (2026) Total Hourly Traffic Volumes – East Side Scenario 1 Low [High]

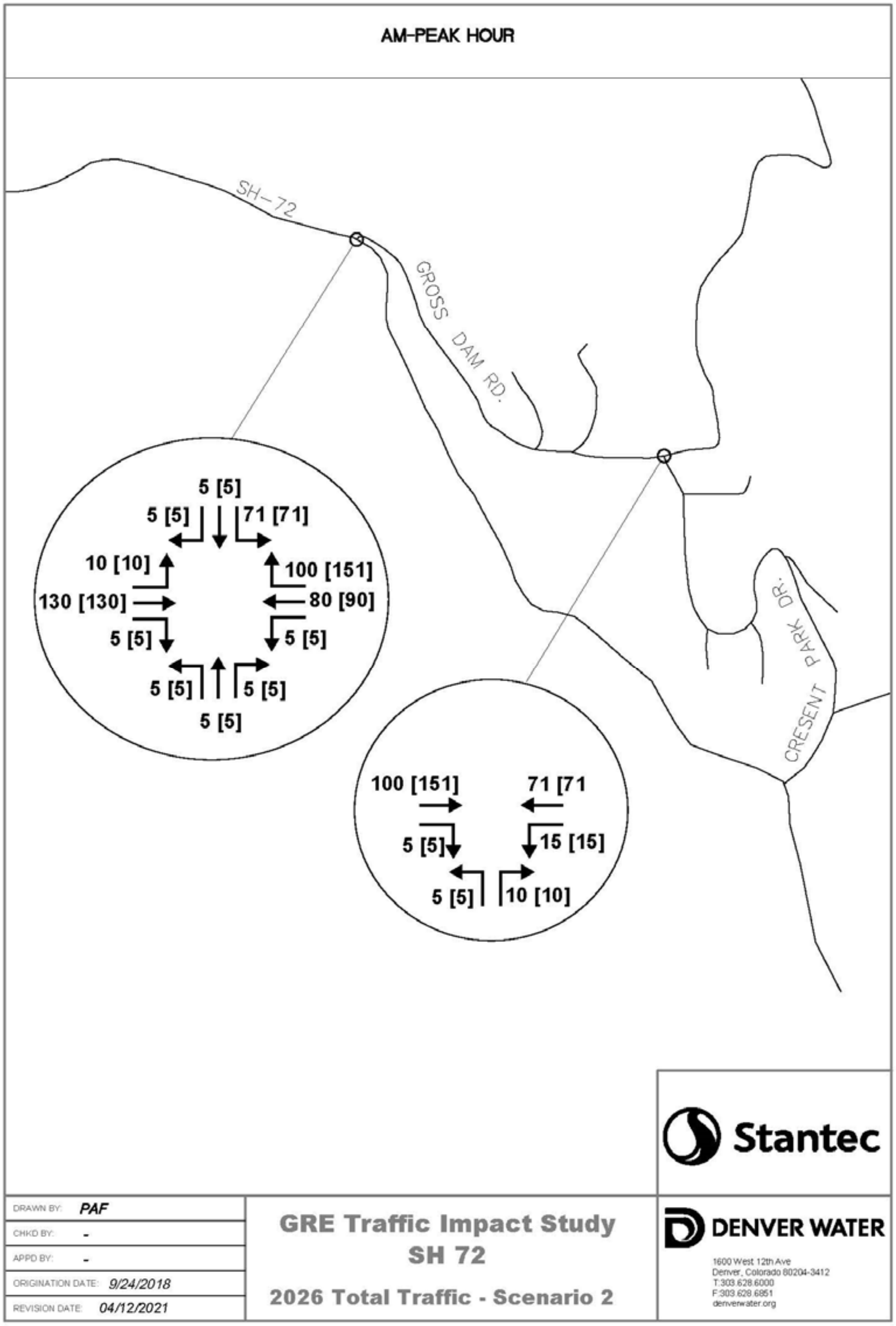

Figure 4-10. Future Year (2026) Total Hourly Traffic Volumes – East Side Scenario 2 Low [High]

4.3.2 Future Year Total Projected Traffic (West Side)

2026 future year total hourly traffic volumes accessing Gross Reservoir from the west were developed by adding the 2026 total peak hour construction traffic (including tree removal only) to the 2026 hourly background volume. This process was completed for both Scenario 1 and Scenario 2. The resulting volumes are listed below in **Table 4-4** and are illustrated on **Figure 4-11** and **Figure 4-12** on the following pages.

Table 4-4. Future Year Total Hourly Traffic Volumes – West Side

		Scenario 1 (Inbound Traffic)		Scenario 2 (Outbound Traffic)	
Intersection	**Movement**	**Total GRE Traffic**	**Future Total Traffic**	**Total GRE Traffic**	**Future Total Traffic**
SH 119 & Magnolia Rd / CR 132	SBL		30		30
	SBT		165		165
	SBR		15		15
	NBL		10		10
	NBT		260		260
	NBR	12	17	0	5
	WBL	0	5	12	17
	WBT		5		5
	WBR		30		30
	EBL		10		10
	EBT		5		5
	EBR		5		5
	Total	**12**	**557**	**12**	**557**

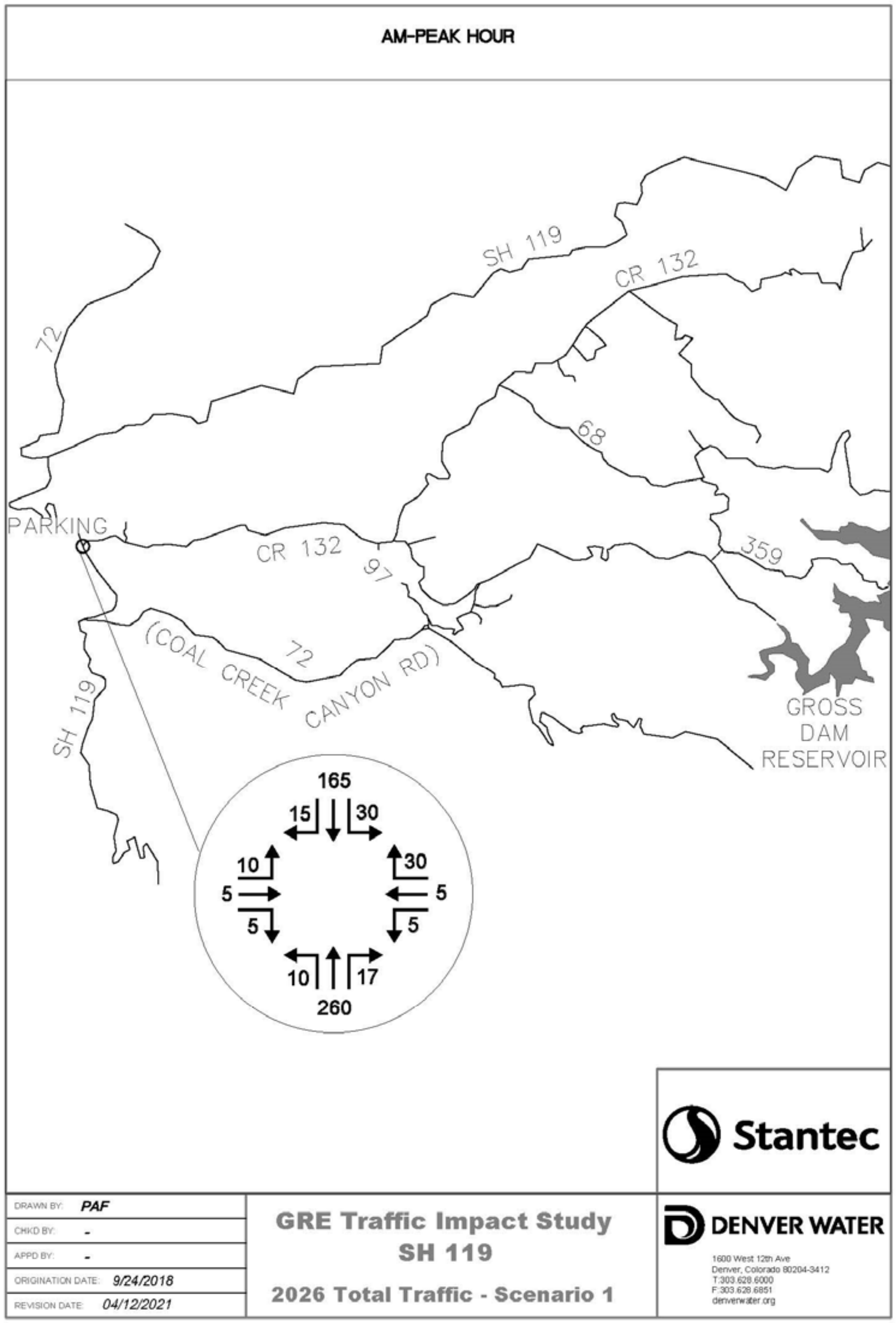

Figure 4-11. Future Year (2026) Total Hourly Traffic Volumes – West Side Scenario 1

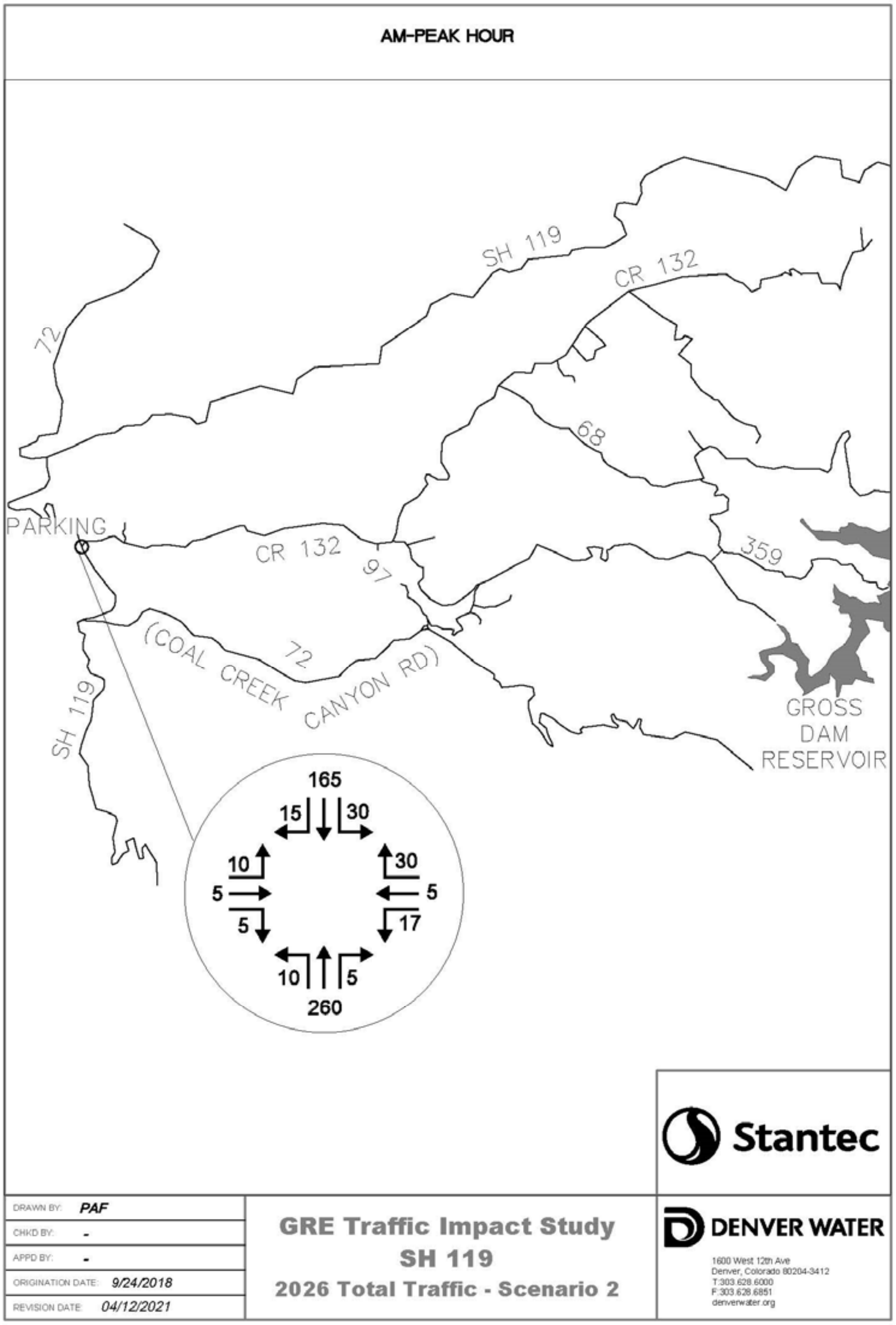

Figure 4-12. Future Year (2026) Total Hourly Traffic Volumes – West Side Scenario 2

(END OF SECTION)

5.0 ANALYSIS RESULTS

5.1 INTERSECTION LEVEL OF SERVICE

The Level of Service (LOS) of the study intersections was analyzed using HCM 2000 methodology within Synchro software using the hourly volumes presented in **Section 4.0**. The results of this analysis are shown in **Table 5-1** for the east side intersections and **Table 5-2** for the west side intersection. Synchro reports are included in **Appendix C**. As these tables indicate, all approaches of the study intersections are expected to operate at a good LOS (LOS C or better), with or without the addition of construction traffic, and very little delay is anticipated.

Table 5-1. Intersection Traffic Analysis Results – East Side

						2026 Total							
						Scenario 1 (Inbound Traffic)				Scenario 2 (Inbound and Outbound Traffic)			
Intersection	Lane Group	Existing		2026 Background		Low Workforce		High Workforce		Low Workforce		High Workforce	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
SH 72 & Gross Dam Rd	EB	0.4	A	0.6	A	0.6	A	0.6	A	0.6	A	0.6	A
	WB	0.1	A	0.3	A	0.2	A	0.1	A	0.2	A	0,2	A
	WBR	-	-	-	-	0.0	A	0.0	A	0.0	A	0.0	A
	NB	0.0	A	10.3	B	10.6	B	10.8	B	10.4	B	10.6	B
	SB	9.0	A	10.7	B	10.4	B	10.4	B	11.1	B	11.1	B
Gross Dam Rd & Crescent Park Dr	EB	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A
	WB	6.4	A	3.1	A	3.2	A	3.3	A	1.4	A	1.4	A
	NB	8.4	A	8.8	A	9.4	A	9.7	A	9.2	A	9.5	A

Table 5-2. Intersection Traffic Analysis Results – West Side

						2026 Total			
Intersection	Lane Group	Existing		2026 Background		Scenario 1 (Inbound Traffic)		Scenario 2 (Outbound Traffic)	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
SH 119/SH 72 & CR 132	EB	11.6	B	15.2	C	15.5	C	15.2	C
	WB	9.5	A	13.9	B	14.1	B	17.3	C
	NB	0.3	A	0.4	A	0.4	A	0.4	A
	SB	1.1	A	2.0	A	2.1	A	2.0	A

5.2 TRAVEL TIME DELAY

The LOS analysis that was completed for the segment of SH 72 on the proposed route in the Report for Gross Reservoir Expansion Alternatives Analysis and Feasibility Study for Roadway Improvements, by Michael Baker International (2015), concluded that there will be minimal impact to the traffic on SH 72. SH 72 and SH 119 are designed to accommodate truck traffic, and the additional traffic from daily construction and tree removal activities on SH 72 east of Gross Dam Road and on SH 119 north of CR 132 will not cause significant delay. However, vehicles traveling on Gross Dam Road and CR 132 will experience delays due to the additional construction traffic. It should be noted that the roadway segment of SH 72 between Gross Dam Rd and CR 97 is not to be utilized by hauling trucks for this project.

Based on field visits, we estimate that the average free flow speed on Gross Dam Road is 20 mph for passenger vehicles and 10 mph for large trucks. The length of the segment of Gross Dam Road between SH 72 and the private access road that the trucks will use to access the site is approximately 4 miles. Therefore, the travel time of this segment of roadway is approximately 12 minutes at 20 mph and 24 minutes at 10 mph. Based on this simple analysis, it is anticipated that vehicles traveling behind trucks will be delayed approximately 12 minutes as they travel this segment of Gross Dam Road. Note that Gross Dam Road is a low volume, rural roadway. As shown on **Figure 4-5**, there are less than 250 vehicle trips per day and 8 vehicles per hour during the morning peak hour on this roadway segment.

Based on field visits, the average free flow speed on CR 132, Lazy Z Road, and FS 359 is estimated 20 mph for passenger vehicles and 10 mph for large trucks. The length of the segment between SH 119 and the Gross Reservoir via Lazy Z Road is approximately 8 miles. Therefore, the travel time of this segment of roadway is approximately 24 minutes at 20 mph and 48 minutes at 10 mph. The length of the segment between SH 119 and the Gross Reservoir via Lazy Z Road and FS 359 is approximately 9 miles. The travel time of this segment of roadway is approximately 27 minutes at 20 mph and 54 minutes at 10 mph. Based on this analysis, it is anticipated that vehicles traveling behind trucks will have an average delay of 25.5 minutes as they travel to/from Gross Reservoir on the west via FS 359, Lazy Z Road, and CR 132. It should be noted that the existing and projected traffic volumes on these roadways is very low and therefore very few vehicles will be delayed due to construction activities.

(END OF SECTION)

6.0 CDOT STATE HIGHWAY ACCESS CODE REQUIREMENTS

Based on *Colorado Department of Transportation (CDOT) State Highway Access Category Assignment Schedule, 2007*:

- SH 72 is classified as category RB (Rural Highway) from SH 93 to the Jefferson/Boulder County Line.
- SH 119 is classified as RA (Regional Highway) from junction of SH 72 to Eldora Road in Nederland.

6.1 STATE HIGHWAY 72 AUXILIARY LANE REQUIREMENTS

The CDOT *State Highway Access Code*, 1998, states the following for an RB highway classification:

- A right turn deceleration lane with taper is required for any access with a projected peak hour right ingress turning volume greater than 25 vph. The taper length shall be included within the required deceleration length.
- A left turn deceleration lane with taper and additional storage is required for any access with a projected left ingress turning volume greater than 10 vph. The taper length shall be included within the required deceleration length.
- A right turn acceleration lane with taper is required for any access with a projected right turning volume greater than 50 vph when the posted speed limit is 45 mph or greater.
- A left turn acceleration lane may be required if it would be a benefit to the safety and operation of the roadway. A left turn acceleration lane is generally not required where the posted speed is less than 45 mph.

Table 6-1 on the next page summarizes the auxiliary lane requirements for SH 72 at its intersection with Gross Dam Rd and identifies if any auxiliary lanes are warranted.

Table 6-1. Auxiliary Lane Requirements/Warrants for SH 72

Highway Category	Auxiliary Lane Type	Approach	2026 Traffic Volume		Auxiliary Lane	
			Scenario 1 High	Scenario 2 High	Requirements	Warranted
R-B SH 72 & Gross Dam Rd *(40 mph)*	Deceleration Lane	WBR from SH 72 to Gross Dam Rd	202	151	Vol > 25 vph	Yes
		EBL from SH 72 to Gross Dam Rd	10	10	Vol > 10 vph	No
	Acceleration Lane	SBR from Gross Dam Rd to SH 72	5	5	Vol > 25 vph AND V > 45 mph	No
		SBL from Gross Dam Rd to SH 72	20	71	Operational & Safety needs AND V > 45 mph	No

Based on the 2026 traffic volumes shown on **Figure 4-6**, **Figure 4-9**, and **Figure 4-10**, peak hour traffic volume turning right onto Gross Dam Road from westbound SH 72 during peak GRE construction activities in all scenarios warrants a right turn deceleration lane in the west bound direction based on the State Highway access code. No significant construction traffic is anticipated to turn left from eastbound SH 72 to Gross Dam Road, therefore an eastbound left turn lane is not required or recommended. An access permit through CDOT may be required for proposed improvements at SH 72 & Gross Dam Rd intersection.

6.1.1 Right Turn Deceleration Lane Design Specifications

Based on the *CDOT State Highway Access Code*, design criteria for a deceleration lane for an RB highway category for a 40-mph posted speed limit is summarized in **Table 6-2**.

Table 6-2. Right Turn Deceleration Lane Design Specifications

Right Turn Deceleration Lane	Design Criteria
Highway Category	R-B Rural Highway
Posted Speed	40 mph
Deceleration Adjustment Factors for 5% to 7% Upgrade *(Table 4-4)*	0.8
Deceleration Length (*Table 4-6)*	370 feet
Transition Taper Ratio *(Table 4-6)*	12 to 1

The minimum westbound right turn deceleration lane dimension is therefore calculated as follows:

Minimum Turn Lane Length = Deceleration Length * Grade Adjustment Factor

= 370 * 0.8 = 296 feet

Minimum Taper Length (ft) = Transition Taper Length Ratio * Width of Speed Change Lane * Grade Adjustment Factor

= 12 * 12 * 0.8 = 115 (ft) included in deceleration length

A schematic illustration with the general dimensions of the right turn deceleration lane requirement is shown on **Figure 6-1**. The existing pavement cross-section cannot accommodate the required deceleration lane. This turn lane is required for all access alternatives discussed in this report.

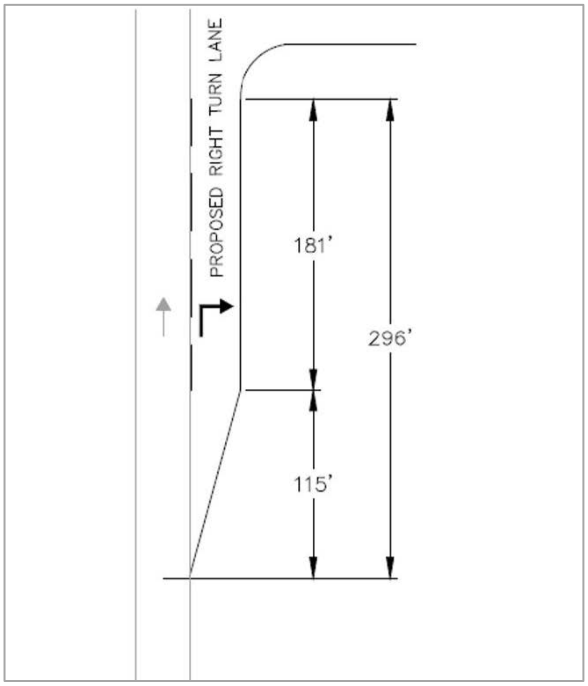

Figure 6-1. Required Dimensions for Westbound Right Turn Lane at SH 72

6.2 STATE HIGHWAY 119 AUXILIARY LANE REQUIREMENTS

The CDOT *State Highway Access Code*, 1998, states the following for an RA classification concerning deceleration lanes based on estimated vehicles per hour (vph):

- A left turn deceleration lane with taper and storage length is required for any access with a projected peak hour left ingress turning volume greater than 10 vph. The taper length will be included within the required deceleration length.
- A right turn deceleration lane and taper length is required for any access with a projected peak hour right ingress turning volume greater than 25 vph. The taper length will be included with the required deceleration length.

- A left turn acceleration lane may be required if it would be a benefit to the safety and operation of the roadway. A left turn acceleration lane is generally not required where the posted speed is less than 45 mph.

- A right turn acceleration lane and taper length is required for any access with a projected peak hour right turning volume greater than 50 vph when the posted speed on the highway is greater than 40 mph.

Based on the 2026 traffic volumes shown on **Figure 4-8**, **Figure 4-11**, and **Figure 4-12**, peak hour traffic volume turning right onto CR 132 from northbound SH 119 during GRE tree removal does not exceed the State Highway Access Code threshold to require a northbound right turn lane. Therefore, no northbound right turn lane is required or recommended. In addition, no tree removal traffic is anticipated to turn left from southbound SH 119 to CR 132. Therefore, a southbound left turn lane is not required or recommended to be constructed by this project.

The CDOT *State Highway Access Code*, 1998, states the following for Change in Land Use and Access Use:

> *Unless there are identified safety problems, existing legal access to the state highway system shall be allowed to remain or be removed or reconstructed under the terms of an access permit in accordance with subsection 2.6 (Change in Land Use and Access Use, State Highway Access Code, 1998) as long as total daily trips to and from the site are less than 100, or as long as only minor modifications are made to the property or as long as the access does not violate any specific permit terms and condition. Minor modifications are defined as anything that does not increase the proposed vehicle volume to the site by 20 percent or more.*

The 2018 daily traffic counts on CR 132 east of SH 119 recorded approximately 600 vehicles per day (**Appendix E**). 2026 total daily tree removal traffic is estimated to be (36 x 3) = 108 passenger car equivalent trips. This is equivalent to approximately 18% impact, so therefore the SH 119 & CR 132 intersection does not require an access permit based on the traffic volume criteria. Evaluation of the oversized/overweight trucks will be included in the final TIS report.

(END OF SECTION)

7.0 SH 72 & GROSS DAM ROAD INTERSECTION

SH 72 near Gross Dam Road is a 2-lane paved 24-foot-wide section with 2-foot shoulders. There are drainage ditches along both sides of the highway. At the access with Gross Dam Road, the highway is striped as a no passing zone. Just east of the current access location, Gross Dam Road is a 24-30' wide gravel roadway with minimal ditches. The existing SH 72 & Gross Dam Road intersection is approximately 100' wide and ties directly into a large United Power parking lot on the north and a private-lane serving about eight residential properties to the south. There is no discernable traffic control on Gross Dam Road in this area.

The existing intersection of SH 72 & Gross Dam Road currently presents many challenges for the truck traffic delivering material to and from the site due to the following reasons:

- Intersection has a skew of 80 degrees where normal maximum allowable is 15 degrees.
- Intersection is on a horizontal and vertical curve.
- Intersection consists of SH 72, Gross Dam Road, access to Community Hall on the south, and a private driveway on the north. This presents many conflicting movements.
- Poor line of sight for Gross Dam Road traffic onto the highway looking both east and west.
- Poor line of sight for east and westbound traffic on SH 72.
- Lack of shoulders, severe erosion and steep roadside ditches along the westbound lane

7.1 INTERSECTION DESIGN OPTIONS

Three options for accommodating construction traffic at the SH 72 & Gross Dam Road intersection have been proposed. As previously stated in **Section 6.1**, a westbound right turn deceleration lane is required for all three of these options:

- Option 1: Full time traffic control at existing intersection location – flaggers
- Option 2: Temporary Traffic Signal at existing intersection location
- Option 3: Re-locate / reconstruct the access slightly east along SH 72

These alternatives were reviewed by CDOT in 2015 and option 3 was determined as the preferred design alternative at the time and is depicted on **Figure 7-1**. AutoTurn simulations have also been analyzed assuming a WB-50 (Customary DOT 55-foot-long intermediate semi-trailer classification) design vehicle for each of the proposed movements for each of the intersection options. AutoTurn truck paths considered for these options shown on **Figure 7-2** and **Figure 7-3**

As shown on **Figure 7-4**, relocating the intersection of Gross Dam Road and SH 72 approximately 300 feet to the east would greatly improve safety and mobility of all traffic at the SH 72 & Gross Dam Road juncture. Gross Dam Road would tie perpendicularly into SH 72. Although the intersection would still be on a curve, sight distances would be greatly improved. Based on AutoTurn analysis, the new section of roadway should be approximately 32-ft wide with shoulders widths varying from 4-ft to 11-ft to accommodate turning truck trailers.

The option that best addresses safety and mobility is to close the existing access at SH 72 and reroute all traffic, including United Power and resident traffic, to a safer location. To prevent crossover traffic, a guardrail, fence, or landscaping should be installed outside the SH 72 clear zone. The intersection should be stop controlled with warning signs located in advance of the intersection on SH 72.

As stated in section 6-1, an access permit through CDOT may be required for the proposed improvements at the intersection of SH 72 & Gross Dam Rd. The design for the SH 72 & Gross Dam Road intersection is being performed by the Design Engineer and will be submitted as a separate document.

Figure 7-1 . Intersection Design: Relocation of Access East Along SH 72

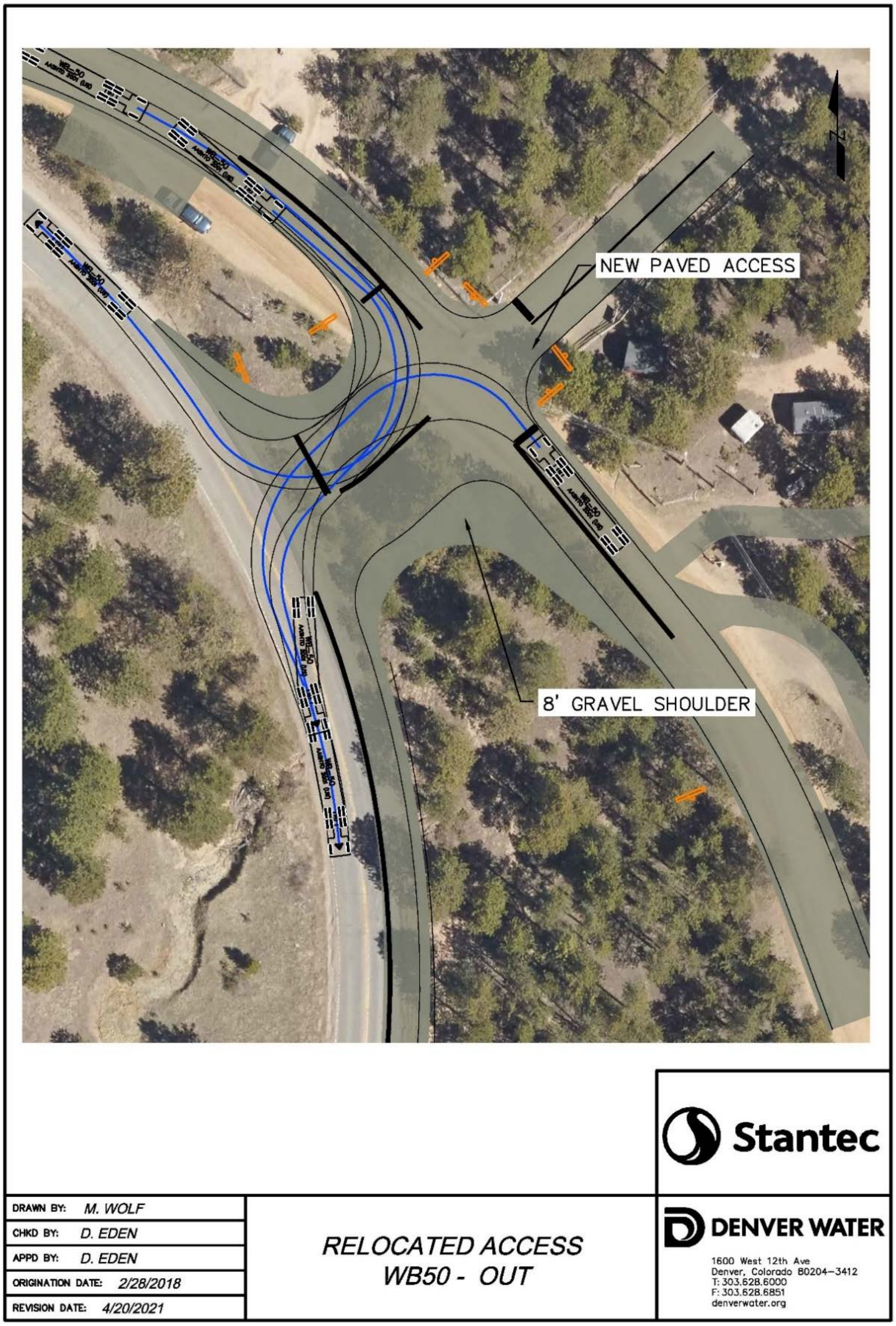

Figure 7-2. Relocated Access Design: WB 50 – Outbound

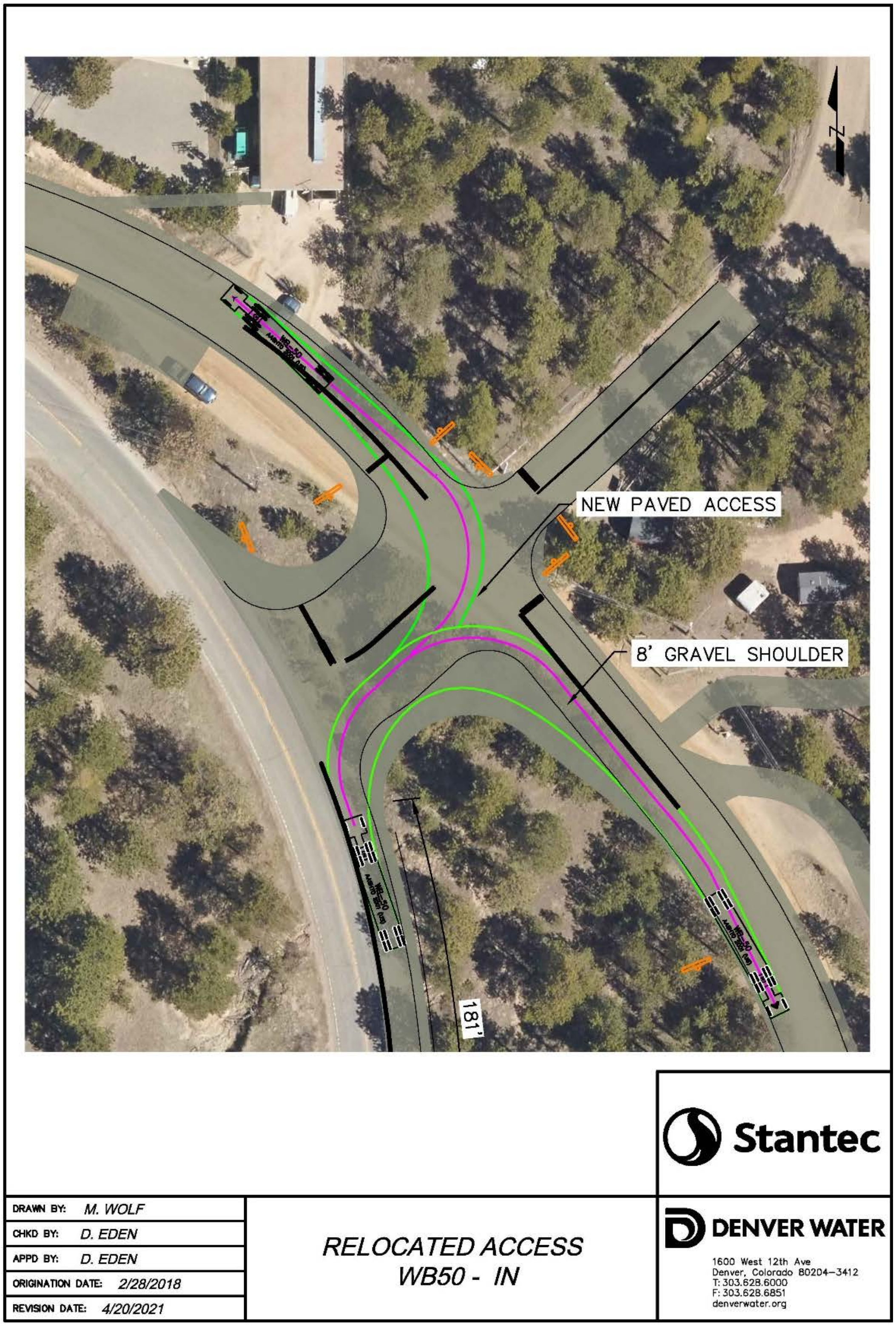

Figure 7-3. Relocated Access Design: WB 50 – Inbound

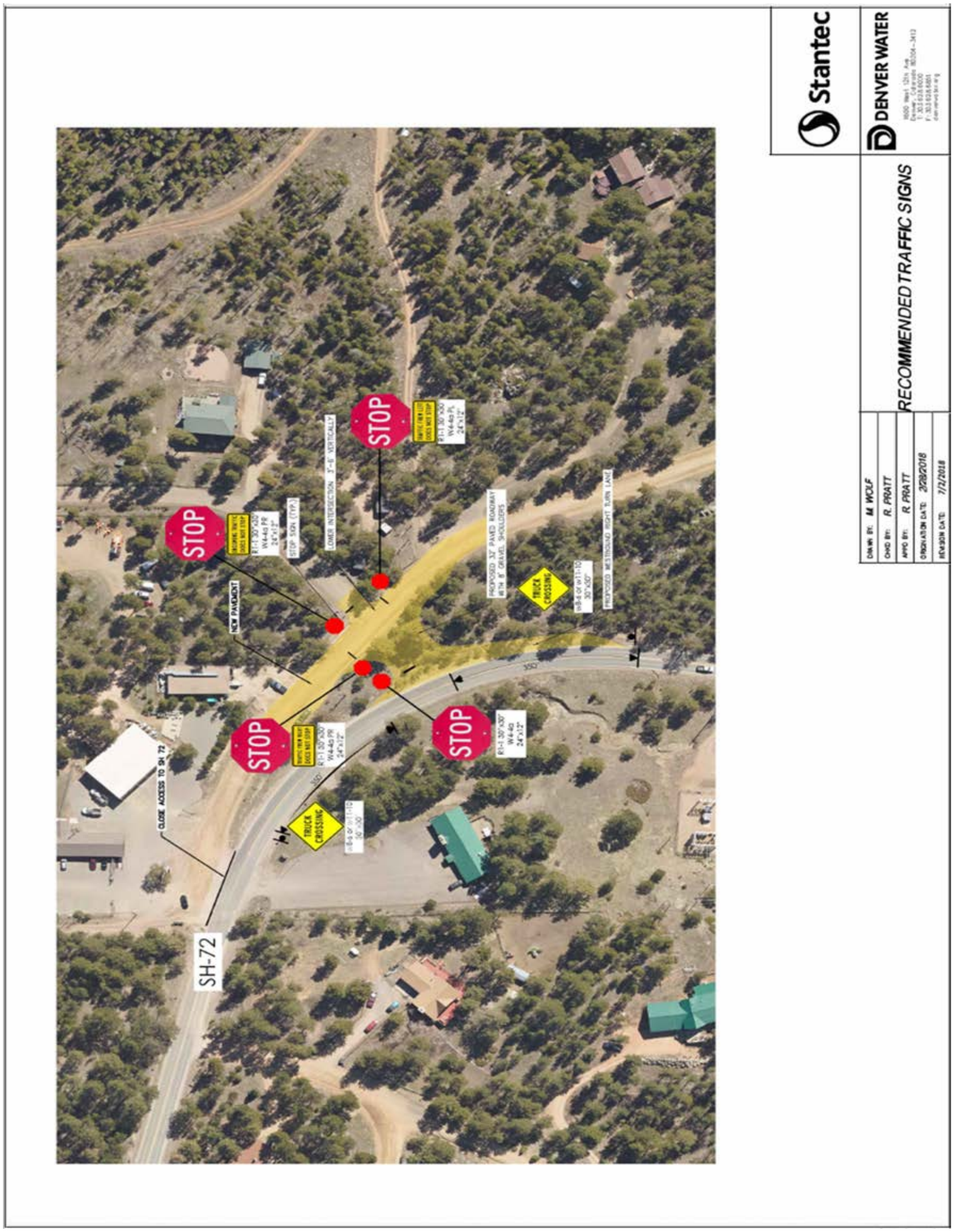

Figure 7-4. Preferred Traffic Control for Relocated Intersection

7.2 SH 72 AND EAST SITE ACCESS ROAD

The available LiDAR data at 1-foot contours has been reviewed for Gross Dam Road from SH 72 to the dam site as well as the internal site access roads. Based on this information, a simple roadway template has been developed and run through AutoTurn simulations for the entire site access route to evaluate if improvements are needed to accommodate construction truck traffic.

7.2.1 Material and Equipment Delivery Vehicle Assumptions

A WB-50 is the assumed design vehicle for the AutoTurn analysis. The goal of the analysis was to determine if improvements are needed to allow for two-way traffic for the entire route. A diesel tractor with "low-boy" design vehicle has also been evaluated at some of the more critical corners and at the railroad crossing and determined that some short-term temporary flaggers will be needed when these vehicles are present as two-way traffic is not possible. All trucks were modelled at 10 mph with assumed 5 feet of clearance between passing trucks and 3 feet of clearance on the outside of each truck.

With the AutoTurn data in hand, the Design Engineer spent time in the field looking at each of the areas to make sure proposed improvements are practical. **Figure 7-4** depicts the areas of potential concern from the AutoTurn analysis. Exhibits are included in **Appendix D** showing AutoTurn analysis for each area of concern. Most of the areas of concern are at sharp curves or narrow stretches of roadway with cut or fill embankments on both sides. The initial analysis indicates that the improvements can generally be accomplished with some grading, excavation, rock scaling and minor drainage improvements like ditches/culverts. These improvements are not expected to greatly impact the footprint, condition, or feel of the roadways.

The strategic placement of warning signs and delineators is also recommended along the site access route. The number and placement of these sings should be coordinated with BOCO as part of the design process. Signs on SH 72 in JEFFCO will also be utilized.

The proposed improvements along Gross Dam Road as outlined in this report are in design development. Other options to accommodate the anticipated construction traffic along Gross Dam Road, such as flagging, were considered but were not selected as the preferred alternative.

Large equipment will be broken down into loads that can be delivered by WB-50 trucks and this will be done outside of material delivery. CDOT Permits will be obtained for oversize loads. As mentioned earlier, the evaluation of oversized/overweight trucks will be included in the final TIS submittal.

7.3 SH 119 AND WEST SITE ACCESS ROAD

A detailed analysis for access from the SH 119 & CR 132 intersection to the GRE site from the west has not been completed. Additional analysis is required to determine if the roadways along this access route need to be improved to accommodate the large trucks needed for tree removal.

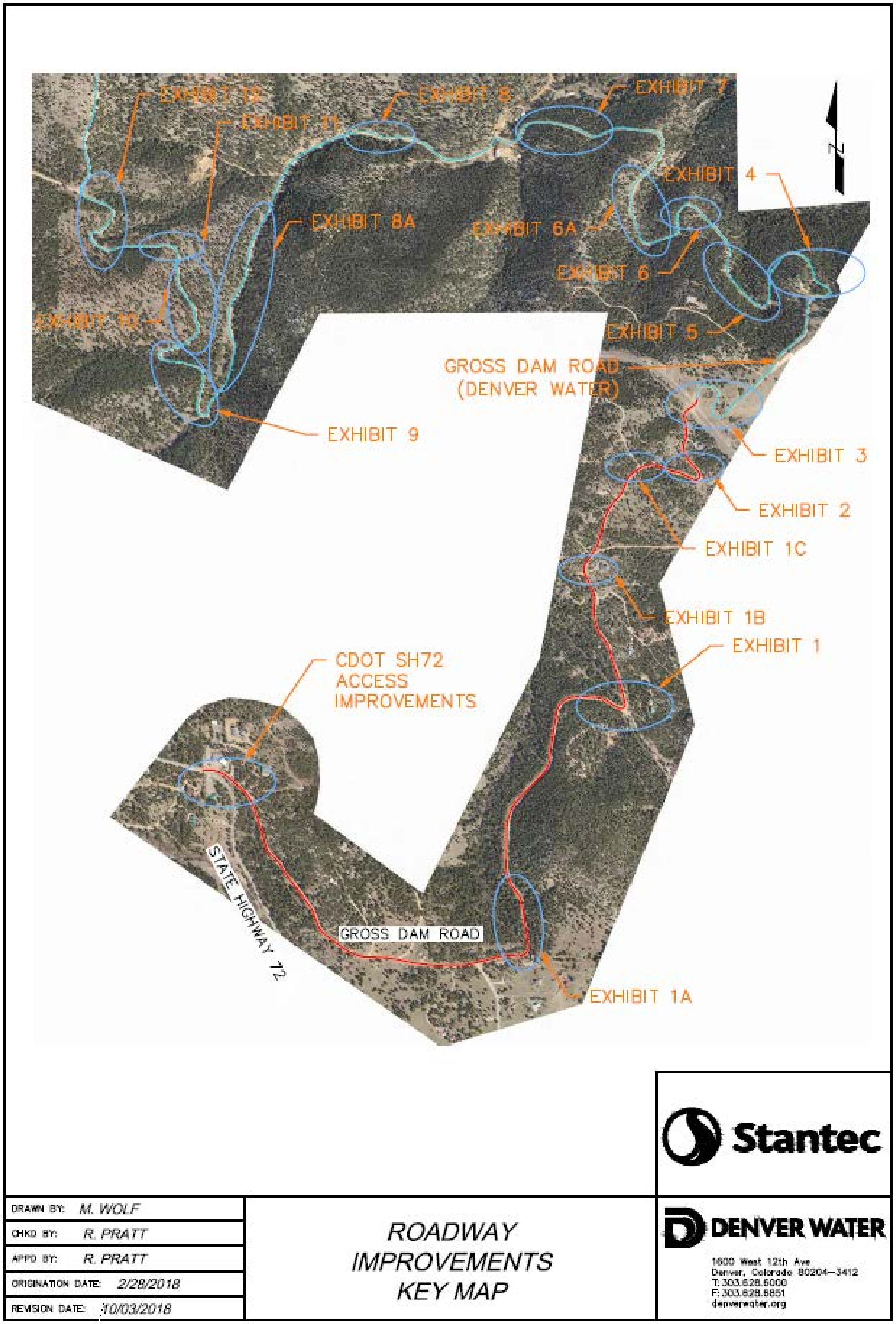

Figure 7-5. Key Map to Improvement Recommendations along Gross Dam Road

7.4 SHUTTLE BUS FOR WORKERS

Denver Water is in the process of considering the feasibility of an off-site staging facility for workers to be transported to the site by shuttle bus; coordination with the shuttle plan is ongoing and will be included in the final TIS submittal. Use of a shuttle bus to transport workers to the site would likely result in a significant reduction of worker vehicular traffic into the site every day. Detailed assessment to consider the potential reduction in the estimated range of construction workforce related to the shuttle bus transport for workers is not included in the traffic count analysis presented in this DM.

7.5 BICYCLE SAFETY

The following safety measures have been identified for consideration to improve safety for bicyclists on SH 72 and SH 119:

- Require bicycle safety to be included as a topic during haul driver orientation.
- Require additional/regular sweeping at the SH 72 & Gross Dam Road and SH 119 & CR 132 entrances, as well as any additional locations where trucks are more likely to track debris onto the highway.
- Place a portable message board near the SH 72 & SH 93 intersection warning cyclists to expect unusually high volumes of large trucks.
- Place a portable message board near the SH 119 & SH 72 intersection warning cyclists to expect unusually high volumes of large trucks.
- Identify "safe" passing zones where it will be easier for haul trucks to pass cyclists, and/or identify the areas where they are prohibited to pass cyclists considering line-of-sight limitations due to grade or curves. Provide this information as a map to drivers at driver orientation.
- Update CDOT online Bicycle & Byways map with a message, alerting riders to anticipate construction traffic.
- Conduct an awareness campaign with local advocacy groups such as 303 Cycling and Bicycle Colorado to alert riders of the conditions.
- Provide a phone number that cyclists can call if they experience issues so that specific areas of concern may be addressed individually.

(END OF SECTION)

8.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations have been compiled based on the analysis presented in this report:

1. Total construction traffic consisting of material delivery, workforce, and tree removal traffic for the east side of the GRE site is proposed to originate from the Denver region, enter SH 72 at the SH 93 intersection, travel west on SH 72 and then north on Gross Dam Road to access the work area. It should be noted that no semi-trailer truck traffic is scheduled to travel on SH 72 between Gross Dam Road and CR 97.

2. Tree removal truck traffic for the west side of the GRE site is proposed to travel from SH 119 on CR 132 and site access roads Lazy Z Road and FS 359 to the west side of Gross Reservoir.

3. The analysis has assumed a worst-case scenario, 4-day material delivery and tree removal schedule limiting truck traffic to Monday, Wednesday, Thursday, and Saturday (or Friday if weekends are prohibited).

4. Peak construction activities are assumed to occur in years 2024-2026, based on the current construction schedule.

5. In Year 2025, construction traffic generated by the GRE Project will consist of truck traffic delivering cement and fly ash material to the site, truck traffic hauling tree removal materials from the site, and traffic from construction workers commuting to and from the site. It is estimated that 17 trucks (including 15 cement and fly ash material delivery trucks and 2 tree removal trucks) per peak hour will be required to access the jobsite on the east side. The required construction workforce, which will use the east side access, is estimated to generate between 50 and 101 commuting worker vehicles per day shift. On the west side, it is estimated that 4 tree removal trucks per peak hour will be required to access the jobsite.

6. For this analysis, on the east access, two scenarios have been analyzed: one where all construction activity trucks and the entire workforce arrives at the site during the morning peak hour, and another where all trucks arrive at the site in the early morning and are departing the site during the morning peak hour while the workforce is arriving.

7. For this analysis, on the west access, two scenarios have been analyzed: one where all peak hour tree removal trucks arrive at the site during the morning peak hour, and another where all trucks exit the site during the morning peak hour.

8. Traffic operations at the SH 72 & Gross Dam Road and Gross Dam Road & Crescent Park Drive intersections were analyzed. The results of this analysis indicate that all

approaches of the study intersections are expected to operate at LOS B or better with or without the addition of construction traffic, and very little delay is anticipated.

9. The LOS analysis that was completed for the segment of SH 72 on the proposed route in the *Report for Gross Reservoir Expansion Alternatives Analysis and Feasibility Study for Roadway Improvements*, by Michael Baker International (2015), concluded that there will be minimal impact to the traffic on SH 72.

10. Traffic operations at the SH 119 & CR 132 intersection were analyzed. The results of this analysis indicate that all approaches are expected to operate at LOS C or better with or without the addition of construction traffic and very little delay is anticipated.

11. Vehicles traveling behind trucks will be delayed approximately 12 minutes as they travel Gross Dam Road between SH 72 and the private access road that the trucks will use to access the site on the east side.

12. Vehicles traveling behind trucks will have average delay of 25.5 minutes as they travel to/from the Gross Reservoir on the west side via FS 359, Lazy Z Road, and CR 132.

13. Based on the State Highway Access Code, a westbound right turn deceleration lane is required for the access to Gross Dam Road on SH 72. This turn lane shall include a minimum deceleration length of 296 feet, including a 115-foot-long taper length.

14. Three options have been reviewed for accommodating construction traffic at the SH 72 & Gross Dam Road junction:

    - Option 1: Full time traffic control at existing intersection location – flaggers
    - Option 2: Temporary Traffic Signal at existing intersection location
    - Option 3: Re-locate the access slightly east along SH 72

    Option 3 is recommended and has been identified by CDOT as the preferred option.

15. Available LiDAR data has been reviewed including data at 1-foot contours for Gross Dam Road from SH 72 to the dam site as well as the internal site access roads. This analysis included looking at low-boy vehicle at some of the more critical corners and the railroad crossing. Based on this information, a simple roadway template was developed and run using AutoTurn simulations assuming WB-50 design vehicle for the entire site access route to determine if improvements are needed to accommodate construction truck traffic.

16. Initial analysis indicates that the improvements can generally be accomplished with some grading, and minor drainage improvements like ditches/culverts. These improvements will not greatly affect the footprint, condition, or feel of the roadways.

17. The strategic placement of warning signs and delineators along the site access route is recommended. The number and placement of these signs should be coordinated with BOCO as part of the design process.

18. Daily truck traffic percent traveling on SH 119 due to GRE tree removal operations is not significant. Therefore, we do not recommend any mitigation on SH 119.

Denver Water is considering the feasibility of offering workers the option of riding a shuttle bus into the job site. The park-and-ride and shuttle bus to the jobsite is an option that is under consideration for this project.

(END OF SECTION)

9.0 REFERENCES

1) Michael Baker (2015). “Report for Gross Reservoir Expansion Alternatives Analysis and Feasibility Study for Roadway Improvements,” June.

2) Alliant Engineering (2015). “Gross Dam Reservoir Expansion, Traffic Control Plan,” December.

3) Denver Water (2018). “Tree Removal Plan – Transportation Analysis – Revision 2,” July 30.

(END OF REPORT)

APPENDIX A

PICTURES OF EXISTING ROADWAYS AND RAILROAD CROSSING

SH 72, Near Site Access

Gross Dam Road

Rail Road Crossing on Gross Dam Road

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APPENDIX B

DENVER WATER TRAFFIC MEMO (INTERNAL)

EMAIL CLARIFICATION

DENVER WATER (INTERNAL) TRAFFIC MEMO

Purpose

This report presents the key results of a cement and fly ash traffic volume study that accounted for both the RCC production requirements and the alternative traffic patterns which affect the community along the proposed haul route for the Gross Reservoir Expansion Project. More specifically, this report outlines the major factors that will affect the final haul schedule such as peak traffic hours, school bus hours, daylight hours, and required concrete production. Several potential hauling schedules are presented within for further consideration by Denver Water and other stakeholders. Additionally, this report presents storage alternatives that are based on cement and fly ash demands to sustain production when the trucks are not hauling.

This report supplements the previous cement haul study conducted in 2014 by Engineering Solutions. Finally, this report aims to provide information for the community and presents a menu of options. Denver Water values the opinions of the community and will work to adapt to balance the impact from hauling activities with the project schedule.

Problem Statement

The Gross Reservoir Expansion Project will require nearly 900,000 CY of roller compacted concrete (RCC) within a tight construction schedule of just two years (from April to November - concrete will not be places during the winter months). This will require large amounts of cement and fly ash to be hauled to the site – up to 7,200 tons (or 288 trucks) per week during peak production. The route to the site is along Highway 72, which is the primary access for the local community who are sensitive to having caravans of dry bulk tankers slowly travelling up and down the community corridor during typical daily commutes. Additionally, this road is along a school bus route, and DW has committed to not hauling during school bus schedules (7:00 AM – 8:30 AM; 3:00 PM – 4:30 PM). All of these factors require that a strategic hauling schedule be developed to create a safer project and to reduce impact to the community as well as to ensure the success of this project.

Figure 1: Dry bulk tanker truck. This is the type of truck that will haul the cement and fly ash up to the site.

Criteria and Assumptions

Haul Route

According to the Traffic Control Report, the curves along Gross Dam Road will need to be taken at 20 mph. Using this speed along the entire route yields a conservative estimated travel time of 45 minutes of travel time from the intersection of Highway 93 to the site (for the purposes of this report, the intersection of Highway 93 and Highway 72 is regarded as the "start" of the canyon, and the RCC batch plant site is the "end"). This travel time was used when calculating how long of an unloading window the trucks will have at the site in order to get them in and out of the canyon at appropriate times.

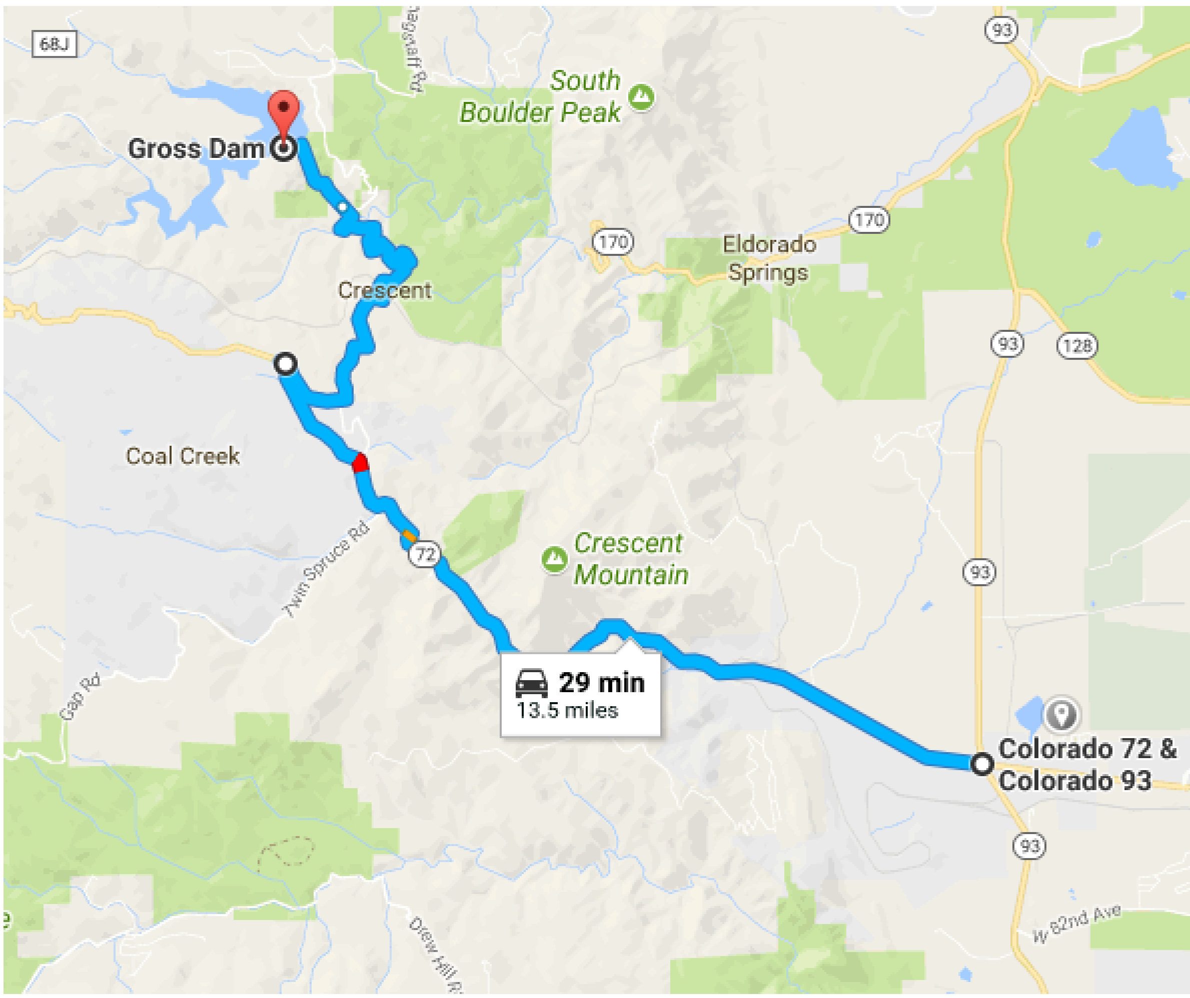


Figure 2: Google Maps image showing the route from Highway 93 up Highway 72 and Gross Dam Road to the RCC batch plant site. Although Google Maps calculated a 29 minute travel time in the canyon, this value was not used as the dry bulk tanker trucks will be much larger and slower than an average vehicle.

Allowable Travel Times

School busses operate on Highway 72 from 7:00 AM – 8:30 AM and from 3:00 PM – 4:30 PM. A traffic control plan conducted by Michael Baker International in 2015 studied the peak hourly traffic at intersections along Highway 72. These findings are summarized in Table 1.

Table 1: Peak traffic hours at intersections along Highway 72

1	SH 72 and Gross Dam Road	9:00-10:00	AM
		4:00-5:00	PM
2	SH 72 and Crescent Park Drive	9:00-10:00	AM
		4:15-5:15	PM
3	SH 72 and Skyline Drive	9:00-10:00	AM
		4:15-5:15	PM
4	Gross Dam Road and Crescent Park Drive	9:30-10:30	AM
		4:00-5:00	PM
5	SH 72 and Blue Mountain Road	9:00-10:00	AM
		4:45-5:45	PM
6	SH 72 and Plainview Road	9:00-10:00	AM
		4:45-5:45	PM
7	SH 72 and Twin Spruce Road	9:15-10:15	AM
		4:45-5:45	PM

For the purposes of this project, the allowable travel times were adjusted such that the cement/fly ash haul trucks would not be in the canyon during school bus activity and attempt to avoid peak commuting traffic hours. Trucks may haul during peak commuting hours if the primary direction of commuter travel is opposite than the direction of the dry bulk tankers. Specifically, the trucks would not be in the canyon any earlier than 5:00 AM or any later than 8:30 PM.

The following delivery windows were calculated based on these "no-haul" times as well as the approximated 45 minute travel time through the canyon.

Table 2: Feasible cement and fly ash deliver windows.

	Enter canyon	First trucks arrive at RCC plant	Last trucks depart RCC plant	Total time at RCC Plant	Exit Canyon
Morning shift	5:00 AM	5:45 AM	6:15 AM	0.5 hr	7:00 AM
Midday shift	9:00 AM	9:45 AM	2:15 PM	4.5 hr	3:00 PM
Evening shift	6:00 PM	6:45 PM	7:30 PM	0.75 hr	8:15 PM

RCC Production Rates

The amount of cement and fly ash required per week was determined based on RCC requirements and the specific RCC mix proportions for this project. The RCC production curve (shown in Figure 3) was created based on past RCC projects and was adapted to fit the Gross dam's geometry and volume per lift. According to the proportioning study conducted by ASI in 2015, the mix will have 400 lbs/CY of cementious material (i.e. cement and fly ash combined). The cementious material demands are shown in Figure 3. The material demand was also converted to volume (see Table 9) the densities of cement and fly ash to create individual demand curves for each material.

Table 3: RCC, Cement, and Fly Ash demands.

	Unit	RCC	Cement	Fly Ash
Total Amount Needed	CY	860717	81392	78470
	Tons	-	103286	68857
Average Weekly Needs	CY	12977	1227	1183
	Tons	-	1557	1038

This model calculated RCC output rates based on the assumption that the RCC batch plant will be able to produce at a rate of 300 CY / hour. This rate dictated how much storage will be needed on site in order to store excess material to keep up with this production. The model also ran under the assumption that the batch plant will be operating 18 hours per day, 7 days per week.

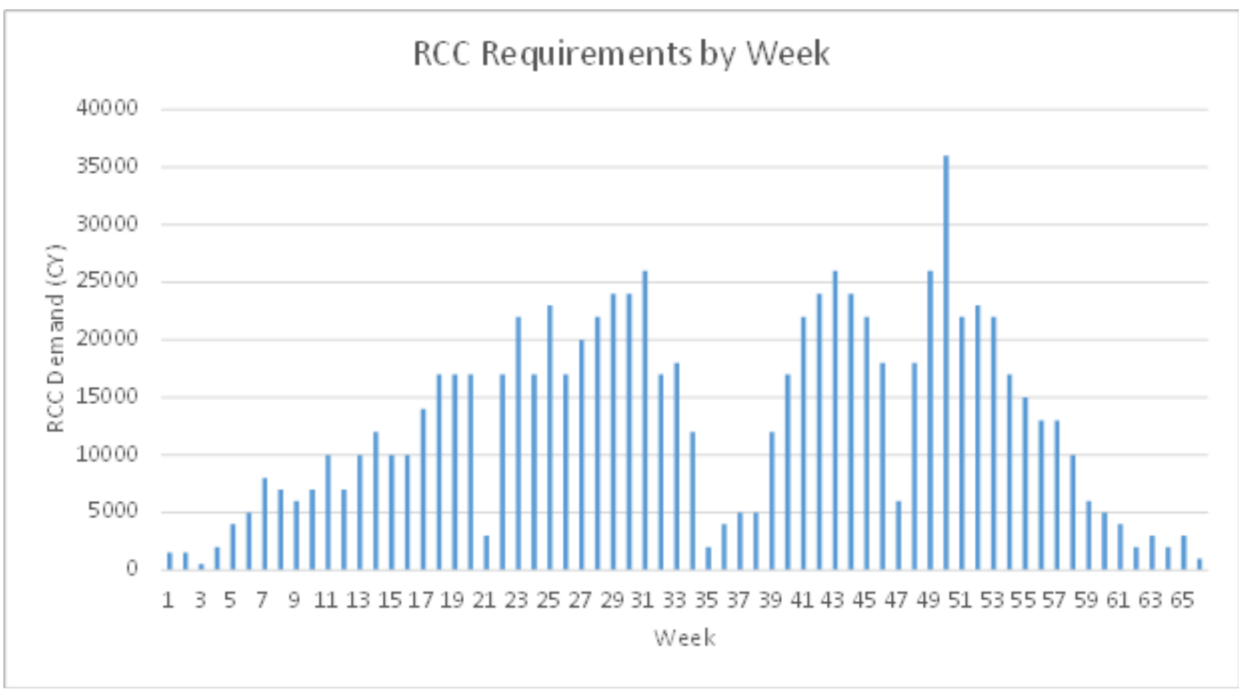


Figure 3: RCC requirements by week. This model shows just how varied the cement and fly ash demands can be on a weekly basis, thus requiring a robust storage and truck hauling plan.

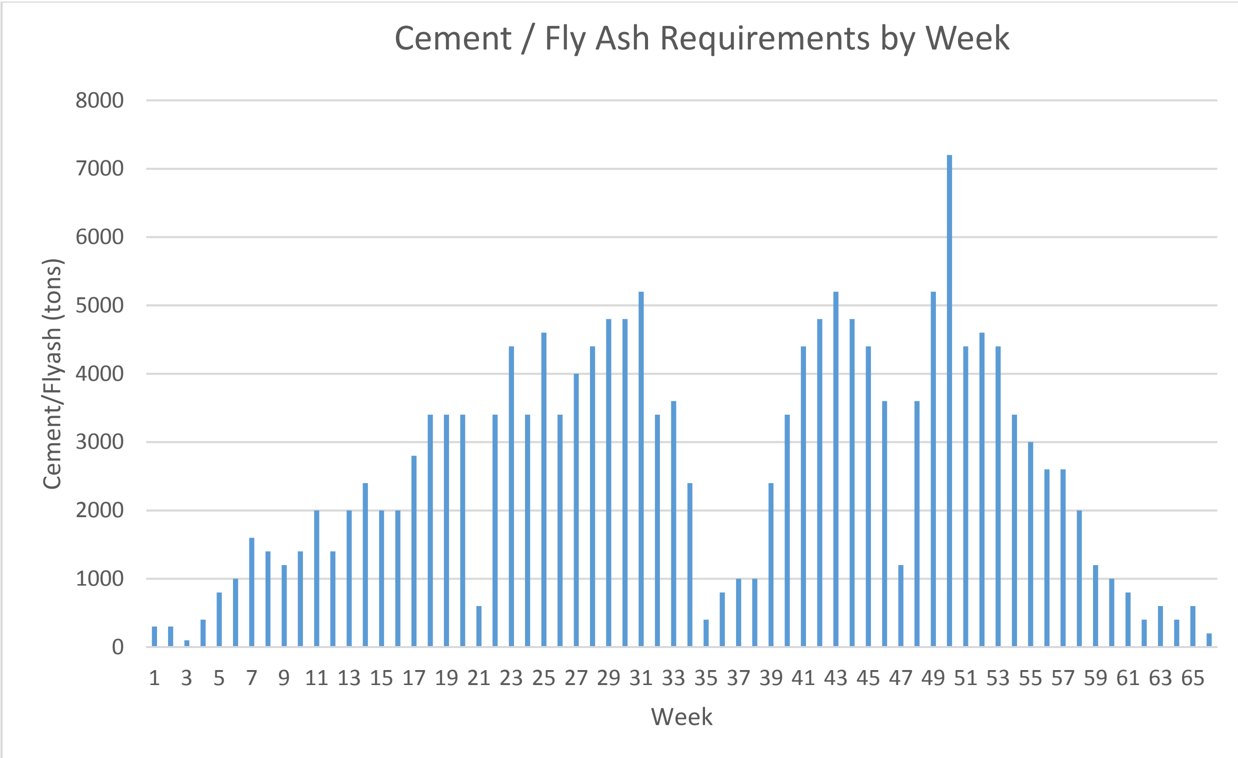


Figure 4: Total cementious material demand

Mechanical Limitations

The cement and fly ash will be delivered via 25 ton capacity dry bulk tankers. This limits the amount of material that can be delivered to the site at one time.

Another criteria is the feasibility of unloading the required amount of trucks in short windows of time. Generally, the vacuum systems that come with bulk cement / fly ash delivery trucks take approximately an hour to unload the material into onsite storage silos. According to the feasible time windows previously shown in Table 2, it is impossible to unload one truck during the morning and evening shifts. However, there are solutions that can be implemented in order to reduce this delivery time. Two potential solutions for this project are listed below:

1) Multiple offloading stations – instead of only unloading one truck at a time, the project will have four unloading stations: two for cement and two for fly ash. This will enable for four trucks to be unloaded simultaneously. A consequence of this scheme is that it calls for four different silos, which may cause some logistical difficulty when getting the material into the batch plant.
2) High velocity pumps – instead of relying solely on the default pumping mechanisms provided with dry bulk cement haulers, the project will implement high velocity pumps or an air booster system instead of screws. This should reduce the offload time per truck to about 15 – 20 minutes.

These two strategies will enable 12-16 trucks to be unloaded per hour rather than just one. Additionally, these strategies will enable the logical utilization of the morning and evening drop off windows. Within the 30 minutes in the morning shift, at least 4 trucks could be unloaded. Within the 45 minutes in the evening shift, at least 8 trucks could be unloaded. The number of trucks feasibly unloaded during each given time window is shown in the table below.

Table 4: Number of trucks feasibly unloaded

	Number of trucks feasibly unloaded
Morning Shift	4
Midday Shift	36
Evening Shift	8
Maximum # trucks per day	48

Storage Requirements and Limitations

Surge storage is required because all the cement and fly ash required for any given day needs to be hauled into the site during small time windows. Furthermore, depending on the weekly haul scheme (e.g. 3-day or 6-day), all the cement and fly ash required for the entire week needs to be delivered during only those days within the allowable time windows. The batch plant will not be able to process this much material that fast, and therefore some surge storage will be required such that the weekly and daily cement and fly ash requirements will be met, but also such that the trucks can deliver all of it within the given days and windows. This study accounts for all surge storage to be stored at the 88th street rail yard rather than at the site at Gross Dam.

Figure 5: 1,000 ton capacity silo. This particular silo, manufactured by Zimmerman Industries, is 70 ft. tall, 27 ft. in diameter, and weighs 8 tons.

Additionally, site storage is limited at the RCC plant site in order to sustain production on days when no trucks are hauling. According to a preliminary aggregate haul study report conducted by Engineering Solutions in 2015, storing more than 2,000 tons of total material was “costly and impractical”. The value of 2,000 tons of material (1,000 tons cement and 1,000 tons fly ash) was used as a general guideline in this study. Silos of this capacity are large – generally about 30 ft. in diameter and around 60-70 ft. tall. Minimizing the amount of site storage will be more logistically feasible and reduce visual pollution.

Minimizing the amount of site storage will also require a strategic hauling schedule. The days without hauling should be distributed through the week as to minimize the maximum amount of time that no materials would be delivered to the site. For example, a 4-day hauling schedule shouldn’t haul on Monday – Thursday, leaving a 72 hour window from Friday to Saturday that the storage would need to sustain RCC production. Rather, the hauling days should be distributed such that the amount of time without hauling is decreased. Potential hauling schemes are represented in the table below.

Table 5: Potential hauling schemes. The x's represent days of hauling.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
6-day hauling	X	X	X	X	X	X	
5-day hauling	X	X	X	X		X	
4-day hauling	X		X	X		X	
3-day hauling	X		X		X		

Noise Limitations

While the noise from the trucks will not affect the trucking schedule nor the capacity of each haul, it is still an important aspect of the project and is a concern. Denver Water aims to quantify the number of homes that could be affected by the noise of the cement and fly ash trucks hauling on the way to the batch plant. According to a preliminary noise and vibration report conducted by Behrens and Associates for Denver Water in 2014, it is generally accepted that a noise change of 3 dBA is perceptive to the average healthy human ear. That is, if the noise level from the trucks exceeds the ambient noise levels by 3 dBA or more, then persons within that range may notice and this may be disruptive. This was used as the threshold of significance. Behrens and Associates chose to use a noise level change of 5 dBA as the threshold of significance. For the purposes of this study, 3 dBA was chosen instead to be more conservative.

The Behrens and Associates evaluated and modelled the noises from a mock truck haul at six different locations along Highway 72 and Gross Dam Road. They created visual maps of each area (see Figure XX) of the noise levels at certain distances away from the road. In order to quantify the number of potentially affected households, the distance at which the noise from the truck haul exceeds the ambient noise levels by 3 dBA was recorded at each locations. These distances were averaged to find a threshold distance of 170 ft. That is, households within 170 ft of the road are at risk of noise disruption caused by the hauling truck. Google Earth was used to create paths representing a region 170 ft. away from the haul route on either side (Figure XX). The houses within this reason were counted. According to this process, 61 homes along the haul route have the potential to be impacted by the noise. It should be noted that the paths 170 ft. away from the road are not exact and more precise and accurate methods (e.g. GIS Applications) should be used to determine an exact number of homes. It should also be noted that the sound levels were based on a modeling software used by Behrens and Associates and may vary from actual observed noise levels.

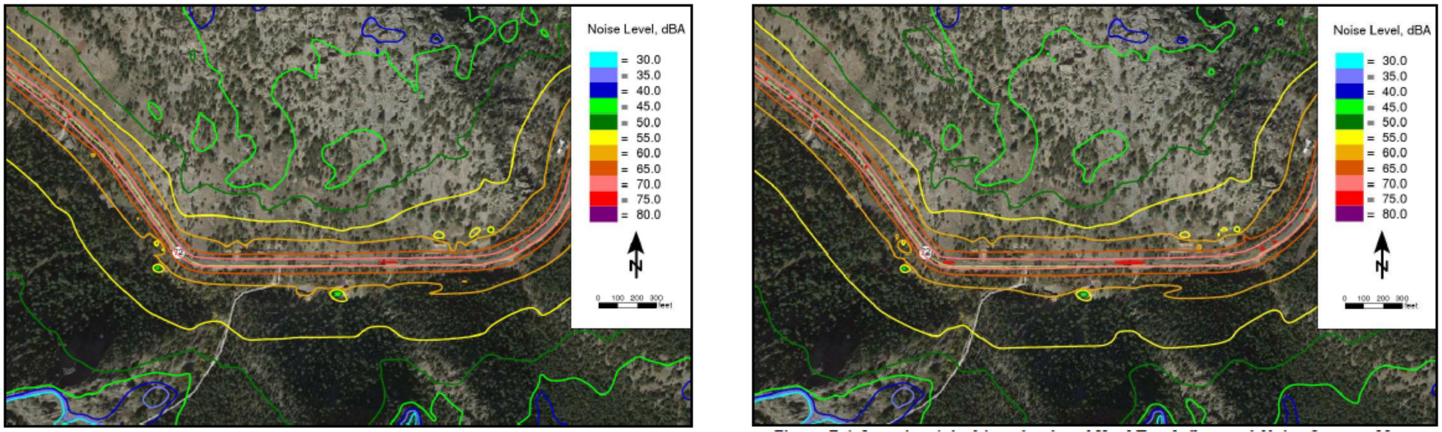


Figure 6: Noise model results at Location 1 from the Behrens and Associates study. The left map shows ambient noise levels and the right map shows noise levels when trucks were in the region. These maps were used to determine the distance at which the noise level changed by at least 3 dBA.

Figure 7: Screen shot of Google Earth and paths used to estimate number of potentially affected homes. The blue line is the path of the haul route, while the yellow and green lines are 170 ft. away from the haul route. This image shows two homes within this region that have the potential to be affected by the noise.

Methodology

Based on the allowable time windows, four different daily haul schemes were generated:

1) Midday only haul
2) Morning and Midday haul
3) Midday and Evening haul
4) Morning, Midday, and evening haul

Within these four different daily schemes are four different possible weekly schemes (i.e. hauling 6 days per week, hauling 5 days per week, hauling 4 days per week, and hauling 3 days per week). This results in 16 different options. Each of these options was analyzed using the modelling process described below in order to reflect the feasibility of the haul schedule based on the number of trucks feasibly entering the site and the required surge storage.

Surge Storage Study

The surge storage was modelled by evaluating the amount of cement and fly ash being hauled into the site based on the RCC production curve and the amount of cement and fly ash being processed using the batch plant production rate of 300 CY of concrete per hour. For every hour over the 66 week duration of the RCC laying process, the model calculated how much storage would be needed based upon the excess material from the previous hour, the inflow of material from the hauling trucks, and the outflow of material from the RCC plant. Examples of this hourly variation in storage on site is shown in Figures 6 and 7. These are taken from weeks 25 (an average production week) and week 50 (the maximum production week) respectively. The week 25 graph was based on a 6-day haul using only the midday shift. The week 50 graph was based on a 6-day haul using the morning, midday, and evening shifts.

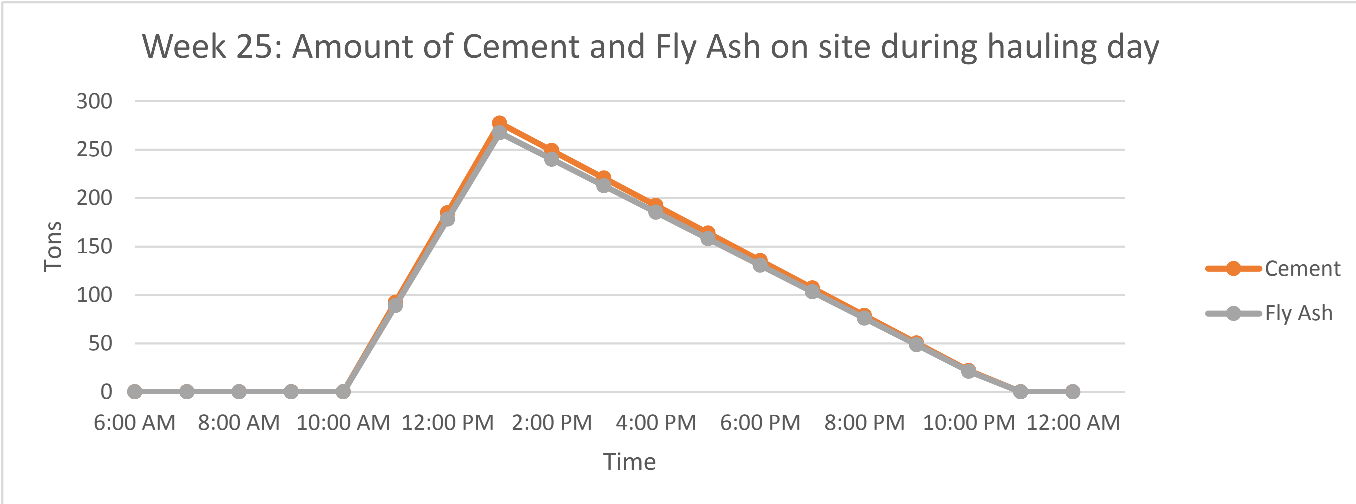


Figure 9: Material on site during hauling day during average production week (week 25). The sharp increase in tonnage on site represents the time when trucks are hauling. The steady decline afterwards represents the processing rate of the RCC plant. The figure does not show storage.

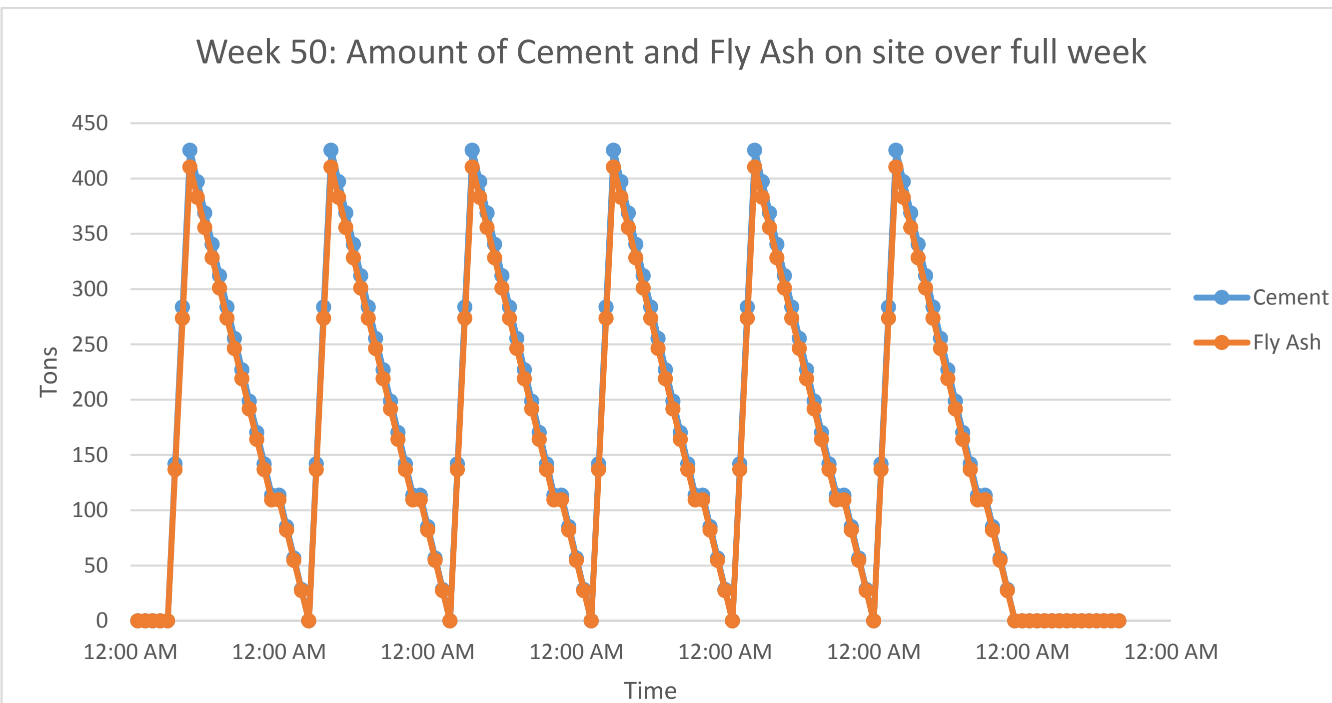


Figure 8: Amount of material on site over the course of the maximum RCC production week, week 50. This graph represents a six-day haul schedule bringing all material onto site.

Trucks per day Study

In order to give the community a better idea of what the trucking scheme will look like, the maximum and average number of trucks per day was calculated based on RCC demands and the capacities of the dry bulk tankers. In hauling schemes with more available hauling days, the number will be less; in hauling schemes with less available hauling days, more trucks will need to supply the material each day. Figure 8 shows the outcome of this study.

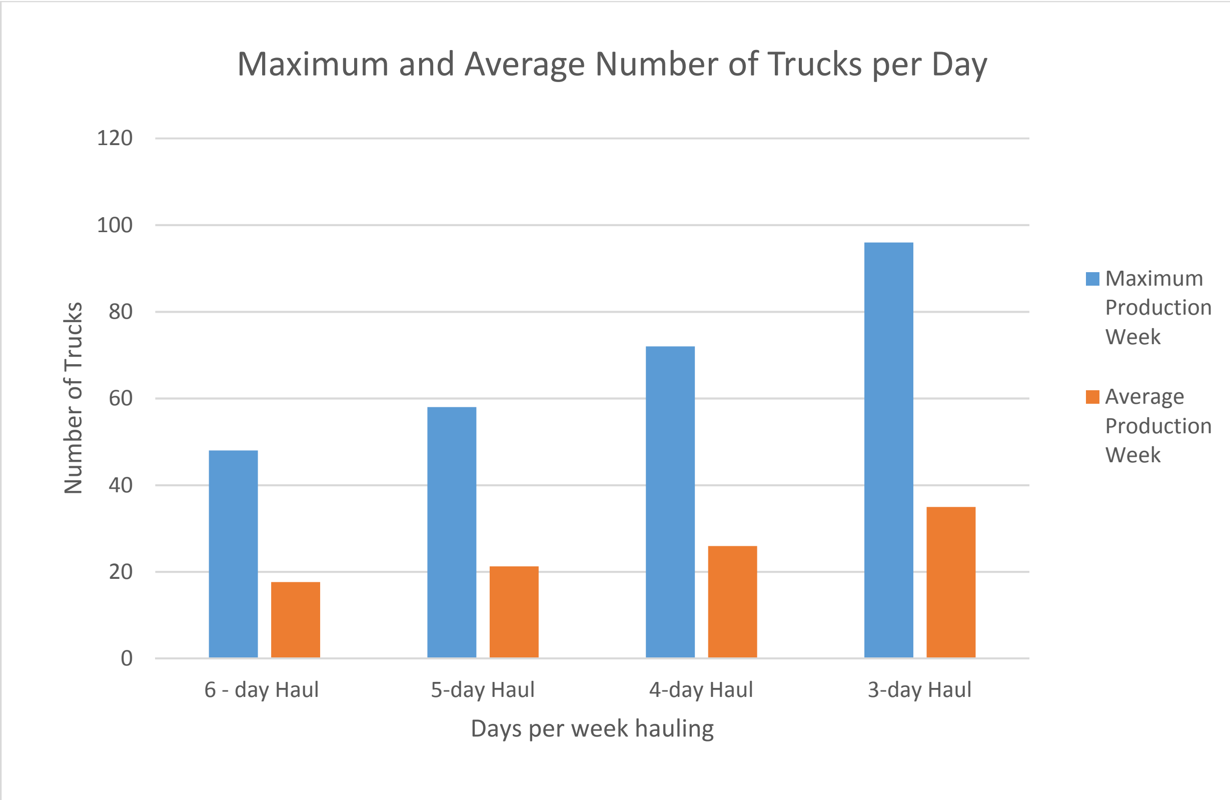


Figure 10: Trucks per day based on weekly hauling scheme.

Sustained Production Study

The amount of storage required on site was mostly determined by the amount of time during which maximum RCC production could be sustained. The longest period of time without hauling was calculated based on the haul schedule and cross referenced with the amount of time that maximum production demand could be sustained based on storage. Three different storage scenarios were analyzed: 1,000 tons, 1,500 tons, and 2,000 tons of each material. The results of this study are shown in the tables below.

Table 6: Sustained hours of maximum production. The cement values are the limiting factors and are highlighted in green. These represent the amount of time that the given storage scenario could sustain maximum RCC output (300 CY/hr).

		Storage Silos		
Tons	per material	1000	1500	2000
Stored cement Volume	CY	788.02	1182.03	1576.04
Stored fly ash Volume	CY	1139.60	1709.40	2279.20
Max. cement output	CY/hr	27.02	27.02	27.02
Max. fly ash out put	CY/hr	26.05	26.05	26.05

Sustained max. cement production	Hours	29	44	58
Sustained max. fly ash production	Hours	44	66	88

Table 7:Maximum number of hours in which storage would need to sustain RCC production without incoming trucks supplying material.

	Maximum hours of no hauling			
	6 day haul	5 day haul	4 day haul	3 day haul
Midday only	30	30	30	48
Morning and Midday	27	27	27	45
Midday and Evening	26	26	26	44
Morning, Midday and Evening	22.5	22.5	22.5	40.5

"No Weekends" Study

In order to not haul on the weekends, additional storage will be required during the maximum production weeks. This additional storage was evaluated to prove its feasibility. A haul schedule in which the weekends would not have trucks would require either a 4-day or a 3-day haul schedule. The maximum time without hauling during which RCC production would rely solely on the onsite storage depends on which time slots are utilized, as shown in Table 8.

Table 8: Amount of time that the storage will need to sustain RCC production if trucks are not hauled on weekends based on the daily hauling schedule.

Daily Hauling Schedule	Amount of time without hauling
Midday only	48 hrs.
Morning and Midday	45 hrs.
Midday and Evening	44 hrs.
Morning, Midday and Evening	40.5 hrs.

The initial feasibility study cross referenced the amount of time without hauling with maximum production rates. However, construction will not always require these maximum production rates. Depending on the daily hauling schedule, there were up to 8 weeks throughout the entire construction process that would require additional storage beyond the 1,000 ton silos for each material. This amount of storage was calculated and the results are shown in the tables below.

Table 9: Extra storage required for large production weeks based on a no-weekends hauling schedule, utilizing only the midday time shift. The maximum amount of extra storage required is highlighted in orange.

Midday Shift Only									
	Week #	29	30	31	42	43	44	48	50
Cement	Extra storage per day (CY)	11.6	11.6	37.2	11.6	37.2	11.6	37.2	165.2
	Extra tonnage per day	14.8	14.8	47.3	14.8	47.3	14.8	47.3	209.7
	Extra storage for week (CY)	81.5	81.5	260.7	81.5	260.7	81.5	260.7	1156.5
	Extra tonnage for week	103.4	103.4	330.8	103.4	330.8	103.4	330.8	1467.6
Flyash	Extra CY/hr	-	-	-	-	-	-	-	0.9
	Extra storage for day (CY)	-	-	-	-	-	-	-	16.8
	Extra tonnage for day	-	-	-	-	-	-	-	21.4
	Extra storage for week	-	-	-	-	-	-	-	124.4
	Extra tonnage for week	-	-	-	-	-	-	-	109.2

Table 10:Extra storage required for large production weeks based on a no-weekends hauling schedule, utilizing the morning and the midday time shift.

Morning and Midday Shifts					
	Week #	31	43	49	50
Cement	Extra storage for day (CY)	17.5	17.5	17.5	145.5
	Extra tonnage for day	22.3	22.3	22.3	184.7
	Extra storage for week (CY)	122.8	122.8	122.8	1018.6
	Extra tonnage for week	155.8	155.8	155.8	1292.6

Table 11: Extra storage required for large production weeks based on a no-weekends hauling schedule, utilizing the midday and evening shifts.

Midday and Evening Shifts					
	Week #	31	43	49	50
Cement	Extra storage for day (CY)	10.4	10.4	10.4	138.4
	Extra tonnage for day	13.2	13.2	13.2	175.6
	Extra storage for week (CY)	72.6	72.6	72.6	968.5
	Extra tonnage for week	92.2	92.2	92.2	1229.0

Table 12: Extra storage required for large production weeks based on a no-weekends hauling schedule, utilizing the midday and evening shifts.

Morning, Midday, and Evening Shifts		
	Week #	50
Cement	Extra storage for day (CY)	110.5
	Extra tonnage for day	140.2
	Extra storage for week (CY)	773.5
	Extra tonnage for week	981.5

A common form of additional storage is the use of cement “guppies” or “pigs”. Generally, these have a capacity of around 150 CY. According to the tables above, all required additional storage could be managed by having one cement guppy onsite for the entire week(s) in question. The exception is if only the midday shift is used, in which case more than one cement guppy would be required with an additional fly ash guppy during the peak production week (week 50).

Figure 11: 4200 cf (~150 cy) capacity cement guppy.

Using guppies as a solution would enable the hauling schedule to be limited to weekdays, though it would add an additional truck that would be travelling up and down the canyon every day for the weeks shown in the tables above. Additionally, it adds the logistical issue of unloading and storing the guppy on site.

Night Haul Study

An additional scenario was added to increase the amount of hours that hauling would enable: bringing cement trucks to the site during nighttime hours from 9:00 PM to 5:00 PM 6 days a week. This would enable trucks to be on site for 6.5 hours and increases the number of trucks that can be feasibly unloaded per week to 532. Because the trucks are still hauling six days a week, there is no added benefit in terms of on-site storage. However, there is an advantage in terms of flexibility and the amount of trucks that can be added per night. This advantage is clearly seen in the truck feasibility study, outlined below.

Truck Feasibility Study

This study cross referenced the required amount of trucks needed to haul material for the entire week and the amount of trucks that could feasibly enter the canyon and be unloaded. This study does not account for on-site storage being there to maintain production on days when hauling is not occurring. However, it does help to see which hauling schedules could have more potential issues. The results of this study are shown below.

Table 13: Truck feasibility study showing the numbers of "problem weeks" or weeks the number of trucks required to maintain production exceeds the number of trucks that can feasibly enter the canyon and unload.

Hauling Schedule		Problem Weeks
6-day haul		
Midday only	9:00 AM - 3:00 PM	1
Morning and Midday	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM	1
Midday and Evening	9:30 AM – 3:00 PM; 6:00 PM – 8:15 PM	1
Morning, Midday and Evening	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM; 6:00 PM – 8:15 PM	0
5-day haul		
Midday only	9:00 AM - 3:00 PM	1
Morning and Midday	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM	1
Midday and Evening	9:30 AM – 3:00 PM; 6:00 PM – 8:15 PM	1
Morning, Midday and Evening	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM; 6:00 PM – 8:15 PM	1
4-day haul (No hauling on weekends, with additional guppies)		
Midday only	9:00 AM - 3:00 PM	8
Morning and Midday	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM	4
Midday and Evening	9:30 AM – 3:00 PM; 6:00 PM – 8:15 PM	1
Morning, Midday and Evening	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM; 6:00 PM – 8:15 PM	1
3-day haul (No hauling on weekends, with additional guppies)		
Midday only	9:00 AM - 3:00 PM	17
Morning and Midday	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM	16
Midday and Evening	9:30 AM – 3:00 PM; 6:00 PM – 8:15 PM	10
Morning, Midday and Evening	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM; 6:00 PM – 8:15 PM	8
Night Haul		
	9:00 PM - 5:00 PM	0

Results

The results show that many different hauling schedules would be feasible. Following the general guideline proposed by the 2015 Engineering Solutions aggregate haul study of storing only 2,000 tons of material on site, the following solutions are proposed such that the site will store 1,000 tons of cement and 1,000 tons of fly ash. The results in Table 8 require no additional storage (i.e. guppies).

Table 14: Results.

6 day haul	Times when trucks are in canyon	Maximum # trucks per day	Average # of trucks per day
Morning and Midday	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM	48	18
Midday and Evening	9:30 AM – 3:00 PM; 6:00 PM – 8:15 PM	48	18
Morning, Midday and Evening	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM; 6:00 PM – 8:15 PM	48	18
5 day haul			
Morning and Midday	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM	58	21
Midday and Evening	9:30 AM – 3:00 PM; 6:00 PM – 8:15 PM	58	21
Morning, Midday and Evening	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM; 6:00 PM – 8:15 PM	58	21
4 day haul			
Morning and Midday	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM	72	26
Midday and Evening	9:30 AM – 3:00 PM; 6:00 PM – 8:15 PM	72	26
Morning, Midday and Evening	5:00 AM – 7:00 AM; 9:00 AM – 3:00 PM; 6:00 PM – 8:15 PM	72	26
Night Haul			
	9:00 PM – 5:00 AM	48	18

If hauling on the weekends is to be prohibited, the following hauling schemes could be followed.

Table 15: No weekend hauling schemes and additional storage requirements. The number of weeks when guppies are required as well as the maximum number of guppies required are the same for both the 4 day and 3 day haul schedules.

		Maximum # of trucks per day	Average # of trucks per day
4 day haul	Monday, Tuesday, Thursday, Friday	72	26
3 day haul	Monday, Wednesday, Friday	96	35
	Number of weeks with guppies	Max. number of guppies**	
Midday only	8	3	
Morning and Midday	4	1	
Midday and Evening	4	1	
Morning, Midday and Evening	1	1	

** This number of guppies would need to be on site every day during that given week*

All solutions would be able to sustain maximum RCC production for the required amount of time. The major difference between these scenarios from an engineering standpoint is that more surge storage would be required at the 88th rail yard for the 5-day and 4-day haul schedules. The 6-day haul schedule would require no surge storage, which would make for a more cost effective solution.

Additional Solutions

These results are somewhat flexible. For example, if the community doesn't want any trucks to be in the canyon in the morning or evening, the haul window could be reduced to the 3-hours in the middle of the day. However, the storage would need to be increased on site in order to maintain maximum production and would increase the project costs and risks.

Further potential solutions could be using different hauling schedules during the maximum production periods or using cement guppies or pigs in order to temporarily increase site storage during these periods.

EMAIL CLARIFICATION

From:	Waldman, Ben
To:	Etemadnia, Hamideh
Subject:	FW: GRE - Cement and Fly Ash Haul Study
Date:	Friday, August 17, 2018 8:33:32 AM
Attachments:	image005.png image007.png

Here is the latest email chain related to GRE cement and fly ash delivery.

Ben Waldman, P.E., PTOE
Transportation Specialist
2000 S. Colorado Boulevard, Suite 2-300
Denver, CO 80222
Phone: (303) 285-4511

From: Arnold, Terry <Terry.Arnold@aecom.com>
Sent: Thursday, August 2, 2018 8:52 AM
To: Raitt, Douglas M. <Douglas.Raitt@denverwater.org>; Garcia, Felipe <felipe.garcia@stantec.com>; Pratt, Rob <rob.pratt@stantec.com>
Cc: Waldman, Ben <Ben.Waldman@stantec.com>; Rogers, Michael <michael.rogers@stantec.com>; Zamensky, Greg A. <Greg.Zamensky@denverwater.org>; Gudenkauf, Keith <keith.gudenkauf@stantec.com>; Gleason, Erin <Erin.Gleason@denverwater.org>
Subject: RE: GRE - Cement and Fly Ash Haul Study

Too all,

Note, then key to shortening delivery days/hours is on- site storage to keep up a minimum of a 6 day RCC placement per week. It would be good to have an on-site storage capacity with any cement and flyash delivery schedule so that this can be used for sizing storage areas on-site and for the estimated construction cost.

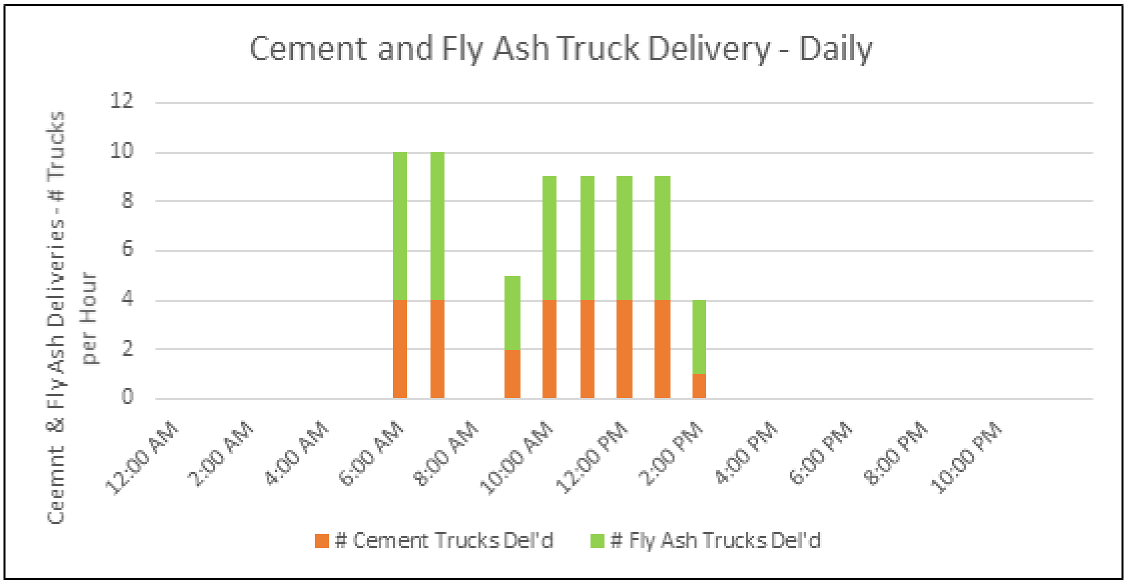
Terry

From: Raitt, Douglas M. [mailto:Douglas.Raitt@denverwater.org]
Sent: Thursday, August 02, 2018 6:46 AM
To: Garcia, Felipe <felipe.garcia@stantec.com>; Pratt, Rob <rob.pratt@stantec.com>
Cc: Waldman, Ben <Ben.Waldman@stantec.com>; Rogers, Michael <michael.rogers@stantec.com>; Arnold, Terry <Terry.Arnold@aecom.com>; Zamensky, Greg A. <Greg.Zamensky@denverwater.org>; Gudenkauf, Keith <keith.gudenkauf@stantec.com>; Gleason, Erin <Erin.Gleason@denverwater.org>
Subject: RE: GRE - Cement and Fly Ash Haul Study

Felipe,

To accomplish the peak RCC production of 5,140 CY/day I leveled cement (4) and fly ash (6) deliveries for a total of 10 trucks per hour for a 4 day delivery window avoiding the bus windows. Anticipating some bunching of trucks on the road and possibly less than 25 tons per truck, a value of 15 trucks per hour would be conservative and appropriate.

Doug



Douglas Raitt, P.E. | Engineering | Engineering Manager - Construction
Denver Water | t: 303.628.6426 | c: 720.837.7288
1600 West 12th Ave. | Denver, CO 80204-3412 (Mail Code 554)
douglas.raitt@denverwater.org | http://www.denverwater.org

INTEGRITY | VISION | PASSION | EXCELLENCE | RESPECT

From: Garcia, Felipe [mailto:felipe.garcia@stantec.com]
Sent: Wednesday, August 1, 2018 4:02 PM
To: Raitt, Douglas M. <Douglas.Raitt@denverwater.org>; Pratt, Rob <rob.pratt@stantec.com>
Cc: Waldman, Ben <Ben.Waldman@stantec.com>; Rogers, Michael <michael.rogers@stantec.com>; Arnold, Terry <Terry.Arnold@aecom.com>; Zamensky, Greg A. <Greg.Zamensky@denverwater.org>; Gudenkauf, Keith <keith.gudenkauf@stantec.com>; Gleason, Erin <Erin.Gleason@denverwater.org>
Subject: RE: GRE - Cement and Fly Ash Haul Study

Hi Doug – Thanks for the information and the update on the model. I think that both models are reasonably close considering that your model shows 5 trucks per hour, and ours shows 7 trucks per hour.

For the purposes of the Traffic Control Plan – 60% DM I would suggest to include a paragraph to describe that a model was developed to evaluate the RCC placement, and number of cement/fly ash trucks throughout the duration of the project. The results of the model show that the number of trucks per hour could range between 2 and 7 depending on stage of construction and other factors. For the purposes of this traffic impact study, the number of cement/fly ash trucks has been conservatively assumed to be 15 trucks per hour.

Please let us know if you agree with this approach.

Regards,
Felipe

From: Raitt, Douglas M. [mailto:Douglas.Raitt@denverwater.org]
Sent: Wednesday, August 01, 2018 3:23 PM
To: Pratt, Rob <rob.pratt@stantec.com>
Cc: Waldman, Ben <Ben.Waldman@stantec.com>; Garcia, Felipe <felipe.garcia@stantec.com>; Rogers, Michael <michael.rogers@stantec.com>; Arnold, Terry <Terry.Arnold@aecom.com>; Zamensky, Greg A. <Greg.Zamensky@denverwater.org>; Gudenkauf, Keith <keith.gudenkauf@stantec.com>; Gleason, Erin <Erin.Gleason@denverwater.org>
Subject: GRE - Cement and Fly Ash Haul Study

Rob,

I took the most recent mix design and concrete quantity data and modeled the truck deliveries for cement and fly ash with a 4 day haul constraint.
I also considered the bus windows that occur twice per day.
You can use this as you deem appropriate for your ongoing traffic studies.

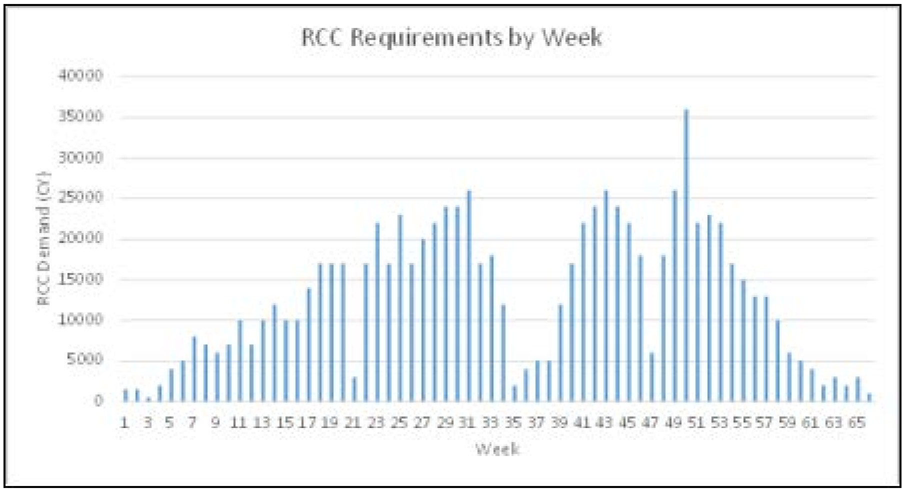
Keith, I observe that we'll need space for at least 5 offloading stations near the batch plant for cement and fly-ash deliveries to support timely return of vehicles to the originating terminals.

For consideration.

Doug

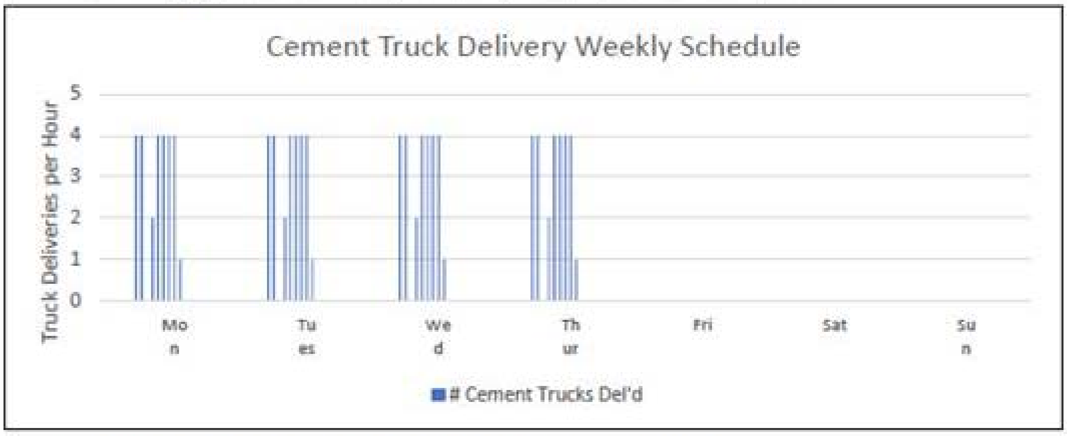
Assumptions:

Weekly RCC Placement Quantity	36,000	CY
Number of Placing Days per Week	7	days
Daily RCC Placing Quantity	5,140	CY
Cement Qty/cy	150	Lbs
Fly Ash Qty/cy	210	Lbs
Daily Cement Consumption	385.5	Tons
Daily Fly Ash Consumption	539.7	Tons
Number of Cement and Fly Ash Delivery Days per Week	4	Days/Week
Qty of Cement and Fly Ash per Truck per Truck	25	Tons
# of Cement Unloading Blowers	2	Ea
Cement Unloading Capacity per Blower	50	Tons/Hr
# of Fly Ash Unloading Blowers	3	Ea
Fly Ash Unloading Capacity per Blower	50	Tons/Hr

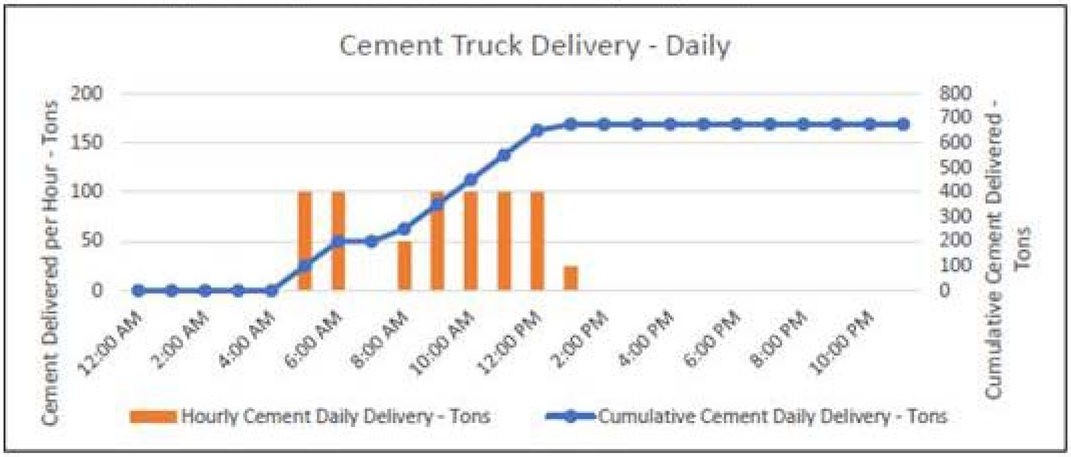


RCC Requirements by Week
RCC Demand (CY)
Week

Cement Delivery Approach - Monday - Thursday Delivery - 36k CY RCC /Week

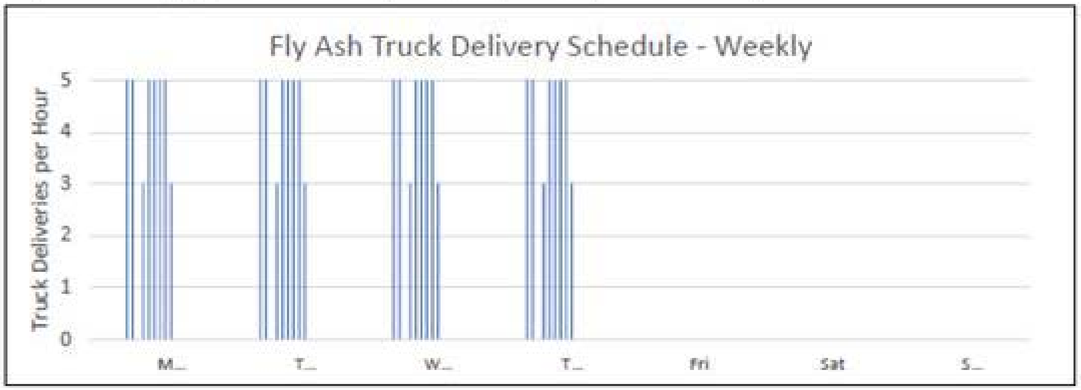


Cement Delivery - 25 Tons per Truck - 2 Offload Blowers @ 50T/Hr Ea.



Weekly Cement Storage for 36k RCC Week - 1,000 Tons Reserve

Fly Ash Delivery Approach - Monday - Thursday Delivery - 36k CY RCC /Week



Fly Ash Delivery - 25 Tons per Truck - 3 Offload Blowers @ 50T/Hr Ea.

Weekly Fly Ash Storage for 36k RCC Week - 1,000 Tons Reserve

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APPENDIX C

SYNCHRO ANALYSIS RESULTS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	87	1	1	52	0	0	0	0	2	0	3
Future Volume (Veh/h)	5	87	1	1	52	0	0	0	0	2	0	3
Sign Control		Free			Free			Stop			Stop	
Grade		-7%			7%			0%			9%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	95	1	1	57	0	0	0	0	2	0	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	57			96			168	164	96	164	165	57
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	57			96			168	164	96	164	165	57
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	1547			1498			792	725	961	797	724	1009

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	101	58	0	5
Volume Left	5	1	0	2
Volume Right	1	0	0	3
cSH	1547	1498	1700	912
Volume to Capacity	0.00	0.00	0.00	0.01
Queue Length 95th (ft)	0	0	0	0
Control Delay (s)	0.4	0.1	0.0	9.0
Lane LOS	A	A	A	A
Approach Delay (s)	0.4	0.1	0.0	9.0
Approach LOS			A	A

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	17.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	0	1	7	1	2	6
Future Volume (Veh/h)	0	1	7	1	2	6
Sign Control	Free			Free	Stop	
Grade	-9%			9%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1	8	1	2	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1		18	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1		18	0
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	99
cM capacity (veh/h)			1622		995	1084

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	1	9	9
Volume Left	0	8	2
Volume Right	1	0	7
cSH	1700	1622	1063
Volume to Capacity	0.00	0.00	0.01
Queue Length 95th (ft)	0	0	1
Control Delay (s)	0.0	6.4	8.4
Lane LOS		A	A
Approach Delay (s)	0.0	6.4	8.4
Approach LOS			A

Intersection Summary			
Average Delay	7.0		
Intersection Capacity Utilization	16.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	10	130	5	5	80	50	5	5	5	20	5	5
Future Volume (Veh/h)	10	130	5	5	80	50	5	5	5	20	5	5
Sign Control		Free			Free			Stop			Stop	
Grade		-7%			7%			0%			9%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	141	5	5	87	54	5	5	5	22	5	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	141			146			297	316	144	297	292	114
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	141			146			297	316	144	297	292	114
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			99	99	99	97	99	99
cM capacity (veh/h)	1442			1436			642	593	904	641	611	938

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	157	146	15	32
Volume Left	11	5	5	22
Volume Right	5	54	5	5
cSH	1442	1436	690	669
Volume to Capacity	0.01	0.00	0.02	0.05
Queue Length 95th (ft)	1	0	2	4
Control Delay (s)	0.6	0.3	10.3	10.7
Lane LOS	A	A	B	B
Approach Delay (s)	0.6	0.3	10.3	10.7
Approach LOS			B	B

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	21.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	50	5	15	20	5	10
Future Volume (Veh/h)	50	5	15	20	5	10
Sign Control	Free			Free	Stop	
Grade	-9%			9%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	54	5	16	22	5	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			59		110	56
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			59		110	56
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	99
cM capacity (veh/h)			1545		877	1010

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	59	38	16
Volume Left	0	16	5
Volume Right	5	0	11
cSH	1700	1545	964
Volume to Capacity	0.03	0.01	0.02
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	3.1	8.8
Lane LOS		A	A
Approach Delay (s)	0.0	3.1	8.8
Approach LOS			A

Intersection Summary			
Average Delay	2.3		
Intersection Capacity Utilization	18.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	130	5	5	80	151	5	5	5	20	5	5
Future Volume (Veh/h)	10	130	5	5	80	151	5	5	5	20	5	5
Sign Control		Free			Free			Stop			Stop	
Grade		-7%			7%			0%			9%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	141	5	5	87	164	5	5	5	22	5	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	251			146			270	426	144	270	265	87
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	251			146			270	426	144	270	265	87
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			99	99	99	97	99	99
cM capacity (veh/h)	1314			1436			669	514	904	667	632	971

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	157	92	164	15	32
Volume Left	11	5	0	5	22
Volume Right	5	0	164	5	5
cSH	1314	1436	1700	660	695
Volume to Capacity	0.01	0.00	0.10	0.02	0.05
Queue Length 95th (ft)	1	0	0	2	4
Control Delay (s)	0.6	0.4	0.0	10.6	10.4
Lane LOS	A	A		B	B
Approach Delay (s)	0.6	0.2		10.6	10.4
Approach LOS				B	B

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	30.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	151	5	15	20	5	10
Future Volume (Veh/h)	151	5	15	20	5	10
Sign Control	Free			Free	Stop	
Grade	-9%			9%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	164	5	16	22	5	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			169		220	166
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			169		220	166
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	99
cM capacity (veh/h)			1409		759	878

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	169	38	16
Volume Left	0	16	5
Volume Right	5	0	11
cSH	1700	1409	837
Volume to Capacity	0.10	0.01	0.02
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	3.2	9.4
Lane LOS		A	A
Approach Delay (s)	0.0	3.2	9.4
Approach LOS			A

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	24.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	130	5	5	80	202	5	5	5	20	5	5
Future Volume (Veh/h)	10	130	5	5	80	202	5	5	5	20	5	5
Sign Control		Free			Free			Stop			Stop	
Grade		-7%			7%			0%			9%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	141	5	5	87	220	5	5	5	22	5	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	307			146			270	482	144	270	265	87
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	307			146			270	482	144	270	265	87
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			99	99	99	97	99	99
cM capacity (veh/h)	1254			1436			669	478	904	666	632	971

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	157	92	220	15	32
Volume Left	11	5	0	5	22
Volume Right	5	0	220	5	5
cSH	1254	1436	1700	639	694
Volume to Capacity	0.01	0.00	0.13	0.02	0.05
Queue Length 95th (ft)	1	0	0	2	4
Control Delay (s)	0.6	0.4	0.0	10.8	10.4
Lane LOS	A	A		B	B
Approach Delay (s)	0.6	0.1		10.8	10.4
Approach LOS				B	B

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	33.5%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	202	5	15	20	5	10
Future Volume (Veh/h)	202	5	15	20	5	10
Sign Control	Free			Free	Stop	
Grade	-9%			9%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	220	5	16	22	5	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			225		276	222
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			225		276	222
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	99
cM capacity (veh/h)			1344		705	817

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	225	38	16
Volume Left	0	16	5
Volume Right	5	0	11
cSH	1700	1344	778
Volume to Capacity	0.13	0.01	0.02
Queue Length 95th (ft)	0	1	2
Control Delay (s)	0.0	3.3	9.7
Lane LOS		A	A
Approach Delay (s)	0.0	3.3	9.7
Approach LOS			A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	24.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	130	5	5	80	100	5	5	5	71	5	5
Future Volume (Veh/h)	10	130	5	5	80	100	5	5	5	71	5	5
Sign Control		Free			Free			Stop			Stop	
Grade		-7%			7%			0%			9%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	141	5	5	87	109	5	5	5	77	5	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	196			146			270	372	144	270	265	87
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	196			146			270	372	144	270	265	87
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			99	99	99	88	99	99
cM capacity (veh/h)	1377			1436			669	552	904	667	632	971

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	157	92	109	15	87
Volume Left	11	5	0	5	77
Volume Right	5	0	109	5	5
cSH	1377	1436	1700	680	677
Volume to Capacity	0.01	0.00	0.06	0.02	0.13
Queue Length 95th (ft)	1	0	0	2	11
Control Delay (s)	0.6	0.4	0.0	10.4	11.1
Lane LOS	A	A		B	B
Approach Delay (s)	0.6	0.2		10.4	11.1
Approach LOS				B	B

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	31.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	100	5	15	71	5	10
Future Volume (Veh/h)	100	5	15	71	5	10
Sign Control	Free			Free	Stop	
Grade	-9%			9%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	109	5	16	77	5	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			114		220	112
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			114		220	112
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	99
cM capacity (veh/h)			1475		759	942

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	114	93	16
Volume Left	0	16	5
Volume Right	5	0	11
cSH	1700	1475	876
Volume to Capacity	0.07	0.01	0.02
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	1.4	9.2
Lane LOS		A	A
Approach Delay (s)	0.0	1.4	9.2
Approach LOS			A

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	21.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	130	5	5	80	151	5	5	5	71	5	5
Future Volume (Veh/h)	10	130	5	5	80	151	5	5	5	71	5	5
Sign Control		Free			Free			Stop			Stop	
Grade		-7%			7%			0%			9%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	141	5	5	87	164	5	5	5	77	5	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	251			146			270	426	144	270	265	87
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	251			146			270	426	144	270	265	87
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			99	99	99	88	99	99
cM capacity (veh/h)	1314			1436			669	514	904	667	632	971

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	SB 1
Volume Total	157	92	164	15	87
Volume Left	11	5	0	5	77
Volume Right	5	0	164	5	5
cSH	1314	1436	1700	660	677
Volume to Capacity	0.01	0.00	0.10	0.02	0.13
Queue Length 95th (ft)	1	0	0	2	11
Control Delay (s)	0.6	0.4	0.0	10.6	11.1
Lane LOS	A	A		B	B
Approach Delay (s)	0.6	0.2		10.6	11.1
Approach LOS				B	B

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	31.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	151	5	15	71	5	10
Future Volume (Veh/h)	151	5	15	71	5	10
Sign Control	Free			Free	Stop	
Grade	-9%			9%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	164	5	16	77	5	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			169		276	166
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			169		276	166
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		99	99
cM capacity (veh/h)			1409		706	878

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	169	93	16
Volume Left	0	16	5
Volume Right	5	0	11
cSH	1700	1409	816
Volume to Capacity	0.10	0.01	0.02
Queue Length 95th (ft)	0	1	1
Control Delay (s)	0.0	1.4	9.5
Lane LOS		A	A
Approach Delay (s)	0.0	1.4	9.5
Approach LOS			A

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	26.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	1	1	0	0	19	6	197	1	20	125	8
Future Volume (Veh/h)	4	1	1	0	0	19	6	197	1	20	125	8
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	1	1	0	0	21	7	214	1	22	136	9
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	434	414	140	414	418	214	145			215		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	434	414	140	414	418	214	145			215		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	100	100	100	97	100			98		
cM capacity (veh/h)	510	518	907	538	515	825	1437			1355		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	6	21	222	167
Volume Left	4	0	7	22
Volume Right	1	21	1	9
cSH	552	825	1437	1355
Volume to Capacity	0.01	0.03	0.00	0.02
Queue Length 95th (ft)	1	2	0	1
Control Delay (s)	11.6	9.5	0.3	1.1
Lane LOS	B	A	A	A
Approach Delay (s)	11.6	9.5	0.3	1.1
Approach LOS	B	A		

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	27.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	5	5	5	5	30	10	260	5	30	165	15
Future Volume (Veh/h)	10	5	5	5	5	30	10	260	5	30	165	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.75	0.25	0.50	0.25	0.25	0.61	0.75	0.82	0.50	0.56	0.93	0.67
Hourly flow rate (vph)	13	20	10	20	20	49	13	317	10	54	177	22
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	703	649	188	664	655	322	199			327		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	703	649	188	664	655	322	199			327		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	95	99	94	95	93	99			96		
cM capacity (veh/h)	304	370	859	343	368	724	1385			1216		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	43	89	340	253
Volume Left	13	20	13	54
Volume Right	10	49	10	22
cSH	397	493	1385	1216
Volume to Capacity	0.11	0.18	0.01	0.04
Queue Length 95th (ft)	9	16	1	3
Control Delay (s)	15.2	13.9	0.4	2.0
Lane LOS	C	B	A	A
Approach Delay (s)	15.2	13.9	0.4	2.0
Approach LOS	C	B		

Intersection Summary			
Average Delay	3.5		
Intersection Capacity Utilization	32.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	5	5	5	5	30	10	260	17	30	165	15
Future Volume (Veh/h)	10	5	5	5	5	30	10	260	17	30	165	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.75	0.25	0.50	0.25	0.25	0.61	0.75	0.82	0.50	0.56	0.93	0.67
Hourly flow rate (vph)	13	20	10	20	20	49	13	317	34	54	177	22
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	715	673	188	676	667	334	199			351		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	715	673	188	676	667	334	199			351		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	94	99	94	94	93	99			95		
cM capacity (veh/h)	298	359	859	336	361	712	1385			1191		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	43	89	364	253
Volume Left	13	20	13	54
Volume Right	10	49	34	22
cSH	387	485	1385	1191
Volume to Capacity	0.11	0.18	0.01	0.05
Queue Length 95th (ft)	9	17	1	4
Control Delay (s)	15.5	14.1	0.4	2.1
Lane LOS	C	B	A	A
Approach Delay (s)	15.5	14.1	0.4	2.1
Approach LOS	C	B		

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	33.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	5	5	17	5	30	10	260	5	30	165	15
Future Volume (Veh/h)	10	5	5	17	5	30	10	260	5	30	165	15
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.75	0.25	0.50	0.25	0.25	0.61	0.75	0.82	0.50	0.56	0.93	0.67
Hourly flow rate (vph)	13	20	10	68	20	49	13	317	10	54	177	22
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	703	649	188	664	655	322	199			327		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	703	649	188	664	655	322	199			327		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	96	95	99	80	95	93	99			96		
cM capacity (veh/h)	304	370	859	343	368	724	1385			1216		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	43	137	340	253
Volume Left	13	68	13	54
Volume Right	10	49	10	22
cSH	397	427	1385	1216
Volume to Capacity	0.11	0.32	0.01	0.04
Queue Length 95th (ft)	9	34	1	3
Control Delay (s)	15.2	17.3	0.4	2.0
Lane LOS	C	C	A	A
Approach Delay (s)	15.2	17.3	0.4	2.0
Approach LOS	C	C		

Intersection Summary			
Average Delay	4.8		
Intersection Capacity Utilization	32.8%	ICU Level of Service	A
Analysis Period (min)	15		

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APPENDIX D

GROSS DAM ROAD PRELIMINARY RECOMMENDATIONS FOR IMPROVEMENTS

Exhibits 1 through 12 illustrate the AutoTurn analysis for each area of concern on Gross Dam Road.

ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	10/03/2018

EXHIBIT 1A

DENVER WATER

1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 1

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	10/03/2018

EXHIBIT 1B

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	10/03/2018

EXHIBIT 1C

DENVER WATER

1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

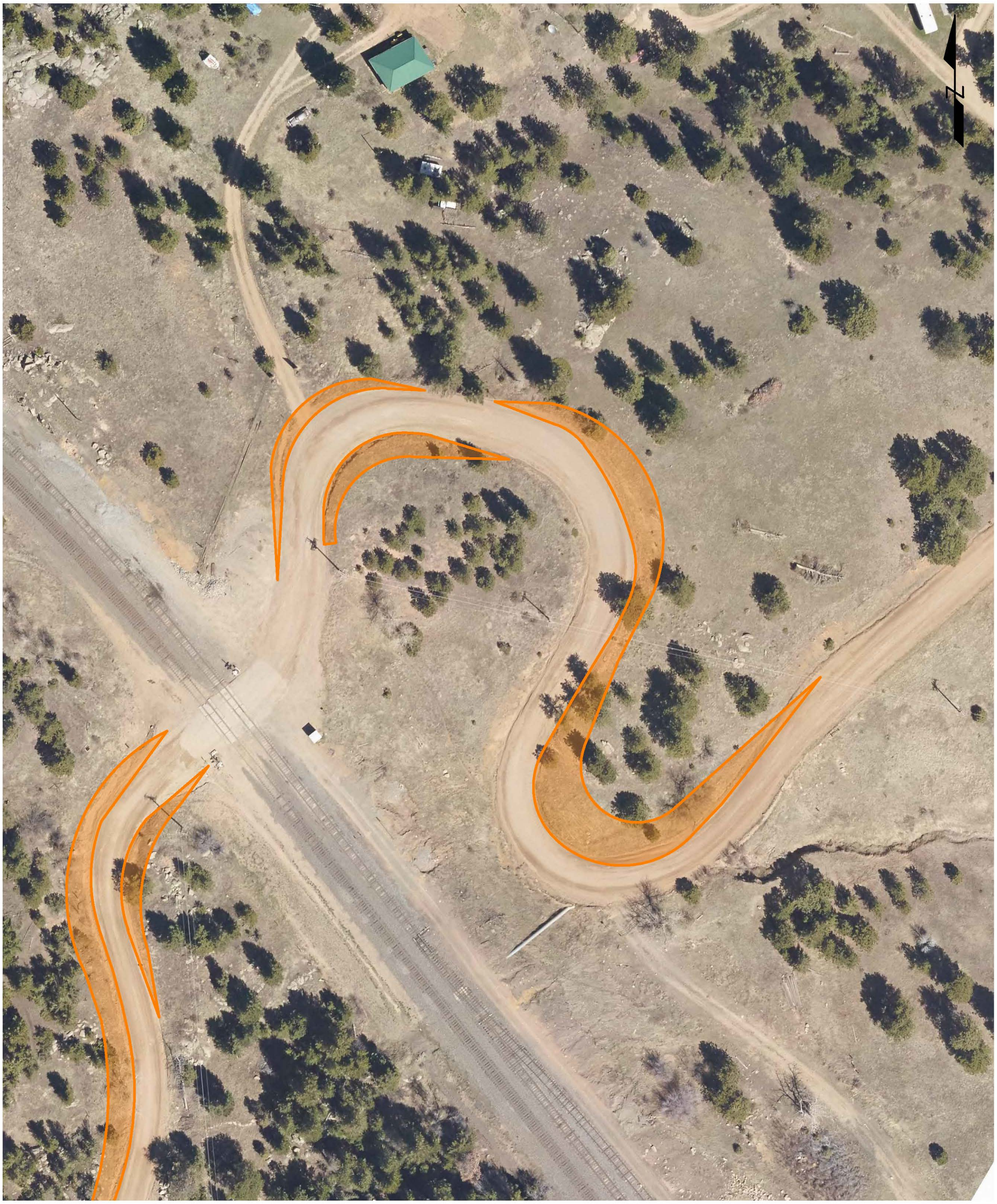
ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 2

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org



ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 3

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 4

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

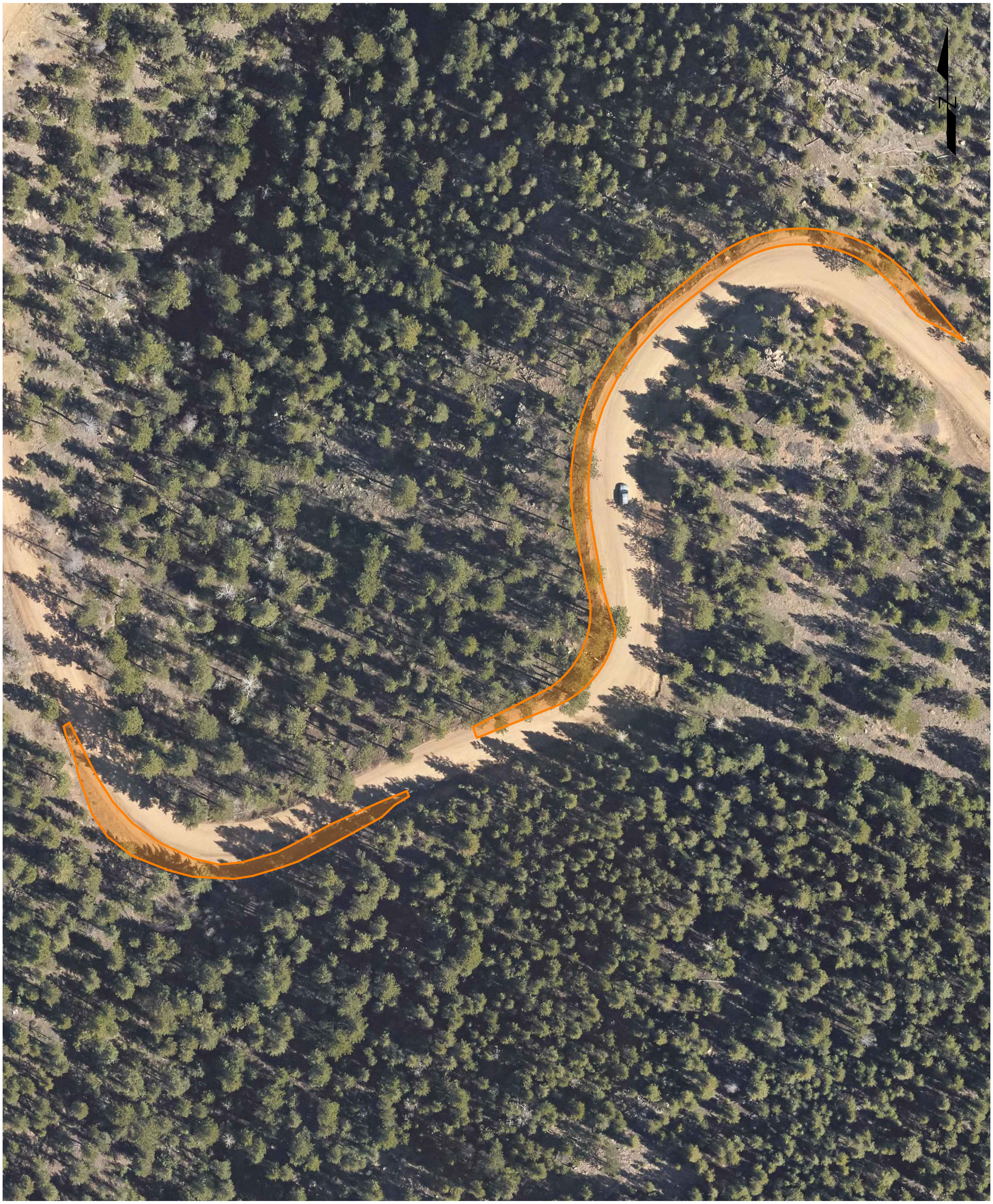
Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 5

DENVER WATER

1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org



ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 6

DENVER WATER

1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	10/03/2018

EXHIBIT 6A

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 7

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

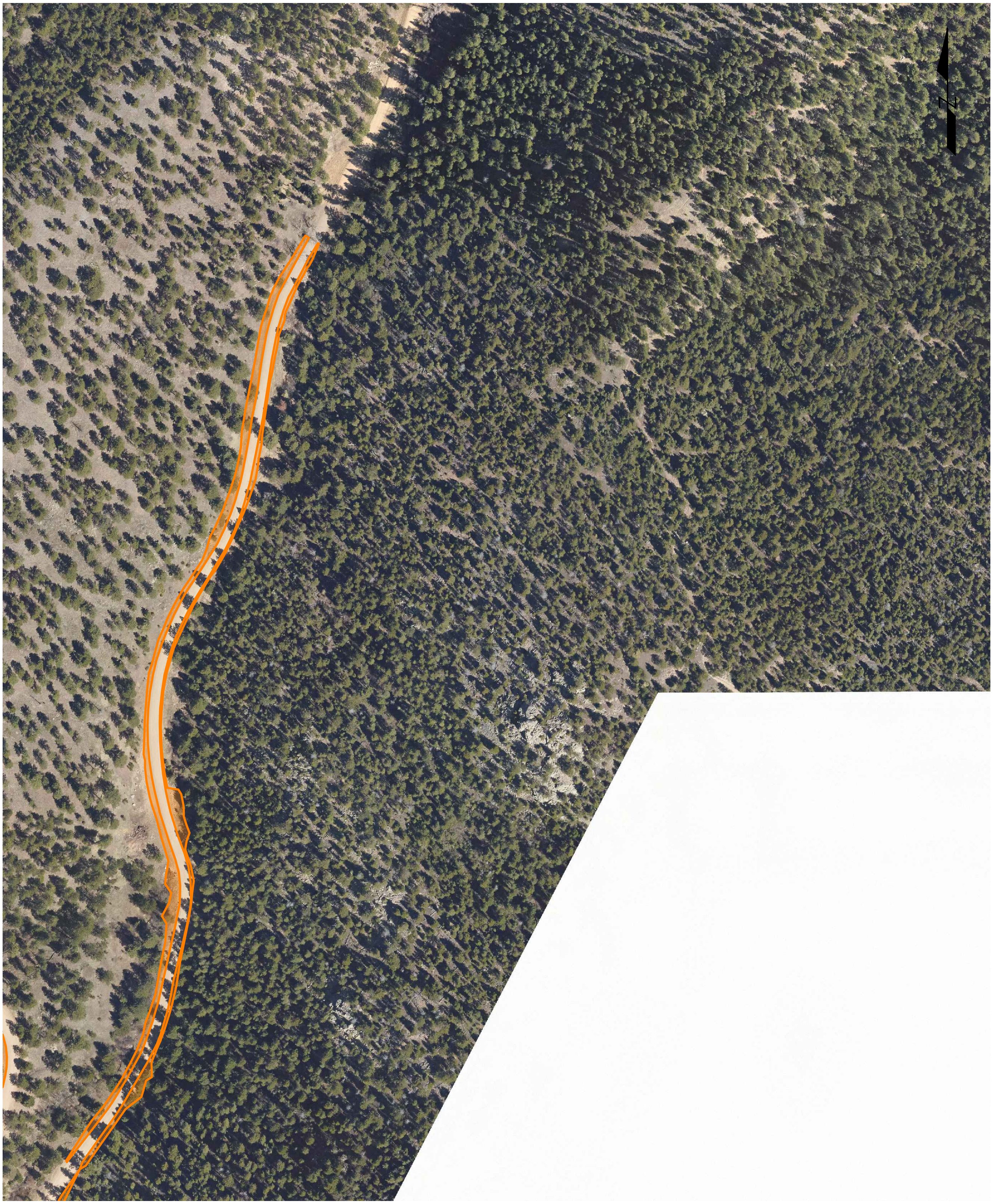
ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 8

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org



ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	10/03/2018

EXHIBIT 8A

DENVER WATER

1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB–50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 9

DENVER WATER

1600 West 12th Ave
Denver, Colorado 80204–3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 10

DENVER WATER

1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 11

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

ROADWAY IMPROVEMENT TO ACCOMMODATE WB-50'S PASSING

Stantec

DRAWN BY:	M. WOLF
CHKD BY:	R. PRATT
APPD BY:	R. PRATT
ORIGINATION DATE:	2/28/2018
REVISION DATE:	2/28/2018

EXHIBIT 12

DENVER WATER
1600 West 12th Ave
Denver, Colorado 80204-3412
T: 303.628.6000
F: 303.628.6851
denverwater.org

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APPENDIX E

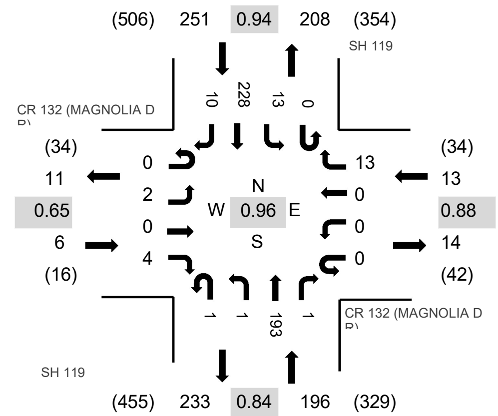
COLLECTED TRAFFIC COUNTS (2018)

All Traffic Data Services Inc.

(303) 216-2439
www.alltrafficdata.net

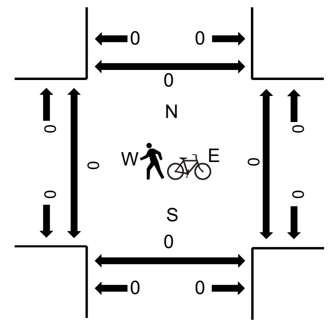
Location: 1 SH 119 & CR 132 (MAGNOLIA DR) PM
Date: Thursday, September 13, 2018
Peak Hour: 04:00 PM - 05:00 PM
Peak 15-Minutes: 04:45 PM - 05:00 PM

Peak Hour - All Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles on Crosswalk



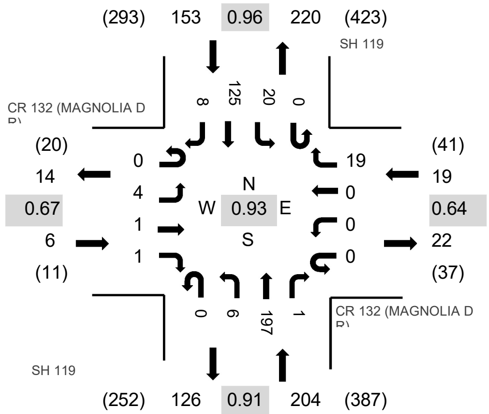
Traffic Counts

Interval Start Time	CR 132 (MAGNOLIA DR) Eastbound U-Turn	Left	Thru	Right	CR 132 (MAGNOLIA DR) Westbound U-Turn	Left	Thru	Right	SH 119 Northbound U-Turn	Left	Thru	Right	SH 119 Southbound U-Turn	Left	Thru	Right	Total	Rolling Hour	Pedestrian Crossings West	East	South	North
4:00 PM	0	0	0	2	0	0	0	3	0	0	58	0	0	0	42	5	110	466	0	0	0	0
4:15 PM	0	1	0	0	0	0	0	4	0	1	51	0	0	5	55	1	118	462	0	0	0	0
4:30 PM	0	0	0	0	0	0	0	5	1	0	42	1	0	1	65	2	117	459	0	0	0	0
4:45 PM	0	1	0	2	0	0	0	1	0	0	42	0	0	7	66	2	121	450	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	4	0	1	30	2	0	8	54	7	106	419	0	0	0	0
5:15 PM	0	0	0	5	0	0	1	5	0	1	33	0	0	8	59	3	115		0	0	0	0
5:30 PM	0	3	1	1	0	0	1	5	0	2	39	0	0	4	51	1	108		0	0	0	0
5:45 PM	0	0	0	0	0	0	1	4	0	1	23	1	0	4	52	4	90		0	0	1	0
Count Total	0	5	1	10	0	0	3	31	1	6	318	4	0	37	444	25	885		0	0	1	0
Peak Hour	0	2	0	4	0	0	0	13	1	1	193	1	0	13	228	10	466		0	0	0	0

(303) 216-2439
www.alltrafficdata.net

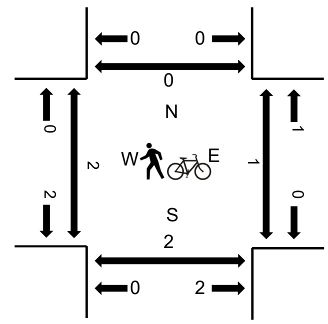
Location: 1 SH 119 & CR 132 (MAGNOLIA DR) AM
Date: Thursday, September 13, 2018
Peak Hour: 09:30 AM - 10:30 AM
Peak 15-Minutes: 09:45 AM - 10:00 AM

Peak Hour - All Vehicles



Note: Total study counts contained in parentheses.

Peak Hour - Pedestrians/Bicycles on Crosswalk



Traffic Counts

Interval Start Time	CR 132 (MAGNOLIA DR) Eastbound U-Turn	Left	Thru	Right	CR 132 (MAGNOLIA DR) Westbound U-Turn	Left	Thru	Right	SH 119 Northbound U-Turn	Left	Thru	Right	SH 119 Southbound U-Turn	Left	Thru	Right	Total	Rolling Hour	Pedestrian Crossings West	East	South	North
9:00 AM	0	1	0	0	0	1	0	5	0	0	39	1	0	7	26	1	81	357	0	0	0	0
9:15 AM	0	0	0	0	0	0	0	2	0	0	34	0	0	2	33	0	71	360	0	0	0	0
9:30 AM	0	0	0	0	0	0	0	6	0	2	54	0	0	5	34	1	102	382	0	0	0	0
9:45 AM	0	1	1	0	0	0	0	9	0	2	52	1	0	3	31	3	103	366	0	0	0	0
10:00 AM	0	2	0	1	0	0	0	1	0	2	40	0	0	9	28	1	84	375	0	0	0	0
10:15 AM	0	1	0	0	0	0	0	3	0	0	51	0	0	3	32	3	93		1	0	1	0
10:30 AM	0	2	0	0	0	0	2	4	0	0	47	1	0	1	28	1	86		2	0	0	0
10:45 AM	0	1	0	1	0	1	0	7	0	0	61	0	0	3	36	2	112		1	0	0	0
Count Total	0	8	1	2	0	2	2	37	0	6	378	3	0	33	248	12	732		4	0	1	0
Peak Hour	0	4	1	1	0	0	0	19	0	6	197	1	0	20	125	8	382		1	0	1	0

All Traffic Data Services
Wheat Ridge, CO 80033

Site Code: 2
Station ID:
FR 359 W/O GROSS RES

Latitude: 0' 0.0000 Undefined

Start Time	13-Sep-18 Thu	EB	WB							Total
12:00 AM		0	0							0
01:00		2	1							3
02:00		0	0							0
03:00		0	0							0
04:00		0	0							0
05:00		0	0							0
06:00		0	0							0
07:00		0	0							0
08:00		0	0							0
09:00		0	1							1
10:00		**5**	**2**							**7**
11:00		2	1							3
12:00 PM		**4**	4							8
01:00		0	1							1
02:00		0	1							1
03:00		1	3							4
04:00		1	0							1
05:00		1	0							1
06:00		3	**6**							**9**
07:00		3	1							4
08:00		3	0							3
09:00		0	2							2
10:00		2	0							2
11:00		0	0							0
Total		27	23							50
Percent		54.0%	46.0%							
AM Peak	-	10:00	10:00	-	-	-	-	-	-	10:00
Vol.	-	5	2	-	-	-	-	-	-	7
PM Peak	-	12:00	18:00	-	-	-	-	-	-	18:00
Vol.	-	4	6	-	-	-	-	-	-	9

All Traffic Data Services
Wheat Ridge, CO 80033

Site Code: 2
Station ID:
FR 359 W/O GROSS RES

Latitude: 0' 0.0000 Undefined

Start Time	14-Sep-18 Fri	EB	WB							Total
12:00 AM		0	0							0
01:00		0	0							0
02:00		0	0							0
03:00		0	0							0
04:00		0	0							0
05:00		0	0							0
06:00		0	0							0
07:00		0	0							0
08:00		0	1							1
09:00		0	0							0
10:00		**2**	0							**2**
11:00		0	**2**							2
12:00 PM		2	1							3
01:00		3	2							5
02:00		5	**4**							9
03:00		4	1							5
04:00		5	3							8
05:00		**9**	0							9
06:00		6	4							10
07:00		8	0							8
08:00		8	3							**11**
09:00		3	1							4
10:00		3	1							4
11:00		1	1							2
Total		59	24							83
Percent		71.1%	28.9%							
AM Peak	-	10:00	11:00	-	-	-	-	-	-	10:00
Vol.	-	2	2	-	-	-	-	-	-	2
PM Peak	-	17:00	14:00	-	-	-	-	-	-	20:00
Vol.	-	9	4	-	-	-	-	-	-	11

All Traffic Data Services
Wheat Ridge, CO 80033

Site Code: 2
Station ID:
FR 359 W/O GROSS RES

Latitude: 0' 0.0000 Undefined

Start Time	15-Sep-18 Sat	EB	WB							Total
12:00 AM		4	0							4
01:00		0	0							0
02:00		0	0							0
03:00		0	0							0
04:00		0	0							0
05:00		3	3							6
06:00		4	1							5
07:00		2	3							5
08:00		**5**	**10**							**15**
09:00		4	9							13
10:00		4	4							8
11:00		3	9							12
12:00 PM		2	5							7
01:00		2	1							3
02:00		3	2							5
03:00		6	**6**							**12**
04:00		4	5							9
05:00		6	3							9
06:00		6	2							8
07:00		**7**	2							9
08:00		0	0							0
09:00		1	1							2
10:00		0	0							0
11:00		0	0							0
Total		66	66							132
Percent		50.0%	50.0%							
AM Peak	-	08:00	08:00	-	-	-	-	-	-	08:00
Vol.	-	5	10	-	-	-	-	-	-	15
PM Peak	-	19:00	15:00	-	-	-	-	-	-	15:00
Vol.	-	7	6	-	-	-	-	-	-	12
Grand Total		152	113							265
Percent		57.4%	42.6%							
ADT		ADT 79		AADT 79						

All Traffic Data

Wheat Ridge, CO 80033

Date Start: 13-Sep-18
Date End: 15-Sep-18
Site Code: 3
LAZY Z (CR97E) S/O CR 132

Start Time	13-Sep-18 Thu	NB	SB							Total
12:00 AM		0	2							2
01:00		0	1							1
02:00		0	1							1
03:00		0	0							0
04:00		3	1							4
05:00		7	0							7
06:00		9	1							10
07:00		**34**	6							**40**
08:00		27	6							33
09:00		16	**13**							29
10:00		15	10							25
11:00		14	7							21
12:00 PM		8	9							17
01:00		13	12							25
02:00		**17**	7							24
03:00		13	21							34
04:00		7	8							15
05:00		10	**26**							**36**
06:00		8	26							34
07:00		6	25							31
08:00		1	13							14
09:00		3	7							10
10:00		2	3							5
11:00		1	1							2
Total		214	206							420
Percent		51.0%	49.0%							
AM Peak	-	07:00	09:00	-	-	-	-	-	-	07:00
Vol.	-	34	13	-	-	-	-	-	-	40
PM Peak	-	14:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	17	26	-	-	-	-	-	-	36

All Traffic Data

Wheat Ridge, CO 80033

Date Start: 13-Sep-18
Date End: 15-Sep-18
Site Code: 3
LAZY Z (CR97E) S/O CR 132

Start Time	14-Sep-18 Fri	NB	SB							Total
12:00 AM		0	2							2
01:00		0	1							1
02:00		0	1							1
03:00		0	0							0
04:00		3	1							4
05:00		3	0							3
06:00		10	0							10
07:00		**29**	5							**34**
08:00		22	5							27
09:00		16	5							21
10:00		18	6							24
11:00		14	**7**							21
12:00 PM		10	19							29
01:00		10	17							27
02:00		18	17							35
03:00		10	21							31
04:00		15	15							30
05:00		**19**	**23**							**42**
06:00		7	16							23
07:00		8	19							27
08:00		4	13							17
09:00		2	9							11
10:00		2	10							12
11:00		0	6							6
Total		220	218							438
Percent		50.2%	49.8%							
AM Peak	-	07:00	11:00	-	-	-	-	-	-	07:00
Vol.	-	29	7	-	-	-	-	-	-	34
PM Peak	-	17:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	19	23	-	-	-	-	-	-	42

All Traffic Data

Wheat Ridge, CO 80033

Date Start: 13-Sep-18
Date End: 15-Sep-18
Site Code: 3
LAZY Z (CR97E) S/O CR 132

Start Time	15-Sep-18 Sat	NB	SB							Total
12:00 AM		0	3							3
01:00		0	1							1
02:00		0	3							3
03:00		0	0							0
04:00		2	1							3
05:00		5	0							5
06:00		7	0							7
07:00		8	0							8
08:00		16	2							18
09:00		**23**	8							**31**
10:00		15	9							24
11:00		13	**14**							27
12:00 PM		**16**	9							25
01:00		11	12							23
02:00		9	15							24
03:00		3	**17**							20
04:00		13	10							23
05:00		12	14							**26**
06:00		9	12							21
07:00		3	10							13
08:00		4	6							10
09:00		1	7							8
10:00		1	11							12
11:00		3	4							7
Total		174	168							342
Percent		50.9%	49.1%							
AM Peak	-	09:00	11:00	-	-	-	-	-	-	09:00
Vol.	-	23	14	-	-	-	-	-	-	31
PM Peak	-	12:00	15:00	-	-	-	-	-	-	17:00
Vol.	-	16	17	-	-	-	-	-	-	26
Grand Total		608	592							1200
Percent		50.7%	49.3%							

ADT ADT 400 AADT 400

All Traffic Data

Wheat Ridge, CO 80033

Date Start: 13-Sep-18
Date End: 15-Sep-18
Site Code: 4
CR 132 E/O SH 119

Start Time	13-Sep-18 Thu	EB	WB							Total
12:00 AM		2	1							3
01:00		1	0							1
02:00		0	1							1
03:00		0	0							0
04:00		0	0							0
05:00		3	2							5
06:00		2	5							7
07:00		2	14							16
08:00		8	**27**							35
09:00		15	22							37
10:00		**20**	20							**40**
11:00		18	18							36
12:00 PM		19	**23**							42
01:00		20	13							33
02:00		18	21							39
03:00		30	23							53
04:00		18	22							40
05:00		29	20							49
06:00		**31**	23							**54**
07:00		30	12							42
08:00		13	9							22
09:00		12	1							13
10:00		3	1							4
11:00		1	1							2
Total		295	279							574
Percent		51.4%	48.6%							
AM Peak	-	10:00	08:00	-	-	-	-	-	-	10:00
Vol.	-	20	27	-	-	-	-	-	-	40
PM Peak	-	18:00	12:00	-	-	-	-	-	-	18:00
Vol.	-	31	23	-	-	-	-	-	-	54

All Traffic Data
Wheat Ridge, CO 80033

Date Start: 13-Sep-18
Date End: 15-Sep-18
Site Code: 4
CR 132 E/O SH 119

Start Time	14-Sep-18 Fri	EB	WB							Total
12:00 AM		1	1							2
01:00		0	0							0
02:00		1	0							1
03:00		0	0							0
04:00		0	0							0
05:00		1	2							3
06:00		2	2							4
07:00		4	19							23
08:00		17	**28**							45
09:00		**22**	25							**47**
10:00		14	16							30
11:00		16	20							36
12:00 PM		29	21							50
01:00		19	19							38
02:00		20	22							42
03:00		29	22							51
04:00		34	25							59
05:00		**35**	**27**							**62**
06:00		21	16							37
07:00		19	19							38
08:00		28	10							38
09:00		17	5							22
10:00		9	5							14
11:00		6	0							6
Total		344	304							648
Percent		53.1%	46.9%							
AM Peak	-	09:00	08:00	-	-	-	-	-	-	09:00
Vol.	-	22	28	-	-	-	-	-	-	47
PM Peak	-	17:00	17:00	-	-	-	-	-	-	17:00
Vol.	-	35	27	-	-	-	-	-	-	62

All Traffic Data

Wheat Ridge, CO 80033

Date Start: 13-Sep-18
Date End: 15-Sep-18
Site Code: 4
CR 132 E/O SH 119

Start Time	15-Sep-18 Sat	EB	WB							Total
12:00 AM		4	1							5
01:00		2	2							4
02:00		1	0							1
03:00		0	0							0
04:00		0	0							0
05:00		0	1							1
06:00		0	4							4
07:00		0	5							5
08:00		10	17							27
09:00		18	26							44
10:00		29	30							59
11:00		**30**	**32**							**62**
12:00 PM		**34**	**38**							**72**
01:00		24	21							45
02:00		22	11							33
03:00		29	30							59
04:00		16	19							35
05:00		26	26							52
06:00		32	20							52
07:00		19	12							31
08:00		23	3							26
09:00		17	6							23
10:00		7	3							10
11:00		4	6							10
Total		347	313							660
Percent		52.6%	47.4%							
AM Peak	-	11:00	11:00	-	-	-	-	-	-	11:00
Vol.	-	30	32	-	-	-	-	-	-	62
PM Peak	-	12:00	12:00	-	-	-	-	-	-	12:00
Vol.	-	34	38	-	-	-	-	-	-	72
Grand Total		986	896							1882
Percent		52.4%	47.6%							
ADT		ADT 627		AADT 627						

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Appendix C:
Expected Traffic Control Plans

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Appendix C, Expected Traffic Control Plans

Location	Work Element	Traffic Control Plan Description	Reviewing Agency	Plan Submission Target Date	Traffic Control Term
SH 72 West of SH 93	Staging Area Grading and Road Widening	Traffic Control Plan showing shoulder closure and construction area entrance	CDOT Region 1	2/1/2022	3/1/22–8/31/22
SH 72	Start of Project Construction	Traffic Control Plan showing variable message sign and advisory	CDOT Region 1	2/1/2022	3/1/22–7/31/27
SH 72 at Gross Dam Road	Intersection Construction	Traffic Control Plan showing shoulder closure and construction area entrance	CDOT Region 1	5/1/2022	7/5/22–12/31/22
Gross Dam Road at SH 72	Intersection Construction	Traffic Control Plan showing roadway construction phasing	Boulder County Public Works	5/1/2022	7/5/22–12/31/22
Gross Dam Road at SH 72	Intersection Construction	Traffic Control Plan showing roadway construction phasing. Detour on Crescent Park Drive	Jefferson County Public Works	5/1/2022	7/5/22–12/31/22
Gross Dam Road from SH 72 to UPRR Crossing	Roadway Construction	Traffic Control Plan showing roadway construction phasing	Boulder County Public Works	5/1/2022	7/5/22–12/31/22
Gross Dam Road, UPRR Crossing to Flagstaff Road*	Roadway Construction	Traffic Control Plan advising of construction related traffic	Boulder County Public Works	2/1/2022	3/1/22–7/31/27
FS 359 (Winiger Ridge) and FS 97	Access Road Improvement Construction (for tree removal)	Traffic Control Plan showing roadway construction phasing	U.S. Forest Service	10/1/2024	4/1/25–9/30/25, 4/1/26–9/30/26
CR 97E (Lazy Z Road)	Roadway Construction and Traffic Movement (for tree removal)	Traffic Control Plan advising of construction related traffic	Boulder County Public Works	10/1/2024	4/1/25–9/30/25, 4/1/26–9/30/26
CR 132 (Magnolia Drive)	Traffic Movement (for tree removal	Traffic Control Plan advising of construction related traffic	Boulder County Public Works	10/1/2024	4/1/25–9/30/25, 4/1/26–9/30/26
SH 119 at CR 132	Traffic Movement (for tree removal)	Traffic Control Plan advising of construction related traffic	CDOT Region 4	10/1/2024	4/1/25–9/30/25, 4/1/26–9/30/26
CR 97 at SH 72	Traffic Movement (for tree removal)	Traffic Control Plan advising of construction related traffic (if this route is used)	Gilpin County	10/1/2024	4/1/25–9/30/25, 4/1/26–9/30/26

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Appendix D:
Traffic Management Organization

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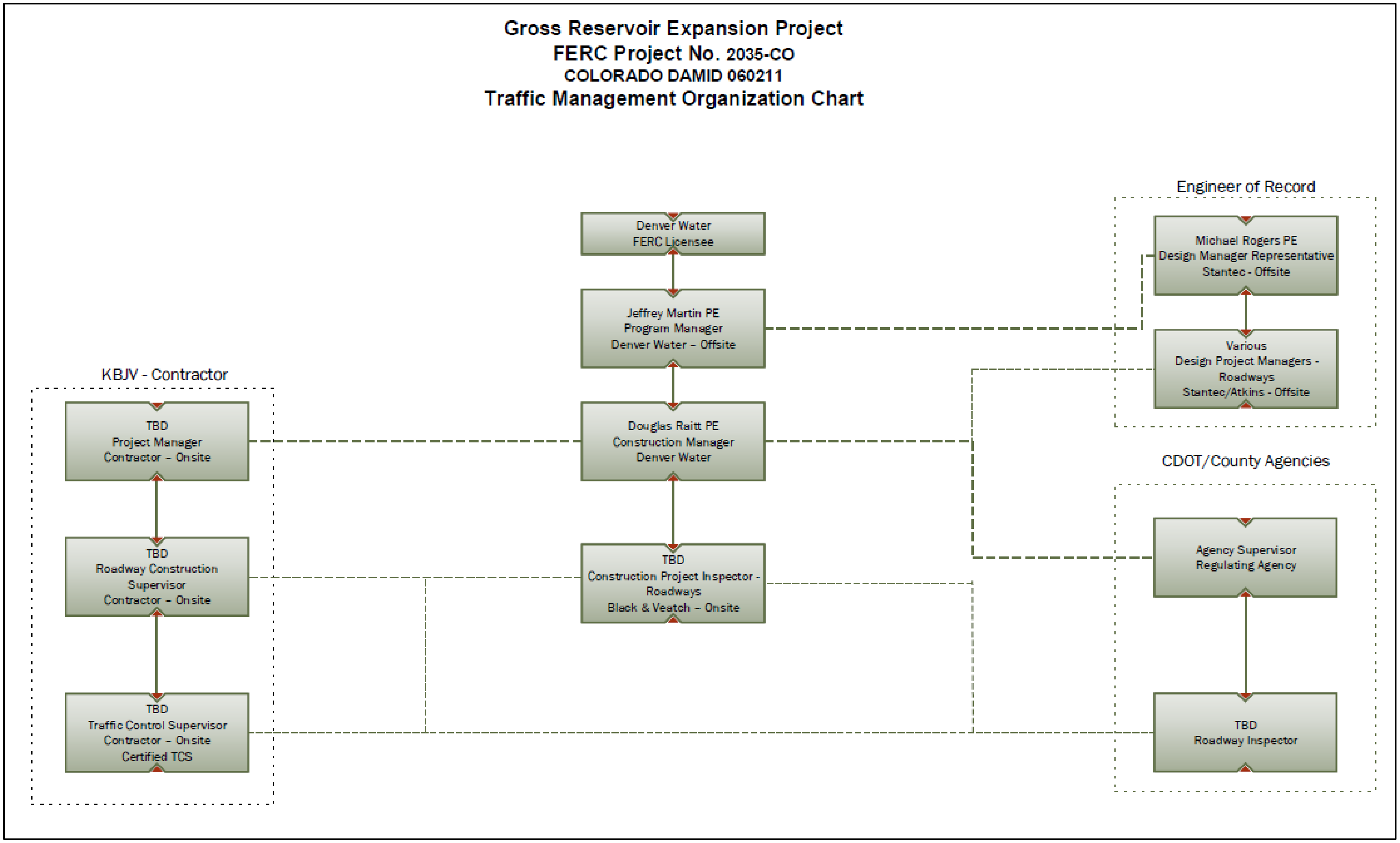
Appendix D, Traffic Management Organization



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