Community Planning and Permitting

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BOULDER COUNTY
BOARD OF COUNTY COMMISSIONERS
PUBLIC HEARING

July 2, 2024 at 01:00 p.m.

All Commissioners' public hearings and meetings will be offered in a hybrid format where attendees can join **through Zoom** or **in-person** at the Boulder County Courthouse, 3rd Floor, 1325 Pearl Street, Boulder.

PUBLIC HEARING

STAFF PLANNER: Sam Walker

Docket LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork

Proposal:	Limited Impact Special Use Review to permit 364,000 cubic yards of earthwork for subsurface coal fire mitigation and redevelopment of the Marshall Mesa trailhead.
Location:	1842 S. Foothills Highway, at the southeast corner of the intersection of SH 170 and SH93 in Section 21, Township 1S, Range 70.
Zoning:	Agricultural (A) and Business (B) Zoning District
Applicant:	City of Boulder Open Space & Mountain Parks (OSMP)
Agent:	Adam Gaylord

STAFF RECOMMENDATION:
Staff recommends that the Board of County Commissioners conditionally approve docket LU-24-0009 Marshall Mesa Mitigation and Trailhead Earthwork.

PACKET CONTENTS:

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o Staff Recommendation	1 – 16
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SUMMARY AND RECOMMENDATION:
This application for Limited Impact Special Review proposes approximately 364,000 cubic yards of non-foundational earthwork to mitigate a subterranean coal seam fire and redevelop the Marshall Mesa trailhead located on the same parcel. Limited Impact Special Use Review is required for the proposed earthwork, and it is therefore analyzed pursuant to the Special Use Standards outlined in Boulder County Land Use Code (the Code) Art. 4-601.

Staff recommends conditional approval of the proposal because, as conditioned, staff finds the proposed earthwork can meet the Limited Impact Special Review Criteria described in the Boulder County Land Use Code (the Code).

DISCUSSION:
The subject property is owned by the City of Boulder and currently houses the Marshall Mesa Trailhead, a popular trailhead that provides connections to many of the other Open Space lands located generally south of the City of Boulder. The property is also one of several potential ignition points identified following the Marshall Fire event of 2021. During the fire, fencing and vault restrooms on the property were completely burned.

The application proposes substantial earthwork to mitigate two active subterranean coal seam fires on the property which were identified as potential ignition sources for the Marshall Fire, as well as redevelopment and improvements to the trailhead area. The proposed mitigation earthwork will take place on the property at 1842 S. Foothills Highway, located on the south side of the intersection of Foothills Highway (SH 93) and Marshall Drive (SH 170).

As shown in Figure 2 below, the initial phase of the proposal, involving the remediation of the coal seam fire, will involve two large areas extending across most of the western area of the parcel. The second phase, redevelopment of the existing trailhead site, is shown in Figure 3 and will happen in largely the same location as the existing trailhead although the vehicular access point will be shifted further east along Marshall Drive and there will be a small expansion to the west of the existing limit of disturbance.

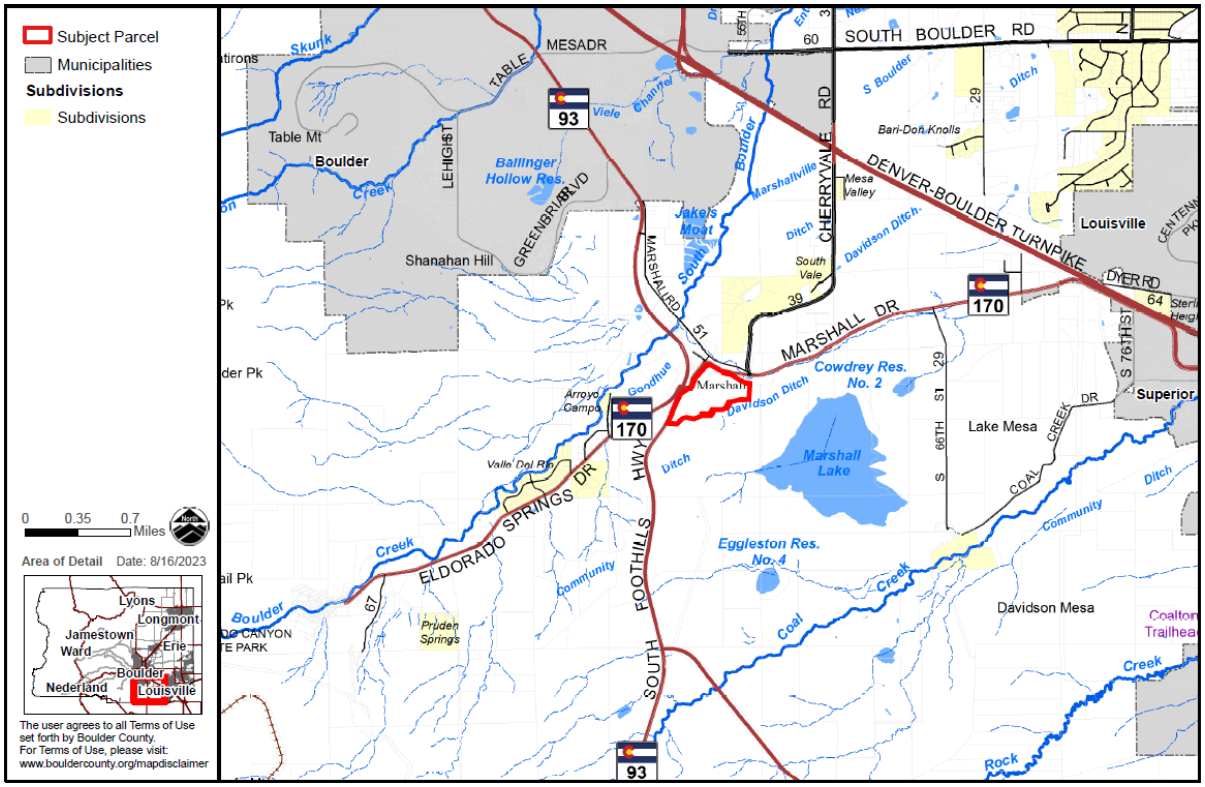

Figure 1: Vicinity Map showing location of the subject parcel.

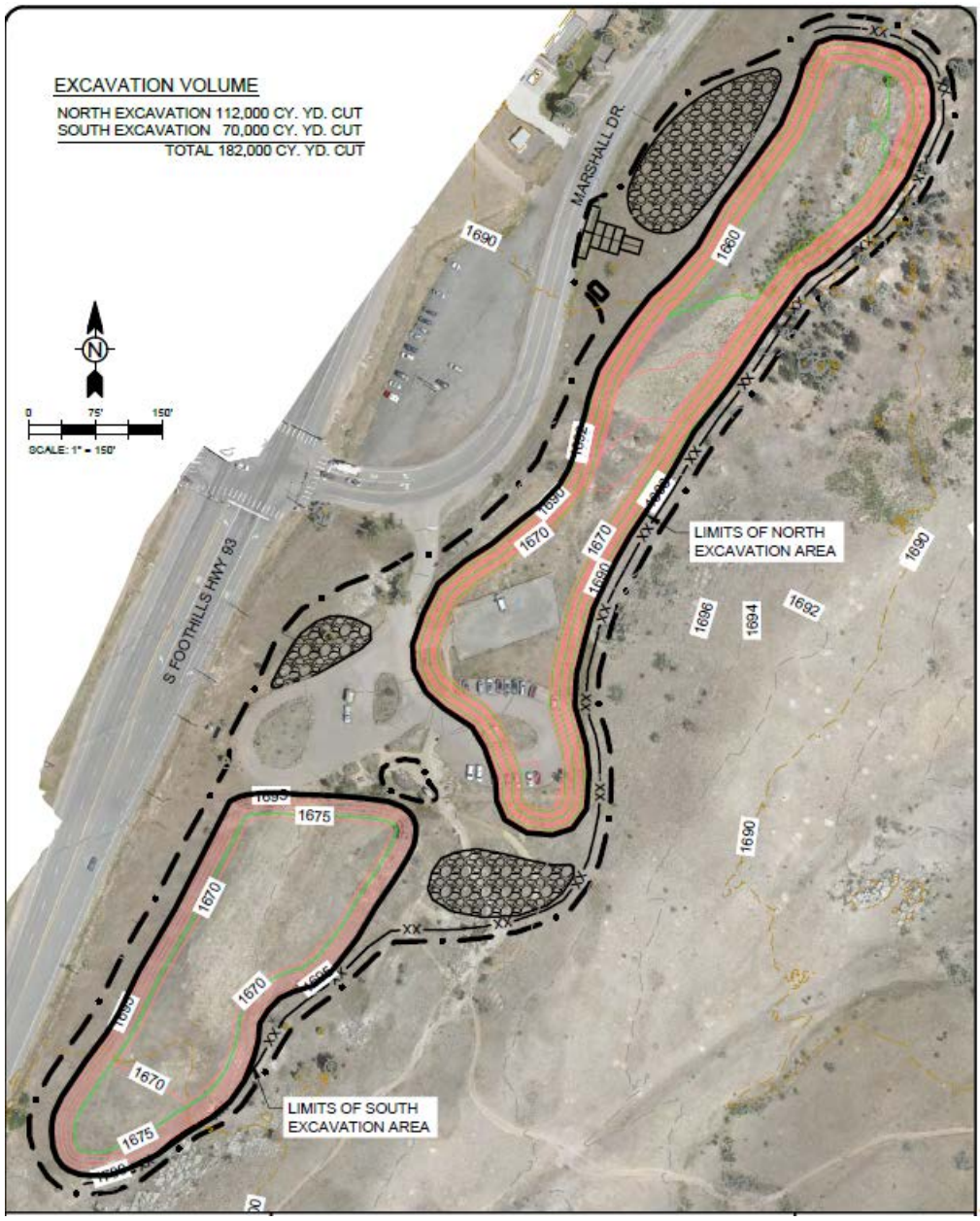

Figure 2: Coal seam fire remediation areas.

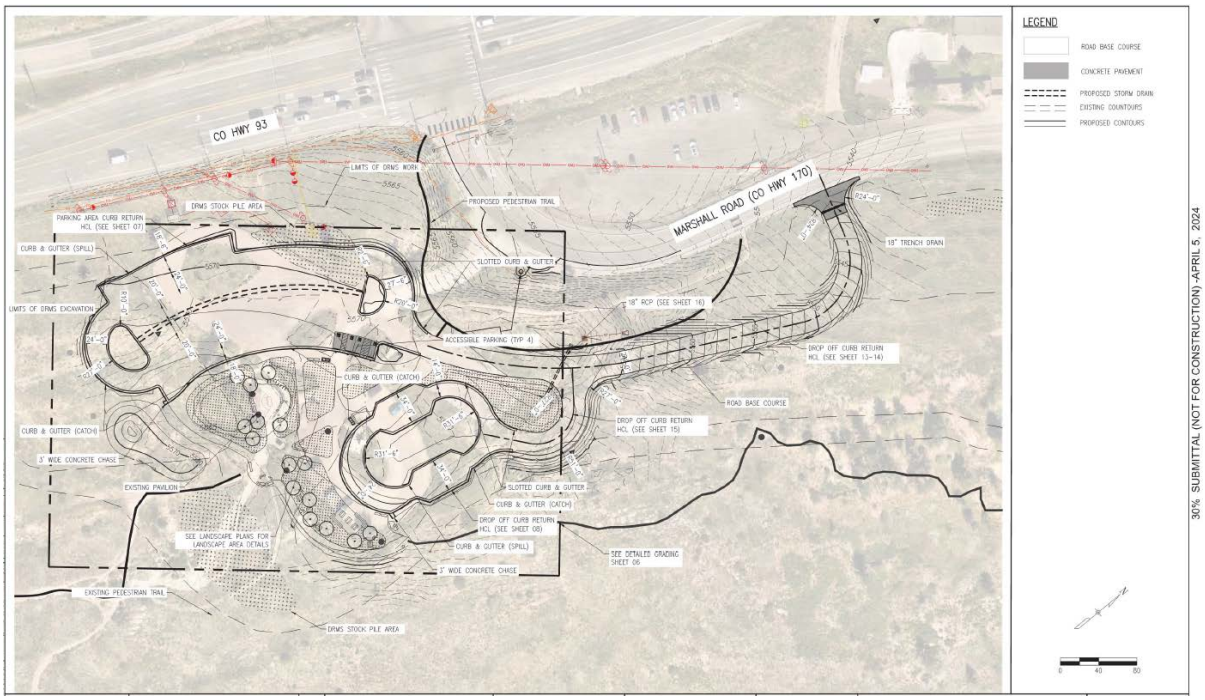

Figure 3: Trailhead redevelopment site plan.

Per discussion between staff and the applicant, fire remediation will take place in an incremental fashion with small cut areas excavated and then re-filled with the removed material before a new cut area is excavated. Between the initial excavation and backfill in the same area, excavated earth will be blended and cooled above grade. At no point will there be large open pits on the property.

The trailhead on the property was originally approved through SPR-06-0078 City of Boulder Change of Use. The project narrative for this proposal noted a 27,000-thousand gallon cistern on the site that was originally intended to support fire suppression for a commercial building that was deconstructed in 2005. The narrative states that the City's intent at the time was to return the cistern to a functional state and keep it full for use by the Fire Protection District although a requirement to keep the cistern full was not included by staff as a condition of approval for the SPR. The SPR was then superseded by an application for Special Use Review, SU-07-0005, for a Public or Quasi-Public Facility (other than specifically listed in the Land Use Code) that included a trailhead parking lot. The SU-07-0005 application narrative also described the existing 27,000 gallon cistern and a proposal that the Rocky Mountain Fire Authority (now Rocky Mountain Fire Protection District) would keep the cistern filled and use it for wildfire operations in the area. However, the cistern was not mentioned in the conditions of approval adopted by the Board of County Commissioners for SU-07-0005, and it does not appear that the cistern was ever restored to operational condition or filled.

As shown in Figure 4, below, the Boulder County Comprehensive Plan ("the Plan") identifies many resources of note on the parcel, including Rare Plant Areas, the Boulder Mountain Park and South Boulder Environmental Conservation Areas, Areas of Very High Biodiversity Significance, Wetlands, and View Protection Scores ranging from 1 to 2.11 on roads in the area. Potential impacts to these identified resources are discussed under Special Use criteria three below.

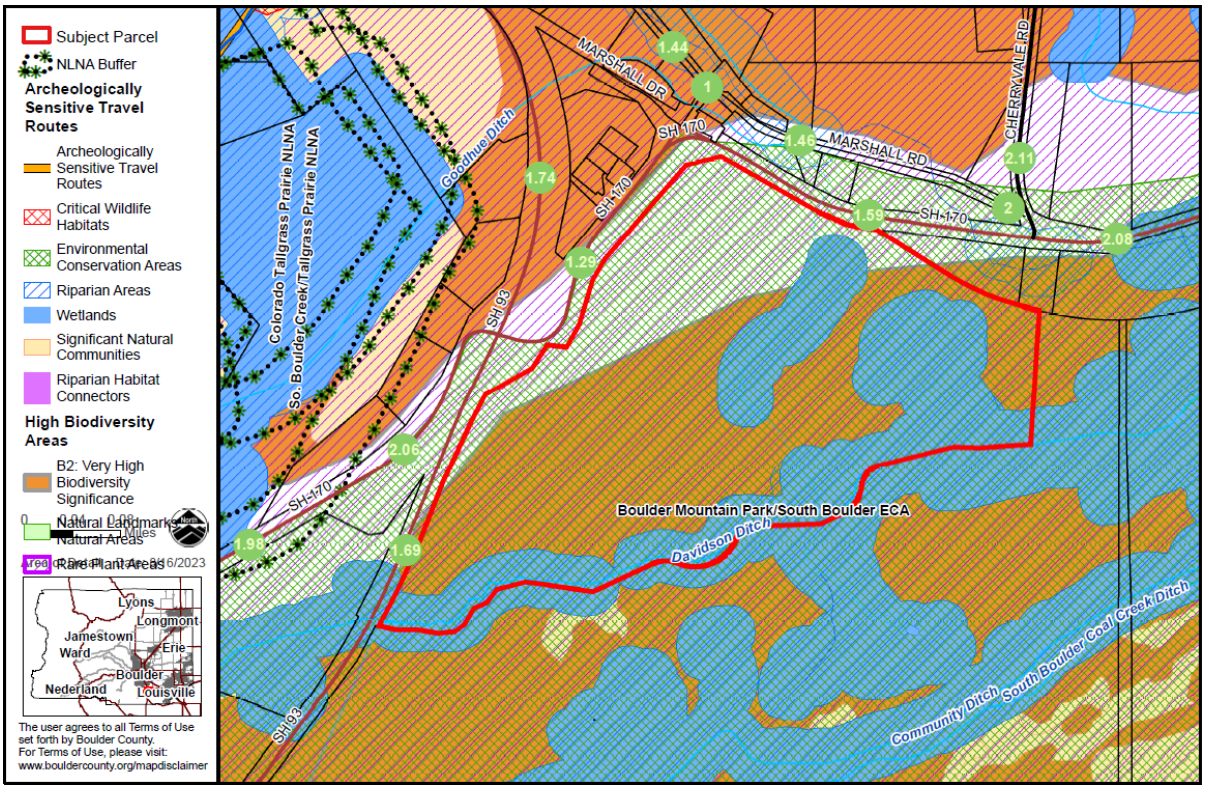

Figure 4: Boulder County Comprehensive Plan layers located on the Subject Parcel.

Significant earthwork is required to mitigate the existing on-site coal seam fires and can assist with the redevelopment of the existing trailhead, and staff finds that the proposed earthwork can meet the applicable standards and criteria for approval as described in the Land Use Code.

REFERRALS:
This application was referred to the typical agencies, departments, and nearby property owners. All responses received are attached and summarized below.

Boulder County Building Safety and Inspection Services Team: Boulder County Building Safety and Inspection Services reviewed the proposal and expressed no conflicts. A grading permit, plan review, and inspection approvals are required for the proposed grading, and the newly redeveloped trailhead area must meet commercial accessibility requirements. Observation Reports by a qualified design professional are also required during construction.

Colorado Division of Public Health and Environment (CDPHE): The CDPHE referral response indicated that odor control measures may be required during site grading, and that measures to mitigate fugitive dust may also be required.

Development Review Team – Access & Engineering: Boulder County Development Review Team – Access & Engineering (DRT A&E) reviewed the proposal and found that legal access to the project area was demonstrated. DRT A&E also indicated that parts of the submitted plan set lacked sufficient detail or illustrated designs that do not meet the Multimodal Transportation Standards (MMTS), and recommended several changes to the plan set for permit submittal. DRT A&E concurred with the findings of the submitted Traffic Impact Study but noted that CDOT approval is required for implementation of the recommendations made in the study, required the submittal of a drainage letter, noted a requirement for a Stormwater Quality Permit, and recommended that all construction staging happen on the subject property during construction.

Boulder County Public Health (BCPH): The BCPH referral response noted that the previously existing vault privy on the site had been permitted appropriately, and that a new permit will be required for the replacement privy described in the application materials.

Xcel Energy: The Xcel referral response noted the presence of electrical and natural gas distribution facilities within the project area and noted requirements for working around those resources.

Colorado Geological Survey: The Colorado Geological Survey referral response expressed support for the proposal.

Adjacent Property Owners: 57 application notices were mailed to nearby property owners, and CPP staff did not receive any comments in response.

Agencies that responded with no conflicts: Boulder County Historic Preservation Team.

Agencies that did not respond include: Boulder County Long Range Planning, Boulder County Wildfire Mitigation Team, Eldorado Springs LID, Boulder County Assessor, Boulder County Attorney Office, Boulder County Parks & Open Space Conservation Easement Team, Boulder County Parks & Open Space Real Estate Team, Boulder County Parks & Open Space Natural Resource Planner, Boulder County Sheriff, Boulder County Treasurer, Boulder County Public Works Road Maintenance Team, Boulder County Public Works Stormwater Quality Team, Nature Conservancy of Colorado, Eldorado Springs Community Association, Eldorado Artesian Springs Inc., City of Boulder Planning & Development Services, City of Boulder Open Space & Mountain Parks, City of Louisville Planning Department, Town of Superior Planning & Building Department, Boulder Valley & Longmont Conservation Districts, History Colorado, Eldorado Canyon State Park, Colorado Department of Transportation, US Fish & Wildlife Service, Mountain View FPD.

LIMITED IMPACT SPECIAL REVIEW SUMMARY:
CPP staff reviewed the conditions and standards for approval of a Limited Impact Special Review as they apply to the proposed non-foundational earthwork per Article 4-601 of the Code and finds the following:

(1) Complies with the minimum zoning requirements of the zoning district in which the use is to be established, and will also comply with all other applicable requirements;

The subject parcel is within the Agricultural and Business zoning districts, and is a legal building lot. Non-foundational earthwork in excess of 500 cubic yards can be permitted as an accessory use in the Agricultural zoning district (Article 4-101), pending approval of a Limited Impact Special Review and subject to the additional provisions outlined in Article 4-516.Q.5 of the Code. The proposed non-foundational earthwork is considered an accessory use to the recreational use of the public facility approved as part of SU-05-0007.

Staff recommend a condition of approval requiring the necessary grading permit be obtained for the proposed non-foundational earthwork. With the required permits and as conditioned, staff finds that this criterion can be met.

Additional Provisions for grading of more than 50 cubic yards under Article 4-516.Q.5 include the following:

a. While it may be exempt from these provisions, grading which impacts a floodplain is not exempt from applying for and receiving a Floodplain Development Permit.

No part of the proposed project area is located within the Floodplain Overlay district, and no Floodplain Development Permit is required for the proposal.

Therefore, this criterion is not applicable.

b. Normal agricultural grading that is exempt from the definition of this use includes but is not limited to: tilling fields, creating or altering irrigation ditch laterals, field leveling, field access roads for agricultural purposes, and other activities associated with farming and agricultural operations. Agricultural grading does not include terraforming for aesthetic purposes, landscaping ponds, altering wetlands, or other nonessential grading.

The proposed non-foundational earthwork will not support an agricultural use and is therefore not exempt from the use definition described in Art. 4-516.Q.1. All proposed earthwork has been reviewed according to the Special Use Review criteria without exception.

Therefore, staff have no concerns regarding this criterion.

c. Ponds to be constructed at a depth of more than 24 inches must obtain a grading permit prior to construction. Ponds used to store/hold water for agricultural purposes (stock ponds, irrigation ponds) shall be exempt from the Site Plan Review or Limited Impact Special Review process unless they require an Individual Floodplain Development Permit.

The subject proposal will not result in the creation of a pond.

Therefore, this criterion is not applicable.

Additional Provisions for a Public or Quasi-public Facility Other Than Listed under Article 4-514.G.5 include the following:

a. This use is not required to be located on a building lot, or comply with the minimum lot size requirement for the district in which it is located.

The proposed use will continue to be located on a building lot that exceeds the minimum lot size for both zoning districts which encompass the parcel.

Therefore, staff find this criterion is met.

b. Electric transmission lines are not required to comply with the height requirement for the district in which it is located.

No electric transmission lines are proposed as part of the earthwork or trailhead redevelopment.

Therefore, this criterion is not applicable.

(2) Will be compatible with the surrounding area. In determining compatibility, the Board should consider the location of structures and other improvements on the site; the size, height and massing of the structures; the number and arrangement of structures; the design of structures and other site features; the proposed removal or addition of vegetation; the extent of site disturbance, including, but not limited to, any grading and

changes to natural topography; and the nature and intensity of the activities that will take place on the site. In determining the surrounding area, the Board should consider the unique location and environment of the proposed use; assess the relevant area that the use is expected to impact; and take note of important features in the area including, but not limited to, scenic vistas, historic townsites and rural communities, mountainous terrain, agricultural lands and activities, sensitive environmental areas, and the characteristics of nearby development and neighborhoods;

For purposes of this review, staff considers the area within 1,500 feet of the subject parcel as the applicable surrounding area, which is consistent with the Site Plan Review definition of a neighborhood. The area around the subject parcel is characterized by a broad array of development types, including commercial businesses, single-family residential properties, a mobile home park, large agricultural areas, and public open space areas crisscrossed by hiking trails. Figures 5 and 6 illustrate the broad variety of uses in the area, showing the zoning districts in the area around the parcel and the physical character of development on those lands.

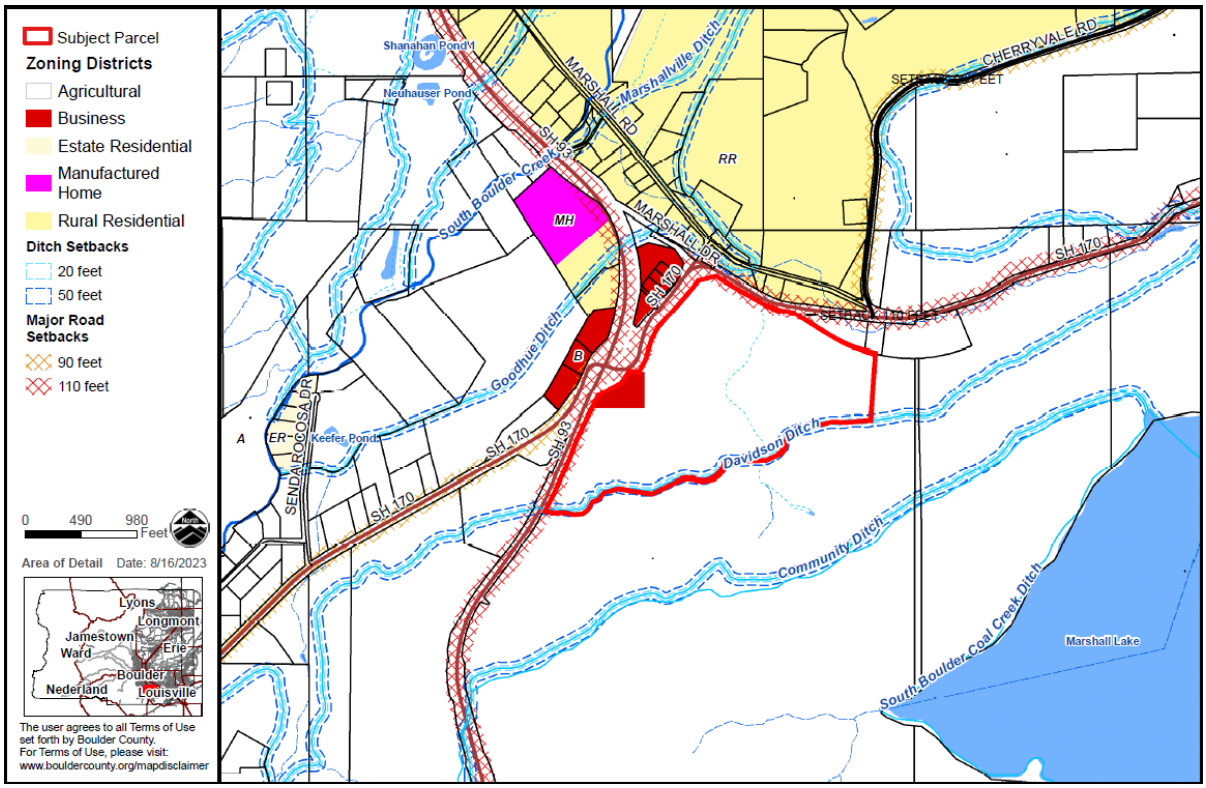

Figure 5: Zoning map

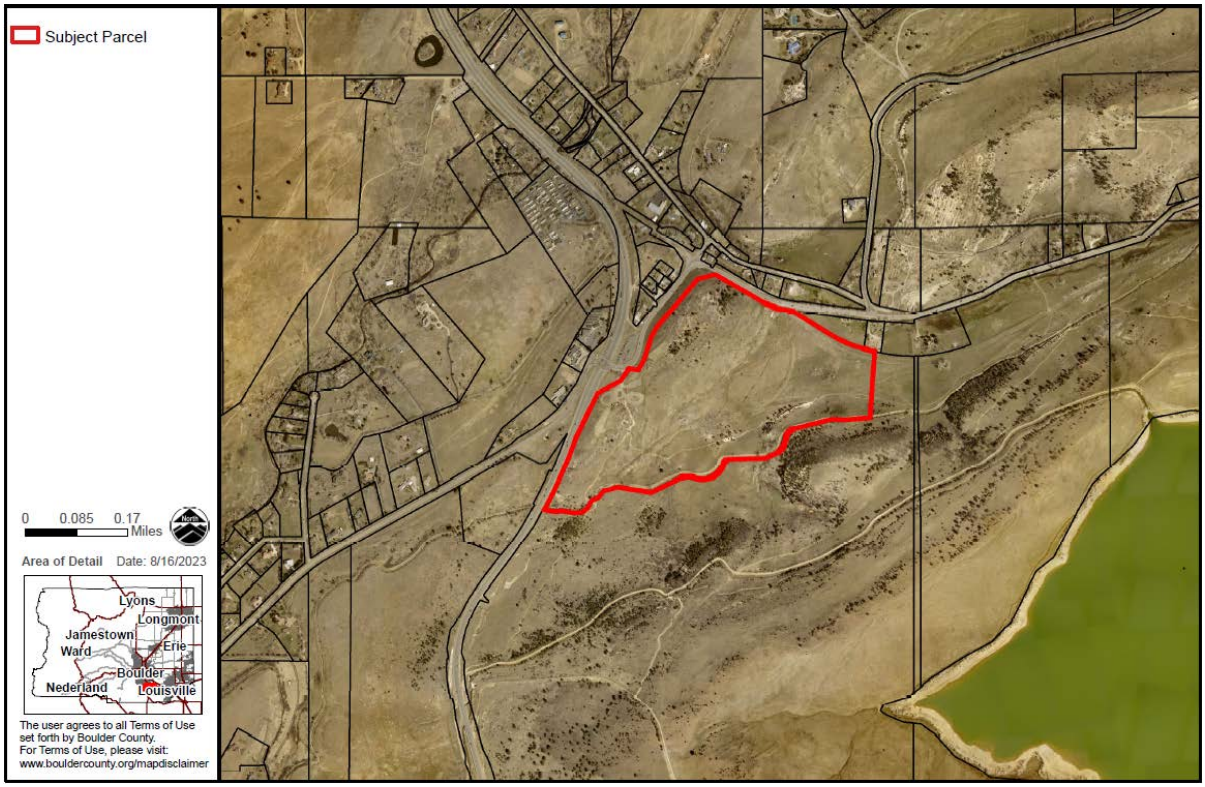

Figure 6: Regional aerial photo

Staff find that the proposed non-foundational earthwork and trailhead redevelopment will be compatible with the surrounding area. Mitigation of the on-site coal seam fires will remove a potential wildfire ignition point, increasing the safety of all other uses in the area. The proposed redevelopment of the trailhead will also increase compatibility with the surrounding uses by improving traffic flow (see discussion under criteria seven below), increasing accessibility to and capacity of the site, and replacing public resources lost during the Marshall Fire.

Therefore, staff finds that this criterion is met.

(3) The use will be in accordance with the Comprehensive Plan;

Staff find that the proposed non-foundational earthwork and trailhead redevelopment supports the following Goals, Policies, and Objectives of the Comprehensive Plan:

- Natural Hazards Element Goal 3. Mitigate Existing Areas at Risk
- NH Policy 1.04 Risk Reduction
- NH Policy 1.06 Cooperation and Coordination
- NH 5.04 Interjurisdictional and Interagency Cooperation
- Open Space Element Goal 2. Promote Safe & Healthy Recreation & Connections to Nature

As described above, the proposal is intended to mitigate existing subterranean coal seam fires on the parcel, and redevelop the existing trailhead and parking area. Staff therefore do not have concerns that the proposal will negatively impact the resources on the subject property identified by the Comprehensive Plan, including but not limited to the Boulder Mountain Park and South Boulder Environmental Conservation Areas, Rare Plant Areas, areas of Very High Biodiversity Significance, or Wetlands.

As discussed under Special Use criteria nine below, staff have limited concerns relating to the impacts of the proposed development on the view protection corridors associated with various County Roads in the area.

Therefore, staff finds that this criterion is met.

(4) Will not result in an over-intensive use of land or excessive depletion of natural resources. In evaluating the intensity of the use, the Board should consider the extent of the proposed development in relation to parcel size and the natural landscape/topography; the area of impermeable surface; the amount of blasting, grading or other alteration of the natural topography; the elimination or disruption of agricultural lands; the effect on significant natural areas and environmental resources; the disturbance of plant and animal habitat, and wildlife migration corridors; the relationship of the proposed development to natural hazards; and available mitigation measures such as the preservation of open lands, the addition or restoration of natural features and screening, the reduction or arrangement of structures and land disturbance, and the use of sustainable construction techniques, resource use, and transportation management.

Although the project will involve significant earthwork, staff are not concerned that the proposal will constitute an over-intensive use of land. The proposed earthwork will mitigate an existing natural hazard risk and improve the trailhead area to better suit the needs of the recreating public. As proposed, the earthwork on-site will be balanced between cut and fill, meaning that there is no import or export of earth. The application narrative also indicates that cut areas will be recontoured to match existing grades (excepting those areas where the redeveloped trailhead and parking areas will extend outside of existing areas of disturbance). Staff therefore recommend approving the total earthwork cut and fill as proposed, with an additional condition requiring that pre-existing grades be reestablished as the mitigation earthwork is completed.

The application materials also included a description of the post-construction revegetation, although a formal revegetation plan was only included for the area immediately around the redeveloped trailhead. Staff recommend a condition of approval requiring the submittal of a revised revegetation plan with the grading permit submittal that accounts for all areas that will be disturbed as part of the site work.

Therefore, as conditioned, staff finds that this criterion is met.

(5) The use will not have a material adverse effect on community capital improvement programs;

Staff have not identified any material adverse effects of the proposal on community capital improvement programs, and no referral agency responded with such a concern.

Therefore, staff finds that this criterion is met.

(6) The use will not require a level of community facilities and services greater than that which is available;

Staff are not concerned that the proposal will require a level of community facilities or services greater than that which is currently available, and no referral agency responded with such a concern.

Therefore, staff finds that this criterion is met.

(7) Will support a multimodal transportation system and not result in significant negative impacts to the transportation system or traffic hazards;

The subject property is accessed via Marshall Drive, also known as SH 170, a Colorado Department of Transportation (CDOT) owned and maintained right-of-way (ROW). Legal access is demonstrated via adjacency to both the SH 170 and SH 93 ROW.

Although physical access to the trailhead is proposed to remain on SH 170 after completion of the earthwork, a new location for that access is proposed further east along the ROW than the existing driveway. The new access will roughly align with the entrance to the RTD park-and-ride lot on the north side of the SH 170 ROW. Staff support the relocation of vehicular access to mitigate issues with occasional traffic backups into the intersection and recommend a condition approving the trailhead site plan as proposed.

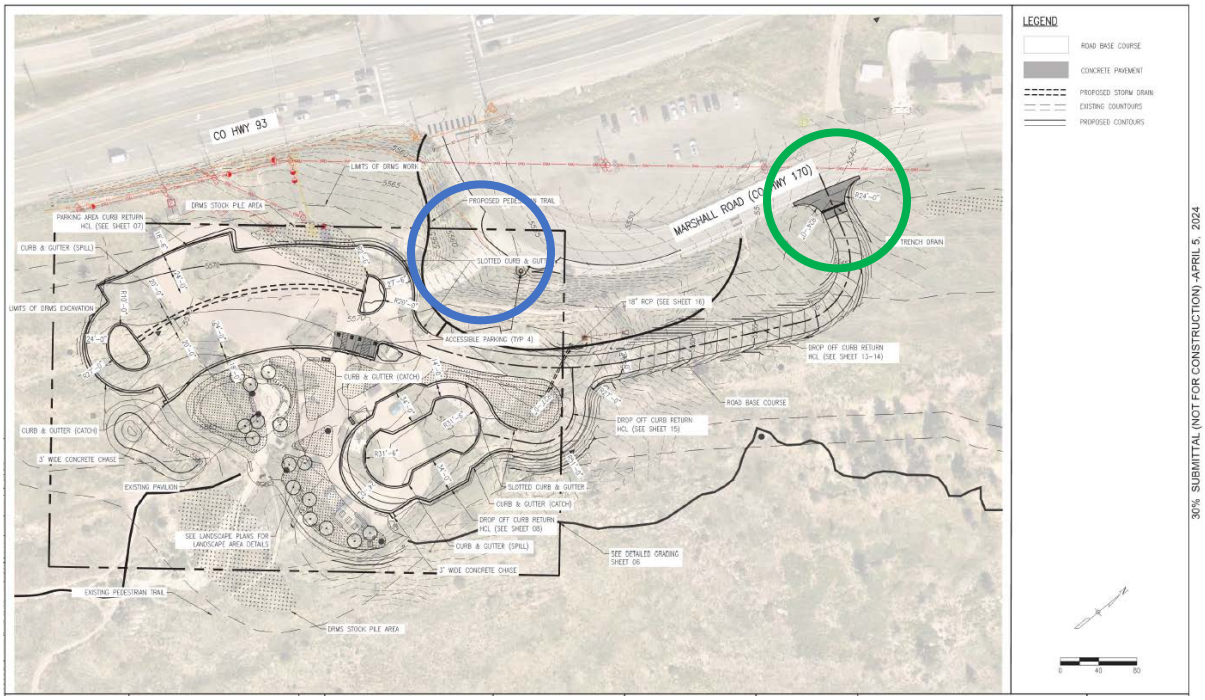

Figure 7: Trailhead site plan with existing vehicle entrance circled in blue, and new vehicle entrance circled in green.

Figure 8: Google Streetview image showing new vehicle entrance area (green circle), with existing RTD park-and-ride lot and crosswalk in view.

The DRT A&E referral response noted that the proposal generally appeared to meet the MMTS, but indicated that there were several issues with the provided plan sets and that no electric vehicle charging stations were shown in the plans. Staff recommend a condition of approval requiring that the permit plans incorporate changes to reflect the comments of and missing information noted by the DRT A&E referral response.

During the application review, staff received several public comments requesting improvements to the existing crosswalk the extends between the RTD park-and-ride and the subject property across SH170. A traffic study included with the application materials also concluded that improvements to this crosswalk should be made, and the DRT A&E referral response concurred with the study's findings. However, the requested improvements would be located in CDOT-owned ROW and staff did not receive a referral response from CDOT, nor is there a clear indication that CDOT will support or implement those improvements. Staff strongly recommend that the applicants work with CDOT to implement the changes to the pedestrian crosswalk described in the submitted traffic report and DRT A&E comments.

To mitigate the potential for traffic impacts during construction, staff also recommend a condition of approval requiring that all construction parking and staging be located on the subject property.

Therefore, as conditioned, staff finds this criterion can be met.

(8) Will not cause significant air, odor, water, or noise pollution;

There is no indication that the proposal will cause significant air, odor, water, or noise pollution once the proposed earthwork and trailhead redevelopment are completed. However, the proposal involves more than one acre of site disturbance and therefore a Boulder County Stormwater Quality Permit (SWQP) is required. Staff recommend conditions of approval requiring the submittal of the SWQP along with the grading permit to reflect these requirements.

The CDPHE referral response noted that odor control equipment or fugitive dust mitigation measures may be required while earthwork and site construction take place, but noted that it is the responsibility of involved parties (City of Boulder and contractors) to determine what regulations they are subject to and follow them accordingly. Staff therefore recommend a condition of approval requiring that the applicants obtain any applicable local, state, or federal permits for the proposed earthwork prior to commencing physical work on the site.

Therefore, as conditioned, staff finds this criterion can be met.

(9) Will be adequately buffered or screened to mitigate any undue visual impacts of the use;

The Plan identifies View Protection Scores that range from 1 to 2.11 along various roads near the project area (including SH 93, SH 170, and Cherryvale Road). However staff are not concerned that the proposed earthwork will result in the creation of any undue visual impacts. Once mitigation work is completed and the area revegetated, the vast majority of the project area will look effectively the same as it does currently. The redeveloped trailhead area will be visible to drivers travelling northbound along SH 93, but staff have no concerns that the proposed redevelopment will change or increase visual impacts for those drivers or the wider area around the trailhead.

Therefore, staff finds this criterion is met.

(10) The use will not otherwise be detrimental to the health, safety, or welfare of the present or future inhabitants of Boulder County;

There is no indication that the proposed earthwork or trailhead redevelopment will be detrimental to the health, safety, or welfare of the present or future inhabitants of the county, and no referral agency responded with such a concern. On the contrary, the proposed earthwork will likely increase the safety of county inhabitants by mitigating a potential wildfire ignition source, while the proposed trailhead redevelopment will increase traffic safety by relocating the vehicular access point and improving internal traffic flows.

However, staff has concerns related to the cistern on the property, which was not filled at the time of the Marshall Fire and is apparently in a state of disrepair. As indicated in the project narrative, Mountain View FPD and the City have agreed to install a new cistern on site as part of the trailhead redevelopment (staff note that there was not a referral response from Mountain View FPD, but that the new cistern was described in the project narrative and shown on the trailhead site plan). Construction and maintenance of a new cistern on the property would help to mitigate the increased intensity of the on-site trailhead use, and would improve first responders' ability to fight any future wildfires in the area. Staff recommend a condition of approval requiring that the materials submitted for permitting include additional details regarding the cistern's construction and any maintenance agreements between the City of Boulder and Rocky Mountain Fire Protection District.

Staff are also concerned that there is a risk of wildfire ignition if a high wind event were to occur while the proposed coal seam fire mitigation earthwork is ongoing, and therefore recommend two conditions of approval requiring the same emergency practices in use by DRMS at the nearby Lewis Mine Fire site, namely halting earthwork and covering hot excavated materials during Red Flag Warnings.

Therefore, staff finds this criterion can be met.

(11) The use will establish an appropriate balance between current and future economic, environmental, and societal needs by minimizing the consumption and inefficient use of energy, materials, minerals, water, land, and other finite resources;

Staff finds that the proposed earthwork strikes an appropriate balance by mitigating an on-site hazard without increasing the impacts of the existing development on the surrounding area, while simultaneously increasing the public's ability to use the site.

Therefore, staff finds this criterion can be met.

(12) The use will not result in unreasonable risk of harm to people or property – both onsite and in the surrounding area – from natural hazards. Development or activity associated with the use must avoid natural hazards, including those on the subject property and those originating off-site with a reasonable likelihood of affecting the subject property. Natural hazards include, without limitation, expansive soils or claystone, subsiding soils, soil creep areas, or questionable soils where the safe-sustaining power of the soils is in doubt; landslides, mudslides, mudfalls, debris fans, unstable slopes, and rockfalls; flash flooding corridors, alluvial fans, floodways, floodplains, and flood-prone areas; and avalanche corridors; all as identified in the Comprehensive Plan Geologic Hazard and Constraint Areas Map or through the Special Review or Limited Impact Special Review process using the best available information. Best available information includes, without limitation, updated topographic or geologic data, Colorado Geologic Survey landslide or earth/debris flow data, interim floodplain mapping data, and creek planning studies.

The Comprehensive Plan identifies areas of Landslide Susceptibility, Moderate to High Swelling Soil Potential, and Extent of Abandoned Coal Mines across the entire project area. However, staff concerns related to these hazards are extremely limited. The purpose of the project is to excavate and then fill the abandoned mine areas and then redevelop the existing trailhead and parking area. The proposed work will effectively mitigate the risks posed by the existing mine areas, and staff concerns related to the landslide susceptibility and swelling soils areas are limited due to the primary physical development proposed being parking areas. Development in swelling soils and landslide areas is common throughout the county.

Therefore, staff finds that this criterion is met.

(13) The proposed use shall not alter historic drainage patterns and/or flow rates unless the associated development includes acceptable mitigation measures to compensate for anticipated drainage impacts. The best available information should be used to evaluate these impacts, including without limitation the Boulder County Storm Drainage Criteria Manual, hydrologic evaluations to determine peak flows, floodplain mapping studies, updated topographic data, Colorado Geologic Survey landslide, earth/debris flow data, and creek planning studies, all as applicable given the context of the subject property and the application.

Staff find that the proposed earthwork will alter some aspects of site drainage, but that the overall pattern of drainage across the parcel will not be dramatically changed (as most of the site will be returned to existing grades as part of the proposed mitigation work). However, the DRT A&E referral response noted that a drainage letter was not included with the application materials to show that the proposed drainage improvements in the parking area have been appropriately sized for anticipated flows. Staff therefore recommend a condition of approval requiring that the permit plans include a drainage letter and hydraulic calculations.

Therefore, as conditioned, staff finds that this criterion is met.

RECOMMENDATION:
Staff has determined that, as conditioned, the proposal can meet all the applicable criteria of the Boulder County Land Use Code for Limited Impact Special Review. Therefore, staff recommend that the Board of County Commissioners **CONDITIONALLY APPROVE** Docket *LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork*, subject to the following conditions:

1. The development is subject to the requirements of the Boulder County Building Safety and Inspection Services Team and adopted County Building Codes, as outlined in the referral comments, including, but not limited to required grading permit, observation reports, and plan review.

2. 364,000 cubic yards of earthwork (184,000 cut, and 184,000 fill) are approved as proposed.

3. Plans submitted for permitting must note existing grades across the entire excavation area, and the excavated area must be returned to pre-existing grade except for those areas where the redeveloped trailhead will extend.

4. ***At grading permit submittal,*** a revised revegetation plan is required. The plan must incorporate mapped delineation of all areas disturbed as part of the proposed coal seam fire mitigation earthwork as well as the trailhead redevelopment areas, construction staging, and stockpiling areas, and include information regarding native grass species to be used, an explanation of the treatment of excavated topsoil, tree protection details, locations of silt fences or erosion control logs down slope of disturbed areas, and matting requirements on steeper slopes.

   Prior to the final inspection, the full installation of the approved Revegetation and Plan must be inspected and approved by the Community Planning & Permitting Department. If weather is not conducive to seeding or if adequate revegetation efforts have not occurred and vegetation is not adequately established at the time of final inspection request, an irrevocable letter of credit or monies deposited into a County Treasurer account will be required to assure the success of revegetation. You should consider the following well in advance of your revegetation inspection:

   Whether you are applying for a Certificate of Occupancy, final inspection, or the return of funds held in escrow for completion of revegetation, some level of germination and growth of grass seed is required.

   Keep in mind that the steeper the slopes and dryer the soil, the greater the attention needed to establish a level of germination adequate to obtain revegetation approval.

   Areas of disturbance found at inspection not included on the revegetation plan are still subject to reseeding and matting.

5. The site plan for the redeveloped trailhead dated April 05, 2024, is approved as proposed.

6. At grading or building permit submittal, the submitted plans must include revisions to address the issues raised in the DRT A&E referral response dated June 14, 2024, including but not limited to grades and curves that exceed MMTS requirements, parking space dimensions, provision of circulation signage, and provision of electrical vehicle charging stations.

7. During construction, all vehicles, materials, machinery, dumpsters, and other items shall be staged on the subject property; no items shall be stored or staged on Marshall Drive (SH170).

8. ***At grading permit***, the Stormwater Quality Permit application must be submitted and obtained prior to any work beginning on the project. A drainage report and Stormwater Management Plan must be submitted with the SWQP application materials.

9. ***Prior to grading permit issuance,*** the proposed development must meet all local, state, and federal regulations, including but not limited to those for odor control and fugitive dust mitigation.

10. Permit plans for the proposed cistern must include additional details not provided with the application materials, including but not limited to location, dimensions, and cut/fill required. The permit submittal must also include details regarding any maintenance or other intergovernmental agreement regarding the cistern's permitting or use between the City of Boulder and Rocky Mountain Fire Protection District.

11. Blending and excavation activities must be halted if a Red Flag warning is issued by the United States National Weather Service for the area where the proposal is located.

12. In the event that blending and excavation activities are halted for high winds, any material exceeding 100 degrees Fahrenheit shall be immediately covered with a minimum of two feet of cold overburden.

13. At building permit, the applicant must submit hydraulic calculations for the proposed culverts and associated drainage facilities for County review and approval.

14. The Applicants are subject to the terms, conditions, and commitments of record and in the file for Docket *LU-24-0009 BCPOS Marshall Mesa Mitigation and Trailhead Earthwork.*

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Web: www.bouldercounty.org/lu
Office Hours: Mon., Wed., Thurs., Fri. 8 a.m. to 4:30 p.m.
Tuesday 10 a.m. to 4:30 p.m.

Shaded Areas for Staff Use Only
Intake Stamp

Planning Application Form

The Land Use Department maintains a submittal schedule for accepting applications. Planning applications are accepted on Mondays, by appointment only. Please call 303-441-3930 to schedule a submittal appointment.

Project Number	Project Name

❑ Appeal	❑ Modification of Site Plan Review	❑ Road Name Change	❑ Special Use (Oil & Gas development)
❑ Correction Plat	❑ Modification of Special Use	❑ Road/Easement Vacation	❑ State Interest Review (1041)
❑ Exemption Plat	❑ Preliminary Plan	❑ Site Plan Review	❑ Subdivision Exemption
❑ Final Plat	❑ Resubdivision (Replat)	❑ Site Plan Review Waiver	❑ Variance
☒ Limited Impact Special Use	❑ Rezoning	❑ Sketch Plan	❑ Other:
❑ Limited Impact Special Use Waiver		❑ Special Use/SSDP	
❑ Location and Extent			

Location(s)/Street Address(es)	1842 South Foothills Hwy, Boulder, CO			
Subdivision Name: TR, 194-198 - COMMERCIAL				
Lot(s)	Block(s)	Section(s): 21	Township(s): 1S	Range(s): 70
Area in Acres: 71.53	Existing Zoning: A - Agricultural	Existing Use of Property: Recreation and cattle grazing		Number of Proposed Lots
Proposed Water Supply		Proposed Sewage Disposal Method		

Applicants:

Applicant/Property Owner: City of Boulder OSMP c/o Adam Gaylord			Email: gaylorda@bouldercolorado.gov
Mailing Address: 2520 55th St			
City: Boulder	State: CO	Zip Code: 80301	Phone: 303-495-8982
Applicant/Property Owner/Agent/Consultant			Email
Mailing Address			
City	State	Zip Code	Phone

Agent/Consultant			Email
Mailing Address			
City	State	Zip Code	Phone

Certification (Please refer to the Regulations and Application Submittal Package for complete application requirements.)

I certify that I am signing this Application Form as an owner of record of the property included in the Application. I certify that the information and exhibits I have submitted are true and correct to the best of my knowledge. I understand that all materials required by Boulder County must be submitted prior to having this matter processed. I understand that public hearings or meetings may be required. I understand that I must sign an Agreement of Payment for Application processing fees, and that additional fees or materials may be required as a result of considerations which may arise in the processing of this docket. I understand that the road, school, and park dedications may be required as a condition of approval.

I understand that I am consenting to allow the County Staff involved in this application or their designees to enter onto and inspect the subject property at any reasonable time, without obtaining any prior consent.

All landowners are required to sign application. If additional space is needed, attach additional sheet signed and dated.

Signature of Property Owner: Dan Burke	Printed Name: Dan Burke	Date: 4/8/24
Signature of Property Owner: NPR	Printed Name: Nuria Rivera-Vandermyde	Date: 5/1/2024

The Land Use Director may waive the landowner signature requirement for good cause, under the applicable provisions of the Land Use Code.

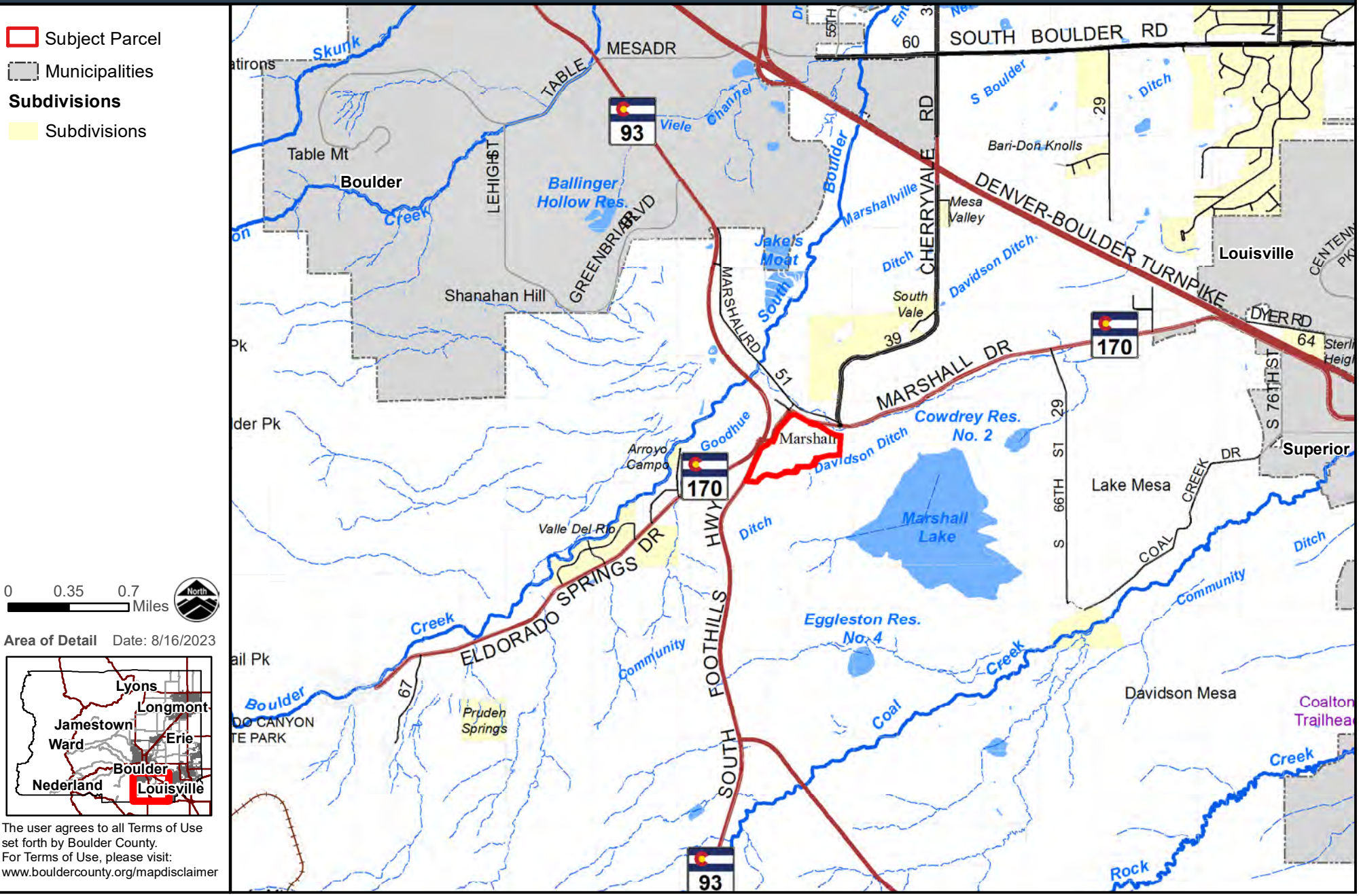
Approved as to form: Janet Michels

Community Planning & Permitting

2045 13th Street, Boulder, CO 80302 303-441-3930 www.bouldercounty.org

Vicinity

1842 S FOOTHILLS HWY



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Location

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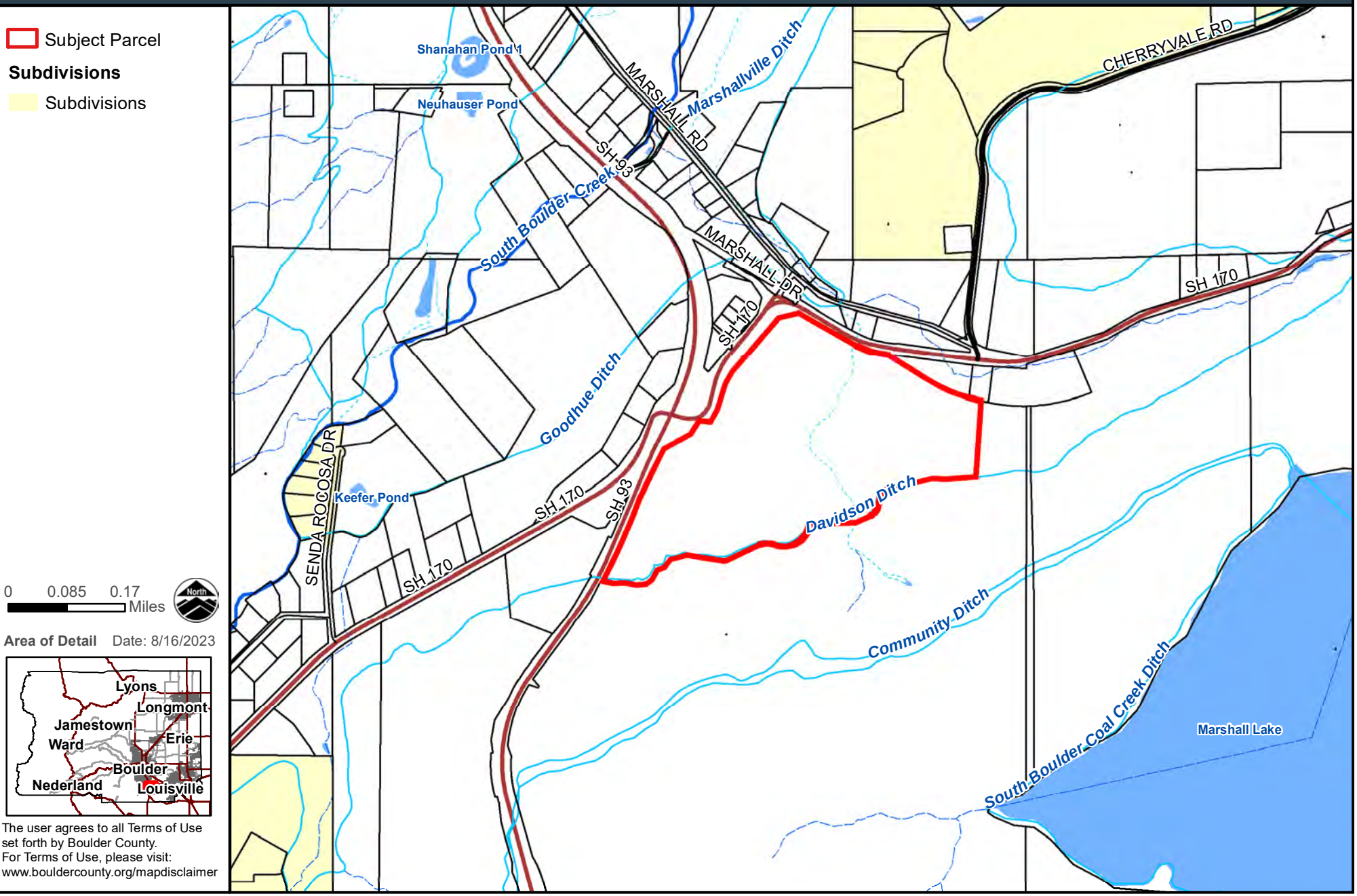

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Aerial

1842 S FOOTHILLS HWY

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Aerial

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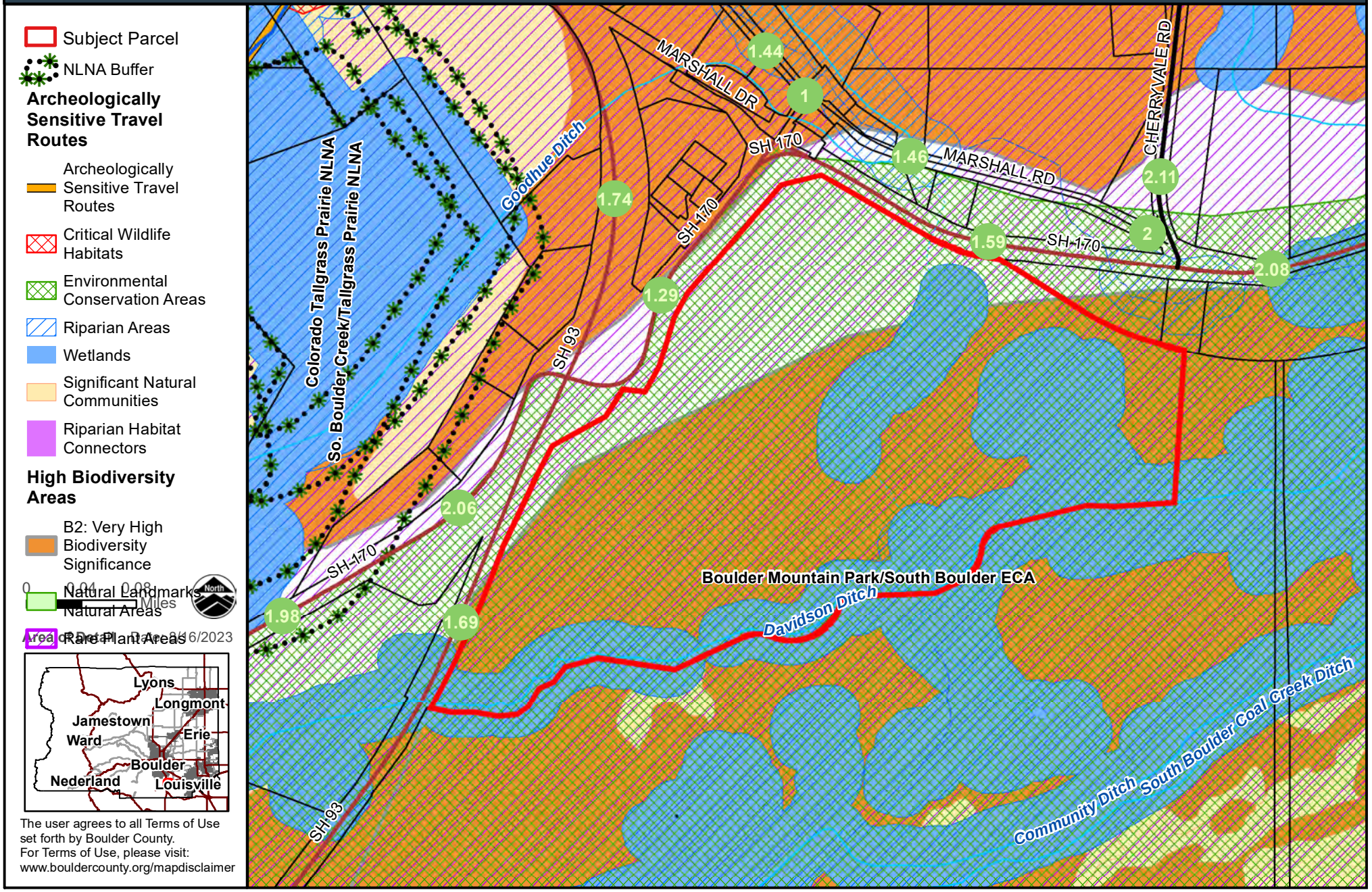
Comprehensive Plan

1842 S FOOTHILLS HWY



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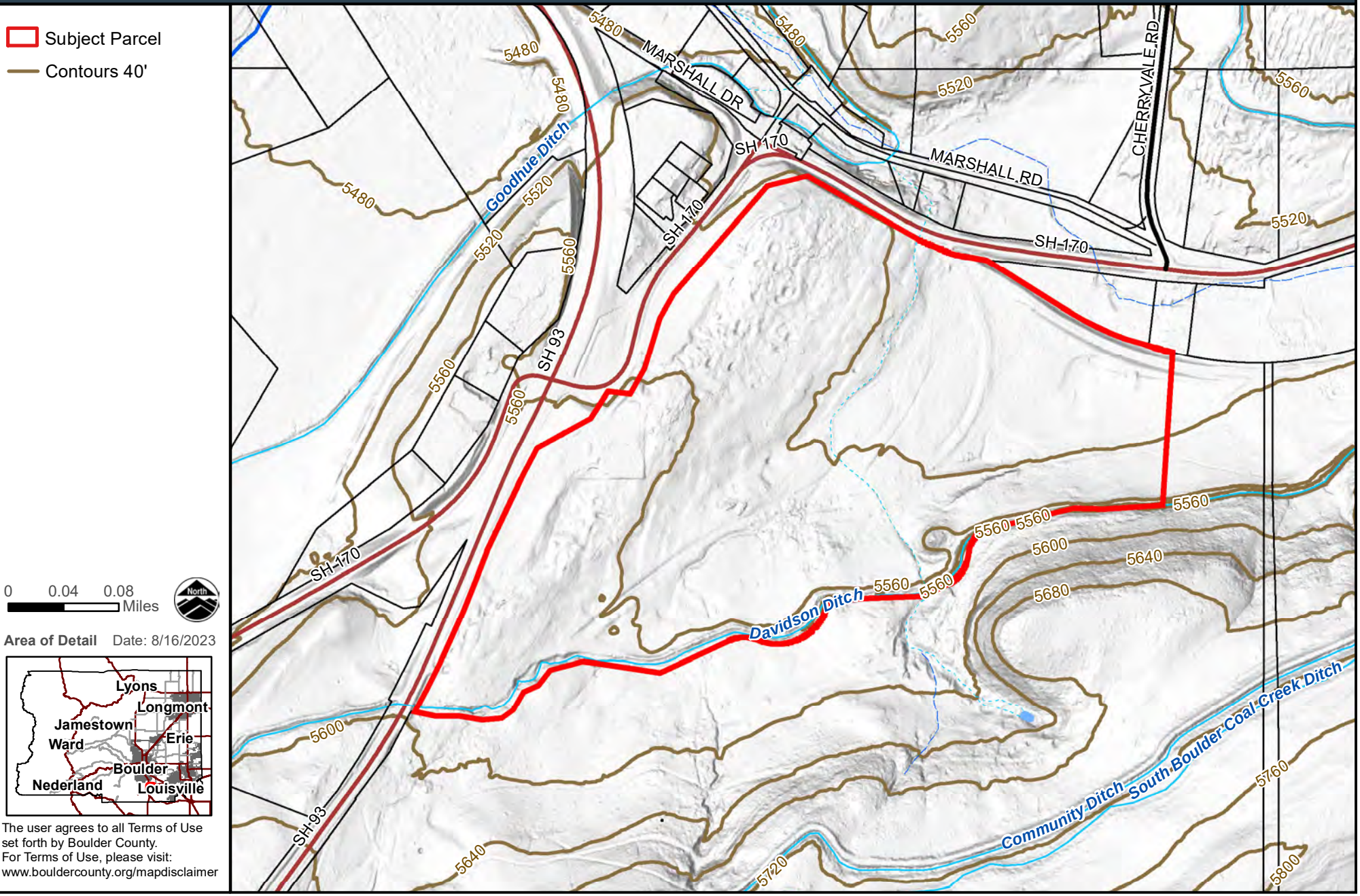
Elevation Contours

1842 S FOOTHILLS HWY



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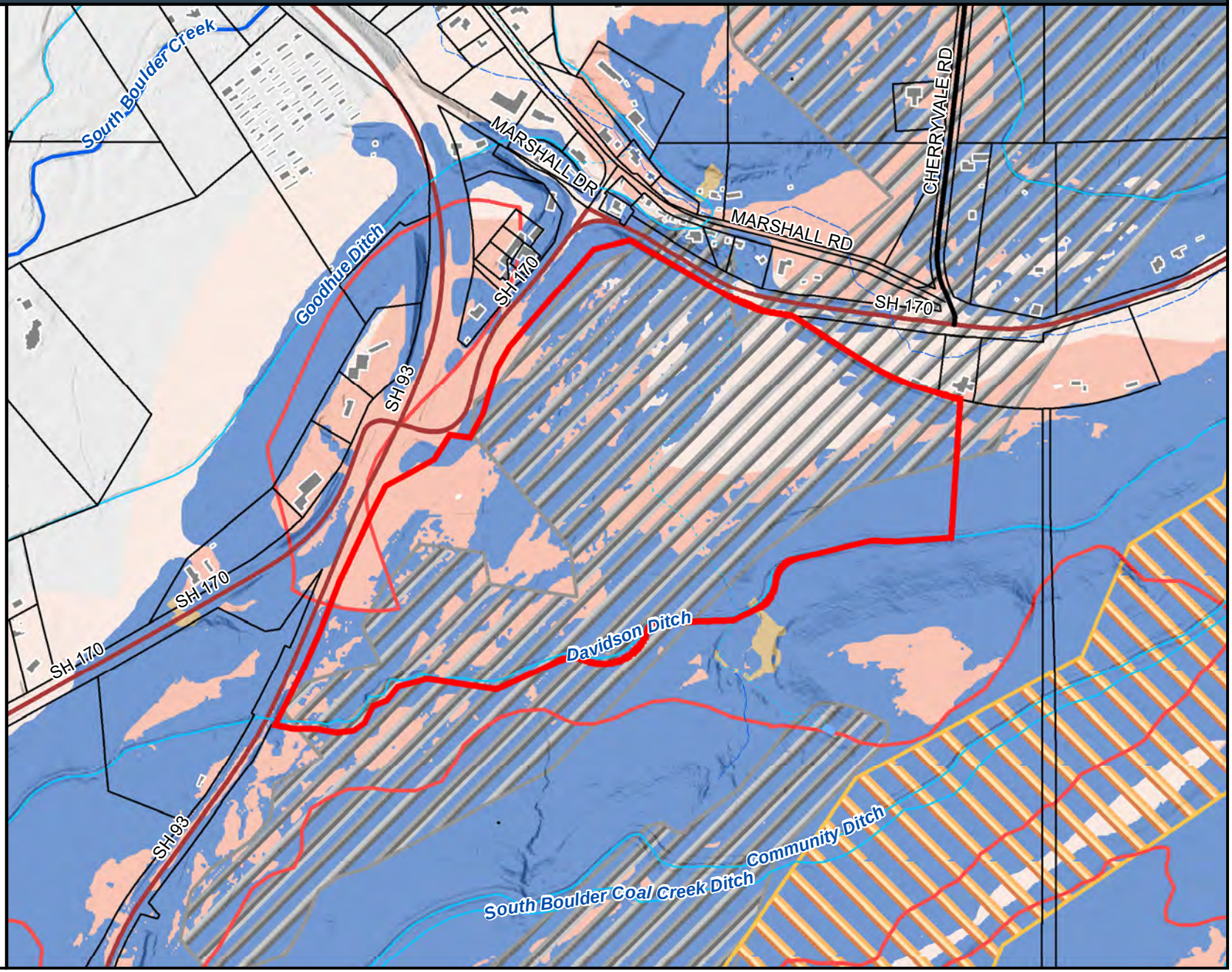
Geologic Hazards

1842 S FOOTHILLS HWY



Subject Parcel

Geologic Hazard & Constraint Areas
Geology Element

Slope Stability
- Debris flow susceptibility area
- Rockfall susceptibility area
- Landside susceptibility area
- Landslide Inventory

Heaving Bedrock
- Steeply Dipping, Heaving Bedrock

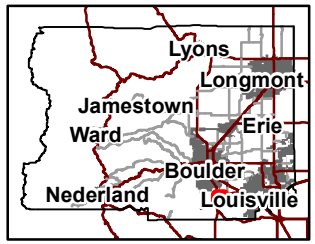
Boulder Coal Field
- Extent of Abandonded Coal Mines

Soil and Bedrock Swell Potential
- Very High
- High
- Moderate

0 290 580 Feet

North

Area of Detail Date: 8/16/2023



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Planning Areas

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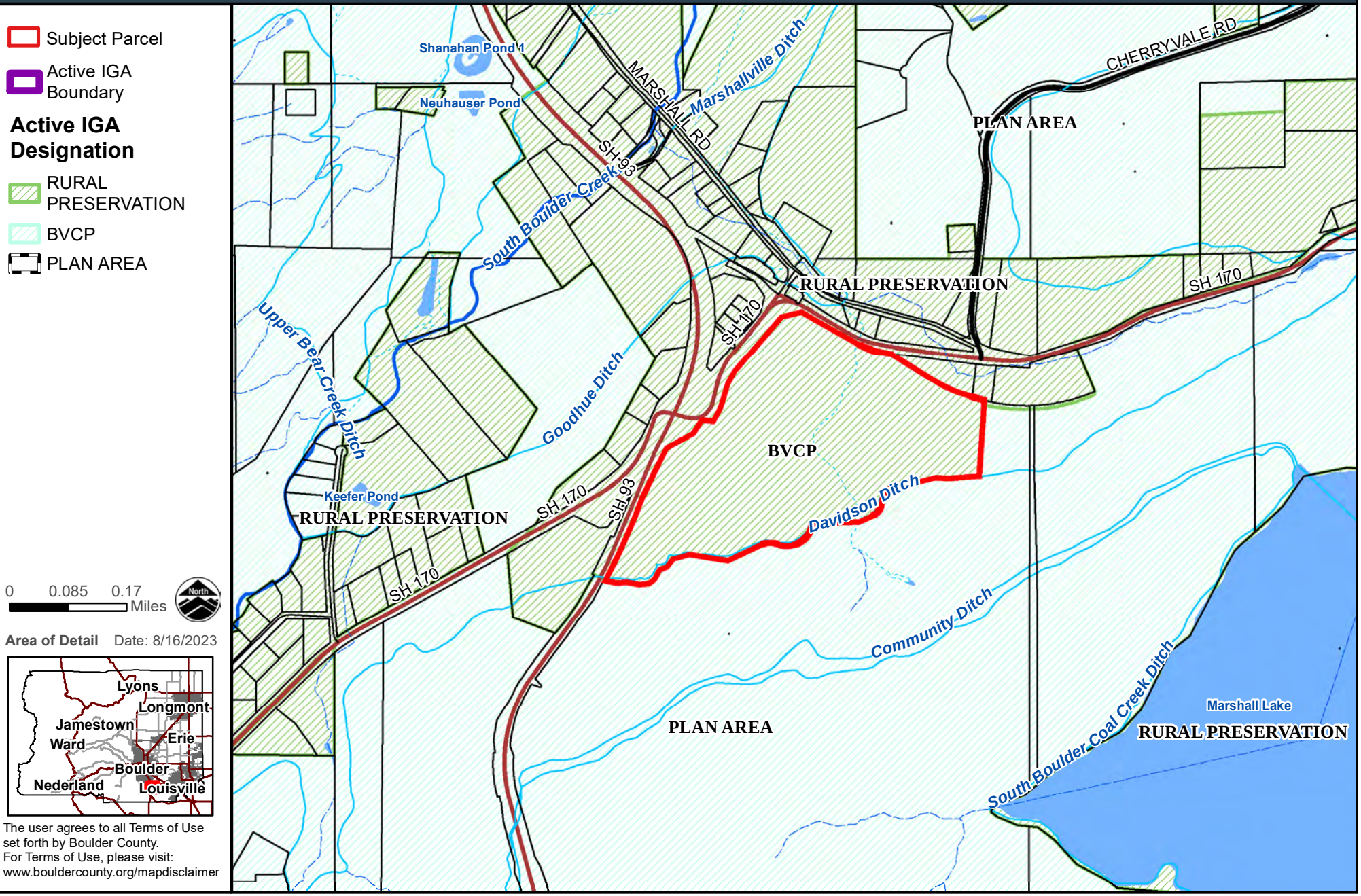

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Prebles

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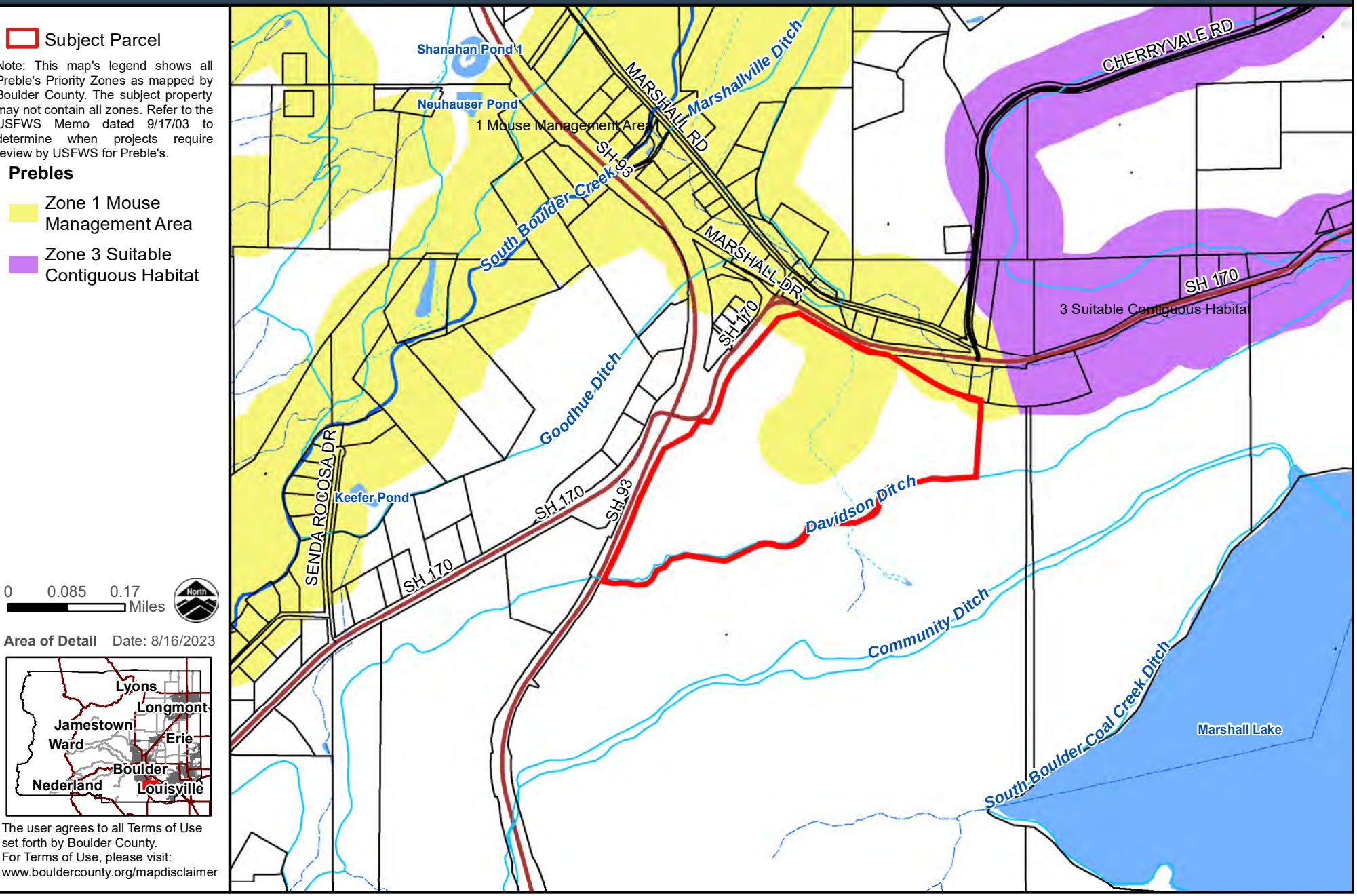

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Public Lands & CEs

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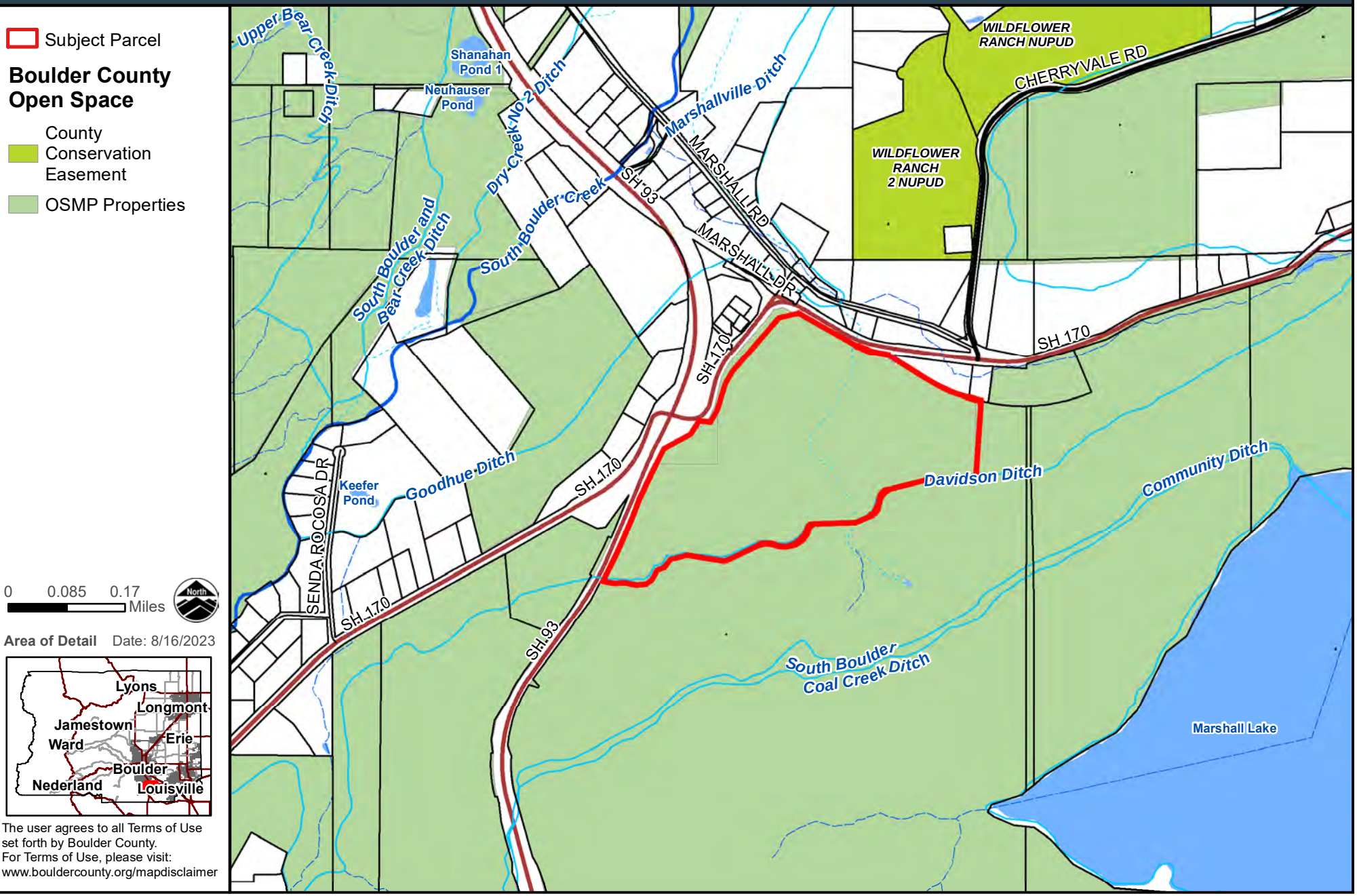

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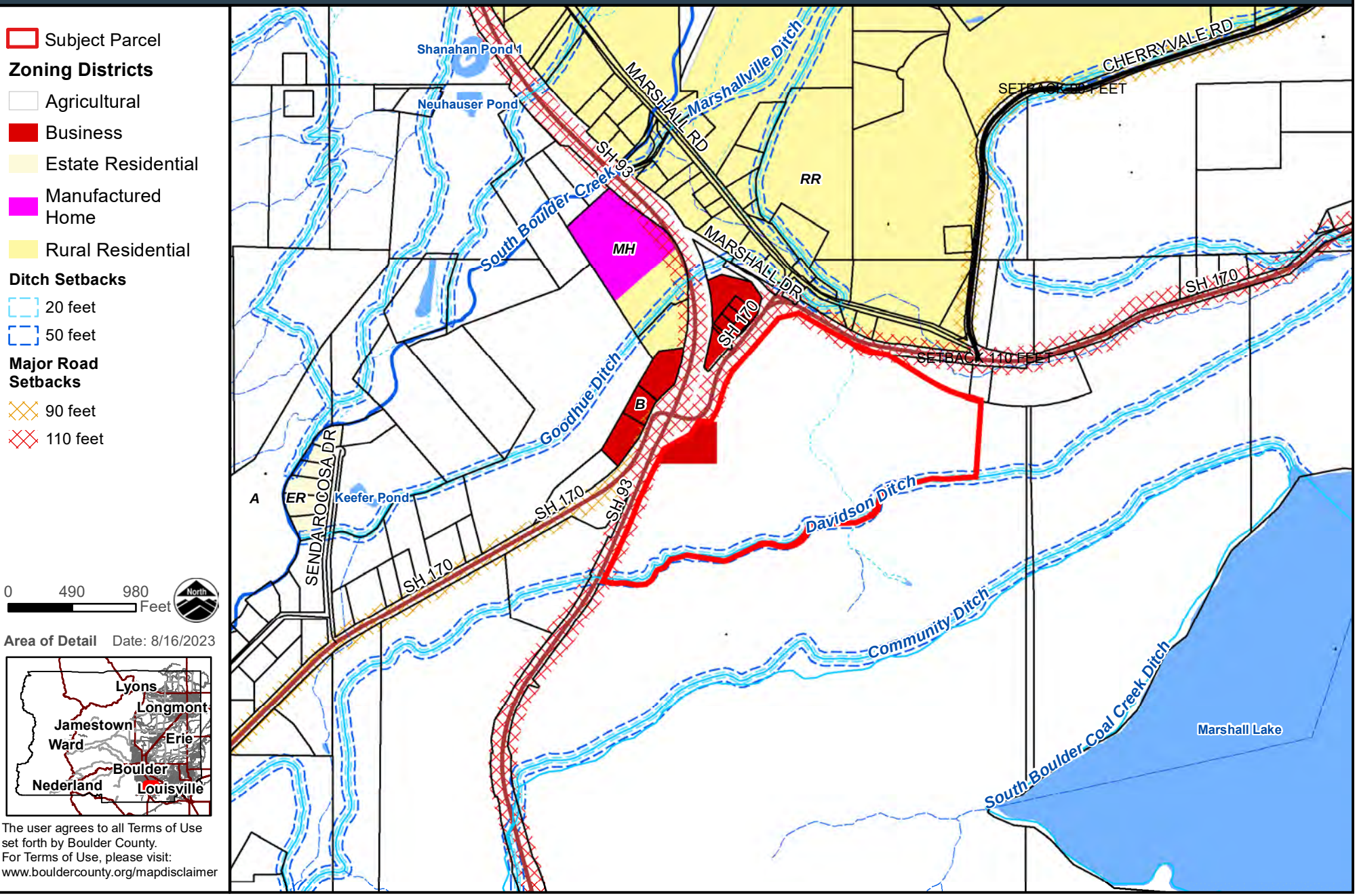
Zoning

1842 S FOOTHILLS HWY



wtodacheene

Limited Impact Special Use Review Fact Sheet

Project Identification

Project Name: Marshall Mesa Reclamation and Trailhead
Property Address/Location: 1842 South Foothills Hwy
Current Owner:
Size of Property in Acres:

The applicant(s) is/are required to complete each section of this Limited Impact Special Use Review Fact Sheet even if the information is duplicated elsewhere in the application. Completed Fact Sheets reduce the application review time which helps expediate the Director's Determination. Please make duplicates of this Limited Impact Special Use Review Fact Sheet if the project involves more than two structures.

Determining Floor Area

If an existing wall(s) and/or roof(s) are removed and a new wall(s)/roof(s) are constructed, the associated floor area due to the new wall(s)/roof(s) are considered new construction and must be included in the calculation of floor area for the Limited Impact Special Use Review and shown on this Fact Sheet.

Structure #1 Information

Type of Structure: (e.g. residence, studio, barn, etc.)					
Total Existing Floor Area: (Finished + Unfinished square feet including garage if attached.)			sq. ft.	**Deconstruction:**	sq. ft.

Are new floor areas being proposed where demolition will occur?

❑ **Yes** (include the new floor area square footage in the table below)

❑ **No**

Proposed Floor Area (New Construction Only)					
	Finished	**Unfinished**	**Total**		
Basement:	sq. ft.	sq. ft.	sq. ft.	**Height** (above existing grade)	
First Floor:	sq. ft.	sq. ft.	sq. ft.	**Exterior Wall Material**	
Second Floor:	sq. ft.	sq. ft.	sq. ft.	**Exterior Wall Color**	
Garage: ❑ Detached ❑ Attached	sq. ft.	sq. ft.	sq. ft.	**Roofing Material**	
Covered Deck:	sq. ft.	sq. ft.	sq. ft.	**Roofing Color**	
Total:	sq. ft.	sq. ft.	sq. ft.	**Total Bedrooms**	

Structure #2 Information

Type of Structure: (e.g. residence, studio, barn, etc.)					
Total Existing Floor Area: (Finished + Unfinished square feet including garage if attached.)			sq. ft.	**Deconstruction:**	sq. ft.

Are new floor areas being proposed where demolition will occur?

❑ **Yes** (include the new floor area square footage in the table below)

❑ **No**

Proposed Floor Area (New Construction Only)					
	Finished	**Unfinished**	**Total**		
Basement:	sq. ft.	sq. ft.	sq. ft.	**Height** (above existing grade)	
First Floor:	sq. ft.	sq. ft.	sq. ft.	**Exterior Wall Material**	
Second Floor:	sq. ft.	sq. ft.	sq. ft.	**Exterior Wall Color**	
Garage: ❑ Detached ❑ Attached	sq. ft.	sq. ft.	sq. ft.	**Roofing Material**	
Covered Deck:	sq. ft.	sq. ft.	sq. ft.	**Roofing Color**	
Total:	sq. ft.	sq. ft.	sq. ft.	**Total Bedrooms**	

Grading Calculation

Cut and fill calculations are necessary to evaluate the disturbance of a project and to verify whether or not a Limited Impact Special Use Review (LISR) is required. A Limited Impact Special Use Review is required when grading for a project involves more than 500 cubic yards (minus normal cut/fill and backfill contained within the foundation footprint).

If grading totals are close to the 500 yard trigger, additional information may be required, such as a grading plan stamped by a Colorado Registered Professional Engineer.

Earth Work and Grading

This worksheet is to help you accurately determine the amount of grading for the property in accordance with the Boulder County Land Use Code. Please fill in all applicable boxes.

Note: Applicant(s) must fill in the shaded boxes even though foundation work does not contribute toward the 500 cubic yard trigger requiring Limited Impact Special Use Review. Also, all areas of earthwork must be represented on the site plan.

Earth Work and Grading Worksheet:

	Cut	Fill	Subtotal
Driveway and Parking Areas			
Berm(s)			
Other Grading	182,000	182,000	364,000
Subtotal			364,000 Box 1

* If the total in Box 1 is greater than 500 cubic yards, then a Limited Impact Special Review is required.

	Cut	Fill	Total
Foundation			
Material cut from foundation excavation that will be removed from the property			

Excess Material will be Transported to the Following Location:

Excess Materials Transport Location:
All cut and fill will be used on site. No excess matial is anticipated.

Is Your Property Gated and Locked?

Note: If county personnel cannot access the property, it could cause delays in reviewing your application.

Certification

I certify that the information submitted is complete and correct. I agree to clearly identify the property (if not already addressed) and stake the location of the improvements on the site within four days of submitting this application. I understand that the intent of the Site Plan Review process is to address the impacts of location and type of structures, and that modifications may be required. Site work will not be done prior to issuance of a Grading or Building Permit.

Signature	Date
Adam J Gaylord	4/8/24

Marshall Mesa Trailhead Redesign
Boulder County Limited Impact Special Use Review Narrative
April 8, 2024

1.0 Introduction

Marshall Mesa Trailhead serves as one of the southern gateways to the City of Boulder Open Space and Mountain Parks (OSMP) system. The trailhead is located south of the intersection of Marshall Road and South Foothills Highway in unincorporated Boulder County south of Boulder, CO (Appendix 1, Cover Sheet). OSMP and the State of Colorado Department of Natural Resources Division of Reclamation, Mining, and Safety (DRMS) are proposing a mitigation effort to remove, to the extent practicable, hazards associated with long-burning subsurface coal fires and, upon completion of this mitigation work, installation of a new trailhead to replace the existing Marshall Mesa Trailhead.

2.0 Project Area

The site is wholly owned and managed by OSMP and consists of the Marshall Mesa Trailhead, access road, and surrounding area. The existing trailhead was constructed in 2007 and includes parking for 48 vehicles (including three ADA spaces), four designated horse trailer spaces, a vault restroom, and three picnic tables north of the parking areas. The area surrounding the trailhead is characterized by xeric tallgrass habitat (Photo 1) composed of a mix of native and non-native grasses such as big bluestem (*Andropogon gerardii*), smooth brome (*Bromus inermis*), western wheatgrass (*Pascopyrum smithii*), and crested wheatgrass (*Andropogon cristatum*) with patches of native shrubs such as yucca (*Yucca glauca*) and three-leaf sumac (*Rhus trilobata*). In December 2021, a destructive wildfire, now known as the Marshall Fire, started near the trailhead and burned eastward through the site, damaging trailhead fencing, the restroom, and burning most of the vegetation surrounding the trailhead. Since then, OSMP has replaced some of the fencing, installed temporary restrooms (Photo 2), and implemented restoration efforts to help habitats recover such as weed management and seeding.

Photo 1. Xeric tallgrass habitat south of Marshall Mesa Trailhead (facing south).

Photo 2. Temporary restrooms installed after Marshall Fire (standing at trailhead entrance facing south).

3.0 Project Description

DRMS will conduct mitigation of underground coal fires including extensive excavation. After mitigation activities are complete, OSMP will replace and reconfigure the existing trailhead to support multimodal access, improve erosion issues, and improve visitor safety. Improvements will also be made to the interior of the South Mesa Spur loop to improve visitor experience and facilitate education and outreach opportunities.

3.1 Subsurface Coal Fire Mitigation

Following the Marshall Fire, the State of Colorado Department of Natural Resources Division of Reclamation, Mining, and Safety (DRMS) and consultants completed a series of investigations on a 7.5-acre area in and around the trailhead to quantify the extents of subsurface heat associated with underground coal fires that have been burning in the area for over 50 years. Please see the attached 'Marshal Mine Underground Coal Fire Report of Investigations' (Appendix 2) for a detailed report of the results of these investigations. DRMS determined that excavating two coal seam areas with elevated subsurface temperatures (greater than 80º F) is appropriate to mitigate risk of future subsurface ignition and subsidence. Please see Appendix 3 for a description of proposed mitigation measures and plan set detailing the work.

DRMS contractors will excavate two areas totaling approximately 364,000 cubic yards of cut and fill (Appendix 4). The project will not result in excess cut. No material will be removed from the project area. Excavated material will be staged in one of three stockpile areas. In both locations, the overburden will be removed to expose burned/unburned coal which will then be spread and blended with overburden until coal temperatures drop below 80º F. Excavated material will then be replaced. Once excavation and replacement are complete, both areas will be graded to match existing topography as closely as feasible. DRMS contractors will also rough grade the redesigned trailhead (described below).

OSMP and the Mountain View Fire Protection District (MVFPD) have a mutual interest in wildfire prevention and suppression in the wildland/urban interface area surrounding Eldorado Springs and Marshall. The Marshall Mesa Trailhead renovation includes a fire protection cistern system that will be designed, installed, and maintained by MVFPD. The cistern will be truck filled from the trailhead above. Water will be accessed by MVFPD from a hydrant located adjacent to a wide shoulder along Highway 170. The approximately 8' diameter and 40' long cistern is designed to hold 20,000 gallons.

3.2 Marshall Mesa Trailhead Redesign

An OSMP system-wide trailhead assessment identified the need to renovate Marshall Mesa Trailhead to improve visitor safety, visitor experience, and access to multimodal transport. Given the damage sustained during the Marshall Fire and that the State's subsurface coal mitigation will necessarily disturb much of the trailhead, OSMP decided to move forward with trailhead renovation upon completion of subsurface mitigation work. In addition to necessary renovations, this project will allow OSMP to implement master plan goals and initiatives such as allowing trailheads to become not just places to access the system, but opportunities for education and outreach, gathering for passive recreation, and demonstration of native plantings and low-impact, sustainable design.

OSMP will reconfigure the existing trailhead largely within the existing footprint and entirely within the limits of disturbance of the proposed subsurface mitigation (Appendix 1). The new design will feature 70 total parking spaces including four designated accessible parking spaces. The new design will also accommodate a shuttle drop off and trailer parking loop. The parking area will be gravel road base over compacted subgrade except for the accessible parking spots, the driveway apron, and some of the access drive, which will be concrete. To prevent erosion and material loss, the parking area will be surrounded by curb and gutter that will direct water to a bioretention area on the south side of the trailhead.

The new trailhead will include bike racks, a rain garden, picnic tables and an updated double vault restroom. To improve visitor safety and decrease traffic congestion at the intersection of CO 93 and Marshall Road and allow full turn movements in and out of the trailhead, a new access road will be constructed with an entrance north of the existing access road, which will be closed and restored.

3.2 Cut and Fill Estimates

The subsurface mitigation will require excavation of approximately 182,000 cubic yards of material. Upon completion of mitigation work, cut material outside of the footprint of the proposed trailhead will be recontoured to match existing grades. Within the footprint of the new trailhead, DRMS contractors will rough grade the proposed design and then OSMP contractors will finish the fine grading. As such, all excavated material will be used on site and the total cut/fill for the project will be approximately 364,000 cy. No material will be transported off site.

3.3 Access and Staging

The project area will be accessed from Marshall Drive. A construction access will be installed across the street (east) of the existing driveway for the Eldorado Shuttle parking area west of Marshall Drive. Upon completion of underground mitigation work, the construction access will be graded to serve as the future trailhead access drive. A temporary vehicle tracking control pad will also be installed within the footprint of the existing trailhead during construction. Material staging will be located in three areas within the project area. Vehicle and equipment staging will be located within the limits of disturbance.

3.5 Project Timeline

Pending on-going regulatory review and permit issuance, DRMS is expected to begin subsurface mitigation in Fall of 2024. Mitigation work is projected to take approximately 12-16 weeks. Upon completion of the mitigation work, OSMP will begin construction of the new trailhead. Trailhead construction is expected to be completed by Fall 2025.

3.6 Best Management Practices

During construction, OSMP will follow all applicable Best Management Practices outlined in Wetland Protections Program Best Management Practices (City of Boulder 1995) and OSMP's Ecological Best Management Practices (City of Boulder 2013). Grading limits will be clearly marked. No dewatering will be necessary. No equipment will need to access the water. Prior to transporting equipment to the site, all machinery will be cleaned to remove weed seeds. A "spill kit" for emergency pollutant isolation, and written clean-up procedures, will be onsite at all times during construction activity.

Please see Sheets 23-25 (Appendix 1) for an erosion control plan for the proposed trailhead. The DRMS contractor will install and maintain erosion control for the underground mitigation work, then OSMP contractors will maintain erosion control during trailhead construction until final stabilization of the site occurs. The following general erosion control measures will be implemented:

- Silt fences shall be placed on the downhill (north/west) sides of the site during construction.
- Certified weed-free coconut fiber logs/waddles shall be installed in key locations around the site to limit runoff.
- Erosion control mats, filter logs, rock checks, durable mulch or a combination thereof shall be used in areas where concentrated water flow is likely to occur to prevent soil movement.
- Soils tracked from the site by vehicles shall be cleaned daily (or more frequently, as necessary) from paved roadway surfaces throughout the duration of construction.
- Other erosion control BMPs will be utilized as necessary.

After construction is complete, restoration areas and areas of temporary impact will be seeded with native species and covered with 100% biodegradable erosion control blanket. Plant material will be obtained from commercial nurseries and seed suppliers or supplied by OSMP. Only local genotypes will be used. Commercial seed lots will be tested for viability and purity and seed lots contaminated with weed seed will be rejected. OSMP supports a volunteer seed collection program where staff-led volunteers collect native seed from OSMP land for use in restoration projects. Any cuttings used for the project will be harvested from OSMP land, preferably within the area of impact for the project. Restoration, including seeding and plantings, will be monitored by an OSMP ecologist for a minimum of three years.

Maintenance will either be performed in house or contracted. Plantings will be irrigated as necessary based on ecological conditions observed during periodic monitoring events. The primary maintenance activity necessary for the long-term success of the project is management of weeds and other undesirable vegetation. The continued control of non-native species including crack willow will be important to allow native trees and shrubs to colonize and persist.

4.0 Regional and Federal Clearances

The proposed project requires clearances from Boulder County and the City of Boulder.

4.1 Boulder County

During the pre-application meeting for this application, Boulder County planning staff requested that OSMP submit a traffic report and updated title information. Please find these materials attached in Appendix 5 and 6, respectively.

OSMP and DRMS will submit separate applications for required building, grading, and stormwater permits, OSMP for the trailhead and DRMS for the underground mitigation.

4.2 City of Boulder

No impacts to these regulated areas are proposed. As such, the project does not require a Wetland Permit.

4.3 Federal Clearances

The project will not impact Water of the U.S. and therefore no Clean Water Act coordination with the U.S. Army Corps of Engineers is required.

The project is not located within suitable habitat for any species listed under the Endangered Species Act. No coordination with the U.S. Fish and Wildlife Service is required.

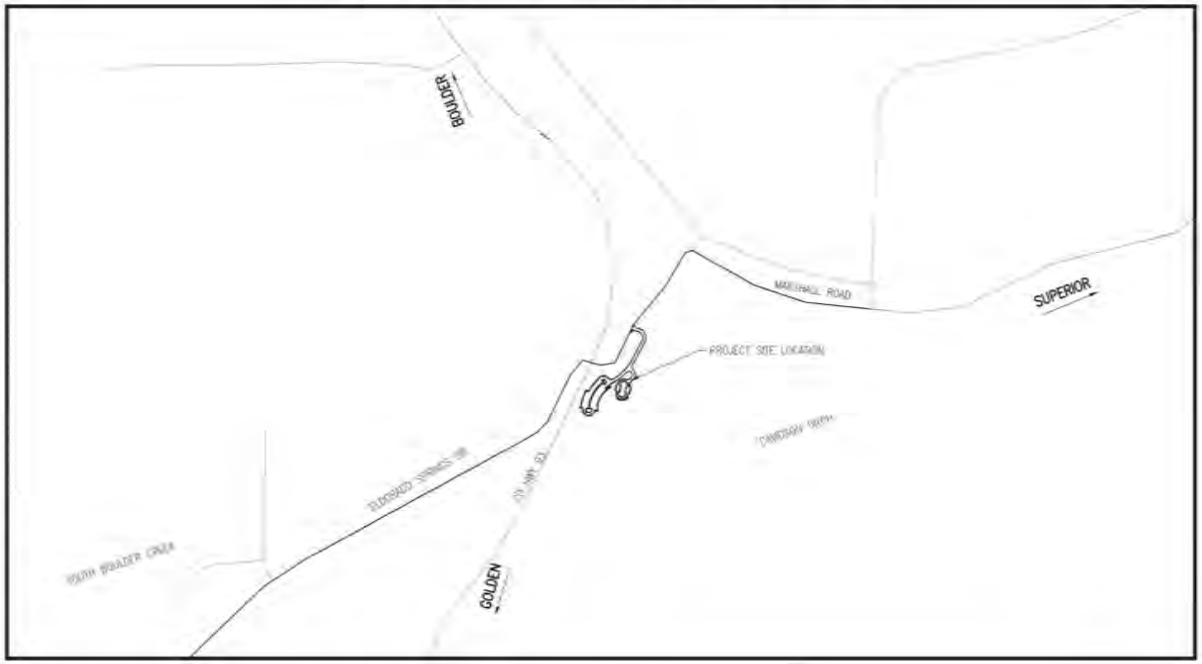
Marshall Mesa Trailhead Redesign

City of Boulder Open Space and Mountain Parks

Appendix 1 – Plan Set

April 8, 2024

CITY OF BOULDER OPEN SPACE & MOUNTAIN PARKS
BOULDER COUNTY
MARSHALL MESA TRAILHEAD RENOVATION



PROJECT LOCATION MAP

0' 500' 1000' 2000'

INDEX OF SHEETS

PROJECT CONTACTS

OWNER
CITY OF BOULDER
OPEN SPACE & MOUNTAIN PARKS
LENE FLAX
2520 55TH ST
BOULDER, CO 80301
P: 303-579-3022

CIVIL ENGINEER
OTAK, INC.
KEVIN DOOLEY, PE
771 CENTENNIAL PARKWAY, SUITE 170
LOUISVILLE, CO 80027
P: 720-258-7721

SURVEY
FLATIRONS, INC.
JAMES COWAN, LS
1155 FORTH AVENUE
LONGMONT, CO 80501
P: 720-206-0156

30% SUBMITTAL (NOT FOR CONSTRUCTION) -APRIL 5, 2024

All seals for this set of drawings are applied to the cover page(s).

Prints Date: Apr 05, 2024
File Name: 21662-01 TITLE SHT (MM).dwg
Horiz. Scale: As Noted Vert. Scale:
Otak

Sheet Revisions		
Date:	Comments	Init.

CITY OF BOULDER Open Space & Mountain Parks

As Constructed	MARSHALL MESA TRAILHEAD RENOVATION	Project No./Code
No Revisions:	Contractor:	21662
Revised:	Designer: T. Rohan / Structure Numbers: / /	
Void:	Detailer: R. Cowell / Sheet Subset: / Subset Sheets:	Sheet Number 01

GENERAL NOTES:

G1. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE COLORADO DEPARTMENT OF TRANSPORTATION, STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, DATED 2011; AND AS SUBSEQUENTLY REVISED, THE STANDARD PLANS DATED JULY, 2012 AND AS SUBSEQUENTLY REVISED, AND IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS INCLUDED HEREIN AND CITY OF BOULDER OPEN SPACE AND MOUNTAIN PARKS TRAIL STANDARDS AND DETAILS.

G2. ALL MATERIALS AND WORKMANSHIP SHALL BE SUBJECT TO INSPECTION BY THE PROJECT MANAGER OR ITS AUTHORIZED REPRESENTATIVES. THE OWNER RESERVES THE RIGHT TO ACCEPT OR REJECT ANY SUCH MATERIAL AND/OR WORKMANSHIP THAT DOES NOT CONFORM TO THE PROJECT STANDARDS AND SPECIFICATIONS.

G3. THE CONTRACTOR SHALL NOTIFY THE OWNER ONE WEEK PRIOR TO THE START OF CONSTRUCTION. A PRECONSTRUCTION MEETING SHALL BE HELD PRIOR TO THE START OF CONSTRUCTION.

G4. THE CONTRACTOR SHALL HAVE: ONE (1) COPY OF THE PLANS, ONE (1) COPY OF THE CONSTRUCTION SPECIFICATIONS AND ONE (1) COPY OF THE STORMWATER MANAGEMENT PLAN FOR THE PROJECT AT THE JOB SITE AT ALL TIMES.

G5. SITE ACCESS POINTS AND STAGING AREAS SHALL BE APPROVED BY THE PROJECT MANAGER PRIOR TO MOBILIZATION. FENCING, GEOTEXTILES, OR OTHER REQUIREMENTS MUST BE INSTALLED PRIOR TO STAGING ANY MATERIALS IN SPECIFIED AREAS.

G6. EROSION CONTROL MEASURES SHALL BE IMPLEMENTED BEFORE CONSTRUCTION AND GRADING OPERATIONS BEGIN. ALL EROSION CONTROL MEASURES SHALL BE PLACED CONTINUALLY AS DRAINAGE FEATURES ARE BEING CONSTRUCTED. MEASURES SHALL REMAIN IN PLACE UNTIL ALL CONSTRUCTION IS COMPLETE AND SUBSTANTIALLY STABILIZED.

G7. CONTRACTOR SHALL LIMIT CONSTRUCTION ACTIVITIES TO THOSE AREAS WITHIN THE LIMITS OF DISTURBANCE AND APPROVED STAGING AREAS AS SHOWN ON THE PLANS AND CROSS SECTIONS. ANY DISTURBANCE OUTSIDE OF THESE AREAS IS NOT ACCEPTABLE. ANY DISTURBANCES BEYOND THESE LIMITS SHALL BE RESTORED TO THE ORIGINAL CONDITION BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE. CONSTRUCTION ACTIVITIES IN ADDITION TO NORMAL CONSTRUCTION PROCEDURE SHALL INCLUDE THE PARKING OF VEHICLES OR EQUIPMENT, DISPOSAL OF LITTER, AND ANY OTHER ACTION WHICH WOULD ALTER EXISTING CONDITIONS. ANY OFF ROAD STAGING AREAS MUST BE PRE-APPROVED BY THE PROJECT ENGINEER. REVIEW PROJECT SPECIAL CONDITIONS.

G8. THE CONTRACTOR SHALL RESTORE ANY EXISTING IMPROVEMENTS, OR VEGETATION DISTURBED BY CONSTRUCTION TO A CONDITION EQUAL TO OR BETTER THAN THAT WHICH EXISTED PRIOR TO CONSTRUCTION. SEE "CONSTRUCTION NOTES", ITEM 4 RE: "VEGETATION" ON THIS PAGE. ALL ASSOCIATED COSTS FOR IMPROVEMENTS REPAIR SHALL BE PAID FOR BY THE CONTRACTOR, AT NO EXPENSE TO THE OWNER, UNLESS SPECIFICALLY DESIGNATED IN THE PLANS AS PAY ITEMS. ALL REPAIRS SHALL MEET CURRENT DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS.

G9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STABILITY OF ALL STRUCTURES DURING CONSTRUCTION.

G10. SALVAGEABLE MATERIAL DESIGNATED TO REMAIN THE PROPERTY OF THE DEPARTMENT-SIGNS, POSTS, TRASH RECEPTACLES, BENCHES, FENCING, AND GATES SHALL BE REMOVED AS NECESSARY TO ACCOMMODATE THE CONSTRUCTION OF THE ROADWAY. SALVAGED MATERIAL SHALL BE STOCKPILED AND STORED AT POINTS NEAR THE ORIGINAL LOCATIONS AND BE MADE ACCESSIBLE AND VISIBLE FOR INSPECTION IN ACCORDANCE WITH 202.03.

G11. EXISTING TRAILS AND STRUCTURES- WHERE SUCH PORTIONS OF EXISTING STRUCTURES LIE WHOLLY OR IN PART WITHIN THE LIMITS OF THE "WORK". THE CONTRACTOR SHALL CONFORM THE WORK TO ACCEPTABLE LINE AND GRADE, AS DETERMINED BY THE PM AND IN ACCORDANCE WITH SECTION 808 OF THE CITY OF BOULDER GENERAL CONDITIONS.

G12. REMOVAL OF ASPHALT MAT SHALL BE SAW CUT TO A VERTICAL EDGE TO A NEAT LINE WITH A SAW OR CUTTING WHEEL.

G13. THE CONTRACTOR SHALL PROTECT ALL WORK AREAS AND FACILITIES FROM WATER AT ALL TIMES. AREAS AND FACILITIES SUBJECTED TO FLOODING, REGARDLESS OF THE SOURCE OF WATER SHALL BE PROMPTLY DEWATERED AND RESTORED AT NO COST TO THE OWNER. THIS SHALL INCLUDE REMOVAL OF ANY DEBRIS CAUSED BY FLOODING.

G14. IF NEEDED, THE CONTRACTOR SHALL OBTAIN A CONSTRUCTION DEWATERING PERMIT FROM THE CDPHE FOR ANY DEWATERING OF GROUNDWATER DURING CONSTRUCTION IN ACCORDANCE WITH WATER QUALITY CONTROL DIVISION (WQCD) REQUIREMENTS. THE CONTRACTOR SHALL APPLY FOR THIS PERMIT AT LEAST 30 DAYS PRIOR TO THE START OF DISCHARGE. ALL COSTS FOR OBTAINING THE PERMIT, CONSTRUCTIONS, MAINTAINING AND REMOVING TEMPORARY DIVERSIONS AND DEWATERING DEVICES SHALL BE INCLUDED IN THE COST OF THE WORK.

G15. THE CONTRACTOR IS REQUIRED TO KEEP ALL DRAINAGE AND FACILITIES FUNCTIONAL AND MAINTAIN DRAINAGE TO THOSE FACILITIES AT ALL TIMES DURING CONSTRUCTION.

G16. THE CONTRACTOR SHALL PREVENT ANY CONSTRUCTION DEBRIS, INCLUDING LITTER, FROM FALLING INTO THE DRAINAGEWAYS, AND SHALL PROMPTLY REMOVE ANY DEBRIS THAT INCIDENTALLY FALLS INTO THE DRAINAGEWAYS. ALL DEBRIS SHALL BE REMOVED AT THE CONTRACTOR'S OWN EXPENSE. EROSION CONTROL FEATURES MUST BE IN PLACE PRIOR TO ANY CONSTRUCTION ACTIVITIES.

G17 HOT WEATHER AND COLD WEATHER CONCRETING OPERATIONS SHALL BE PERFORMED IN ACCORDANCE WITH CITY OF BOULDER DESIGN AND CONSTRUCTION STANDARDS (2023). THIS COST SHALL BE INCLUDED IN WORK.

UTILITIES:

U1. FOR UTILITY LOCATES, THE CONTRACTOR IS RESPONSIBLE FOR CONTACTING THE UTILITY NOTIFICATION CENTER OF COLORADO (UNCC) AT 811 AT LEAST THREE (3) WORKING DAYS (NOT INCLUDING THE INITIAL DAY OF CONTACT) PRIOR TO DIGGING, GRADING OR EXCAVATING.

U2. THE LOCATION OF EXISTING UTILITIES SHOWN ON THESE DRAWINGS HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS THE CONTRACTOR'S RESPONSIBILITY TO FIELD VERIFY HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES PRIOR TO COMMENCING CONSTRUCTION AND TO NOTIFY THE OWNER OF ANY DISCREPANCY. ALL CONFLICTING UTILITIES SHALL BE EXPOSED BY THE CONTRACTOR PRIOR TO CONSTRUCTION AND INSPECTED BY THE OWNER TO VERIFY CONFORMANCE WITH THE PLANS. THIS PARTICULARLY APPLIES TO UNDERGROUND WORK TO BE COMPLETED ON THIS PROJECT BY THE CONTRACTOR. RELOCATION OF EXISTING UTILITIES IS NOT A PART OF THIS CONTRACT EXCEPT AS SHOWN ON THESE DRAWINGS. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF UTILITY RELOCATIONS BY UTILITY COMPANIES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROTECTING UTILITIES DURING CONSTRUCTION AND SHALL HOLD THE CITY OF THE OWNER HARMLESS FOR DAMAGES ARISING FROM CONTRACTOR'S FAILURE TO ADEQUATELY PROTECT EXISTING UTILITIES.

U3. THE CONTRACTOR SHALL REFERENCE THE PROJECT TECHNICAL SPECIFICATIONS FOR ADDITIONAL ITEMS THE CONTRACTOR SHALL ADHERE TO IN COOPERATION WITH UTILITIES.

EARTHWORK:

E1. EXCAVATION REQUIRED FOR COMPACTION OF BASES OF CUTS AND FILLS WILL BE CONSIDERED AS SUBSIDIARY TO THAT OPERATION AND WILL NOT BE PAID FOR SEPARATELY.

E2. THE TYPE OF COMPACTION FOR EARTHWORK ON THIS PROJECT SHALL BE 95% (STANDARD PROCTOR). PROOF ROLLING OF ALL SUBGRADE WILL BE REQUIRED PRIOR TO PLACEMENT OF SURFACING AND SHALL BE INCLUDED IN COST OF THE WORK.

E3. FINAL GRADES SHOWN REFLECT FINISHED GRADE OF THE PROPOSED EARTHWORK.

E4. ALL ON AND OFF-SITE MATERIAL USED ON THIS PROJECT IS SUBJECT TO REVIEW AND APPROVAL BY THE OWNER, GEOTECHNICAL ENGINEER, AND THE ENGINEER PRIOR TO ITS INCORPORATION INTO THE PROJECT.

E5. ALL EXCAVATION & EMBANKMENT FOR THIS PROJECT IS CONSIDERED UNCLASSIFIED AND COMPLETE-IN-PLACE. STRUCTURE EXCAVATION & BACKFILL WILL NOT BE MEASURED OR PAID FOR SEPARATELY.

EROSION CONTROL, SEEDING AND MULCHING NOTES:

SEE EROSION CONTROL NOTES AND DETAILS.

ENVIRONMENTAL NOTES:

EN1. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN EXISTING BMPs AND ENSURE THEIR COMPLETE REMOVAL ONCE 70% VEGETATION HAS BEEN RE-ESTABLISHED IN DISTURBED AREAS.

VEGETATION NOTES:

V1. THE CONTRACTOR SHALL REVIEW THE SITE WITH THE OWNER PRIOR TO CONSTRUCTION. NO TREES OR SHRUBS SHALL BE REMOVED WITHOUT PRIOR APPROVAL FROM THE OWNER. THE CONTRACTOR SHALL PROTECT EXISTING TREES TO THE GREATEST EXTENT POSSIBLE.

V2. THE COST OF REMOVAL OF TREES REQUIRED TO ACCOMPLISH THE WORK SHALL BE INCLUDED IN THE COST OF CLEARING & GRUBBING (LS).

V3. THE PAY LIMITS FOR SEEDING ARE DEFINED BY THE DISTURBANCE LIMITS INCLUDING THE APPROVED STAGING/STOCKPILE AREAS SHOWN IN THE PLANS. THESE ITEMS WILL BE PAID FOR BASED UPON PLAN QUANTITIES. ANY ADDITIONAL DISTURBED AREAS SHALL BE SEEDED AT NO ADDITIONAL COST TO THE PROJECT.

V4. NO SHRUBS SHALL BE REMOVED FROM THE PROJECT SITE UNLESS SPECIFIED IN THE PLANS. PRUNING OF SHRUB BRANCHES MUST MEET CLEARING LIMIT SPECIFICATIONS.

PERMITS

THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AS OUTLINED BY THE PROJECT DOCUMENTS AND/OR BOULDER COUNTY (SEE GENERAL AND SPECIAL CONDITIONS).

SURVEY NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CONSTRUCTION SURVEYING. LAYOUT AND STAKING OF ALL IMPROVEMENTS SHALL BE APPROVED BY THE PROJECT MANAGER PRIOR TO INSTALLATION OF IMPROVEMENTS. DISCREPANCIES TO THE BASE INFORMATION SHALL BE BROUGHT TO THE PROJECT MANAGER ATTENTION FOR A DECISION PRIOR TO COMMENCING WITH THE WORK. NOTIFICATION OF REQUEST FOR FIELD REVIEW SHALL BE MADE A MINIMUM OF 48 HOURS IN ADVANCE AND SHOWN IN THE CONSTRUCTION PROGRESS SCHEDULE.
2. ALL UNDERGROUND UTILITIES MUST BE FIELD LOCATED BY THE APPROPRIATE AGENCY OR UTILITY COMPANY PRIOR TO ANY EXCAVATION, PURSUANT TO C.R.S. SEC. 9-1.5-103.
3. COLORADO STATE PLANE COORDINATE SYSTEM, COLORADO NORTH ZONE, NORTH AMERICAN DATUM 1983 (NAD83). ALL BEARINGS SHOWN HEREON ARE RELATIVE THERETO.
4. AUTOCAD FILES OF THE PROJECT WILL BE PROVIDED TO THE CONTRACTOR FOR THEIR USE DURING CONSTRUCTION.
5. THE CONTRACTOR SHALL ESTABLISH AND MAINTAIN CENTERLINE STATIONING AT 50' MAXIMUM SPACING. EACH STAKE SHALL BE CLEARLY LABELED WITH STATION NUMBERING CORRESPONDING TO THE PLANS. AN APPROVED OFFSET SHALL BE USED WHEN NEEDED TO MAINTAIN THE STAKING THROUGHOUT CONSTRUCTION.
6. IN ADDITION TO CENTERLINE STATIONING, THE FOLLOWING FEATURES MUST ALSO BE STAKED AND LABELED WITH THE FEATURE NAME AND STATION:
   - CULVERT INVERTS
   - BEGIN AND END OF RETAINING WALLS AND DITCH FLOW LINES
   - CORNER POINTS OF STAGING / STOCK PILE LOCATIONS AND RIPRAP
7. EXISTING EDGE OF TRAVEL WAY SHALL BE MARKED WITH STAKE CHASERS AT 20' MAX SPACING.
8. UPON COMPLETION OF THE STAKING, THE CONTRACTOR SHALL WALK THE ENTIRE PROJECT WITH THE PROJECT MANAGER AND ADJUST THE STAKING AS DIRECTED.
9. STATIONS, ELEVATIONS, AND DIMENSIONS CONTAINED ON THESE PLANS ARE CALCULATED FROM THE SOUTH MESA TRAILHEAD AREA SURVEY CONDUCTED BY BOULDER LAND CONSULTANTS, INC. ON DECEMBER 11, 2023. THE CONTRACTOR SHALL VERIFY ALL DEPENDENT DIMENSIONS IN THE FIELD BEFORE ORDERING OR FABRICATING ANY MATERIAL AND SHALL BE RESPONSIBLE FOR THE FIT OF ALL NEW CONSTRUCTION.
10. ALL STAKING MATERIALS SHALL BE REMOVED FROM THE SITE UPON RECEIVING A FAVORABLE FINAL INSPECTION REPORT.

CONSTRUCTION NOTES:

1. ALIGNMENT: IT IS EXPECTED THAT THE CONTRACTOR MAKE MINOR ADJUSTMENTS TO THE ALIGNMENT DURING CONSTRUCTION TO IMPROVE DRAINAGE, AVOID IMPACTS TO VEGETATION THAT ARE NOT SPECIFICALLY IDENTIFIED FOR REMOVAL, MINIMIZE SITE IMPACTS, AND BALANCE EARTHWORK. ALIGNMENT SHIFTS OF GREATER THAN 2' SHALL BE APPROVED BY THE OWNER PRIOR TO STARTING CONSTRUCTION. MINOR MODIFICATIONS TO THE DESIGN DURING CONSTRUCTION ARE AN EXPECTED PART OF THE WORK AND NOT JUSTIFICATION FOR CHANGES TO THE CONTRACT.
2. GRADING: THE CONTRACTOR SHALL FOLLOW THE PLANS WHEN SPECIFIC GRADING AND/OR ROAD PROFILE INFORMATION IS PROVIDED. IN AREAS WHERE GRADING AND/OR PROFILE INFORMATION IS NOT PROVIDED, THE CONTRACTOR SHALL CONSTRUCT THE TRAIL TO APPROXIMATELY THE EXISTING GRADES OF THE SITE. MINOR DEVIATIONS FROM EXISTING GRADES SHOULD BE MADE TO ASSURE POSITIVE DRAINAGE FROM THE TRAIL TREAD, TO CONSTRUCT DRAINAGE FEATURES IDENTIFIED IN THE PLANS OR OTHERWISE DETERMINED TO BE NEEDED AND TO BALANCE EARTHWORK. MINOR MODIFICATIONS TO THE DESIGN DURING CONSTRUCTION ARE AN EXPECTED PART OF THE WORK AND NOT JUSTIFICATION FOR CHANGES TO THE CONTRACT.
3. CROSS SLOPE: THE TREAD CROSS SLOPE SHALL BE GREATER THAN 2% AND LESS THAN 5% UNLESS OTHERWISE SHOWN IN THE PLANS. THE CONTRACTOR SHALL VERIFY CROSS SLOPE WITH A DIGITAL SMART LEVEL OR OTHER APPROPRIATE MEASURING TOOLS DURING CONSTRUCTION TO PROPERLY CONSTRUCT TREAD CROSS SLOPE.
4. VEGETATION: THE CONTRACTOR SHALL PROTECT EXISTING VEGETATION NOT SPECIFICALLY IDENTIFIED FOR REMOVAL TO THE GREATEST EXTENT POSSIBLE. REMOVAL OF TREES AND SHRUBS, UNLESS SPECIFICALLY IDENTIFIED IN THE PLANS, SHALL BE APPROVED BY THE OWNER PRIOR TO REMOVAL.
5. USE AND DISPOSAL OF EXCAVATED MATERIAL: EXCESS SITE MATERIALS (SOILS AND ORGANIC MATERIALS) SHALL BE CONSERVED AND USED ON THE SITE. EXCESS SOILS SHALL BE DEPOSITED IN RESTORATION AREAS. ROCKS UNEARTHED IN EXCAVATIONS SHALL BE USED TO STABILIZE DRAINAGE AREAS.
6. SITE ACCESS: THE CONTRACTOR SHALL USE THE EXISTING ROAD FOR THE TRANSPORT OF MATERIALS AND EQUIPMENT DURING CONSTRUCTION. THE CREATION OF ADDITIONAL PARALLEL ACCESS ROUTES WILL NOT BE ALLOWED. DISTURBANCE OF CURRENTLY UNDISTURBED AREAS MUST BE AVOIDED. ANY AREA DISTURBED OUTSIDE OF THE FINISHED TREAD MUST BE RESTORED TO PRECONSTRUCTION CONDITIONS AT NO ADDITIONAL COST TO THE PROJECT.

PORTLAND CEMENT CONCRETE PAVEMENT:

1. CONCRETE PAVEMENT SHALL BE FINISHED WITH AN APPROVED, SELF-PROPELLED, SLIP FORM PAVER. EXCEPTIONS WILL BE MADE FOR SMALLER AREAS ASSOCIATED WITH INTERSECTION PAVING WORK ONLY. METAL OR STRAIGHT, SOUND TIMBER FORMS MAY ONLY BE USED FOR PAVEMENT AREAS WITH IRREGULAR DIMENSIONS.
2. ALL PORTLAND CEMENT CONCRETE PAVEMENT SHALL BE TESTED IN ACCORDANCE WITH COMPRESSIVE STRENGTH CRITERIA.
3. CONCRETE PAVEMENT SHALL CONFORM TO THE REQUIREMENTS OF CLASS D CONCRETE.
4. JOINT SEALANT WITH BACKER ROD SHALL BE USED AS JOINT FILLERS. JOINT SEALANT MATERIAL SHALL BE A SILICONE THAT IS CURRENTLY ON THE CDOT APPROVED PRODUCTS LIST.
5. ALL CONCRETE PAVEMENT AND CURB AND GUTTER PREFORMED JOINT MATERIAL SHALL BE A FLEXIBLE FOAM EXPANSION JOINT FILLER, MEETING THE REQUIREMENTS OF ASTM D-5249, TYPE 2, 10 PSI MINIMUM AND 25 PSI MAXIMUM. CONCRETE SIDEWALK EXPANSION JOINT MATERIAL SHALL MEET THE REQUIREMENTS OF ASTM D-1751 OR D-1752.
6. FOR THE FINAL FINISH, A PLASTIC TURF DRAG SHALL BE DRAGGED LONGITUDINALLY OVER THE FULL WIDTH OF THE PAVEMENT. TINING AND STATIONING IS NOT REQUIRED.

30% SUBMITTAL (NOT FOR CONSTRUCTION) -APRIL 5, 2024

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Date:	Comments	Init

CITY OF BOULDER Open Space & Mountain Parks

As Constructed
No Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
GENERAL NOTES

Designer: T. Rohan | Structure Numbers
Detailer: R. Cordell
Sheet Subset: GN | Subset Sheets: 1 of 1

Project No./Code
31662

Sheet Number 02

TOPOGRAPHIC EXHIBIT

LOCATED IN THE NORTHWEST QUARTER OF SECTION 21, TOWNSHIP 1 SOUTH, RANGE 70 WEST OF THE 6TH P.M., COUNTY OF BOULDER, STATE OF COLORADO

SHEET 1 OF 1

Parcel Description

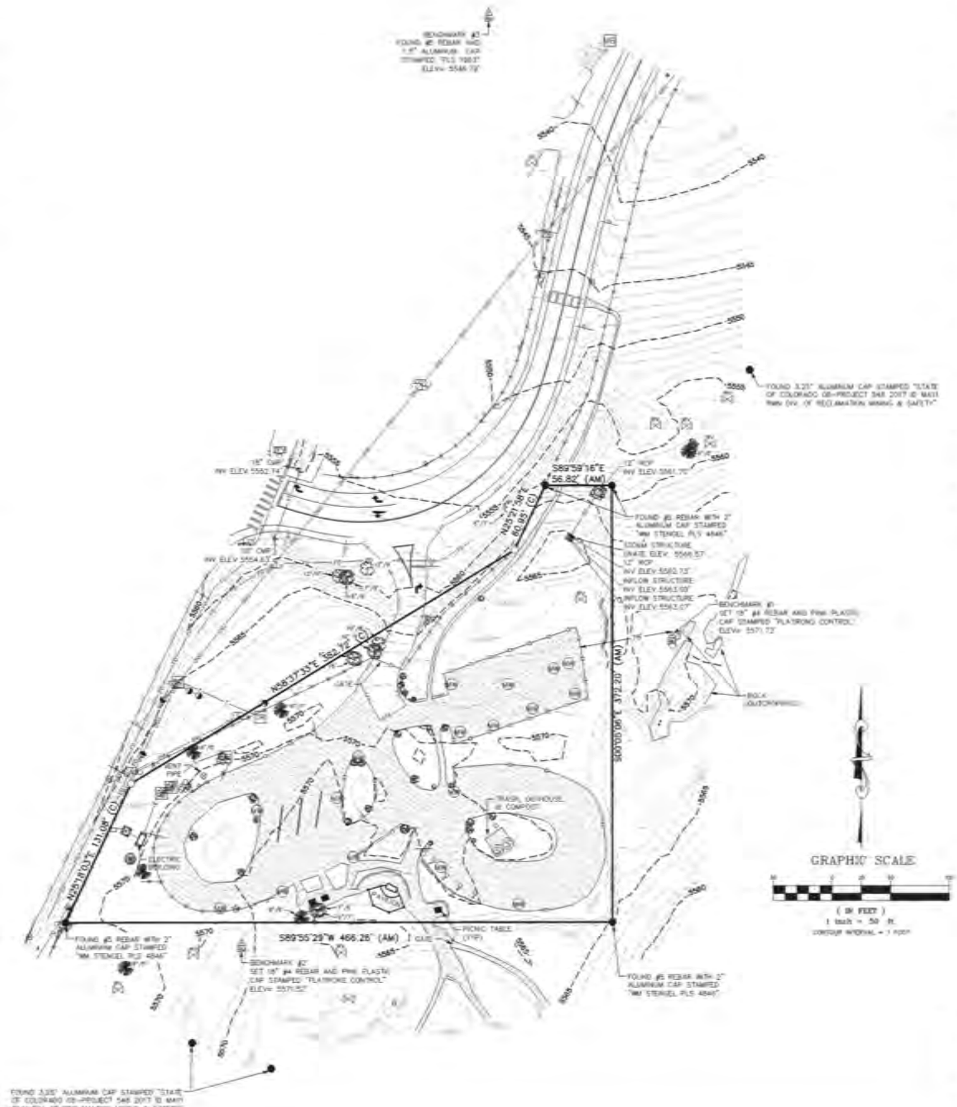
(PROVIDED BY CLIENT)

A PORTION OF LAND ON ELDORADO SPRINGS DRIVE AND EAST OF SOUTH FOOTHILLS HIGHWAY COLORADO STATE HIGHWAY #93, LOCATED IN THE NORTHWEST QUARTER OF SECTION 21, TOWNSHIP 1 SOUTH, RANGE 7 WEST OF THE 6TH PRINCIPAL MERIDIAN
COUNTY OF BOULDER
STATE OF COLORADO

Vicinity Map
NOT TO SCALE

Legend

- FOUND MONUMENT AS DESCRIBED
- CALCULATED POSITION (NOT FOUND OR SET)
- TEMPORARY BENCHMARK/CONTROL AS DESCRIBED, AND REQUESTED BY CLIENT
- CONCRETE
- EDGE OF ASPHALT
- GRAVEL
- BOULDERS & RIPRAP
- FENCE
- HITCH AND RAIL FENCING
- SIGN
- BOLLARD
- DECIDUOUS TREE (TRUNK DIAMETER/DRIP LINE RADIUS)
- CONIFEROUS TREE (TRUNK DIAMETER/DRIP LINE RADIUS)
- HANDICAP PARKING SPACE
- WATER LINE
- WELL
- MONITOR WELL
- WATER SPIGOT
- FIRE DEPARTMENT CONNECTION
- IRRIGATION VALVE
- SANITARY SEWER MANHOLE
- CLEANOUT
- GRATE INLET
- FLARED END SECTION
- ELECTRIC LINE
- ELECTRICAL PANEL
- TRANSFORMER
- LIGHT POLE
- OVERHEAD UTILITY LINE
- UTILITY POLE
- GUY WIRE
- TRAFFIC LIGHT
- TRAFFIC VAULT
- FIBEROPTIC LINE
- TELEPHONE LINE
- TELEPHONE RISER
- GAS VALVE
- MAILBOX
- CENTERLINE
- INV — INVERT
- ELEV — ELEVATION
- TYP — TYPICAL



Notes

1. THIS EXHIBIT WAS PREPARED WITHOUT THE BENEFIT OF A CURRENT TITLE COMMITMENT AND DOES NOT CONSTITUTE A TITLE SEARCH BY FLATIRONS, INC. TO DETERMINE TITLE OR EASEMENTS OF RECORD. THIS EXHIBIT DOES NOT PURPORT TO REFLECT ANY OF THE FOLLOWING WHICH MAY BE APPLICABLE TO THE SUBJECT REAL ESTATE: EASEMENTS, OTHER THAN POSSIBLE EASEMENTS THAT WERE VISIBLE AT THE TIME OF MAKING THIS EXHIBIT; BUILDING SETBACK LINES; RESTRICTIVE COVENANTS; SUBDIVISION RESTRICTIONS; ZONING OR OTHER LAND-USE REGULATIONS; AND ANY OTHER FACTS THAT AN ACCURATE AND CURRENT TITLE SEARCH MAY DISCLOSE.
2. ACCORDING TO COLORADO LAW, YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS EXHIBIT WITHIN THREE YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT IN THIS EXHIBIT BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.
3. THIS EXHIBIT WAS PREPARED FOR THE EXCLUSIVE USE OF CITY OF BOULDER & OTAK, NAMED IN THE STATEMENT HEREON. SAID STATEMENT DOES NOT EXTEND TO ANY UNNAMED PERSON WITHOUT AN EXPRESS STATEMENT BY THE SURVEYOR NAMING SAID PERSON.
4. THIS EXHIBIT IS VALID ONLY IF PRINT HAS SEAL AND SIGNATURE OF SURVEYOR.
5. SOURCE INFORMATION FROM PLANS AND MARKINGS HAVE BEEN COMBINED WITH OBSERVED EVIDENCE OF UTILITIES TO DEVELOP A VIEW OF THOSE UNDERGROUND UTILITIES. HOWEVER, LACKING EXCAVATION, THE EXACT LOCATION OF UNDERGROUND FEATURES CANNOT BE ACCURATELY, COMPLETELY AND RELIABLY DEPICTED. WHERE ADDITIONAL OR MORE DETAILED INFORMATION IS REQUIRED, THE CLIENT IS ADVISED THAT EXCAVATION MAY BE NECESSARY. NO EXCAVATIONS WERE MADE DURING THE PROGRESS OF THIS EXHIBIT TO LOCATE BURIED UTILITIES AND STRUCTURES. ALL UNDERGROUND UTILITIES MUST BE FIELD LOCATED BY THE APPROPRIATE AGENCY OR UTILITY COMPANY PRIOR TO ANY EXCAVATION, PURSUANT TO C.R.S. SEC. 9-1.5-103.
6. THE DISTANCE MEASUREMENTS SHOWN HEREON ARE U.S. SURVEY FOOT.
7. THE CONTOURS REPRESENTED HEREON WERE INTERPOLATED BY AUTOCAD CIVIL 3D (DIGITAL TERRAIN MODELING) SOFTWARE BETWEEN ACTUAL MEASURED SPOT ELEVATIONS. DEPENDING ON THE DISTANCE FROM A MEASURED SPOT ELEVATION AND LOCAL VARIATIONS IN TOPOGRAPHY, THE CONTOUR SHOWN MAY NOT BE AN EXACT REPRESENTATION OF THE SITE TOPOGRAPHY. THE PURPOSE OF THIS TOPOGRAPHIC MAP IS FOR SITE EVALUATION AND TO SHOW SURFACE DRAINAGE FEATURES. ADDITIONAL TOPOGRAPHIC OBSERVATIONS MAY BE NECESSARY IN SPECIFIC AREAS OF DESIGN. TOPOGRAPHY SHOWN HEREON COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS.
8. BENCHMARK INFORMATION: SMARTNET NORTH AMERICA CONTINUOUSLY OPERATING REFERENCE STATIONS (CORS) NETWORK WAS USED TO ESTABLISH A GPS DERIVED ELEVATION ON AN ON-SITE BENCHMARK 78 FEET EAST OF THE RECTANGULAR PARKING LOT, BEING A 18" #4 REBAR AND PINK PLASTIC CAP STAMPED "FLATIRONS CONTROL" WITH AN ELEVATION OF 5571.72 FEET (NAVD 88). NGS POINT C-408, BEING A 3.5" BRASS DISK LOCATED 0.2 MILES SOUTHERLY OF THE INTERSECTION OF HIGHWAY 93 AND ELDORADO SPRINGS DRIVE ALONG THE EAST SIDE OF HIGHWAY 93 FOUND IN A ROCK OUTCROPPING 35 FEET EAST OF THE EDGE OF ASPHALT, WITH A PUBLISHED ELEVATION OF 5592.20 FEET WAS CHECKED INTO WITH AN AS-MEASURED ELEVATION OF 5592.12 FEET. NO DIFFERENTIAL LEVELING WAS PERFORMED TO ESTABLISH THE ELEVATION OF THE ON-SITE BENCHMARK.
9. HORIZONTAL DATUM: COORDINATE VALUES AND DISTANCES SHOWN HEREON ARE MODIFIED STATE PLANE & ZONE, NORTH AMERICAN DATUM 1983 [NAD83(2011)], SCALED FROM LATITUDE N39°57'11.74264"N, LONGITUDE W105°13'49.86579", AT AN ELLIPSOID HEIGHT OF 5526.77' WITH A COMBINED SCALE FACTOR OF 1.00029351.
10. DATES OF FIELDWORK: JANUARY 24, 2024
11. BOUNDARY DETERMINATION IS NOT A PART OF THIS EXHIBIT. THIS IS NOT A "LAND SURVEY PLAT" OR "IMPROVEMENT SURVEY PLAT" AND THIS EXHIBIT IS NOT INTENDED FOR PURPOSES OF TRANSFER OF TITLE OR SUBDIVISIONS OF LAND AND THAT IT IS NOT TO BE RELIED UPON FOR THE ESTABLISHMENT OF A FENCE, BUILDING OR OTHER FUTURE IMPROVEMENT LINES.

Surveyor's Statement

I, JAMES Z. GOWAN, A LAND SURVEYOR LICENSED IN THE STATE OF COLORADO, DO HEREBY STATE FOR AND ON BEHALF OF FLATIRONS, INC., TO CITY OF BOULDER & OTAK, THAT THIS TOPOGRAPHIC EXHIBIT WAS PREPARED BY ME OR UNDER MY RESPONSIBLE CHARGE, IS IN ACCORDANCE WITH APPLICABLE STANDARDS OF PRACTICE AND IS NOT A GUARANTY OR WARRANTY, EITHER EXPRESSED OR IMPLIED. SAID EXHIBIT AND THE RELATIVE ELEVATIONS SHOWN HEREON ARE ACCURATE TO THE BEST OF MY KNOWLEDGE, INFORMATION AND BELIEF.

JAMES Z. GOWAN COLORADO P.L.S. #29038
VICE PRESIDENT, FLATIRONS, INC.

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TOPOGRAPHIC EXHIBIT
PREPARED FOR
CITY OF BOULDER & OTAK

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Land Surveying Services
www.FlatironsInc.com
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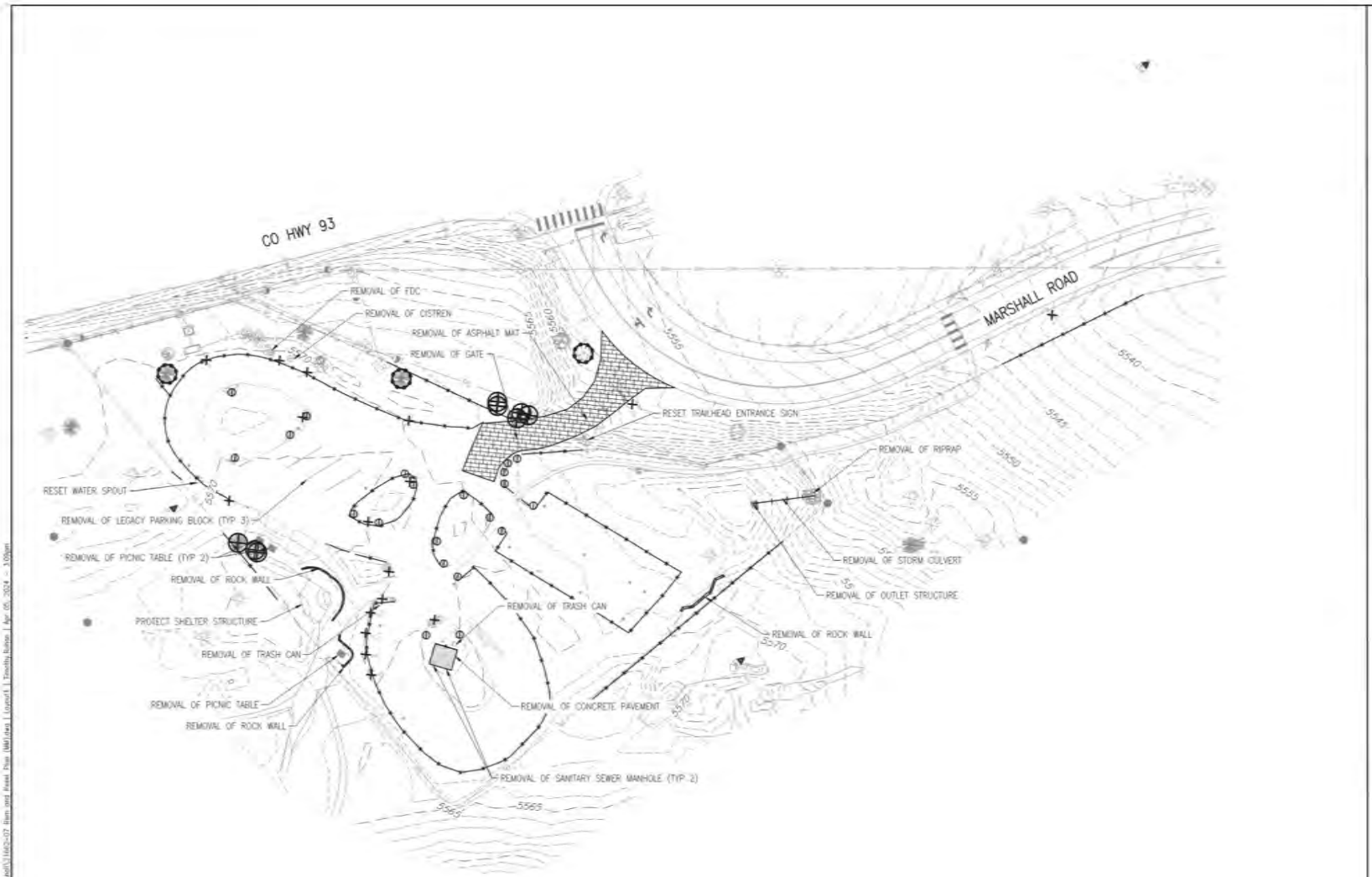
JOB NUMBER:	23-80230
DATE:	02-29-2024
DRAWN BY:	E. LABURDA
CHECKED BY:	TGH/JJK/JZG

SHEET 1 OF 1



LEGEND

- REMOVAL OF ROCK WALL
- REMOVAL OF CONCRETE PAVEMENT
- REMOVAL OF ASPHALT MAT
- CLEARING AND GRUBBING LIMITS
- REMOVAL OF FENCE
- REMOVAL OF STORM CULVERT
- REMOVAL OF TREE
- PROTECT TREE
- REMOVAL OF SIGN
- REMOVAL OF BOULDER

NOTES:

1. EXISTING LANDSCAPE/WALL BOULDERS LOCATED ON THE SITE SHALL BE STOCKPILED AND REUSED ON THE PROJECT AS NECESSARY TO STABILIZE SLOPES, OR WHERE CALLED FOR.
2. GROUNDWATER MONITORING WELLS, TO BE RESET TO FINISHED GRADE
3. IRRIGATION VALVES TO BE RESET TO FINISHED GRADE OR REMOVED IF WITHIN CONSTRUCTION AREA

0 40 80

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CITY OF BOULDER Open Space & Mountain Parks

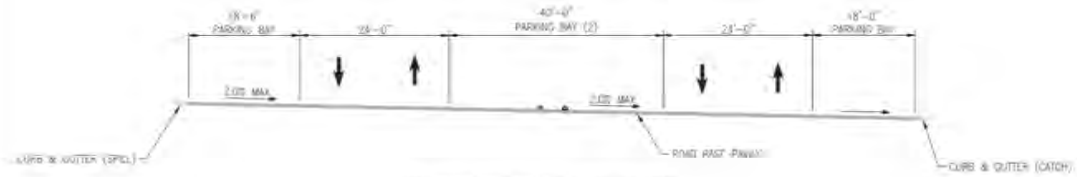
As Constructed
No. Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
REMOVAL AND RESET PLAN

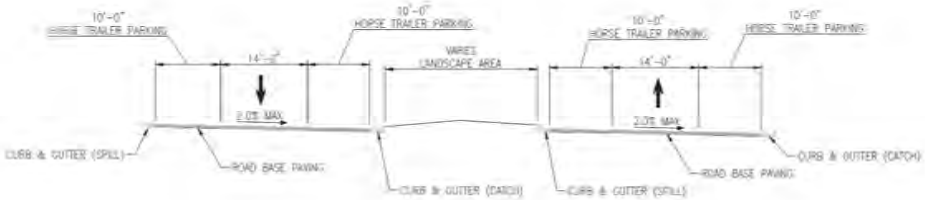
Designer: T. Rohan
Detailer: R. Condell
Sheet Subset: REM
Structure Numbers:
Subset Sheets: 1 of 1

Project No./Code: 21662

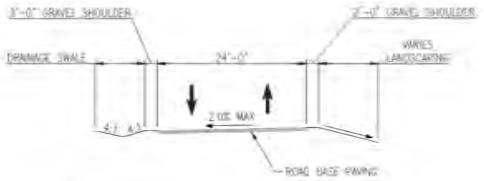
Sheet Number: 04



TRAILHEAD TYPICAL SECTION 1 (LOOKING EAST)



TRAILHEAD TYPICAL SECTION 2 (LOOKING EAST)



TRAILHEAD ENTRANCE ROAD TYPICAL SECTION 3 (LOOKING EAST)

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Print Date: Apr 05, 2024
File Name: 21662-03 Typical Sections (MM).dwg
Horiz. Scale: Vert. Scale:
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Sheet Revisions		
Date:	Comments	Init

CITY OF BOULDER Open Space & Mountain Parks

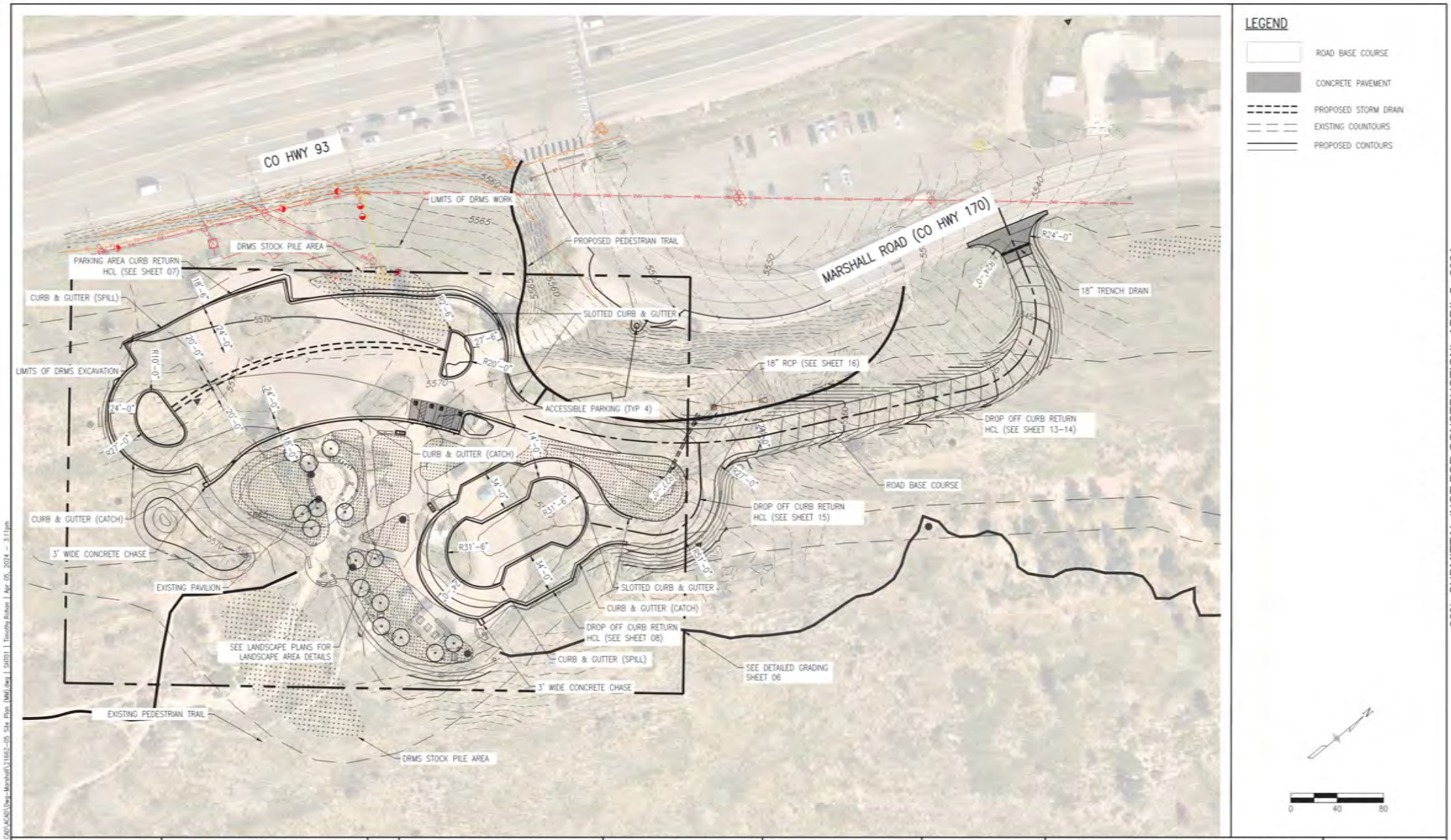
As Constructed
No Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
TYPICAL SECTIONS

Designer: T. Rohan | Structure Numbers:
Detailer: R. Cenedi
Sheet Subset: TYPSEC | Subset Sheets: 1 of 1

Project No./Code: 21662

Sheet Number: 05



30% SUBMITTAL (NOT FOR CONSTRUCTION) -APRIL 5, 2024

D:\PROJECTS\21662\21662\04 CAD\ACAD\Dwg-Marshall\21662-05 Site Plan (MM).dwg | SHT01 | Timothy Rohan | Apr 05, 2024 - 3:11pm

All seals for this set of drawings are applied to the cover page(s)

Print Date: Apr 05, 2024
File Name: 21662-05 Site Plan (MM).dwg
Horiz. Scale: As Noted Vert. Scale: As Noted

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Sheet Revisions		
Date:	Comments	Init.

CITY OF BOULDER Open Space & Mountain Parks

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No Revisions:	
Revised:	
Void:	

MARSHALL MESA TRAILHEAD RENOVATION
SITE PLAN

Designer:	T. Rohan	Structure Numbers	
Detailer:	R. Condell		
Sheet Subset:	SITE	Subset Sheets:	1 of 1

Project No./Code: 21662

Sheet Number: 06

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Print Date: Apr 05, 2024
File Name: 21662-04 Detailed Grading Plans (MP).dwg
Horiz. Scale: As Noted Vert. Scale: As Noted

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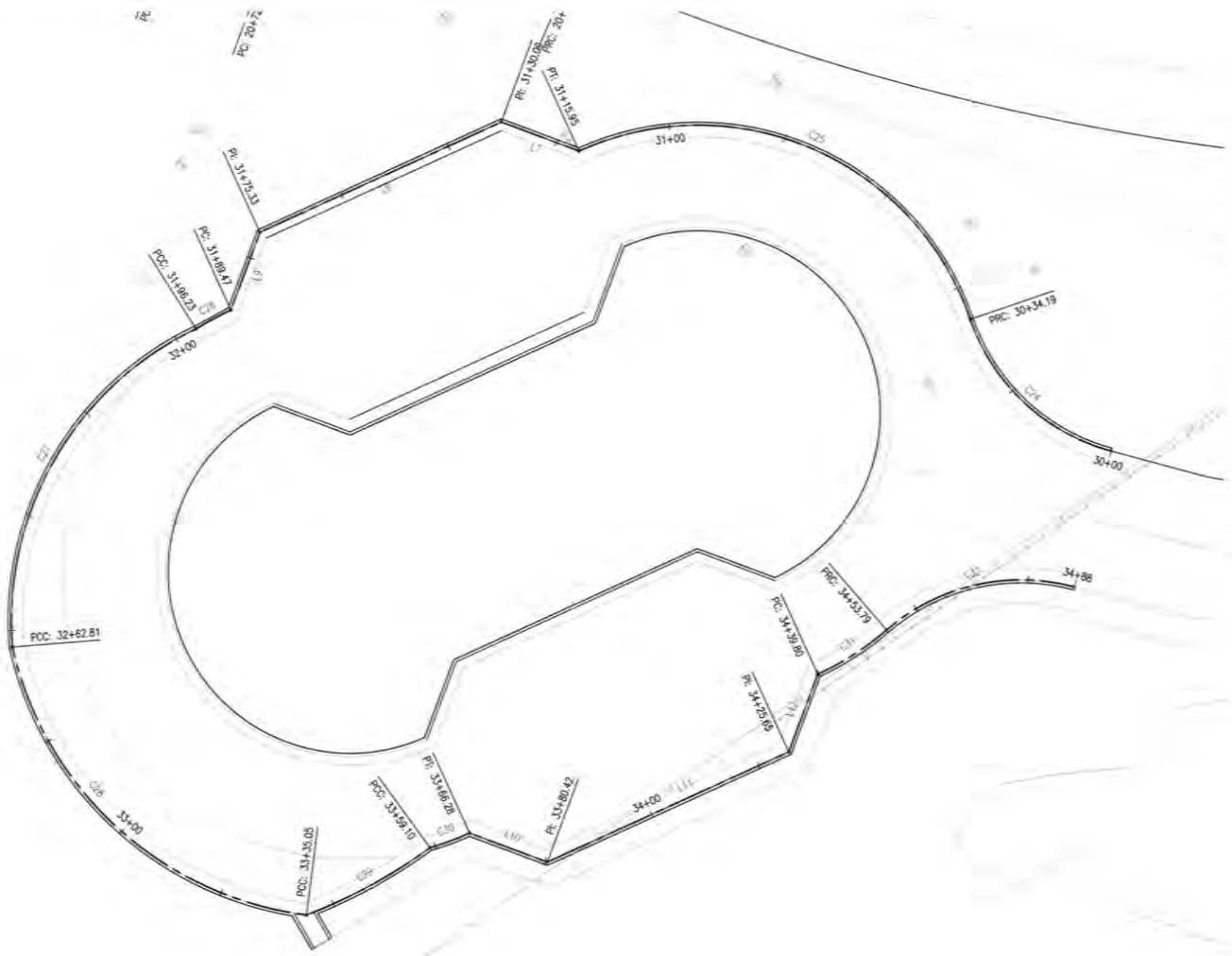
Sheet Revisions		
Date:	Comments	Init

CITY OF BOULDER Open Space & Mountain Parks

As Constructed	MARSHALL MESA TRAILHEAD RENOVATION GRADING PLANS			Project No./Code
No Revisions:				21662
Revised:	Designer: T. Rohan	Structure Numbers		
Void:	Detailer: R. Condell			
	Sheet Subset: GRADE	Subset Sheets: 1 of 1		Sheet Number 07



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L7	31+15.95	1225859.64	3075404.83	14.14		S55°02'56.21"W
L8	31+30.09	1225851.53	3075393.23	45.24		S10°02'56.21"W
L9	31+75.33	1225806.99	3075385.34	14.14		S34°57'03.79"E
C26	31+89.47	1225796.40	3075393.44	6.76	49.00	S06°05'40.15"W
C27	31+96.23	1225788.68	3075392.73	66.58	55.14	S25°25'40.77"E
C28	32+62.81	1225732.14	3075418.61	72.24	59.00	N78°54'10.36"E
C29	33+35.05	1225747.51	3075485.66	24.05	91.00	N06°01'54.94"E
C30	33+59.10	1225771.35	3075488.16	7.68	49.37	N14°13'40.55"E
L10	33+66.28	1225778.30	3075489.94	14.14		N65°02'56.21"E
L11	33+80.42	1225786.40	3075501.53	45.24		N10°02'56.21"E
L12	34+25.65	1225830.95	3075509.42	14.14		N34°57'03.79"W
C31	34+39.80	1225842.54	3075501.32	13.99	49.00	N01°52'09.69"E
C32	34+53.79	1225856.47	3075501.78	34.19	35.00	N21°40'42.01"E

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Print Date: Apr 05, 2024
File Name: 21662-08 Horizontal Controls (MM).dwg
Horiz. Scale: As Noted Vert. Scale: As Noted

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Date:	Comments	Init

CITY OF BOULDER Open Space & Mountain Parks

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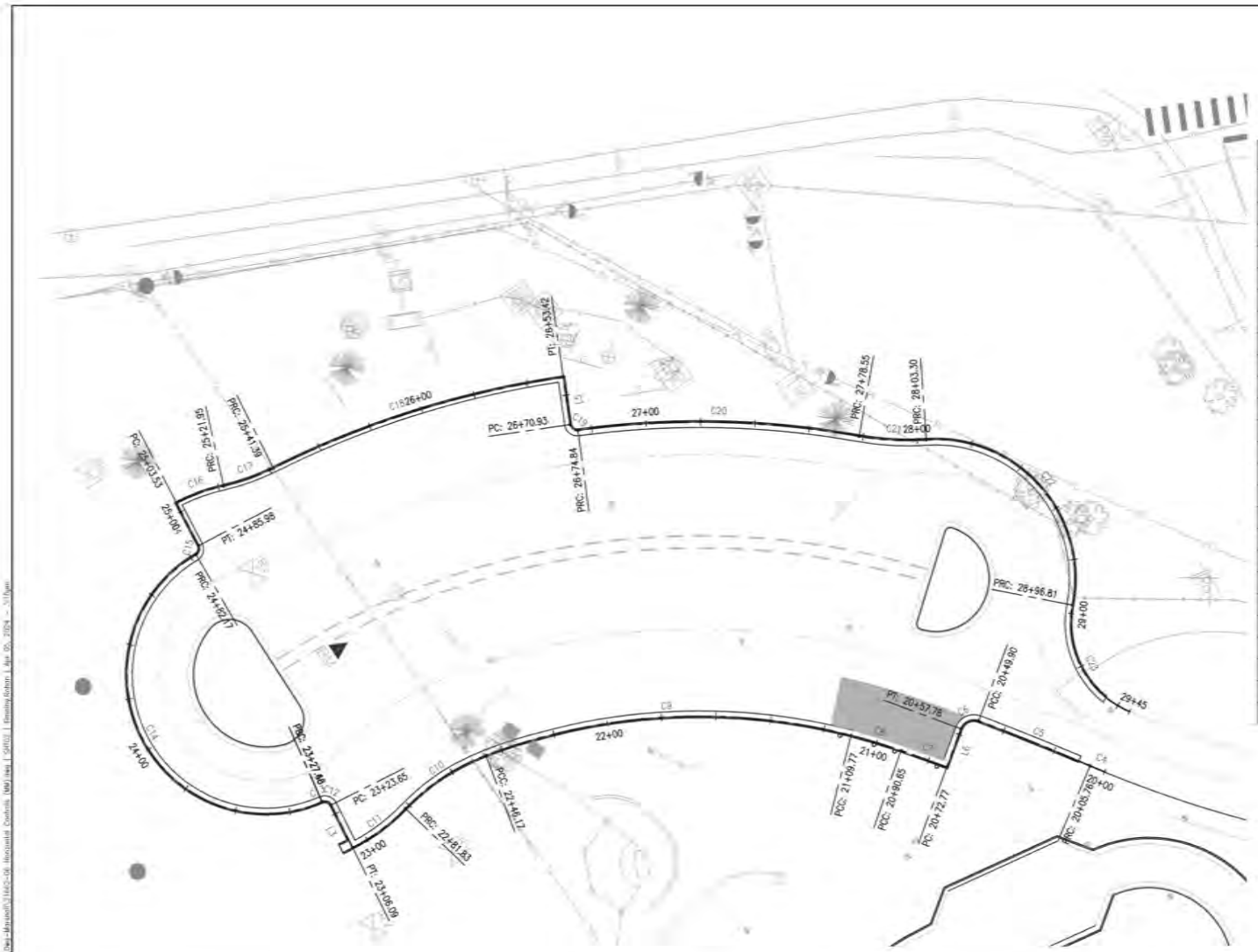
No Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
HORIZONTAL CONTROL LINE DATA

Designer: T. Rohan
Detailer: R. Cavdell
Structure Numbers:
Sheet Subset: HOR-CON
Subset Sheets: 7 of 12

Project No./Code: 21662

Sheet Number: 08



PARKING LOT C&G HORIZONTAL CONTROL LINE DATA

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C5	20+05.76	1225876.36	3075378.57	44.15	1000.00	S56°31'59.05"W
C6	20+49.90	1225652.02	3075341.75	7.88	5.00	S120°07'27.66"W
L6	20+57.78	1225845.04	3075340.50	14.99		S35°01'10.59"E
C7	20+72.77	1225832.76	3075349.10	17.88	980.00	S54°27'27.76"W
C8	20+90.65	1225822.37	3075334.55	19.12	222.44	S51°28'21.28"W
C9	21+09.77	1225810.46	3075319.60	136.40	222.44	S31°26'35.45"W
C10	22+46.17	1225695.91	3075249.56	35.65	80.00	S01°06'30.42"W
C11	22+81.83	1225660.55	3075248.87	24.27	71.00	S01°52'02.00"E
L3	23+06.09	1225636.42	3075249.66	17.56		N82°04'30.37"W
C12	23+23.65	1225638.84	3075232.27	3.81	2.50	S54°15'50.65"W
C13	23+27.46	1225636.82	3075229.47	0.22	51.00	S10°43'38.88"W
C14	23+27.68	1225636.60	3075229.42	154.48	51.00	N82°22'18.53"W
C15	24+82.17	1225650.12	3075128.49	3.81	2.50	N39°15'22.11"W
L4	24+85.98	1225652.80	3075126.30	17.56		N82°55'01.08"W
C16	25+03.53	1225654.96	3075108.88	18.42	71.00	N14°30'48.66"E
C17	25+21.95	1225672.74	3075113.48	19.44	80.00	N14°58'59.78"E
C18	25+41.39	1225691.47	3075118.49	112.03	350.44	N17°10'51.68"E
L5	26+53.42	1225798.05	3075151.45	17.51		S65°39'37.80"E
C19	26+70.93	1225790.28	3075167.14	3.91	2.50	N71°33'16.82"E
C20	26+74.84	1225791.39	3075170.48	103.71	330.44	N35°45'39.41"E
C21	27+78.55	1225875.20	3075230.64	24.75	100.00	N57°38'42.52"E
C22	28+03.30	1225894.75	3075245.92	93.51	51.00	N83°05'53.42"E
C23	28+96.81	1225904.48	3075326.29	48.02	55.00	S83°40'43.14"E

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File Name: 21662-08 Horizontal Controls (MM).dwg
Horiz. Scale: As Noted Vert. Scale: As Noted

Otak

Sheet Revisions

Date:	Comments	Init

CITY OF BOULDER Open Space & Mountain Parks

As Constructed
No. Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
HORIZONTAL CONTROL LINE DATA

Designer: T. Rohan
Detailer: R. Condell
Structure Numbers:
Sheet Subset: HOR-CON
Subset Sheets: 2 of 2

Project No./Code: 21662

Sheet Number: 09

SEEDING NOTES

1. SEEDBED PREPARATION: Seedbed should be well settled, firm, and friable, to facilitate seed placement at required depths. Grade slopes to minimize future water erosion. Loosen or areas of compacted soil by machinery or by hand, if hand ripping is effective to 6" minimum depth. Break soil clumps larger than 3 inches in diameter.

2. SEEDING RATES: Seeding rates are expressed in pure live seed (PLS) pounds per acre and are based on planting a predetermined number of live seeds per square foot to achieve a specific plant density. For preservation purposes, seeding rates have been established to achieve the desired plant density of around 20–40 live seeds per square foot. The seed mix must be specified or otherwise approved by Open Space and Mountain Parks restoration ecologists; no substitutions are allowed.

3. SEEDING METHODS:
   A. DRILL: Plant seed with a drill on dil slopes at 3:1 or flatter. The drill must meet specifications for the type of seed and seeding rates recommended.
   B. BROADCAST: Seed may be broadcast by hand, by mechanical spreader, or by hydraulic equipment on areas that are small, too steep, and/or inaccessible for seed-drilling.
   C. HYDROSEEDING: Hydraulic seeding and mulching in a single operation is unacceptable because seedlings suspended in the mulch may die if they are not in good contact with the soil. Seeding and hydro mulching must be done in two separate applications. Rake seed in by hand before mulching.

4. SEEDING DEPTH: Seed planted with a drill should be placed between ¼ inch and ½ inch below the surface. Broadcast seed should be incorporated into the surface soil by raking or harrowing at depths not to exceed ½ inch.

5. SEEDING DATES: October 15 – May 15

6. SEEDING CONDITIONS: Soil should not be frozen or wet at time of seeding.

7. MULCHING (When required): Following seeding, mulch the area with weed-free material (no straw or hay is permitted). Jute netting or excelsior blanket (with bio-degradable material ONLY) are recommended for slopes greater than 2 to 1. Hydromulch is an acceptable alternative only when applied after seeding.

SEED MIXES

1. SEED MIXES: No substitutions may be made to the attached seed mix unless approved by an OSMP plant ecologist or restoration specialist. Seed tests for each seed lot included in the mix must be sent by OSMP staff for review and approval prior to purchasing seed. Seed tests must include a complete list of seed contaminants, including noxious weeds, other weeds, and crops.

OSMP Low Elevation Grass Seed Mix

Botanical Name	Common Name	Variety	lbs/ Mix	PLS Lbs per acre (broadcast rate)
Pascopyrum smithii	Western wheatgrass	Arriba	30	9.6
Elymus lanceolatus	Thickspike wheatgrass	Critana	10	2.2
Elymus trachycaulus	Slender wheatgrass	Pryor	10	2.2
Nassella viridula	Green needlegrass	Lodorm	10	2.0
Bouteloua curtipendula	Sideoats grama	Butte	15	2.7
Chondrosum gracile	Blue grama	Bad River	10	0.6
Schizachyrium scoparium	Little bluestem	Camper	5	0.9
Buchloe dactyloides	Buffalograss	Bison	10	3.8
		Total	100	23.2

Note: Drill seed at half the broadcast rate, 11.6 PLS Lbs per acre

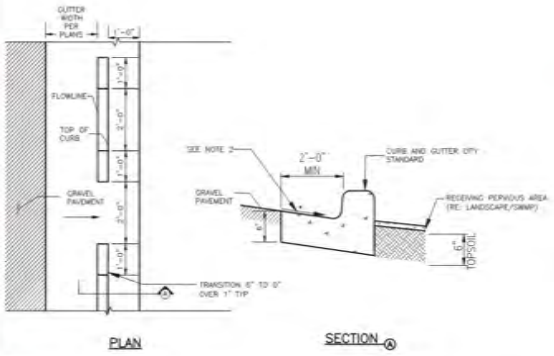
OSMP Reinvention/ Moist Area Grass Seed Mix

Botanical Name	Common Name	Variety	lbs/ Mix	PLS Lbs per acre (broadcast rate)
Pascopyrum smithii	Western Wheatgrass	Arriba	0.2	0.06
Bouteloua curtipendula	Sideoats Grama	Butte	0.2	0.41
Elymus canadensis	Canada Wildrye		0.15	0.82
Elymus elymoides	Bottlebrush squirreltail		0.1	0.273
Schizachyrium scoparium	Little Bluestem		0.1	0.01
Deschampsia elongata	Inland Saltgrass		0.05	0.02
Bouteloua gracilis	Blue Grama	Bad River	0.05	0.32
Elymus trachycaulus	Slender Wheatgrass		0.01	0.71
Osteospermum	Purple Prairie Clover		0.05	0.55
Ratibida columnifera	Yellow/Prairie Coneflower		0.05	0.13
Asclepias speciosa	Showy milkweed		0.05	1.80
Desmanthus illinoensis	Rocky Mountain bee plant		0.02	0.92
		Total	PLS Lbs. per acre	33.0000

Note: Drill seed at half the broadcast rate, 16.50 PLS Lbs per acre

CITY OF BOULDER COMP
SEEDING DETAILS
TRAILHEAD CONSTRUCTION DETAIL

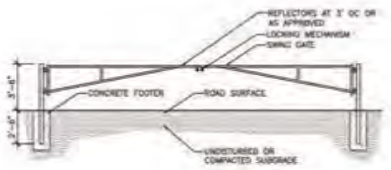
REVISED: 11/7/2023
SCALE: VARIES
DETAIL: 7.04-01



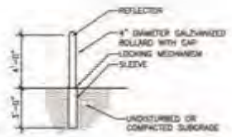
PLAN SECTION A

NOTES:
1. ALL WORK, INCLUDING FORMWORK, SPLASH PAD, EXCAVATION, AND CONCRETE SHALL BE INCLUDED IN THE COST OF ITEM 506 – CURB SLOT (EACH). SLOTTED CURB LOCATIONS ARE INCLUDED IN THE LENGTH OF THE ESTIMATED STANDARD CURB AND GUTTER PAY ITEMS.
2. GUTTER SLOPE SHALL CONFORM TO THE STANDARD CURB DETAILS AND PLANS.

SLOTTED CURB DETAIL– 1/10
N.T.S.



SWING GATE DETAIL 2/10
NTS



BOLLARD DETAIL 3/10
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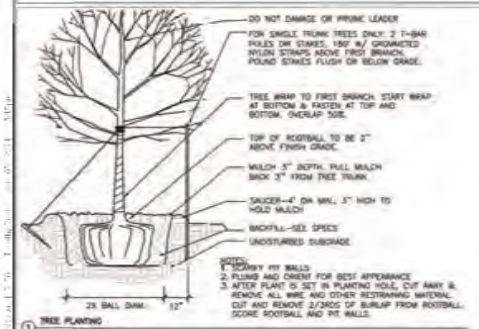
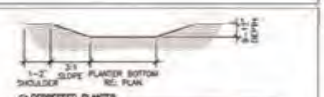
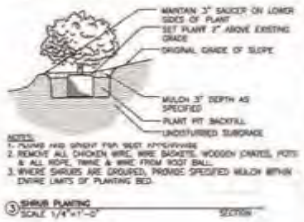
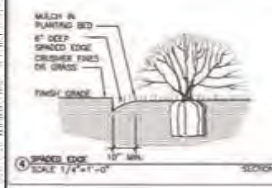








PLANTING SOIL PREPARATION NOTES

1. SOIL PREPARATION:
   A. Tree pit backfill: excavated soil with 0.4 cubic feet (±2.5 gallons) exploded shale, mycorrhizal innoculant and biochar at each tree, fully incorporated.
   B. Native shrub and perennial beds: 2" depth exploded shale, mycorrhizae innoculant and biochar incorporated into top 8" of soil.
   C. Rain garden: 18" depth bioretention media per mile high flood district (MHFD) standards.
2. SOIL CONDITIONERS:
   A. Expanded shale: Hydro expanded shale or approved equal.
   B. Mycorrhizal innoculant: Sustane 3-6-3 or 4-8-4 at 800–1200 pounds per acre.
   C. Biochar: Use manufacturer's recommended rate.
   D. Compost: not typical, and only as approved by ecological staff.
3. MULCH: Where specified: 2" depth nuggets (1/4" minus stone) mulch.

CITY OF BOULDER COMP
PLANTING DETAILS
TRAILHEAD CONSTRUCTION DETAIL

REVISED: 11/7/2023
SCALE: VARIES
DETAIL: 7.04-01

TYPICAL TRAILHEAD TREES

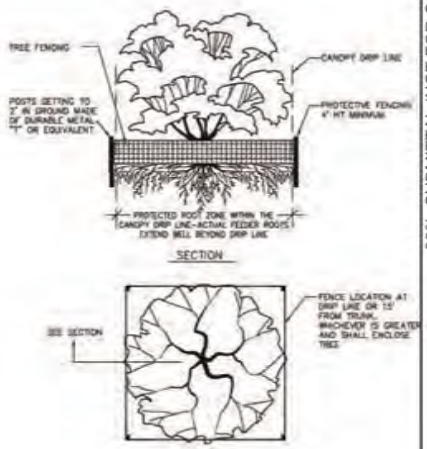
KEY	COMMON NAME	BOTANIC NAME	SIZE	HEIGHT	SPREAD
AS	Serviceberry	Amelanchier sp.	#5 to 1 1/2" Cal B&B	15'–25'	15'–20'
CV	Cerro Hawthorn	Crataegus arnoldiana	#5 to 1 1/2" Cal B&B	12'–15'	13'–15'
CS	Western Catalpa	Catalpa speciosa	#5 to 1 1/2" Cal B&B	40'–60'	30'–50'
CO	Western Hackberry	Celtis occidentalis	#5 to 1 1/2" Cal B&B	50'–80'	40'–50'
GD	Kentucky Coffeetree	Gymnocladus dioica	#5 to 1 1/2" Cal B&B	50'–80'	40'–50'
JS	Rocky Mountain Juniper	Juniperus scopulorum	#5 to 6' Ht B&B	20'–30'	6'–12'
MS	Apples	Malus sp.	#5 to 1 1/2" Cal B&B	10'–20'	12'–15'
PR	Plum	Prunus americana	#5	10'–20'	6'–12'
PD	Prairie Cottonwood	Populus deltoides	#5 to 1 1/2" Cal B&B	40'–75'	30'–50'
PP	Colorado Blue Spruce	Picea pungens	#5 to 6' Ht B&B	40'–60'	20'–30'
PN	Ponderosa Pine	Pinus ponderosa	#5 to 6' Ht B&B	60'–80'	30'–40'
PV	Chokecherry	Prunus virginiana	#5 to 1 1/2" Cal B&B	6'–20'	8'–12'
QG	Gambel Oak	Quercus gambelii	#5 to 1 1/2" Cal B&B	8'–30'	6'–12'
QM	Bur Oak	Quercus macrocarpa	#5 to 1 1/2" Cal B&B	50'–80'	50'–80'

TYPICAL TRAILHEAD SHRUBS

KEY	COMMON NAME	BOTANIC NAME	SIZE	SPACING	HEIGHT	SPREAD
AC	Saltbush	Atriplex canescens	#1 or #5	4' OC	2'–6'	2'–4'
AF	Silver Sage	Artemisia frigida	#1 or #5	4' OC	2'–3'	1'–9'
AP	Pinchbir Manzanita	Arctostaphylos x coloradensis 'Panchito'	#1 or #5	3' OC	1'–2'	3'–5'
EC	Tall Green Rabbitbrush	Ericameria nauseosa ssp. nauseosa var. glabrata	#1 or #5	4' OC	2'–8'	3'–6'
ER	Dwarf Blue Rabbitbrush	Ericameria nauseosa var. nauseosa	#1 or #5	4' OC	2'–6'	2'–6'
FN	New Mexico Privet	Frankenia pulverulenta v. tomentosa	#1 or #5	5' OC	8'–12'	8'–6'
FP	Apache Plume	Fallugia paradoxa	#1 or #5	4' OC	3'–6'	3'–6'
JC	Common Juniper	Juniperus communis	#1 or #5	5' OC	3'–5'	3'–8'
KL	Winterfat	Krascheninnikovia lanata	#1 or #5	2' OC	2'–3'	1'–2'
MR	Compact Oregon Grape Holly	Mahonia aquifolium 'Compacta'	#1 or #5	2' OC	2'–3'	2'–3'
MR	Creeping Colorado Holly	Mahonia repens	#1 or #5	1' OC	1'–18"	1'–18"
PA	Shrub Potentilla	Potentilla fruticosa	#1 or #5	3' OC	2'–5'	3'–3'
PR	Creeping Sand Cherry	Prunus pumila 'Prostrata'	#1 or #5	4' OC	18"–3'	4'–6'
RA	Creeping Three-Leaf Sumac	Rhus trilobata v. flabelliformis	#1 or #5	6' OC	1'–18"	6'–8'
RT	Three-Leaf Sumac	Rhus trilobata	#1 or #5	4' OC	3'–8'	3'–6'
WS	Woods Rose	Rosa woodsii	#1 or #5	3' OC	3'–6'	3'–6'
YF	Soapweed	Yucca glauca	#1 or #5	2' OC	2'–4'	2'–4'

TYPICAL RAINGARDEN PLANTINGS

KEY	COMMON NAME	BOTANIC NAME	SIZE	SPACING
BG	Blue grama	Bouteloua gracilis	4" Pot	1' OC
CN	Nebraska sedge	Carex nebrascensis	4" Pot	1' OC
DC	Tufted hair grass	Deschampsia cespitosa	4" Pot	1' OC
IM	Western blue flag iris	Iris missouriensis	4" Pot	1' OC
JA	Arctic rush	Juncus arcticus	4" Pot	1' OC
JT	Torrey's Rush	Juncus torreyi	4" Pot	1' OC
SH	Prairie dropseed	Sporobolus heterolepis	4" Pot	1' OC



TREE PROTECTION FENCING (DETAIL 4/10)
CITY STANDARD DETAIL 3.12
NTS

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All seals for this set of drawings are applied to the cover page(s)

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Sheet Revisions

Date:	Comments	Init.

CITY OF BOULDER
Open Space & Mountain Parks

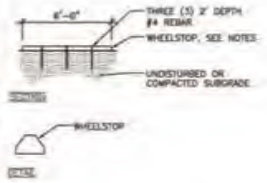
As Constructed
No Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
CONSTRUCTION DETAILS

Designer: T. Rohan
Detailer: R. Condell
Sheet Subset: DETS
Structure Numbers
Subset Sheets: 1 of 3

Project No./Code: 21662

Sheet Number: 10



WHEELSTOP DETAIL 1/11
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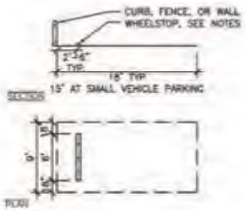

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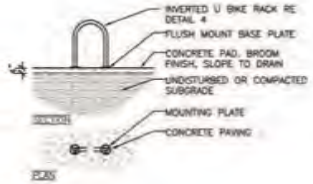
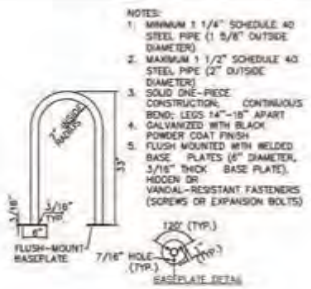
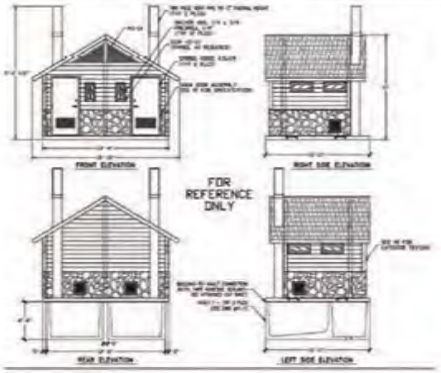
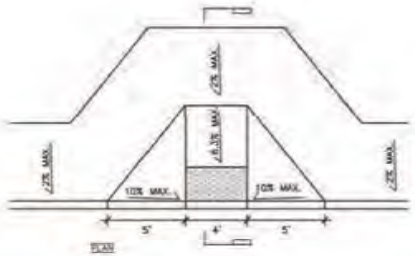


BIKE RACK ON CONCRETE PAD DETAIL 3/11
SCALE $\frac{1}{2}$"=1'-0"

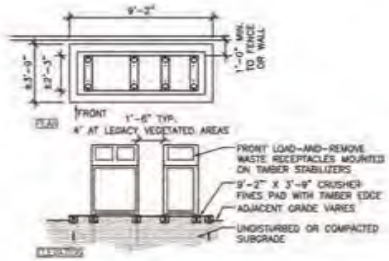


CITY STANDARD DETAIL 2.52 (DETAIL 4/11)
NTS

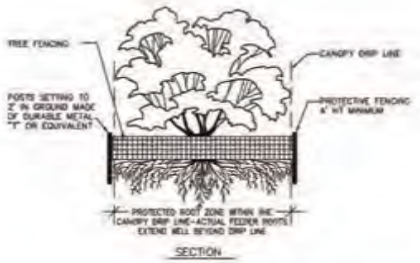


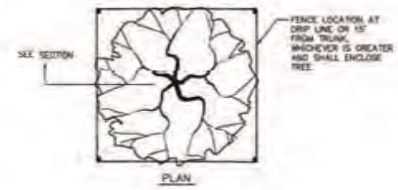


CURB RAMP DETAIL 5/11
NTS

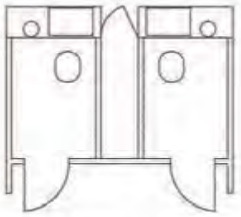


WASTE LAYOUT ON AGGREGATE PAD DETAIL 7/11
SCALE $\frac{1}{2}$"=1'-0"

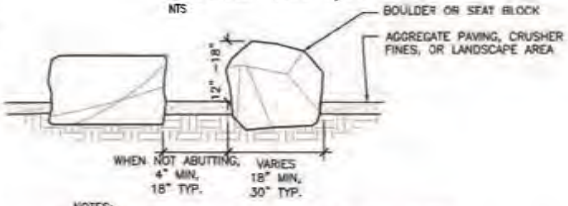




TREE PROTECTION FENCING DETAIL 9/11
NTS

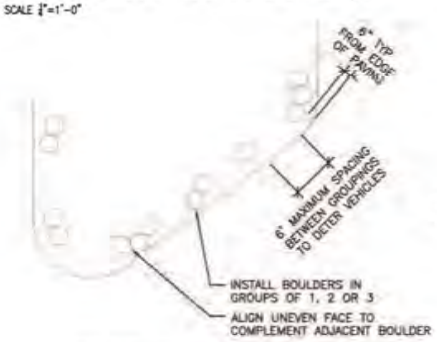


DOUBLE VAULT RESTROOM DETAIL 10/11
NTS



NOTES:
1. APPROXIMATELY $\frac{1}{3}$ OF STONE TO BE BURIED BELOW GRADE.
2. SEAT BLOCKS AND BOULDERS TO BE SET WITH A FLAT SIDE UP TO PROVIDE LEVEL SEATING SURFACE. HEIGHT TO BE 12-18".

BOULDER, SEAT BLOCK, OR MEMORIAL BENCH DETAIL 6/11
NTS



BOULDER CLUSTER TYPICAL LAYOUT DETAIL 8/11
NTS

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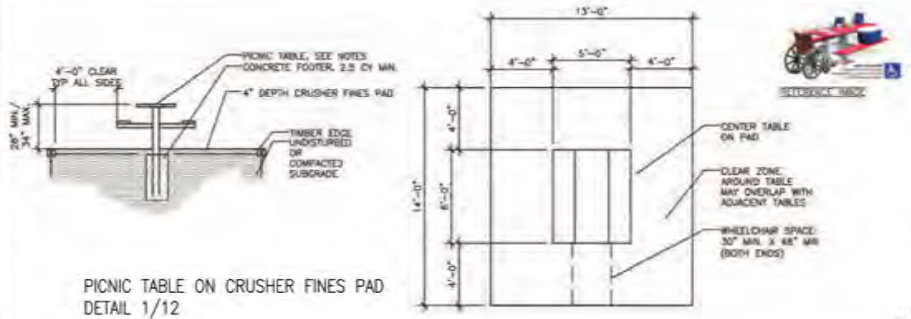
Sheet Revisions		
Date:	Comments	Init.

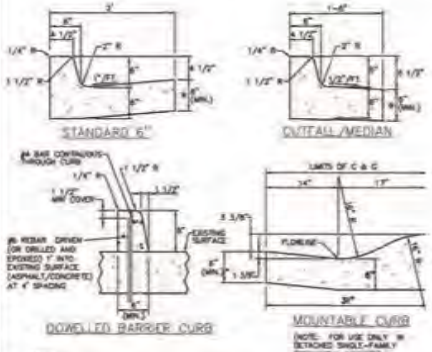
CITY OF BOULDER Open Space & Mountain Parks

As Constructed	MARSHALL MESA TRAILHEAD RENOVATION CONSTRUCTION DETAILS		Project No./Code
No Revisions:			21662
Revised:	Designer: T. Rohan	Structure Numbers	
Void:	Detailer: R. Condell		
	Sheet Subset: DETS	Subset Sheets: 2 of 3	Sheet Number 11

30% SUBMITTAL (NOT FOR CONSTRUCTION) -APRIL 5, 2024

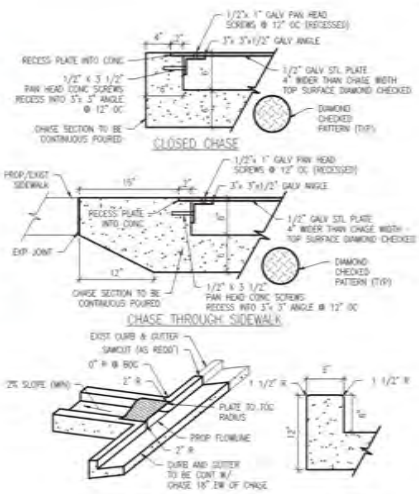


PICNIC TABLE ON CRUSHER FINES PAD
DETAIL 1/12
NTS



NOTES:
1. ALL EXPOSED CONCRETE SHALL HAVE A BROOM FINISH.
2. EXPANSION JOINTS SHALL BE INSTALLED AT 300 FOOT MAXIMUM INTERVALS SEE EXPANSION JOINT DETAIL.
3. CONTRACTION JOINTS SHALL BE INSTALLED AT END OF CURB RETURNS AND AT 10 FOOT MAXIMUM INTERVALS – SEE CURB CONTRACTION JOINT DETAIL.
4. WHEN JOINING EXISTING CURB, PROVIDE A MINIMUM OF THREE (#) x 18" DOWELS (9" EMBEDMENT) EVENLY SPACED.
5. WHEN PLACING CURB ADJACENT TO CONCRETE PAVEMENT, THICKEN GUTTER TO MATCH PAVEMENT DEPTH.

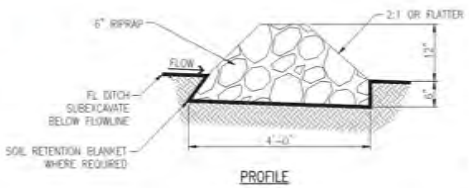
CONCRETE CURB DETAIL 2/12
NTS



NOTES:
1. CONCRETE SHALL BE CDT CLASS "D" 4500 PSI @ 28 DAYS.
2. SUBGRADE TO CONFORM TO CONCRETE PAVEMENT SECTION DETAIL.
3. WHEN ATTACHING TO EXISTING WALKS REPLACE CURB AND GUTTER 18" EW OF CHASE CONNECTION WITH CONT POURED CHASE SECTION (SAWCUT AS REQ'D).
4. DEPTH OF CHASE MAY VARY WHEN SPECIFIED ON PLANS (6" MIN DEPTH)
5. WIDTH OF CHASE SHALL BE MEASURED BETWEEN INTERIOR FACES OF CHASE
6. PROFILE GRADE OF CURBS AND GUTTERS SHALL BE LOCATED AT THE FLOW LINE.
7. CONCRETE SHALL CONTAIN 1.5 POUNDS PER CUBIC YARD APPROVED POLYPROPYLENE FIBERS.

SIDEWALK CHASE DRAIN DETAIL – 3/12
N.T.S.

PROFILE VIEW ALONG DITCH FLOWLINE

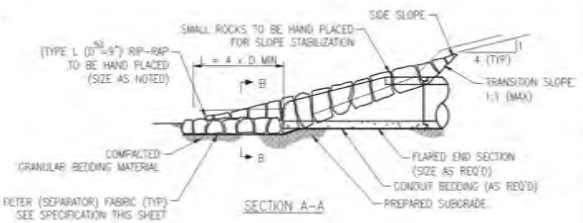


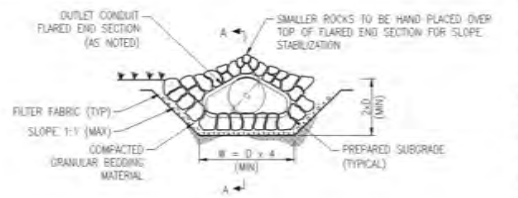
PROFILE

ROCK CHECK DAM

1. RIPRAP SIZE D50 = 6–INCHES
2. ROCK CHECK DAM TO BE PLACED IN DITCH LINES AND LEAD–OFF DITCHES EVERY 20–FEET, KEY–IN 6–INCHES.
3. ROCK CHECK DAMS TO BE APPROXIMATELY 4–FEET LONG X 6–FEET WIDE X 18–INCHES HIGH.
4. ENDS OF RIPRAP CHECK DAM SHALL BE 12–INCHES HIGHER THAN CENTER OF CHECK DAM.

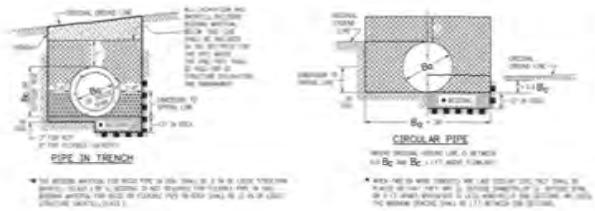
ROCK CHECK DAM DETAIL 4/12
NTS





NOTE: ALL WORK, INCLUDING EXCAVATION, FILTER FABRIC, GRANULAR BEDDING MATERIAL, RIPRAP, AND ANY NECESSARY DEWATERING SHALL BE INCLUDED IN THE COST OF ITEM 506 – RIPRAP (9–INCH)

RIP RAP AT PIPE OUTFALL DETAIL 5/12
NTS



PIPE BEDDING DETAIL 6/12
NTS

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Sheet Revisions		
Date:	Comments	Init.

CITY OF BOULDER Open Space & Mountain Parks

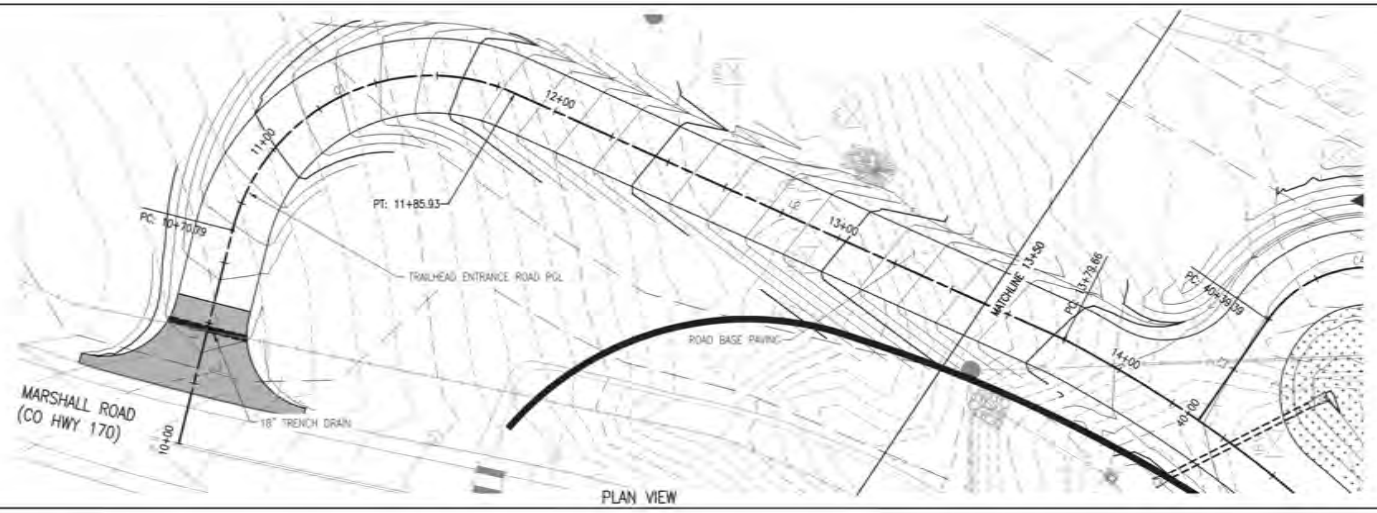
As Constructed
No. Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
CONSTRUCTION DETAILS

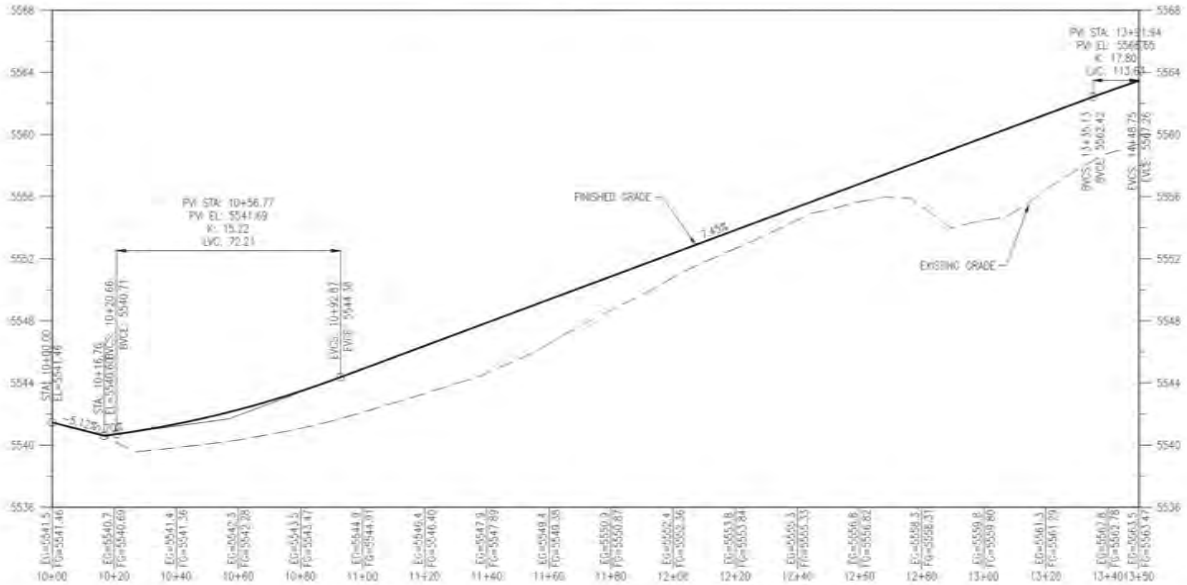
Designer:	T. Rohan	Structure Numbers	
Detailer:	R. Condell		
Sheet Subset:	DETS	Subset Sheets:	3 of 3

Project No./Code: 21662

Sheet Number: 12



PLAN VIEW



PROFILE VIEW

TRAILHEAD ENTRANCE ROAD HORIZONTAL CONTROL LINE DATA						
SEGMENT NUMBER	START STATION	START NORTHING	START EASTING	LENGTH	RADIUS	LINE/CHORD DIRECTION
L1	10+00.00	1226319.28	3075486.64	70.79		S74°08'49.13"E
C1	10+70.79	1226299.90	3075554.73	115.14	66.00	S24°08'14.71"E
L2	11+85.93	1226207.65	3075596.06	193.73		S25°50'19.72"W
T2	13+79.66	1226033.29	3075511.63	204.57	610.84	S4°31'59.83"W

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Horiz. Scale: As Noted Vert. Scale: As Noted

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Sheet Revisions		
Date:	Comments	Init

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No Revisions:	
Revised:	
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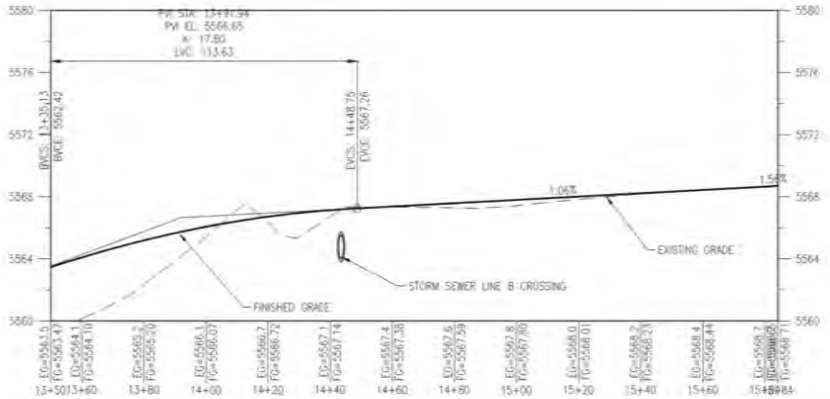
MARSHALL MESA TRAILHEAD RENOVATION
ROADWAY PLAN AND PROFILE

Designer:	T. Rohan	Structure Numbers:	
Detailer:	R. Condell		
Sheet Subset:	P&P	Subset Sheets:	1 of 3

Project No./Code: 21662

Sheet Number: 13

PLAN VIEW



PROFILE VIEW

TRAILHEAD ENTRANCE ROAD HORIZONTAL CONTROL LINE DATA						
SEGMENT NUMBER	START STATION	START NORTHING	START EASTING	LENGTH	RADIUS	LINE/CHORD DIRECTION
L1	10+00.00	1226319.28	3075486.84	70.79		S74°08'49.13"E
C1	10+70.79	1226299.90	3075554.73	115.14	66.00	S24°08'14.71"E
L2	11+85.93	1226207.65	3075598.06	193.75		S25°50'19.72"W
C2	13+79.66	1226033.29	3075511.63	204.57	410.84	S43°31'59.83"W

Print Date: Apr 05, 2024
File Name: 21662-12 Roadway P&P (MM).dwg
Horiz. Scale: As Noted Vert. Scale: As Noted

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Sheet Revisions		
Date:	Comments	Init

CITY OF BOULDER Open Space & Mountain Parks

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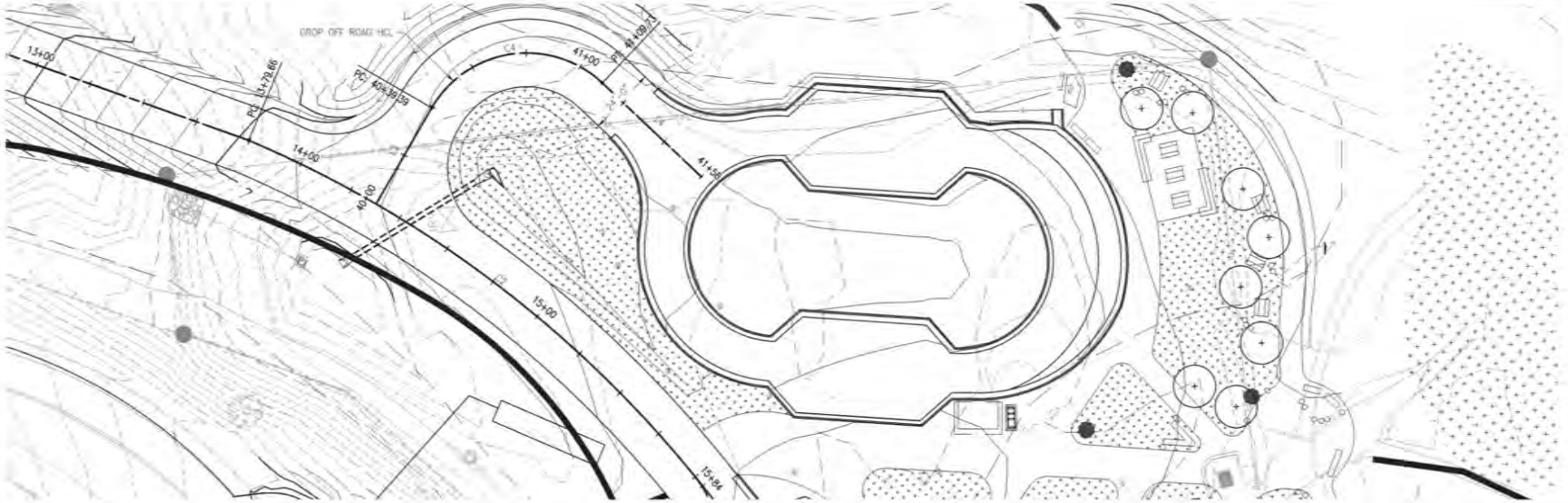
No Revisions:	
Revised:	
Void:	

MARSHALL MESA TRAILHEAD RENOVATION
ROADWAY PLAN AND PROFILE

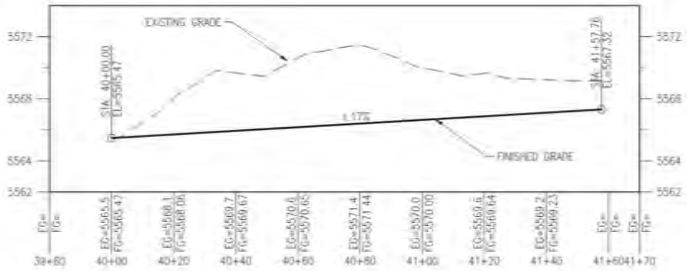
Designer:	T. Rohan	Structure Numbers	
Detailer:	R. Condell		
Sheet Subset:	P&P	Subset Sheets:	2 of 3

Project No./Code: 21662

Sheet Number: 14



PLAN VIEW



PROFILE VIEW

DROP OFF HORIZONTAL CONTROL LINE DATA

SEGMENT NUMBER	START STATION	START NORTHING	START EASTING	LENGTH	RADIUS	LINE/CHORD DIRECTION
L3	40+00.00	1225990.80	3075484.25	39.39		S53°40'40.12"E
C4	40+39.39	1225967.47	3075515.99	70.34	39.00	S02°00'19.64"E
L4	41+09.73	1225908.32	3075518.13	48.34		S49°40'00.84"W

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Date:	Comments	Init

CITY OF BOULDER Open Space & Mountain Parks

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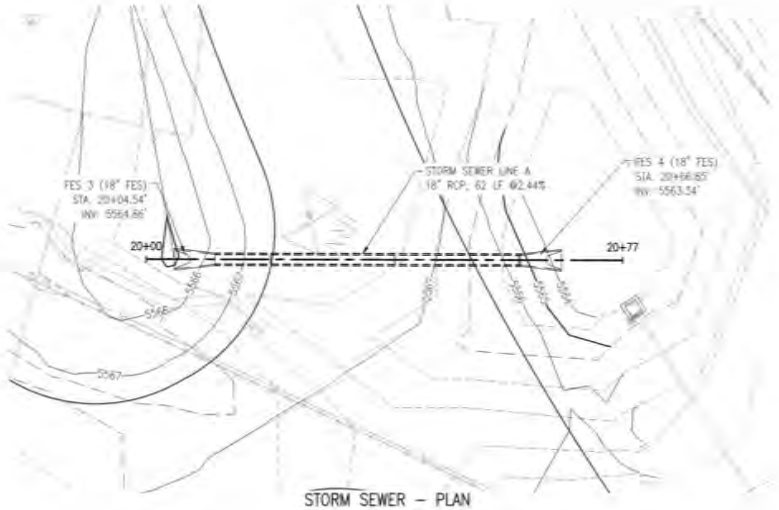
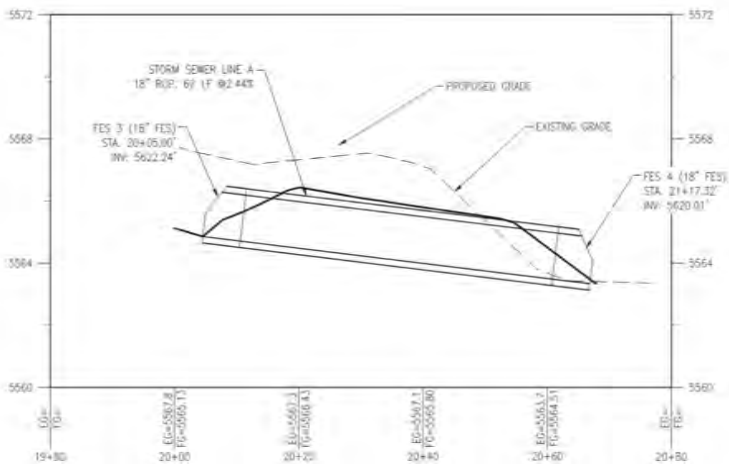
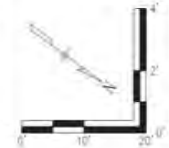
No Revisions:				21662
Revised:	Designer: T. Rohan	Structure Numbers:		
Void:	Detailer: R. Condell			
	Sheet Subset: P&P	Subset Sheets: 3 of 3		Sheet Number 15



STORM SEWER – PLAN
LINE A



STORM SEWER LINE A – PROFILE



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Sheet Revisions		
Date:	Comments	Init

CITY OF BOULDER
Open Space & Mountain Parks

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MARSHALL MESA TRAILHEAD RENOVATION
STORM PLAN AND PROFILE

Designer:	T. Rohan	Structure Numbers:	
Detailer:	R. Condell		
Sheet Subset:	P&P	Subset Sheets:	1 @ 1

Project No./Code
21662

Sheet Number 16

SWMP Template (Plan Sheets) for Projects with 1 Acre or More of Disturbance 2/25/2022 UPDATE

1. SITE DESCRIPTION

The Contractor shall comply with all CDOT contractual requirements, and all requirements associated with the CDPS-SCP on this project. The SWMP Administrator for Construction shall update the SWMP to reflect current project site conditions.

A. PROJECT SITE LOCATION:
Location or address of construction office: The Marshall Mesa Trailhead is located at 5258 Eldorado Springs Dr. Boulder, CO 80303. Located adjacent to CO 93 and Marshall Road.

B. PROJECT SITE DESCRIPTION:
The Marshall Mesa Trailhead project will involve the reconstruction of the existing Marshal Mesa Trailhead and relocation of the existing entrance road to the trailhead. The site will consist of a gravel parking lot and entrance road, a vault toilet as well as drainage and landscape improvements.

C. PROPOSED SCHEDULE FOR SEQUENCE FOR MAJOR CONSTRUCTION ACTIVITIES:
Stabilize all areas that are not paved or landscaped through establishment of vegetation cover.

D. ACRES OF DISTURBANCE:
1. Total area of construction site (LOC (PERMITTED AREA)): 3.81 acres
2. Total area of proposed disturbance (LDA): 3.39 acres
3. Total area of seeding: 1.40 acres
4. Total area of pre-project impervious surface: 4567 sq. ft.
5. Total area of final impervious surface: 5477 sq. ft.

E. EXISTING SOIL DATA:
Natural Resources Conservation Service (NRCS) classifies the soils on site as Hydrologic Soil Group C. HdD (Hargreave fine sandy loam) and Ro (Rock Outcrop).

Data Source(s): -Natural Resources Conservation Service (NRCS)

F. EXISTING VEGETATION, INCLUDING PERCENT OF VEGETATIVE COVER:
During design, the SWMP Administrator for Design in consultation with the Engineer will determine if the SWMP Administrator for Design or the SWMP Administrator for Construction will conduct the Vegetation Transects. If the site is disturbed, an Adequate Reference Site(s) may be utilized, refer to the permit.

G. POTENTIAL POLLUTANTS SOURCES:
Refer to Potential Pollutant Sources in SWMP Section 4A. The SWMP Administrator for Construction shall prepare a list of all potential pollutants and their locations in accordance with subsection 107.25.

H. DRAINAGE PATTERNS AND RECEIVING WATER(S):
1. Description of drainage patterns from the Site:
The site has a general flow direction to the Northeast.
2. Names of immediate and ultimate receiving water(s) on site: South Boulder Creek
3. Description of all stream crossings located within the Construction Site Boundary: NA

Location	Stream Name	Description Of Any Disturbed Upland Areas

I. ALLOWABLE NON-STORMWATER DISCHARGES:

Discharge Description	Site Map #	Method Statement (Location)
Uncontaminated Springs	Off-Road	
Concrete Washout Water (in-ground washout structure)#	Various Locations	
Landscape Irrigation Return Flows	Sediment Traps	
Discharges from Diversions of State Waters	Fire Hydrant	
Emergency Fire Fighting	Off-Road	

#Concrete washout water associated with the washing of concrete tools and concrete mixer chutes can be discharged to the ground if site is managed accordingly to prevent the water from leaving the site as surface runoff or reaching receiving waters.

J. DIVERSION CRITERIA:
1. Is a diversion planned for the Site? No

K. ALTERNATIVE TEMPORARY STABILIZATION SCHEDULE:
(If applicable, provide a description of the alternative temporary stabilization schedule. If temporary stabilization exceeds the 14-day schedule, then the SWMP must document the constraints necessitating the alternative schedule, provide the alternative
schedule, and identify all the locations where the alternative schedule is applicable on the site map. Alternative temporary stabilization schedules must be approved by CDOT prior to implementation)

2. SITE MAP COMPONENTS:

A. PROJECT CONSTRUCTION POTENTIAL SITE BOUNDARIES:
See Erosion Control Plans

B. FLOW ARROWS THAT DEPICT STORMWATER FLOW DIRECTIONS ON-SITE, RUN-ON AND RUNOFF DIRECTION:
See Erosion Control Plans

C. ALL AREAS OF GROUND SURFACE DISTURBANCE:
See Erosion Control Plans

D. AREAS OF CUT AND FILL:
See Erosion Control Plans

E. AREAS USED FOR STORING AND STOCKPILING OF MATERIALS, STAGING AREAS (field trailer, fueling, etc.) and LOCATIONS OF ALL WASTE ACCUMULATION and BATCH PLANTS INCLUDING MASONRY MIXING STATIONS:
See Erosion Control Plans

F. LOCATION OF ALL STRUCTURAL CONTROL MEASURES IDENTIFIED IN THE SWMP:
See Erosion Control Plans

G. LOCATION OF NON-STRUCTURAL CONTROL MEASURES AS APPLICABLE IN THE SWMP:
See Erosion Control Plans

H. SPRINGS, STREAMS, WETLANDS, DIVERSIONS, AND OTHER STATE WATERS, INCLUDING AREAS THAT REQUIRE PRE-EXISTING VEGETATION BE MAINTAINED WITHIN 50 FEET OF A RECEIVING WATER:
See Erosion Control Plans

I. LOCATIONS OF ALL STREAM CROSSING LOCATED WITHIN THE CONSTRUCTION SITE BOUNDARY:
Not Applicable

J. PROTECTION OF TREES, SHRUBS, SENSITIVE HABITAT, AND CULTURAL RESOURCES:
See existing Reset and Removal plans as well as erosion control plans.

K. LOCATIONS WHERE ALTERNATIVE TEMPORARY STABILIZATION SCHEDULES APPLY:
Not applicable in design phase.

3. QUALIFIED STORMWATER MANAGERS:

A. SWMP ADMINISTRATOR FOR DESIGN:
CDOT Certified Individual responsible for developing SWMP Plan Sheets and SWMP Site Maps during the design phase.

Name/Title	Contact Information	Certification #

Template Revised: 2.25.2022

30% SUBMITTAL (NOT FOR CONSTRUCTION) -APRIL 5, 2024

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CITY OF BOULDER Open Space & Mountain Parks

As Constructed
No Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
SWMP NOTES

Designer: T. Rohan | Structure Numbers:
Detailer: R. Cowell
Sheet Subset: DDP | Subset Sheets: 1 of 6

Project No./Code: 21662

Sheet Number: 17

Timothy R. Rohan, P.E.	1-720-758-7731, timothy.rohan@otak.com	#5890EF

B. SWMP ADMINISTRATOR FOR CONSTRUCTION: (As defined in Section 208) The Contractor shall designate a SWMP Administrator for Construction upon accepting co-permittee of the permit. The SWMP Administrator for Construction shall become the operator for the SWMP and assume responsibility for all design changes to the SWMP implementation and maintenance in accordance to 208.03. the SWMP shall remain the property of CDOT. The SWMP Administrator for Construction shall be responsible for implementing, maintaining and revising SWMP, including the title and contact information. The activities and responsibilities of the SWMP Administrator for Construction shall address all aspects of the project's SWMP. (Update the information below for each new SWMP Administrator for Construction) (A copy of TECS Certification must be included in the SWMP.)

Name/Title	Contact Information (phone & email)	Certification #	Start Date	Engineer Approval

C. EROSION CONTROL INSPECTOR: (As defined in Section 208) The Contractor may designate an Erosion Control Inspector. The Erosion Control Inspector shall complete duties in accordance with subsection 208.03 (c) (Copy of TECS Certification must also be included in the SWMP.)

Name/Title	Contact Information (phone & email)	TECS Certification #	Start Date	Engineer Approval

D. PERMANENT STABILIZATION SUBJECT MATTER EXPERT: This qualified individual will be either a Regional Environmental Staff member, or an Independent Contractor Controller (Independent Assurance Program). This expert is a project team leader responsible for ensuring project adherence to requirements of the 207 and 212 Project Special Provisions as follows and will be available for questions regarding permanent stabilization requirements.

1. Review the Topsoil Management Plan and the Permanent Stabilization Site Maps.
2. Attend the Environmental Pre-Construction Conference.
3. Coordinate the Site Pre-Vegetation Conference.
4. Review and recommend approval of products.
5. Review and recommend approval of the Quantities Verification Prerequisite.
6. Attend the Partial Landscape Completion Walkthrough.
7. Attend the Final Landscape Completion Walkthrough.

Name/Title	Contact Information

4. STORMWATER MANAGEMENT CONTROLS FOR FIRST CONSTRUCTION ACTIVITIES

THE CONTRACTOR SHALL PERFORM THE FOLLOWING:

A. POTENTIAL POLLUTANT SOURCES:
Evaluate, identify, locate and describe all potential sources of pollutants at the site in accordance with subsection 107.25, CDPS-SCP and place in the SWMP. All control measures related to potential pollutants shall be shown on the SWMP Site Map by the Contractor's SWMP Administrator for Construction.

B. OFFSITE DRAINAGE (RUN ON WATER):
Describe and record control measures on the SWMP Site Map that have been implemented to address off site run-on water in accordance with subsection 208.03.

C. VEHICLE TRACKING CONTROL:
Control measures shall be implemented in accordance with subsection 208.04.

D. PERIMETER CONTROL:
1. Perimeter control shall be established as the first item on the SWMP to prevent the potential for pollutants leaving the construction site boundaries, entering the stormwater drainage system, or discharging to state waters. Perimeter control shall be in accordance with subsection 208.04
2. Perimeter control may consist of berms, silt fence, erosion logs, existing landforms, or other control measures as approved.

5. DURING CONSTRUCTION

RESPONSIBILITIES OF THE SWMP ADMINISTRATOR FOR CONSTRUCTION: Considered a "living document", the SWMP is continuously reviewed and modified throughout the construction phases. During construction, SWMP Administrator for Construction shall add, update, or amend the items A-G below as needed in accordance with subsection 208.03.

During construction, indicate how items that were not addressed during design are being handled in construction. If items are covered in other sections of the SWMP, indicate below what section the discussion takes place.

A. MATERIALS HANDLING AND SPILL PREVENTION AND RESPONSE PLAN: Prior to construction commencing the Contractor shall submit a Spill Response Plan. Materials handling and Spill Response Plan shall be in accordance with subsection 208.06.

B. OTHER CDPS PERMITS: List applicable CDPS permits associated with the permitted site and activities.

C. STOCKPILE MANAGEMENT: Shall be done in accordance with subsections 107.25 and 208.07.

D. CONCRETE WASHOUT: Concrete washout water or waste from field laboratories and paving equipment shall be contained in accordance with subsection 208.05.

E. SAW CUTTING: Shall be done in accordance with subsections 107.25, 208.04, 208.05

F. STREET SWEEPING: Shall be done in accordance with subsection 208.04.

6. INSPECTIONS

A. Water Quality Inspections shall be in accordance with subsection 208.03(c).

B. Permanent Stabilization Inspections shall be in accordance with subsections 208.04(e)4 and 208.10

7. CONTROL MEASURE MAINTENANCE

Maintenance shall be in accordance with subsection 208.04(f).

8. RECORD KEEPING

Records shall be kept in accordance with subsection 208.03(d).

9. INTERIM, PERMANENT STABILIZATION and LONG-TERM STORMWATER MANAGEMENT

The Contractor shall comply with all interim stabilization and permanent stabilization requirements in accordance with subsection 208.04(e).

A. SEEDING PLAN:
The following seed mix(es) and rates are for drill seeding method as shown on the Permanent Stabilization Site Maps shall be used:

COMMON NAME	BOTANICAL NAME	LBS. PLS PER ACRE
	Total	

B. SEEDING APPLICATION METHOD:
The following seeding methods shall be used for all areas shown on the Permanent Stabilization Site Maps. Soil compaction shall be minimized for areas where permanent stabilization will be achieved through vegetative cover.

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CITY OF BOULDER Open Space & Mountain Parks

As Constructed	MARSHALL MESA TRAILHEAD RENOVATION SWMP NOTES	Project No./Code
No. Revisions:		21662
Revised:	Designer: T. Rohan / Structure Numbers:	
Void:	Detailer: R. Cordell	
	Sheet Subset: EDP / Subset Sheets: 2 of 6	Sheet Number: 18

Pay Item	Seeding Method (subsection 212.05)	Acre
212-00706	Seeding (Native) Drill	
212-00707	Seeding (Native) Hydraulic	
212-00708	Seeding (Native) Broadcast	
	Total	

C. SOIL STABILIZATION METHODS:
Minimum soil stabilization methods (attached mulch) for all disturbances to receive seeding.
Prior to winter shutdown or the summer seeding window closure: Uncompleted slopes shall be mulched with 2 tons of mulching (weed free) per acre, mechanically crimped into the topsoil in combination with an organic mulch tackifier in accordance with Sections 208 and 213.

D. SPECIAL REQUIREMENTS:
1. Soil amendments, seedbed preparation, and permanent stabilization mulching shall be accomplished within four working days of placing the topsoil on the de-compacted civil subgrades. If placed topsoil is not mulched with permanent stabilization mulch within four working days, the Contractor shall complete interim stabilization methods in accordance with subsection 208.04(e) at no additional cost to the Department.
2. Complete permanent stabilization mulching within 24 hours of hydraulic application of native seed.
3. The Contractor shall submit a proposed Permanent Stabilization Phasing Plan to the Engineer for approval showing how implementation of SWMP Permanent Stabilization Plans will minimize damage to seeded areas.

E. SOIL AMENDMENT REQUIREMENTS: Minimum amendment material requirements for all disturbances to receive seeding.

X.XX **Total Acres of Seeding (Native) Drill With Topsoil Generated From** (selection one of the following and delete the others: Topsoil (Onsite), Seeding Media and Topsoil (Offsite))

	Pay Item	Description	Amount/Acre	Units	Total For This Method
Seeding (Native) Drill Pay Item 212-00706	212-00700	Organic Fertilizer [illegible]		Pounds	
	212-00701	Compost (Mechanically Applied)		CY	
	212-00703	Humate		Pounds	
	212-00704	Mycorrhizae		Pounds	
	212-00705	Elemental Sulfur		Pounds	

F. Permanent Stabilization Application Under Structures:
Under structures shade patterns should be considered and the use of Median Cover Material (Stone) or other stabilized options with an approved Project Special Provision should be used. See SWMP Site Map for locations.

G. RESEEDING OPERATIONS/CORRECTIVE STABILIZATION:
Prior to stormwater construction work partial acceptance.
1. All seeded areas shall be reviewed by the SWMP Administrator for Construction and or Erosion Control Inspector for bare soils caused by surface or wind erosion. Bare areas caused by surface or gully erosion, blown away mulch, etc. shall be re-graded, seeded, and have the designated mulching applied as necessary, at no additional cost to the project.
2. The Contractor shall maintain seeding/mulch/tackifier/blanket/TRM, mow to control weeds or apply herbicide to control weeds in the seeded areas, at no additional cost to the project.

H. LOCATION AND DESCRIPTION OF PLANNED PERMANENT CONTROL MEASURES: Is Permanent Water Quality Required. Yes
[illegible]

[illegible]

10. PRIOR TO PROJECT FINAL ACCEPTANCE

A. When directed by the Engineer, removal and disposal of temporary control measures shall be included in the cost of work.

B. At the end of the project, all ditch checks shall consist of either temporary erosion logs (or equivalent) or permanent riprap.

C. All storm drains shall be cleaned prior to the Final Acceptance of the project. If required, include work in 202-04002 Clean Culvert. [**Check with Region Water Quality staff to see if CLEAN CULVERT PSP is needed and what Pay Item to use.**]

D. Refer to subsection 208.10 for items to be completed prior to requesting partial acceptance of water quality work.

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MARSHALL MESA TRAILHEAD RENOVATION
SWMP NOTES

Designer: T. Rohan
Detailer: R. Cardell
Sheet Subset: ECP
Structure Numbers:
Subset Sheets: 3 of 6

Project No./Code
21662
Sheet Number 19

11. NARRATIVES

Control Measure Matrixes During Construction:

1. Control measure narratives have been included for the CDOT Standard Specifications and Standard Plan M-208 and M-216 along with any non-standard control measures approved during the design process. If a Non-Standard Control Measure not included in the SWMP is proposed and approved by the Engineer the SWMP Administrator for Construction shall do the following: Place an "X" in the column for non-standard and complete a Non-Standard Control Measure Specification and Narrative covering the what, when, where and why the control measure is being used shall be add to the SWMP. The appropriate "X" shall also be added to the implementation phase(s)
2. The SWMP Administrator for Construction shall place an "X" in the column In Use On Site when the control measure has been installed.
3. A "B" in the initial Activities Column indicates that the control measure shall be installed **before** construction activity starts. Locations and quantities will be discussed during the Environmental Pre-Construction Conference with the Regional Water Pollution Control Manager.

STRUCTURAL Control Measures that may be potentially used on the project for erosion and sediment control; practices may include, but are not limited to the following:

APPLICATION, CONTROL MEASURE	NARRATIVE	M- 208 STANDARD or "X" for NON-STANDARD	CONTROL MEASURE IMPLEMENTATION PHASE			
			IN USE ON SITE	INITIAL ACTIVITIES	INTERIM ACTIVITIES	PERMANENT STABILIZATION
PROTECTION OF EXISTING WETLANDS *Fence (plastic) and erosion logs*	Fence (plastic) shall be placed in combination with erosion logs to prevent encroachment of construction traffic and sediment into state waters prior to start of construction disturbances. Fence (plastic) shall be placed adjacent to the wetlands; erosion logs shall be placed between the plastic fence and disturbance area. Logs shall be placed to direct flows away from or filter water running into wetlands from disturbance areas.					
PROTECTION OF EXISTING TREES/LANDSCAPING *Fence (plastic)*	Fence (plastic) shall be used in areas indicated in the plans to prevent encroachment of construction traffic and sediment for the protection of sensitive habitat, mature trees and/or existing landscaping prior to start of construction disturbances.		X	X	X	
CHECK DAM/DITCH CHECK *Erosion log, silt berm, silt dike, rock check dam*	Placed in ditches immediately upon completion of ditch grading to reduce velocity of runoff in ditch. For existing ditches, place prior to start of construction disturbances.	M-208		X	X	
Storm Drain Inlet Protection In Paved Roadways (Type 1, 2 and 3 as shown on M-208-1, sheet 5 of 11)	Manufactured storm drain inlet protection placed prior to construction disturbances as detailed in M-208-1, to protect existing inlets or immediately upon completion of new inlets to prevent sediment from entering the inlet throughout construction.	M-208		B or X	X	X
Storm Drain Inlet Protection In Native Seed Areas (M-604 Standard Inlets Type C and D)	Erosion logs or aggregate bags placed around inlet grate to prevent sediment from entering inlet. Place prior to construction disturbances to protect existing inlets or immediately upon completion of new inlets.	M-208		B or X		
CULVERT INLET/OUTLET PROTECTION *Erosion logs, aggregate bags*	Placed at mouth of culvert inlets and over top of culvert at inlet and outlet where disturbance may be occurring adjacent to pipe to prevent sediment laden water from entering pipe or drainage. Place prior to the start of construction disturbances.	M-208		B or X	X	X
TYPE C, TYPE D AND TYPE 13 PROTECTION *Erosion logs, aggregate bags, erosion bales*	Placed around inlet grate or slope and ditch paving to prevent sediment from entering inlet. Place prior to the start of construction disturbances.	M-208		B or X	X	X
STOCKPILE PROTECTION *Temporary berm, erosion logs, aggregate bags**	Placed within specified distance, in accordance with subsection 208.06, from toe to contain sediment around stockpile. *Aggregate bags are easily moved and replaced for access during the work day. Place prior to start of stockpiling, increase control as the stockpile increases size.	M-208			X	
TOE OF FILL PROTECTION *Erosion logs, temporary berm, silt fence, topsoil windrow**	Place prior to slope/embankment work to capture sediment and protect and delineate undisturbed areas. *Can be used to stockpile topsoil for salvage.	M-208		X	X	
PERIMETER CONTROL *Erosion logs, silt fence, temporary berm, topsoil windrow**	Placed prior to construction commencing to address potential run-on water from off site, and to divert around disturbed area. *Can be used to stockpile topsoil for salvage.	M-208		B or X	X	
SLOPE CONTROL *Silt fence, erosion logs*	Placed on the contour of a slope to contain and slow down construction runoff. Place prior to the start of construction disturbances.	M-208		X	X	
TEMPORARY SEDIMENT TRAP	Used to capture sediment laden runoff from disturbed areas < 5 acres during construction. Place prior to the start of construction disturbances. Outlets that withdraw water from or near the surface may be installed when discharging from basins and impoundments.	M-208		X	X	
TEMPORARY SLOPE DRAIN	Placed as a conduit or chute to drain runoff down slope and to prevent erosion of slope.	M-208			X	X
OUTLET PROTECTION *Riprap, or approved other*	Material placed as an energy dissipater to prevent erosion at outlet structure.	M-601-12			X	X
CONCRETE WASHOUT *In-ground or fabricated*	Construction control, used for waste management of concrete and concrete equipment cleaning. Place prior to the start of concrete activities.	M-208		X	X	

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MARSHALL MESA TRAILHEAD RENOVATION
SWMP NOTES

Designer: T. Rohan | Structure Numbers:
Detailer: R. Condel
Sheet Subset: EDP | Subset Sheets: 4 of 6

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APPLICATION, CONTROL MEASURE	NARRATIVE	M- 208 STANDARD or "X" for NON-STANDARD	IN USE ON SITE	CONTROL MEASURE IMPLEMENTATION PHASE		
				INITIAL ACTIVITIES	INTERIM ACTIVITIES	PERMANENT STABILIZATION
VEHICLE TRACKING PAD	Source control, placed to prevent tracking of sediment from disturbed area to offsite surface. Place prior to the start of construction disturbances.	M-208		8 or X	X	
Engineered SEDIMENT BASIN	Constructed early in the project, prior to storm sewer/ditches and in accordance with 208.05(p) to capture storm flow. Outlet structure and/or outfall shall be modified for temporary sediment control using an approved non-standard detail. Outlets that withdraw water from or near the surface shall be installed when discharging from basins and impoundments, unless infeasible			X	X	
DEWATERING (Contractor is responsible for obtaining a permit from Colorado Department of Health and Environment.)	Shall be done in such a manner to prevent potential pollutants from entering state waters.			X	X	
TEMPORARY STREAM CROSSING	Constructed over stream or drainage to prevent discharge of pollutants from construction equipment into water.			X	X	
CLEAN WATER DIVERSION	Placed to divert clean surface or groundwater around the disturbance area to prevent it from mixing with construction runoff.			X	X	
OTHER						

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MARSHALL MESA TRAILHEAD RENOVATION
SWMP NOTES

Designer: T. Rohan | Structure Numbers:
Detailer: R. Cordell
Sheet Subset: EOP | Subset Sheets: 5 of 6

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NON-STRUCTURAL Control Measures that may be potentially used on the project for erosion and sediment control practices may include, but are not limited to:
Erosion control devices are used to limit the amount of soil loss on site. Sediment control devices are designed to capture sediment on the project site. Construction controls are control measures related to construction access and staging. Control Measure locations are indicated on the SWMP Site Map.

*** Use of vegetative buffer strip requirements.** The CDPHE Water Quality Control Division Technical Memorandum dated August 27, 2015 clarifies the requirements for utilization of existing vegetation as a buffer type of sediment control measure, while maintaining compliance with the CDPS permit for Stormwater Discharges Associated with Construction Activity – CDPS Permit No. COR4000000. In general, the division does not recommend that vegetated buffers be implemented as a sediment removal control measure for runoff from disturbed areas of construction sites, unless implemented as a "finishing" component of a treatment train comprised of additional, adequate up-gradient Control Measures. The entire memorandum can be found at: https://www.colorado.gov/pacific/sites/default/files/Vegetative%20Buffer%20Memo.pdf

APPLICATION, CONTROL MEASURE	NARRATIVE	M-STANDARD or "For NON-STANDARD	IN USE ON SITE	CONTROL MEASURE IMPLEMENTATION PHASE		
				INITIAL ACTIVITY	INTERIM ACTIVITIES	PERMANENT STABILIZATION
* VEGETATIVE BUFFER STRIP	Finishing component for filtering sediment-laden runoff from disturbance area. Area within CDOT ROW or temporary easement to be identified on SWMP prior to construction starting.			X	X	X
GRADING APPLICATIONS (LANDFORM)	Existing or created landforms may be used as a control measure if they prevent sediment from entering or leaving the disturbance area. If a landform directs flow of water to a concentrated outfall point, the outfall point shall be protected to prevent erosion. Area to be identified on SWMP prior to construction starting.	M-208		X	X	
TOPSOIL MANAGEMENT STOCKPILE/SALVAGE Stockpile	Prior to any site disturbance work commencing, existing topsoil shall be scraped to a depth six inches or as specified, and placed in stockpiles or windrows. Upon completion of final grading, topsoil shall be evenly distributed over embankment to a depth of six inches or as specified.	M-208		X	X	X
SURFACE ROUGHENING / GRADING TECHNIQUES	Temporary stabilization of disturbance and to minimize wind and erosion.				X	
SEEDING (TEMPORARY)	Temporary stabilization used for over wintering of disturbance or used to control erosion for areas scheduled for future construction.				X	
BONDED FIBER MATRIX or MULCHING (HYDRAULIC)	Not to be used in areas of concentrated flows, i.e. ditch lines. To be for either Interim or Permanent Stabilization placed as a surface cover for erosion control. May be used as surface cover when work is temporarily halted and as approved by the Engineer for stockpiles.				X	
Straw or Hay MULCH/MULCH TACKIFIER	Interim or Permanent Stabilization placed as a surface cover for erosion control and or seeding establishment. To be installed as Interim Stabilization as a surface cover when work is temporarily halted and as approved by the Engineer				X	X
SPRAY-ON MULCH BLANKET (Not to be used in areas of concentrated flows, i.e. ditch lines.)	Interim or Permanent Stabilization placed as a surface cover for erosion control and or seeding establishment. To be installed as temporary surface cover when work is temporarily halted and as approved by the Engineer				X	X
SEEDING PERMANENT (NATIVE PERENNIAL)	Permanent Stabilization of disturbance and to reduce runoff and control erosion on disturbed areas.					X
SOIL RETENTION BLANKET (SRB)	Permanent Stabilization of disturbance and to reduce runoff and control erosion on disturbed areas.	M-216			X	X
TURF REINFORCEMENT MAT (TRM)	Permanent Stabilization of disturbance and to reduce runoff and control erosion on disturbed areas. Placed in channels or on slopes for erosion control, channel liner and seeding establishment.	M-216				X
Sweeping	Source control, used to remove sediment tracked onto paved surfaces and to prevent sediment from entering drainage system. Sweep daily and at the end of the construction shift as needed. Kick brooms shall not be permitted.			X	X	X
OTHER						

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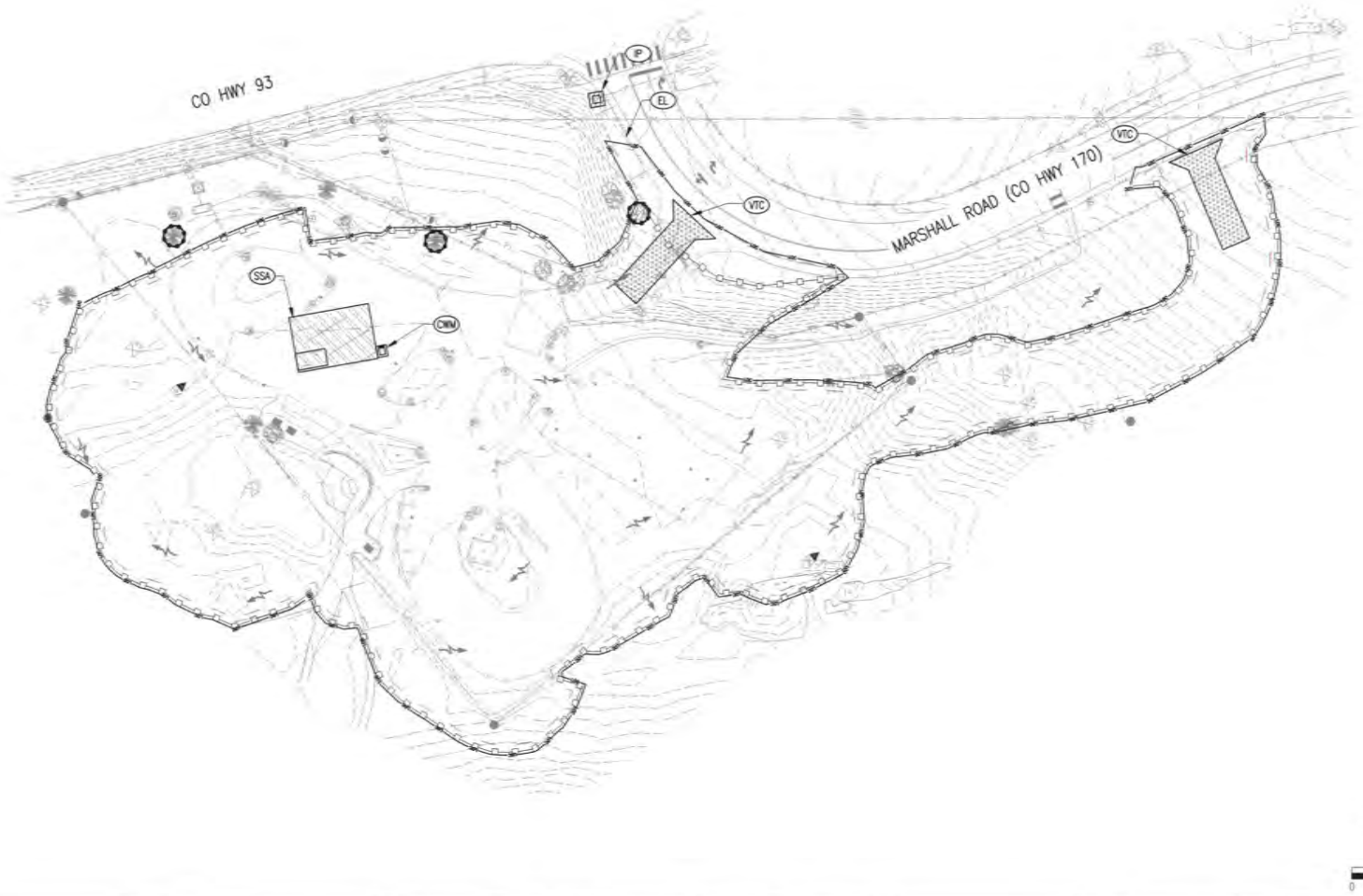
	Sheet Subset: EDP	Subset Sheets: 6 of 6	Sheet Number: 22



LEGEND:

- CWM — CONCRETE WASHOUT STRUCTURE
- CF — CONSTRUCTION FENCE
- ECB — SEEDING & EROSION CONTROL BLANKET
- EL — EROSION LOG TYPE 1 (12 INCH)
- EL — EROSION LOG TYPE 1 (20 INCH)
- IP — INLET PROTECTION (TYPE III)
- LOC — LIMITS OF CONSTRUCTION
- LOD — LIMITS OF DISTURBANCE
- RS — ROCK SOCK
- RRC — RRC FOR CULVERT PROTECTION
- SM — SEEDING AND MULCHING
- SF — SILT FENCE
- SSA — STABILIZED STAGING AREA
- VTC — VEHICLE TRACKING CONTROL
- DIRECTION OF OVERLAND FLOW (PROPOSED CONDITIONS)
- DIRECTION OF OVERLAND FLOW (EXISTING CONDITIONS)
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- TREE PROTECTION FENCE

NOTES:

1. ALL BMP DEVICES SHALL BE MAINTAINED PER CDOT STANDARDS & SPECIFICATIONS.
2. EXISTING TREES SHALL BE PROTECTED TO THE FULLEST EXTENT POSSIBLE. IF TREES ARE DAMAGED DURING CONSTRUCTION, THE CONTRACTOR SHALL REPLACE THE TREES AT NO ADDITIONAL COST TO THE PROJECT.
3. INLET PROTECTION FOR PROPOSED CULVERTS TO BE INSTALLED IMMEDIATELY AFTER CULVERT INSTALLATION.

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MARSHALL MESA TRAILHEAD RENOVATION
EROSION CONTROL PLAN – INITITAL

Designer: T. Rohan
Detailer: R. Condell
Sheet Subset: ECP
Structure Numbers:
Subset Sheets: 1 of 3

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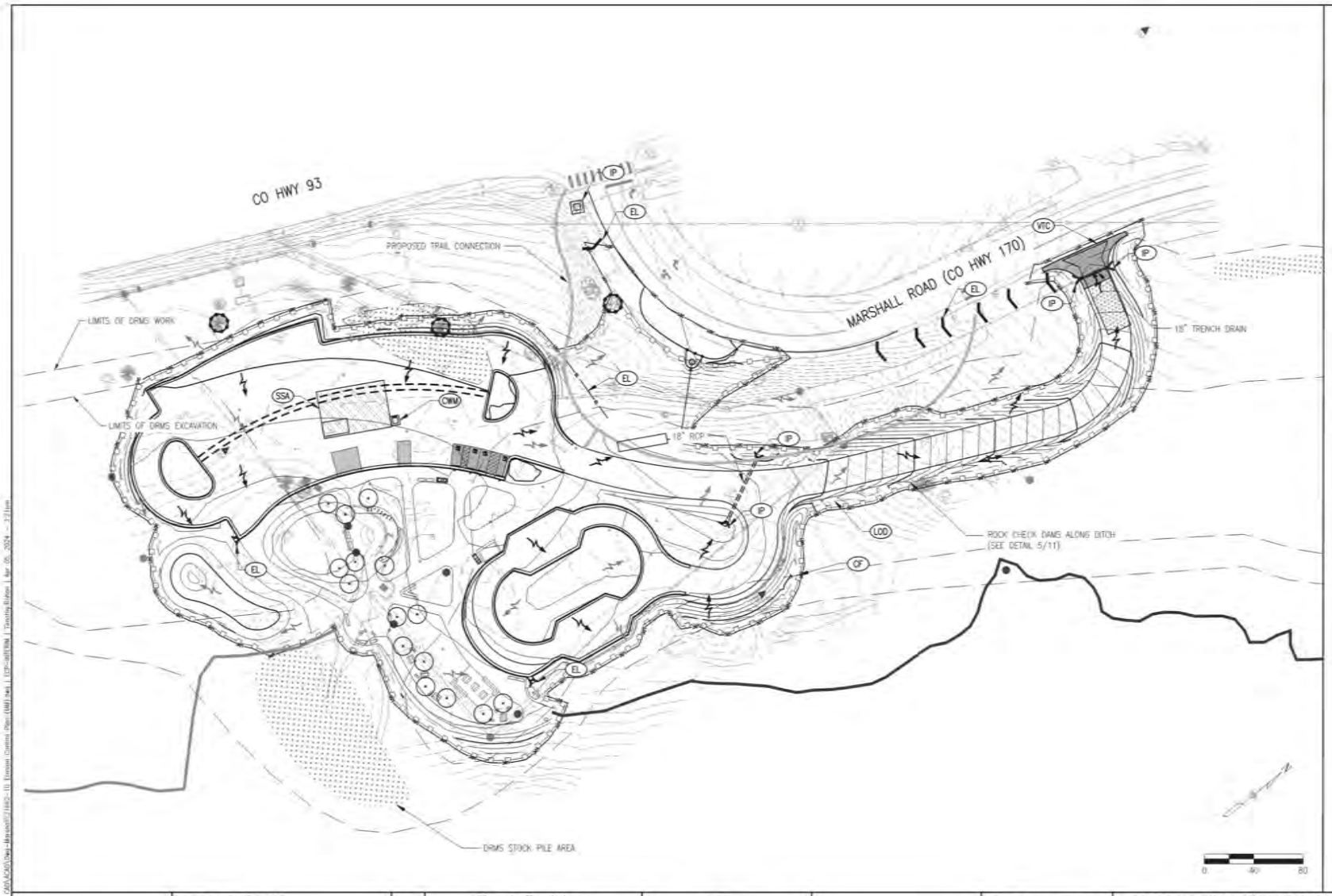

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EROSION CONTROL PLAN – INTERIM

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Detailer: R. Condell
Structure Numbers:
Sheet Subset: ECP
Subset Sheets: 2 of 3

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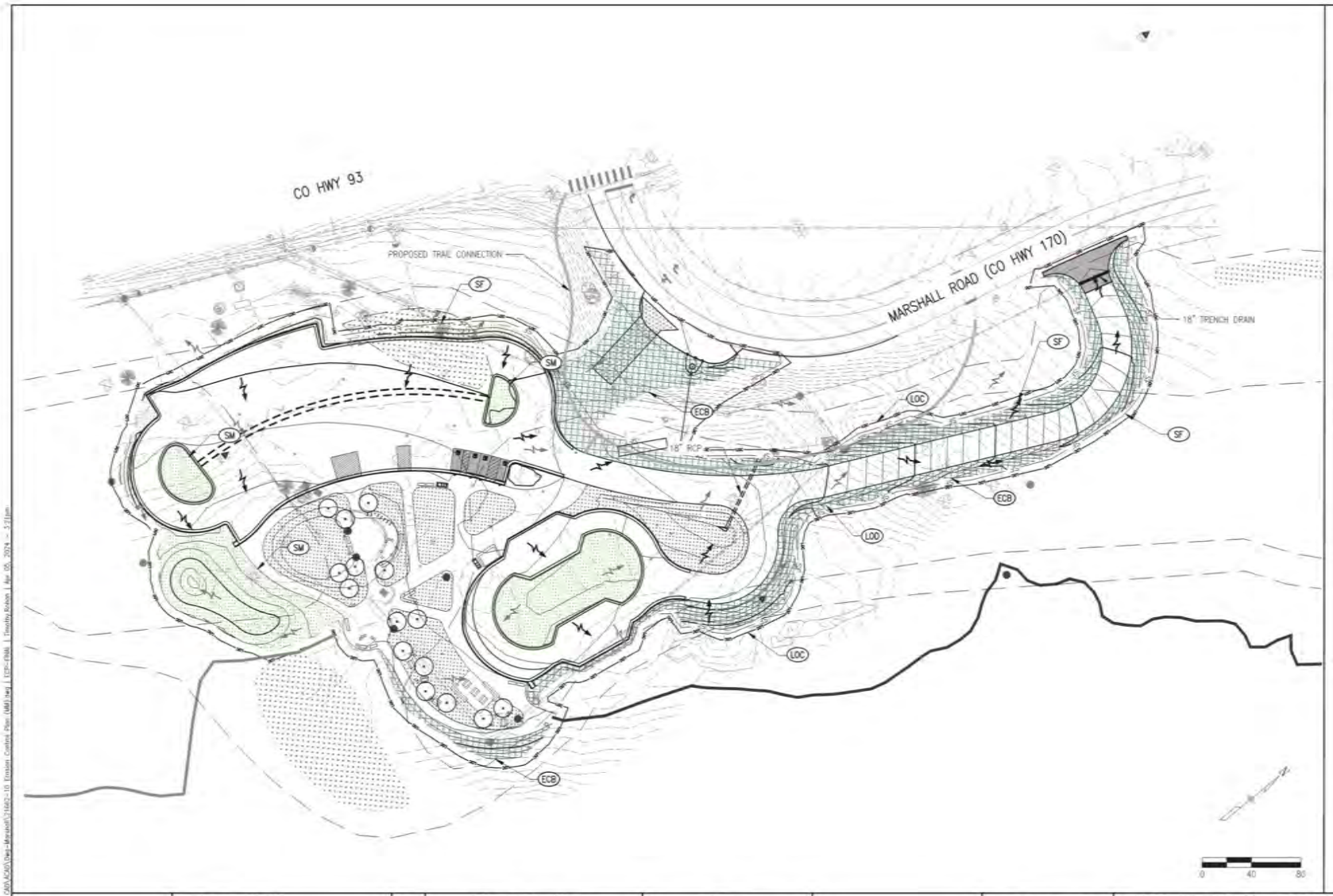

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- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

NOTES:

1. ALL BMP DEVICES SHALL BE MAINTAINED PER CDOT STANDARDS & SPECIFICATIONS.
2. EXISTING TREES SHALL BE PROTECTED TO THE FULLEST EXTENT POSSIBLE. IF TREES ARE DAMAGED DURING CONSTRUCTION, THE CONTRACTOR SHALL REPLACE THE TREES AT NO ADDITIONAL COST TO THE PROJECT.

30% SUBMITTAL (NOT FOR CONSTRUCTION) -APRIL 5, 2024

All seals for this set of drawings are applied to the cover page(s).

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Otak

Sheet Revisions		
Date:	Comments	Init.

CITY OF BOULDER Open Space & Mountain Parks

As Constructed
No Revisions:
Revised:
Void:

MARSHALL MESA TRAILHEAD RENOVATION
EROSION CONTROL PLAN – FINAL

Designer: T. Rohan
Detailer: R. Candell
Structure Numbers:
Sheet Subset: ECP
Subset Sheets: 3 of 3

Project No./Code: 21662

Sheet Number: 25

Marshall Mesa Trailhead Redesign

City of Boulder Open Space and Mountain Parks

Appendix 2 – Marshall Mine Underground Coal Fire

Report of Investigations

April 8, 2024

Project Number: 117-8295005

Marshall Mine Underground Coal Fire Report of Investigations

Colorado Department of Natural Resources
Division of Reclamation, Mining, and Safety

September 15, 2023

TETRA TECH

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Acronyms/Abbreviations

Acronyms/Abbreviations	Definition
ags	above ground surface
AML	Abandoned Mine Lands
amsl	above mean sea level
AOI	Area of Interest
bgs	below ground surface
CO_2	Carbon Dioxide
CO	Carbon monoxide
DRMS	Colorado Department of Natural Resources Division of Reclamation, Mining, and Safety
ft	feet
°F	Degrees Fahrenheit
GPS	Global Positioning System
Hwy	highway
H_2S	Hydrogen sulfide
LEL	Lower explosive limit
Preliminary Report	*Report of Preliminary Investigations Marshall Underground Coal Fire*
Site	Marshall Mesa Underground Coal Fire site
SOW	Scope of Work
UAV	Unmanned Aerial Vehicle or System

1. Introduction

This report presents the findings of Tetra Tech, Inc.'s (Tetra Tech) investigations of the Marshall Mesa Underground Coal Fire site (Site) evaluations of options for fire management and/or mitigation. The work completed on the site was authorized by the State of Colorado Department of Natural Resources Division of Reclamation, Mining, and Safety (DRMS).

On December 30, 2021, a destructive wildfire, called the Marshall Wildfire, started near State Highway 93 and Marshall Road (**Figure 1**) and burned eastward through the Site. Following the fire, DRMS requested that Tetra Tech complete a preliminary investigation of the conditions across the approximately 7.5-acre southern portion of the Marshall Mesa Underground Coal Fire site (Marshall Mesa South, **Figure 1**) which is located near the southwest corner of the Marshall Wildfire impacted area. The primary goal of the preliminary investigation was to quantify the extents of subsurface heat and/or fire in the southern area of interest (AOI), which included surface-feature temperature and combustion gas observations, unmanned aerial vehicle (UAV) based infrared thermal/visual scans, drilling investigation, and subsurface temperature monitoring. Initial site evaluation work began in January 2022, and the drilling and thermocouple installations were completed by the end of February 2022. Long-term coal seam temperature monitoring was initiated March 3, 2022. Results of the preliminary investigation were presented to the DRMS on March 16, 2022, in *Report of Preliminary Investigations Marshall Underground Coal Fire* (Preliminary Report). The Preliminary Report is provided in **Appendix A**.

Subsequently, from March 2022 to present, the investigation expanded to include both the southern AOI and the approximately 17.5-acre area north of the Site or northern AOI (Marshall Mesa North, **Figure 1**). The goal of this continuing investigation is to ascertain subsurface conditions and potential mine fire activity and includes Site-wide (both northern and southern AOI's) microgravity geophysical surveys, drilling and geologic investigation, monitoring well installation and hydrogeologic evaluation, and ongoing subsurface temperature monitoring. This report summarizes the findings of the preliminary and continuing investigations and recommendations for future fire monitoring and/or abatement activities.

1.1 Location and Site Characteristics

The Marshall underground coal mine fire site is located on the City of Boulder, Colorado (Marshall Mesa Trailhead Open Space) property located south of Boulder, immediately east State Highway 93 (Hwy 93) and south of State Highway 170 (**Figure 1**). The Site comprises undeveloped, open space land, owned and managed by the City of Boulder bounded by Hwy 93 to the west, Marshall Road to the north, Coal Seam trail to the east, Davidson Ditch to the south, the Marshall Mesa Trailhead (Trailhead) (**Photo 1, Appendix B**) located on the southwest corner of the northern AOI (**Figure 1**) and is the primary access location for the site.

The site sits at an elevation of approximately 5,500 feet above mean sea level (ft amsl) and is generally flat with some hummocky areas due to suspected subsidence features related to historic coal mines and mine fires. A sandstone outcrop cuts across the southern AOI at southwest to northeast trend, underlies most of the Trailhead parking lot (Marshall Mesa Trailhead**, Figure 1**) and continues as a prominent ridge that largely bisects the northern AOI along its major southwest to northeast axis. This sandstone outcrop forms a topographic high which is approximately 15 to 30 feet higher in elevation than in the adjacent lower lying areas to the northwest and southeast. Vegetation is mostly grass with some shrubs and trees. Although much of the site burned during the Marshall Wildfire, vegetation has regrown and currently covers most of the site.

1.2 Previous Site Visits/Assessments

There is an extensive history of underground fires, both in mines and outcrops, at Marshall Mesa documented through historical photographs, reports, and mine maps describing underground fires dated more than 100 years ago. As described in the 2018 Mine Fire Inventory report (Tetra Tech, 2019), the recent, 20-year, history highlights the dynamic, ever-changing conditions at mine fire sites. During a site visit in October 2003, it was reported that the fire was moderately active with ground temperatures ranging from 118°F to 130°F. The smell of coal combustion was noted near the venting fractures (Renner, 2005). These features were located in the northern portion of the Marshall Mesa site in a recently active subsidence feature.

In February 2005, a recently constructed building was inspected for damage caused by subsidence believed to be related to the Marshall Coal Mine. Vents and subsidence features were identified under and around the building (Amundson, 2005). The building was ultimately demolished after the property was acquired by the City of Boulder for construction of the Trailhead area.

On December 20, 2005, a brush fire was reportedly started by a 373°F vent in the northern portion of the Marshall Mesa site. The fire was quickly contained and extinguished. In January 2006, fire abatement was undertaken by the State of Colorado Office of Surface Mining to fill in vents with small rock material to reduce the potential of starting another surface fire. 275 tons of unwashed aggregate was placed over the vent area to a total depth of 18 inches (Blackburn, 2006).

In 2017, two areas of trough subsidence were excavated, compacted, and backfilled to natural grade. Both were in areas where surface expression of the mine fire had been observed (2017 Mitigation Area, **Figure 1**). During the subsidence mitigation work, a few small vents were uncovered in both locations. In all cases, the exhaust was warm, moist air with temperature less than 90°F. No new evidence of subsidence or other indicators of the coal mine fire were observed during the completion of the remedial activities. Gas monitoring during construction did not detect gases associated with coal combustion over the background levels.

The site was visited in the morning following a small, overnight, snowstorm in October 2018. No signs of venting, heat, odors, or snowmelt were observed (Tetra Tech, 2019).

1.3 Geologic Setting

Surface and bedrock units in the vicinity consist of late Cretaceous sedimentary rocks (Roberts, 2007). The most prominent and youngest unit in the area is the Laramie Formation, a set of brackish to freshwater deposits up to 800 feet thick. The upper Laramie Formation contains mainly clay and sandy shale, is highly variable laterally, and is easily eroded. Underlying the Laramie Formation in the area is the Fox Hills Sandstone which in turn is underlain by the Pierre Shale.

Most surface rocks across Marshall Mesa are the comparatively erosion-resistant shaly sandstones, comprised of primarily of quartzose and arkosic sandstone benches separated by clay, shale, or coal seams (Spencer, 1961) of the lower 80 to 125 feet of the Laramie Formation. A ubiquitous horizon of varnished, very durable ripple marks up to 1 inch deep at the top of the "C sandstone" member of the lower Laramie Formation outcrops northeast of the site near Marshall Road, providing a stratigraphic marker.

The site lies in the late Cretaceous Laramie Formation, west (on the footwall) of the east-dipping Fox Fault, which is the first major Laramide back thrust east of the Rocky Mountain Front Range (**Figure 2**). Units within the Site dip six to twelve degrees to the southeast (e.g., Trudgill, 2015). Between the Fox Fault and the Gorham Fault some 500 meters southeast, multiple anastomosing fault strands create an elliptical anticlinorium elongated to the northeast.

The lower Laramie Formation also contains most of the coal seams mined in the area, with most activity concentrated in the three- to eight-foot-thick No. 3 Seam within the lower 40 feet of the formation, some 20 to 40 feet below the C sandstone. The underlying Fox Hills Sandstone varies from 80 to 250 feet across the Marshall Mesa because of depositional variations, inter-tonguing with the underlying shales, and duplication by faults (**Figure 2**).

In addition to the main, mapped faults (Fox, Pine Ridge, Peerless, Pittsburgh, South Gorham, and West Fox; **Figure 2**), there are a series of smaller unmapped faults present, further complicating the site.

1.3.1 Stratigraphy

The lower Laramie Formation below the C sandstone comprises alternating sandstone and shale with notable coal seams. Several coal seams have been mined in the lower Laramie. At three to eight feet thick, the No. 3 coal seam is the thickest and most prominent. Near the site, this seam lies approximately ten feet below the top of the lower Laramie, underlying 17 feet of friable shaly and loose sandy material. This erodible unit is capped by up to ten feet of the "C" sandstone (Emmons, 1896) member, with its diagnostic oxide-varnished ripple-marked top and locally abundant oxidized concretions. Few members in this interval resist erosion, creating muddy flats with few outcrops. Erodible shales, sandstones, and some coal streaks in

the lowest portion of the Laramie manifest as low- relief areas between the C sandstone and the massive grey sandstone at the top of the Fox Hills, in the swath from the C sandstone ridge southeast of the site.

1.3.2 Mining and Mine Workings

Coal mining started in the area as early as 1859 and continued through the 1950s. **Figure 3** shows the approximate extents of various coal mines in the immediate vicinity around the Site. Historical maps identifying underground workings are only available for some of these mines, including the Marshall No. 3, Black Diamond, and Eldorado Mines. Others, including the Marshall No. 1 and No. 2, are known to exist to the north of the project areas, but mine maps have not been located for these mines. The No. 3 Mine map shows workings to the south and east of the Marshall Mesa Trailhead, stopping just to the east of the project area. Two adits or airways are shown to extend west across the southern portion of the site to the slope west of Hwy 93.

It should be noted that the accuracy of available mine maps has not been confirmed and may not reflect the final extents and configuration the mines. Mine working extents and locations should therefore be considered approximate.

2. 2022-2023 Site Investigations

Site investigations beginning in January 2022 are summarized in this section and include the preliminary surface and subsurface investigations from January through March 2022, previously reported in the Preliminary Report (**Appendix A**), a Site-wide site microgravity conducted from February through July 2022, and Site-wide site geotechnical and subsurface investigations occurring in March and April 2023, with site-wide monitoring continuing to the present.

2.1 Preliminary Site Surface Investigations

Preliminary site surface investigations, including a site reconnaissance, surficial fracture gas and temperature observations, site thermal, mapping, and snowmelt imagery, are summarized below, with details of the investigations provided in the Preliminary Report (**Appendix A**).

2.1.1 Site Reconnaissance

Initial data collection at the site included a reconnaissance of the southern area as well as the surrounding areas. The Marshall No. 3 Mine workings appear to show two adits extending under Hwy 93, potentially daylighting out of the slope to the west (**Figure 3**). This area was inspected January 7, 2022; no signs of mine openings, recent subsidence, vents, or intakes were observed.

2.1.2 Surficial Fracture Gas and Temperature Observations

Two rounds of gas and temperature readings were completed January 7, 2022 and January 14, 2022 at ten discrete locations within the southern AOI as shown on **Figure 4**. These locations were selected by DRMS to screen for potential connectivity between the surface and underground mine workings suspected to be present in the area. Details of the January 2022 gas and temperature investigation are provided in the Preliminary Report (**Appendix A**).

Tetra Tech performed temperature measurements and obtained gas readings at each location to screen for subsurface temperatures and combustion gases typically associated with oxidizing and/or burning coal. A FLIR Infrared (IR) thermometer, Trimble R2 GPS unit, and a Landtec GEM 5000 gas analyzer with the capability to measure Methane %, Carbon Dioxide % (CO2), Oxygen % (O2), hydrogen sulfide (H2S), and carbon monoxide (CO) were used for the observations. **Photo 2, Appendix B** shows gas and temperature readings being taken.

The Trimble R2 GPS survey antenna was used to survey the ten observation locations (MV1-MV10) identified during the January 7, 2022, site activities. The IR thermometer was aimed at the deepest part of the fracture to take a reading representative of venting atmosphere/gas temperature. In most cases movement of air or gases in or out of the fractures was not apparent. The gas analyzer's silicone inlet tube was inserted as far in the hole as possible in the direction of

suspected air movement and the analyzer was turned on. The analyzer was run long enough (typically 1 to 2 minutes) to purge the suction line, for the gas reading to stabilize and to understand if there were short term fluctuations in gas concentrations. **Table 1** presents the gas concentration and temperature readings of each feature.

Tetra Tech noted slightly elevated temperatures and combustion gases at location MV-10 (**Figure 4**). The presence of CO without heat and CO2 is typically associated with incomplete combustion or oxidation of subsurface coal. No other indications of mine fire activity were observed including odors, heat, venting gases, or intakes. Fracture temperatures at feature MV01 to MV09 were close to ambient (33°F) and no discernable airflow (intake or vent) was observed.

2.1.3 Site Imaging

Thermal Imaging

On January 8, 2022, Tetra Tech performed a UAV-based thermal inspection and mapping of the southern AOI within the Marshall Mesa Open Space. Details of the January 2022 UAV thermal inspection are in the Preliminary Report (**Appendix A**).

A flight was performed to develop a thermal overlay of the southern AOI to map potential thermal anomalies, or features with sharp contrast, hot or cold, with the surrounding area (**Figure 5**). The colors on **Figure 5** ranges from approximately 10-300°F with the darker blues and purples representing the cooler temps (~20°F) and the brighter orange colors representing the relatively warmer temps (25-30°F). The warm circles (~28°F), primarily on the southern portion of the figure, are conifer trees that trap and hold warmer air. The snowmelt area displayed only slightly elevated temperature (~1-2°F) above the surrounding area and was consistent with on the ground temperature observations. Low altitude video inspections were also performed to provide more detail of the fractures in question and actively search for thermal anomalies that may not be observed from higher altitude thermal mapping; no additional surface coal fire expression features were identified during the detailed imaging. Ground reconnaissance of the hot spot (53 to 300°F, **Figure 5**) features to the east of the Site revealed these were residual heat in vegetation burned during the Marshall Wildfire.

Site Mapping

On February 9, 2022, Tetra Tech completed a UAV-based visual photogrammetry flight of the property to develop baseline aerial imagery for the drilling program. The imagery was captured using a 45-megapixel survey-grade camera flown at approximately 200 feet above ground level. The map was georeferenced using eight ground control points, surveyed using a Trimble R2 GPS antenna with precision RTX.

Snowmelt Imagery

With multiple snowfall events occurring in Boulder during January, February, and March 2022, Tetra Tech was able to visit the southern AOI several times to observe snowmelt patterns. During these visits an area was observed that consistently had snowmelt before the surrounding areas despite similarities in aspect and surface material or other factors that could influence differential melting patterns other than subsurface heat. **Figure 6** provides a perspective image of the consistent snowmelt area during a snowstorm event. The consistent snowmelt area is outlined as typical snowmelt on **Figure 4**. Ground temperature observations with the handheld IR thermometer showed ground temperatures in the snow free areas were just above freezing at 34°F and only 1°F to 3°F warmer than background surface temperatures. No other areas of snowmelt were identified in the southern AOI. **Photos 3 to 10** in **Appendix B** provides additional photographs of snowmelt areas in the southern AOI. In addition, two suspected snowmelt areas were identified in the northern AOI during the snowmelt imaging (Additional Snowmelt Areas, **Figure 4**).

2.2 Microgravity Survey

A comprehensive microGal-precision relative gravity (“microgravity”) survey of the site was conducted from February through July 2022 with the primary goals of mapping the extent of the known subsurface disturbance in the central portion of the site (snowmelt area in **Figure 6**), determining whether that coal seam is continuous with potential voids and the coal interval near the suspected fire origin, and to provide additional details on subsidence features and a natural gas pipeline at

the southern end of the site. The scope was expanded to include the northern AOI with the additional goal to image any voids related to mine workings underlying the Marshall Site.

Data comprised 1760 measurements at 1288 unique locations. The entire Site was sampled at maximum 30-foot spacing. This geometry provides sensitivity to signals from 10 to 60 feet bgs, or approximately the entire coal-bearing stratigraphic interval of the lower Laramie between the surface and the top of the Fox Hills sandstone. Denser data, locally as fine as approximately 5-foot spacing, was acquired in the southern AOI to allow higher-resolution imaging near the suspected wildfire origin, around subsidence features, and surrounding the natural gas pipeline. The gravity data were processed to calculate the Complete Bouguer Anomaly, which was detrended to isolate the residual gravity anomaly.

The primary feature of the residual gravity field is a discontinuous set of north-northeast (NNE)-trending negative residual (low) gravity anomalies (**Figure 7**). The most prominent of these low anomalies overlies the known surface heat expression and snowmelt in the southern AOI (**Figure 4**), extending NNE through the Trailhead parking lot. Although some of this signal may arise from the sand and gravel fill used to level the lot, the anomaly extends beyond the parking lot, especially to the NNE and east. As illustrated on **Figure 7,** the majority of boreholes drilled during 2022 and 2023 geotechnical investigations, which are detailed in **Section 2.3**, were drilled within these low anomalies. In North AOI, several roughly circular low-gravity anomalies occur along a general NNE trend; these lows generally coincide with surface subsidence features. Narrow low-gravity anomalies emanate perpendicularly from several of these circular lows, trending east-southeast.

High-pass filtering of residual gravity anomaly data is used to amplify comparatively shallow signals and is especially useful to identify smaller-scale anomalies when seismic measurement density is relatively high. This was particularly true in the southern AOI. within the coal-bearing stratigraphic interval of the lower Laramie between the surface and the top of the Fox Hills sandstone. Small-scale low gravity anomalies identified in the southern AOI include but are not limited to: those likely due to NNE trending jointing within the sandstone, above the coal-bearing interval; those along the southwestern edge of the southern AOI (adjacent to S. Foothills Hwy, **Figure 7**) which coincide with subsidence features and are likely associated with entrances to the Marshall No. 3 Mine and infrastructure surrounding them; and finally, the underground pipeline near the southern end of the Site. Within the area of surface heat expression and snowmelt in the southern AOI, the prominent set of north-northeast (NNE)-trending negative residual anomalies converge with the small-scale anomalies, and several meter- to decameter-scale subsidence features superpose additional low-gravity signals on the signals from natural jointing.

Negative residual (low) gravity anomalies are an indication of a mass deficit in subsurface material relative nearby material; the cause of mass deficits include but are not limited to burning coal or previously burned-out coal interval, open mine workings or rubble zones, jointing in rock, or other lower density geologic materials.

2.3 Geotechnical and Subsurface Investigations

In 2022 and 2023, Tetra Tech performed several subsurface investigations of the Site, including geotechnical drilling, downhole gas monitoring, thermocouple deployment and downhole temperature measurements, monitoring well installation, hydrogeologic testing and evaluation, and a test pit geotechnical investigation.

2.3.1 Borehole Drilling Program

Geotechnical drilling, downhole gas monitoring, thermocouple deployment and downhole temperature measurements, and monitoring well installation were performed to characterize the subsurface conditions. **Photos 11 to 24** in **Appendix B** record select drilling investigation activities. **Table 2** summarizes the borehole data, and the boring logs are included as **Appendix C**.

All drilling work was completed by Authentic Drilling based in Kiowa, Colorado using either a track mounted CME-55 or Acker Renegade drill rig. Boreholes were drilled using a track-mounted drill rig utilizing a 5.5-inch air-rotary tricone bit. If needed, an ODEX casing advance system was employed to advance through the overburden and into competent rock. This drilling method was effective in advancing through the fractured overburden and rubble zones where fluid-based drilling methods

would be ineffective due to fluid loss. Foam and water were pre-mixed and on standby in-case hot or burning conditions were encountered.

Drilling occurred in two phases. Phase 1 drilling work was performed from February 21, 2022, through February 25, 2022, as a part of the preliminary site investigation with nine boreholes (MM-01 through MM-09) completed within the southern AOI (**Figure 8**). The Phase 1 drilling was intended to quantify the extents of subsurface heat and/or fire in the southern AOI, with borehole locations positioned to examine the main snow melt area within the southern AOI. Details of the Phase 1 drilling are provided in in the Preliminary Report (**Appendix A**).

Phase 2 drilling work was performed from March 6, 2023, through April 5, 2023, with 67 boreholes (MM-10 through MM-76) completed within both the southern and northern AOIs (**Figure 8**). Geotechnical drilling was performed to characterize the site geology, evaluate the extents of the subsurface heat, and potentially identify the extents of mine workings in proximity to current surface expressions of the underground coal fire at the Site. Borehole locations for geotechnical drilling were selected based on the microgravity results (generally low gravity areas are associated with disturbed ground, i.e. rubble, void, ash, etc..), surface expression of the fire, and site geology; preliminary locations were revised as appropriate in light of drilling results.

Tetra Tech geologists logged the lithology encountered during drilling of each hole. Logged data includes depth, classifications, drilling rates, and observations/notes, as appropriate for the drilling methods. Borehole logs are included as **Appendix C**. Throughout drilling, surface and downhole air monitoring was performed to test for the presence of mine gases hydrogen sulfide (H_2S), carbon monoxide (CO), and lower explosive limit (LEL), as well as oxygen (O_2) percentage using a 4-gas monitor. Light odors and/or venting were observed during drilling from seven open boreholes, and downhole borehole temperatures were also monitored from the surface with an IR thermometer for the presence of mine fire during drilling, and an elevated borehole temperature above 100°F was observed in only two boreholes (MM-21 and MM-74, each 103°F) at time of drilling. Borehole emissions data are summarized in Section 2.33 and provided in **Table 5**. A downhole camera was used in select boreholes to confirm the lithology and nature of the fractured/void zones.

Monitoring wells were completed in five of the boreholes for evaluation of hydrogeologic conditions of the Site. Boreholes completed as monitoring wells are identified on **Figure 8,** and well completion data is provided in **Table 3.** A summary of well completion, well development activities, and Site hydrogeologic conditions is provided in Section 2.2.6.

In general, the stratigraphy at the Site comprises from top to bottom:

1) Hard sandstone and/or interbedded shale/sandstone at surface to between about 5 and 30ft bgs. In places the lower sandstone is altered to reddish tan clinker
2) Upper coal seam and/or rubble/void zones, from about 3 to 20 feet thick (Upper Coal Interval), likely the No. 3 coal seam; underlain by 5-to-10 feet of shale.
3) Coal, typically about 2-feet thick (2nd Coal Interval); underlain by underlain by 5-to-10 feet of shale.
4) Coal, typically about 2-feet thick (3rd Coal Interval); underlain by underlain by at least 30 feet of shale.

Three cross-section alignments, providing a graphical representation of the Site stratigraphy, are shown on **Figure 8**; Section Line A-A' (**Figure 9**), which provides a northeast-trending transect along the northwestern length of the Site; Section Line B-B' (**Figure 10**), which provides a southeast-trending transect in the southern AOI; and Section Line C-C' (**Figure 11**), which provides a southeast-trending transect in the northern AOI.

The Upper Coal Interval (i.e. No. 3 coal Seam) is characterized throughout the Site by intact coal, as well as by evidence of mining and/or mine fire, including voids, rubble, adjacent ash/clinker, and or downhole heat. Evidence of mining activity and or mine fire appears to be limited to the Upper Coal Interval and is not noted in the lower two coal seams at the Site. At the Site the upper coal seam generally dips about 3 to 10 degrees to the east-southeast, in the southern AOI, the elevation of Upper Coal Interval lies between about 5,552 and 5,565 ft amsl (MM-05 to MM-15, **Figure 9**) and then drops in elevation both to the northeast (~5,528 ft amsl at MM-42, **Figure 9**) and southeast (~5,515 ft amsl at MM-50MW, **Figure 10**). **Figure 12** shows depth to the base of coal or rubble contours.

The condition of the Upper Coal Interval varies throughout the Site, and can be broadly categorized as :

1) Intact coal with no evidence of mining and/or underground coal fire;
2) actively burning or smoldering, as indicated by elevated subsurface temperatures measured by installed thermocouple monitoring (see Section 2.3.2) or venting observed during drilling;
3) burned out with clinker/baked zones, rubble, and/or voids; and
4) mined area, indicated as zone with rubble but no adjacent clinker or baked rock.

As shown on **Figure 13**, these upper coal seam intervals occur in distinct zones spatially at the Site. In general, evidence of actively burning or smoldering coal in the upper coal interval is limited to two areas: one in the southern AOI and a second in the Trailhead parking lot area. At a third, smaller area approximately 300 feet northeast of the Trailhead parking lot, upper coal seam temperatures at 12 ft bgs in two boreholes (MM-31 and MM-57) are slightly elevated relative to that in surrounding boreholes and may also indicate some coal smoldering activity. These actively burning or smoldering upper coal intervals are sandwiched between are area to the northwest where the upper coal interval is intact and broad area to the southeast where the upper coal interval has burned out, with only clinker/baked zones, rubble, and/or voids remnants. In some boreholes to the southeast (i.e. MM-46, M-54, MM-55), rubble was encountered but there was no evidence of any clinker or baking, these rubble zones may be an artifact of mining activities. The Upper Coal Interval, or remnants thereof, was not encountered in the northeast corner of the northern AOI as the ground surface here is below the bottom elevation of the upper coal seam interval.

2.3.2 Thermocouple Installations

Type K thermocouples were installed in upper coal seam/rubble/clinker interval at 74 borehole locations within the upper coal seam/rubble/clinker interval. Additional thermocouples were installed in the 2nd coal seam in 5 of the 74 boreholes. The thermocouples were installed at or near the top of a coal seam/rubble/clinker interval by hanging the thermocouple wire in the open test hole and then grouting from the bottom of the test hole to just below the surface. Bentonite, cement, or bentonite-cement slurry grout was used for the bottom-up grouting. Thermocouple placement depths are provided in **Table 2** and are graphically shown in the borehole logs (**Appendix C**).

Table 4 provides a summary of borehole temperature readings from thermocouples associated with the upper coal seam. Upper coal seam temperatures collected on May 23 and 24, 2023 were used to develop a downhole temperature contour map of the site as illustrated on **Figure 14**. Across most of the Site borehole temperatures are relatively cool (less than 85°F). Higher temperatures (greater than 85°F), that indicate heat is being generated from coal beds, were encountered in the upper coal seam at only two locations at the Site (**Figure 14**): in the upper coal seam in borehole MM-22 immediately north of the Trailhead parking lot (21 ft bgs, max. 241°F) and towards the southern end of the AOI in MM-02 (15 ft bgs, max. 171°F). At a third area approximately 300 feet northeast of the Trailhead parking lot, upper coal seam temperatures at 12 ft bgs in two boreholes (MM-31 and MM-57) are slightly elevated relative to surrounding coal seam temperatures (81°F and 80°F, respectively) (**Figure 14**).

Temperature data is recorded continuously at 15 locations to evaluate long-term subsurface temperature conditions throughout the site. Data is recorded hourly using Lascar Electronics EL-USB-TC-LCD Thermocouple USB Data Loggers. Continuous temperature data from March 9, 2022, through May 24, 2023 is provided graphically in **Appendix D.** Data logging began on March 9, 2022 at eight locations in the Southern AOI and began at the five other locations throughout the Site as data loggers were installed.

2.3.3 Borehole Emissions

During drilling, venting was observed and/or gas emissions detected from four open boreholes in the southern portion of the Site (MM-01, MM-02, MM-17, and MM-18) and three boreholes just north of the Marshall Mesa Trailhead Parking Lot (MM-21, MM-72, and MM-74, **Figure 8**). Emissions and venting from boreholes in or near areas of elevated borehole temperatures (see Section 2.2.3). No other venting was observed, nor emissions detected, throughout the remainder of the Site. Borehole emissions were measured using a 4-gas monitor and temperature measured with infrared gun; observations and data recorded is provided in **Table 5**.

2.3.4 Test pits

Seven test pits were excavated at the site on April 12, 2023, and their locations are shown on **Figure 8**. Following inspection, each test pit was backfilled, and the area restored to original grade.

Test Pit #1

Located between test holes MM-02 and MM-11 and completed to a depth of 13. 5 ft bgs (**Appendix A, Photo 25**).

- 0.0 to 1.0 ft – topsoil
- 1.0 to 12.5 - Sandstone, tan, dry, hard (R2)
- Traces of heat alteration at 10 ft bgs in the southern part of the test pit.
- 12.5 to 13.0 - Shale, dark brown, organic, dry, hard
- No elevated temperatures or coal combustion odors observed.

Test Pit #2

Located east of MM-18 and completed to a depth of 11.0 ft bgs

- 0.0 to 0.5 ft – topsoil
- 0.5 to 11.0- Fractured Sandstone, tan, dry, traces of shale at 11 ft.
- Refusal at 11.0 ft bgs.
- No elevated temperatures or coal combustion odors observed.

Test Pit #3

Located at the southern end of the previous excavation area, east of MM-01. Total depth 11.5 ft bgs. (**Appendix A, Photo 26**).

- 0.0 to 6.0 ft – Fill, with traces of trash, brown, dry, easy digging.
- 6.0 to 10.0 – Fractured Sandstone, tan, dry, same as Test Pit 2.
- 10.0 to 11.5 – Fractured Sandstone, hints of red, heat altered rock, traces of clinker and ash.
- Temperature 100 F at bottom of test pit. This test pit is immediately northeast of MM-02 which has a temperature of 171 F during the test pit excavation. The heat observed in Test Pit # is likely associated with the smoldering coal area just to the west.

Test Pit #4

Located between test holes MM-37and MM-61 and completed to a depth of 11.0 ft bgs (**Appendix A, Photo 27**).

- 0.0 to 1.0 ft – topsoil
- 1.0 to 1.5 ft – coal waste
- 1.5 to 11.0 – Clinker, bright red heat altered sandstone, fractured, more intense heat alteration to the east.
- Refusal at 11.0. No heat or odors observed.

Test Pit #5

Located at the northeast corner of the "gravel piles" from previous OSM mitigation work, south of MM-39 (**Appendix A, Photo 28**).

- 0.0 to 0.5 ft – Gravel, loose, dry
- 0.5 to 8.5 – Fill, silty sand with chunks of sandstone, easy digging.
- 8.5 to 9.0 – Coal waste with chunks of clinker over organic shale, dark brown, wet, mine floor?
- 9.0 – Total depth.

Test Pit #6

Located west of Test Pit 5, between MM-40 and MM-35 (**Appendix A, Photo 29**).

- 0.0 to 0.5 ft – topsoil
- 0.5 to 1.5 – Coal waste.
- 1.5 to 2.0 - Shale, dark brown, organic, dry, hard
- 2.0 – Total depth.

Test Pit #7

Located between test holes MM-35 and MM-58 and completed to a depth of 13. 5 ft bgs (**Appendix A, Photo 30**).

- 0.0 to 0.5 ft – topsoil/clinker, waste rock
- 0.5 to 1.5 – Coal waste, boney coal transition to organic shale.
- 1.5 to 5.0 - Shale, dark brown, organic, dry, hard
- 5.0 – Shale, grey, dry, hard. Total depth.

The findings from the test pits were consistent with the conditions encountered during the drilling. In the southern portion of the investigation area, Test Pits 1, 2, and 3 further constrained the boundary between the burned-out areas, actively burning areas, and unburned coal. In the northern portion of the site Test Pit 4 encountered extensively heat altered and fractured conditions with no remaining coal. Test Pits 5, 6, and 7 encountered the bottom of the coal seam (possibly mine floor) and underlying shale.

2.3.5 Groundwater

Monitoring wells were installed at the Site to evaluate groundwater flow direction as well as to estimate hydraulic conductivity (K) for the aquifer at the Site. Monitoring wells were installed during drilling at boreholes MM-11MW, MM-39MW, MM-50MW, MM-60MW, and MM-62MW (**Figure 8**). Monitoring well completion data is provided in **Table 3** and graphically in the borehole logs (**Appendix C**).

Well development was completed on April 24 and 25, 2023 at five of the wells, MM-11MW, MM-39MW, MM-50MW, MM-60MW, and MM-62MW. The well development was performed using a combination of bailing and purging to clear the screens and remove excess sediments from base of the wells. Development removed greater than three times the static water volume in each well and water chemistry was monitored to document changes in turbidity, temperature, pH, and conductivity as water from the surrounding aquifer began moving freely through the piezometer screens.

Aquifer testing followed the development by greater than 24 hours to determine the effective permeability of the surrounding rock. Slug tests were administered on April 26, 2023, on monitoring wells MM-11MW, MM-39MW, MM-50MW, MM-60MW, and MM-62MW. Slug tests were also administered on April 26, 2023, at three piezometers at the Lewis Mine Fire Site located directly north of the Site across Marshall Road (**Figure 1**). Slug test observations were evaluated using the Bouwer-Rice straight line method to obtain an estimated Hydraulic Conductivity (K) for the aquifer at the Marshall and Lewis Mine Fire Sites. Mean conductivity estimated from combined slug test data from both mine fire sites was 0.73, which is representative of weathered sandstone and siltstone. Groundwater flow potentially occurs through open bedrock fractures at the site, which would likely result in hydraulic conductivities values orders of magnitude higher than those observed during the slug tests. The extent to which the aquifer test results reflects the contribution of any fractured flow is unknown.

Static water levels were obtained from Site wells on April 24 and 25, 2023. Water level data is provided in **Table 3**. Groundwater flow is generally northeast across the Site, as shown in the potentiometric contours in **Figure 15**.

3. Summary of Findings

Subsurface investigation findings indicate heat (>85°F) is being generated from the upper coal bed interval at two areas at the Site: one north of and under to the Trailhead Parking Lot and near the southern end of the southern AOI (**Figure 13**), with maximum borehole temperatures of each area of 241°F and 171°F, respectively. These areas of elevated temperatures correlate with the spatial extent of observed snowmelt, delineating the extent of anomalous heat, and minor dispersed surface venting and borehole gas emissions that are commonly associated with coal oxidation and/or low intensity combustion. A third area of upper coal bed temperatures that are slightly elevated relative to surrounding coal seam temperatures occurs approximately 300 feet northeast of the Trailhead Parking Lot at boreholes MM-33 and MM-57 (81°F and 82°F, respectively) (**Figure 14**).

The primary feature of the residual gravity field is a discontinuous set of NNE-trending negative residual (low) gravity anomalies (**Figure 7**). The most prominent of these low anomalies occur in the area with surface and subsurface coal burning within the southern AOI and extends through burned-out/clinker through to the area with surface and subsurface coal burning in the Trailhead parking lot area (**Figure 13**). Although some of this signal may arise from the sand and gravel fill used to level the lot, the anomaly extends beyond the parking lot, especially to the NNE and southeast, coinciding with the upper coal seam burning/smoldering/ash zone. Towards the northeast half of the northern AOI, low residual gravity anomalies appear to be mostly associated with burned/rubble zone of the upper coal interval; several roughly circular low-gravity anomalies occur within this area, these appear to coincide largely with surface subsidence features.

Throughout the Site, hard sandstone and and/or interbedded shale/sandstone is found from surface to between about 5 and 30 ft bgs and is underlain by the Upper Coal Interval (i.e. No. 3 coal Seam) which is typically about 3 to 20 feet thick underlain by 5-to-10 feet of shale. Underlying this shale are two thinner (~2 feet thick) coal seams (2nd and 3rd Coal Intervals) separated by 5 to 10 feet of shale, with the stratigraphic units slightly dipping the east-southeast.

Evidence of underground mining is suspected from the rubble zones of three boreholes (MM-46, MM-54, and MM-55, **Figure 13**) located in the eastern to southeastern portions of the investigation areas; more commonly in boreholes throughout the Site the upper coal interval is characterized as burned-out with clinker/baked zones, rubble, and/or voids (Burned/Rubblized, **Figure 13**). Many of surface depressions found at the Site, especially in the northern AOI, are associated with these subsurface burned-out zones. Northwest of the burned-out zone the upper coal seam lies largely intact coal with no evidence of mining and/or mine fire. (Intact Coal, **Figure 13**).

Evidence of the actively burning or smoldering coal within the upper coal interval is mainly limited to two areas on the Site: one in the southern AOI and in the Trailhead parking lot area (Burning/Smoldering/Ash Zone. **Figure 13**). In the southern AOI, maximum upper coal seam temperatures were measured at 171°F (**Figure 14**). In the Trailhead parking lot area, elevated upper coal seam temperatures up to 241°F (MM-22) occur in the northeast parking are that is closed to the public. (**Figure 14**). Venting was observed and/or gas emissions detected in several boreholes with the in areas of elevated subsurface temperatures including MW-01, MW-02, MW-17, and MW-18 (**Figure 8**) in the southern AOI and in MW-21, MW-72, and MW-74 (**Figure 8**) in the parking lot area (**Table 5**). These areas with evidence of active, subsurface coal burning or smoldering also generally coincide with surface expressions of coal burning, including typical snowmelt areas (**Figure 4**). Evidence of snowmelt also occurs 300 feet northeast of the Trailhead parking lot (**Figure 4**), upper coal seam temperatures in this area are slightly elevated (up to 80°F) relative to that in surrounding boreholes (**Figure 14**) and may also indicate some smoldering coal activity.

The findings from the test pits were consistent with the conditions encountered during the drilling. In the southern portion of the investigation area, Test Pits 1, 2, and 3 further constrained the boundary between the burned-out areas, actively burning areas, and unburned coal. In the northern portion of the site Test Pit 4 encountered extensively heat altered and fractured conditions with no remaining coal. Test Pits 5, 6, and 7 encountered the bottom of the coal seam (possibly mine floor) and underlying shale.

4. References

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.

TABLES

Table 1. Preliminary Surficial Gas and Temperature Readings

Feature	Temperature ˚F	GEM 500 Readings-January 14, 2022				
		CH_4	CO_2	O_2	H_2S	CO
		%	%	%	PPM	PPM
Ambient/Cal	33	0	0.1	20.9	0	0
MV1	33	0	0.1	20.9	0	0
MV2	35	0	0.5	20.7	0	0
MV3	36	0	0.8	20.4	0	0
MV4	36	0	0.1	20.9	0	0
MV5	35	0	0.3	21.0	0	0
MV6	32	0	0.1	21.3	0	0
MV7	32	0	0.1	21.4	0	0
MV8	30	0	0.1	21.4	0	0
MV9	28	0	0.1	21.0	0	0
MV10	40	0.1	12.9	8.5	0	218

NOTES:
CH4 =Methane, CO2 = Carbon Dioxide, O2 = Oxygen, H2S = hydrogen sulfide, CO carbon monoxide

Table 2. Borehole Data, Coal and Void Depths, and Thermocouple Placement Summary

Borehole ID	Date Drilled	Latitude	Longitude	Surface Elevation	Upper Coal/Void/ Rubble/ Clinker Interval		Total Depth	Water Level	Thermo-couple	Comments
					Top	Bottom	Depth(s)			
		NAD 1983		ft AMSL	ft bgs		ft bgs			
MM-01	2/24/2022	39.952100	-105.232100	5573.458	13.5	23.5	33.5	--	17	warm venting, emissions
MM-02	2/21/2022	39.951710	-105.232460	5579.232	17	24	24	--	15	warm venting, emissions
MM-03	2/21/2022	39.951440	-105.232710	5580.938	12.5	26.5	32	--	21.5	
MM-04	2/22/2022	39.951170	-105.232910	5587.139	20	31	35	--	23	MW installed
MM-05	2/23/2022	39.950940	-105.233030	5594.915	29	39	50	--	--	MW installed
MM-06	2/24/2022	39.951860	-105.232500	5576.411	11	22	25	--	12	
MM-07	2/24/2022	39.952060	-105.232260	5573.983	11	21.5	25	--	12	
MM-08	2/24/2022	39.952070	-105.231970	5570.505	22	28	49	--	24	MW installed
MM-09	2/24/2022	39.952247	-105.232140	5571.752	10	20	54	--	12, 29	
MM-10	4/3/2023	39.951519	-105.232817	5579.724	5	17	39	--	12	
MM-11MW	4/3/2023	39.951728	-105.232668	5579.068	7	17.5	44	--	7	MW installed
MM-12	4/3/2023	39.951970	-105.232506	5574.409	6	13	50	--	7, 27	
MM-13	4/3/2023	39.952233	-105.232317	5570.013	5	7.5	30	--	6	
MM-14	3/30/3023	39.952437	-105.232184	5568.832	4	7	40	--	17	
MM-15	3/30/2023	39.952516	-105.231955	5570.046	5	13	40	--	14, 22	
MM-16	3/30/2023	39.952262	-105.232019	5572.474	11	22	45	--	11	

NOTES:
Ft AMSL = Feet above mean sea level
Ft bgs =feet below ground surface
N/A = no thermocouple installed
MW = Monitoring well
-- indicates no data recorded

Table 2. Borehole Data, Coal and Void Depths, and Thermocouple Placement Summary (Continued)

Borehole ID	Date Drilled	Latitude	Longitude	Surface Elevation	Upper Coal/Void/ Rubble/ Clinker Interval		Total Depth	Water Level	Thermo-couple	Comments
					Top	Bottom	Depth(s)			
		NAD 1983		ft AMSL	ft bgs		ft bgs			
MM-17	4/5/2023	39.951711	-105.232276	5577.92	7	25.5	35	--	15	warm venting, emissions
MM-18	4/5/2023	39.951574	-105.232509	5579.167	4	25	35	--	12	warm venting, emissions
MM-19	4/5/2023	39.952190	-105.231651	5567.848	11	28	35	--	15	
MM-20	3/21/2023	39.952413	-105.231483	5567.454	14.5	27	35	--	10	
MM-21	3/8/2023	39.953023	-105.230961	5569.948	17	20	40	--	25	warm venting, emissions
MM-22	3/7/2023	39.953052	-105.231040	5569.357	17	28	40	--	21	
MM-23	3/7/2023	39.953090	-105.230922	5568.996	21	27	40	--	22	
MM-24	3/6/2023	39.953126	-105.230792	5568.635	21	27	50	--	22	
MM-25	3/7/2023	39.953149	-105.230996	5568.406	13	27	50	--	17	
MM-26	3/6/2023	39.953185	-105.230856	5568.143	18	23	45	--	20	
MM-27	3/6/2023	39.953196	-105.230812	5568.012	21	31	60	--	22	
MM-28	3/7/2023	39.953253	-105.230858	5567.454	4	28	50	--	20	
MM-29	3/9/2023	39.953644	-105.230413	5560.63	7	17	39	--	17	
MM-30	3/8/2023	39.953752	-105.230546	5553.117	9	11	44	40.8	11	
MM-31	3/9/2023	39.953751	-105.230452	5555.217	12	15	39	38.4	13	
MM-32	3/29/2023	39.953960	-105.230184	5551.476	7	10	40	--	11	

NOTES:
Ft AMSL = Feet above mean sea level
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N/A = no thermocouple installed
MW = Monitoring well
-- indicates no data recorded

Table 2. Borehole Data, Coal and Void Depths, and Thermocouple Placement Summary (Continued)

Borehole ID	Date Drilled	Latitude	Longitude	Surface Elevation	Upper Coal/Void/ Rubble/ Clinker Interval		Total Depth	Water Level	Thermo-couple	Comments
					Top	Bottom	Depth(s)			
		NAD 1983		ft AMSL	ft bgs		ft bgs			
MM-33	3/9/2023	39.953816	-105.230452	5555.479	5	12.5	40	39.4	13	
MM-34	3/13/2023	39.953802	-105.229818	5553.543	8	28	35	--	15	
MM-35	3/29/2023	39.954449	-105.229900	5541.175	10.5	12	30	--	17	
MM-36	3/13/2023	39.954182	-105.229078	5540.584	14.5	28	35	--	20	
MM-37	3/15/2023	39.954642	-105.229030	5547.671	6	28	34	--	17	
MM-38	3/13/2023	39.954310	-105.228513	5533.268	7	9	45	--	30	
MM-39MW	3/15/2023	39.954960	-105.229291	5547.539	11	14	79	--	12	MW installed
MM-40	3/29/2023	39.955275	-105.229510	5528.314	N/A	N/A	50	--	20	
MM-41	3/29/2023	39.955515	-105.229240	5525.394	N/A	N/A	50	--	20	
MM-42	3/15/2023	39.955295	-105.228450	5542.651	12	26	34	--	16	
MM-43	3/15/2023	39.955071	-105.228070	5537.5	14.5	19.5	40	--	25	
MM-44	3/13/2023	39.954648	-105.227913	5527.592	N/A	N/A	40	--	30	
MM-45	4/5/2023	39.952744	-105.231467	5569.357	7	25	30	--	10	
MM-46	3/27/2023	39.953251	-105.229208	5538.189	35	47	50	--	33	
MM-47	3/22/2023	39.953394	-105.229853	5555.118	19.5	37	55	--	38	
MM-48	3/22/2023	39.953011	-105.230279	5563.025	11	15	55	--	40	

NOTES:
Ft AMSL = Feet above mean sea level
Ft bgs =feet below ground surface
N/A = no thermocouple installed
MW = Monitoring well
-- indicates no data recorded

Table 2. Borehole Data, Coal and Void Depths, and Thermocouple Placement Summary (Continued)

Borehole ID	Date Drilled	Latitude	Longitude	Surface Elevation	Upper Coal/Void/ Rubble/ Clinker Interval		Total Depth	Water Level	Thermo-couple	Comments
					Top	Bottom	Depth(s)			
		NAD 1983		ft AMSL	ft bgs		ft bgs			
MM-49	3/24/2023	39.952585	-105.230029	5546.982	29.5	47	50	--	40	
MM-50MW	3/21/2023	39.951828	-105.230854	5554.528	19.5	47	80	--	N/A	MW installed
MM-51	3/17/2023	39.952634	-105.230966	5573.064	22	23.5	65	--	26, 42	
MM-52	3/20/2023	39.952168	-105.231196	5565.223	38.5	42	60	--	38	
MM-53	3/20/2023	39.952010	-105.231021	5563.386	24.5	41	45	--	26	
MM-54	3/20/2023	39.951695	-105.231721	5577.1	12	14.5	55	--	35	
MM-55	4/5/2023	39.951464	-105.232056	5582.644	13.5	14.5	55	--	25	
MM-56	3/7/2023	39.953037	-105.231142	5568.996	15	26	40	--	16	
MM-57	3/8/2023	39.953813	-105.230327	5556.135	17	18	50	48.2	12, 23, 29	
MM-58	3/9/2023	39.953886	-105.230294	5553.871	8	13	40	--	10	
MM-59	3/8/2023	39.953709	-105.230381	5557.579	20	21	44	43.5	20	
MM-60MW	3/13/2023	39.954506	-105.227576	5525.00	37.5	49.5	65	--	N/A	MW installed
MM-61	3/15/2023	39.954747	-105.229148	5548.294	7	24	29	--	12	
MM-62MW	3/30/2023	39.953148	-105.231167	5567.848	10.5	21.5	44.5	--	11	MW installed
MM-63	3/27/2023	39.952825	-105.230916	5569.488	16	22	44.5	--	26	
MM-64	3/22/2023	39.952882	-105.231517	5569.423	7	19	19.5	--	10	

NOTES:
Ft AMSL = Feet above mean sea level
Ft bgs =feet below ground surface
N/A = no thermocouple installed
MW = Monitoring well
-- indicates no data recorded

Table 2. Borehole Data, Coal and Void Depths, and Thermocouple Placement Summary (Continued)

Borehole ID	Date Drilled	Latitude	Longitude	Surface Elevation	Upper Coal/Void/ Rubble/ Clinker Interval		Total Depth	Water Level	Thermo-couple	Comments
				NAVD88	Top	Bottom	Depth(s)			
		NAD 1983		ft AMSL	ft bgs		ft bgs			
MM-65	3/17/2023	39.952721	-105.231202	5569.783	10	33	44.5	--	14	
MM-66	3/28/2023	39.952664	-105.231683	5568.865	4	17	19.5	--	8	
MM-67	3/22/2023	39.952854	-105.231759	5570.112	4.5	7.5	34.5	--	22	
MM-68	3/23/2023	39.952626	-105.231873	5570.571	5	13.5	14.5	--	5	
MM-69	3/24/2023	39.952522	-105.231506	5564.895	12	24.5	29.5	--	14	
MM-70	3/23/2023	39.952979	-105.231452	5569.915	9	18	19.5	--	9	
MM-71	3/23/2023	39.952897	-105.231160	5569.652	9.5	30.5	34.5	--	20	
MM-72	3/23/2023	39.952954	-105.231030	5570.112	15	35	39.5	--	22	warm venting, emissions
MM-73	3/23/2023	39.953034	-105.231276	5569.357	10	22.5	24.5	--	10	
MM-74	3/23/2023	39.952993	-105.230754	5568.996	17	20	40	--	25	warm venting, emissions
MM-75	3/23/2023	39.953152	-105.230661	5568.57	21	27	50	--	22	
MM-76	3/23/2023	39.953345	-105.230774	5567.356	27	28	50	--	20	

NOTES:
Ft AMSL = Feet above mean sea level
Ft bgs =feet below ground surface
N/A = no thermocouple installed
MW = Monitoring well
-- indicates no data recorded

Table 3. Monitoring Well Completion Summary

Borehole ID	Total Depth (ft bgs)	Borehole Diameter (in)	Well Diameter (in)	Screen Interval (ft bgs)	Filter Pack Interval (ft bgs)	Depth to Water (ft TOC)	Groundwater Elevation (ft amsl)	Water Level Measurement Date
MM-11MW	44	5.5	2	13-43	13-43	33.30	5545.8	4/25/2023
MM-39MW	79	5.5	2	48-78	46-78	53.87	5493.7	4/24/2023
MM-50MW	79.5	5.5	2	49-79	47-79	46.12	5508.4	4/25/2023
MM-60MW	64.5	5.5	2	34-64	32-64	47.17	5477.8	4/25/2023
MM-62MW	44.5	5.5	2	14-44	12-44	37.16	5530.7	4/24/2023

NOTES:
Ft bgs = feet below ground surface
In. = inches
Ft TOC = feet below top of casing
Ft amsl = feet above mean sea level

Table 4. Upper Coal Seam Borehole Temperature Readings

Borehole	Thermocouple Depth (ft bgs)	Temperature Readings (˚F)						
		3/23/2023	5/4/2023	5/5/2023	5/17/2023	5/23/2023	5/24/2023	5/26/2023
MM-01	7	104	--	--	--	--	--	--
MM-02	15	174	--	--	--	171	--	--
MM-03	21.5	60	--	--	--	60	--	--
MM-04	23	59	--	--	--	--	64	--
MM-05	27	56	--	--	--	--	58	--
MM-06	12	--	--	--	--	86	--	--
MM-07	12	59	--	--	--	63	--	--
MM-08	24	67	--	--	--	--	--	68
MM-09	12	59	--	--	--	75	--	67
MM-10	12	--	--	65	--	55	--	--
MM-12	7	--	--	52	56	55	--	--
MM-13	6	--	--	57	59	60	--	--
MM-14	17	--	--	61	65	60	--	--
MM-15	14	--	--	60	66	63	--	--
MM-16	11	--	--			81	--	--
MM-17	15	--	79	87	90	86	--	--
MM-18	12	--	90	90	91	91	--	--
MM-19	15	--	--	--	--	56	--	--
MM-20	10	--	--	--	--	53	--	--
MM-21	25	110	--	112	110	110	--	--
MM-22	21	216	--	--	--	241	--	--
MM-23	22	107	--	--	112	112	--	--
MM-24	22	82	--	--	82	88	--	--
MM-25	17	81	--	--	87	88	--	--
MM-26	20	97	--	--	--	78	--	--
MM-27	22	66	--	--	--	77	--	--
MM-28	20	65	--	--	--	67	--	--
MM-29	17	66	62	--	--	--	--	--
MM-30	11	68	66	--	64	--	61	--
MM-31	13	67	66	--	68	--	64	--
MM-32	11	NA	66	--	68	--	65	--
MM-33	13	91	88	--	73	--	81	--
MM-34	15	49	53	--	58	--	59	--
MM-35	17	--	53	--	65	--	59	--

Note: -- indicates no data recorded

Table 4. Upper Coal Seam Borehole Temperature Readings (Continued)

Borehole	Thermocouple Depth (ft bgs)	Temperature Readings (˚F)						
		3/23/2023	5/4/2023	5/5/2023	5/17/2023	5/23/2023	5/24/2023	5/26/2023
MM-36	20	53	58	--	68	--	66	--
MM-37	17	54	53	--	63	--	54	--
MM-38	30	57	58	--	72	--	67	--
MM-39	12	50	--	--	60	--	55	--
MM-40	20	--	--	--	--	--	54	--
MM-41	20	--	--	--	--	--	55	--
MM-42	16	53	53	--	--	--	61	--
MM-43	25	54	58	--	--	--	64	--
MM-44	30	56	61	--	--	--	68	--
MM-45	10	--	--	51	57	--	--	--
MM-46	33	--	60	--	--	--	71	--
MM-47	38	--	61	--	--	--	--	--
MM-48	40	--	61	--	--	--	69	--
MM-49	40	--	57	--	--	--	65	--
MM-51	26	54	--	--	--	55	84	--
MM-52	38	--	--	--	N/A	65	--	--
MM-53	26	--	--	--	N/A	67	--	--
MM-54	35	--	--	51	75	51	--	--
MM-55	25	--	--	--	N/A	59	--	--
MM-56	16	97	--	--	106	101	--	--
MM-57	12	84	86	--	78	76	80	--
MM-58	10	80	74	--	72	70	--	--
MM-59	20	71	71	--	69	65	67	--
MM-61	12	54	56	--	--	--	54	--
MM-62	11	44	--	--	--	--	--	--
MM-63	26	62	--	--	82	81	--	83
MM-64	10	73	--	55	58	56	--	--
MM-65	14	49	--	68	--	65	--	65
MM-66	8	59	--	51	56	60	--	--
MM-67	22	52	--	57	--	59	--	--
MM-68	5	--	--	53	58	60	--	--
MM-69	14	--	56		61	55	--	--
MM-70	9	--	--	50	56	50	--	--

Note: -- indicates no data recorded

Table 4. Upper Coal Seam Borehole Temperature Readings (Continued)

Borehole	Thermocouple Depth (ft bgs)	Temperature Readings (˚F)						
		3/23/2023	5/4/2023	5/5/2023	5/17/2023	5/23/2023	5/24/2023	5/26/2023
MM-71	20	--	--	72	77	75	--	--
MM-72	22	--	--	81	--	71	--	--
MM-73	10	--	--	60	66	64		--
MM-74	25	--	65	--	58	64	63	--
MM-75	22	--	60	--	63		59	--
MM-76	20	--	57	--	65	66	57	--

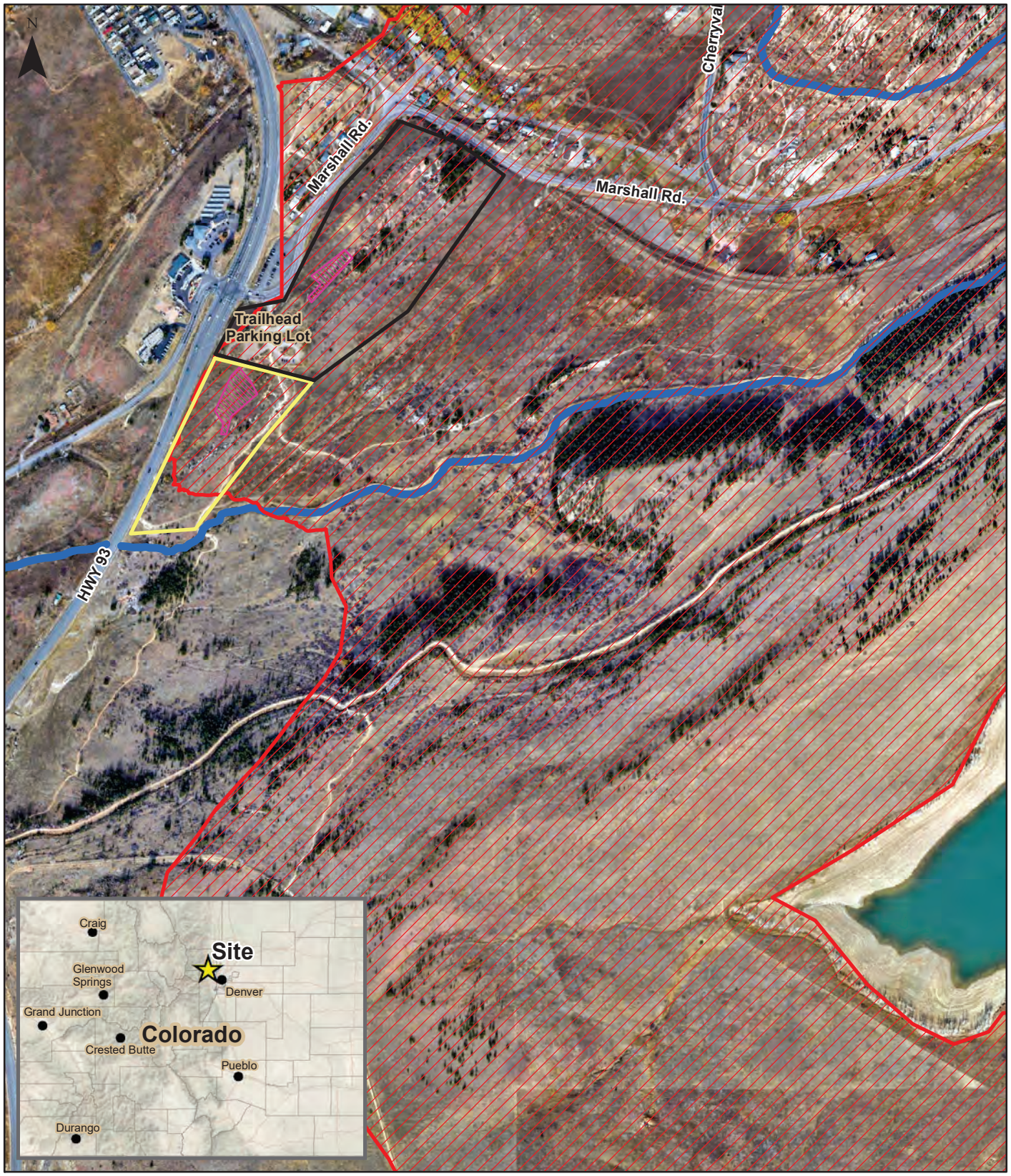
NOTES: -- indicates no data recorded

Table 5. Borehole Emissions Data

Feature	Date	LEL	O_2	H_2S	CO	Comments
		%	%	PPM	PPM	
MM-01	2/24/2022	--	--	--	1700	warm venting
MM-02	2/21/2022	--	18.8	--	53	89°F venting
MM-17	4/5/2023	--	--	--	--	warm venting
MM-18	4/5/2023	--	--	2.2	450	warm venting
MM-21	3/8/2023	--	--	5.3	300	103°F venting
MM-72	3/3/2023	--	--	--	--	Light venting, musty odor, low O2, trace H2S
MM-74	3/23/23	--	--	5.3	300	103°F venting

Notes:
-- indicates no data recorded
LEL= Lower Explosive Limit, O2 = Oxygen, H2S = hydrogen sulfide, CO carbon monoxide

FIGURES



\\tt.local\gfs\USVolume4\Legacy\tts134fs1\ECA\GEOSUP\VOL1\PROJECTS\DATA\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\ROI 1 Marshall Mesa Site Location v2.mxd July 2023: christina.coulter

Legend

- Northern AOI
- Southern AOI
- Marshall Wildfire Impacted Area
- 2017 Mitigation Area

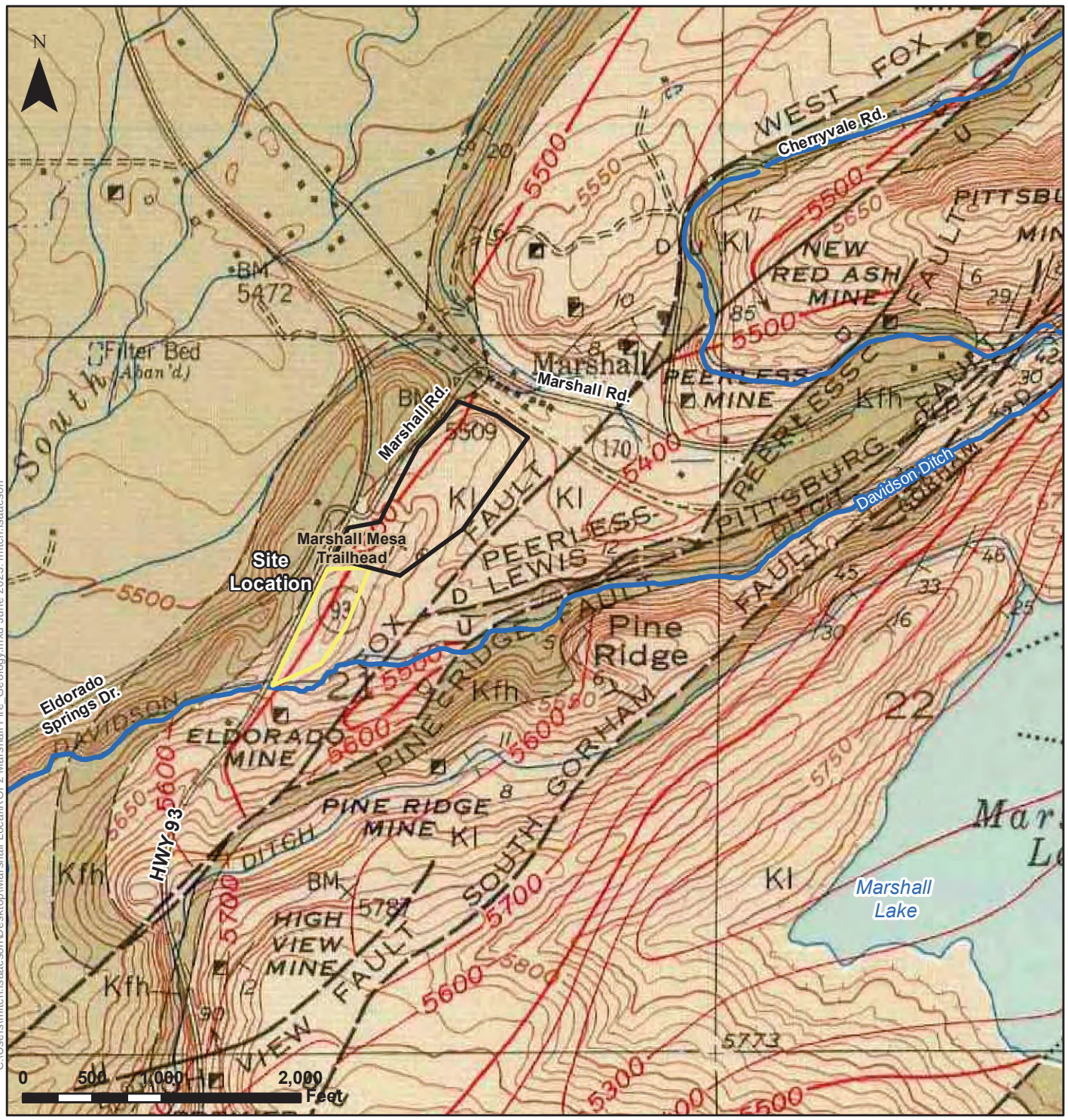
0 250 500 1,000 Feet

Notes:
- Coordinate System: NAD 1983 UTM Zone 13N
- Projection: Transverse MercatorNorth American 1983
- World Imagery Basemap from ESRI, June 15, 2021

TITLE: **Underground Coal Fire Investigation Site Location Map**

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN	FIGURE
DRAFTED	MRI, CEC	1
PROJECT#	114-910499	
DATE	03/16/2022	



C:\Users\mitch.isaacson\Desktop\Marshall Local\ROI 2 Marshall Fire Geology.mxd June 2023: mitch.isaacson

Legend

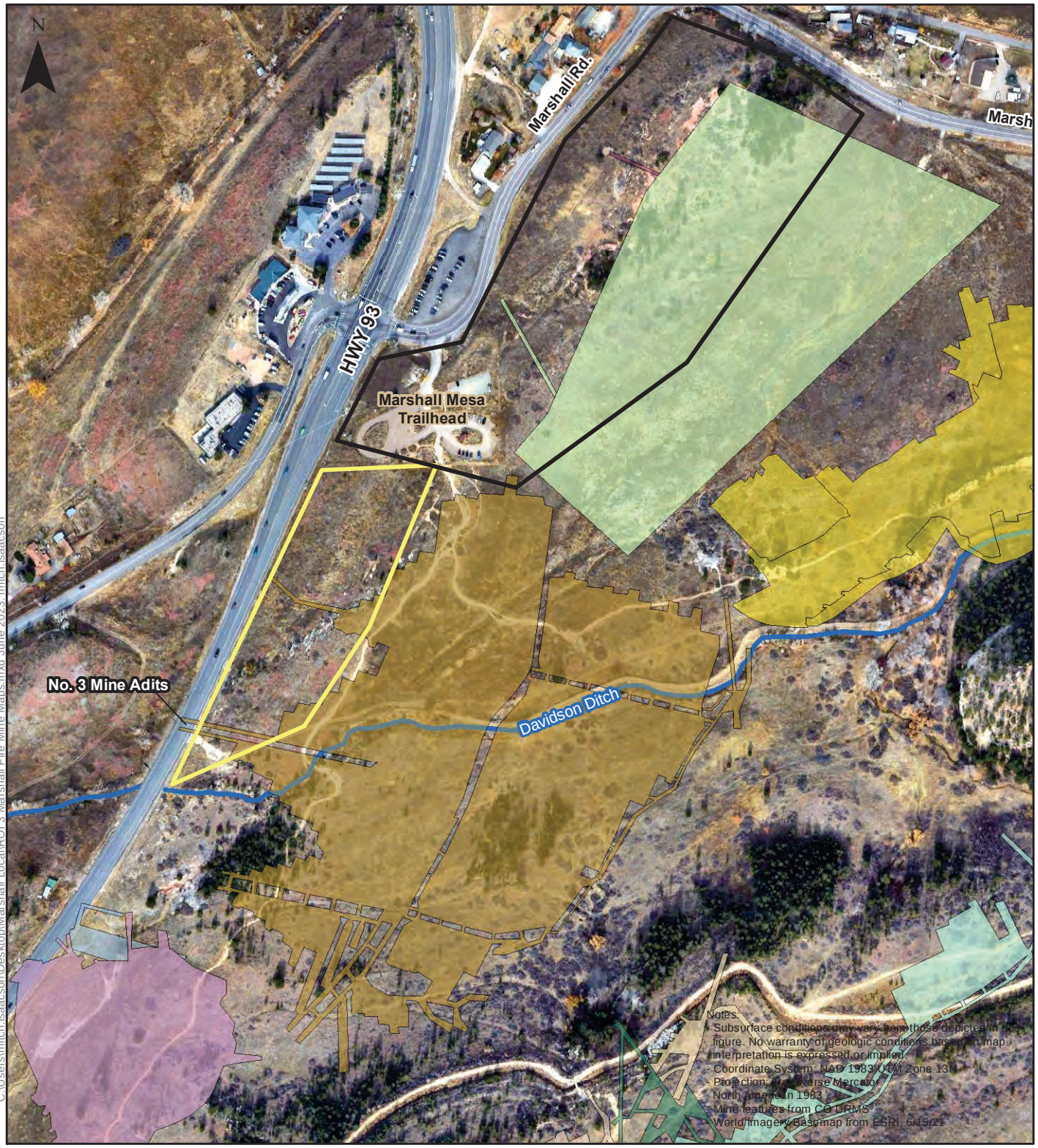
- Northern AOI
- Southern AOI
- Kl — Laramie formation
- Kfh — Fox Hills Sandstone
- Kp — Pierre shale
- 60 — Strike and dip of beds
- 64 — Strike and dip of overturned beds
- Mine Shaft
- Sand, gravel, or clay pit
- 5500 — Structure contour *(top of the Fox Hills Sandstone) Contour Interval 100 ft*
- Contact (dashed where approx., dotted where concealed)
- High-angle fault, showing dip *(dashed where approx, dotted where concealed. U, upthrown side; D, downthrown side)*
- Doubtful or probable fault

Note:
Geologic Map from: Spencer, F. D., 1961, Bedrock geology of the Louisville quadrangle, Colorado, USGS Publications Warehouse, 10.3133/gq151, https://pubs.er.usgs.gov/publication/gq151

TITLE: **Underground Coal Fire Investigation Geologic Map**

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN	FIGURE 2
DRAFTED	CEC MRI	
PROJECT#	117-8295005	
DATE	06/28/2023	



C:\Users\mitch.isaacson\Desktop\Marshall Local\ROI 3 Marshall Fire Mine Maps.mxd June 2023; mitch.isaacson

Legend

Northern AOI

Southern AOI

Marshall Mine Workings (CO DRMS)

- Big Tom Mine
- Black Diamond
- Eldorado 1939
- Kitchen Slope
- Lewis No 1 and No 2
- Marshall No 1
- Marshall No 3
- Marshall No 5
- Marshall No 7
- Pine Cliff 1940

0 250 500 Feet

TITLE: **Underground Coal Mine Fire Investigation Historic Mine Workings**

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN
DRAFTED	CEC, MRI
PROJECT#	117-8295005
DATE	06/29/2023

FIGURE 3

\\tt.local\gis\USVolume4Legacy\tts134fs1\ECA\GEOSUPVOL1\PROJECTS\DATA\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\ROI 4 Marshall Site Investigation Map2.mxd July 2023: christina.coulter

Legend

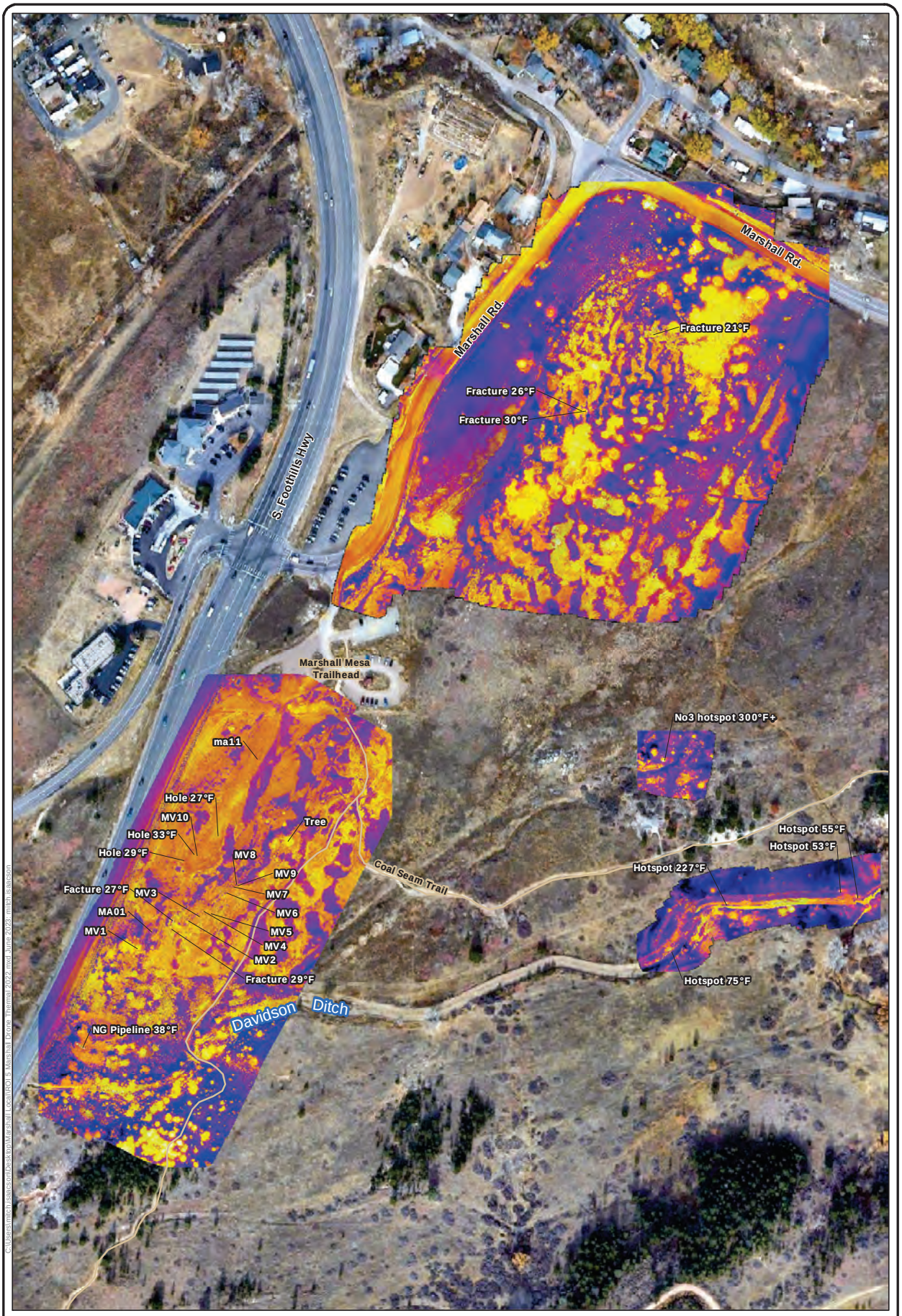
- Borehole Locations
- Southern AOI
- Gas and Temperature Readings (01/14/2022)
- Typical Snowmelt
- Additional Snowmelt Areas
- Marshall Wildfire Impacted Area

TITLE: **Underground Coal Fire Investigation 2022 Preliminary Site Investigation- Locations and Features**

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN
DRAFTED	CEC
PROJECT#	114-910499
DATE	07/19/2023

FIGURE 4



N

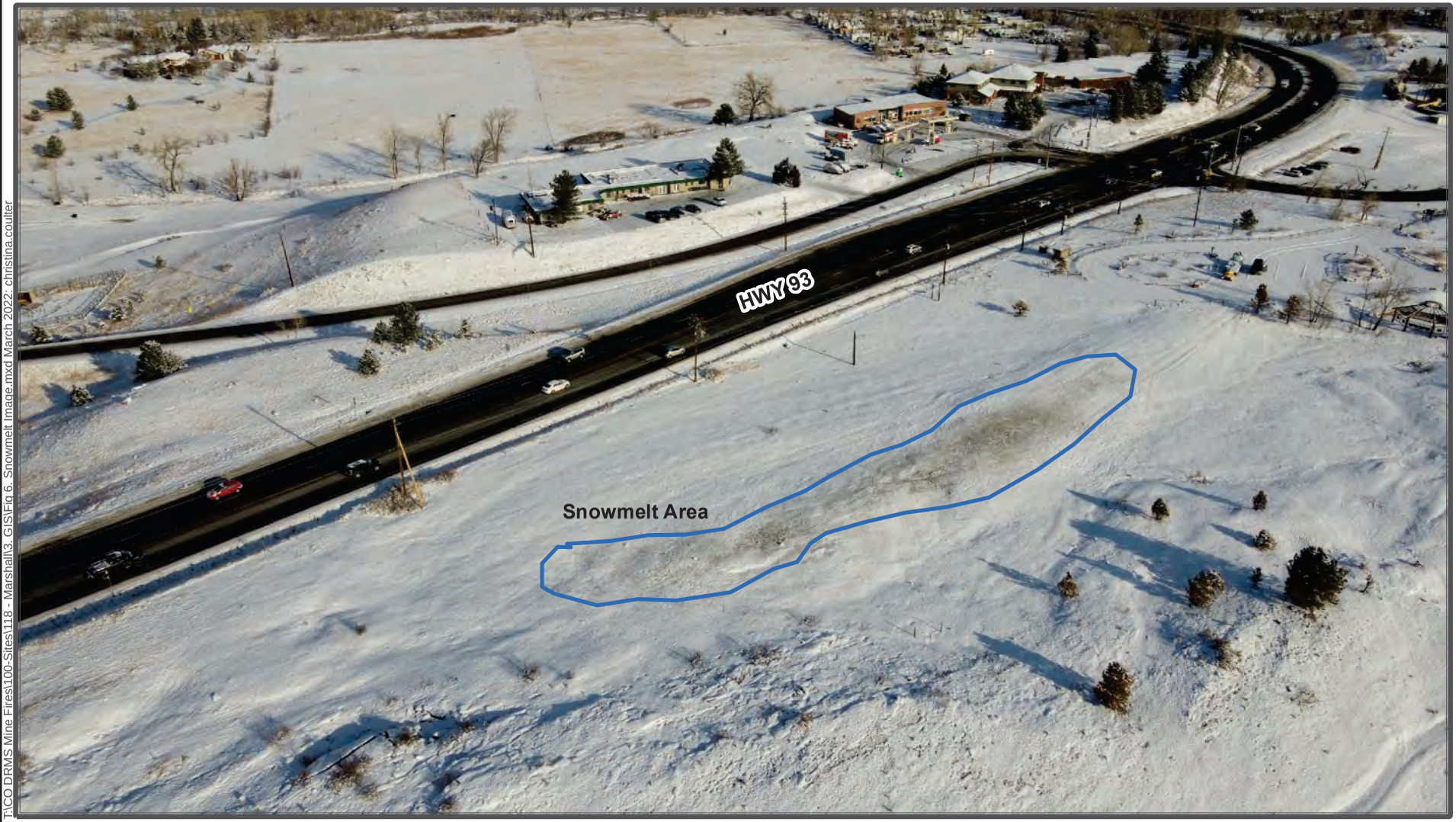
0 50 100 200 Feet

Notes:
- Aerial Imagery: July 2022 Tt UAV Imagery
- Coordinate System: NAD 1983 2011 UTM Zone 13N
- Projection: Transverse Mercator NAD 1983 2011
- Faults, geologic, and site features from CO DRMS

TITLE: **Underground Coal Mine Fire Investigation**
January 2022 UAV Thermal Imagery

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN	FIGURE
DRAFTED	MRI	5
PROJECT#	117-8295005	
DATE	6/29/2023	



T:\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\Fig 6. Snowmelt Image.mxd March 2022: christina.coulter

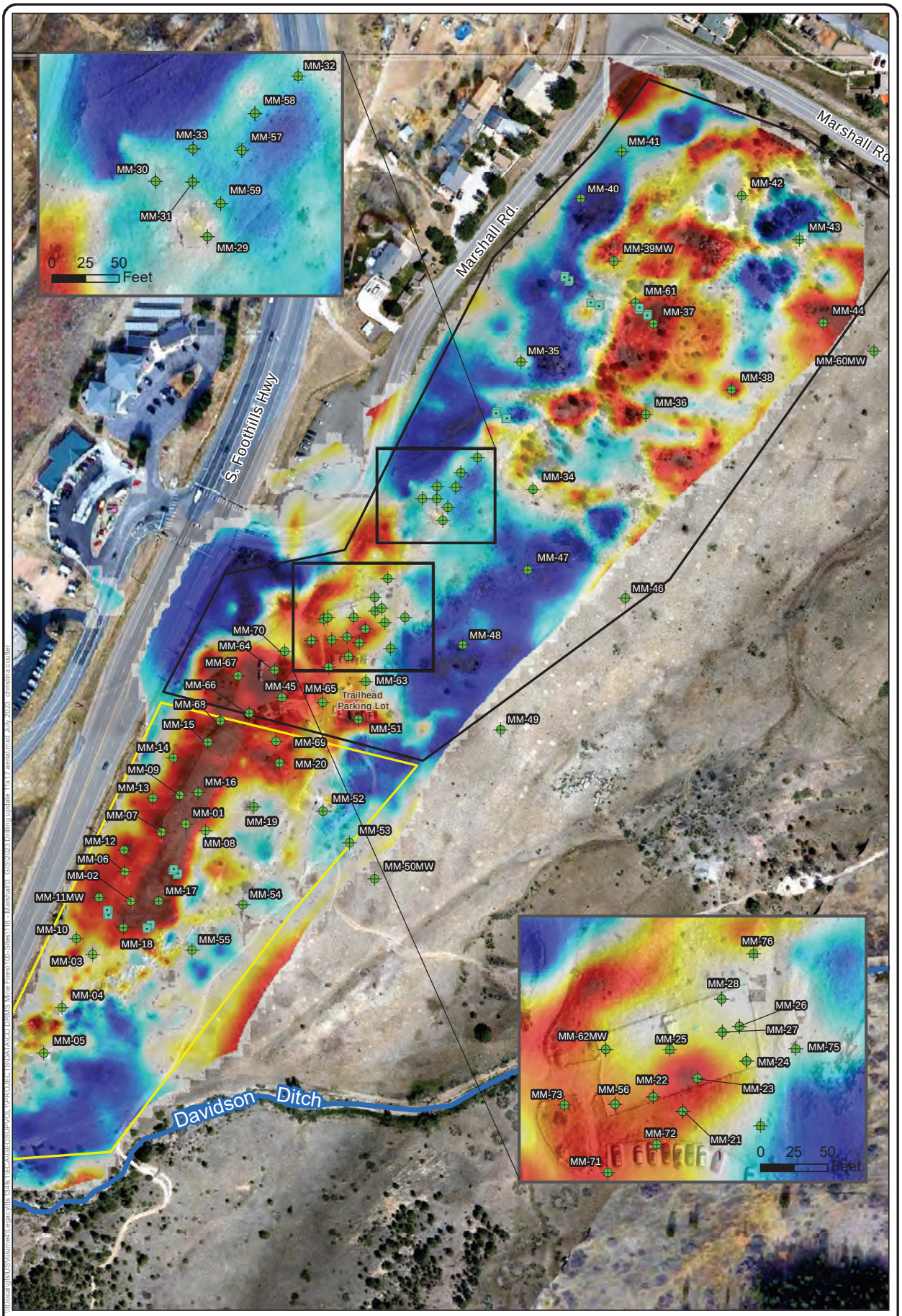
Notes:
- View to the northwest
- Photo taken by Tetra Tech on 3/10/2022

TITLE: **Underground Coal Mine Fire Investigation Aerial Imagery of Snowmelt from March 10, 2022**

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN
DRAFTED	CEC MRI
PROJECT#	117-8295005
DATE	06/27/2023

FIGURE 6



Legend

- Asbuilt Boring Location
- Asbuilt Test Pit Location
- Northern AOI
- Southern AOI
- Davidson Ditch

mGal: 0.04, 0.02, 0, -0.02, -0.04

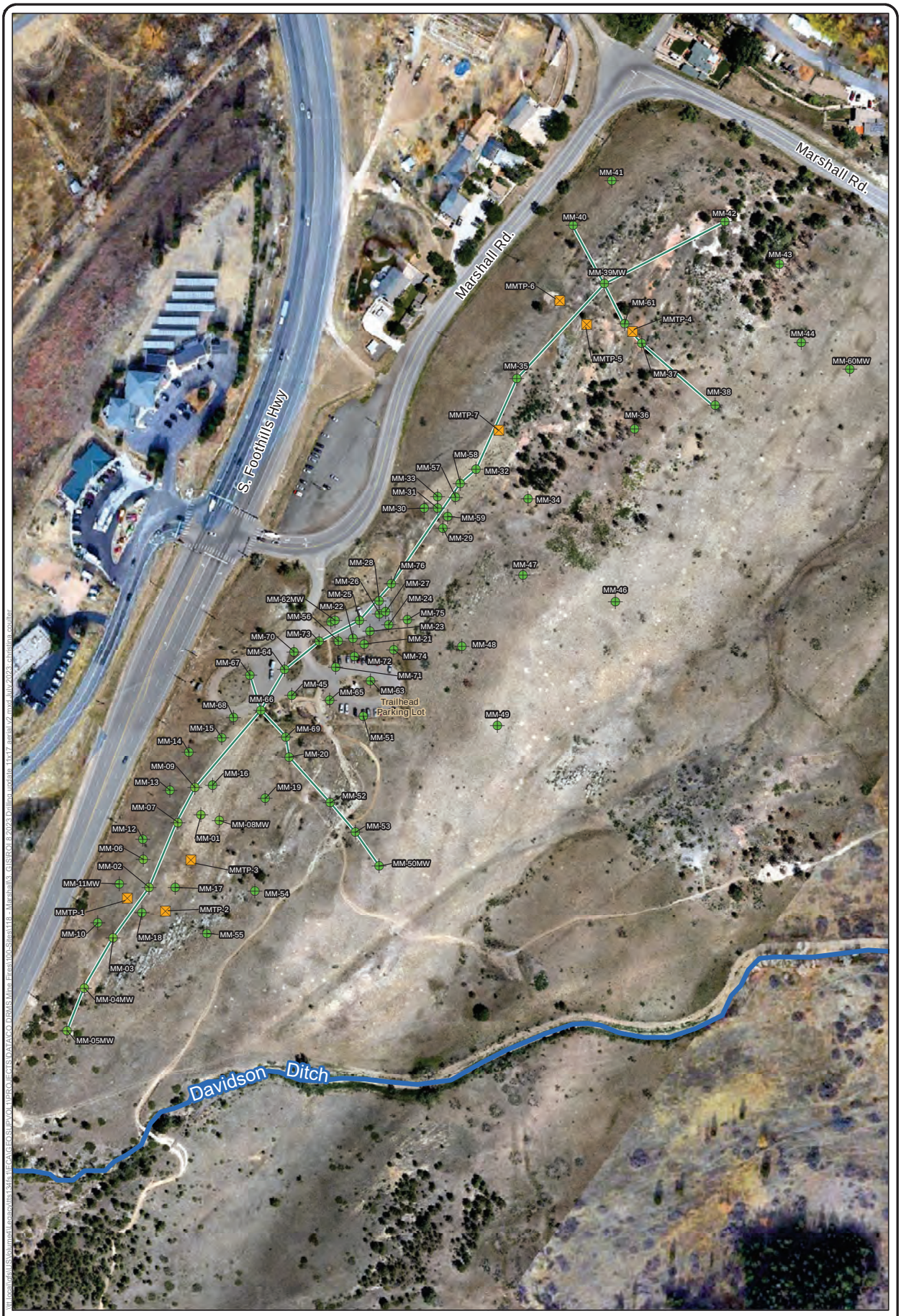
Notes:
- Aerial Imagery: July 2022 Tt UAV Imagery
- Coordinate System: NAD 1983 UTM Zone 13N
- Projection: Transverse MercatorNorth American 1983
- Faults, geologic, and site features from CO DRMS

TITLE: **Underground Coal Mine Fire Investigation**
2022 Residual Gravity Survey Results

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN
DRAFTED	MRI
PROJECT#	117-8295005
DATE	07/19/2023

FIGURE 7



Legend

- Asbuilt Boring Location (MM-05)
- Asbuilt Test Pit Location
- Davidson Ditch
- Cross Section Lines

N

0 50 100 200 Feet

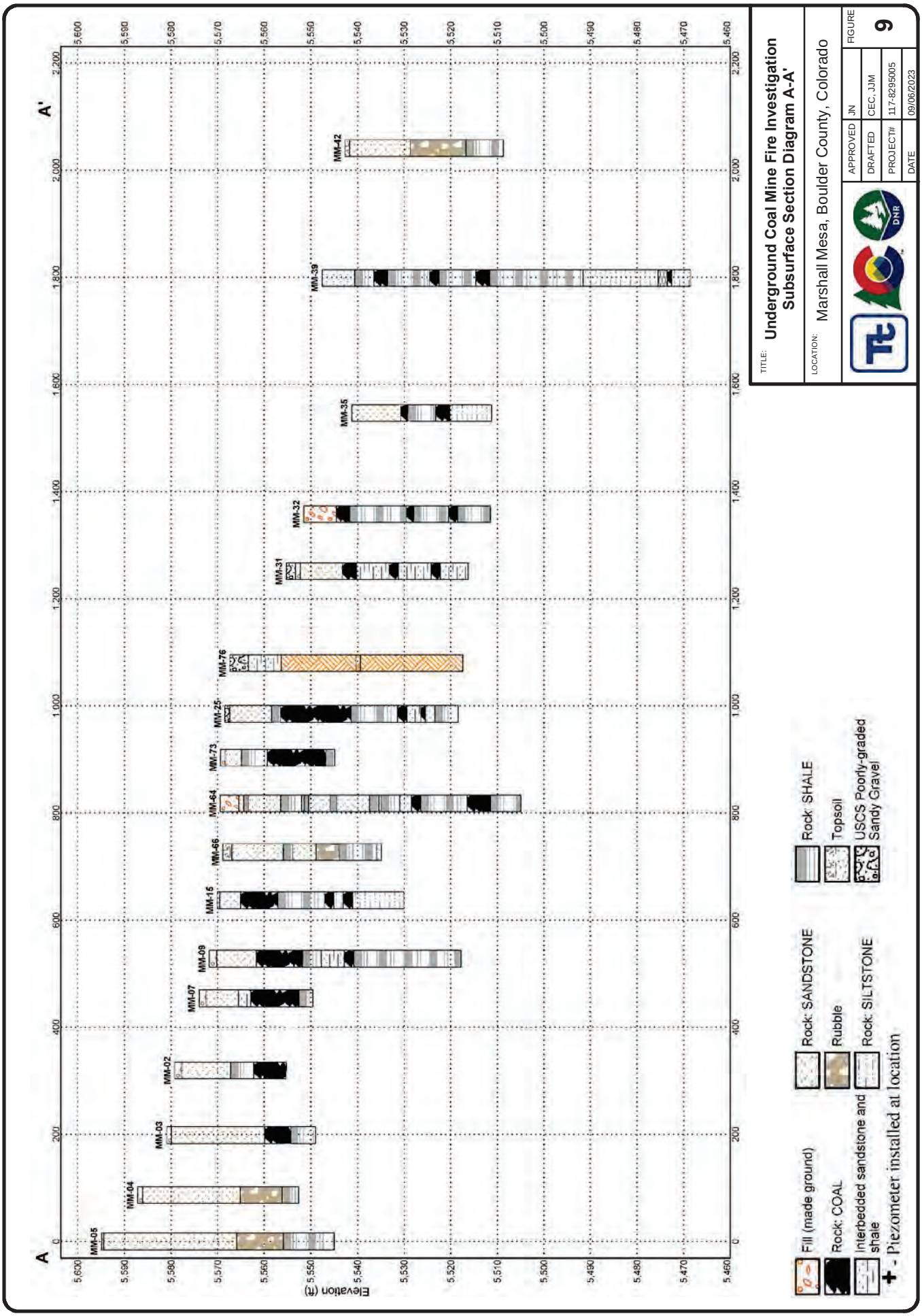
Notes:
- Aerial Imagery: July 2022 Tt UAV Imagery
- Coordinate System: NAD 1983 2011 UTM Zone 13N
- Projection: Transverse MercatorNAD 1983 2011
- Faults, geologic, and site features from CO DRMS

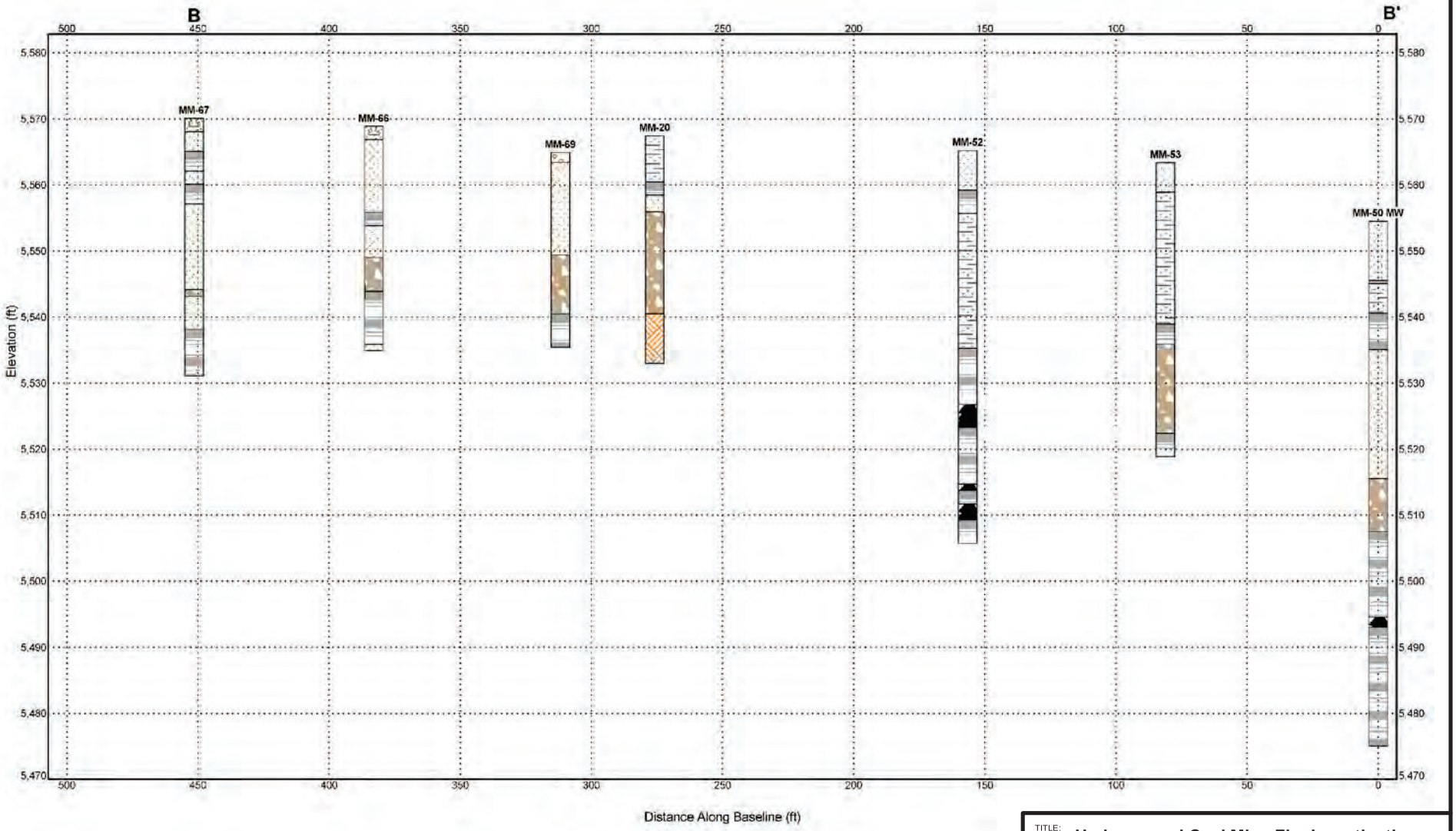
TITLE: Underground Coal Mine Fire Investigation
As-built Borehole and Test Pit Location

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN
DRAFTED	MRI, CEC
PROJECT#	117-8295005
DATE	07/27/2023

FIGURE 8


A
A'
Elevation (ft)
MM-05
MM-04
MM-03
MM-02
MM-07
MM-09
MM-15
MM-66
MM-64
MM-73
MM-25
MM-76
MM-31
MM-32
MM-35
MM-39
MM-42
Fill (made ground)
Rock: COAL
Interbedded sandstone and shale
Rock: SANDSTONE
Rubble
Rock: SILTSTONE
Rock: SHALE
Topsoil
USCS Poorly-graded Sandy Gravel
+ - Piezometer installed at location
TITLE:
Underground Coal Mine Fire Investigation
Subsurface Section Diagram A-A'
LOCATION:
Marshall Mesa, Boulder County, Colorado
APPROVED JN
DRAFTED CEC, JJM
PROJECT# 117-8295005
DATE 09/06/2023
FIGURE
9

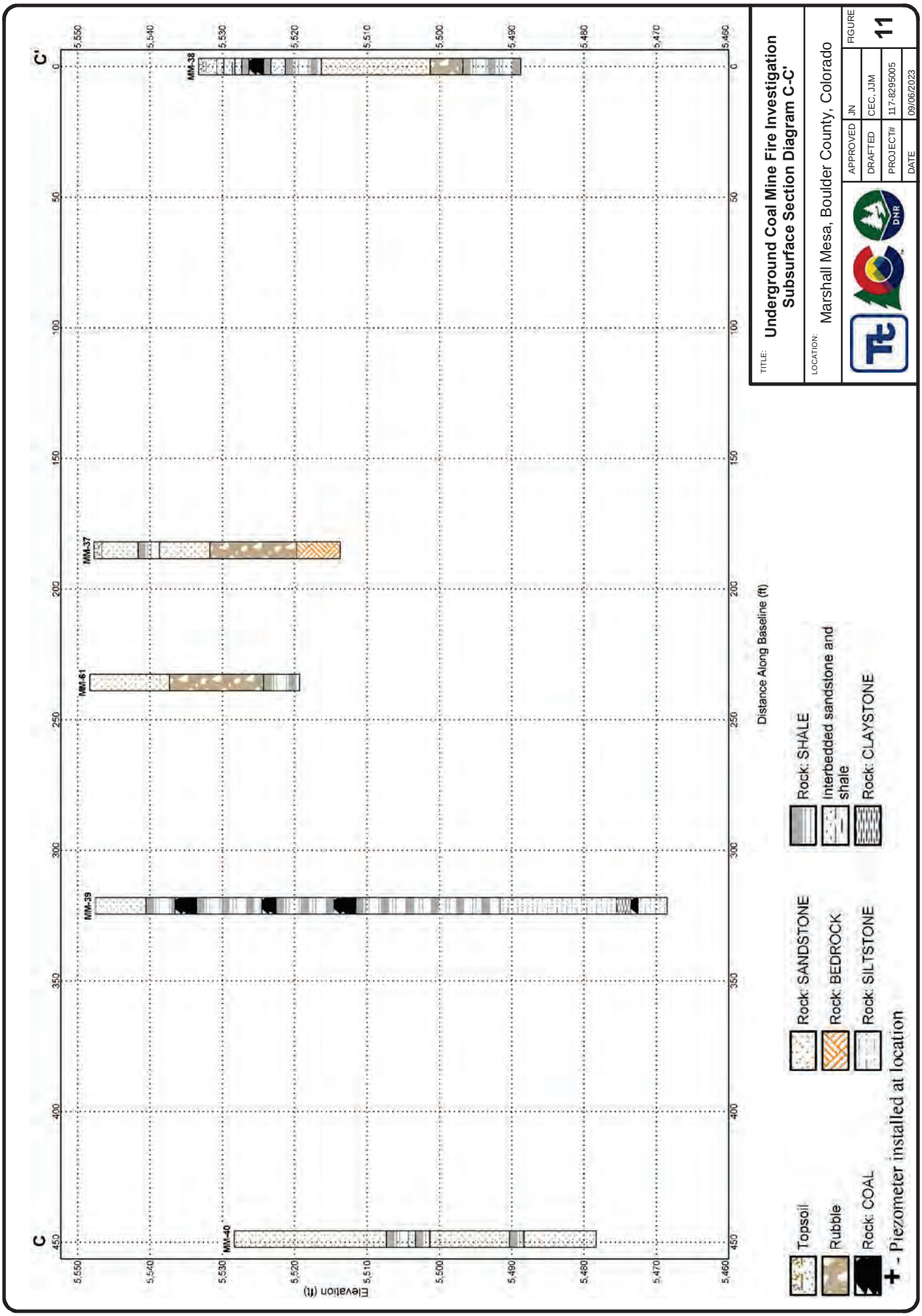


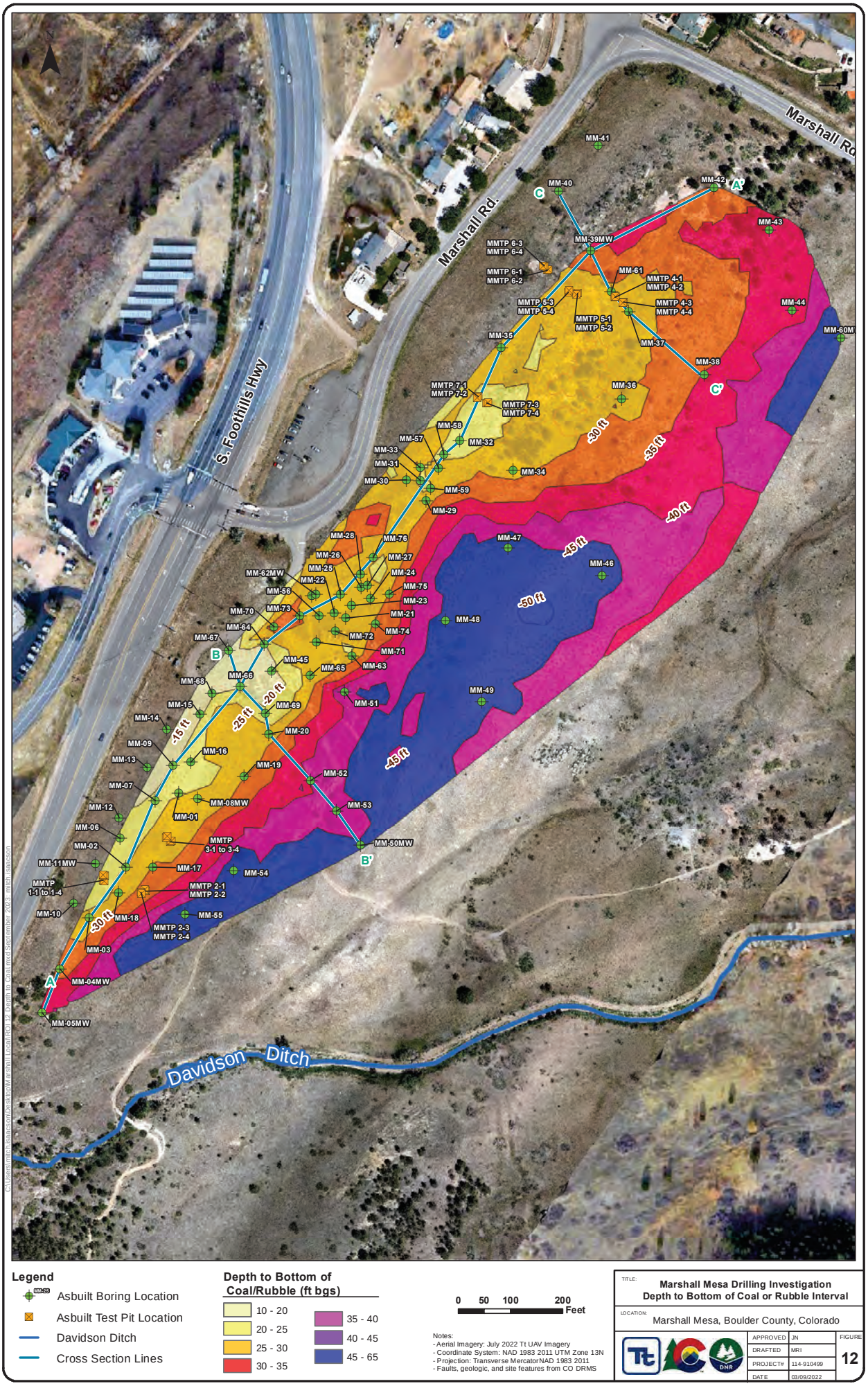
TITLE: **Underground Coal Mine Fire Investigation Subsurface Section Diagram B-B'**

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN
DRAFTED	CEC, JJM
PROJECT#	117-8295005
DATE	09/06/2023

FIGURE 10


C
C'
MM-38
MM-37
MM-61
MM-39
MM-40
5,550
5,540
5,530
5,520
5,510
5,500
5,490
5,480
5,470
5,460
0
50
100
150
200
250
300
350
400
450
Elevation (ft)
Distance Along Baseline (ft)
Topsoil
Rubble
Rock: COAL
Rock: SANDSTONE
Rock: BEDROCK
Rock: SILTSTONE
Rock: SHALE
Interbedded sandstone and shale
Rock: CLAYSTONE
+ - Piezometer installed at location
TITLE:
Underground Coal Mine Fire Investigation
Subsurface Section Diagram C-C'
LOCATION:
Marshall Mesa, Boulder County, Colorado
APPROVED JN
DRAFTED CEC, JJM
PROJECT# 117-8295005
DATE 09/06/2023
FIGURE
11



Legend

- Asbuilt Boring Location
- Asbuilt Test Pit Location
- Davidson Ditch
- Cross Section Lines

Depth to Bottom of Coal/Rubble (ft bgs)

- 10 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 65

0 50 100 200 Feet

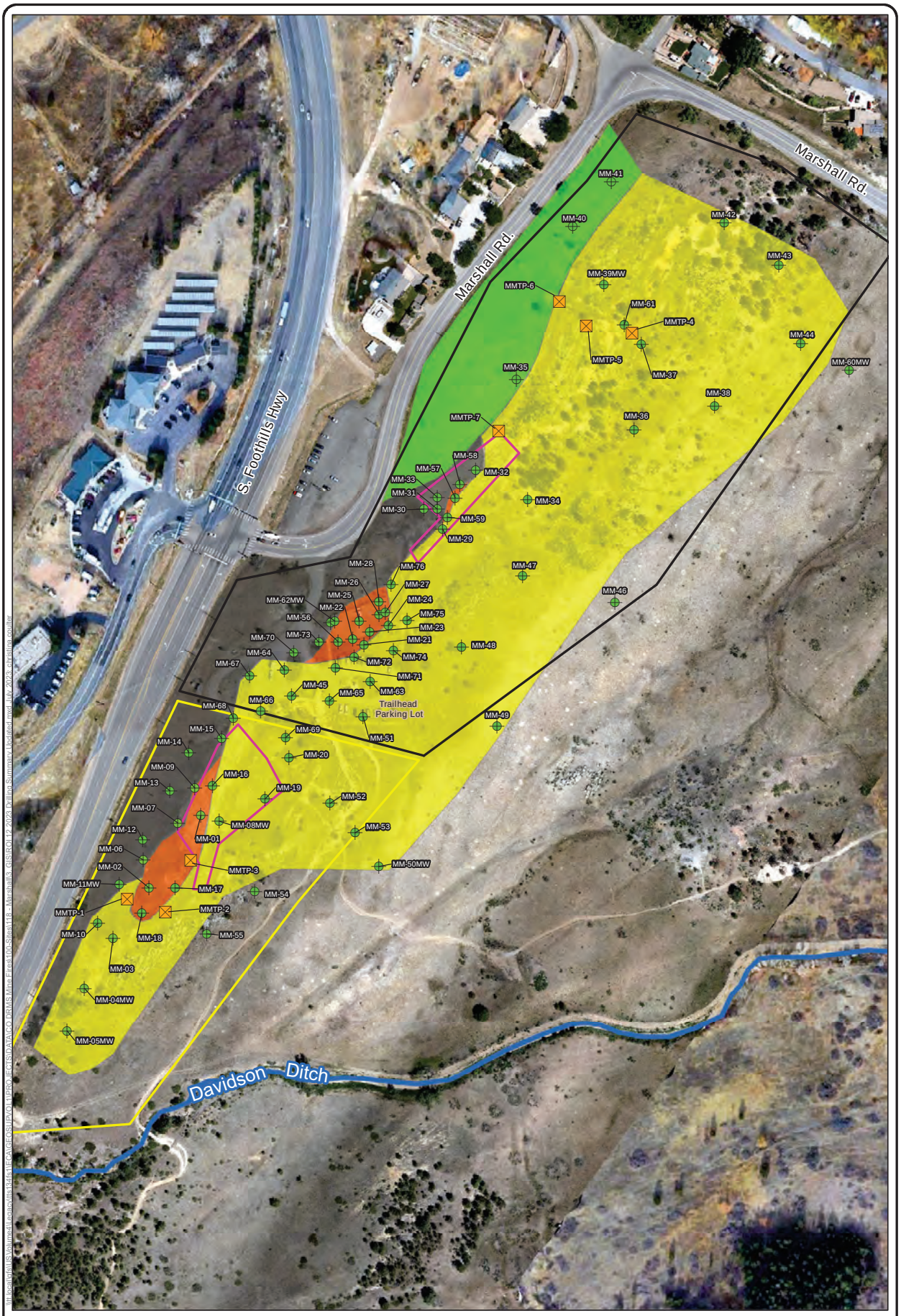
Notes:
- Aerial Imagery: July 2022 Tt UAV Imagery
- Coordinate System: NAD 1983 2011 UTM Zone 13N
- Projection: Transverse Mercator NAD 1983 2011
- Faults, geologic, and site features from CO DRMS

TITLE: **Marshall Mesa Drilling Investigation**
Depth to Bottom of Coal or Rubble Interval

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN	FIGURE
DRAFTED	MRI	12
PROJECT#	114-910499	
DATE	03/09/2022	

C:\Users\mitch.isaacson\Desktop\Marshall Local\ROI to Depth to Coal.mxd September 2023 mitch.isaacson



Legend

- Asbuilt Boring Location
- Asbuilt Test Pit Location
- Northern AOI
- Southern AOI
- 2017 Mitigation Areas

Upper Coal Seam Interval Condition

- Below Coal Seam
- Burned/Rubblized
- Burning/Smoldering/Ash Zone
- Intact Coal

N

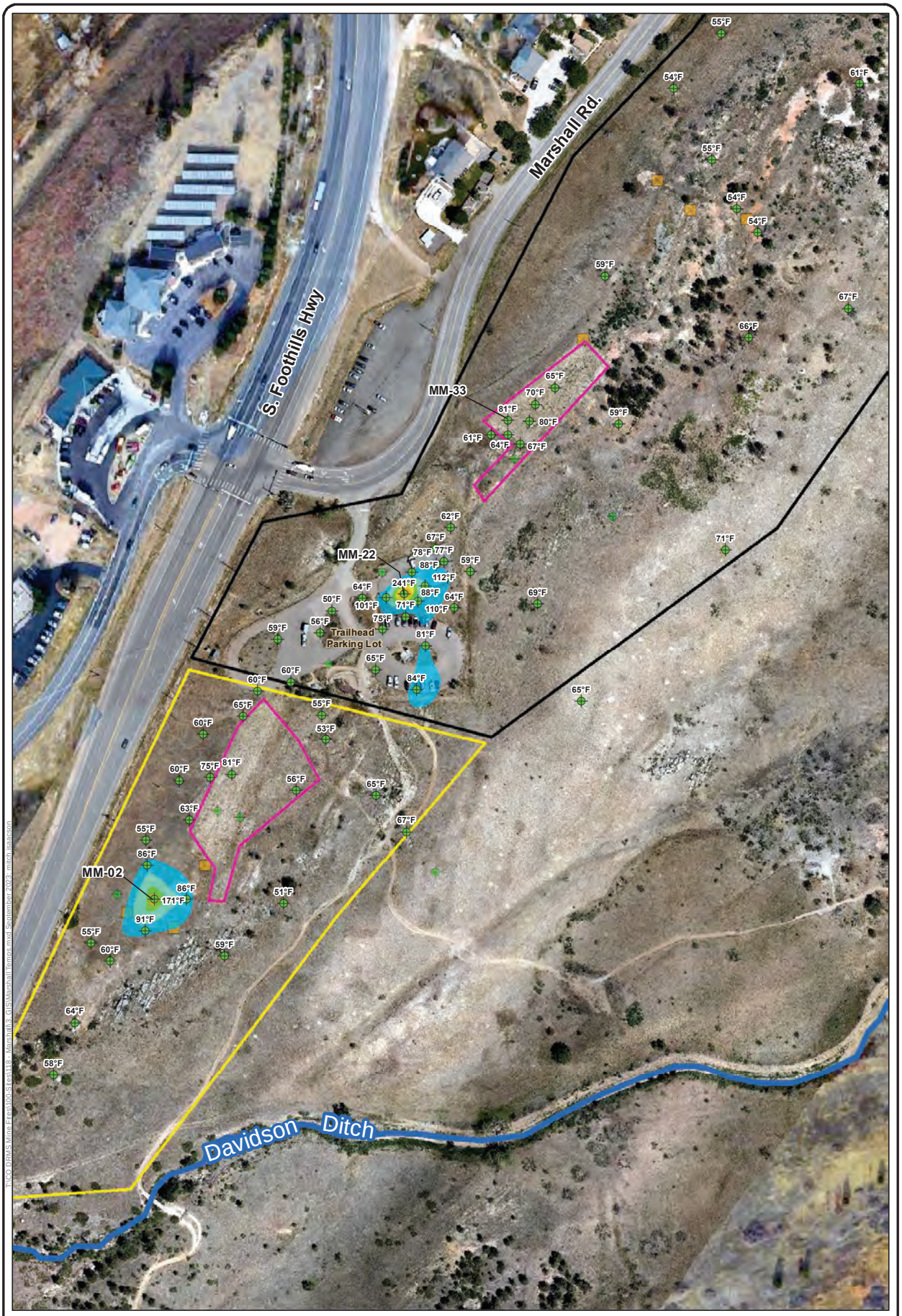
0 50 100 200 Feet

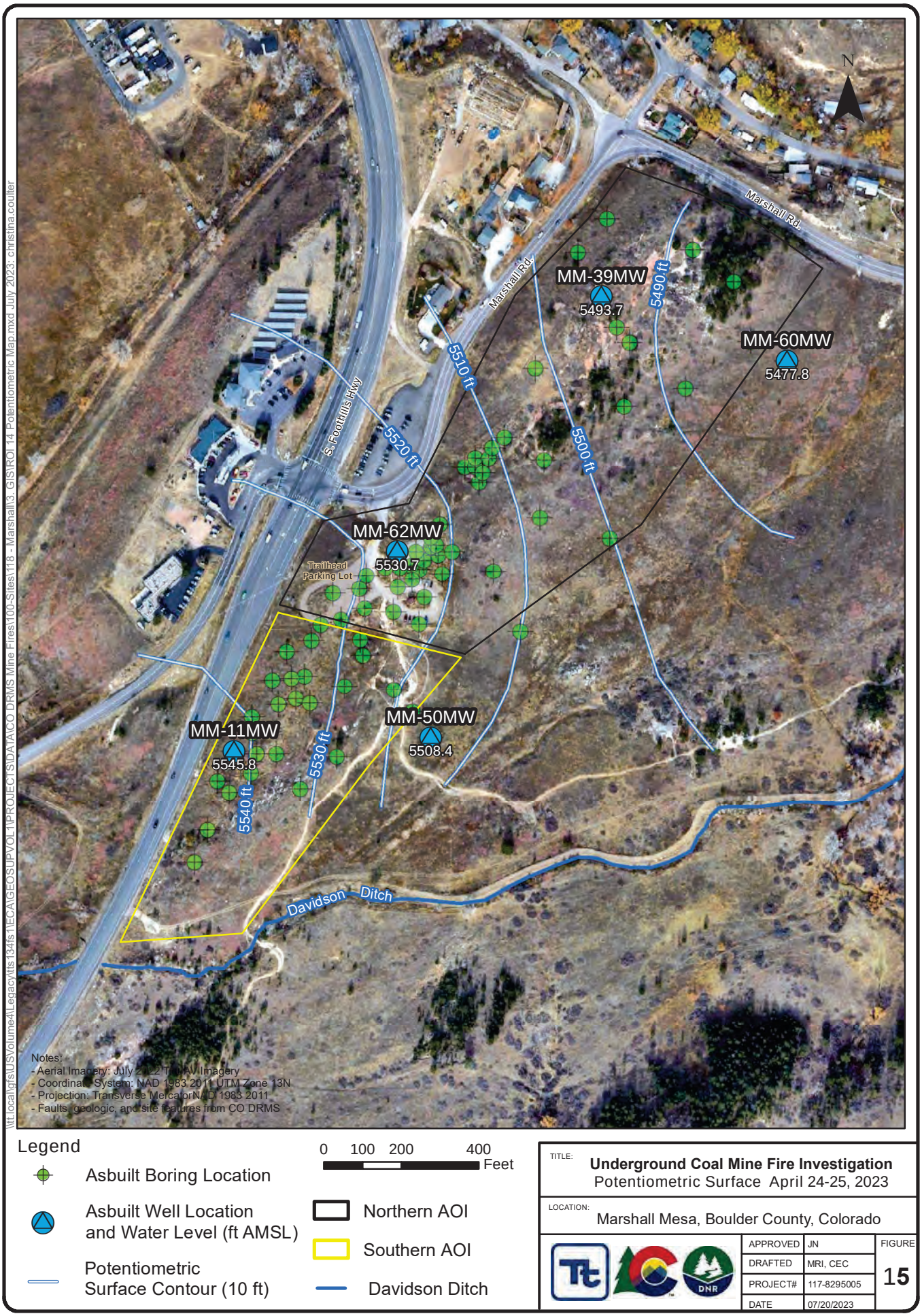
Notes:
- Aerial Imagery: July 2022 Tt UAV Imagery
- Coordinate System: NAD 1983 2011 UTM Zone 13N
- Projection: Transverse MercatorNAD 1983 2011
- Faults, geologic, and site features from CO DRMS

TITLE: Underground Coal Mine Fire Investigation
Upper Coal Seam Interval Generalized Conditions

LOCATION: Marshall Mesa, Boulder County, Colorado

APPROVED	JN	FIGURE
DRAFTED	MRI, CEC	13
PROJECT#	117-8295005	
DATE	07/27/2023	


S. Foothills Hwy
Marshall Rd.
MM-33
MM-22
MM-02
Trailhead Parking Lot
Davidson Ditch
55°F
54°F
61°F
55°F
64°F
64°F
59°F
67°F
66°F
65°F
70°F
81°F
80°F
59°F
61°F
64°F
67°F
62°F
67°F
78°F
77°F
88°F
112°F
59°F
71°F
64°F
241°F
88°F
64°F
50°F
101°F
71°F
110°F
69°F
56°F
75°F
59°F
81°F
65°F
60°F
84°F
60°F
65°F
65°F
55°F
53°F
60°F
60°F
75°F
81°F
56°F
65°F
63°F
67°F
55°F
86°F
86°F
171°F
51°F
91°F
55°F
60°F
59°F
64°F
58°F
Legend
Asbuilt Boring Location
Asbuilt Test Pit Location
Northern AOI
Southern AOI
2016 Mitigation Areas
Temperatue °F
<70
70 - 100
100 - 130
130 - 160
160 - 190
190 - 230
N
0 50 100 200 Feet
Notes:
- Aerial Imagery: July 2022 Tt UAV Imagery
- Coordinate System: NAD 1983 2011 UTM Zone 13N
- Projection: Transverse MercatorNAD 1983 2011
- Faults, geologic, and site features from CO DRMS
TITLE: Underground Coal Mine Fire Investigation
Upper Coal Seam Temperatures, May 23-26, 2023
LOCATION: Marshall Mesa, Boulder County, Colorado
APPROVED JN
DRAFTED MRI, CEC
PROJECT# 117-8295005
DATE 09/18/2023
FIGURE 14


N
Marshall Rd.
Marshall Rd.
S. Foothills Hwy
MM-39MW
5493.7
MM-60MW
5477.8
MM-62MW
5530.7
Trailhead Parking Lot
MM-11MW
5545.8
MM-50MW
5508.4
5490 ft
5510 ft
5520 ft
5500 ft
5530 ft
5540 ft
Davidson Ditch
Notes:
- Aerial Imagery: July 2022 TerraColor Imagery
- Coordinate System: NAD 1983 2011 UTM Zone 13N
- Projection: Transverse Mercator NAD 1983 2011
- Faults, geologic, and site features from CO DRMS
\\tt.local\grs\USVolume4\Legacy\tts 134fs1\ECA\GEOSUP\VOL1\PROJECTS\DATA\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\ROI 14 Potentiometric Map.mxd July 2023: christina.coulter
Legend
Asbuilt Boring Location
Asbuilt Well Location and Water Level (ft AMSL)
Potentiometric Surface Contour (10 ft)
0 100 200 400 Feet
Northern AOI
Southern AOI
Davidson Ditch
TITLE: Underground Coal Mine Fire Investigation
Potentiometric Surface April 24-25, 2023
LOCATION: Marshall Mesa, Boulder County, Colorado
APPROVED JN
DRAFTED MRI, CEC
PROJECT# 117-8295005
DATE 07/20/2023
FIGURE 15

APPENDIX A: Marshall Mesa Underground Coal Fire Investigation Report of Preliminary Investigations

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

TETRA TECH

Marshall Mesa Underground Coal Fire Investigation

Report of Preliminary Investigations

March 16, 2022

#114-910599

Report of Preliminary Investigations Marshall Underground Coal Fire

#114-910599
March 16, 2022

PRESENTED TO

Colorado Department of Natural Resources
Division of Reclamation, Mining, and Safety
1313 Sherman Street, Room 212
Denver, CO 80203

PRESENTED BY

Tetra Tech
350 Indiana Street, Suite 500
Golden, CO 80401
P +1-303-217-5700
tetratech.com

Disclaimer

The contents of this report do not necessarily represent the views or policies of the State of Colorado Department of Natural Resources, Division of Reclamation, Mining, and Safety, or United States Department of the Interior, Office of Surface Mining Reclamation and Enforcement. Subsurface conditions may vary from those depicted in this report. No warranty of geologic conditions is expressed or implied.

The site conditions and resulting recommendations presented in this document are based on conditions encountered at the specific underground coal mine location at the time of inspection. Due to the dynamic nature of underground coal mine fires, the complexity and variability of natural earth and rock formations and materials, significant variations may occur between and around these locations or with time. Because these data represent a very small statistical sampling of overall site conditions, it is possible that conditions may be encountered that are substantially different from those indicated. In these instances, modification and adjustment to the recommendations presented may be warranted.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
agl	Above ground level
AML	Abandoned Mine Lands
amsl	Above mean sea level
AOI	Area of Interest
bgs	Below Ground Surface
CO_2	Carbon Dioxide
CO	Carbon Monoxide
DRMS	Division of Reclamation, Mining and Safety
ft	Feet
°F	Degrees Fahrenheit
Hwy	highway
H_2S	Hydrogen sulfide
OSM	Office of Surface Mining
O_2	oxygen
No.	Number
UAV	Unmanned Aerial Vehicle or System

1. INTRODUCTION

Following the Marshall Wildfire on December 30, 2021, Colorado Division of Reclamation, Mining, and Safety (DRMS) requested Tetra Tech complete a preliminary evaluation of the conditions across the southern half of the Marshall Underground Coal fire site which is located near the southwest corner of the Marshall Wildfire impacted area.

The preliminary evaluations included surface-feature temperature and combustion gas observations, unmanned aerial vehicle (UAV) based infrared thermal/visual scans, drilling investigation, and subsurface temperature monitoring. Initial site evaluation work was initiated in January and the drilling and thermocouple installations were completed by the end of February. Long-term coal seam temperature monitoring was initiated March 3, 2022. This report summarizes the findings of the initial evaluations, follow up inspections, drilling investigation, and initial subsurface temperature monitoring.

2. SITE DESCRIPTION

Location and Setting

The Marshall underground coal mine fire site is located on the City of Boulder, Colorado (Marshall Mesa Trailhead Open Space) property located south of Boulder, immediately southeast of the intersection of State Highway 93 (Hwy 93) and Eldorado Springs Road. The southern half of the of the Marshall Mesa Site or Area of Interest (AOI) for the investigations is undeveloped, open space land, owned and managed by the City of Boulder bounded by the Marshall Mesa trailhead parking area to the north, Coal Seam trail to the east, Davidson Ditch to the south, and Hwy 93 to the west (**Figure 1**).

Image 1: Marshall Mesa Trailhead and AOI (November 2018)

The site sits at an elevation of approximately 5,500 feet above mean sea level (ft amsl) and is generally flat with some hummocky areas due to suspected subsidence features related to historic coal mines. A sandstone outcrop cuts across the southern half of the AOI (at SW to NE trend). Vegetation is mostly grass with some shrubs and trees although much of the site burned during the Marshall Wildfire. **Figure 1** shows the perimeter of the Marshall Wildfire and impacted areas of the AOI.

Recent Site History

There is an extensive history of underground fires at Marshall Mesa documented through historical photographs, reports, and mine maps describing underground fires more than 100 years ago. As described in the 2018 Mine Fire Inventory report (Tetra Tech, 2019), the recent, 20-year, history highlights the dynamic, ever changing conditions at mine fire sites. During a site visit in October 2003, it was reported that the fire was moderately active with ground temperatures ranging from 118°F to 130°F. The smell of coal combustion was noted near the venting fractures

(Renner, 2005). These features were located in the northern portion of the Marshall Mesa site in a recently active subsidence feature.

In February 2005, a recently constructed building was inspected for damage caused by subsidence believed to be related to the Marshall Coal Mine. Vents and subsidence features were identified under and around the building (Amundson, 2005). The building was ultimately demolished after the property was acquired by the City of Boulder for construction of the Marshall Mesa Trailhead.

On December 20, 2005, a brush fire was started by a hot vent from the Marshall Mesa Coal Fire. The fire was quickly contained and extinguished. The origin of the fire was traced back to a 373°F vent in the northern portion of the Marshall Mesa site. In January 2006, fire abatement was undertaken by the Office of Surface Mining to fill in vents with small rock material to reduce the potential of starting another surface fire. 275 tons of unwashed aggregate was placed over the vent area to a total depth of 18 inches (Blackburn, 2006).

In 2016-2017, two areas of trough subsidence were excavated, compacted, and backfilled to natural grade. Both areas, shown on **Figure 1**, were in areas where surface expression of the mine fire had been observed. During the subsidence mitigation work, a few small vents were uncovered in both locations. In all cases, the exhaust was warm, moist air with temperature less than 90°F. No new evidence of subsidence or other indicators of the coal mine fire were observed during the completion of the remedial activities. Gas monitoring during construction did not detect gases associated with coal combustion over the background levels.

The site was visited in the morning following a small, overnight, snowstorm in October 2018. No signs of venting, heat, odors, or snowmelt were observed (Tetra Tech, 2019).

Regional Geology

The site lies in the late Cretaceous Laramie formation, west (on the footwall) of the east-dipping Fox Fault, which is the first major Laramide back thrust east of the Rocky Mountain Front Range (**Figure 2**). Units within the AOI dip six to twelve degrees to the southeast (e.g., Trudgill, 2015). Between the Fox Fault and the Gorham Fault some 500 meters southeast, multiple anastomosing fault strands create an elliptical anticlinorium elongated to the northeast.

Surface and bedrock units in the vicinity consist of late Cretaceous sedimentary rocks. The most prominent and youngest unit in the area is the Laramie Formation, a set of brackish to freshwater deposits up to 800 feet thick. The upper Laramie contains mainly clay and sandy shale, is highly variable laterally, and is easily eroded. Most surface rocks across Lake Marshall and Davidson Mesas are from the comparatively erosion-resistant shaly sandstones of lower 80–125 feet of the Laramie. A ubiquitous horizon of varnished, very durable ripple marks up to 1 inch deep at the top of the “C sandstone” member of the lower Laramie outcrops northeast of the site near Marshall Road, providing a stratigraphic marker.

In addition to the main, mapped faults (i.e., Fox, Pine Ridge, Peerless, Pittsburgh, South Gorham, and West Fox), there are a series of smaller faults present further complicating the site. The lower Laramie formation also contains nearly all of the coal seams mined in the area, with most activity concentrated in the three to eight-foot thick No. 3 Seam within the lower 40 feet of the formation, some 20 to 40 feet below the C sandstone. The underlying Fox Hills Sandstone varies from 80 to 250 feet across the Mesa because of depositional variations, inter-tonguing with the underlying shales, and duplication by faults **Figure 2**.

The Pierre Shale is an extensive clay to mudstone, though limestone and sandstone members are present at various locations and intervals within the unit’s ~8,000-foot total thickness. In places, the Pierre is effectively water-soluble, spontaneously decomposing into suspended sediment and secondary settling silt and sand grains. The flat bottom of the South Boulder Creek plain in the vicinity of Marshall is entirely underlain by Pierre Shale.

Stratigraphy

The lower Laramie Formation below the C sandstone comprises alternating sandstone and shale with notable coal seams. Several coal seams have been mined in the lower Laramie in the area. At three to eight feet thick, the No. 3 coal seam is the thickest and most prominent. Near the site, this seam lies approximately ten feet below the top of the lower Laramie, underlying 17 feet of friable shaly and loose sandy material. This erodible unit is capped by up to ten feet of the "C" sandstone (Emmons, 1896) member, with its diagnostic oxide-varnished ripple-marked top and locally abundant oxidized concretions. Few members in this interval resist erosion, creating muddy flats with few outcrops. Erodible shales, sandstones, and some coal streaks in the lowest portion of the Laramie manifest as low-relief areas between the C sandstone and the massive grey sandstone at the top of the Fox Hills, in the swath from the C sandstone ridge southeast of the site.

Mine Maps

Coal mining started in the area as early as 1859 and continued through the 1950s. **Figure 3** shows the approximate extents of various coal mines in the immediate vicinity around the Marshall Mesa Trailhead. Historical maps identifying underground workings are only available for some of these mines, including the Marshall No. 3, Black Diamond, and Eldorado Mines. Others, including the Marshall No. 1 and No. 2, are known to exist to the north of the project areas, but mine maps are not currently available for these mines. The No. 3 Mine map shows workings to the south and east of the Marshall Mesa Trailhead, stopping just to the east of the project area. Two adits or airways are shown to extend west across the southern portion of the site to the slope west of Hwy 93.

It should be noted that the accuracy of available mine maps have not been confirmed and may not reflect the final extents and configuration of a given mine. Mine working extents and locations should therefore be considered approximate.

3. INVESTIGATION

As directed by DRMS, the preliminary investigation of the southern portion of the Marshall Mesa underground coal fire, was conducted in a phased approach utilizing a multi-disciplinary methodology for gathering background data, evaluating site conditions, and performing a targeted drilling investigation. The goal of the investigation was to quantify the extents of subsurface heat and extents of potential subsurface coal fire activity relative to the suspected ignition area of the Marshall Wildfire. The preliminary activities of the evaluation are summarized below.

Preliminary Site Inspection

Site Reconnaissance

The first part of data collection at the site included a reconnaissance of the project site as well as the surrounding areas. The No. 3 Mine map shows two adits potentially extending under Hwy 93 and daylighting out the slope to the west (**Figure 3**). This area was inspected January 7, 2022 and no signs of mine openings, recent subsidence, vents, or intakes were observed.

Surficial Fracture Gas and Temperature Observations

Two rounds of gas and temperature readings were completed January 7, 2022 and January 14, 2022 at ten discrete locations within the AOI shown on **Figure 4**. These locations were selected by DRMS to screen for potential connectivity between the surface and underground mine workings suspected to be present in the area. Tetra Tech performed temperature measurements and obtained gas readings at each location to screen for subsurface temperatures and combustion gases typically associated with oxidizing and/or burning coal. A FLIR Infrared (IR)

thermometer, Trimble R2 GPS unit, and a Landtec GEM 5000 gas analyzer with the capability to measure Methane %, Carbon Dioxide % (CO_2), Oxygen % (O_2), hydrogen sulfide (H_2S), and carbon monoxide (CO) were used for the observations.

The Trimble R2 GPS survey antenna was used to survey the ten observation locations (MV1-MV10) identified during the January 7th, 2022 site activities. The IR thermometer was aimed at the deepest part of the fracture to take a reading representative of venting atmosphere/gas temperature. In most cases movement of air or gases in or out of the fractures was not apparent. The gas analyzer's silicone inlet tube was inserted as far in the hole as possible in the direction of suspected air movement and the analyzer was turned on. The analyzer was run long enough (typically 1 to 2 minutes) to purge the suction line, for the gas reading to stabilize and to understand if there were short term fluctuations in gas concentrations. **Table 1** presents the gas concentration and temperature readings of each feature.

Image 2: Gas and Temp Observations January 14, 2022.

Table 1. Preliminary Gas and Temperature Readings

Feature	GEM 5000 Readings – January 14, 2022					
	Temp °F	CH_4 %	CO_2 %	O_2 %	H_2S PPM	CO PPM
Ambient	33	0	0.1	20.9	0	0
MV01	33	0	0.1	20.9	0	0
MV02	35	0	0.5	20.7	0	0
MV03	36	0	0.8	20.4	0	0
MV04	36	0	0.1	20.9	0	0
MV05	35	0	0.3	21	0	0
MV06	32	0	0.1	21.3	0	0
MV07	32	0	0.1	21.4	0	0
MV08	30	0	0.1	21.4	0	0
MV09	28	0	0.1	21	0	0
MV10	40	0.1	12.9	8.5	0	218

Tetra Tech noted slightly elevated temperatures and combustion gases at location MV-10 (**Figure 4**). The presence of CO without heat and CO_2 is typically associated with incomplete combustion or oxidation of subsurface coal. No other indications of mine fire activity were observed including odors, heat, venting gases, or intakes. Fracture temperatures at feature MV01 to MV09 were close to ambient (33°F) and no discernable airflow (intake or vent) was observed.

Site Imaging

Thermal Imaging

On January 8, 2022, Tetra Tech performed a UAV-based thermal inspection and mapping of the AOI within Marshall Mesa Open Space. A flight was performed to develop a thermal overlay of the AOI to map potential thermal anomalies, or features with sharp contrast, hot or cold, with the surrounding area (**Figure 5**). The color scale on the

figure ranges from approximately 10-30^{0}F with the darker blues and purples representing the cooler temps (~20°F) and the brighter colors representing the relatively warmer temps (25-30°F).

The warm circles (~28°F), primarily on the southern portion of the figure, are conifer trees that trap and hold warmer air. The area snowmelt area displayed a slightly elevated temperature (~1-2°F) above the surrounding area that was consistent with on the ground temperature observations. Low altitude video inspections were also performed to provide more detail of the fractures in question and actively search for thermal anomalies that may not be observed from higher altitude thermal mapping. No additional features were identified during the detailed imaging.

Site Mapping

On February 9, 2022, Tetra Tech completed a UAV-based visual photogrammetry flight of the property to develop baseline aerial imagery for the drilling program. The imagery was captured using a 45-megapixel survey-grade camera flown at approximately 200 feet above ground level (ft agl). The map was georeferenced using eight ground control points, surveyed using a Trimble R2 GPS antenna with precision RTX, and is used as the base imagery for **Figure 4** and **Figure 7.**

Snowmelt Imagery

With multiple snowfall events occurring in Boulder during January, February, and March 2022, Tetra Tech was able to visit the site several times to observe snowmelt patterns. During these visits an area was observed that consistently had snowmelt before the surrounding areas despite similarities in aspect and surface material or other factors that could influence differential melting patterns other than subsurface heat. **Image 3** and **Figure 6** show ground and perspective shots of the consistent snowmelt area during a recent storm and an outline of the consistent snowmelt area is shown on **Figure 4**. On the ground temperature observations with the handheld IR thermometer showed ground temperatures in the snow free areas were just above freezing at 34°F and only 1°F to 3°F warmer than background surface temperatures. No other areas of snowmelt were identified in the AOI.

Image 3: View to south of snowmelt in AOI, March 7, 2022.

North of the AOI, two suspected snowmelt areas were identified during the snowmelt imaging. These areas were not evaluated further since they are out of the scope of this investigation. Their locations were documented and recommendations for further evaluation are included in Section 4.2. **Appendix A** provides additional photographs of snowmelt areas at the site.

Microgravity Calibration Readings

A preliminary microgravity survey was completed across the AOI to evaluate the suitability of the method for the site, given the shallow coal mining, large extents of undermined areas, and extensive faulting. Results from the preliminary survey will identify areas These data will be calibrated with the preliminary drilling data and used to guide additional investigations.

Drilling Investigation

DRMS and Tetra Tech developed a borehole drilling program to quantify the extents of subsurface heat and/or fire in the AOI. Borehole locations were positioned to examine the main snow melt area and area to the south beneath the possible origin point of the Marshall wildfire. Drilling work was completed between February 21, 2022 and February 25, 2022 by Authentic Drilling based in Kiowa, Colorado. A track mounted CME-55 utilizing an ODEX casing advance system advanced the boreholes through the overburden and into competent rock. The boreholes were then

completed to depth with an air-rotary tricone bit. Foam and water were pre-mixed and on standby in-case hot or burning conditions were encountered. A downhole camera was used to examine select boreholes and confirm the lithology and nature of the fractured/void zones. **Table 2** summarizes the borehole data and the boring logs are included as **Appendix B**. Borehole locations are shown on **Figure 4**.

Descriptions of the subsurface conditions observed, and select monitoring data, in each of the boreholes are summarized below:

1. **MM-01** - The location of borehole MM-01 in the middle of the primary snowmelt feature, was selected based on the snowmelt imaging and observed slightly elevated surface temperatures **Figure 6**. The borehole encountered 8.5 feet of backfill from the 2016 mitigation work, comprised of a brown, sandy, silty mixture with gravel and cobbles. Competent rock was encountered at 8.5 feet below ground surface (ft bgs), however circulation was lost shortly after. Drilling advancement was easy to 15 ft bgs and the ODEX casing was set at 13.5 ft bgs. The borehole began venting low temp (<90°F) gases with a strong, sulfurous coal combustion odor, typical of underground coal fires. Carbon monoxide concentrations fluctuated but were observed up to 1743 parts per million (ppm), H_2S was detected at 4.2 ppm, CO at 10 %, no methane was detected, and low oxygen conditions were present. A tri-cone bit was used to advance the borehole from 15 ft bgs through soft conditions and no circulation to 24 ft bgs, where solid rock was again encountered. From there the borehole was advanced through 9.5 ft of solid rock to a total depth of 33.5 ft bgs.

2. **MM-02 –** Borehole MM-02 was located approximately 160 feet to the south of MM-01, at the southern end of surface heat documented with the snowmelt imagery. This borehole encountered a light-colored sandstone just below the surface which extended to a depth of approximately 15 feet where there was a transition to a dark brown shale with coal encountered from 17 to 24 ft bgs. No gases, heat or odors were observed. The borehole was covered, allowed to sit overnight, and was checked the following morning. CO was the only gas detected at a concentration of 199 ppm and the IR thermometer recorded a temperature of 89°F at the bottom of the borehole. A thermocouple was installed to 15 ft bgs and grouted in place.

Image 4: Drilling MM-03 with reddish colored cuttings.

3. **MM-03 –** Sandstone, brown to reddish brown, with interbedded shale was encountered just below the surface at this location. From 12 to 17 ft bgs the color became redder and there was some bit chatter, likely indicating a fractured or disturbed zone (**Image 3**). Coal was encountered from 21 to 26.5 ft bgs, with a grey shale underlying the coal from 26.5 ft bgs to the total depth of 32.0 ft bgs. The borehole remained open overnight and the following morning venting, gases, odors, or heat were not observed. A thermocouple was grouted in the borehole to a depth of 21.5 ft bgs.

4. **MM-04 –** Similar to MM-03, sandstone with some shale intervals were encountered from the surface to 20 ft bgs where the color became reddish and then circulation was lost at 22 ft bgs. From 22 to 31 ft bgs there was rig chatter and the bit was bouncing, indicating fractured conditions, possible faulting, rubble, or ash. The borehole drilled solid and smooth from 31 to 34.5 ft bgs, the total depth. Three-inch steel casing was installed to 34 ft bgs with a slotted interval from 24 to 34 ft bgs. The borehole was sealed from 20 ft bgs to 16 ft bgs with bentonite and then grouted to the surface. No odors, gases, or heat were observed during drilling or the casing installation. A thermocouple was hung in the steel casing to 23 ft bgs.

5. **MM-05 –** MM-05 drilled solidly through interbedded, brown, sandstone and shales from the surface to a depth of 29.0 ft bgs where circulation was lost. There was soft drilling, with intermittent rig chatter from 29.0 to 39.0 ft bgs indicative of a fractured, fault, rubble, or ash zone. There was smooth, steady drilling from 39.0 to 50.0 ft bgs, the total depth of the borehole. The borehole was examined with a downhole camera and no obvious voids or coal were observed. Three-inch steel casing was installed to 50 ft bgs with a slotted interval from 30 to 40 ft bgs. The borehole was sealed with bentonite from 23 to 27 ft bgs and then grouted to the surface. A thermocouple was hung in the steel casing at a depth of 30 ft bgs. Venting, gases, odors, or heat were not observed following drilling or casing installation.

6. **MM-06 –** This borehole was advanced through brown to grey, sandstones and shales from the surface to 11.0 ft bgs where coal was encountered. The coal seam extended from 11.0 to 22.0 ft bgs and was underlain by a competent grey shale. The total depth of the borehole was 24.5 ft and it was allowed to sit open overnight and the following morning venting, gases, odors, or heat were not observed, and a thermocouple was grouted in to 12 ft bgs.

7. **MM-07 –** Borehole MM-07, located 50 feet west of MM-01, was advanced through interbedded sandstone and shale with intact coal encountered from 11 to 21.5 ft bgs. Grey shale was encountered from 21.5 to 24.5 ft bgs, the borehole's total depth. It sat open overnight and the following morning venting, gases, odors, or heat were not observed, and a thermocouple was grouted in to 12 ft bgs.

8. **MM-08 –** This borehole encountered 3.5 feet of fill underlain by a brown sandstone with interbedded shale to a depth of 11.0 ft bgs. From 11 to 24 ft bgs there was interbedded, red to light tan, sandstones and shales. Coal was encountered from 24 to 28 ft bgs with a grey sandy shale extending from 28 to 35 ft bgs. Another coal interval was encountered from 35 to 41 ft bgs with grey shale from 41 to 49 ft bgs. Following completion of drilling and sitting of overnight, no venting, gases, odors, or heat were observed, however, approximately four feet of water was measured in the bottom of the open borehole. Three-inch steel casing was installed to 49 ft bgs with a slotted interval from 41 to 49 ft bgs to monitor the water level in the borehole. A thermocouple was grouted in the annulus between the steel casing and borehole wall at a depth of 24 ft bgs.

9. **MM-09 -** MM-09 drilled very similarly to MM-06 and MM-07 with coal encountered from 10 to 20 ft bgs. The borehole was advanced through interbedded shales, sandstones, and a thin coal seam from 29 to 31 ft bgs. A grey, sandy shale was encountered from 31 to 54 ft bgs where the borehole was terminated. It was left open overnight. The following morning venting, gases, odors, or heat were not observed, and two thermocouples were grouted in borehole MM-09, one at 12 ft bgs and one at 29 ft bgs.

Table 2: Borehole Summary

Borehole ID	Date Drilled	Total Depth (ft bgs)	Top of Coal (ft bgs)	Bottom of Coal (ft bgs)	Venting	Casing	Screened Interval (ft bgs)	Thermocouple Depth (ft bgs)	Comments
MM-01	2/21/2022	33.5	-	-	yes	no	-	7	Warm venting borehole. 1743ppm CO. Casing installation failed due to collapsing borehole. Losing grout at 14 ft bgs. Needed 1yd of cement to backfill. Suspected coal interval 13.5 23.5 ft bgs.
MM-02	2/21/2022	24.0	17.0	24.0	slightly	no	-	15	Venting 199 ppm CO the day after drilling. No other gases detected. 89F in borehole.
MM-03	2/23/2022	32.0	21.0	26.5	no	no	-	21.5	Reddish overburdern and partial coal seam. No current fire activity.
MM-04	2/22/2022	34.5	-	-	no	yes	24-34	23	Reddish coloring above and circulation lost in anticipated coal interval. No signs of ongoing fire activity.
MM-05	2/23/2022	50.0	-	-	no	yes	30-40	30	Ciculation lost in suspected coal interval. Rubble or ash from 22-31 ft bgs. No current fire activty.
MM-06	2/24/2022	24.5	11.0	22.0	no	no	-	12	Solid borehole, no signs of coal mine fire.
MM-07	2/24/2022	24.5	11.0	21.5	no	no	-	12	Solid borehole, no signs of coal mine fire.
MM-08	2/24/2022	49.0	24.0	28.0	no	yes	41-49	24	~4 ft of water in the borehole 2/25/21 0830. Second coal interval from 35-41 ft bgs. No signs of coal mine fire.
MM-09	2/24/2022	54.0	10.0	20.0	no	no	-	12, 29	Thin coal seam ecountered from 29-31 ft bgs. No signs of coal mine fire.

Each of the boreholes was completed with a 12-inch, flush mount monitoring well cover that was cemented in place. The well covers were installed a few inches above the natural ground surface to promote drainage and prevent ponding on the well covers.

3.1.1 Borehole Emissions Observations

Emissions readings were taken during the drilling from the open boreholes once the boreholes were advanced to their total depth. To obtain emissions readings, the drilling rods were removed, equipment was switched off, and the boreholes sat open for a minimum of ten minutes prior to taking initial readings. Follow up readings were obtained in the morning after the boreholes sat overnight. Boreholes MM-01 and MM-02 were the only boreholes where combustion gases were detected during the initial or follow up readings with the findings from the follow up measurements presented below in **Table 3**.

Table 3: Borehole Gas Readings

Feature	GEM 5000 Readings – February 22, 2022					
	Temp °F	CH_4 %	CO_2 %	O_2 %	H_2S PPM	CO PPM
Ambient	5	0	0.1	20.9	0	0
MM-01	109	0	9.8	10.1	4	1743
MM-02	89	0	5.1	13.5	1	199

3.1.2 Thermocouple Installation

Type K thermocouples were installed in all the boreholes at or near the top of the coal seam interval. In boreholes MM-01, MM-04, and MM-05 where coal was not encountered, the thermocouples were installed at the top of the suspected coal interval. Thermocouples were installed by hanging the thermocouple wire in the open borehole and then grouting in place or by hanging the thermocouple wire down the inside of the steel casing installed in the borehole.

On March 9, 2022 thermocouple dataloggers were installed in the well monuments to record hourly temperature readings. This baseline data will be harvested monthly to allow DRMS to track potential changes in mine fire activity and correlate subsurface changes to weather events and variations in ambient conditions. **Table 4** summarizes the baseline thermocouple data collected prior to the installation of the dataloggers. The thermocouple in MM-06 was potentially damaged during installation and is not reading properly. No thermocouple data is available for this location.

Table 4: Downhole Thermocouple Temperature Data

Date	MM-01 7 ft bgs	MM-02 15 ft bgs	MM-03 21.5 ft bgs	MM-04 23 ft bgs	MM-05 30 ft bgs	MM-06* 12 ft bgs	MM-07 12 ft bgs	MM-08 24 ft bgs	MM-09S 12 ft bgs	MM-09D 29 ft bgs
3/3/2022	120.3	165.5	84.9	-	-	-	67.3	89.0	65.1	83.1
3/4/2022	119.0	166.2	62.3	82.3	78.6	-	67.1	69.5	64.3	83.1
3/7/2022	116.0	165.5	62.2	58.8	58.1	-	65.8	70.3	62.5	84.9
3/8/2022	117.9	165.3	61.0	60.4	58.3	-	66.7	69.7	62.9	82.8
3/9/2022	118.3	164.3	59.9	58.1	57.5	-	61.9	67.9	61.1	82.1

Notes: Thermocouples grouted in borehole: MM-01, MM-02, MM-03, MM-06, MM-07, MM-08, MM-09S, MM-09D. Thermocouples in MM-04 and MM-05 are hanging in slotted steal casing. *Error message thermocouple likely damaged during installation.

Figure 7 presents an overview of the subsurface temperatures observed near the top of the upper coal seam as observed on March 9, 2022. Temperature observations from March 3 to March 9, 2022 remained relatively consistent.

4. SUMMARY OF FINDINGS

Findings

The findings of the investigation of the southern half of the Marshall Mesa Underground Coal Mine Fire AOI are summarized below:

- No surface heat, vents, intakes, or recent subsidence, indicative of changing subsurface conditions, were identified during site reconnaissance of the AOI and surrounding areas.
- One fracture (MV-10) was observed to have a slightly elevated temperature (40F vs 33F ambient) and low CO (199 ppm) readings.
- No heat anomalies were identified with UAV mounted thermal and visual cameras.
- A relatively small area of enhanced snowmelt, with surface temperatures a few degrees above background, was identified in the AOI. Two possible snowmelt areas were identified north of the project area but within the overall Marshall Mesa site.
- Two of nine boreholes (MM-01 and MM-02) encountered coal combustion gases and elevated temperatures (~90F).
  - Conditions encountered in boreholes MM-01 and MM-02 indicate that the underground conditions are hot in discrete locations that seem to correspond with observed snowmelt patterns but are below active burning levels and more indicative of a semi-dormant fire or intense oxidation of the fractured coal.
  - The discrete areas of oxidation and/or low-level combustion with heat are seemingly constrained by the flat lying geology, faulting, and relatively intact overburden in the areas currently exhibiting heat.
  - With no observed vents or intakes, there is currently little air flow to the warm areas of coal.

- Boreholes MM-03 through MM-09 showed no evidence of current fire activity. No heat, gases, or odors typically associated with mine fires were observed in these boreholes.
- No significant voids or mine workings were encountered by any of the boreholes. Circulation loses were attributed to fracturing, rubble, or ash zones based on bit chatter in these intervals when no resistance is typically encountered from open voids.
- Baseline thermocouple data show subsurface heat distribution consistent with borehole observations, snowmelt patterns, and site reconnaissance observations.

Recommendations

The southern portion of the Marshall Mesa underground coal mine fire that was the focus of this investigation is currently exhibiting the characteristics of a low activity, semi-dormant mine fire. No dangerous surface features or hazardous conditions related to the underground coal fire were observed. Given the extents of the historic behavior of the mine fire, observed site conditions, and remaining portion of the site to be investigated, Tetra Tech has the following recommendations.

1. Site Monitoring – The site should be visited on a regular basis to conduct snow melt observations (both north and south site areas), ground and UAV based thermal imaging, thermocouple readings, and record gas concentration measurements as appropriate. These data will be compared to weather data to establish if there is a relationship between atmospheric and subsurface conditions as well as document changes to fire activity.
2. Additional Investigations
    a. Geophysical Investigation – Preliminary microgravity data was collected across the AOI to calibrate for future investigations. The results of the calibration modeling show the methodology will provide useful results at the Marshall Mesa site. A sitewide microgravity survey modelled on the preliminary microgravity data and calibrated by the existing borehole data, would allow extrapolation and understanding of subsurface conditions, including faulting and mine workings, across the site away from the discrete borehole locations. This data would expand the understanding subsurface conditions across the site while helping to guide geotechnical drilling.
    b. Geotechnical Drilling - Additional drilling is recommended at the site to completely quantify the extents of the subsurface heat, confirm the orientation and offset of faults which could provide structural control on underground fire extents, and identify the extents of mine workings in proximately to current expressions of the underground coal fire at the Marshall Mesa site. Collection of core samples for detailed logging of stratigraphy should be considered as well as installation of additional thermocouples more comprehensive subsurface temperature monitoring.

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Tweto, Ogden, 1979, Geologic Map of Colorado, MIG-16, scale 1:500,000.

FIGURES

Legend

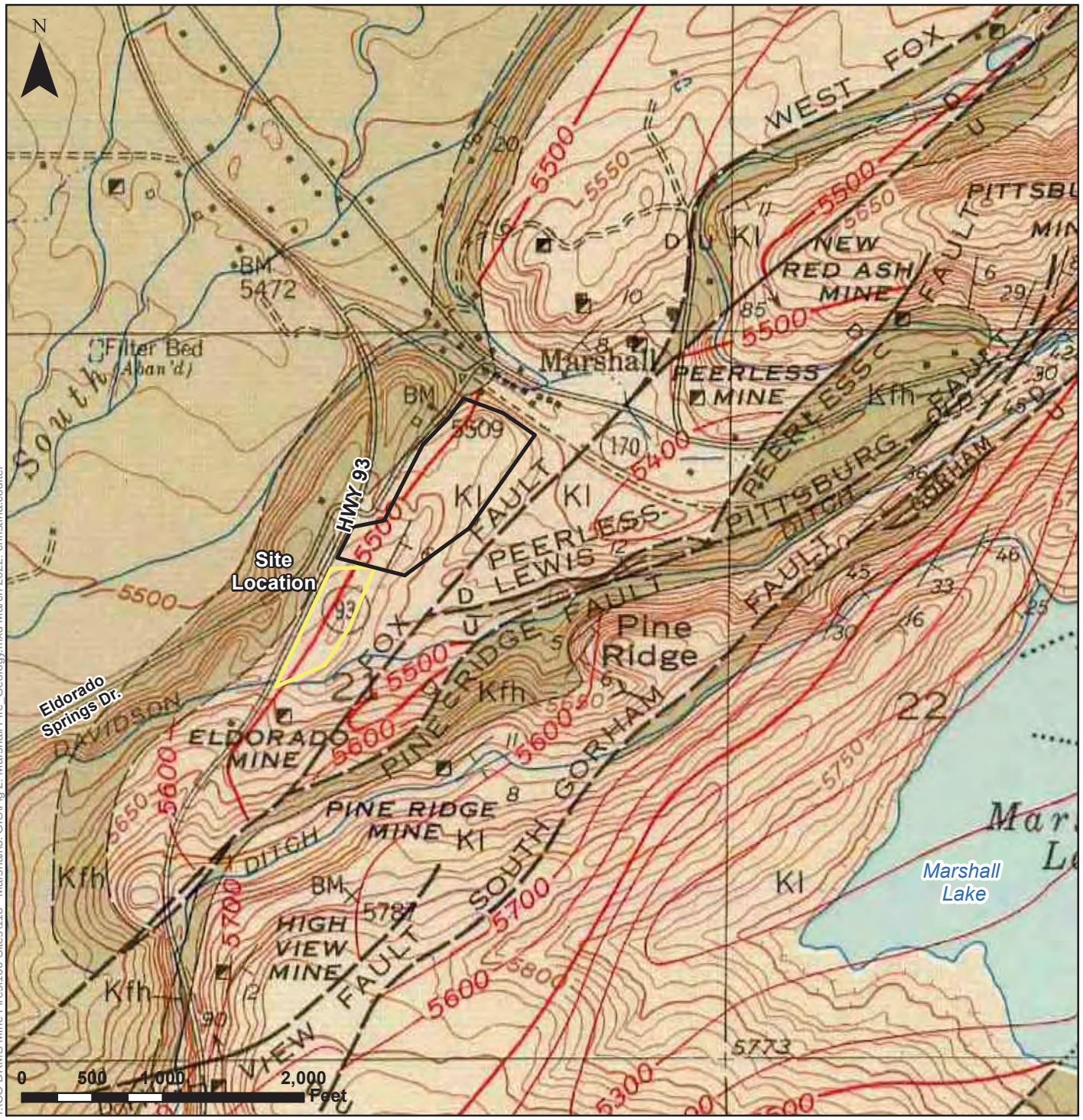
- Marshall Mesa North
- Marshall Mesa South
- Marshall Wildfire Impacted Area
- 2016 Mitigation Area - North
- 2016 Mitigation Area - South

0 250 500 1,000 Feet

TITLE: **Marshall Mesa**
Underground Coal Fire Investigation
Site Location Map

LOCATION: Marshall Area, Boulder, Colorado

APPROVED	JN	FIGURE
DRAFTED	CEC	1
PROJECT#	114-910499	
DATE	03/16/2022	



T:\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\Fig 2. Marshall Fire Geology.mxd March 2022: christina.coulter

Legend

- Marshall Mesa North
- Marshall Mesa South
- KI — Laramie formation
- Kfh — Fox Hills Sandstone
- Kp — Pierre shale
- 60 — Strike and dip of beds
- 64 — Strike and dip of overturned beds
- Mine Shaft
- Sand, gravel, or clay pit
- 5500 — Structure contour *(top of the Fox Hills Sandstone) Contour Interval 100 ft*
- Contact (dashed where approx., dotted where concealed)
- D / U — High-angle fault, showing dip *(dashed where approx, dotted where concealed. U, upthrown side; D, downthrown side)*
- ? — Doubtful or probable fault

Note:
Geologic Map from: Spencer, F. D., 1961, Bedrock geology of the Louisville quadrangle, Colorado, USGS Publications Warehouse, 10.3133/gq151, https://pubs.er.usgs.gov/publication/gq151

TITLE:	**Marshall Mesa Underground Coal Fire Investigation Geologic Map**
LOCATION:	Marshall Area, Boulder, Colorado

APPROVED	JN	FIGURE	2
DRAFTED	CEC		
PROJECT#	114-910499		
DATE	03/16/2022		

T:\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\Fig 3. Marshall Fire Mine Maps_v10.7.mxd March 2022: christina.coulter

Legend

- Marshall Mesa North
- Marshall Mesa South

Marshall Mine Workings (CO DRMS)

- Big Tom Mine
- Black Diamond
- Eldorado 1939
- Kitchen Slope
- Lewis No 1 and No 2
- Marshall No 1
- Marshall No 3
- Marshall No 5
- Marshall No 7
- Pine Cliff 1940

Notes:
- Coordinate System: NAD 1983 UTM Zone 13N
- Projection: Transverse Mercator North American 1983
- Mine features from CO DRMS
- World Imagery Basemap from ESRI, 6/15/21

Note: Subsurface conditions may vary from those depicted in this figure. No warranty of geologic conditions based on map interpretation is expressed or implied.

TITLE: **Marshall Mesa**
Underground Coal Mine Fire Investigation
Mine Maps

LOCATION: Marshall Area, Boulder, Colorado

APPROVED	JN
DRAFTED	CEC, MRI
PROJECT#	114-910499
DATE	03/16/2022

FIGURE **3**

T:\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\Fig 4. Marshall Site Investigation Map.mxd March 2022; christina.coulter

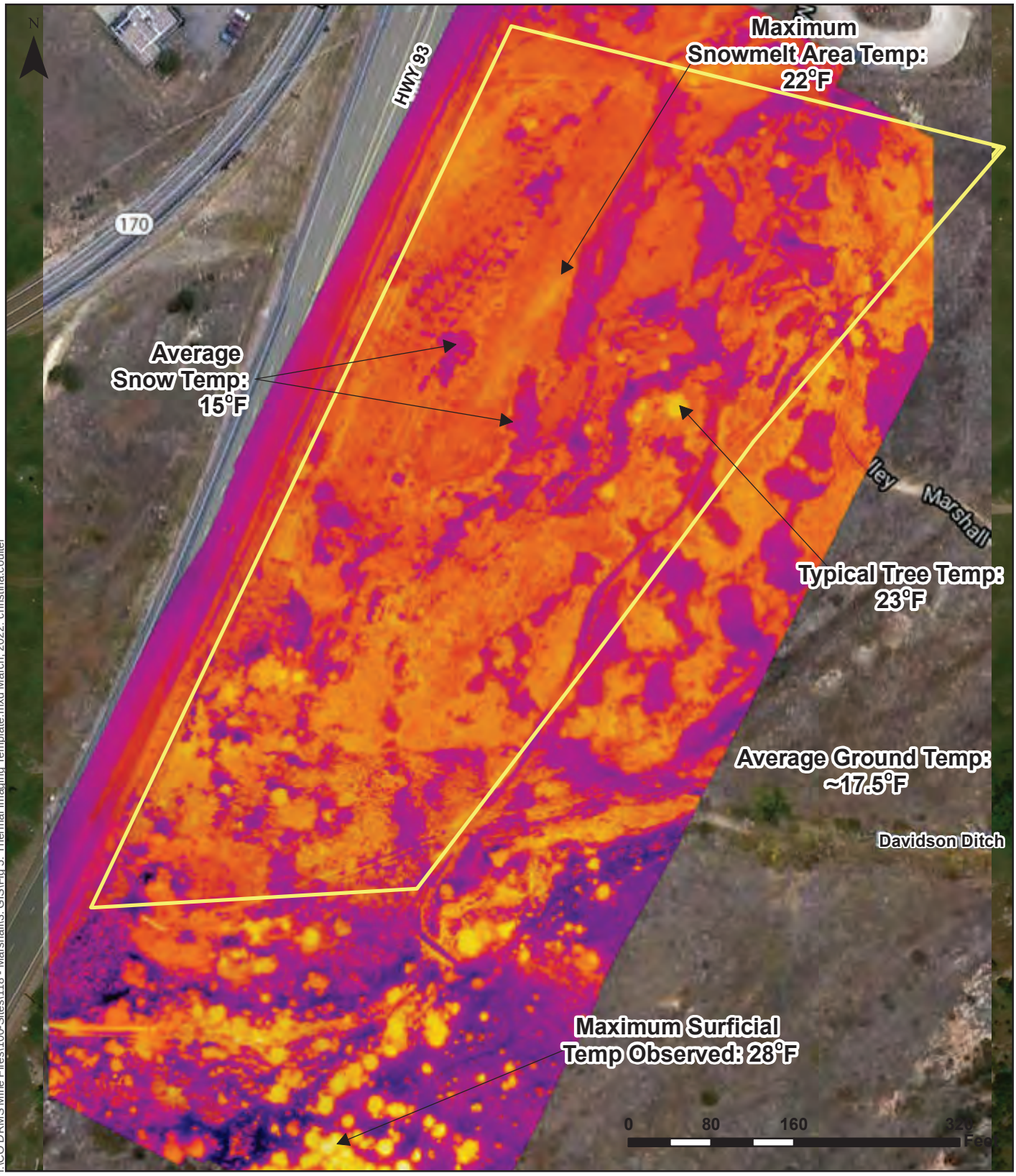
Legend

- Site Location
- Borehole Locations
- Gas and Temperature Readings (01/14/2022)
- Typical Snowmelt
- Additional Snowmelt Areas
- Marshall Wildfire Impacted Area

TITLE: **Marshall Mesa**
Underground Coal Fire Investigation
Site Investigation Locations and Features

LOCATION: Marshall Area, Boulder, Colorado

APPROVED	JN	FIGURE 4
DRAFTED	CEC	
PROJECT#	114-910499	
DATE	03/14/2022	



T:\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\Fig 5. Thermal Imaging Template.mxd March, 2022: christina.coulter

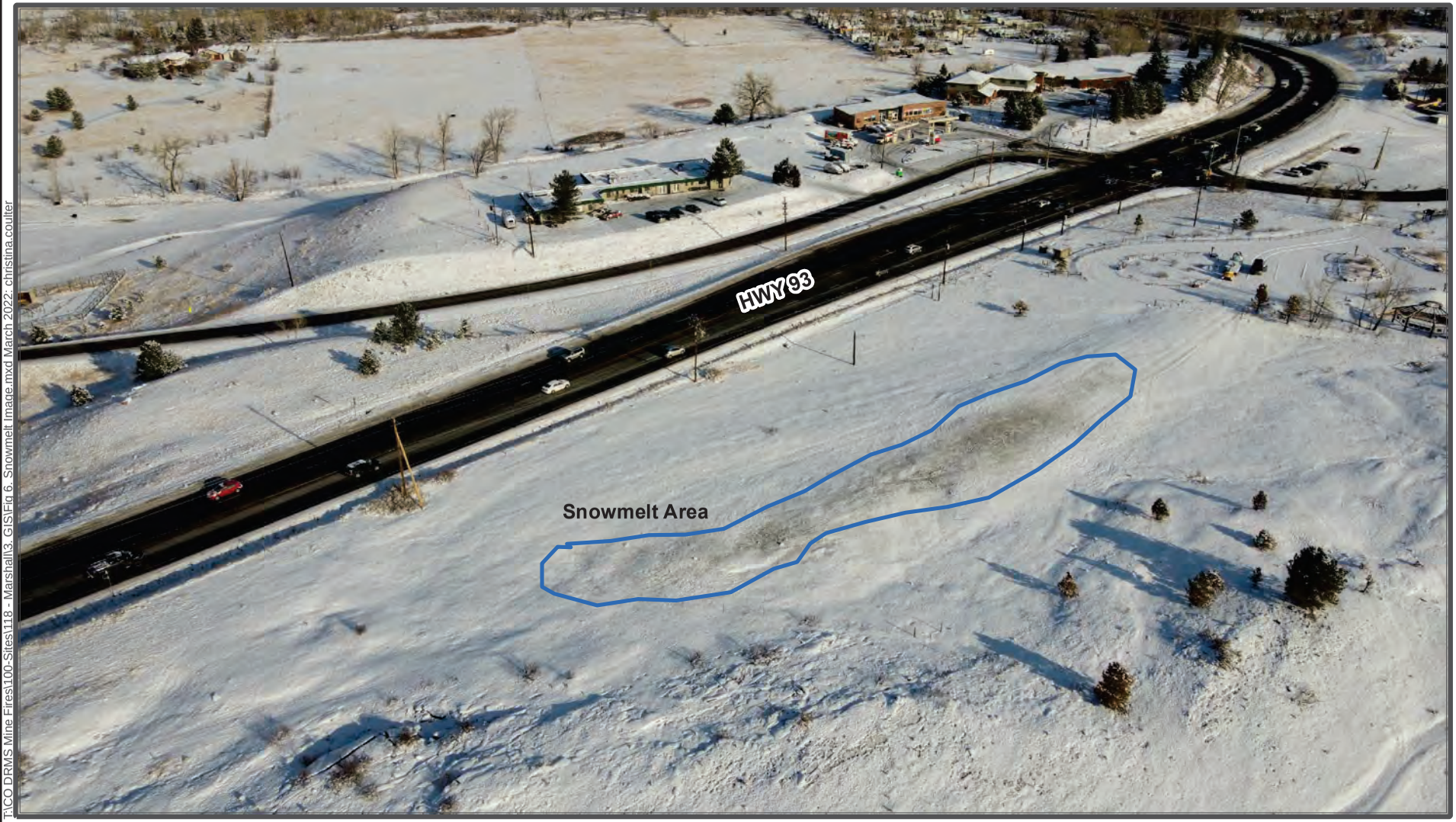
Legend

Marshall Mesa South

Notes:
- Thermal imaging performed by Tetra Tech on 01/08/2022.
- Ambient Temp. at 0600 was 34°F, light wind, cloudy.
- Max surficial Temp Oberved was 28°F (a tree in the southern portion of the site).
- World Imagery Basemap from ESRI, June 15, 2021.

TITLE:	Marshall Mesa Underground Coal Fire Investigation Thermal Imaging
LOCATION:	Marshall Area, Boulder, Colorado

APPROVED	JN	FIGURE
DRAFTED	CEC	5
PROJECT#	114-910499	
DATE	03/16/2022	



T:\CO DRMS Mine Fires\100-Sites\118 - Marshall\3. GIS\Fig 6. Snowmelt Image.mxd March 2022: christina.coulter

Notes:
- View to the northwest
- Photo taken by Tetra Tech on 3/10/2022

TITLE:	**Marshall Mesa Underground Coal Fire Investigation Snowmelt Image**		
LOCATION:	Marshall Area, Boulder, Colorado		
	APPROVED	JN	FIGURE
	DRAFTED	CEC	6
	PROJECT#	114-910499	
	DATE	03/16/2022	

T:\CO_DRMS_Mine Fires\100-Sites\118 - Marshall\3_GIS\Fig 7_Marshall Downhole Temperature Contours.mxd March 2022; christina.coulter

Legend

- Borehole Locations
- Marshall Mesa North
- Marshall Mesa South
- Marshall Wildfire Impacted Area
- Southern Snowmelt Area
- Additional Snowmelt Areas

Temperature Contours (°F)

- 75°F
- 100°F
- 125°F
- 150°F

TITLE: **Marshall Mesa Underground Coal Fire Investigation Top of Coal Seam Temperature Contour Map - March 9, 2022**

LOCATION: Marshall Area, Boulder, Colorado

APPROVED	JN
DRAFTED	CEC
PROJECT#	114-910499
DATE	03/16/2022

FIGURE **7**

APPENDIX A: PHOTO LOG

Appendix A
Marshall Mesa Underground Coal Mine Fire Investigation Photolog
Boulder, CO

PHOTOGRAPH 1 02-17-2022 View of the snowmelt area to the south.

PHOTOGRAPH 2 02-17-2022 View to north across AOI with snowmelt visible.

PHOTOGRAPH 3 Fracture sample location MV07 with animal tracks entering/exiting.

PHOTOGRAPH 4 02-21-2022 Drilling MM-01

PHOTOGRAPH 5 03-06-2022 UAV Snowmelt looking South.

PHOTOGRAPH 6 03-10-22 Snowmelt looking to the south.

Boulder, CO

PHOTOGRAPH 7 03-06-2022 UAV snowmelt looking Northwest.

PHOTOGRAPH 8 02-22-2022 MM-03 Drilling

PHOTOGRAPH 9 02-24-2022 MM-06 Drilling through coal.

PHOTOGRAPH 10 02-24-2022 MM-01 Grouting

PHOTOGRAPH 11 03-06-2022 Possible snowmelt areas north of the AOI.

PHOTOGRAPH 12 03-09-2022 Parking lot possible snowmelt.

APPENDIX B: BOREHOLE LOGS

Tetra Tech Inc
3801 Automation Way, Suite 100
Fort Collins, CO, 80525
Telephone: 970-223-9600
Fax: 970-223-7171

BOREHOLE ID: MM-01

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 2022

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/21/2022
CONSULTANT: Tetra Tech
CONTRACTOR: Authentic Drilling
EQUIPMENT: CME 55

GROUND ELEVATION: 5575 ft
LATITUDE: 39.952038 N
LONGITUDE: -105.232111 W
INCLINATION: Vertical

METHOD: ODEX
LOGGED BY: Jeffrey Nuttall
DRILLED BY: Jake
LOCATION: Marshall Mesa

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Completion
0			**FILL** silty sand with cobbles (1"-6"), brown, dry	
5			5.0 — 5569.7	
			FILL silty sand with cobbles and boulders, brown, dry Easy drilling	
			8.5 — 5566.2	
10			**SANDSTONE** tan to brown, surface casing set at 13.5' drilling softer, lost returns 900ppm CO 4.2 H2S 13% O2 venting from casing	
			13.5 — 5561.2	
15			Thermocouple wire installed to a depth of 7' Grout/bentonite tremmied from bottom of borehole to surface **RUBBLE** switch to tri-cone bit, no returns from 13.5' to 18.5' easy drilling, fill/rubble, coal, ash zone venting from casing at 13.5'	
20			little to no resistance from 18.5' to 23.5', ash pocket	
			23.5 — 5551.2	
25			**SANDSTONE** tan to brown no returns, rig chatter from 23.5' to 28.5' solid drilling 24-33.5'	Grout/bentonite
30			Warm venting borehole 1700ppm CO	
			33.5 — 5541.2	
			-Borehole grouted from 14' to 33.5' -Pumped 2 batches but couldn't bring the level above 14'. -Concrete truck pumped 1 yard down the borehole to complete 0' to 14'	
			Bottom of borehole at 33.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

TETRA TECH
Tetra Tech Inc
3801 Automation Way, Suite 100
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Fax: 970-223-7171

BOREHOLE ID: MM-02

CLIENT State of Colorado DRMS
PROJECT NAME Marshall Drilling 2022
PROJECT NUMBER 114-910599
PROJECT LOCATION Boulder County, CO

DATE(S) OF DRILLING: 02/21/2022
GROUND ELEVATION: 5580 ft
METHOD: ODEX
CONSULTANT: Tetra Tech
LATITUDE: 39.951678 N
LOGGED BY: Jeffrey Nuttall
CONTRACTOR: Authentic Drilling
LONGITUDE: -105.232449 W
DRILLED BY: Jake
EQUIPMENT: CME 55
INCLINATION: Vertical
LOCATION: Marshall Mesa

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Completion
0			**FILL** overburden material — 1.5 — 5578.9	
			SANDSTONE tan to light tan, surface casing set at 8.5'	
5			steady drilling	
10			12.0 — 5568.4	
			SHALE gray/dark gray	
15			Thermocouple wire installed to a depth of 15'	
			17.0 — 5563.4	
			COAL black	
20				Grout/bentonite
			24.0 — 5556.4	
25			H2S-0.0 ppm CO-53 ppm LEL 0% O2-18.8 Borehole sat overnight temperature was 89 degrees F	
30			Bottom of borehole at 34.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

Tetra Tech Inc
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Fax: 970-223-7171

BOREHOLE ID: MM-03

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 2022

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/23/2022
CONSULTANT: Tetra Tech
CONTRACTOR: Authentic Drilling
EQUIPMENT: CME 55

GROUND ELEVATION: 5582 ft
LATITUDE: 39.951415 N
LONGITUDE: -105.232666 W
INCLINATION: Vertical

METHOD: ODEX
LOGGED BY: Jeffrey Nuttall
DRILLED BY: Jake
LOCATION: Marshall Mesa

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Completion
0					
			1.0 **FILL** overburden	5581.1	
			SANDSTONE brown to reddish brown, surface casing set at 8.5'		
5					
10					
			12.5 **CLINKER/RED SANDSTONE** reddish tan, ash lens	5569.6	
15					
20			Thermocouple wire installed to a depth of 21.5'		
			21.0 Grout/bentonite tremmied from bottom of borehole to surface	5561.1	
			COAL black, no gasses detected		
25					Grout/bentonite
			26.5 **SHALE** gray	5555.6	
30			No gas detected, no odors, no heat		
			32.0	5550.1	
			Bottom of borehole at 32.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

Tetra Tech Inc
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Fax: 970-223-7171

BOREHOLE ID: MM-04

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 2022

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/22/2022 **GROUND ELEVATION: 5589 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **LATITUDE: 39.951154 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **LONGITUDE: -105.232891 W** **DRILLED BY: Jake**

EQUIPMENT: CME 55 **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Completion
0				
1.0			**FILL** overburden material	5587.7
			SANDSTONE brown, interbedded with shale, solid drilling, surface casing set at 8.5'	
5				
10				Grout/bentonite
15				
20			Red sandstone and clinker from 20' to 22'	Bentonite
22.0				5566.7
			RUBBLE/ASH rubble and ash zones, lost circulation at 22', bit bouncing Thermocouple wire installed to a depth of 23'	
25				slotted 3" pipe
30				
31.0				5557.7
			SHALE solid drilling 31' to 34.5' Grout basket at 20' Slotted pipe from 24' to 34'	
34.5				5554.2
			Bottom of borehole at 34.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

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Tetra Tech Inc
3801 Automation Way, Suite 100
Fort Collins, CO, 80525
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Fax: 970-223-7171

BOREHOLE ID: MM-05

CLIENT State of Colorado DRMS
PROJECT NAME Marshall Drilling 2022
PROJECT NUMBER 114-910599
PROJECT LOCATION Boulder County, CO

DATE(S) OF DRILLING: 02/23/2022
CONSULTANT: Tetra Tech
CONTRACTOR: Authentic Drilling
EQUIPMENT: CME 55
GROUND ELEVATION: 5595 ft
LATITUDE: 39.950918 N
LONGITUDE: -105.232997 W
INCLINATION: Vertical
METHOD: ODEX
LOGGED BY: Jeffrey Nuttall
DRILLED BY: Jake
LOCATION: Marshall Mesa

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Completion
0			0.5 **OVERBURDEN MATERIAL** 5594.4 brown **SANDSTONE** brown, shale lenses, surface casing set at 8.5'	
29.0			**RUBBLE/ASH** 5565.9 soft, voids, rig chatter Lost circulation at 29'	
39.0			**SHALE** 5555.9 steady drilling, no returns	
50.0			No gas detected No heat detected Installed 3" steel casing Slotted pipe from 30' to 40' 5544.9 Bottom of borehole at 50.0 feet.	

Grout/bentonite
Bentonite
3" slotted pipe

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

TETRA TECH
Tetra Tech Inc
3801 Automation Way, Suite 100
Fort Collins, CO, 80525
Telephone: 970-223-9600
Fax: 970-223-7171

BOREHOLE ID: MM-06

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 2022

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5578 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **LATITUDE: 39.951799 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **LONGITUDE: -105.232474 W** **DRILLED BY: Jake**

EQUIPMENT: CME 55 **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Completion
0	**OVERBURDEN** sandy silt, brown		
1.5		5576.5	
	SANDSTONE brown, dry, steady drilling, surface casing set to 8.5'		
8.5	Color changing to gray, shale increasing	5569.5	
	SANDSTONE/SHALE brown/gray		
11.0		5567.0	
	COAL black Thermocouple wire installed to a depth of 12' Grout/bentonite tremmied from bottom of borehole to surface		Grout/bentonite
22.0		5556.0	
	SHALE gray, steady drilling		
24.5		5553.5	
	Bottom of borehole at 24.5 feet.		

5
10
15
20

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

Tetra Tech Inc
3801 Automation Way, Suite 100
Fort Collins, CO, 80525
Telephone: 970-223-9600
Fax: 970-223-7171

BOREHOLE ID: MM-07

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 2022

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5576 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **LATITUDE: 39.952014 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **LONGITUDE: -105.232266 W** **DRILLED BY: Jake**

EQUIPMENT: CME 55 **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Completion
0			**OVERBURDEN** sandy silt, brown		
1.5				5574.0	
			SANDSTONE brown, dry, steady drilling, good circulation		
8.5				5567.0	
			SANDSTONE/SHALE brown, green/gray		
11.0				5564.5	
			COAL black Thermocouple wire installed to a depth of 12' Grout/bentonite tremmied from bottom of borehole to surface		Grout/bentonite
21.5				5554.0	
			SHALE gray, steady drilling		
24.5				5551.0	
			Bottom of borehole at 24.5 feet.		

5
10
15
20

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

TETRA TECH
Tetra Tech Inc
3801 Automation Way, Suite 100
Fort Collins, CO, 80525
Telephone: 970-223-9600
Fax: 970-223-7171

BOREHOLE ID: MM-08

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 2022

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5570 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **LATITUDE: 39.952027 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **LONGITUDE: -105.231949 W** **DRILLED BY: Jake**

EQUIPMENT: CME 55 **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Completion
0	**FILL** clayey sand/sandy lean clay		
3.5		5566.6	
5	**SANDSTONE** tan		
11.0		5559.1	
10	**SANDSTONE** interbedded with shale, red to tan, clinker? iron rich layer?		
15			
20			Grout/bentonite
22.0		5548.1	
25	**COAL** carbonaceous shale, black Thermocouple wire installed to a depth of 24' Grout/bentonite tremmied from bottom of borehole to surface		
28.0		5542.1	
30	**SHALE** gray, sandstone lenses		
35			
35.0		5535.1	
40	**COAL** black		Bentonite
41.0		5529.1	
45	**SHALE** gray, sandstone lenses		3" slotted pipe
49.0	no gas detected no heat detected no odor Slotted pipe interval from 41' to 49'	5521.1	

Bottom of borehole at 49.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

Tetra Tech Inc
3801 Automation Way, Suite 100
Fort Collins, CO, 80525
Telephone: 970-223-9600
Fax: 970-223-7171

BOREHOLE ID: MM-09

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 2022

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5574 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **LATITUDE: 39.952156 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **LONGITUDE: -105.232168 W** **DRILLED BY: Jake**

EQUIPMENT: CME 55 **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Completion
0					
			OVERBURDEN brown/tan	5572.7	
1.5			**SANDSTONE** brown, steady drilling, good circulation		
10.0				5564.2	
			COAL good circulation Thermocouple wire installed to 12' Thermocouple wire installed to 29' Grout/bentonite tremmied from bottom of borehole to surface		
20.0				5554.2	
			SHALE gray		
24.0				5550.2	
			SHALE/SANDSTONE gray/tan, good circulation		
29.0				5545.2	
			COAL changes to brown shale with depth		Grout/bentonite
34.0				5540.2	
			SHALE brown to gray, sandstone lenses, good returns		
54.0				5520.2	
			Bottom of borehole at 54.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022.GPJ ALL REPORTS JLR 2-14-11.GDT 3/11/22

APPENDIX B: Photo Log

APPENDIX B – PHOTO LOG

Marshall Mesa Underground Mine Fire Report of Investigation Photo Log

PHOTOGRAPH 1 Marshall Mesa Trailhead looking southwest, November 2018

PHOTOGRAPH 2 1-14-2022 Gas and Temperature Observations

PHOTOGRAPH 3 2-17-2022 Snowmelt looking West

PHOTOGRAPH 4 2-17-2022 Snowmelt looking South

PHOTOGRAPH 5 2-17-2022 Snowmelt looking North

PHOTOGRAPH 6 03-06-2022 UAV snowmelt looking Northwest.

APPENDIX B – PHOTO LOG

Marshall Mesa Underground Mine Fire Report of Investigation Photo Log

PHOTOGRAPH 7 03-06-2022 UAV parking lot snowmelt

PHOTOGRAPH 8 03-06-2022 UAV Snowmelt looking South.

PHOTOGRAPH 9 03-09-2022 Parking lot snowmelt

PHOTOGRAPH 10 03-10-22 Snowmelt looking to the south.

PHOTOGRAPH 11 2-21-2022 Drilling MM-01

PHOTOGRAPH 12 02-24-2022 MM-01 Grouting

APPENDIX B – PHOTO LOG

Marshall Mesa Underground Mine Fire Report of Investigation Photo Log

PHOTOGRAPH 13 02-22-2022 MM-03 Drilling

PHOTOGRAPH 14 02-24-2022 MM-06 Drilling

PHOTOGRAPH 15 03-06-2023 Set up on MM-26

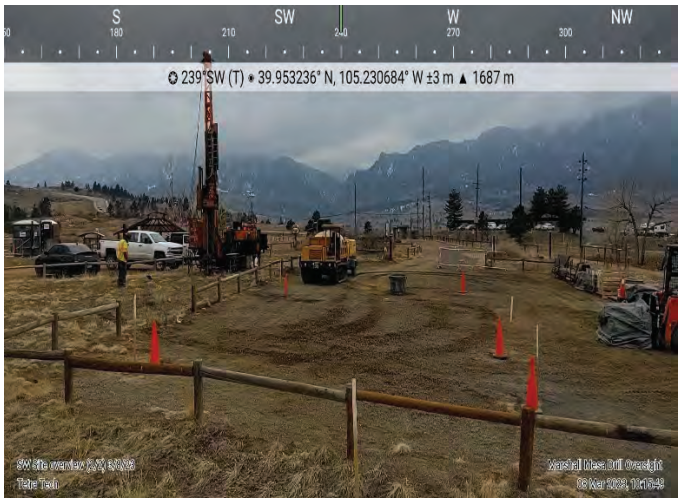
PHOTOGRAPH 16 02-24-2022 MM-26 Drilling through coal

PHOTOGRAPH 17 03-08-2023 Site overview looking south from parking lot

PHOTOGRAPH 18 03-08-2023 Site overview looking southeast from parking lot

APPENDIX B – PHOTO LOG

Marshall Mesa Underground Mine Fire Report of Investigation Photo Log



PHOTOGRAPH 19 03-08-2023 Site overview looking southwest from parking lot

PHOTOGRAPH 20 MM-21, in foreground

PHOTOGRAPH 21 03-08-2023Snow melt area borehole location, looking southwest

PHOTOGRAPH 22 View to north. MM-29 in the foreground, Marshall Rd in background.

PHOTOGRAPH 23 Clinker cuttings from MM-47, looking north.

PHOTOGRAPH 24 Drilling MM-36, view to the west.

APPENDIX B – PHOTO LOG

Marshall Mesa Underground Mine Fire Report of Investigation Photo Log

PHOTOGRAPH 25 Setting up on Test Pit 1.

PHOTOGRAPH 26 Fractured sandstone and shale in Test Pit 3.

PHOTOGRAPH 27 Test Pit 4 clinker and coal waste.

PHOTOGRAPH 28 Test Pit 5 in the OSM reclamation area.

PHOTOGRAPH 29 Test Pit 6, coal waste underlain by sandstone.

PHOTOGRAPH 30 Test Pit 7 looking east.

APPENDIX C: Borehole Logs

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BOREHOLE ID: MM-01

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/21/2022 **GROUND ELEVATION: 5573 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771800.165000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075111.453000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**FILL** silty sand with cobbles (1"-6"), brown, dry		Thermocouple wire
5				5568.5	Bentonite grout
			5.0 **FILL** silty sand with cobbles and boulders, brown, dry Easy drilling	
			8.5	5565.0
10			**SANDSTONE** tan to brown, surface casing set at 13.5' drilling softer, lost returns venting from casing	
			13.5	5560.0
15			**RUBBLE** switch to tri-cone bit, no returns from 13.5' to 18.5' easy drilling, fill/rubble, coal, ash zone venting from casing at 13.5'	
20			little to no resistance from 18.5' to 23.5', ash pocket	
			23.5	5550.0
25			**SANDSTONE** tan to brown no returns, rig chatter from 23.5' to 28.5' solid drilling 24-33.5'	
30			Warm venting borehole GEM 5000 Readings 2/22/22 CO2 9.8% O2 10.1% H2S 4ppm CO 1743ppm Temperature 109 degrees F -Borehole grouted from 14' to 33.5' -Pumped 2 batches but couldn't bring the level above 14'. -Concrete truck pumped 1 yard down the borehole to complete 0' to 14' -Grouted borehole with thermocouple set to 17 ft. -Completed with 12" landscape flush mount vault		
			33.5	5540.0
			Bottom of Test Hole at 33.5 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-02

CLIENT State of Colorado DRMS
PROJECT NAME Marshall Drilling 202T
PROJECT NUMBER 114-910599
PROJECT LOCATION Boulder County, CO

DATE(S) OF DRILLING: 02/21/2022
GROUND ELEVATION: 5579 ft
METHOD: ODEX
CONSULTANT: Tetra Tech
NORTHING: 1771657.791000 N
LOGGED BY: Jeffrey Nuttall
CONTRACTOR: Authentic Drilling
EASTING: 3075010.939000 E
DRILLED BY: Jacob Bakken
EQUIPMENT: Acker Renegade
INCLINATION: Vertical
LOCATION: Marshall Mesa

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0				
			1.5 — 5577.7 **FILL** overburden material	
			SANDSTONE tan to light tan, surface casing set at 8.5'	Thermocouple wire
5				Bentonite grout
			steady drilling	
10				
			12.0 — 5567.2 **SHALE** gray/dark gray	
15				
			17.0 — 5562.2 **COAL** black	
20				
			24.0 — 5555.2 GEM 5000 Readings 2/22/22 CO2 5.1% O2 13.5% H2S 1ppm CO 199ppm Borehole sat overnight temperature was 89 degrees F. -Grouted borehole with thermocouple set to 15 ft. -Completed with 12" landscape flush mount vault Bottom of Test Hole at 24.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-03

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/21/2022 **GROUND ELEVATION: 5581 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771559.224000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3074941.135000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			1.0 **FILL** overburden	5579.9	
			SANDSTONE brown to reddish brown, surface casing set at 8.5'		Thermocouple wire
5					Bentonite grout
10			12.5 **CLINKER/RED SANDSTONE** reddish tan, ash lens	5568.4	
15					
20			21.0 **COAL** black, no gasses detected	5559.9	
25			26.5 **SHALE** gray	5554.4	
30			No gas detected, no odors, no heat		
			32.0 -Grouted borehole with thermocouple set to 21.5 ft. -Completed with 12" landscape flush mount vault	5548.9	
			Bottom of Test Hole at 32.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-04

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/22/2022 **GROUND ELEVATION: 5587 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771460.699000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3074885.349000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0				
			1.0 **FILL** overburden material 5586.1	
			SANDSTONE brown, interbedded with shale, solid drilling, surface casing set at 8.5'	
5				
10				Grout/bentonite
15				Bentonite
20			Red sandstone and clinker from 20' to 22'	
			22.0 5565.1	slotted 3" pipe
25			**RUBBLE/ASH** rubble and ash zones, lost circulation at 22', bit bouncing Grouted borehole with thermocouple set to 23 ft. Slotted pipe from 24 to 34 feet below ground surface. No heat, odors, or gases observed. Completed with 12-inch flush mount well vault.	
30			31.0 5556.1	
			SHALE solid drilling 31' to 34.5'	
			34.5 5552.6	
			Bottom of Test Hole at 34.5 feet.	

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BOREHOLE ID: MM-05

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/23/2022 **GROUND ELEVATION: 5595 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771376.811000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3074851.951000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			0.5 **OVERBURDEN MATERIAL** 5594.4 brown **SANDSTONE** brown, shale lenses	
5				
10			Surface casing set at 8.5 feet below ground surface.	Grout/bentonite
15				
20				
25				Bentonite
30			29.0 5565.9 **RUBBLE/ASH** soft, voids, rig chatter Lost circulation at 29 feet below ground surface.	
35				3" slotted pipe
40			39.0 5555.9	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-05

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** steady drilling, no returns *(continued)*	
45				
50			No gas detected No heat detected Installed 3-inch steel casing. 5544.9 Slotted pipe from 30 to 40 feet below ground surface. 50.0 Grout basket at 27 feet below ground surface. Grouted borehole with thermocouple set to 27 ft. Completed with 12" landscape flush mount vault Bottom of Test Hole at 50.0 feet.	

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BOREHOLE ID: MM-06

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5576 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771712.403000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3074999.563000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**OVERBURDEN** sandy silt, brown	5574.9	
			1.5		
			SANDSTONE brown, dry, steady drilling, surface casing set to 8.5'		Thermocouple wire
5					Bentonite grout
			8.5	5567.9	
			Color changing to gray, shale increasing		
10			**SANDSTONE/SHALE** brown/gray		
			11.0	5565.4	
			COAL black		
15					
20					
			22.0	5554.4	
			SHALE gray, steady drilling		
			24.5	5551.9	
			Grouted borehole with thermocouple set to 12 ft. Completed with 12" landscape flush mount vault Bottom of Test Hole at 24.5 feet.		

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BOREHOLE ID: MM-07

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5574 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771785.461000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075066.637000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**OVERBURDEN** sandy silt, brown	5572.5	
			1.5		
			SANDSTONE brown, dry, steady drilling, good circulation		Thermocouple wire
5					Bentonite grout
			8.5	5565.5	
			SANDSTONE/SHALE brown, green/gray		
10			11.0	5563.0	
			COAL black		
15					
20			21.5	5552.5	
			SHALE gray, steady drilling		
			24.5	5549.5	
			Grouted borehole with thermocouple set to 12 ft. Completed with 12" landscape flush mount vault Bottom of Test Hole at 24.5 feet.		

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BOREHOLE ID: MM-08

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5571 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771789.344000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075147.934000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**FILL** clayey sand/sandy lean clay		
3.5				5567.0	
5			**SANDSTONE** tan		
10					
11.0				5559.5	
15			**SANDSTONE** interbedded with shale, red to tan, clinker? iron rich layer?		
20					← Grout/bentonite
25					
26.0			Grouted borehole with thermocouple set to 24 ft. Completed with 12" landscape flush mount vault	5544.5	
28.0			**COAL** carbonaceous shale, black	5542.5	
30			**SHALE** gray, sandstone lenses		
35					
35.0				5535.5	
40			**COAL** black		← Bentonite

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-08

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40				
			41.0 5529.5 **SHALE** gray, sandstone lenses	
45			▽	3" slotted pipe
			no gas detected no heat detected no odor	
			49.0 5521.5 Installed 49 feet of steel casing. Grout basket at 40 feet below ground surface and grouted to the surface. Slotted pipe interval from 41 to 49 feet below ground surface. Water level 45 feet below ground surface. Completed with 12-inch flush mount well vault. Bottom of Test Hole at 49.0 feet.	

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BOREHOLE ID: MM-09

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 02/24/2022 **GROUND ELEVATION: 5572 ft** **METHOD: ODEX**

CONSULTANT: Tetra Tech **NORTHING: 1771853.591000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075099.954000 E** **DRILLED BY: Jacob Bakken**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0					
			OVERBURDEN brown/tan		
1.5				5570.3	
			SANDSTONE brown, steady drilling, good circulation		Thermocouple wire
5					Bentonite grout
10					
10.0				5561.8	
			COAL good circulation		
15					
20					
20.0				5551.8	
			SHALE gray		
24.0				5547.8	
25			**SHALE/SANDSTONE** gray/tan, good circulation		
29.0				5542.8	
30			**COAL** changes to brown shale with depth		
31.0				5540.8	
			SHALE brown to gray, sandstone lenses, good returns		
35					
40					

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-09

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** brown to gray, sandstone lenses, good returns *(continued)*	
45				
50				
			54.0 5517.8	

First thermocouple wire installed to 12 feet below ground surface.
Second thermocouple wire installed to 29 feet below ground surface.
Completed with 12-inch flush mount well vault.

Bottom of Test Hole at 54.0 feet.

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BOREHOLE ID: MM-10

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/03/2023 **GROUND ELEVATION: 5580 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771587.947000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3074910.982000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			
	0.5 **TOPSOIL** Brown	5579.2	
	SANDSTONE Tan, dry, hard, drill chatter to 2 feet Softer, color changed to tan to tannish brown		Thermocouple wire
5	5.0	5574.7	Bentonite grout
	CLINKER SANDSTONE Red to reddish tan, some chatter at hard lenses		
10			
	12.0	5567.7	
	RUBBLE Poor returns of red, fast drilling		
15	Loss of circulation		
	17.0	5562.7	
	SHALE Firm, no returns, steady drilling		
20	Poor returns of dark gray shale to 20 feet Loss of returns		
25	Good returns of gray shale, drill chatter to 27 feet Steady drilling		
30			
	32.0	5547.7	
	COAL Black, soft		
35	36.0	5543.7	
	SHALE Dark brown to dark gray, steady drilling		
	39.0	5540.7	
	Grouted borehole with thermocouple set to 12 ft.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-10

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
			Completed with 6" landscape flush mount vault No heat, odors, or gases were observed. Bottom of Test Hole at 39.0 feet.	

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BOREHOLE ID: MM-11MW

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/03/2023 **GROUND ELEVATION: 5579 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771664.306000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3074952.628000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Tan to light gray, dry, hard		
				5.0 / 5574.1	
			INTERBEDDED SHALE AND SANDSTONE Dark gray to tan, fast drilling		
				7.0 / 5572.1	
			COAL Black, soft, set thermocouple wire at 7 feet		
				17.5 / 5561.6	
			SHALE Gray to dark gray, some coal content in upper 6 inches, hard, slower drilling		
				26.0 / 5553.1	
			SANDSTONE Tan to light gray, moist, hard		
				28.0 / 5551.1	
			SHALE Gray, slightly moist		
				30.0 / 5549.1	
			COAL Black		
				35.0 / 5544.1	
			SHALE Gray to dark brown, slightly moist, some coal content in upper foot, steady drilling		

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-11MW

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** Gray to dark brown, slightly moist, some coal content in upper foot, steady drilling *(continued)*	
			Drill chatter	
		44.0	5535.1	
			Screen placed to 30 feet and sand added to 2 feet below ground surface. Bottom of Test Hole at 44.0 feet.	

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BOREHOLE ID: MM-12

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/03/2023 **GROUND ELEVATION: 5574 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771752.504000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3074997.897000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Brown to tan, dry, hard		Thermocouple wire
5.5				5568.9	
6.5			**SHALE** Gray to brownish gray	5567.9	Bentonite grout
			COAL Black, dry, hard, good circulation		
13.0				5561.4	
			SHALE Gray, dry		
18.0				5556.4	
			INTERBEDDED SANDSTONE AND SHALE Gray to brown, hard		
21.0				5553.4	
			SANDSTONE Brown to tan, hard, good circulation		
24.5			Shale layers from 24 to 24.5 feet below ground surface.	5549.9	
			SHALE Dark gray, dry, hard		
26.5			Color change to brown.	5547.9	
			COAL Black Grouted borehole with thermocouple set to 7 ft and 27 ft. Completed with 6"" landscape flush mount vault.		
30.5				5543.9	
			SHALE Brown, hard, good circulation		
32.5				5541.9	
			SANDSTONE Gray, moist, hard		
40					

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-12

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SANDSTONE** Gray, moist, hard *(continued)*	
45			46.0 5528.4 **SHALE** Gray, hard	
			49.5 5524.9 **SANDSTONE** Brown Bottom of Test Hole at 49.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-13

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/03/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771848.433000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075050.509000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			
	0.5 **TOPSOIL**	5569.5	
	SANDSTONE Brown to tan, dry		Thermocouple wire
	4.5	5565.5	
5	5.0 **SHALE** Brown, dry, hard	5565.0	
	COAL Black		Bentonite grout
	7.5 **SHALE** Gray to brown	5562.5	
10	Gray		
	Gray and brown layers		
	13.5	5556.5	
	14.5 **SANDSTONE** Brown	5555.5	
15	15.5 **SHALE** Gray	5554.5	
	16.5 **SANDSTONE** Tan to gray	5553.5	
	SHALE Gray to dark gray, dry, hard		
20	21.0	5549.0	
	COAL Black		
	22.5	5547.5	
	23.0 **SHALE** Thin layer	5547.0	
25	25.0 **COAL** Black	5545.0	
	26.0 **INTERBEDDED SHALE AND SANDSTONE** Gray	5544.0	
	SANDSTONE Gray, hard, steady drilling		
	29.5	5540.5	

Grouted borehole with thermocouple set to 6 ft.
Completed with 6" landscape flush mount vault.

No heat, odors, or gases were observed.

Bottom of Test Hole at 29.5 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-14

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/30/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771922.767000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075087.597000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			0.5 **TOPSOIL** Gravel	5568.3	
			SANDSTONE Tan		
			4.0	5564.8	
5			**COAL** Mildly volatilized/weathered		Thermocouple wire
			7.0	5561.8	
			SILTSTONE Brown		
10					Bentonite grout
			13.0	5555.8	
			SANDSTONE Brown to tan		
15			17.0	5551.8	
			COAL Intact		
20			22.0	5546.8	
			SILTSTONE Gray, increased moisture, slight increase in clay portion with depth		
25					
30					
35			35.0	5533.8	
			SHALE Dark gray		
40			40.0	5528.8	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-14

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
			Grouted borehole with thermocouple set to 17 ft. Completed with 6" landscape flush mount vault. Bottom of Test Hole at 40.0 feet.	

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BOREHOLE ID: MM-15

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/30/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771951.843000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075151.684000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			0.5 **TOPSOIL** Gravel	5569.5	
			SANDSTONE Light brown		
5			5.0	5565.0	Thermocouple wire
			COAL Sharp boundary		
10					Bentonite grout
			13.0	5557.0	
15			**SILTY SHALE** Dark gray		
			Increased moisture and sand portion.		
20			Transitioning to light gray color.		
			23.0	5547.0	
25			**COAL** 25.0	5545.0	
			SILTSTONE Brown		
			27.0	5543.0	
			COAL		
30			29.0	5541.0	
			SILTSTONE Brown, transitioning to light gray and increased moisture with depth		
35					
40			40.0	5530.0	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-15

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
			Grouted borehole and theremocouple wires set at 14 and 22 feet below ground surface. Completed with 6-inch flush mount irrigation vault. No heat, odors, or gases were observed. Bottom of Test Hole at 40.0 feet.	

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BOREHOLE ID: MM-16

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/30/2023 **GROUND ELEVATION: 5572 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771859.370000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075133.925000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**FILL** Gravel		
			3.0	5569.5	
			SANDSTONE Tan		
5					Thermocouple wire
10			10.0	5562.5	Bentonite grout
			INTERBEDDED SANDSTONE AND SHALE Shale lenses in sandstone		
			11.0	5561.5	
			COAL Intact		
15					
20					
			22.0	5550.5	
			SANDY SHALE Gray		
25					
30					
			32.0	5540.5	
			COAL Intact		
35			35.0	5537.5	
			SILTY SHALE Gray		
40					

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-16

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SILTY SHALE** Gray *(continued)*	
45			45.0 5527.5 Grouted borehole with thermocouple set to 11 ft. Completed with 6" landscape flush mount vault. No heat or odors observed. Bottom of Test Hole at 45.0 feet.	

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BOREHOLE ID: MM-17

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/05/2023 **GROUND ELEVATION: 5578 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771658.140000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075062.436000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			1.0 **TOPSOIL**	5576.9	
			SANDSTONE Brown to tan, dry		
5			4.5 **INTERBEDDED SHALE** Gray, reddish, cooked material, fractured	5573.4	Thermocouple wire
10					Bentonite grout
			13.0 **RUBBLE/VOIDS** rubble, fractured, no returns	5564.9	
15					
20					
25			25.5 **UNKNOWN BEDROCK** Firm drilling, no returns	5552.4	
30			Rods dropping Steady drilling		
			32.0	5545.9	
			33.0 **UNKNOWN BEDROCK** Very hard	5544.9	
			34.5 **UNKNOWN BEDROCK** Steady drilling, no returns	5543.4	
			Grouted borehole with thermocouple set to 15 ft. Completed with 6" landscape flush mount vault. Venting warm		
			Bottom of Test Hole at 34.5 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-18

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/05/2023 **GROUND ELEVATION: 5579 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771608.170000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3074997.408000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			
	1.0 **TOPSOIL** Damp	5578.2	
	SANDSTONE Brown to tan, dry, highly fractured to 2 feet below ground surface.		
	4.5	5574.7	
5	**CLINKER SANDSTONE** Reddish tan, soft drilling, high fractured from 6 to 8 feet below ground surface.		Thermocouple wire
10			Bentonite grout
	14.5	5564.7	
15	**RUBBLE/VOIDS** Lost returns		
20	Bit dropped, almost no resistance to 25 feet below ground surface.		
25	25.0	5554.2	
	UNKNOWN BEDROCK Firm drilling, no returns		
30			
	32.0	5547.2	
	33.0 **UNKNOWN BEDROCK** Very hard	5546.2	
	34.5 **UNKNOWN BEDROCK** Steady drilling, no returns	5544.7	
	Grouted borehole with thermocouple set to 12 ft. Completed with 6" landscape flush mount vault.No heat or odors observed.		
	Venting warm air H2S=2.2 ppm CO=450 ppm		
	Bottom of Test Hole at 34.5 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-19

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/05/2023 **GROUND ELEVATION: 5568 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771833.357000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075237.374000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Brown to tan, dry, hard, good returns		
			Hints of red coloring.		
			Color changed to brown.		
10			10.0	5557.8	
			SHALE 11.0 Gray, dry, hard	5556.8	
			12.0 **SANDSTONE**	5555.8	
			13.0 Brown	5554.8	
			CLINKER SANDSTONE 14.0 Red, faster drilling	5553.8	
15			**SHALE** Gray		
			CLINKER SANDSTONE Deep red		
			18.0 Lost returns	5549.8	
20			**RUBBLE** No returns		
25			28.0	5539.8	
			UNKNOWN BEDROCK Firm drilling, no returns		
30			33.0	5534.8	
			34.0 **UNKNOWN BEDROCK** Grinding bit	5533.8	
			34.5	5533.3	
			UNKNOWN BEDROCK Firm drilling		
			Grouted borehole with thermocouple set to 15 ft. Completed with 6" landscape flush mount vault. No heat or odors observed. Bottom of Test Hole at 34.5 feet.		

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-20

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: Not Recorded **GROUND ELEVATION: 5567 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771914.545000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075283.966000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**INTERBEDDED SANDSTONE AND SHALE** Light brown to gray		
			7.0	5560.5	
			SHALE Brown with a hint of red coloring		
			9.0	5558.5	
			SANDSTONE Yellowish brown		
			11.5	5556.0	
			RUBBLE/VOID Lost circulation		
			27.0	5540.5	
			UNKNOWN BEDROCK No returns, firm drilling		
			Slight grinding		
			34.5	5533.0	
			Grouted borehole with thermocouple set to 10 ft. Completed with 6" landscape flush mount vault. No heat or odors observed. Bottom of Test Hole at 34.5 feet.		

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-21

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/08/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772137.210000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075429.670000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDY GRAVEL**		
			2.0	5567.9	
			SANDSTONE Brown to tan		
5					Thermocouple wire
10			10.0	5559.9	Bentonite grout
			INTERBEDDED SHALE AND SANDSTONE		
15			17.0	5552.9	
			VOID Venting: -Temperature: 103 F -H2S: 5.3 ppm -CO: 300 ppm		
20			20.0	5549.9	
			UNKNOWN BEDROCK Gravel returns to begin then lost circulation, steady drilling		
25			Grouted borehole with thermocouple set to 25 ft. Completed with 6" landscape flush mount vault.		
30					
35					
40			40.0	5529.9	

Bottom of Test Hole at 40.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-22

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/07/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772147.745000 N** **LOGGED BY: Jeff DeTienne**

CONTRACTOR: Authentic Drilling **EASTING: 3075407.518000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDY GRAVEL**	5568.4	
1.0			**SANDSTONE** Tan to light brown		
9.0				5560.4	
			SHALE Gray		
			Softer drilling		
21.0				5548.4	
			COAL		
			Grouted borehole with thermocouple set to 21 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.		
28.0				5541.4	
			SHALE Gray to dark brown		
40.0				5529.4	

Thermocouple wire

Bentonite grout

Bottom of Test Hole at 40.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-23

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/07/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772161.898000 N** **LOGGED BY: Not Recorded**

CONTRACTOR: Authentic Drilling **EASTING: 3075440.578000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	
0				
			1.0 **SANDY GRAVEL**	5568.0
			2.0 **SILTY SAND** Brown	5567.0
			SANDSTONE Tan to light brown	
5				
			8.0	5561.0
			9.0 **SHALE** Gray	5560.0
10			**SHALE** Tan to light brown	
			13.0	5556.0
			14.0 **SHALE** Gray	5555.0
15			**SANDSTONE** Tan with reddish staining	
20			21.0	5548.0
			VOID Lost circulation	
			23.0 Grouted borehole with thermocouple set to 22 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.	5546.0
25			**RUBBLE**	
			27.0	5542.0
			ASSUMED SHALE No returns, hard, drilling	
30				
35				
			39.0	5530.0
40				

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-23

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION
40			
			UNKNOWN BEDROCK Soft drilling *(continued)*
45			
50			50.0 5519.0 Bottom of Test Hole at 50.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-24

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/06/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772174.889000 N** **LOGGED BY: Jeff DeTienne**

CONTRACTOR: Authentic Drilling **EASTING: 3075477.189000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			
	SANDY GRAVEL	5567.6	
1.0			
	SILTY SAND Brown	5566.1	
2.5			
	SANDSTONE Tan to light brown		
5			Thermocouple wire
8.0		5560.6	
8.5	**SHALE** Gray	5560.1	
10	**SHALE** Tan to light brown		Bentonite grout
13.0		5555.6	
14.0	**SHALE** Gray	5554.6	
15	**SANDSTONE** Tan with reddish staining		
20			
21.0		5547.6	
	VOID Lost circulation		
23.0	Grouted borehole with thermocouple set to 22 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.	5545.6	
25	**RUBBLE**		
27.0		5541.6	
	ASSUMED SHALE No returns, hard, drilling ?		
30			
35			
39.0		5529.6	
40			

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-24

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40				
			UNKNOWN BEDROCK Soft drilling *(continued)*	
45				
50			50.0 5518.6 Bottom of Test Hole at 50.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-25

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/07/2023 **GROUND ELEVATION: 5568 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772183.223000 N** **LOGGED BY: Jeff DeTienne**

CONTRACTOR: Authentic Drilling **EASTING: 3075419.912000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			1.0 **SANDY GRAVEL**	5567.4	
			SANDSTONE Tan		
5					Thermocouple wire
10			10.0	5558.4	Bentonite grout
			SHALE Gray		
			12.0	5556.4	
			COAL Black, good circulation		
15					
			Grouted borehole with thermocouple set to 17 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.		
20					
25			27.0	5541.4	
			SHALE Dark gray to dark brown, steady drilling, good circulation		
30					
35			37.0	5531.4	
			COAL Black		
40			39.0	5529.4	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-25

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40			**INTERBEDDED SHALE AND SANDSTONE** Tan to gray *(continued)*		
			42.0	5526.4	
			43.0 **COAL** Black	5525.4	
			SANDSTONE		
45			45.0 Light brown	5523.4	
			SHALE Gray		
50			50.0	5518.4	

Bottom of Test Hole at 50.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-26

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/06/2023 **GROUND ELEVATION: 5568 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772196.356000 N** **LOGGED BY: Jeff DeTienne**

CONTRACTOR: Authentic Drilling **EASTING: 3075459.040000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDY GRAVEL**	
			2.0 — 5566.1	
			SANDSTONE Tan to light brown, very fine grained	
5				Thermocouple wire
10				Bentonite grout
15				
			18.0 — 5550.1	
			RUBBLE Lost returns Grouted borehole with thermocouple set to 20 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.	
20				
			23.0 — 5545.1	
			ASSUMED SHALE Steady drilling	
25				
30				
35				
			35.0 — 5533.1	
			SHALE Dark gray to dark brown, regained circulation	
40				

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-26

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40				
			SHALE Dark gray to dark brown, regained circulation *(continued)*	
45			45.0 5523.1 Bottom of Test Hole at 45.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-27

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/06/2023 **GROUND ELEVATION: 5568 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772200.627000 N** **LOGGED BY: Jeff DeTienne**

CONTRACTOR: Authentic Drilling **EASTING: 3075471.522000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0					
			1.0 **SANDY GRAVEL**	5567.0	
			2.0 **FILL**	5566.0	
			SANDSTONE Tan with reddish staining		
5			6.0	5562.0	Thermocouple wire
			SHALE		
			9.0	5559.0	
10			**SANDSTONE** Tan with reddish staining		Bentonite grout
15					
20			21.0 Color changed to reddish tan.	5547.0	
			RUBBLE Did not lose circulation, soft Grouted borehole with thermocouple set to 22 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.		
25			Dark red returns to 27 feet.		
			28.0	5540.0	
			COAL Black		
30			31.0	5537.0	
			SHALE Gray, moderate drilling		
35					
40					

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-27

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40					
			41.0	5527.0	
			COAL Black		
			43.0	5525.0	
			SHALE Gray		
45					
			46.0	5522.0	
			COAL Black		
			48.0	5520.0	
			SHALE Gray		
50					
55					
60			60.0	5508.0	
			Bottom of Test Hole at 60.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-28

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/07/2023 **GROUND ELEVATION: 5567 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772221.406000 N** **LOGGED BY: Jeff DeTienne**

CONTRACTOR: Authentic Drilling **EASTING: 3075458.301000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDY GRAVEL**	
			SANDSTONE	
			4.0 5563.5	
5			**INTERBEDDED SHALE AND SANDSTONE** Dark red, very fine grained	Thermocouple wire
10			11.0 5556.5	Bentonite grout
			UNKNOWN BEDROCK Steady drilling, not hard	
15				
20			Grouted borehole with thermocouple set to 20 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.	
25			27.0 5540.5	
			28.0 5539.5 **RUBBLE** Drill chatter	
30			**UNKNOWN BEDROCK** Steady drilling	
35				
40				

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-28

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**UNKNOWN BEDROCK** Steady drilling *(continued)*	
45				
50			50.0 5517.5 Bottom of Test Hole at 50.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-29

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/09/2023 **GROUND ELEVATION: 5561 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772364.097000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075582.651000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDY GRAVEL** Smooth drilling		
			2.0	5558.6	
			SANDSTONE Tan, smooth drilling		
5					Thermocouple wire
			7.0	5553.6	
			CLINKER Sandstone, red, burnt, smooth drilling		
10					Bentonite grout
15					
			17.0	5543.6	
			UNKNOWN BEDROCK Lost circulation		
20					
25					
30					
35					
			39.0	5521.6	
			Grouted borehole with thermocouple set to 17 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-29

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
			Bottom of Test Hole at 39.0 feet.	

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BOREHOLE ID: MM-30

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/08/2023 **GROUND ELEVATION: 5553 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772403.300000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075545.245000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			1.0 **SANDY GRAVEL**	5552.1	
			SANDSTONE Brown to tan		
5					Thermocouple wire
			9.0	5544.1	
10			**COAL** Brown, weathered/burnt		Bentonite grout
			11.0	5542.1	
			INTERBEDDED SHALE AND SANDSTONE Light gray		
15					
			18.0	5535.1	
			COAL		
20			21.0	5532.1	
			INTERBEDDED SHALE AND SANDSTONE Gray		
25					
			26.0	5527.1	
			COAL Brown		
			29.0	5524.1	
30			**INTERBEDDED SHALE AND SANDSTONE** Brown to gray		
35					
40					

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-30

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**INTERBEDDED SHALE AND SANDSTONE** Brown to gray *(continued)*	
			44.0 Grouted borehole with thermocouple set to 11 ft. 5509.1 Completed with 6" landscape flush mount vault. No heat or odors observed.	
			Bottom of Test Hole at 44.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-31

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/08/2023 **GROUND ELEVATION: 5555 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772403.050000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075571.754000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**SANDY GRAVEL**		
2.0		5553.2	
3.0	**FILL**	5552.2	
	SANDSTONE Brown to tan		Thermocouple wire Bentonite grout
12.0		5543.2	
	COAL -Grouted borehole with thermocouple set to 13 ft. -Completed with 6" landscape flush mount vault -Temperature: 60 F -H2S and CO: 0 ppm		
15.0		5540.2	
	INTERBEDDED SHALE AND SANDSTONE Light gray		
22.0		5533.2	
	COAL		
24.0		5531.2	
	INTERBEDDED SHALE AND SANDSTONE Dark gray to gray		
31.0		5524.2	
	COAL		
33.0		5522.2	
	INTERBEDDED SHALE AND SANDSTONE Light gray		
39.0		5516.2	
	Bottom of Test Hole at 39.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-32

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/29/2023 **GROUND ELEVATION: 5551 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772479.505000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075646.705000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**FILL** Gravel		
7.0		5544.5	
	COAL Intact		Thermocouple wire Bentonite grout
10.0		5541.5	
	SHALE Gray Grouted borehole with thermocouple set to 11 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.		
22.0		5529.5	
	COAL		
23.5		5528.0	
	SHALE Transition to brown Color changed to gray.		
	Transition to light gray.		
31.0		5520.5	
	COAL		
33.0		5518.5	
	SHALE Light gray		
40.0		5511.5	

Bottom of Test Hole at 40.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-33

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/09/2023 **GROUND ELEVATION: 5555 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772426.840000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075571.704000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0					
			1.0 **SANDY GRAVEL**	5554.5	
			SANDSTONE Tan		
5			5.0	5550.5	Thermocouple wire
			COAL		Bentonite grout
10			-Grouted borehole with thermocouple set to 12 ft. -Completed with 6" landscape flush mount vault		
			12.5	5543.0	
			INTERBEDDED SHALE AND SANDSTONE Dark gray to light gray, shale content increasing with depth, slow drilling and chatter to 15 feet.		
15					
20			21.0	5534.5	
			COAL		
			23.0	5532.5	
			SHALE Gray to dark gray		
25			Hard to 30 feet.		
30			30.0	5525.5	
			COAL		
			32.0	5523.5	
			SILTSTONE Dark grayish brown to light gray		
35					
40			40.0	5515.5	

Bottom of Test Hole at 40.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-34

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/13/2023 **GROUND ELEVATION: 5554 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772422.158000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075749.344000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**FILL** Brown, little resistance		
2.0				5551.5	
			INTERBEDDED SHALE AND SANDSTONE Tan to brown		
10.0				5543.5	
			CLINKER Reddish brown to red, good circulation -Grouted borehole with thermocouple set to 15 ft. -Completed with 6" landscape flush mount vault		
17.0				5536.5	
			RUBBLE fractures Lost circulation at 17', some bit chatter, no odors or gases		
28.0				5525.5	
			SHALE firm drilling, no returns		
34.5				5519.0	
			Bottom of Test Hole at 34.5 feet.		

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-35

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/29/2023 **GROUND ELEVATION: 5541 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772657.862000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075725.745000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Light orange transitioning to tan		
10.5				5530.7	
			COAL		
12.0				5529.2	
			SILTY SHALE Gray		
18.0			-Grouted borehole with thermocouple set to 17 ft. -Completed with 6" landscape flush mount vault	5523.2	
			COAL		
21.0				5520.2	
			SILTSTONE Gray, increased moisture		
30.0				5511.2	
			Bottom of Test Hole at 30.0 feet.		

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-36

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/13/2023 **GROUND ELEVATION: 5541 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772561.109000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075956.390000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**FILL** Brown, dry	
			3.0 — 5537.6	
			SANDSTONE Tan to brown, steady, good circulation	
5				Thermocouple wire
			Drill chatter	Bentonite grout
			9.5 — 5531.1	
10			**SHALE** Brown, dry, good circulation	
			Color change to light gray	
15			Color change to brown Color change to reddish brown	
			Color change to gray Color change to reddish brown, drill chatter	
20			-Grouted borehole with thermocouple set to 20 ft. -Completed with 6" landscape flush mount vault	
			22.5 — 5518.1	
			RUBBLE Lost circulation	
25				
			28.0 — 5512.6	
			SHALE firm drilling, no returns	
30				
			34.5 — 5506.1	
			Bottom of Test Hole at 34.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-37

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/15/2023 **GROUND ELEVATION: 5548 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772728.666000 N** **LOGGED BY: Ed Muller**

CONTRACTOR: Authentic Drilling **EASTING: 3075969.512000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0					
			1.0 **TOPSOIL** Brown	5546.7	
			SANDSTONE Grayish tan, moderately hard drilling Color change to pinkish gray		
5			6.0	5541.7	Thermocouple wire
			SHALE Altered, dark gray, soft drilling		
			9.0	5538.7	Bentonite grout
10			**SANDSTONE** Orange red with gray intervals, moderately hard drilling, minor chatter from 11 feet to 14 feet		
15			16.0	5531.7	
			RUBBLE Loss of circulation, minor to heavy chatter, no returns -Grouted borehole with thermocouple set to 17 ft. -Completed with 6" landscape flush mount vault		
20					
25			28.0	5519.7	
			UNKNOWN BEDROCK Firm, moderatley hard drilling, no returns, shale?		
30			34.0	5513.7	
			Bottom of Test Hole at 34.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-38

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/13/2023 **GROUND ELEVATION: 5533 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772608.353000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3076114.609000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**TOPSOIL** Brown, soft, dry		
2.5		5530.8	
3.5	**SANDSTONE** Tan to light brown, dry, no odor	5529.8	
5.0	**INTERBEDDED SANDSTONE AND SHALE** Gray to light gray	5528.3	Thermocouple wire
6.0	**SANDSTONE** Tan	5527.3	
7.0	**SHALE** Gray, dry, steady drilling, good circulation	5526.3	Bentonite grout
9.0	**COAL** Black, dry	5524.3	
10.0	**SHALE** Brown	5523.3	
12.0	**SANDSTONE** Tan	5521.3	
	SHALE Gray, dry, good circulation Color change to reddish brown. Color change to brown.		
17.0		5516.3	
	SANDSTONE Gray Intense burned red zone to 18 feet. Color change to reddish brown to tan. A little drill chatter. Color changed to reddish tan to reddish brown.		
	More tan than red returns.		
	Drill chatter and quick drilling		
	Steady drilling Color change to brown to reddish brown. -Grouted borehole with thermocouple set to 30 ft. -Completed with 6" landscape flush mount vault		
32.0		5501.3	
	RUBBLE Lost circulation, drill chatter		
36.5		5496.8	
	SHALE Steady drilling, no returns		
40			

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-38

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** Steady drilling, no returns *(continued)*	
			44.5 5488.8 Rubble falling on bit while tripping out. Bottom of Test Hole at 44.5 feet.	

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BOREHOLE ID: MM-39

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/15/2023 **GROUND ELEVATION: 5548 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772844.439000 N** **LOGGED BY: Ed Muller**

CONTRACTOR: Authentic Drilling **EASTING: 3075895.890000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** Tannish gray to tan, moderate to soft drilling	
7.0				5540.5
			SHALE Altered, very soft drilling, brown	
11.0				5536.5
			COAL Dark brown to black, soft -Grouted borehole with thermocouple set to 12 ft. -Completed with 6" landscape flush mount vault	
14.0				5533.5
			SHALE Gray, moderate to hard drilling	
23.0				5524.5
			COAL Black	
25.0				5522.5
			SHALE Gray, moderate to hard drilling	
33.0				5514.5
			COAL Black	
36.0				5511.5
			SHALE Light gray, moderate to hard drilling, slightly moist	

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-39

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40			**SHALE** Light gray, moderate to hard drilling, slightly moist *(continued)*		
45					
50					
55					
			56.0	5491.5	
			SILTSTONE Orangish brown, minor clay, slightly moist, moderate to hard drilling		
60					
			64.0	5483.5	
65			**CLAYEY SILTSTONE** Brown, slightly moist		
70					
			72.0	5475.5	
			SILTY CLAYSTONE Dark brown, soft drilling		
			74.0	5473.5	
75			75.0 **COAL** Black	5472.5	
			SILTSTONE Dark brown, dry		
			79.0	5468.5	
			Bottom of Test Hole at 79.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-40

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/29/2023 **GROUND ELEVATION: 5528 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772958.791000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075834.112000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Tan to brown		
21.0			-Grouted borehole with thermocouple set to 20 ft. -Completed with 6" landscape flush mount vault	5507.3	
			CLAYEY SHALE Dark gray		
24.0				5504.3	
25.0			**SANDSTONE** Brown	5503.3	
27.0			**SHALE** Dark gray	5501.3	
			SANDSTONE Brown		
38.0				5490.3	
			SHALE Dark gray		
40.0				5488.3	

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-40

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40				
45			**SANDSTONE** Brown to tan	
50			50.0 5478.3 After trip out bubbling water could be heard downhole. Temp=56 degrees F. Bottom of Test Hole at 50.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-41

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/29/2023 **GROUND ELEVATION: 5525 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1773046.792000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075909.498000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Tan to light brown		
17.0				5508.4	
18.0			**CLAYSTONE** Red to brown	5507.4	
			SANDSTONE Tan to light brown -Grouted borehole with thermocouple set to 20 ft. -Completed with 6" landscape flush mount vault		
28.0				5497.4	
			SILTSTONE Gray		
30.0				5495.4	
			SANDSTONE Tan to light brown, consistent throughout		
37.0			Increased moisture	5488.4	
			SHALE Brown to black, high organics, increased silt and clay		
40.0				5485.4	

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-41

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40				
			SANDSTONE Tan to light brown, dry to damp	
45				
50			50.0 5475.4 Bottom of Test Hole at 50.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-42

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/15/2023 **GROUND ELEVATION: 5543 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772967.228000 N** **LOGGED BY: Ed Muller**

CONTRACTOR: Authentic Drilling **EASTING: 3076131.356000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0				
			1.0 **TOPSOIL** 5541.7 Brown, soft drilling	
			SANDSTONE Grayish tan with reddish gray intervals Moderate to hard drilling to 4 feet.	
5			Soft drilling to 6 feet.	Thermocouple wire
			Moderate to hard drilling to 12 feet with minor drill chatter.	Bentonite grout
10			12.0 5530.7	
			CLINKER SANDSTONE Red, soft drilling	
			14.0 5528.7	
15			**RUBBLE** Heavy chatter	
			Loss of circulation -Grouted borehole with thermocouple set to 16 ft. -Completed with 6" landscape flush mount vault	
20				
			Heavy chatter to 26 feet.	
25			26.0 5516.7	
			SHALE Firm, moderate to hard drilling, no returns	
30			34.0 5508.7	
			Bottom of Test Hole at 34.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-43

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/15/2023 **GROUND ELEVATION: 5538 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772885.806000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3076238.176000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**SANDSTONE** Tan to light gray		
8.0	Color changed to brown.	5529.5	
9.5	**SHALE** Gray, hard, steady drilling	5528.0	
	INTERBEDDED SANDSTONE AND SHALE Brown to gray, dry, hard, 4 to 6 inch coal seam		
14.5		5523.0	
	INTERBEDDED CLINKER SHALE AND SANDSTONE Red to reddish brown to gray Drill chatter to 17.5 feet.		
19.5		5518.0	
20.5	**SHALE** Gray, steady drilling	5517.0	
22.0	**SANDSTONE**	5515.5	
22.5	Brown	5515.0	
	SHALE Gray		
	CLINKER SANDSTONE Red to gray -Grouted borehole with thermocouple set to 25 ft.		
27.0	-Completed with 6" landscape flush mount vault	5510.5	
	RUBBLE Loss of circulation, drill chatter		
	Some clinker falling in on bit, fast penetration		
	Intermittent returns during reaming.		
37.0		5500.5	
	SHALE No returns, steady, hard drilling		
39.5		5498.0	

Thermocouple wire

Bentonite grout

Bottom of Test Hole at 39.5 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-44

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/13/2023 **GROUND ELEVATION: 5528 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772731.881000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3076282.668000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**TOPSOIL** Brown, dry		
1.5				5526.1	
			SANDSTONE Tan to light brown		
10.0				5517.6	
			INTERBEDDED SANDSTONE AND SHALE Brown		
12.0				5515.6	
			SHALE Gray, dry Color changed to reddish brown. Color changed to brown		
19.5				5508.1	
			INTERBEDDED SANDSTONE AND SHALE Red to brown Color changed to gray to tan. -Grouted borehole with thermocouple set to 30 ft. -Completed with 6" landscape flush mount vault		
28.0				5499.6	
			SANDSTONE Tan, dry, good circulation		
30.0				5497.6	
			CLINKER SANDSTONE Reddish brown Drill chatter, limited circulation		
37.0				5490.6	
			SHALE Steady drilling		
39.5				5488.1	

Thermocouple wire

Bentonite grout

Bottom of Test Hole at 39.5 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-45

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/05/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772035.361000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075288.150000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0					
			1.0 **PARKING LOT** Brown, dry	5568.4	
			SANDSTONE Brown, dry, medium hard		
5					Thermocouple wire
			7.0	5562.4	
			INTERBEDDED SANDSTONE AND SHALE Brown		Bentonite grout
10			-Grouted borehole with thermocouple set to 10 ft. -Completed with 6" landscape flush mount vault		
			Lost circulation		
			14.5	5554.9	
15			**RUBBLE** no returns		
20					
25			25.0	5544.4	
			SHALE Steady drilling, no returns		
30			30.0	5539.4	
			Bottom of Test Hole at 30.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-46

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/27/2023 **GROUND ELEVATION: 5538 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772221.759000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075921.009000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			1.0 **PARKING LOT** Brown, dry 5537.2	
			SANDSTONE Brown, dry, medium hard	
5				Thermocouple wire
10				Bentonite grout
15				
20			20.0 5518.2	
			SHALE gray, dry, hard, sandstone lenses, color changing to brown with depth	
25				
30				
35			-Grouted borehole with thermocouple set to 33 ft. -Completed with 6" landscape flush mount vault 35.0 5503.2	
			RUBBLE no returns 37.0 5501.2	
40			**SHALE** Steady drilling, little to no returns	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-46

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** Steady drilling, little to no returns *(continued)*	
45				
			49.5 5488.7 Bottom of Test Hole at 49.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-47

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/22/2023 **GROUND ELEVATION: 5555 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772273.404000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075740.116000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** brown to light brown	
11.0				5544.1
			SHALE/SANDSTONE interbedded layers, gray/dark brown, possible rider seam interbedded	
19.5				5535.6
			CLINKER reddish layers, limited returns, shale and sandstone, red/gray/brown	
37.0				5518.1
			SHALE gray, dry, hard, reddish sandstone layers -Grouted borehole with thermocouple set to 38 ft. -Completed with 6" landscape flush mount vault	

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-47

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40				
			SHALE gray, dry, hard, reddish sandstone layers *(continued)*	
45			46.5 5508.6	
			COAL	
			48.5 5506.6	
50			**SHALE** dark gray, dry, hard	
			54.5 5500.6	
			Bottom of Test Hole at 54.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-48

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/22/2023 **GROUND ELEVATION: 5563 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772133.710000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075621.092000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Tan, dry, hard		
11.0				5552.0	
			COAL		
14.5				5548.5	
			SANDSTONE Brown, dry, good circuation		
19.5				5543.5	
			SHALE Gray, dry, hard		
22.5				5540.5	
			SANDSTONE Yellowish brown to tan		
24.5				5538.5	
			SHALE Gray		
26.5				5536.5	
			SANDSTONE Brown to tan		
28.5				5534.5	
			CLINKER Reddish brown		
			Ash or shale layer to 39.5 feet.		

Thermocouple wire

Bentonite grout

5 10 15 20 25 30 35 40

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-48

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40					
			CLINKER Reddish brown *(continued)* -Grouted borehole with thermocouple set to 40 ft. -Completed with 6" landscape flush mount vault		
			43.0 Color changed to red.	5520.0	
45			**RUBBLE** Drill chatter Loss of circulation		
			47.0	5516.0	
			SHALE Solid drilling		
50					
			54.5	5508.5	
			Bottom of Test Hole at 54.5 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-49

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/24/2023 **GROUND ELEVATION: 5547 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771978.391000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075691.638000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** Tan, dry, hard	
9.5				5537.5
			SHALE Gray, dry, hard	
20.0				5527.0
			INTERBEDDED shale, sandstone, dark gray/gray/grayish brown	
39.5				5507.5

Thermocouple wire

Bentonite grout

5 10 15 20 25 30 35 40

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-49

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** Gray *(continued)*	
			43.0 5504.0	
			COAL	
45				
			47.0 5500.0	
			SHALE Gray	
			49.5 -Grouted borehole with thermocouple set to 40 ft. -Completed with 6" landscape flush mount vault 5497.5	
			Bottom of Test Hole at 49.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-50 MW

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/21/2023 **GROUND ELEVATION: 5555 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771702.127000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075461.002000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDSTONE** Light gray to tan, dry, hard		2" PVC riser
9.0				5545.5	
9.5			**SHALE** Gray, dry, steady drilling	5545.0	Bentonite grout
			INTERBEDDED SHALE AND SANDSTONE Trace coal		
14.0				5540.5	
			SHALE Brown		
19.5				5535.0	
			CLINKER SANDSTONE AND SHALE Reddish brown		
39.0			Loose to 39 feet.	5515.5	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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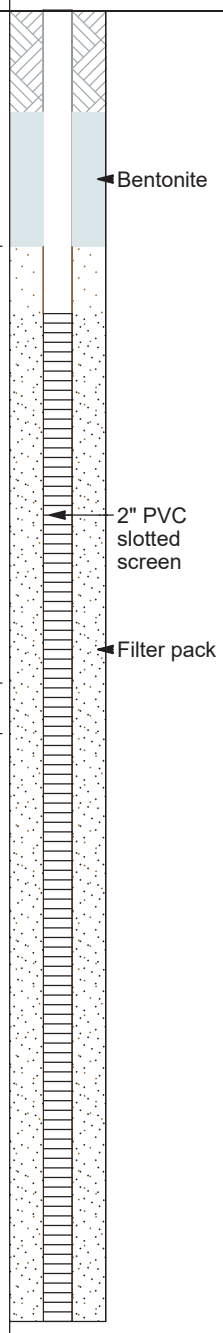
BOREHOLE ID: MM-50 MW

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION
40			**RUBBLE** Soft, loss of circulation *(continued)*
45			Ash? Soft, fast drilling
			47.0 5507.5 **SHALE** Firm drilling
50			
55			Faint returns of greenish gray shale
60			60.0 5494.5 Let hole sit open 5 minutes, no odor
			61.5 5493.0 **COAL** Black
			SHALE
65			Lost returns
70			
75			
			79.5 5475.0 Bottom of Test Hole at 79.5 feet.

Thermocouple Wire Installation



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BOREHOLE ID: MM-51

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/27/2023 **GROUND ELEVATION: 5573 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771995.606000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075428.930000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**FILL** Dark brown, moist		
4.0		5569.1	
5	**SANDSTONE** Light brown, slightly moist, steady drilling		Thermocouple wire
7.0		5566.1	
	SHALE Light gray, slightly moist, hard		
10			Bentonite grout
13.0		5560.1	
	SANDSTONE Tan, slightly moist		
15			
16.0		5557.1	
	CLINKER SANDSTONE Red, slightly moist		
20			
22.0		5551.1	
23.0	**SHALE** Light gray, slightly moist	5550.1	
23.5		5549.6	
	SANDSTONE Tan, slightly moist		
25			
	SHALE Light gray, slightly moist Softer for 2 feet -Grouted borehole with thermocouple set to 26 ft.		
28.5	-Completed with 6" landscape flush mount vault Hard for 2 feet	5544.6	
30	**VOID** Loss of circulation		
32.0		5541.1	
	SHALE Poor returns of gray shale Soft to 37 feet, few returns		
35	No returns		
	Firm		
40			

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-51

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			Poor returns of dark gray to black shale with some coal **SHALE** Poor returns of gray shale *(continued)* Loss of returns, even firmer Hard, drill chatter	
			44.5 5528.6 Bottom of Test Hole at 44.5 feet.	

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BOREHOLE ID: MM-52

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/20/2023 **GROUND ELEVATION: 5565 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771825.850000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075364.944000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** Tan to light gray	
6.0				5559.2
			SHALE Brown to gray, dry, hard Little bit of drill chatter.	
9.5				5555.7
			INTERBEDDED SHALE AND SANDSTONE Gray to brown, dry, mostly shale with thin sandstone layers, good circulation	
30.0				5535.2
			SHALE Brown	
38.5				5526.7
			COAL Black	

Thermocouple wire

Bentonite grout

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-52

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40					
			COAL Black *(continued)*		
			42.0	5523.2	
			SHALE dark brown		
45					
50					
			50.5	5514.7	
			51.5 **COAL** black	5513.7	
			SHALE 53.5 brownish gray	5511.7	
			COAL black		
55			56.0	5509.2	
			SHALE brownish gray		
			59.5 -Grouted borehole with thermocouple set to 38 ft. -Completed with 6" landscape flush mount vault	5505.7	
			Bottom of Test Hole at 59.5 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-53

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/20/2023 **GROUND ELEVATION: 5563 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771768.182000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075413.974000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** gray/tan	
4.5				5558.9
5			**INTERBEDDED** shale/sandstone, brown/gray, hard, steady drilling, good circulation	Thermocouple wire
10				Bentonite grout
15				
20				
24.5				5538.9
25			**SHALE** gray	
27.5				5535.9
30			**CLINKER/RUBBLE** sandstone/red clinker, tan/reddish, rods dropping	
35				
40				

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-53

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40				
			41.0 5522.4 **SHALE** solid drilling	
			44.5 5518.9 -Grouted borehole with thermocouple set to 26 ft. -Completed with 6" landscape flush mount vault	
			Bottom of Test Hole at 44.5 feet.	

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BOREHOLE ID: MM-54

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/20/2023 **GROUND ELEVATION: 5577 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771652.781000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075218.160000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** brown/tan	Thermocouple wire Bentonite grout
12.0				5565.1
			COAL black	
14.5				5562.6
			INTERBEDDED shale/sandstone, brown/tan/gray	
			-Grouted borehole with thermocouple set to 35 ft. -Completed with 6" landscape flush mount vault	
37.0				5540.1
			RUBBLE/VOID no circulation	
40				

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-54

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**RUBBLE/VOID** no circulation *(continued)*	
45			47.0 5530.1 **SHALE** harder drilling	
50			54.5 5522.6 Bottom of Test Hole at 54.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-55

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 04/05/2023 **GROUND ELEVATION: 5583 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771568.375000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075124.478000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** brown/tan, dry, hard	Thermocouple wire
9.5				5573.1
			SHALE brown/gray, hard	Bentonite grout
13.5				5569.1
14.5			**COAL** black	5568.1
			INTERBEDDED shale/sandstone, brown/tan/gray	
			-Grouted borehole with thermocouple set to 25 ft. -Completed with 6" landscape flush mount vault	
29.5			**RUBBLE/VOID** no circulation	5553.1

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-55

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40			**RUBBLE/VOID** no circulation *(continued)*		
			42.0	5540.6	
			SHALE steady drilling		
45			46.0	5536.6	
			COAL very soft drilling, no returns		
			48.0	5534.6	
50			**SHALE** steady drilling		
			54.5	5528.1	
			Bottom of Test Hole at 54.5 feet.		

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BOREHOLE ID: MM-56

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/07/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772142.276000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075379.117000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0				
			SANDSTONE brown/tan, dry, hard	Thermocouple wire
8.0				5561.0
			INTERBEDDED shale/sandstone, brown/tan/gray	Bentonite grout
15.0				5554.0
			COAL black, good circulation -Grouted borehole with thermocouple set to 16 ft. -Completed with 6" landscape flush mount vault	
26.0				5543.0
			SHALE brown/gray, hard	
36.0				5533.0
37.5			**COAL** very soft drilling, no returns	5531.5
			SHALE steady drilling, brown	
40.0				5529.0

Bottom of Test Hole at 40.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-57

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/08/2023 **GROUND ELEVATION: 5556 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772425.830000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075606.736000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**GRAVEL**		
2.0		5554.1	
	SANDSTONE brown/tan, dry, hard		Thermocouple wire Bentonite grout
12.0		5544.1	
	INTERBEDDED shale/sandstone, brown/tan/gray -Grouted borehole with thermocouple set to 15 ft. -Grouted borehole with thermocouple set to 23 ft. -Completed with 6" landscape flush mount vault		
17.0		5539.1	
	COAL black, good circulation		
19.0		5537.1	
	SHALE light gray, sandstone lenses		
27.0		5529.1	
	COAL black		
29.0		5527.1	
	SHALE gray		
34.0		5522.1	
	COAL black		
37.0		5519.1	
	SHALE dark gray		
40			

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-57

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** dark gray *(continued)*	
45				
50			50.0 5506.1 Bottom of Test Hole at 50.0 feet.	

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BOREHOLE ID: MM-58

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/09/2023 **GROUND ELEVATION: 5554 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772452.294000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075615.953000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**GRAVEL**		
			2.0	5551.9	
			FILL sandstone/shale/coal/gravel/sand/debris		
			4.0	5549.9	
5			**COAL** highly weathered, could be fill, dark brown		
			6.0	5547.9	
			INTERBEDDED shale/sandstone, brown/tan/gray		
			8.0	5545.9	
			COAL black -Grouted borehole with thermocouple set to 10 ft. -Completed with 6" landscape flush mount vault		Thermocouple wire Bentonite grout
10			13.0	5540.9	
			INTERBEDDED shale/sandstone, brown/tan/gray		
15					
20			22.0	5531.9	
			COAL black		
			24.0	5529.9	
25			**SHALE** light gray, brown silty/sandy lenses		
30					
35					
40			40.0	5513.9	

Bottom of Test Hole at 40.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-59

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/08/2023 **GROUND ELEVATION: 5558 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772387.889000 N** **LOGGED BY: Dan Bochicchio**

CONTRACTOR: Authentic Drilling **EASTING: 3075591.795000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**GRAVEL**		
			2.0	5555.6	
			SANDSTONE tan, iron staining, some red		Thermocouple wire
5					
					Bentonite grout
10					
15					
20			20.0	5537.6	
			21.0 **COAL** black, good circulation	5536.6	
			SHALE light gray, sandstone lenses -Grouted borehole with thermocouple set to 20.5 ft. -Completed with 6" landscape flush mount vault		
25					
30			30.0	5527.6	
			COAL black		
			32.0	5525.6	
			SHALE gray, interbedded sandstone		
35					
			37.0	5520.6	
			COAL black		
40			40.0	5517.6	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-59

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** dark gray	
			44.0 5513.6	
			Bottom of Test Hole at 44.0 feet.	

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BOREHOLE ID: MM-60 MW

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/13/2023 **GROUND ELEVATION: 5525 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772680.452000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3076377.088000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** brown/tan, dry, hard	2" PVC riser
11.0				5514.0
			SHALE brown/gray, hard	Bentonite grout
15.0				5510.0
16.0			**COAL** black	5509.0
			INTERBEDDED shale/sandstone, gray, dry, steady drilling, good circulation	
			Good circulation, steady drilling	
			Color changing to brown/brownish gray	Bentonite
			Good circulation, steady drilling	
37.5				5487.5
			COAL black	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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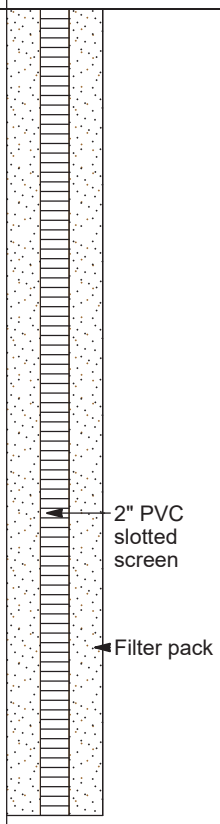
BOREHOLE ID: MM-60 MW

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
			COAL black *(continued)*	
49.5				5475.5
			SHALE steady drilling	
58.0				5467.0
59.5			**COAL** black, dry	5465.5
			SHALE gray	
64.5				5460.5
			Bottom of Test Hole at 40.0 feet.	



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BOREHOLE ID: MM-61

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

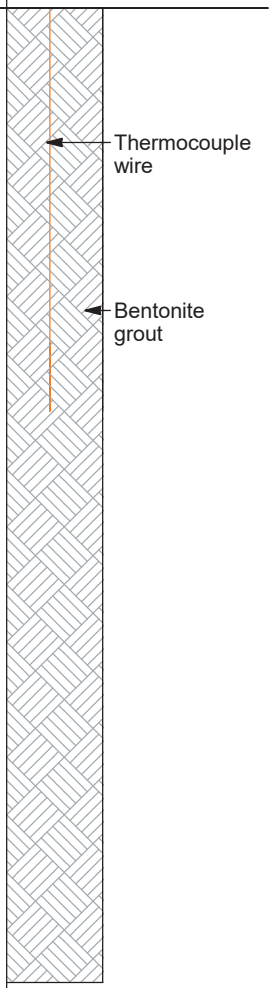
DATE(S) OF DRILLING: 03/15/2023 **GROUND ELEVATION: 5548 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772766.905000 N** **LOGGED BY: Ed Muller**

CONTRACTOR: Authentic Drilling **EASTING: 3075936.332000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** grayish tan, moderately hard drilling	
11.0				5537.3
			RUBBLE lost circulation, heavy chatter -Grouted borehole with thermocouple set to 12 ft. -Completed with 6" landscape flush mount vault	
24.0				5524.3
			SHALE firm drilling, no recovery	
29.0				5519.3
			Bottom of Test Hole at 29.0 feet.	



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BOREHOLE ID: MM-62

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/30/2023 **GROUND ELEVATION: 5568 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772182.898000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075371.976000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**FILL**	5566.8	
			1.0 **SANDSTONE** Brown, dry		
5			6.0	5561.8	Thermocouple wire
			INTERBEDDED SANDSTONE AND SHALE Gray to brown		
10			9.5	5558.3	Bentonite grout
			10.5 **SHALE** Gray, dry, hard	5557.3	
			COAL Black, dry, steady drilling -Grouted borehole with thermocouple set to 11 ft. -Completed with 6" landscape flush mount vault		
15					
20			21.5	5546.3	
			SHALE Brownish gray		
25			24.5	5543.3	
			INTERBEDDED SHALE AND SANDSTONE 26.0 Brown to gray	5541.8	
			SHALE Gray		
30			32.0	5535.8	
			COAL 33.5 Black	5534.3	
			34.0 **SHALE** Brown	5533.8	
35			**COAL**		
			37.0	5530.8	
			SHALE Gray		
40					

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-62

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40			**SHALE** Gray *(continued)*		
			43.0	5524.8	
			SANDY SHALE Greenish gray		
			44.5	5523.3	
			Bottom of Test Hole at 44.5 feet.		

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BOREHOLE ID: MM-63

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/27/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772065.355000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3075442.506000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**FILL** Dark brown, moist		
4.0		5565.5	
5	**SANDSTONE** Light brown, slightly moist, steady drilling		Thermocouple wire
7.0		5562.5	
	SHALE Light gray, slightly moist, hard		
10			Bentonite grout
13.0		5556.5	
	SANDSTONE Tan, slightly moist		
15			
16.0		5553.5	
	CLINKER SANDSTONE Red, slightly moist		
20			
22.0		5547.5	
23.0	**SHALE** Light gray, slightly moist	5546.5	
23.5		5546.0	
	SANDSTONE Tan, slightly moist		
25	**SHALE** Light gray, slightly moist Softer for 2 feet -Grouted borehole with thermocouple set to 26 ft.		
28.5	-Completed with 6" landscape flush mount vault Hard for 2 feet	5541.0	
30	**VOID** Loss of circulation		
32.0		5537.5	
	SHALE Poor returns of gray shale Soft to 37 feet, few returns		
35	No returns		
	Firm		
40			

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-63

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			Poor returns of dark gray to black shale with some coal **SHALE** Poor returns of gray shale *(continued)* Loss of returns, even firmer Hard, drill chatter	
			44.5 5525.0 Bottom of Test Hole at 44.5 feet.	

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BOREHOLE ID: MM-64

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/27/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772085.697000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3075274.140000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**FILL** Light brown, dry		
	4.0	5565.4	
5	**SANDSTONE** Light brown, slightly moist, hard	5564.4	Thermocouple wire
	6.0	5563.4	
	SHALE Dark brown, slightly moist, with some low grade coal		
	SANDSTONE Tan, slightly moist		
10			Bentonite grout
	13.0	5556.4	
	SHALE Dark gray, slightly moist, with some low grade coal		
15			
	17.5	5551.9	
	18.0	5551.4	
	SANDSTONE Tan		
	19.0	5550.4	
20	**SHALE** Dark gray, slightly moist		
	SANDSTONE Tan, slightly moist		
	22.0	5547.4	
	CLINKER SANDSTONE Red		
	23.5	5545.9	
	SHALE Light gray, dry		
25	25.0	5544.4	
	CLINKER SANDSTONE Red -Grouted borehole with thermocouple set to 26 ft. -Completed with 6" landscape flush mount vault		
30			
	32.0	5537.4	
	SHALE Dark gray, soft		
	34.0	5535.4	
35	34.5	5534.9	
	CLINKER SANDSTONE Red		
	SHALE Light gray, dry		
	38.5	5530.9	
40	**CLINKER SANDSTONE** Reddish brown, steady drilling		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-64

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
40			41.0	5528.4	
			COAL Black, very soft, dry Thermocouple wire at 42 feet.		
			43.0	5526.4	
			SHALE Dark gray, dry		
45					
			Color changed to light gray. Some drill chatter.		
50			Steady drilling		
			53.0	5516.4	
			COAL Black, soft		
55					
			58.0	5511.4	
			SHALE Dark gray, dry		
60					
			64.5	5504.9	
			Bottom of Test Hole at 64.5 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-65

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/27/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772026.995000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3075362.649000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0	**FILL** Brown, dry		
3.0		5566.8	
	SANDSTONE Light brown, dry, hard		Thermocouple wire
5.5		5564.3	
	SHALE Light brown to light gray, slightly moist		
8.0		5561.8	
8.5	**SANDSTONE** Tan, dry	5561.3	Bentonite grout
10.0	**SHALE** Light brown to light gray	5559.8	
	CLINKER SANDSTONE Red to grayish red, dry		
15.0	-Grouted borehole with thermocouple set to 14 ft. -Completed with 6" landscape flush mount vault	5554.8	
17.0	**RUBBLE** Loss of circulation	5552.8	
	CLINKER SANDSTONE Firm, no returns		
	Poor red returns		
25.0		5544.8	
27.0	**RUBBLE** Loss of circulation, no returns	5542.8	
28.5	**CLINKER SANDSTONE** Poor red returns	5541.3	
	RUBBLE Loss of circulation Some drill chatter		
33.0		5536.8	
	SHALE Firm, no returns, steady drilling		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-65

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** Firm, no returns, steady drilling *(continued)*	
			44.5 5525.3 Bottom of Test Hole at 44.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-66

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/28/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

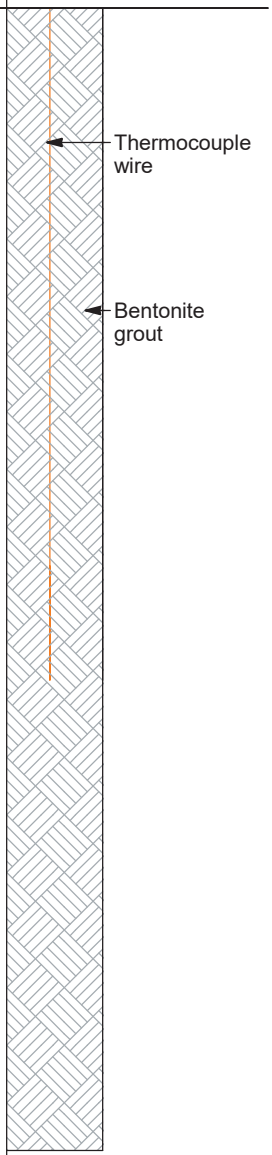
CONSULTANT: Tetra Tech **NORTHING: 1772006.142000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3075227.835000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			**TOPSOIL** Brown, moist	
			2.0	5566.9
			SANDSTONE Tan, steady drilling	
5				
			7.0	5561.9
			CLINKER SANDSTONE Brownish red	
10				
			13.0	5555.9
			SHALE Gray	
15			15.0	5553.9
			CLINKER SANDSTONE Brownish red	
20			20.0	5548.9
			RUBBLE No returns, slightly rubbly, collar not allowing returns to come up -Grouted borehole with thermocouple set to 20 ft. -Completed with 6" landscape flush mount vault	
25			25.0	5543.9
			SHALE Hard, chatter to 26 feet Steady drilling, no returns Very dark gray returns of shale with some coal	
30				
			33.0	5535.9
			34.0 **SANDSTONE** Light gray	5534.9
			Bottom of Test Hole at 34.0 feet.	

Thermocouple Wire Installation



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BOREHOLE ID: MM-67

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/28/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772075.019000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3075206.121000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**TOPSOIL** Dark brown, moist		
				2.0 / 5568.1	
			SANDSTONE Tan, steady drilling		
5				5.0 / 5565.1	Thermocouple wire
			SHALE Brownish gray		
				8.0 / 5562.1	
			SANDSTONE Brown		Bentonite grout
10				10.0 / 5560.1	
			SHALE Brownish gray		
				13.0 / 5557.1	
			SANDSTONE Brown	14.5 / 5555.6	
15			**CLINKER SANDSTONE** Brownish red to grayish red		
20			-Grouted borehole with thermocouple set to 20 ft. -Completed with 6" landscape flush mount vault		
			Lost returns due to a collar.		
25			Regained returns. Color changed to reddish gray.	26.0 / 5544.1	
			RUBBLE Lost returns due to a collar. Slightly rubbly.	27.0 / 5543.1	
			CLINKER SANDSTONE Reddish gray Lost returns due to a collar.		
30				32.0 / 5538.1	
			SHALE Very dark gray to dark gray, with some low grade coal to 34 feet.		
35					
			Color changed to dark gray.		
				39.0 / 5531.1	
			Bottom of Test Hole at 39.0 feet.		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-68

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/28/2023 **GROUND ELEVATION: 5571 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771991.857000 N** **LOGGED BY: Zach Spence**

CONTRACTOR: Authentic Drilling **EASTING: 3075174.553000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0					
			1.0 **TOPSOIL** Dark brown, moist	5569.6	
			SANDSTONE Tan		
			3.0	5567.6	
			3.5 **COAL** Very dark brown	5567.1	
5			**INTERBEDDED SHALE AND SANDSTONE** Tan to gray, steady drilling		Thermocouple wire
10					Bentonite grout
15					
			19.0 Color changed to dark gray. Very soft	5551.6	
20			**SANDSTONE** Dark brown to brown		
			-Grouted borehole with thermocouple set to 22 ft. -Completed with 6" landscape flush mount vault		
25			Lost returns due to a collar, hard		
30			Regained returns of light brown to brown sandstone Lost returns due to a collar.		
35			Regained returns of brown sandstone. Lost returns due to a collar.		
			37.0	5533.6	
40			**SHALE** Very dark brown, interbedded with coal		

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

(Continued Next Page)

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BOREHOLE ID: MM-68

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
40			**SHALE** Very dark brown, interbedded with coal *(continued)* Lost returns due to a collar. Steady drilling, firmer	
			44.0 5526.6 Bottom of Test Hole at 44.0 feet.	

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BOREHOLE ID: MM-69

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: Not Recorded **GROUND ELEVATION: 5565 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1771954.245000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075277.417000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**OVERBURDEN MATERIAL** 1.5 5563.4	
			SANDSTONE brown/gray, some red, shale lenses	Thermocouple wire
5				
				Bentonite grout
10			Clinker	
			-Grouted borehole with thermocouple set to 14 ft. -Completed with 6" landscape flush mount vault	
15			15.5 Fractured 5549.4	
			RUBBLE no returns	
20				
			24.5 5540.4	
25			**SHALE** no returns, borehole collapsing	
			29.5 5535.4	
			Bottom of Test Hole at 29.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-70

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/23/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772120.951000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075292.283000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDSTONE** brown/gray, some red, shale lenses	Thermocouple wire Bentonite grout
9.0				5560.9
			COAL black, dry, good circulation -Grouted borehole with thermocouple set to 9 ft. -Completed with 6" landscape flush mount vault	
18.0				5551.9
			SHALE	
19.5			no returns, borehole collapsing	5550.4
			Bottom of Test Hole at 19.5 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-71

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/23/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772091.316000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075374.043000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			1.0 **OVERBURDEN MATERIAL**	5568.7	
			SHALE/SANDSTONE interbedded layers, brown/tan/gray		Thermocouple wire
5					
10			9.5 **SANDSTONE** clinker, reddish brown	5560.2	Bentonite grout
15			14.5 **RUBBLE** lost circulation	5555.2	
20			-Grouted borehole with thermocouple set to 20 ft. -Completed with 6" landscape flush mount vault		
25					
30			29.5 **SHALE** solid drilling, no returns	5540.2	
			34.5	5535.2	

Bottom of Test Hole at 34.5 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-72

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/23/2023 **GROUND ELEVATION: 5570 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772112.151000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075410.450000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			1.0 **OVERBURDEN MATERIAL** gravel 5569.1	
			SANDSTONE brown to tan	
5				Thermocouple wire
10				Bentonite grout
15				
20			19.5 5550.6	
			CLINKER sandstone/shale/ash, rig chatter, lost circulation	
			-Grouted borehole with thermocouple set to 22 ft. -Completed with 6" landscape flush mount vault	
25				
30				
35			35.0 5535.1	
			SHALE solid drilling, no returns	
			Light venting, mostly odor, low O2, trace H2S	
			39.5 5530.6	

Bottom of Test Hole at 39.5 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-73

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/23/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772141.233000 N** **LOGGED BY: Jeffrey Nuttall**

CONTRACTOR: Authentic Drilling **EASTING: 3075341.340000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			1.0 **OVERBURDEN MATERIAL** gravel	5568.4	
			SANDSTONE brown to tan		
5			4.5 **SHALE** gray/brown, dry, hard, sandstone lenses	5564.9	Thermocouple wire
					Bentonite grout
10			10.0 **COAL** black, dry, intact -Grouted borehole with thermocouple set to 10 ft. -Completed with 6" landscape flush mount vault	5559.4	
15					
20			22.5 **SHALE** solid drilling, no returns	5546.9	
			24.5 Bottom of Test Hole at 24.5 feet.	5544.9	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-74

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: 03/23/2023 **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772126.500000 N** **LOGGED BY: Not Recorded**

CONTRACTOR: Authentic Drilling **EASTING: 3075487.735000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0			**SANDY GRAVEL**		
			2.0	5567.0	
			SANDSTONE Brown to tan		
5					Thermocouple wire
					Bentonite grout
10			10.0	5559.0	
			INTERBEDDED SHALE AND SANDSTONE		
15					
			17.0	5552.0	
			VOID Venting: -Temperature: 103 F -H2S: 5.3 ppm -CO: 300 ppm		
20			20.0	5549.0	
			UNKNOWN BEDROCK Gravel returns to begin then lost circulation, steady drilling		
25			Grouted borehole with thermocouple set to 25 ft. Completed with 6" landscape flush mount vault.		
			40.0	5529.0	

Bottom of Test Hole at 25.0 feet.

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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BOREHOLE ID: MM-75

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: Not Recorded **GROUND ELEVATION: 5569 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772184.466000 N** **LOGGED BY: Not Recorded**

CONTRACTOR: Authentic Drilling **EASTING: 3075513.767000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION		Thermocouple Wire Installation
0					
			1.0 **SANDY GRAVEL**	5567.6	
			2.5 **SILTY SAND** Brown	5566.1	
			SANDSTONE Tan to light brown		
5					Thermocouple wire
					Bentonite grout
			8.0	5560.6	
			8.5 **SHALE** Gray	5560.1	
10			**SHALE** Tan to light brown		
			13.0	5555.6	
			14.0 **SHALE** Gray	5554.6	
15			**SANDSTONE** Tan with reddish staining		
20			21.0	5547.6	
			VOID Lost circulation		
			23.0 Grouted borehole with thermocouple set to 22 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.	5545.6	
25			**RUBBLE**		
			27.0	5541.6	
			ASSUMED SHALE No returns, hard, drilling ?		
			39.0	5529.6	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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Fax: 970-22T-7171

BOREHOLE ID: MM-75

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
			UNKNOWN BEDROCK Soft drilling *(continued)*	
50.0				5518.6
			Bottom of Test Hole at 25.0 feet.	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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Fax: 970-22T-7171

BOREHOLE ID: MM-76

CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DATE(S) OF DRILLING: Not Recorded **GROUND ELEVATION: 5567 ft** **METHOD: Air Rotary**

CONSULTANT: Tetra Tech **NORTHING: 1772254.974000 N** **LOGGED BY: Not Recorded**

CONTRACTOR: Authentic Drilling **EASTING: 3075481.878000 E** **DRILLED BY: John Tegtmeier**

EQUIPMENT: Acker Renegade **INCLINATION: Vertical** **LOCATION: Marshall Mesa**

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
0			**SANDY GRAVEL**	
			SANDSTONE	
			4.0 5563.4	
5			**INTERBEDDED SHALE AND SANDSTONE** Dark red, very fine grained	Thermocouple wire
				Bentonite grout
10			11.0 5556.4	
			UNKNOWN BEDROCK Steady drilling, not hard	
15				
20			Grouted borehole with thermocouple set to 20 ft. Completed with 6" landscape flush mount vault. No heat or odors observed.	
25			27.0 5540.4	
			28.0 5539.4 **RUBBLE** Drill chatter	
			UNKNOWN BEDROCK Steady drilling	

BOREHOLE/TP/WELL - VECTOR MARSHALL FILRE DRILLIING 2022 (3).GPJ ALL REPORTS JLR 2-14-11.GDT 7/14/23

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c elephone: 970-22T-9600
Fax: 970-22T-7171

BOREHOLE ID: MM-76

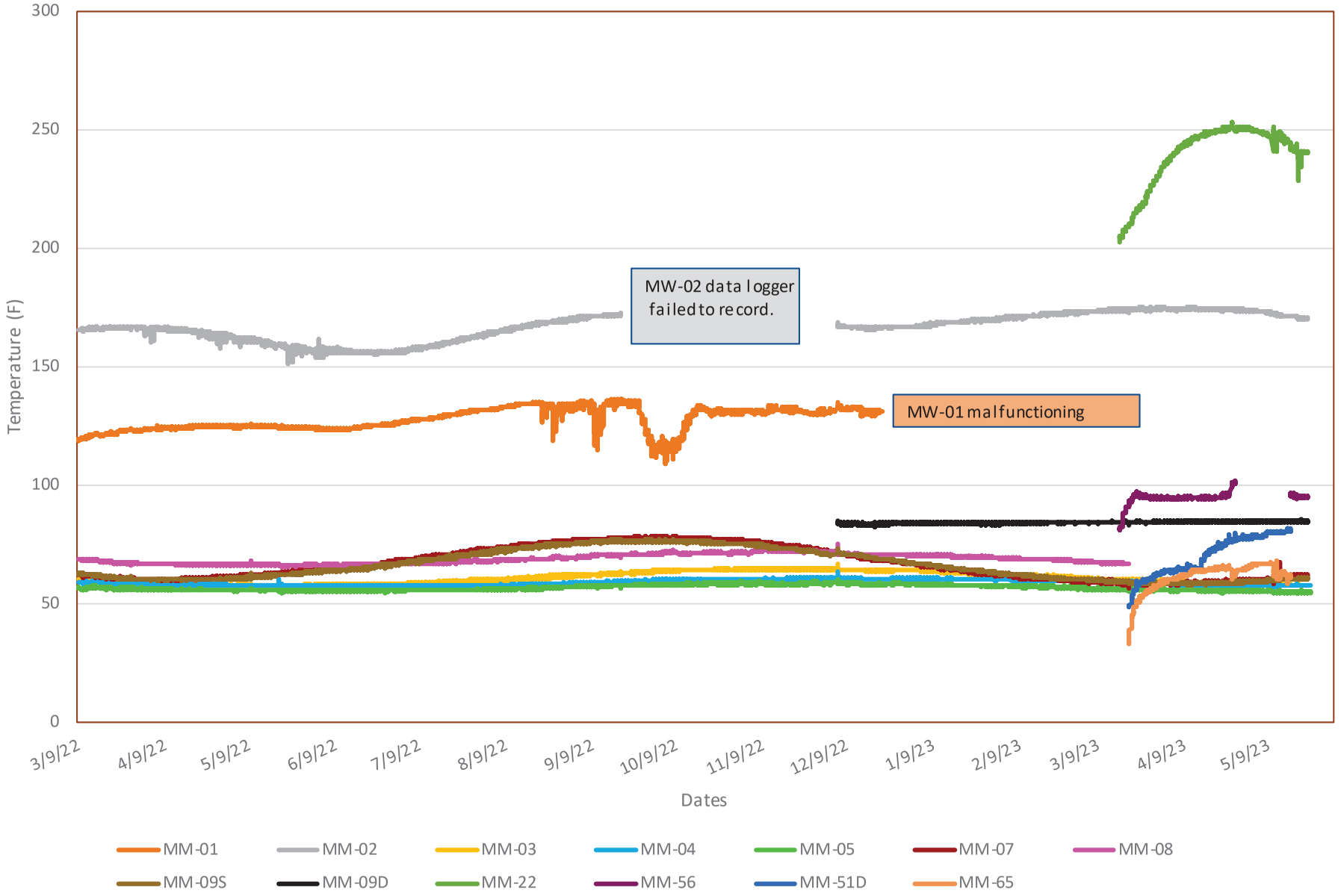
CLIENT State of Colorado DRMS **PROJECT NAME** Marshall Drilling 202T

PROJECT NUMBER 114-910599 **PROJECT LOCATION** Boulder County, CO

DEPTH (ft)	SAMPLE TYPE	GRAPHIC LOG	MATERIAL DESCRIPTION	Thermocouple Wire Installation
			UNKNOWN BEDROCK Steady drilling *(continued)*	
50.0				5517.4
			Bottom of Test Hole at 25.0 feet.	

APPENDIX D: Thermocouple Time-Series Data

Appendix D Marshall Mesa Thermocouple Time-Series Data, March 9, 2022 to May 24, 2023



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Marshall Mesa Trailhead Redesign

City of Boulder Open Space and Mountain Parks

Appendix 3 – Marshall Mine Underground Coal Fire Mitigation Plan

April 8, 2024

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

Date: January 16, 2024

To: Bethany Collins, City of Boulder Open Space and Mountain Parks

From: Jeff Graves, Colorado Division of Reclamation, Mining & Safety

Re: Mitigation of Underground Coal Fire, Marshall Mesa Trailhead, Boulder County, Colorado

Dear Bethany,

During the winters of 2021 and 2022 DRMS conducted subsurface investigations in order to determine the nature and extent of the underground coal fire at the Marshall Mesa Trailhead. The detailed finding of these investigations can be found in the *Marshall Mine Underground Coal Fire Report of Investigations* Sept. 2023, located on the DRMS website at drms.colorado.gov. In summary elevated temperatures, defined for this site as greater than 80°F, are being generated from the upper coal bed interval at two areas within the Site: directly north of and under the Trailhead Parking Lot and approximately 1,000 ft south of the parking area. Maximum borehole temperatures of each area are 241°F and 171°F, respectively. These areas of elevated temperatures correlate with the spatial extent of observed snowmelt which delineates the extent of anomalous heat, and minor dispersed surface venting and borehole gas emissions that are commonly associated with coal oxidation and/or low intensity combustion. Outside of the areas where heat was observed, the upper coal interval is characterized as burned-out with clinker/baked zones, rubble, and/or voids. Many of the surface depressions found at the Site, especially north of the parking area, are associated with these subsurface burned-out zones. The upper coal seam lies largely intact with no evidence of mining or mine fire activity further north/northeast of the parking area.

DRMS recommends that a mitigation effort be conducted at the Marshal Mesa Trailhead to remove, to the extent possible, hazards associated with the current and previous subsurface coal fire activity. Additionally DRMS recommends that, where possible, burnt out unburned coal, adjacent to areas with elevated temperatures, should be mitigated to prevent future subsurface ignition and subsidence.

Due to the shallow nature of the coal seam at the Marshall Mesa Site (>35 ft), excavation of the coal seam is the most effective form of mitigation. DRMS proposes total excavation of the two coal

Physical Address: 1313 Sherman Street, Room 215, Denver, CO 80203 P 303.866.3567 F 303.832.8106
Mailing Address: DRMS Room 215, 1001 E 62nd Ave, Denver, CO 80216 https://drms.colorado.gov
Jared S. Polis, Governor | Dan Gibbs, Executive Director | Michael Cunningham, Acting Director

seam areas with elevated subsurface temperatures (>80°F). Figure 14 in the *Marshall Mine Underground Coal Fire Report of Investigations* identifies the areas with subsurface temperatures exceeding 80°F. The northern mitigation area will include a portion of the parking area with elevated subsurface temperatures, and extend northward to also remove areas of potential subsidence and unburned coal. The second mitigation area is located south of the trailhead and will remove the area of observed subsurface heat as well as areas of potential future subsidence. Mitigation will be achieved by excavating overburden and coal (burned/unburned) to the bottom of the coal seam, blending and cooling any material exceeding 80° F, and then replacing the material back into the excavation. Following excavation and grading, the mitigated areas will be graded to resemble the natural surrounding topography. OSMP will be responsible for further trail development and revegetation following completion of the work outlined above.

The proposed mitigation for the Marshall Mesa Trailhead is included with this letter. Please review these plans and provide comments or changes to DRMS at your earliest convenience.

Sincerely,

Jeff Graves
Director of Active and Inactive Mines

Marshall Mesa Trailhead Redesign

City of Boulder Open Space and Mountain Parks

Appendix 4 – Marshall Mine Underground Coal Fire Mitigation Cut & Fill Calculations

April 8, 2024

February 1, 2024

Mr. Jeremy Reineke, P.G.
Environmental Protection Specialist
Colorado Division of Reclamation, Mining, and Safety
1313 Sherman Street, Room 215
Denver, CO 80203
Email: Jeremy.reineke@state.co.us

Subject: **Marshall Mitigation – Cut and Fill Calculation**

Dear Mr. Reineke:

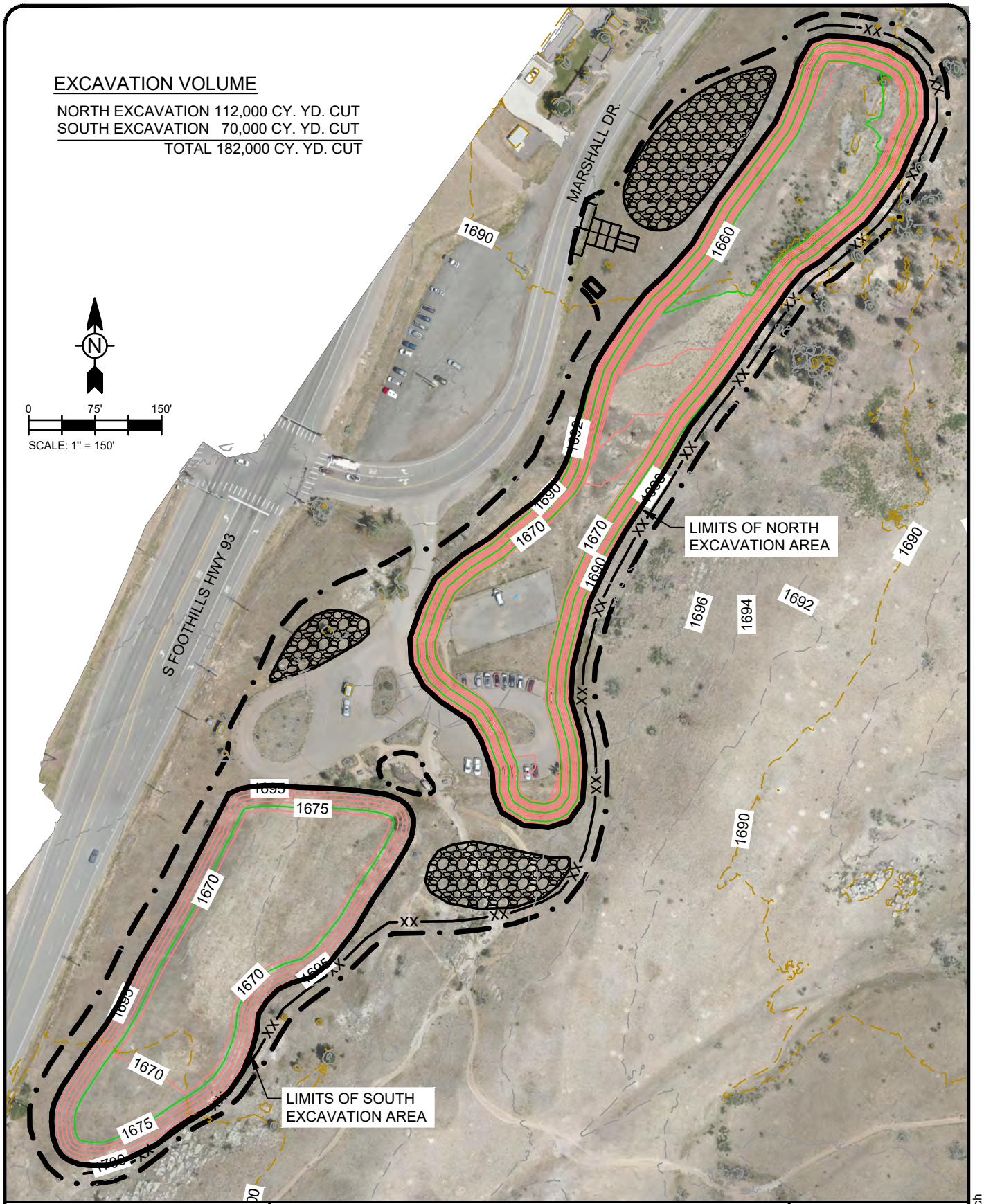
Please find attached a figure that shows the overall excavation for the Marshall Fire Mitigation in Boulder County. There will be approximately 112,000 cy and 70,000 cy excavation in the north and south excavations, respectively. It is anticipated that most of the excavated materials will be blended and placed back in the excavations. These calculations are based on a 1:1 side slope down from the limits of excavation and an overall depth of 30'. These excavations would likely be staged such that the entire area is not open at one time; excavation and backfill would be happening at the same time to reduce the amount of open excavation at any time.

Sincerely,

Tetra Tech, Inc.

Brad Bijold, P.E.
Department Lead

Tetra Tech
390 Union Blvd, Suite 400, Lakewood, CO 80228
Tel 303.217.5700 www.tetratech.com



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STATE OF COLORADO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF RECLAMATION, MINING AND SAFETY

MARSHALL MINE FIRE MITIGATION
BOULDER COUNTY, COLORADO
EXCVATION VOLUME

PROJ:	117-8295005
DATE:	1/30/2024
DESN:	

Figure
1

Bar Measures 1 inch

Marshall Mesa Trailhead Redesign

City of Boulder Open Space and Mountain Parks

Appendix 5 – Marshall Mesa Trailhead Redesign Traffic Report

April 8, 2024

MARSHALL MESA TRAILHEAD

TRAFFIC IMPACT STUDY

October 2023

Prepared for:

City of Boulder
2520 55th St
Boulder, CO 80301

Prepared by:

Muller Engineering Company
7245 West Alaska Drive
Suite 300
Lakewood, Colorado 80226
303.988.4939

Muller Project Number: 23-025.01

MULLER ENGINEERING COMPANY

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APPENDICES

1 INTRODUCTION

1.1 Project Background

The City of Boulder, Open Space & Mountain Parks (OSMP) is proposing a new access driveway for the Marshall Mesa Trailhead on State Highway (CO) 170 (Eldorado Springs Drive), east of CO 93. The current driveway is a right-in/right-out (RIRO) driveway located approximately 120 feet east of the CO 93/CO 170 intersection in Boulder County.

The proposed access relocation would shift the trailhead parking lot access to be aligned with the recently created Eldorado Park-n-Ride access, located approximately 500 east of the CO 93/CO 170 intersection. The modified intersection would operate as a full access, two-way stop-controlled intersection (TWSC). As part of the driveway relocation, the parking lot will also be expanded from 45 parking spaces to 75 parking spaces.

1.2 Study Area

The following intersections were analyzed as part of this study:

1. CO 93 (Foothills Hwy) and CO 170 (Eldorado Spring Dr) – Signalized
2. CO 170 (Eldorado Spring Dr) and Marshall Mesa Trailhead Driveway – TWSC
3. CO 170 (Eldorado Spring Dr) and Eldorado Park-n-Ride Driveway – TWSC
4. CO 170 (Eldorado Spring Dr) and Marshall Dr – TWSC

A vicinity map, showing the proposed driveway, existing driveway, and study intersection is shown in **Figure 1**.

The 2023 existing intersection geometries are shown in **Figure 2**.

CO 93 (Foothills Hwy), south is CO 170 is an undivided two-lane roadway with a climbing lane in the southbound direction. North, of CO 170 is a divided two-lane roadway with a two-way left turn lane (TWLTL). Additional turn lanes are present at the signalized intersection. The posted speed is 45 MPH. The CDOT Access Code classification is R-A: Regional Highway. For the purpose of this study, CO 93 is identified a north-south facility.

CO 170 (Eldorado Springs Dr) within the project area is an undivided two-lane roadway. The posted speed limit is 30 MPH. The CDOT Access Code classification is R-B: Rural Highway. For the purpose of this study, CO 170 is identified as an east-west facility. At the intersection of CO 170 and Marshall Dr, the portion of CO 170 that is Marshall Rd will be identified as a north-south facility.

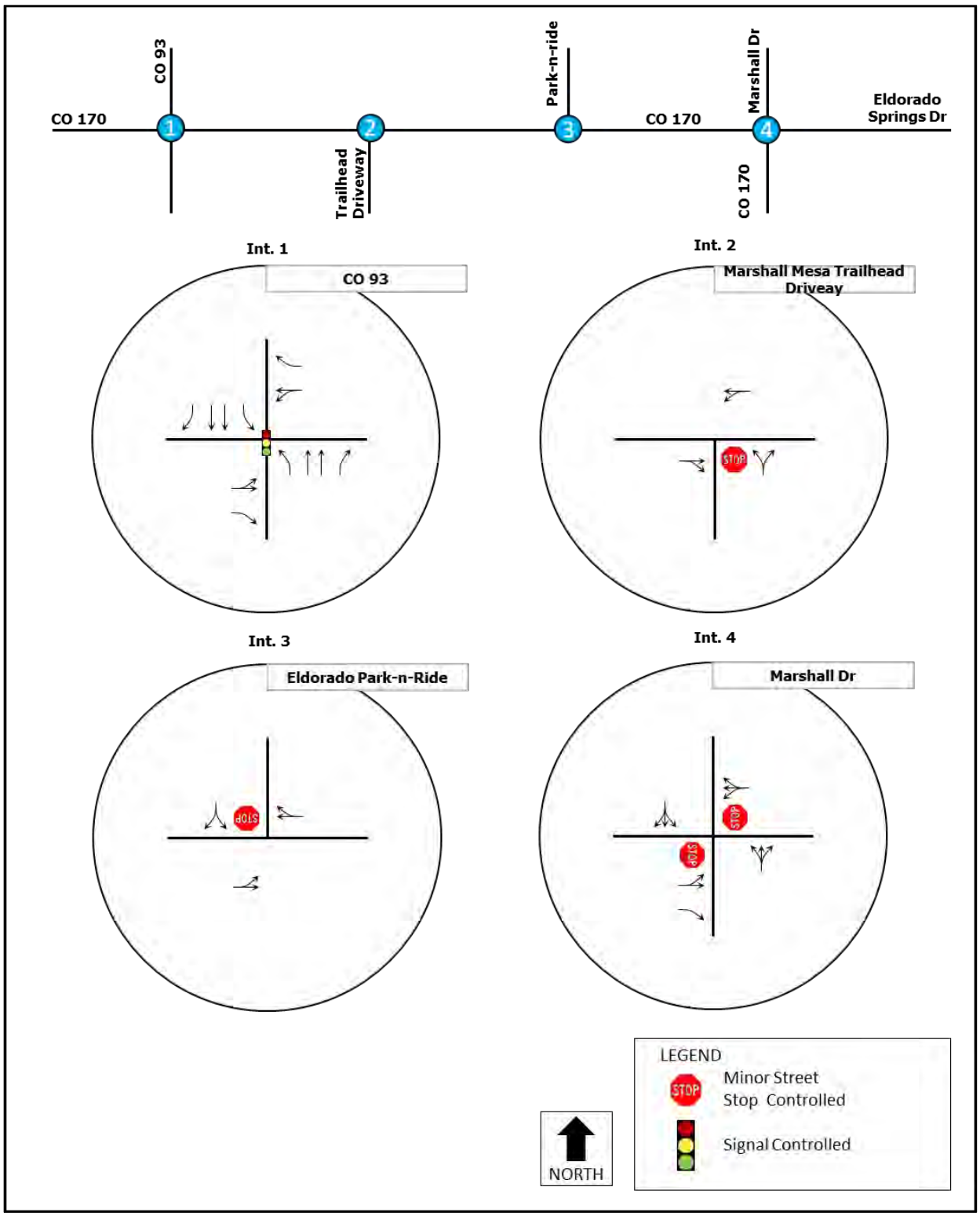
Marshall Mesa Trailhead Driveway (Trailhead Driveway) is a private driveway with no posted speed limit. For the purpose of this `study, the Trailhead Driveway is identified as a north-south facility.

Eldorado Park-n-Ride Driveway (Park-n-Ride Driveway) is a private driveway with no posted speed limit. For the purpose of this study, the Park-n-Ride Driveway is identified as a north-south facility.

Marshall Dr provides access to private driveways and there is no posted speed limit. For the purpose of this study, Marshall Dr is identified as a north-south facility.

Figure 1 – Vicinity Map

Figure 2 – Existing 2023 Geometry



1.3 Study Years and Time Periods

The following analysis years were evaluated at part of this study:

- Existing 2023
- Build 2023
- No Build 2043
- Build 2043

The following peak periods were evaluated for each of the above study years:

- AM Peak Period
- PM Peak Period
- Weekend (Saturday) Peak Period

2 EXISTING CONDITIONS

The existing conditions were evaluated to develop a baseline for comparison with the project's growth. Traffic data, existing operations, and crash data are documented in the following sub sections.

2.1 Data Collection

Turning movement counts (TMCs) were collected at the four study intersections. Counts were collected during the AM peak, PM peak, and Saturday (Weekend peak). At the intersection of CO 93 and CO 170, weekday AM and PM peak period counts from February 2019 were used, and new counts were collected for the Weekday peak period. Turning movement counts were collected on the following dates and time periods:

- 6:45 AM to 8:00 AM - Wednesday, February 20, 2019
  - CO 93 and CO 170
- 4:45 PM to 6:00 PM - Wednesday, February 20, 2019
  - CO 93 and CO 170
- 7:00 AM to 8:30 AM - Wednesday, July 12, 2023
  - CO 170 and Trailhead Driveway
  - CO 170 and Park-n-Ride Driveway
  - CO 170 and Marshall Dr
- 4:30 PM to 6:00 PM - Wednesday, July 12, 2023
  - CO 170 and Trailhead Driveway
  - CO 170 and Park-n-Ride Driveway
  - CO 170 and Marshall Dr
- 11:00 AM to 1:00 PM - Saturday, July 8, 2023
  - CO 93 and CO 170
  - CO 170 and Trailhead Driveway
  - CO 170 and Park-n-Ride Driveway
  - CO 170 and Marshall Dr

Traffic count data can be found in **Appendix A**.

2.2 Existing 2023 Traffic Volumes

As noted above, previous counts from February 2019 were used for the AM and PM peak hours. Upon comparing the 2019 and 2023 turning moving counts, it was noted that the volumes were unbalanced. Volume balancing was applied to the intersection of CO 93 and CO 170 in order to balance volumes along CO 170 with the more recent July 2023 counts. All volume balancing adjustments were applied proportionally to each turning movement.

No volume adjustments were needed at the CO 93 and CO 170 intersection during the PM peak hour counts.

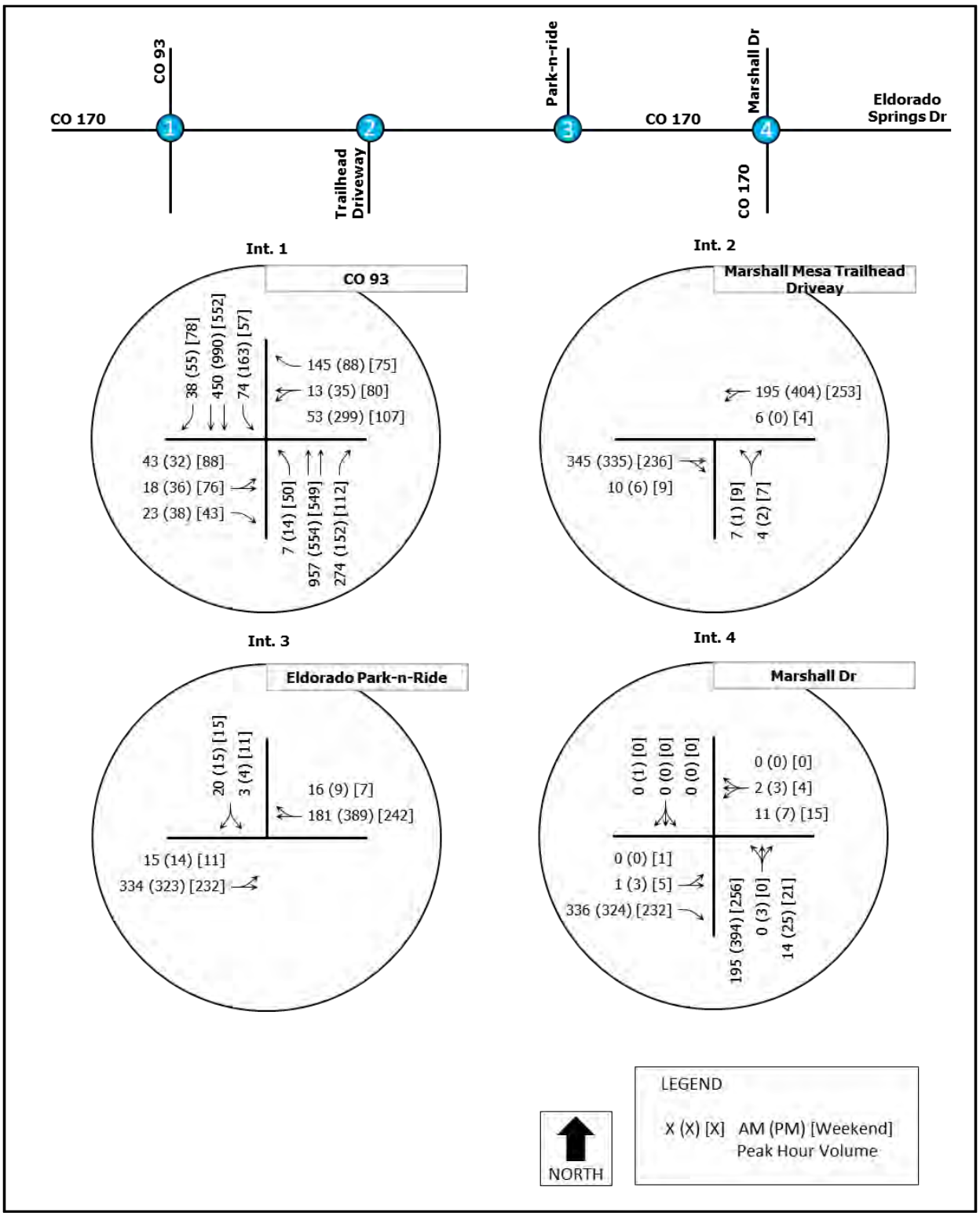
The volume worksheets with the identified volume adjustments can be found in **Appendix B**.

It should be noted that the intersection of CO 170 and Trailhead Driveway is a RIRO, however, in the traffic counts both westbound left-turn and northbound left-turn movements were observed.

During the 5 hours of counts (AM, PM & Weekend), there were no equestrian trailers observed turning in or out of the Trailhead Driveway. Additionally, the City of Boulder previously conducted a parking study. During 25 days of observations, only two trailers were observed using the lot on one day in total. The parking lot expansion will not increase the number of equestrian spaces provided. Since no equestrian usage was observed during the peak hours, no increase in usage is expected in the future. Thus, traffic volumes were not adjusted for passenger car equivalents (PCE).

The Existing 2023 traffic volumes for the AM, PM, and Weekend peak periods are shown in **Figure 3**.

Figure 3 – Existing 2023 Traffic Volumes



2.3 Existing 2023 Traffic Analysis

The Existing 2023 AM, PM, and Weekend scenarios were analyzed using Highway Capacity Manual methods and Synchro 11 software. The existing signal timings and existing geometry were utilized in the existing analysis.

The 95th percentile queue, v/c ratio, delay, and LOS for all movements are shown in **Table 1**, **Table 2**, and **Table 3** for the AM, PM, and Weekend peak hours, respectively.

At the signalized intersection of CO 93 and CO 170 for the AM peak hour, the eastbound left-turn movement and the westbound right-turn movement operate at LOS E. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

In the PM peak hour, at the CO 93 and CO 170 intersection, the eastbound left-turn movement and the eastbound right-turn movement operate at LOS E. The shared westbound through/left-turn movement has a v/c ratio greater than 1 and operates at a LOS F. Additionally the westbound through/left-turn queue extends to approximately 558'. All other movements operate at LOS D, no other movements are over capacity, and no other 95th percentile queues extend past the available storage.

In the Weekend peak hour, at the CO 93 and CO 170 intersection, the eastbound left-turn movement and the westbound left-turn movement operate at LOS E. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

All traffic movements at the existing two access driveways on CO 170 and at the CO 170 and Marshall Dr / Eldorado Springs Dr intersection operate at LOS C or better, with the exception of the westbound left-turn movement at the CO 170 and Marshall Dr / Eldorado Springs Dr Intersection. This movement operates at a LOS D in the PM peak hour.

The Synchro Reports are shown in **Appendix C**.

Table 1. Existing 2023 AM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Existing 2023 AM			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	95	0.54	61.3	E
			EBT			0	0.0	A
			EBR	55	0	0.23	51.6	D
		Westbound (SH 170)	WBL	450*	100	0.31	45.1	D
			WBT			0	0.0	A
			WBR	100	59	0.78	64.7	E
		Northbound (SH 93)	NBL	205	10	0.02	14.1	B
			NBT	-	444	0.64	23.2	C
			NBR	205	107	0.41	20.1	C
		Southbound (SH 93)	SBL	320	53	0.3	15.8	B
			SBT	-	178	0.28	14.5	B
			SBR	325	0	0.05	12.5	B
		Intersection		-	-	-	25.4	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125	0	0.01	10.6	B
		WBL (SH 170)		335	0	0.01	8.1	A
		Intersection		-	-	-	0.3	-
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100				
		EBL (SH 170)		480*	0	0.01	7.7	A
		WBL (SH 170)		775*				
		SBL (Park-n-ride)		100	3	0.04	10.2	B
		Intersection		-	-	-	0.6	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	13	0.14	7.6	A
		EBL (SH 170)		775*	43	0.36	10.2	B
		WBL (Eldorado Springs Dr)		165	5	0.05	17.5	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	9.2	-

** Length to next intersection*

Table 2. Existing 2023 PM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Existing 2023 PM			
					95th Queue (ft)	v/c	delay	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	107	0.62	70.9	E
			EBT	-		0	0.0	A
			EBR	55	0	0.4	61.6	E
		Westbound (SH 170)	WBL	450*	#558	1.04	107.5	F
			WBT			0	0.0	A
			WBR	100	19	0.31	42.8	D
		Northbound (SH 93)	NBL	205	17	0.06	19.0	B
			NBT	-	243	0.39	23.0	C
			NBR	205	44	0.24	21.4	C
		Southbound (SH 93)	SBL	320	116	0.43	16.7	B
			SBT	-	480	0.63	24.3	C
			SBR	325	0	0.08	16.5	B
		Intersection		-	-	-	37.0	D
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125	0	0.00	10.4	B
		WBL (SH 170)		335	0	0	0.0	A
		Intersection		-	-	-	0.0	-
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100				
		EBL (SH 170)		480*	0	0.01	8.3	A
		WBL (SH 170)		775*				
		SBL (Park-n-ride)		100	3	0.04	12.1	B
		Intersection		-	-	-	0.4	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	28	0.27	8.0	A
		EBL (SH 170)		775*	35	0.33	9.9	A
		WBL (Eldorado Springs Dr)		165	5	0.07	30.2	D
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	8.8	-

** Length to next intersection*

 # 95th Percentile Volume exceeds capacity, queue may be longer

Table 3. Existing 2023 Weekend Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Existing 2023 Saturday			
					95th Queue (ft)	v/c	delay	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	211	0.74	64.5	E
			EBT	-		0	0.0	A
			EBR	55	0	0.22	48.0	D
		Westbound (SH 170)	WBL	450*	238	0.75	63.6	E
			WBT			0	0.0	A
			WBR	100	0	0.36	49.0	D
		Northbound (SH 93)	NBL	205	44	0.12	15.5	B
			NBT	-	237	0.35	21.7	C
			NBR	205	30	0.17	19.7	B
		Southbound (SH 93)	SBL	320	49	0.14	15.5	B
			SBT	-	237	0.36	21.6	C
			SBR	325	6	0.11	18.8	B
		Intersection		-	-	-	30.7	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125	0	0.01	9.7	A
		WBL (SH 170)		335	0	0.00	7.8	A
		Intersection		-	-	-	0.3	-
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100				
		EBL (SH 170)		480*	0	0.01	7.8	A
		WBL (SH 170)		775*				
		SBL (Park-n-ride)		100	3	0.04	11.2	B
		Intersection		-	-	-	0.7	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	15	0.18	7.7	A
		EBL (SH 170)		775*	23	0.24	9.3	A
		WBL (Eldorado Springs Dr)		165	5	0.08	18.8	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	8.5	-

** Length to next intersection*

2.4 Crash History

Crash Data from CDOT was analyzed at the existing Trailhead Driveway and the at the proposed Trailhead Driveway. From January 2015 through December 2020, no crashes were reported at either driveway location.

3 NO BUILD CONDITIONS

Future traffic is defined by the planning horizon year of 2043 for the AM, PM, and Weekend peak periods. The 2043 forecasted traffic was calculated based on the DRCOG Regional Model and CDOT's OTIS traffic data.

3.1 No Build 2043 Traffic Volumes

To determine the No Build 2043 traffic volumes, both the Denver Regional Council of Governments (DRCOG) Regional Model and CDOT's Online Transportation Information System (OTIS) traffic were analyzed. The DRCOG Regional Model gave 2020 and 2050 traffic projections for all legs of the CO 93 and CO 170 intersection. These projections were used to calculate a growth factor that could be applied to the 2023 traffic volumes to obtain No Build 2043 traffic volumes.

CDOT's OTIS historic and projected traffic data was obtained at the following count stations:

- Sta. 103930 (along CO 93, north of CO 170)
- Sta. 103929 (along CO 93, south of CO 170)
- Sta. 104949 (along CO 170, west of CO 93)
- Sta. 104950 (along CO 170, east of CO 93)

CDOT's OTIS traffic data was obtained for the 2021 AADT and the 2043 AADT. This traffic data was used to calculate a growth factor that could be applied to the Existing 2023 traffic volumes to project No Build 2043 traffic volumes. The DRCOG Regional Model and the OTIS traffic data growth factors are both shown in **Table 4**.

Table 4. 2043 Growth Rates

Approach	DRCOG Regional Model Growth Factor	OTIS Growth Factor
CO 93 – North Leg	1.42	1.12
CO 93 – South Leg	1.41	1.13
CO 170 – West Leg	1.00	1.16
CO 170 – East Leg	1.21	1.24

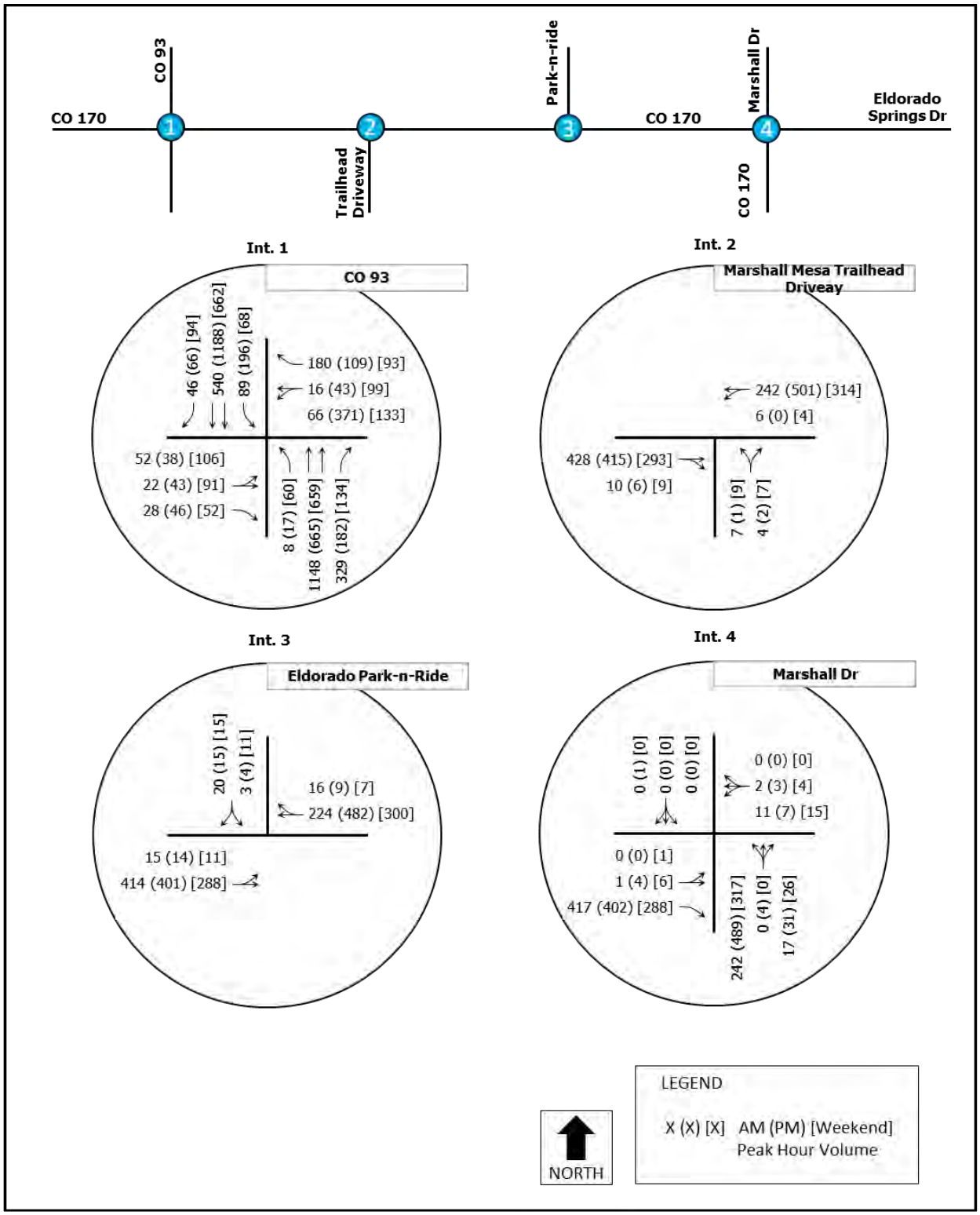
As shown in **Table 4**, the growth factors using the DRCOG Regional Model and OTIS were inconsistent. The higher DRCOG growth rates for CO 93 were judged to be overly robust when considering the highway is already near capacity and recent planning documents (Boulder

County TMP and CDOT's WestConnect PEL) call for CO 93 to remain as a two-lane highway. Conversely, the OTIS growth factors imply almost no vehicle traffic growth and were deemed too constrained. As such, a growth factor of 1.2 was selected for the north and south legs of CO 93 as well as the west leg of CO 170 to compromise between the two available growth factors. For CO 170, east of CO 93, a growth factor of 1.24 was used to represent the highest expected growth. Growth factors were not applied to movements that are not expected to be impacted by regional growth (i.e. driveways or roads that service limited residential). The growth factors were applied in the following way:

- CO 170 and CO 93
  - North Leg: 1.2
  - South Leg: 1.2
  - East Leg: 1.2
  - West Leg: 1.24
- CO 170 and Trailhead Driveway
  - East Leg (EBT Only): 1.24
  - West Leg (WBT Only): 1.24
  - All other movements: 1.0
- CO 170 and Park-n-Ride Driveway
  - East Leg (WBT Only): 1.24
  - West Leg (EBT Only): 1.24
  - All other movements: 1.0
- CO 170 and Marshall Dr
  - West Leg (CO 170): 1.24
  - South Leg (CO 170): 1.24
  - East Leg (Eldorado Springs Dr): 1.0
  - North Leg (Marshall Dr): 1.0

The growth factors were applied to the Existing 2023 volumes to obtain the No Build 2043 traffic volumes. The projected No Build 2043 traffic volumes for the AM, PM, and Weekend peak periods are shown in **Figure 4.**

Figure 4 – No Build 2043 Traffic Volumes



3.2 No Build 2043 Traffic Analysis

The No Build 2043 Traffic volumes were analyzed for the AM, PM, and Weekend peak using Highway Capacity Manual methods and Synchro 11 software. The existing signal timings and existing geometry were utilized in the existing analysis.

The 95th percentile queue, v/c ratio, delay, and LOS for all movements are shown in **Table 5**, **Table 6**, **Table 7** for the AM, PM, and Weekend peak hours, respectively.

At the signalized intersection of CO 93 and CO 170, in the AM peak hour, there were no LOS changes from the Existing 2023 analysis to the No Build 2043 analysis. The eastbound left-turn movement and the westbound right-turn movement operate at LOS E. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

In the PM peak hour, there were no LOS changes from the Existing 2023 analysis to the No Build 2043 analysis; however, at the CO 93 and CO 170 intersection, the westbound through-left turn queue lengthened from 558' to 725' in the No Build 2043 Analysis. The eastbound left-turn movement and the eastbound right-turn movement operate at LOS E. The shared westbound through/left-turn movement has a v/c ratio greater than 1 and operates at a LOS F. All other movements operate at LOS D, no other movements are over capacity, and no other 95th percentile queues extend past the available storage.

In the Weekend peak hour, there were no LOS changes from the Existing 2023 analysis to the No Build 2043 analysis. The eastbound left-turn movement and the westbound left-turn movement at the CO 93 and CO 170 intersection, operate at LOS E. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

All traffic movements at the existing two access driveways on CO 170 and at the CO 170 and Marshall Dr / Eldorado Springs Dr intersection operate at LOS C or better, with the exception of the westbound left-turn movement at the CO 170 and Marshall Dr / Eldorado Springs Dr Intersection. This movement operates at a LOS E in the PM peak hour.

The Synchro Reports are shown in **Appendix C**.

Table 5. No Build 2043 AM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	No Build 2043 AM			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	113	0.64	68.2	E
			EBT			0	0.0	A
			EBR	55	0	0.27	53.8	D
		Westbound (SH 170)	WBL	450*	118	0.32	44.6	D
			WBT			0	0.0	A
			WBR	100	68	0.81	67.2	E
		Northbound (SH 93)	NBL	205	12	0.02	15.2	B
			NBT	-	588	0.75	27.7	C
			NBR	205	162	0.48	22.8	C
		Southbound (SH 93)	SBL	320	66	0.41	20.5	C
			SBT	-	224	0.33	16.2	B
			SBR	325	0	0.06	13.7	B
		Intersection		-	-	-	28.9	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125	0	0.01	11.1	B
		WBL (SH 170)		335	0	0.01	8.3	A
		Intersection		-	-	-	0.2	-
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100				
		EBL (SH 170)		480*	0	0.01	7.8	A
		WBL (SH 170)		775*				
		SBL (Park-n-ride)		100	3	0.04	10.5	B
		Intersection		-	-	-	0.5	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	15	0.16	7.6	A
		EBL (SH 170)		775*	53	0.42	10.7	B
		WBL (Eldorado Springs Dr)		165	5	0.06	20.5	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	9.5	-

** Length to next intersection*

Table 6. No Build 2043 PM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	No Build 2043 PM			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	122	0.66	73.2	E
			EBT	-		0	0.0	A
			EBR	55	0	0.44	62.6	E
		Westbound (SH 170)	WBL	450*	#725	1.31	205.6	F
			WBT			0	0.0	A
			WBR	100	40	0.39	45.4	D
		Northbound (SH 93)	NBL	205	20	0.09	21.5	C
			NBT	-	301	0.47	25.3	C
			NBR	205	48	0.29	23.2	C
		Southbound (SH 93)	SBL	320	140	0.56	19.3	B
			SBT	-	624	0.75	28.3	C
			SBR	325	1	0.09	17.1	B
		Intersection		-	-	-	53.6	D
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125	0	0.00	11.0	B
		WBL (SH 170)		335	0	0	0.0	A
		Intersection		-	-	-	0.0	-
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100				
		EBL (SH 170)		480*	0	0.02	8.5	A
		WBL (SH 170)		775*				
		SBL (Park-n-ride)		100	3	0.05	13.5	B
		Intersection		-	-	-	0.4	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	35	0.33	8.3	A
		EBL (SH 170)		775*	50	0.40	10.5	B
		WBL (Eldorado Springs Dr)		165	10	0.11	47.7	E
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	9.3	-

** Length to next intersection*

 # 95th Percentile Volume exceeds capacity, queue may be longer

Table 7. No Build 2043 Weekend Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	No Build 2043 Saturday			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	251	0.79	69.1	E
			EBT	-		0	0.0	A
			EBR	55	0	0.25	49.1	D
		Westbound (SH 170)	WBL	450*	#316	0.82	70.0	E
			WBT			0	0.0	A
			WBR	100	16	0.39	50.0	D
		Northbound (SH 93)	NBL	205	50	0.17	18.5	B
			NBT	-	291	0.45	26.0	C
			NBR	205	43	0.21	23.0	C
		Southbound (SH 93)	SBL	320	56	0.2	18.5	B
			SBT	-	293	0.45	25.9	C
			SBR	325	17	0.14	21.9	C
		Intersection		-	-	-	35.0	D
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125	0	0.01	10.2	B
		WBL (SH 170)		335	0	0.00	8.0	A
		Intersection		-	-	-	0.3	-
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100				
		EBL (SH 170)		480*	0	0.01	8.0	A
		WBL (SH 170)		775*				
		SBL (Park-n-ride)		100	5	0.06	12.4	B
		Intersection		-	-	-	0.7	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	20	0.21	7.8	A
		EBL (SH 170)		775*	30	0.29	9.6	A
		WBL (Eldorado Springs Dr)		165	8	0.10	23.4	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	8.7	-

** Length to next intersection*

4 BUILD CONDITIONS

The build conditions analysis includes the development of site generated traffic from the parking lot expansion as well as the relocation of the Trailhead Driveway.

4.1 Site Generated Traffic

Trip generation for this project was estimated for the AM, PM, and Weekend peak hours based on the proportion of existing spaces to proposed spaces. The existing Marshall Mesa Trailhead Parking Lot has 45 spaces. The proposed lot has 75 spaces. Thus, the ratio of proposed to existing spaces is approximately 1.67. This ratio was applied to all turning movements into the trailhead as well as all turning movements leaving the trailhead. The additional trips for each turning movement are shown in **Table 8**.

Table 8. Proposed Site Peak Hour Trip Generation

	Trailhead Driveway In		Trailhead Driveway Out	
	EBR	WBL	NBL	NBR
AM Peak Hour				
Existing Movement (veh)	10	6	7	4
Additional Trips (veh)	7	4	5	3
Proposed Movement (veh)	17	10	12	7
PM Peak Hour				
Existing Movement (veh)	6	0	1	2
Additional Trips (veh)	4	0	1	1
Proposed Movement (veh)	10	0	2	3
Weekend Peak Hour				
Existing Movement (veh)	9	4	9	7
Additional Trips (veh)	6	3	6	5
Proposed Movement (veh)	15	7	15	12

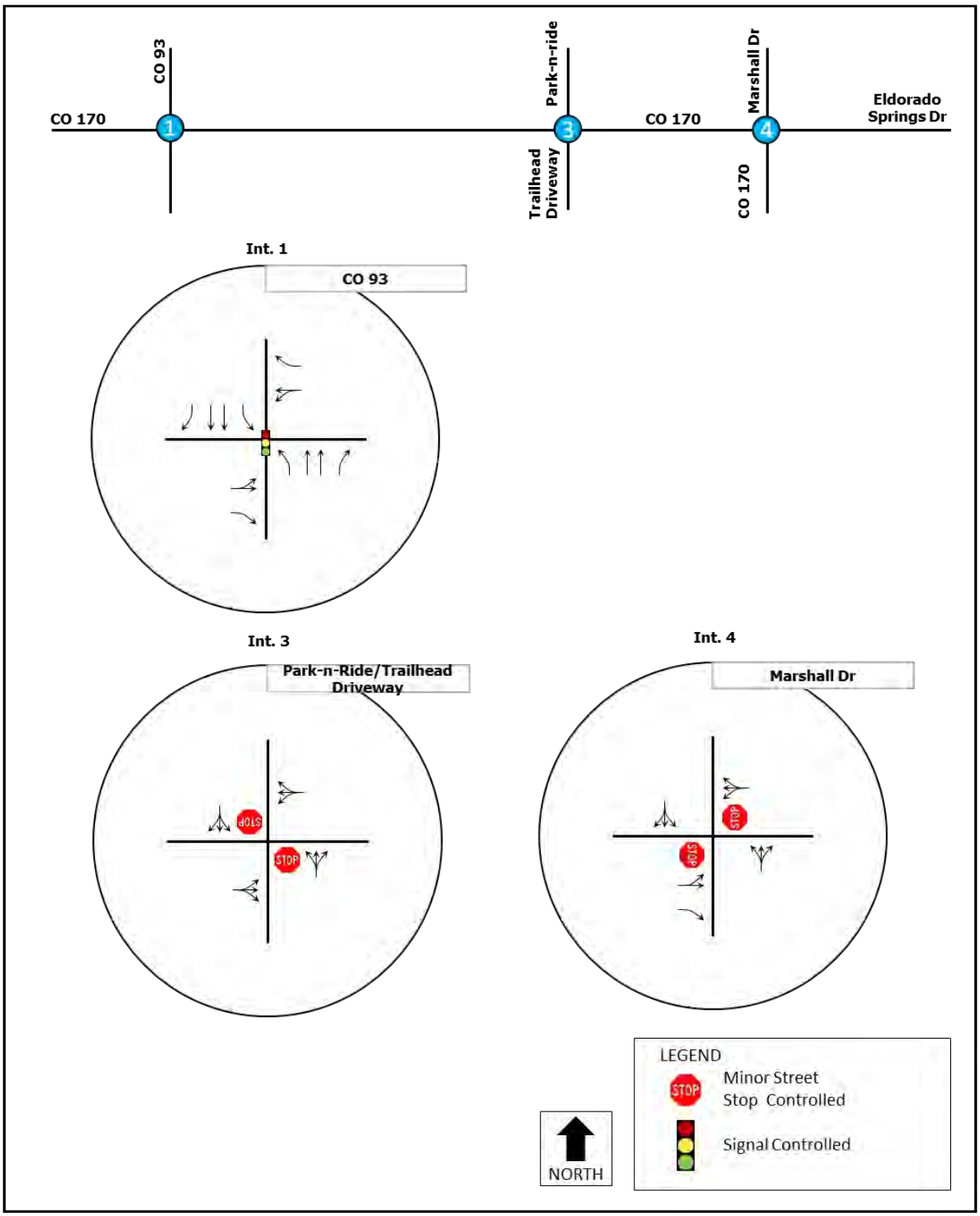
4.2 Trip Distribution and Assignment

Although the existing trailhead driveway is RIRO, vehicles were observed turning left out of and into the trailhead driveway. The proposed driveway is planned as full access. Thus, the turning movements were not reassigned but only relocated to the proposed driveway location.

The additional trips expected to be generated from the parking lot expansion have been applied to the entire network in the same proportion as the existing turning movements.

The proposed Build intersection geometry is shown in **Figure 5**.

Figure 5 – Build Geometry



4.3 Build 2023 Traffic Analysis

For the Build 2023 traffic analysis, the additional site generated trips were added to the Existing 2023 traffic volumes.

The Build 2023 traffic volumes for the AM, PM, and Weekend peak periods are shown in **Figure 6**.

The Build 2023 AM, PM, and Weekend scenarios were analyzed using Highway Capacity Manual methods and Synchro 11 software. The Existing 2023 analysis indicated the WBL/WBT movement at the CO 93 and CO 170 intersection had an extensive queue. To mitigate this queue, the signal timings were modified to provide additional time to the westbound approach in the Build 2023 analysis. This timing change did not negatively impact the overall intersection operation nor CO 93 traffic movements. The geometry used in the Build 2023 Analysis reflects the relocated Trailhead Driveway location.

The 95th percentile queue, v/c ratio, delay, and LOS for all movements are shown in **Table 9**, **Table 10**, and **Table 11** for the AM, PM, and Weekend peak hours, respectively.

At the signalized intersection of CO 93 and CO 170, in the AM peak hour, the proposed changes improved the eastbound left-turn movement and the westbound right-turn movement from LOS E to LOS D. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

In the PM peak hour, at the CO 93 and CO 170 intersection, the proposed changes improved the westbound left-turn movement from LOS F to LOS D. The queue was also reduced from 558’ to 392’. The eastbound left-turn movement and the eastbound right-turn movement are still projected to operate at LOS E. All other movements operate at LOS D, no other movements are over capacity, and no other 95th percentile queues extend past the available storage.

In the Weekend peak hour, at the CO 93 and CO 170 intersection, the proposed changes improved the eastbound right-turn movement from LOS E to LOS D. All movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

All traffic movements at the existing two access driveways on CO 170 and at the CO 170 and Marshall Dr / Eldorado Springs Dr intersection operate at LOS C or better, with the exception of the westbound left-turn movement at the CO 170 and Marshall Dr / Eldorado Springs Dr Intersection. This movement operates at a LOS D in the PM peak hour.

The Synchro Reports are shown in **Appendix C**.

Figure 6 – *Build 2023 Traffic Volumes*

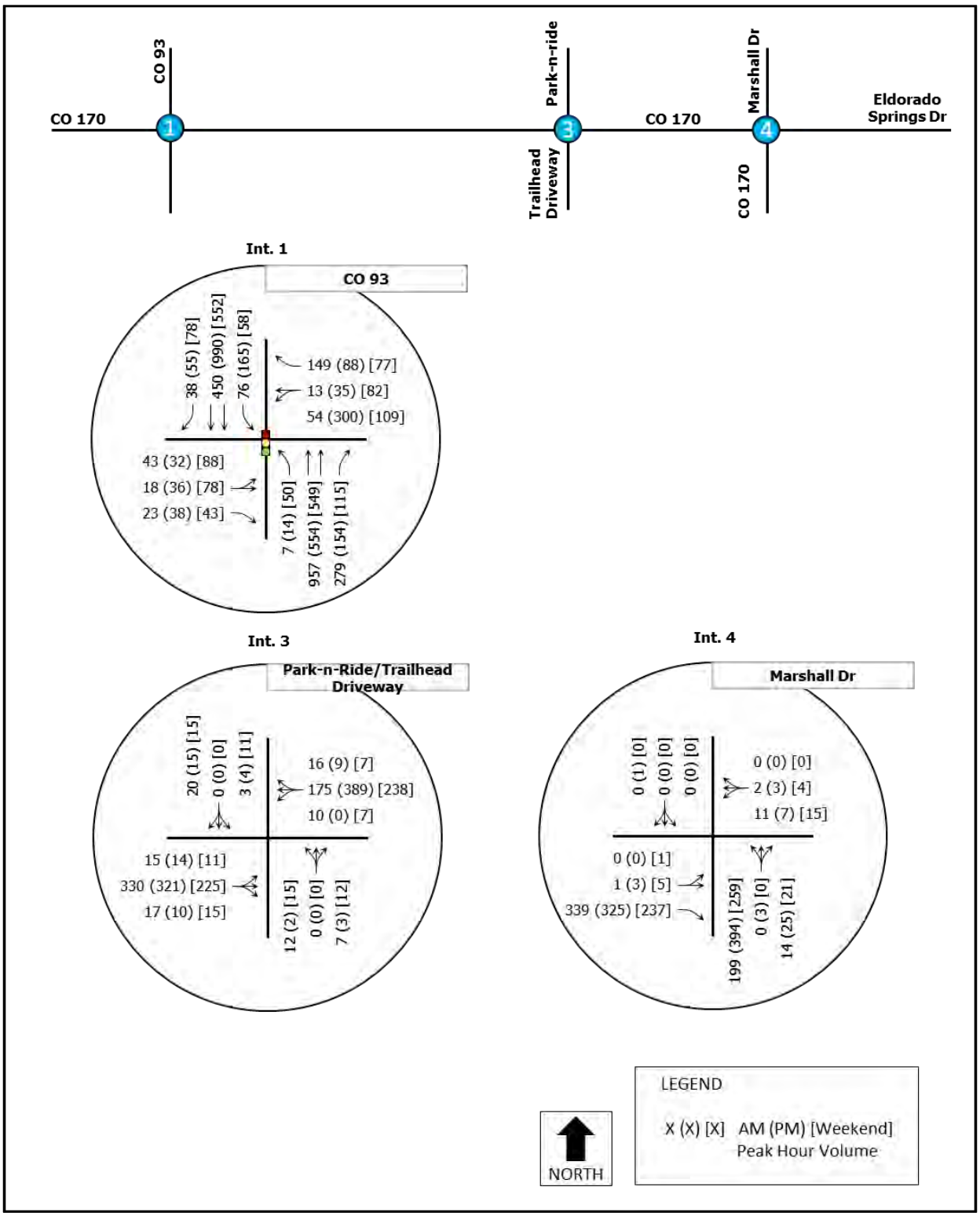


Table 9. Build 2023 AM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Build 2023 AM			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	88	0.5	53.5	D
			EBT			0	0.0	A
			EBR	55	0	0.21	45.8	D
		Westbound (SH 170)	WBL	450*	91	0.28	39.1	D
			WBT			0	0.0	A
			WBR	100	59	0.69	52.3	D
		Northbound (SH 93)	NBL	205	10	0.02	15.3	B
			NBT	-	421	0.68	25.1	C
			NBR	205	121	0.44	21.9	C
		Southbound (SH 93)	SBL	320	52	0.3	16.4	B
			SBT	-	170	0.29	15.6	B
			SBR	325	0	0.05	13.5	B
		Intersection		-	-	-	25.5	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125				
		WBL (SH 170)		335				
		Intersection		-				
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100	3	0.05	13.6	B
		EBL (SH 170)		480*	0	0.01	7.7	A
		WBL (SH 170)		775*	0	0.01	8.1	A
		SBL (Park-n-ride)		100	3	0.04	10.2	B
		Intersection		-	-	-	1.1	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	13	0.13	7.6	A
		EBL (SH 170)		775*	38	0.34	10.0	B
		WBL (Eldorado Springs Dr)		165	3	0.04	16.5	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	9.0	-

** Length to next intersection*

Table 10. Build 2023 PM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Build 2023 PM			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	113	0.6	67.5	E
			EBT	-		0	0.0	A
			EBR	55	0	0.38	59.1	E
		Westbound (SH 170)	WBL	450*	392	0.79	51.1	D
			WBT			0	0.0	A
			WBR	100	15	0.24	35.1	D
		Northbound (SH 93)	NBL	205	21	0.08	23.9	C
			NBT	-	291	0.46	28.9	C
			NBR	205	52	0.29	27.0	C
		Southbound (SH 93)	SBL	320	149	0.48	21.2	C
			SBT	-	#611	0.72	31.0	C
			SBR	325	0	0.09	20.6	C
		Intersection		-	-	-	33.7	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125				
		WBL (SH 170)		335				
		Intersection		-				
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100	0	0.01	13.4	B
		EBL (SH 170)		480*	0	0.01	8.2	A
		WBL (SH 170)		775*	0	0	0.0	A
		SBL (Park-n-ride)		100	3	0.04	12.5	B
		Intersection		-	-	-	0.5	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	28	0.26	8.0	A
		EBL (SH 170)		775*	35	0.33	9.9	A
		WBL (Eldorado Springs Dr)		165	5	0.07	29.5	D
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	8.8	-

** Length to next intersection*

 # 95th Percentile Volume exceeds capacity, queue may be longer

Table 11. Build 2023 Weekend Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Build 2023 Saturday			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	#238	0.79	66.9	E
			EBT	-		0	0.0	A
			EBR	55	0	0.24	44.4	D
		Westbound (SH 170)	WBL	450*	206	0.66	49.9	D
			WBT			0	0.0	A
			WBR	100	2	0.31	41.3	D
		Northbound (SH 93)	NBL	205	43	0.13	16.5	B
			NBT	-	233	0.4	23.1	C
			NBR	205	33	0.19	21.0	C
		Southbound (SH 93)	SBL	320	48	0.15	16.5	B
			SBT	-	233	0.4	22.9	C
			SBR	325	7	0.13	19.9	B
		Intersection		-	-	-	30.2	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125				
		WBL (SH 170)		335				
		Intersection		-				
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100	5	0.06	12.7	B
		EBL (SH 170)		480*	0	0.01	7.9	A
		WBL (SH 170)		775*	0	0.006	7.8	A
		SBL (Park-n-ride)		100	5	0.05	12.0	B
		Intersection		-	-	-	1.4	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	15	0.17	7.7	A
		EBL (SH 170)		775*	23	0.24	9.2	A
		WBL (Eldorado Springs		165	5	0.07	18.4	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	8.4	-

** Length to next intersection*

4.4 Build 2043 Traffic Analysis

For the Build 2043 traffic analysis, the additional site generated trips were added to the No Build 2043 traffic volumes.

The Build 2043 traffic volumes for the AM, PM, and Weekend peak periods are shown in **Figure 7.**

The Build 2043 AM, PM, and Weekend scenarios were analyzed using Highway Capacity Manual methods and Synchro 11 software. The Build 2043 analysis utilized the same signal timing modification used in the Build 2023 analysis. Additionally, the geometry used in the Build 2043 Analysis reflects the relocated Trailhead Driveway.

The 95th percentile queue, v/c ratio, delay, and LOS for all movements are shown in **Table 12**, **Table 13**, and **Table 14** for the AM, PM, and Weekend peak hours, respectively.

At the signalized intersection of CO 93 and CO 170, in the AM peak hour, compared to the No Build 2043, the westbound right-turn movement improved from a LOS E to LOS D. The eastbound left-turn movement is still expected to operate at LOS E. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

In the PM peak hour, compared to the No Build 2043, the proposed changes at the CO 93 and CO 170 intersection improved the WBL LOS from LOS F to LOS D. The queue was also reduced from 725’ to 536’. The eastbound left-turn movement and the eastbound right-turn movement are still projected to operate at LOS E. All other movements operate at LOS D, no other movements are over capacity, and no other 95th percentile queues extend past the available storage.

In the Weekend peak hour, compared to the No Build 2043, at the CO 93 and CO 170 intersection, the westbound left-turn movement improved from LOS E to LOS D. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

All traffic movements at the existing two access driveways on CO 170 and at the CO 170 and Marshall Dr / Eldorado Springs Dr intersection operate at LOS C or better, with the exception of the westbound left-turn movement at the CO 170 and Marshall Dr / Eldorado Springs Dr Intersection. This movement operates at a LOS E in the PM peak hour.

The Synchro Reports are shown in **Appendix C**.

Figure 7 – *Build 2043 Traffic Volumes*

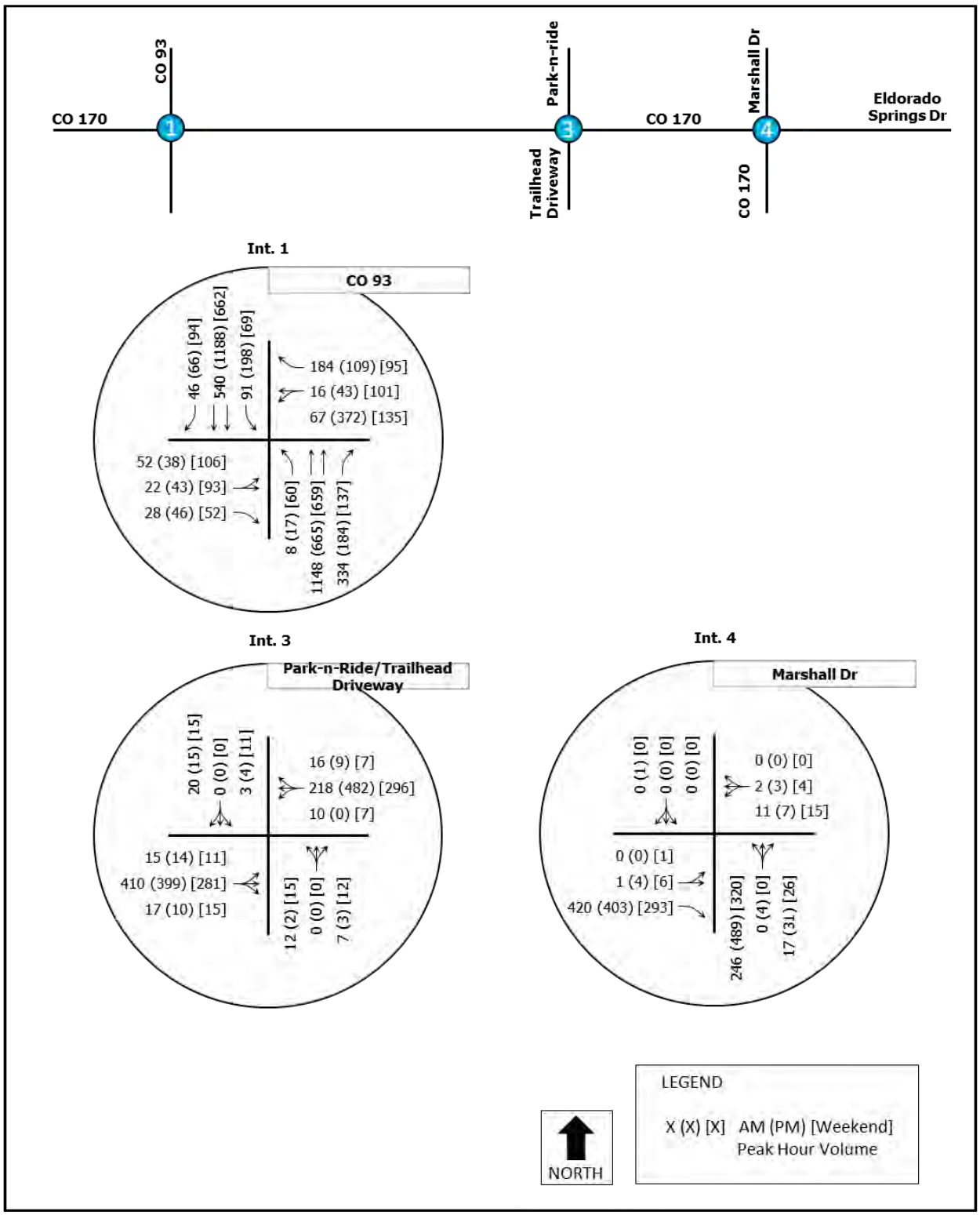


Table 12. Build 2043 AM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Build 2043 AM			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	104	0.6	60.2	E
			EBT			0	0.0	A
			EBR	55	0	0.25	48.5	D
		Westbound (SH 170)	WBL	450*	108	0.29	38.4	D
			WBT			0	0.0	A
			WBR	100	64	0.73	52.3	D
		Northbound (SH 93)	NBL	205	11	0.02	16.9	B
			NBT	-	#606	0.85	33.4	C
			NBR	205	177	0.55	26.3	C
		Southbound (SH 93)	SBL	320	71	0.43	22.6	C
			SBT	-	214	0.36	18.1	B
			SBR	325	0	0.07	15.2	B
		Intersection		-	-	-	30.9	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125				
		WBL (SH 170)		335				
		Intersection		-				
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100	5	0.06	15.5	B
		EBL (SH 170)		480*	0	0.01	7.8	A
		WBL (SH 170)		775*	0	0.01	8.3	A
		SBL (Park-n-ride)		100	3	0.04	10.8	B
		Intersection		-	-	-	1.0	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	15	0.17	7.7	A
		EBL (SH 170)		775*	53	0.42	10.7	B
		WBL (Eldorado Springs Dr)		165	5	0.06	20.9	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	9.6	-

** Length to next intersection*

 # 95th Percentile Volume exceeds capacity, queue may be longer

Table 13. Build 2043 PM Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Build 2043 PM			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	130	0.71	79.4	E
			EBT	-		0	0.0	A
			EBR	55	0	0.46	66.0	E
		Westbound (SH 170)	WBL	450*	#536	0.86	56.5	E
			WBT			0	0.0	A
			WBR	100	33	0.25	34.5	C
		Northbound (SH 93)	NBL	205	24	0.14	30.6	C
			NBT	-	357	0.59	35.6	D
			NBR	205	65	0.37	32.5	C
		Southbound (SH 93)	SBL	320	#207	0.69	31.7	C
			SBT	-	#817	0.92	46.7	D
			SBR	325	1	0.12	24.2	C
		Intersection		-	-	-	43.9	D
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125				
		WBL (SH 170)		335				
		Intersection		-				
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100	0	0.02	15.6	B
		EBL (SH 170)		480*	0	0.02	8.5	A
		WBL (SH 170)		775*	0	0	0.0	A
		SBL (Park-n-ride)		100	5	0.05	14.2	B
		Intersection		-	-	-	0.5	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	35	0.33	8.3	A
		EBL (SH 170)		775*	50	0.40	10.5	B
		WBL (Eldorado Springs Dr)		165	10	0.11	47.7	E
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	9.3	-

** Length to next intersection*

 # 95th Percentile Volume exceeds capacity, queue may be longer

Table 14. Build 2043 Weekend Peak Hour Level of Service

Intersection	Control Type	Approach	Movement	Exist. Storage	Build 2043 Saturday			
					95th Queue (ft)	v/c	delay (s)	LOS
CO 93 & CO 170	Signalized	Eastbound (SH 170)	EBL	-	#321	0.86	76.6	E
			EBT	-		0	0.0	A
			EBR	55	0	0.27	46.2	D
		Westbound (SH 170)	WBL	450*	252	0.7	51.6	D
			WBT			0	0.0	A
			WBR	100	17	0.33	41.6	D
		Northbound (SH 93)	NBL	205	53	0.18	19.6	B
			NBT	-	304	0.5	27.9	C
			NBR	205	46	0.24	24.6	C
		Southbound (SH 93)	SBL	320	60	0.21	19.7	B
			SBT	-	307	0.51	27.8	C
			SBR	325	19	0.16	23.3	C
		Intersection		-	-	-	34.7	C
CO 170 & Marshall Mesa Trailhead	TWSC	NBL (Trailhead)		125				
		WBL (SH 170)		335				
		Intersection		-				
CO 170 & Park-n-Ride/Proposed Driveway	TWSC	NBL (Trailhead)		100	5	0.07	14.1	B
		EBL (SH 170)		480*	0	0.01	8.0	A
		WBL (SH 170)		775*	0	0.01	7.9	A
		SBL (Park-n-ride)		100	5	0.06	13.2	B
		Intersection		-	-	-	1.3	-
CO 170 & Marshall Dr/ Eldorado Springs Dr	TWSC	NBL (SH 170)		-	20	0.21	7.8	A
		EBL (SH 170)		775*	30	0.29	9.6	A
		WBL (Eldorado Springs		165	8	0.10	23.7	C
		SBL (Marshall Dr)		450	0	0	0.0	A
		Intersection		-	-	-	8.7	-

** Length to next intersection*

 # 95th Percentile Volume exceeds capacity, queue may be longer

5 AUXILIARY TURN LANES

Within the project vicinity, CO 170 is defined as an R-B Rural Highway. The CDOT Access Code states the following regarding Auxiliary Lane Requirement on an R-B Rural Highway:

"(8) Auxiliary turn lanes shall be installed according to the criteria below.

(a) A left turn deceleration lane with taper and additional storage length is required for an access with a projected peak hour left ingress turning volume greater than 10 vph. The taper length shall be included within the required deceleration length.
(b) 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."

The 2043 projected turning movements into the relocated Trailhead Driveway indicate that the right-turns and the left-turns do not exceed the thresholds stated in the CDOT Access Code. **Table 15** summarizes the projected 2043 turning movements compared to the CDOT Access Code thresholds.

Table 15. Lane Storage and Taper Lengths

Location	Peak Period	Peak Hour Volume	Threshold	Auxiliary Lane Req'd
Eastbound Right-Turn	AM	17	>25	No
	PM	10		No
	Weekend	15		No
Westbound Left-Turn	AM	10	>10	No
	PM	0		No
	Weekend	7		No

The eastbound right-turn lane volume is below the threshold for all three peak periods and therefore an eastbound right-turn auxiliary lane is not recommended.

The westbound left-turn lane volume is below the threshold for the PM and Weekend peak periods and at the threshold for the AM Peak period. As shown in **Table 9** through **Table 14**, the WBL is expected to operate at LOS A for all three-peak periods for 2023 and 2043 conditions. The intersection is expected to operate with a maximum delay of 1.0 sec during the Build 2043 AM peak hour.

Additionally, as described **Section 2.4**, there is no history of crashes at the existing trailhead driveway.

The implementation of a westbound left-turn auxiliary is not recommended due to the following reasons:

- The projected site traffic is below the CDOT Access Code threshold during the PM and Weekend peak hours.
- The projected site traffic is at the CDOT Access Code threshold during the AM peak hour. However, the threshold is not exceeded.
- The operational analysis does not indicate an operational issue at the intersection without a westbound left-turn lane.
- The upstream signal creates sufficient gaps for left turning traffic.
- There are no historic crashes from January 2015 through December 2020 involving the westbound left-turn.
- The proposed driveway relocation shifts the trailhead driveway further from the horizontal curve and the intersection of CO 93 and CO 170. The proposed driveway will provide an improved safety and operational condition for vehicles turning left into the trailhead driveway.

6 PEDESTRIAN CONSIDERATIONS

There is an existing mid-block pedestrian crossing located approximately 150' west of the existing CO 170 and Park-n-Ride Driveway. This pedestrian crossing services pedestrians and bicyclists going from the Eldorado Park-n-Ride to the trailhead. This crossing is also approximately 300' east of the intersection of CO 93 and CO 170. Additionally, a relocated crosswalk located at the proposed driveway was evaluated. This new crossing location is deemed the most optimal spot based on the existing roadway geometry because:

- There is a horizontal curve along CO 170 approaching CO 93. Increasing the distance between the proposed crosswalk and the horizontal curve increases stopping sight distance for eastbound vehicles.

With the assumption that the crosswalk location is to be relocated to the proposed driveway, both CDOT's Pedestrian Crossing Installation Guide and City of Boulder's Crossing Treatment Installation Guidelines were reviewed to determine if the existing crossing treatment should be modified. The pedestrian crossing worksheets were filled out for each guide. These worksheets can be found in **Appendix D**.

Following Figure C3 and Table C1 in CDOT's Guide, the recommended treatment is a marked crosswalk with W11-2 advanced pedestrian signs. Figure 1 and Table 1 in City of Boulder's Guidelines also recommended a marked crosswalk with advanced pedestrian signs. Both CDOT's and City of Boulder's Guidelines indicate these treatments are applicable if the minimum pedestrian volume thresholds are met. For the propose crossing location, the volume thresholds are met, as indicated in

Figure *9* – Eastbound Sight Distance (Without Westbound Queue)

Figure 10 – *Eastbound Sight Distance (Without Westbound Queue)*

Rectangular Rapid Flashing Beacon (RRFB)

CDOT's Guide states that an RRFB may be considered at locations where a HAWK signal (Pedestrian Hybrid Beacon) is not warranted and pedestrian volume meets the thresholds. Both CDOT and City of Boulder recognize the volume thresholds for an RRFB as:

- 20 pedestrians per hour in any one hour
- 18 pedestrians per hour in any two hours
- 15 pedestrians per hour in any three hours
- 10 school aged pedestrians traveling to or from school in any one hour

Error! Not a valid bookmark self-reference. shows the peak hour pedestrian volumes compared to the RRFB threshold. As indicated in **Table 16,** the Weekend PM peak period at CO 170 and Park-n-Ride Driveway exceeds the hourly threshold, thus a RRFB is recommended.

Table 16.

CDOT indicates an SSD of 8x the speed limit required. For CO 170, the required SSD is 240'. This sight distance can be met in the westbound direction as there are no horizontal or vertical obstructions 240' east of the crosswalk. The eastbound direction experiences more limited SSD due to existing the horizontal curve as well as limited SSD when the westbound left-turn queue extends to the crosswalk. Sight distance is shown in **Figure 8** through **Figure 10**Error! Reference source not found.. Due to the SSD limitations in the eastbound direction that is not feasible to remove, it is recommended an enhanced crosswalk be evaluated, such as an RRFB.

Figure 8 – *Westbound Sight Distance*

Figure 9 – *Eastbound Sight Distance (Without Westbound Queue)*

Figure 10 – *Eastbound Sight Distance (Without Westbound Queue)*

Rectangular Rapid Flashing Beacon (RRFB)

CDOT's Guide states that an RRFB may be considered at locations where a HAWK signal (Pedestrian Hybrid Beacon) is not warranted and pedestrian volume meets the thresholds. Both CDOT and City of Boulder recognize the volume thresholds for an RRFB as:

- 20 pedestrians per hour in any one hour
- 18 pedestrians per hour in any two hours
- 15 pedestrians per hour in any three hours
- 10 school aged pedestrians traveling to or from school in any one hour

Error! Not a valid bookmark self-reference. shows the peak hour pedestrian volumes compared to the RRFB threshold. As indicated in Error! Not a valid bookmark self-reference., the Weekend PM peak period at CO 170 and Park-n-Ride Driveway exceeds the hourly threshold, thus a RRFB is recommended.

Table 16. Pedestrian Volume Threshold

Location	Peak Hour Period	Ped Volume Across CO 170	Threshold	Threshold Met?
CO 170 and Trailhead Driveway	AM	4	20	No
	PM	4		No
	Weekend	4		No
CO 170 and Park-n-Ride Driveway	AM	10		No
	PM	5		No
	Weekend	36		Yes

Additional Signing Improvements

The RRFB must be installed in accordance with the MUTCD Interim Approval 21. As noted in the MUTCD, the existing W11-2 (Pedestrian) and W16-7P (Diagonal Arrow) shall be relocated and to the same support as the RRFB.

In addition to the RRFB, it is recommended that Advanced Pedestrian Warning Signs (W11-2, Pedestrian) be installed in advance of the crosswalk in both the eastbound and westbound direction.

7 SUMMARY AND CONCLUSION

7.1 Final Operational Conditions

The purpose of this study is to assess potential traffic impacts of relocating the existing Marshall Mesa Trailhead access on CO 170 in Boulder County. The existing access is located approximately 120 feet from the signalized intersection of CO 93 and CO 170. The proposed access location is approximately 500 feet east of the signalized intersection and aligned with the Eldorado Park-n-Ride access to the north. The study also provides recommendations for relocating the existing pedestrian crosswalk across CO 170 to the proposed driveway location.

Based on the findings of this study, relocating the Trailhead Driveway from the existing location to across from the Eldorado Park-n-Ride Driveway has no adverse operational or safety impacts at the study intersections. In conjunction with signal timing adjustments at CO 93 and CO 170, the Build 2043 scenario is an improved condition compared to No Build 2043.

An analysis of the final operational conditions at the CO 93/CO 170 intersection revealed the following:

- In the Build 2043 AM peak hour, the eastbound left-turn movement is expected to operate at LOS E. However, the eastbound left-turn volume is low, servicing approximately 52 vehicles per hour. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.
- In the Build 2043 PM peak hour, the eastbound left-turn movement and the eastbound right-turn movement are projected to operate at LOS E. The westbound left-turn is expected to operate at LOS E with a queue of 536 feet. However, this is an improvement compared to the No Build scenario that operated at a LOS F with a queue of 725 feet.
- In the Build 2043 Weekend peak hour, the eastbound left-turn movement is expected to operate at LOS E. However, the eastbound left-turn volume is low, servicing approximately 106 vehicles per hour. All other movements operate at LOS D or better. No movements are over capacity and no 95th percentile queues extend past the available storage.

In the Build 2043 PM peak hour at CO 170 and Marshall Dr, the westbound left-turn is expected to operate at LOS E, however the westbound approach is only expected to have a volume of 10 vehicles per hour. All other movements at this intersection and at the proposed Trailhead Driveway/Eldorado Park-n-Ride intersection operate at LOS C or better for all time periods. No other movements are over capacity, and no other 95th percentile queues extend past the available storage.

7.2 Proposed Improvements

The following improvements are recommended for the Marshall Mesa Trailhead Driveway relocation:

- Adjust CO 93 and CO 170 signal timings to provide additional time to the westbound left-turn delay. This mitigation will help reduce the westbound left-turn queue while maintaining an acceptable level of service for CO 93 traffic flow.
- The new access driveway should be constructed in accordance with CDOT design standards for access driveways onto category R-B state highways.
- Relocate the existing location of the pedestrian crosswalk to the proposed driveway location
    - Install RRFB
    - Install Advanced Pedestrian Warning Signs

APPENDIX A

TRAFFIC COUNT DATA

All Traffic Data Services

093A01363 SH 93 & ELDORADO SPRINGS DR AM
Wednesday, February 20, 2019

Peak Hour
07:15 AM - 08:15 AM
Peak 15-Minutes
07:45 AM - 08:00 AM

Traffic Counts - All Vehicles

	ELDORADO SPRINGS DR					ELDORADO SPRINGS DR					SH 93					SH 93						
	Eastbound					Westbound					Northbound					Southbound						Rolling
Time	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	Total	Hour
6:45 AM	0	6	1	5	0	0	14	2	11	0	0	2	170	48	0	0	11	89	2	0	361	1,924
7:00 AM	0	9	6	3	0	0	24	5	30	0	0	1	158	44	0	0	7	101	6	0	394	2,247
7:15 AM	0	4	2	5	0	0	21	7	42	0	0	0	223	82	0	0	9	119	6	0	520	2,400
7:30 AM	0	15	7	9	0	0	20	4	86	0	0	1	265	101	0	0	24	108	9	0	649	0
7:45 AM	0	10	6	3	0	0	24	5	86	0	0	4	271	108	0	0	40	117	10	0	684	0
8:00 AM	0	14	10	6	0	0	26	7	37	0	0	2	198	96	0	0	32	106	13	0	547	0

Peak Rolling Hour Flow Rates

	Eastbound					Westbound					Northbound					Southbound					
Vehicle Type	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	Total
Articulated Trucks	0	0	1	0	0	0	0	1	0	0	0	0	2	0	0	0	0	1	0	0	5
Lights	0	41	23	23	0	0	87	21	247	0	0	7	945	387	0	0	103	435	34	0	2,353
Mediums	0	2	1	0	0	0	4	1	4	0	0	0	10	0	0	0	2	14	4	0	42
Total	0	43	25	23	0	0	91	23	251	0	0	7	957	387	0	0	105	450	38	0	2,400
Bicycles on Crosswalk			0					0					0					0			0
Heavy Vehicle Percentage			4.4%					2.7%					0.9%					3.5%			2.0%
Heavy Vehicle Percentage	0.0%	4.7%	8.0%	0.0%	0.0%	0.0%	4.4%	8.7%	1.6%	0.0%	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%	1.9%	3.3%	10.5%	0.0%	2.0%
Peak Hour Factor (PHF)			0.73					0.79					0.88					0.89			0.88
Peak Hour Factor (PHF)	0.00	0.72	0.63	0.64	0.00	0.00	0.88	0.82	0.73	0.00	0.00	0.44	0.88	0.90	0.00	0.00	0.66	0.95	0.73	0.00	0.88

Traffic Counts by Vehicle Type

	Eastbound					Westbound					Northbound					Southbound					
Time	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	Total
Articulated Trucks																					
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2
8:00 AM	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Lights																					
6:45 AM	0	6	1	5	0	0	12	2	11	0	0	2	169	47	0	0	11	89	1	0	356
7:00 AM	0	7	5	3	0	0	22	5	30	0	0	1	156	43	0	0	7	100	6	0	385
7:15 AM	0	4	2	5	0	0	21	7	41	0	0	0	223	82	0	0	8	117	5	0	515
7:30 AM	0	14	7	9	0	0	19	2	83	0	0	1	262	101	0	0	24	107	9	0	638
7:45 AM	0	9	6	3	0	0	22	5	86	0	0	4	265	108	0	0	40	109	9	0	666
8:00 AM	0	14	8	6	0	0	25	7	37	0	0	2	195	96	0	0	31	102	11	0	534
Mediums																					
6:45 AM	0	0	0	0	0	0	2	0	0	0	0	0	1	1	0	0	0	0	1	0	5
7:00 AM	0	2	1	0	0	0	2	0	0	0	0	0	1	1	0	0	0	1	0	0	8
7:15 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2	1	0	5
7:30 AM	0	1	0	0	0	0	1	1	3	0	0	0	3	0	0	0	0	1	0	0	10
7:45 AM	0	1	0	0	0	0	2	0	0	0	0	0	5	0	0	0	0	7	1	0	16
8:00 AM	0	0	1	0	0	0	1	0	0	0	0	0	2	0	0	0	1	4	2	0	11

Bicycles on Crosswalk

	Eastbound			Westbound			Northbound			Southbound		
Time	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0

Pedestrians

	Eastbound			Westbound			Northbound			Southbound		
Time	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total
6:45 AM	0	0	0	0	1	1	1	1	2	0	0	0
7:00 AM	1	0	1	0	1	1	0	0	0	1	0	1
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	1	0	1	0	0	0	0	0	0	1	0	1
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0

All Traffic Data Services

093A01363 SH 93 & ELDORADO SPRINGS DR PM
Wednesday, February 20, 2019

Peak Hour
05:00 PM - 06:00 PM
Peak 15-Minutes
05:15 PM - 05:30 PM

Traffic Counts - All Vehicles

	ELDORADO SPRINGS DR					ELDORADO SPRINGS DR					SH 93					SH 93						
	Eastbound					Westbound					Northbound					Southbound						
Time	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	Total	Rolling Hour
4:45 PM	0	28	11	11	0	0	64	8	25	0	0	5	126	37	0	0	33	217	18	0	583	2,437
5:00 PM	0	9	17	8	0	0	66	11	12	0	1	2	133	37	0	0	35	232	18	0	581	2,456
5:15 PM	0	7	5	10	0	0	92	8	26	0	0	5	135	47	0	0	39	289	10	0	673	2,305
5:30 PM	0	4	5	4	0	0	66	7	26	0	0	1	148	32	0	0	48	246	13	0	600	0
5:45 PM	0	12	9	16	0	0	75	9	24	0	0	5	138	36	0	0	41	223	14	0	602	0
6:00 PM	0	16	7	7	0	0	40	10	13	0	0	0	107	25	0	0	28	163	14	0	430	0

Peak Rolling Hour Flow Rates

	Eastbound					Westbound					Northbound					Southbound					
Vehicle Type	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	Total
Articulated Trucks	0	0	1	1	0	0	1	2	0	0	0	0	3	0	0	0	0	3	0	0	11
Lights	0	32	35	37	0	0	297	33	88	0	1	13	546	150	0	0	163	983	55	0	2,433
Mediums	0	0	0	0	0	0	1	0	0	0	0	0	5	2	0	0	0	4	0	0	12
Total	0	32	36	38	0	0	299	35	88	0	1	13	554	152	0	0	163	990	55	0	2,456
Bicycles on Crosswalk			0					0					0					0			0
Heavy Vehicle Percentage			1.9%					0.9%					1.4%					0.6%			0.9%
Heavy Vehicle Percentage	0.0%	0.0%	2.8%	2.6%	0.0%	0.0%	0.7%	5.7%	0.0%	0.0%	0.0%	0.0%	1.4%	1.3%	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.9%
Peak Hour Factor (PHF)			0.60					0.84					0.96					0.89			0.91
Peak Hour Factor (PHF)	0.00	0.43	0.56	0.59	0.00	0.00	0.81	0.80	0.86	0.00	0.25	0.65	0.94	0.81	0.00	0.00	0.85	0.86	0.82	0.00	0.91

Traffic Counts by Vehicle Type

	Eastbound					Westbound					Northbound					Southbound					
Time	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	U-Turn	Left	Thru	Right	RTOR	Total
Articulated Trucks																					
4:45 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5:00 PM	0	0	0	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	4
5:15 PM	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	0	6
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lights																					
4:45 PM	0	28	10	11	0	0	63	8	24	0	0	5	121	37	0	0	33	217	18	0	575
5:00 PM	0	9	17	8	0	0	65	9	12	0	1	2	130	37	0	0	35	231	18	0	574
5:15 PM	0	7	5	9	0	0	91	8	26	0	0	5	133	47	0	0	39	285	10	0	665
5:30 PM	0	4	5	4	0	0	66	7	26	0	0	1	146	30	0	0	48	244	13	0	594
5:45 PM	0	12	8	16	0	0	75	9	24	0	0	5	137	36	0	0	41	223	14	0	600
6:00 PM	0	16	7	7	0	0	40	10	13	0	0	0	106	25	0	0	28	162	14	0	428
Mediums																					
4:45 PM	0	0	0	0	0	0	1	0	1	0	0	0	5	0	0	0	0	0	0	0	7
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	3
5:15 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	2
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	2	0	0	6
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	2

Bicycles on Crosswalk

	Eastbound			Westbound			Northbound			Southbound		
Time	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total
4:45 PM	0	0	0	0	0	0	0	0	0	1	0	1
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0

Pedestrians

	Eastbound			Westbound			Northbound			Southbound		
Time	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total	CCW	CW	Total
4:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0	0	1	0	1
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0
6:00 PM	0	0	0	0	0	0	0	0	0	0	0	0

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Hwy 93

File Name : US 170 and Hwy 93 Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 1

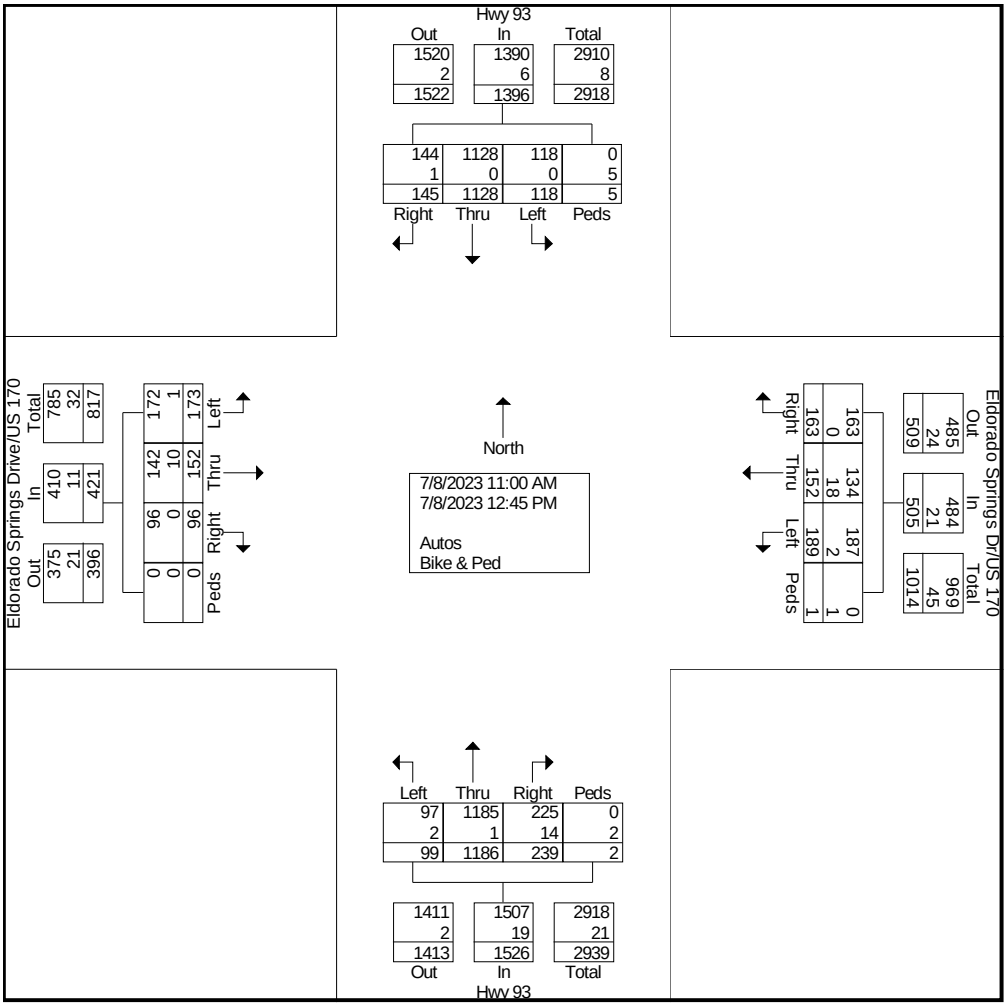
Groups Printed- Autos - Bike & Ped

	Eldorado Springs Drive/US 170 Eastbound					Eldorado Springs Dr/US 170 Westbound					Hwy 93 Northbound					Hwy 93 Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
11:00 AM	18	14	7	0	39	13	17	19	0	49	10	158	29	0	197	19	141	16	1	177	462
11:15 AM	28	24	6	0	58	33	24	19	0	76	15	124	35	0	174	17	113	23	2	155	463
11:30 AM	17	14	15	0	46	22	31	9	0	62	14	147	27	0	188	11	155	16	0	182	478
11:45 AM	20	19	9	0	48	27	20	31	0	78	10	130	24	0	164	17	147	15	2	181	471
Total	83	71	37	0	191	95	92	78	0	265	49	559	115	0	723	64	556	70	5	695	1874
12:00 PM	24	21	13	0	58	26	11	16	0	53	11	148	32	0	191	12	137	24	0	173	475
12:15 PM	21	24	22	0	67	24	16	21	0	61	13	160	22	0	195	6	134	19	0	159	482
12:30 PM	22	14	12	0	48	16	18	24	1	59	13	135	37	2	187	18	155	14	0	187	481
12:45 PM	23	22	12	0	57	28	15	24	0	67	13	184	33	0	230	18	146	18	0	182	536
Total	90	81	59	0	230	94	60	85	1	240	50	627	124	2	803	54	572	75	0	701	1974
Grand Total	173	152	96	0	421	189	152	163	1	505	99	1186	239	2	1526	118	1128	145	5	1396	3848
Apprch %	41.1	36.1	22.8	0		37.4	30.1	32.3	0.2		6.5	77.7	15.7	0.1		8.5	80.8	10.4	0.4		
Total %	4.5	4	2.5	0	10.9	4.9	4	4.2	0	13.1	2.6	30.8	6.2	0.1	39.7	3.1	29.3	3.8	0.1	36.3	
Autos	172	142	96	0	410	187	134	163	0	484	97	1185	225	0	1507	118	1128	144	0	1390	3791
% Autos	99.4	93.4	100	0	97.4	98.9	88.2	100	0	95.8	98	99.9	94.1	0	98.8	100	100	99.3	0	99.6	98.5
Bike & Ped	1	10	0	0	11	2	18	0	1	21	2	1	14	2	19	0	0	1	5	6	57
% Bike & Ped	0.6	6.6	0	0	2.6	1.1	11.8	0	100	4.2	2	0.1	5.9	100	1.2	0	0	0.7	100	0.4	1.5

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Hwy 93

File Name : US 170 and Hwy 93 Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 2

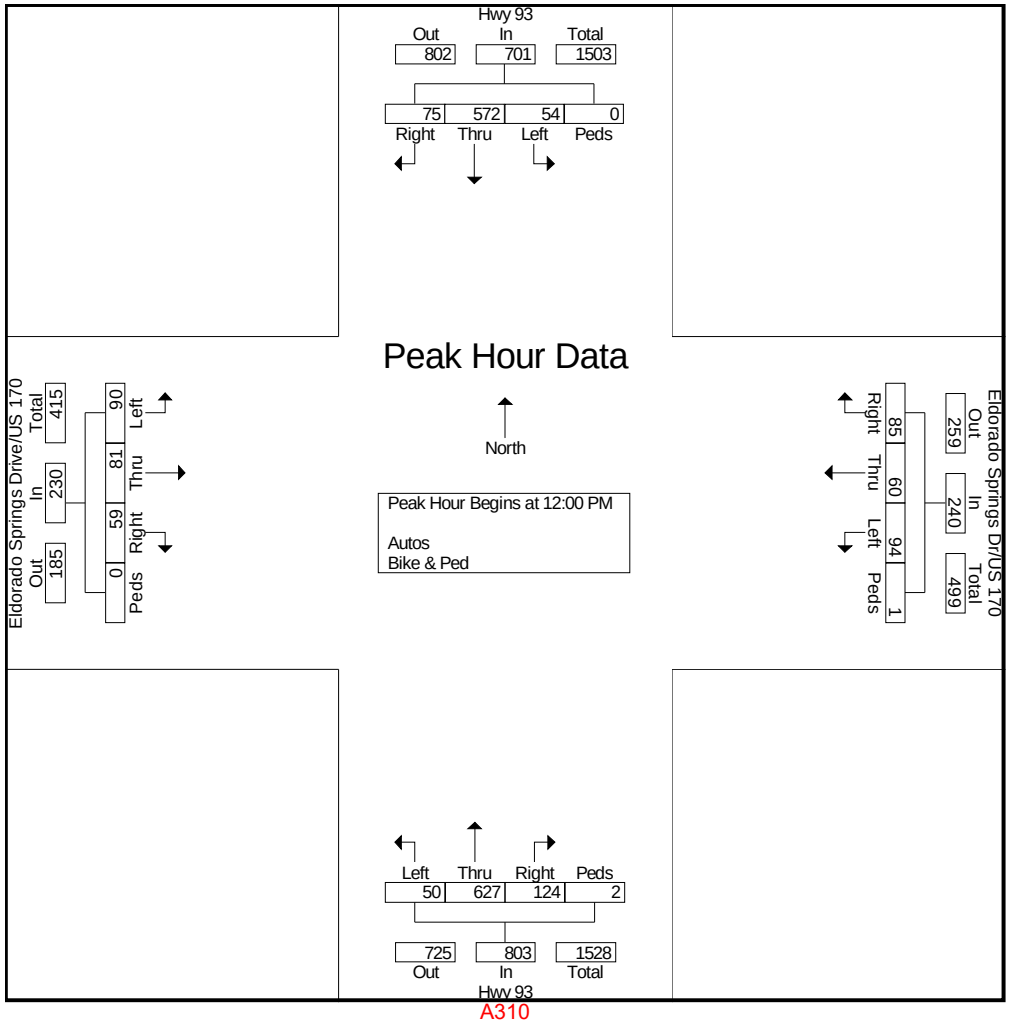


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Hwy 93

File Name : US 170 and Hwy 93 Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 3

	Eldorado Springs Drive/US 170 Eastbound					Eldorado Springs Dr/US 170 Westbound					Hwy 93 Northbound					Hwy 93 Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 12:00 PM																					
12:00 PM	**24**	21	13	0	58	26	11	16	0	53	11	148	32	0	191	12	137	**24**	0	173	475
12:15 PM	21	**24**	**22**	0	**67**	24	16	21	0	61	**13**	160	22	0	195	6	134	19	0	159	482
12:30 PM	22	14	12	0	48	16	**18**	**24**	**1**	59	13	135	**37**	**2**	187	**18**	**155**	14	0	**187**	481
12:45 PM	23	22	12	0	57	**28**	15	24	0	**67**	13	**184**	33	0	**230**	18	146	18	0	182	**536**
Total Volume	90	81	59	0	230	94	60	85	1	240	50	627	124	2	803	54	572	75	0	701	1974
% App. Total	39.1	35.2	25.7	0		39.2	25	35.4	0.4		6.2	78.1	15.4	0.2		7.7	81.6	10.7	0		
PHF	.938	.844	.670	.000	.858	.839	.833	.885	.250	.896	.962	.852	.838	.250	.873	.750	.923	.781	.000	.937	.921



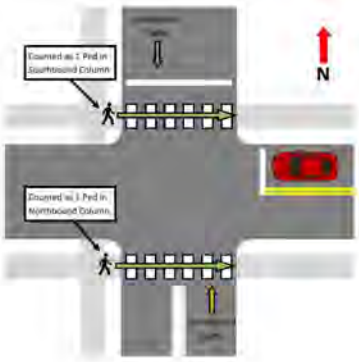
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Hwy 93

File Name : US 170 and Hwy 93 Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
Trailhead Driveway

File Name : Trailhead Driveway AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 1

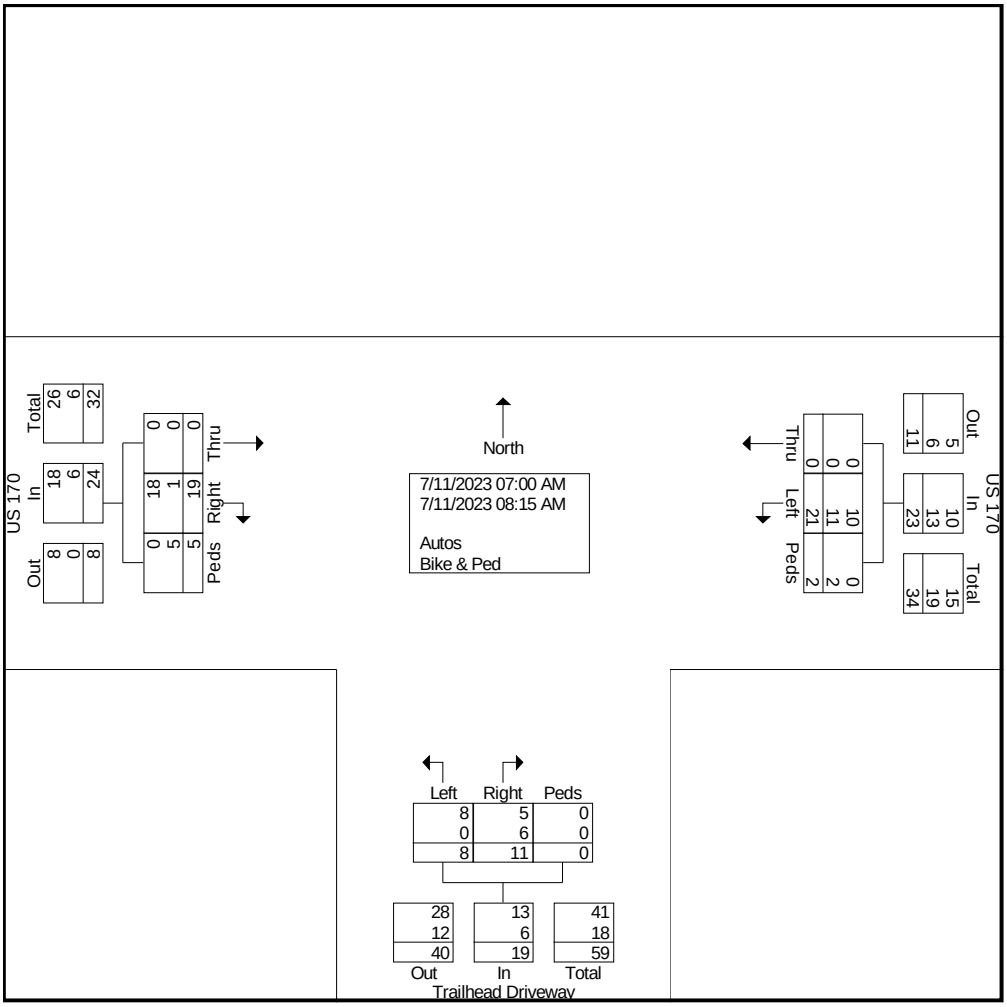
Groups Printed- Autos - Bike & Ped

	US 170 Eastbound				US 170 Westbound				Trailhead Driveway Northbound				
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
07:00 AM	0	6	2	8	6	0	1	7	0	2	0	2	17
07:15 AM	0	2	0	2	4	0	0	4	1	0	0	1	7
07:30 AM	0	4	0	4	4	0	0	4	1	0	0	1	9
07:45 AM	0	3	0	3	2	0	0	2	1	2	0	3	8
Total	0	15	2	17	16	0	1	17	3	4	0	7	41
08:00 AM	0	2	2	4	2	0	0	2	3	6	0	9	15
08:15 AM	0	2	1	3	3	0	1	4	2	1	0	3	10
Grand Total	0	19	5	24	21	0	2	23	8	11	0	19	66
Apprch %	0	79.2	20.8		91.3	0	8.7		42.1	57.9	0		
Total %	0	28.8	7.6	36.4	31.8	0	3	34.8	12.1	16.7	0	28.8	
Autos	0	18	0	18	10	0	0	10	8	5	0	13	41
% Autos	0	94.7	0	75	47.6	0	0	43.5	100	45.5	0	68.4	62.1
Bike & Ped	0	1	5	6	11	0	2	13	0	6	0	6	25
% Bike & Ped	0	5.3	100	25	52.4	0	100	56.5	0	54.5	0	31.6	37.9

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
Trailhead Driveway

File Name : Trailhead Driveway AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 2

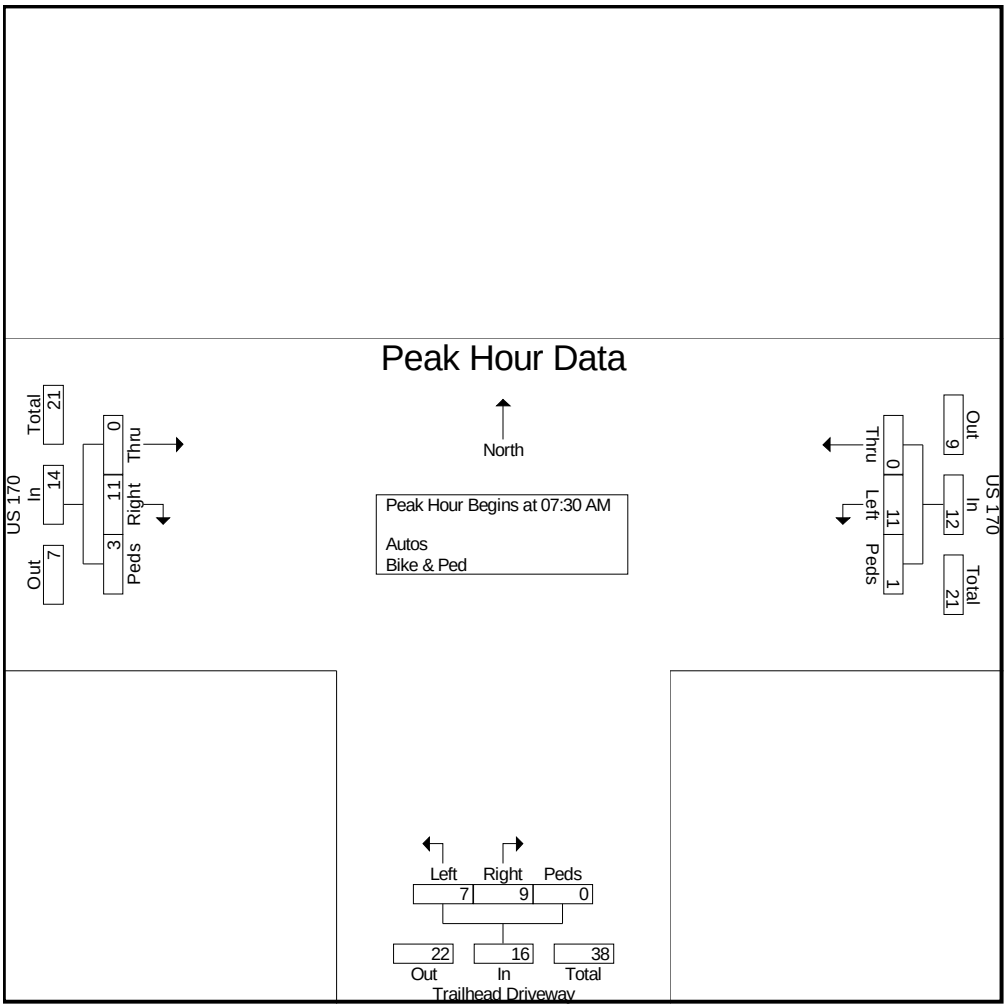


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
Trailhead Driveway

File Name : Trailhead Driveway AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 3

	US 170 Eastbound				US 170 Westbound				Trailhead Driveway Northbound				
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:15 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	0	**4**	0	**4**	**4**	0	0	**4**	1	0	0	1	9
07:45 AM	0	3	0	3	2	0	0	2	1	2	0	3	8
08:00 AM	0	2	**2**	4	2	0	0	2	**3**	**6**	0	**9**	**15**
08:15 AM	0	2	1	3	3	0	**1**	4	2	1	0	3	10
Total Volume	0	11	3	14	11	0	1	12	7	9	0	16	42
% App. Total	0	78.6	21.4		91.7	0	8.3		43.8	56.2	0		
PHF	.000	.688	.375	.875	.688	.000	.250	.750	.583	.375	.000	.444	.700



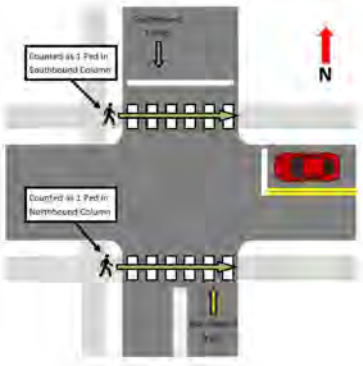
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
Trailhead Driveway

File Name : Trailhead Driveway AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
Trailhead Driveway

File Name : Trailhead Driveway PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 1

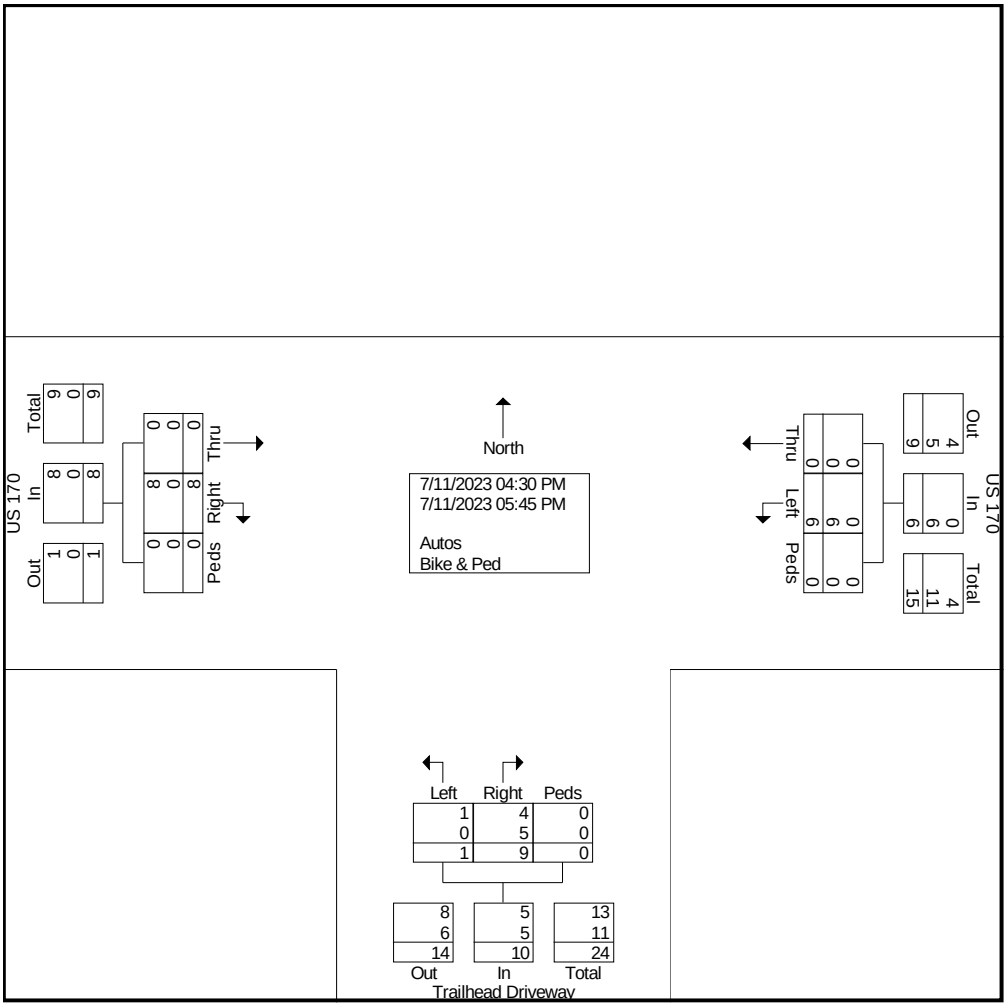
Groups Printed- Autos - Bike & Ped

	US 170 Eastbound				US 170 Westbound				Trailhead Driveway Northbound				
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
04:30 PM	0	0	0	0	2	0	0	2	0	0	0	0	2
04:45 PM	0	2	0	2	0	0	0	0	0	2	0	2	4
Total	0	2	0	2	2	0	0	2	0	2	0	2	6
05:00 PM	0	0	0	0	1	0	0	1	0	0	0	0	1
05:15 PM	0	0	0	0	1	0	0	1	0	1	0	1	2
05:30 PM	0	0	0	0	1	0	0	1	0	3	0	3	4
05:45 PM	0	6	0	6	1	0	0	1	1	3	0	4	11
Total	0	6	0	6	4	0	0	4	1	7	0	8	18
Grand Total	0	8	0	8	6	0	0	6	1	9	0	10	24
Apprch %	0	100	0		100	0	0		10	90	0		
Total %	0	33.3	0	33.3	25	0	0	25	4.2	37.5	0	41.7	
Autos	0	8	0	8	0	0	0	0	1	4	0	5	13
% Autos	0	100	0	100	0	0	0	0	100	44.4	0	50	54.2
Bike & Ped	0	0	0	0	6	0	0	6	0	5	0	5	11
% Bike & Ped	0	0	0	0	100	0	0	100	0	55.6	0	50	45.8

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
Trailhead Driveway

File Name : Trailhead Driveway PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 2

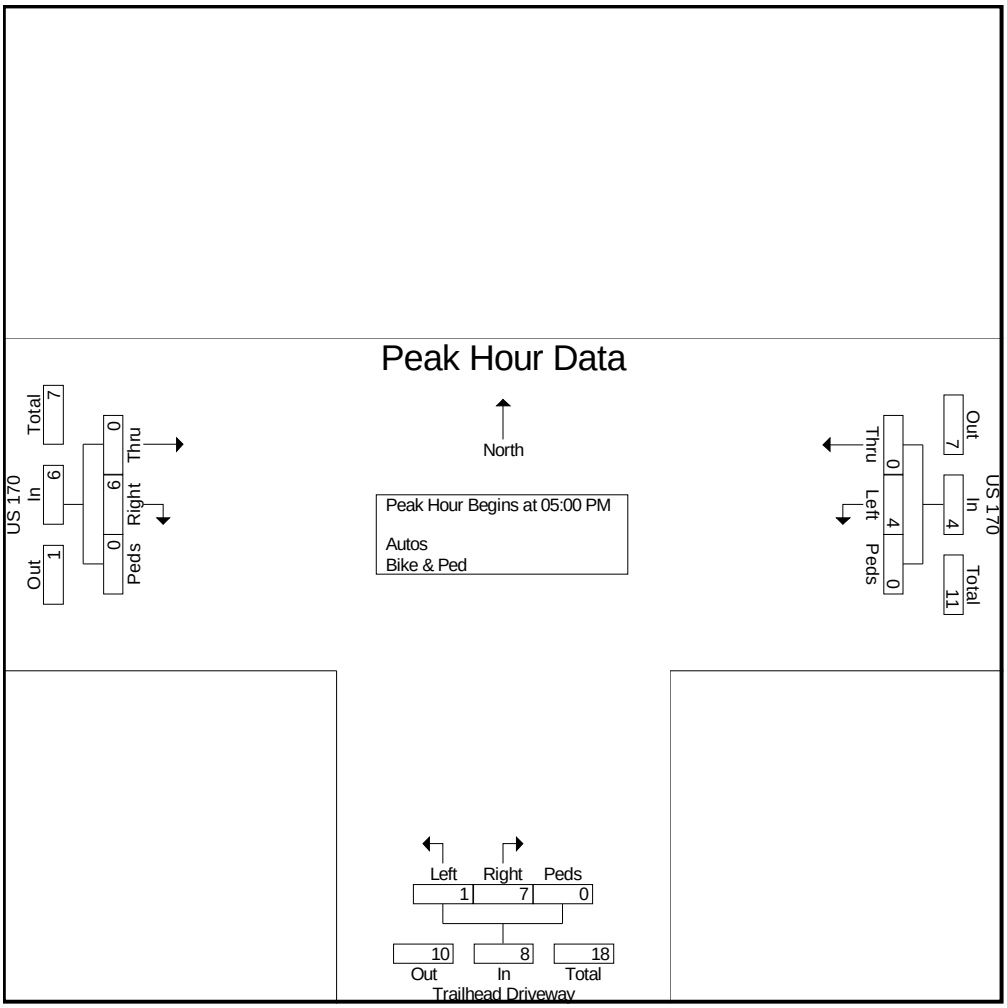


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
Trailhead Driveway

File Name : Trailhead Driveway PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 3

	US 170 Eastbound				US 170 Westbound				Trailhead Driveway Northbound				
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:30 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	0	0	0	0	**1**	0	0	**1**	0	0	0	0	1
05:15 PM	0	0	0	0	1	0	0	1	0	1	0	1	2
05:30 PM	0	0	0	0	1	0	0	1	0	**3**	0	3	4
05:45 PM	0	**6**	0	**6**	1	0	0	1	**1**	3	0	**4**	**11**
Total Volume	0	6	0	6	4	0	0	4	1	7	0	8	18
% App. Total	0	100	0		100	0	0		12.5	87.5	0		
PHF	.000	.250	.000	.250	1.00	.000	.000	1.00	.250	.583	.000	.500	.409



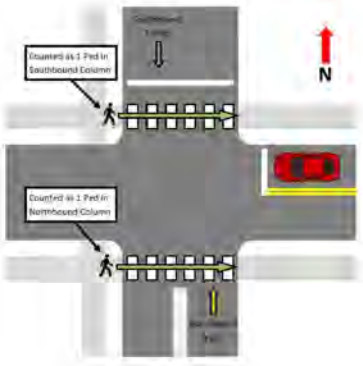
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
Trailhead Driveway

File Name : Trailhead Driveway PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
Trailhead Driveway

File Name : Trailhead Driveway SAT REV
Site Code : MUL
Start Date : 7/8/2023
Page No : 1

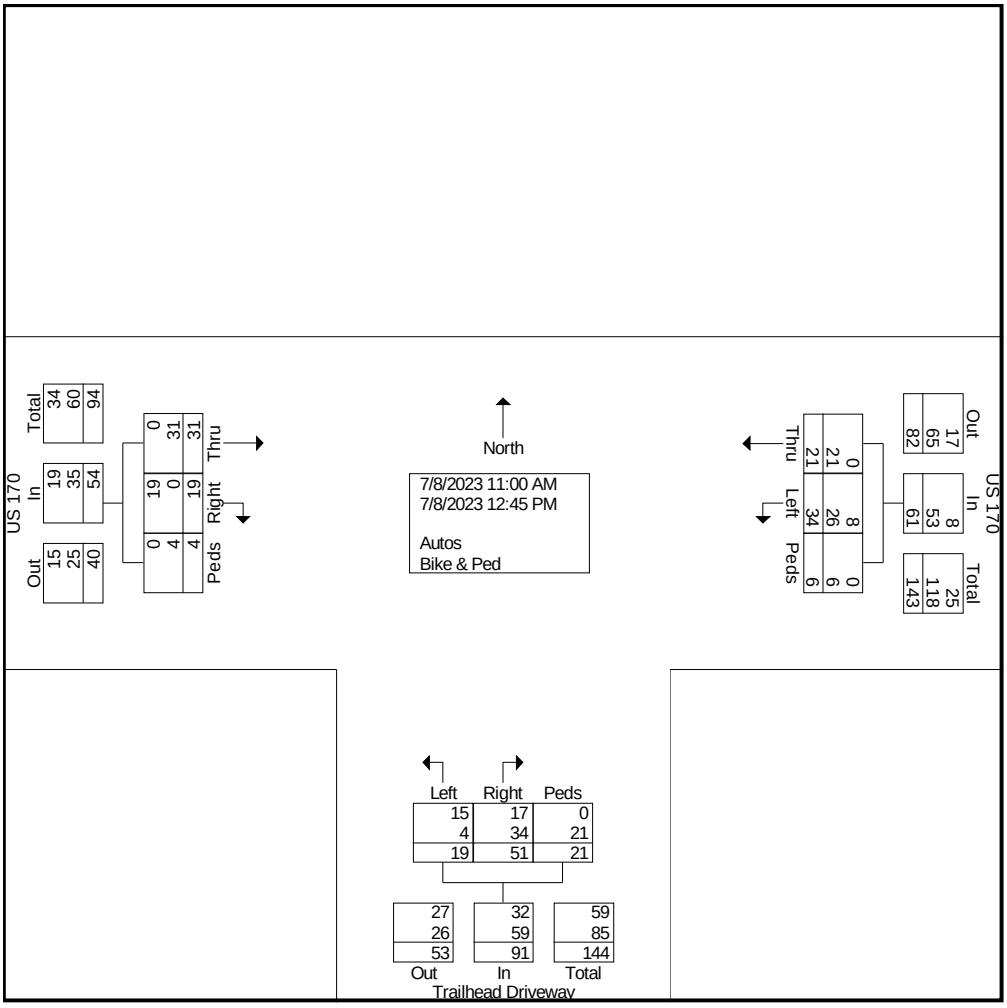
Groups Printed- Autos - Bike & Ped

	US 170 Eastbound				US 170 Westbound				Trailhead Driveway Northbound				
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
11:00 AM	2	3	0	5	5	3	0	8	3	11	3	17	30
11:15 AM	5	2	0	7	5	0	0	5	1	3	3	7	19
11:30 AM	2	3	3	8	4	2	0	6	1	4	7	12	26
11:45 AM	3	3	0	6	8	4	1	13	3	4	1	8	27
Total	12	11	3	26	22	9	1	32	8	22	14	44	102
12:00 PM	1	1	0	2	3	1	0	4	6	2	0	8	14
12:15 PM	6	1	1	8	2	4	0	6	1	9	4	14	28
12:30 PM	6	2	0	8	2	6	0	8	2	13	0	15	31
12:45 PM	6	4	0	10	5	1	5	11	2	5	3	10	31
Total	19	8	1	28	12	12	5	29	11	29	7	47	104
Grand Total	31	19	4	54	34	21	6	61	19	51	21	91	206
Apprch %	57.4	35.2	7.4		55.7	34.4	9.8		20.9	56	23.1		
Total %	15	9.2	1.9	26.2	16.5	10.2	2.9	29.6	9.2	24.8	10.2	44.2	
Autos	0	19	0	19	8	0	0	8	15	17	0	32	59
% Autos	0	100	0	35.2	23.5	0	0	13.1	78.9	33.3	0	35.2	28.6
Bike & Ped	31	0	4	35	26	21	6	53	4	34	21	59	147
% Bike & Ped	100	0	100	64.8	76.5	100	100	86.9	21.1	66.7	100	64.8	71.4

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
Trailhead Driveway

File Name : Trailhead Driveway SAT REV
Site Code : MUL
Start Date : 7/8/2023
Page No : 2

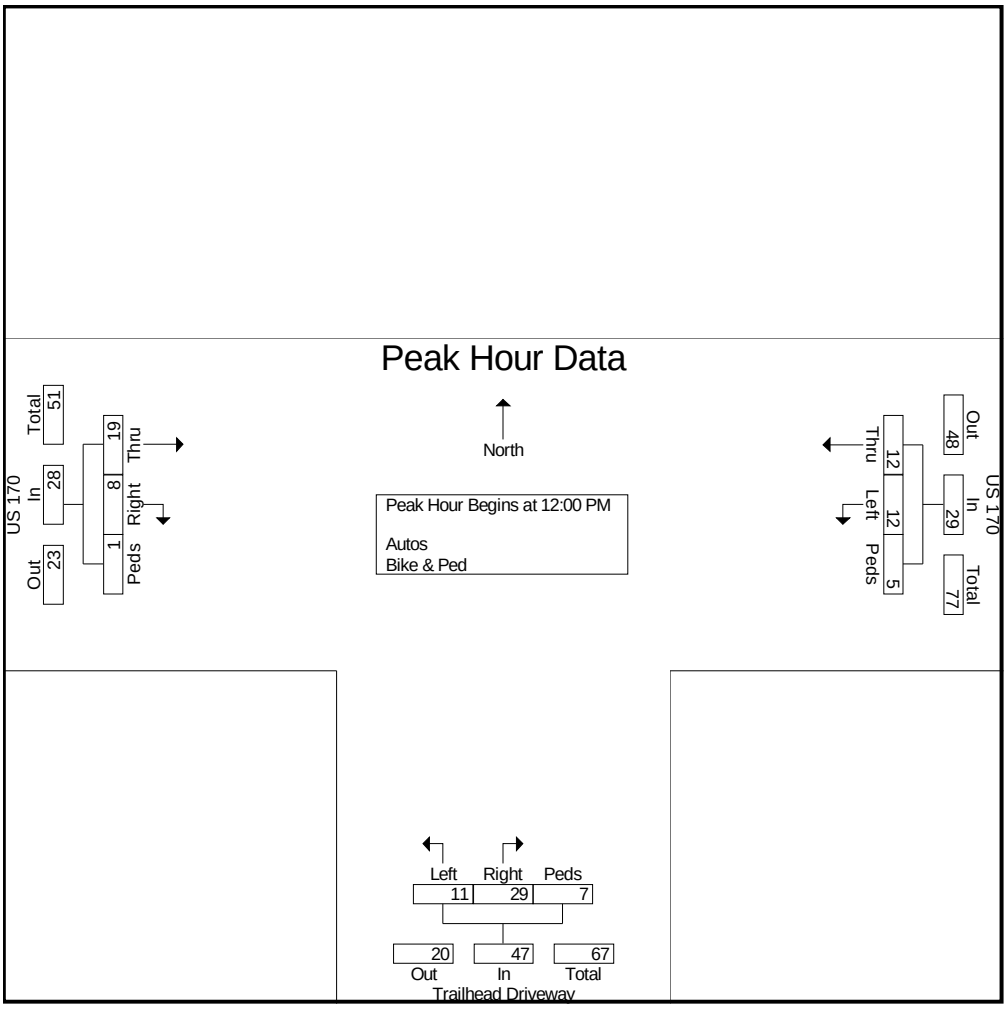


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
Trailhead Driveway

File Name : Trailhead Driveway SAT REV
Site Code : MUL
Start Date : 7/8/2023
Page No : 3

	US 170 Eastbound				US 170 Westbound				Trailhead Driveway Northbound				
Start Time	Thru	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Left	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 12:00 PM													
12:00 PM	1	1	0	2	3	1	0	4	**6**	2	0	8	14
12:15 PM	**6**	1	**1**	8	2	4	0	6	1	9	**4**	14	28
12:30 PM	6	2	0	8	2	**6**	0	8	2	**13**	0	**15**	**31**
12:45 PM	6	**4**	0	**10**	**5**	1	**5**	**11**	2	5	3	10	31
Total Volume	19	8	1	28	12	12	5	29	11	29	7	47	104
% App. Total	67.9	28.6	3.6		41.4	41.4	17.2		23.4	61.7	14.9		
PHF	.792	.500	.250	.700	.600	.500	.250	.659	.458	.558	.438	.783	.839



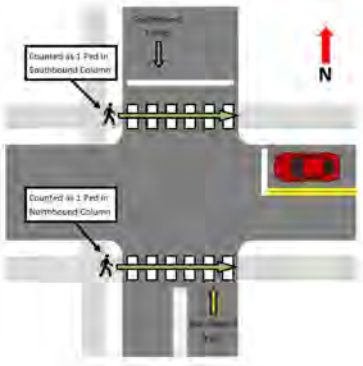
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
Trailhead Driveway

File Name : Trailhead Driveway SAT REV
Site Code : MUL
Start Date : 7/8/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
North Overflow Driveway

File Name : Overflow Driveway AM
Site Code : MUL
Start Date : 7/12/2023
Page No : 1

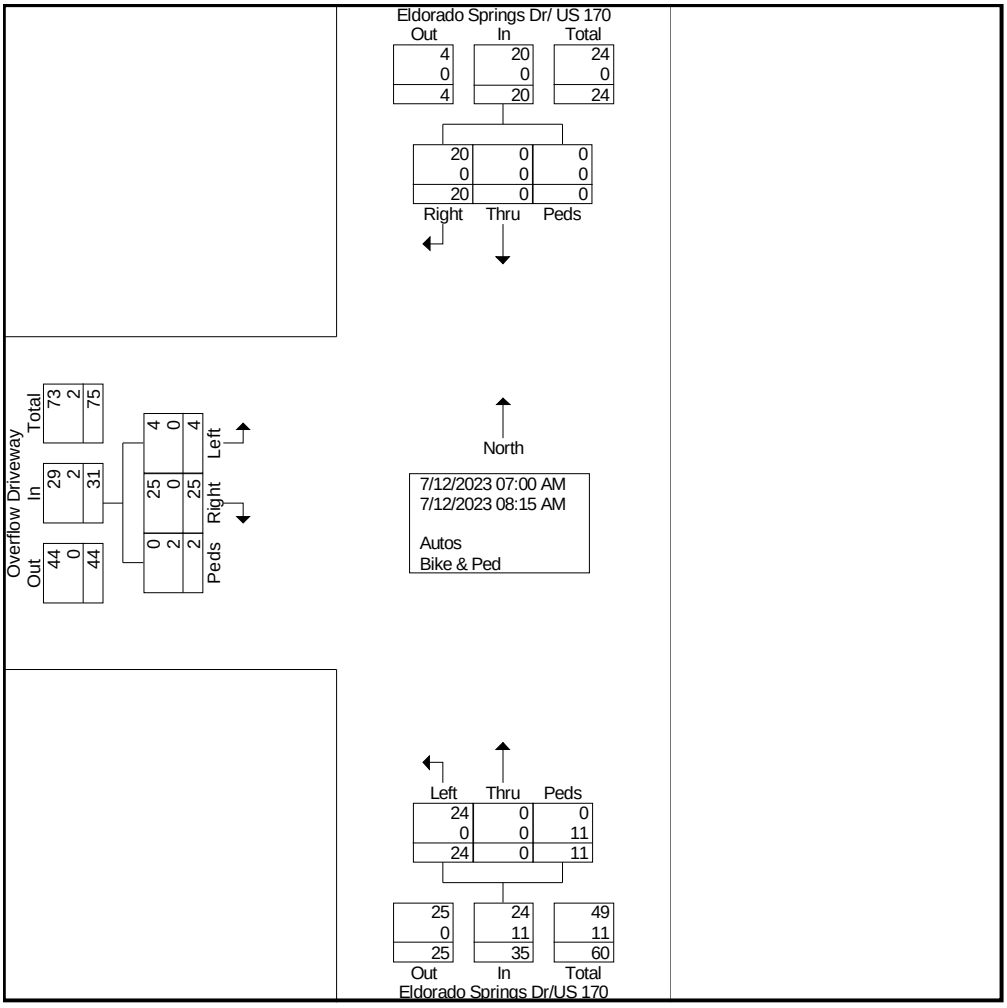
Groups Printed- Autos - Bike & Ped

	Overflow Driveway Eastbound				Eldorado Springs Dr/US 170 Northbound				Eldorado Springs Dr/ US 170 Southbound				
Start Time	Left	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	1	2	0	3	6	0	0	6	0	4	0	4	13
07:15 AM	0	3	0	3	3	0	1	4	0	0	0	0	7
07:30 AM	1	5	1	7	0	0	6	6	0	2	0	2	15
07:45 AM	1	4	1	6	4	0	2	6	0	6	0	6	18
Total	3	14	2	19	13	0	9	22	0	12	0	12	53
08:00 AM	1	4	0	5	8	0	2	10	0	4	0	4	19
08:15 AM	0	7	0	7	3	0	0	3	0	4	0	4	14
Grand Total	4	25	2	31	24	0	11	35	0	20	0	20	86
Apprch %	12.9	80.6	6.5		68.6	0	31.4		0	100	0		
Total %	4.7	29.1	2.3	36	27.9	0	12.8	40.7	0	23.3	0	23.3	
Autos	4	25	0	29	24	0	0	24	0	20	0	20	73
% Autos	100	100	0	93.5	100	0	0	68.6	0	100	0	100	84.9
Bike & Ped	0	0	2	2	0	0	11	11	0	0	0	0	13
% Bike & Ped	0	0	100	6.5	0	0	100	31.4	0	0	0	0	15.1

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
North Overflow Driveway

File Name : Overflow Driveway AM
Site Code : MUL
Start Date : 7/12/2023
Page No : 2

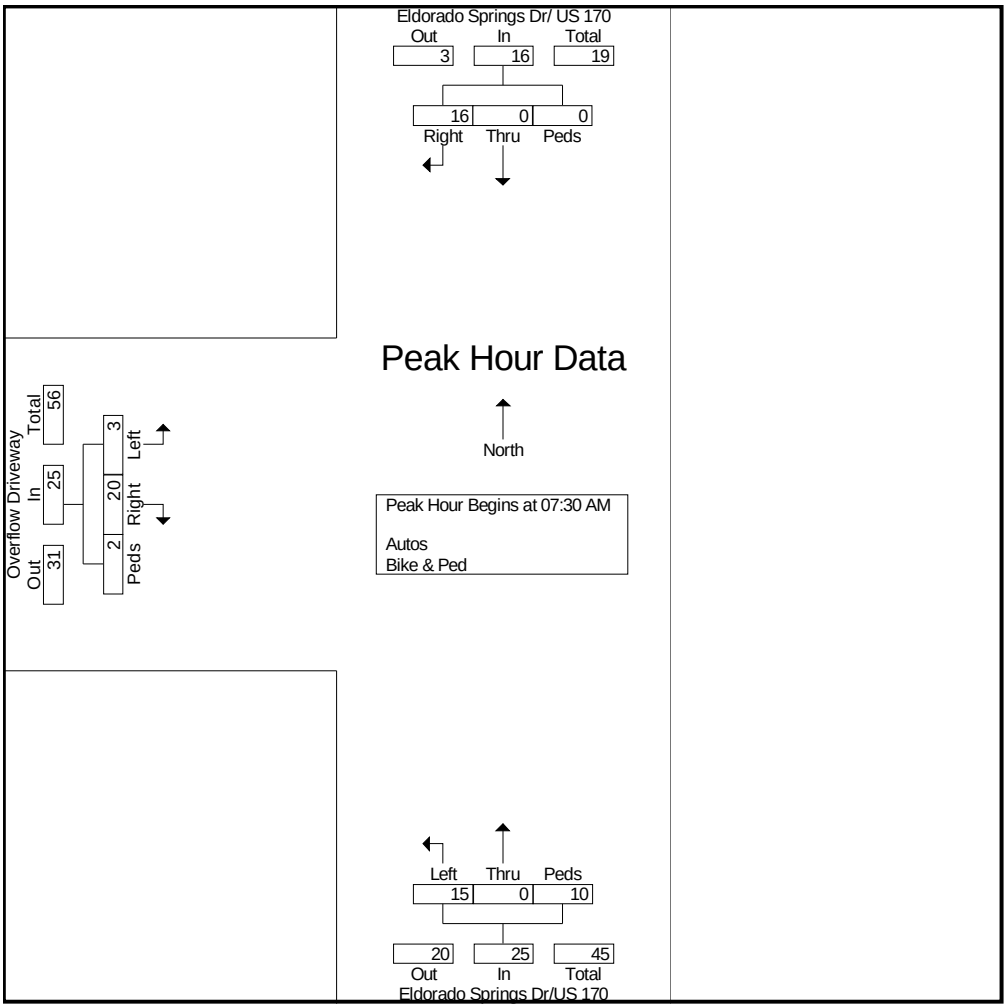


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
North Overflow Driveway

File Name : Overflow Driveway AM
Site Code : MUL
Start Date : 7/12/2023
Page No : 3

	Overflow Driveway Eastbound				Eldorado Springs Dr/US 170 Northbound				Eldorado Springs Dr/ US 170 Southbound				
Start Time	Left	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:15 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	**1**	5	**1**	**7**	0	0	**6**	6	0	2	0	2	15
07:45 AM	1	4	1	6	4	0	2	6	0	**6**	0	**6**	18
08:00 AM	1	4	0	5	**8**	0	2	**10**	0	4	0	4	**19**
08:15 AM	0	**7**	0	7	3	0	0	3	0	4	0	4	14
Total Volume	3	20	2	25	15	0	10	25	0	16	0	16	66
% App. Total	12	80	8		60	0	40		0	100	0		
PHF	.750	.714	.500	.893	.469	.000	.417	.625	.000	.667	.000	.667	.868



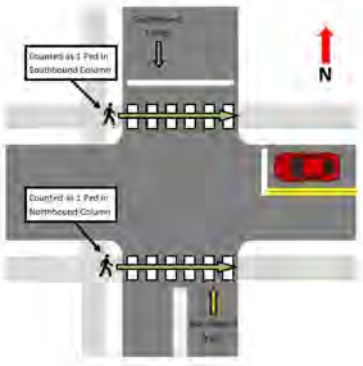
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
North Overflow Driveway

File Name : Overflow Driveway AM
Site Code : MUL
Start Date : 7/12/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
North Overflow Driveway

File Name : Overflow Driveway PM REV
Site Code : MUL
Start Date : 7/12/2023
Page No : 1

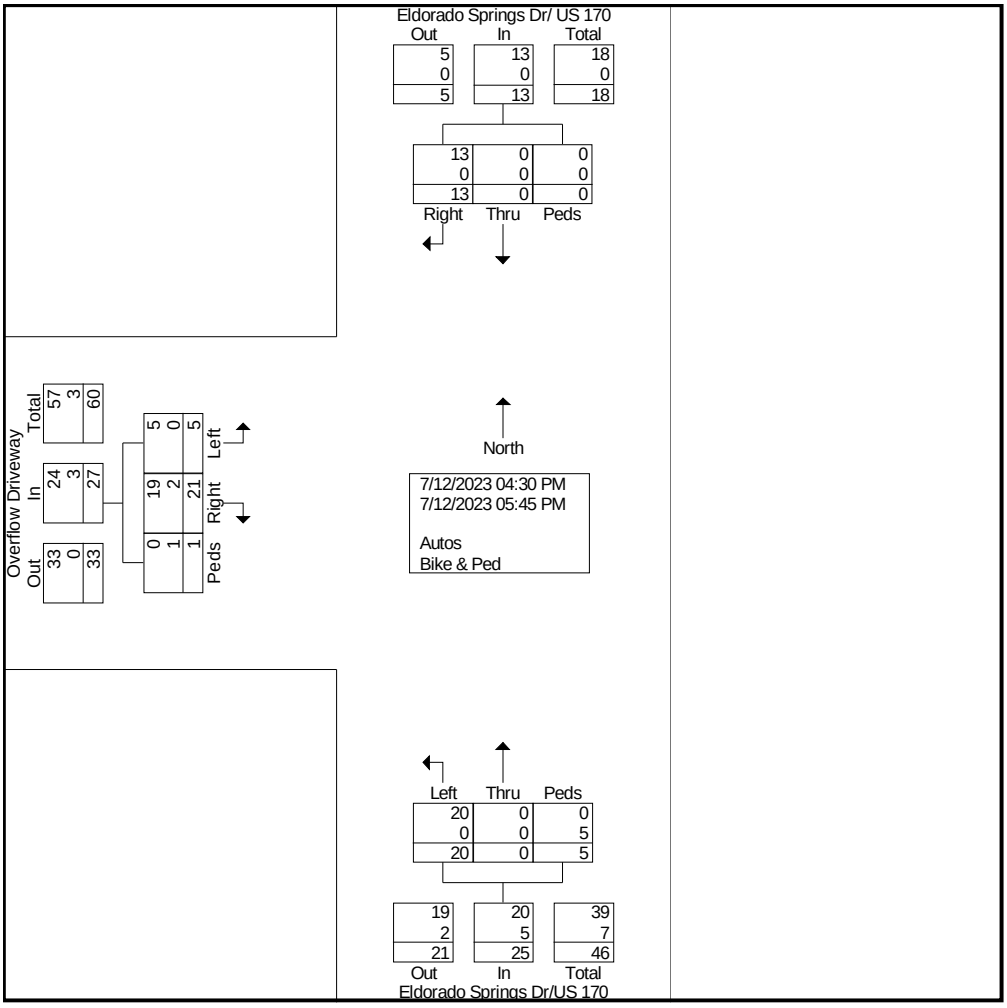
Groups Printed- Autos - Bike & Ped

	Overflow Driveway Eastbound				Eldorado Springs Dr/US 170 Northbound				Eldorado Springs Dr/ US 170 Southbound				
Start Time	Left	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Thru	Right	Peds	App. Total	Int. Total
04:30 PM	1	2	0	3	2	0	0	2	0	3	0	3	8
04:45 PM	0	2	0	2	4	0	0	4	0	1	0	1	7
Total	1	4	0	5	6	0	0	6	0	4	0	4	15
05:00 PM	2	4	1	7	5	0	2	7	0	2	0	2	16
05:15 PM	0	7	0	7	4	0	2	6	0	3	0	3	16
05:30 PM	2	3	0	5	2	0	1	3	0	2	0	2	10
05:45 PM	0	3	0	3	3	0	0	3	0	2	0	2	8
Total	4	17	1	22	14	0	5	19	0	9	0	9	50
Grand Total	5	21	1	27	20	0	5	25	0	13	0	13	65
Apprch %	18.5	77.8	3.7		80	0	20		0	100	0		
Total %	7.7	32.3	1.5	41.5	30.8	0	7.7	38.5	0	20	0	20	
Autos	5	19	0	24	20	0	0	20	0	13	0	13	57
% Autos	100	90.5	0	88.9	100	0	0	80	0	100	0	100	87.7
Bike & Ped	0	2	1	3	0	0	5	5	0	0	0	0	8
% Bike & Ped	0	9.5	100	11.1	0	0	100	20	0	0	0	0	12.3

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
North Overflow Driveway

File Name : Overflow Driveway PM REV
Site Code : MUL
Start Date : 7/12/2023
Page No : 2

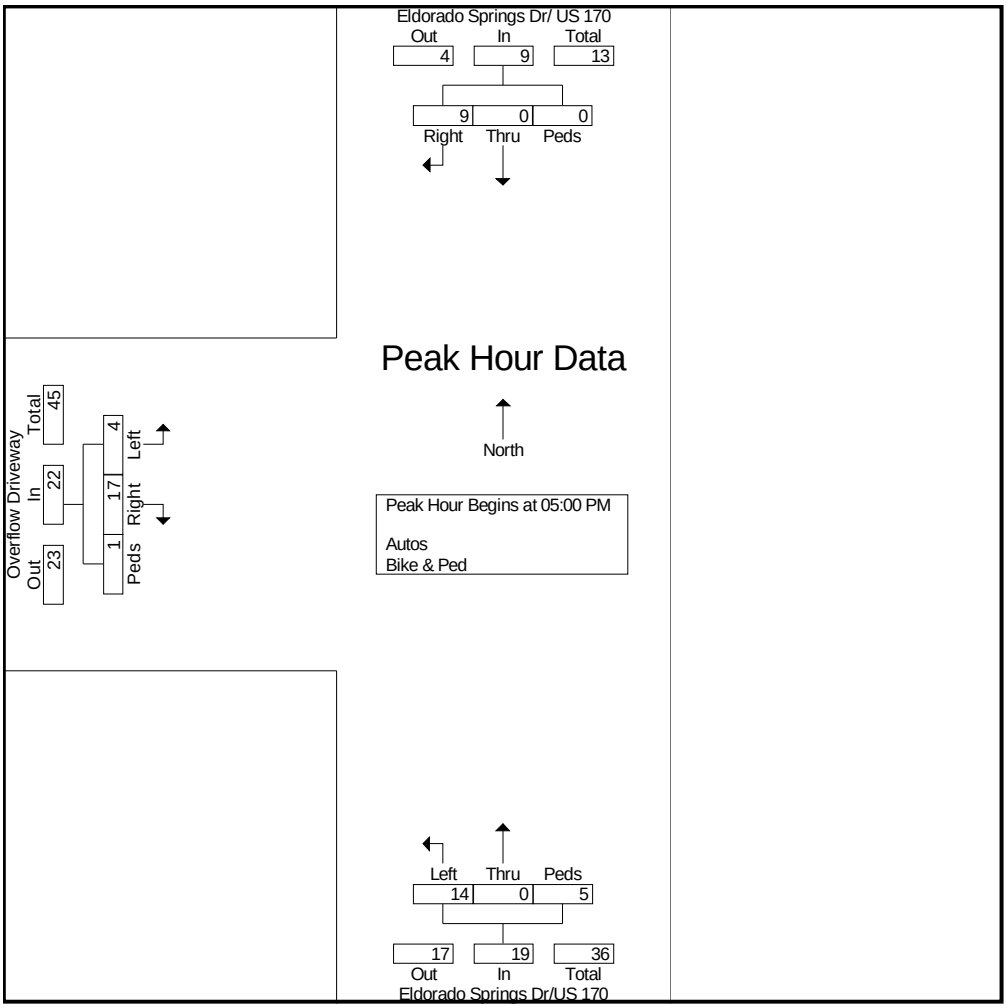


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
North Overflow Driveway

File Name : Overflow Driveway PM REV
Site Code : MUL
Start Date : 7/12/2023
Page No : 3

	Overflow Driveway Eastbound				Eldorado Springs Dr/US 170 Northbound				Eldorado Springs Dr/ US 170 Southbound				
Start Time	Left	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:30 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	**2**	4	**1**	**7**	**5**	0	**2**	**7**	0	2	0	2	**16**
05:15 PM	0	**7**	0	7	4	0	2	6	0	**3**	0	**3**	16
05:30 PM	2	3	0	5	2	0	1	3	0	2	0	2	10
05:45 PM	0	3	0	3	3	0	0	3	0	2	0	2	8
Total Volume	4	17	1	22	14	0	5	19	0	9	0	9	50
% App. Total	18.2	77.3	4.5		73.7	0	26.3		0	100	0		
PHF	.500	.607	.250	.786	.700	.000	.625	.679	.000	.750	.000	.750	.781



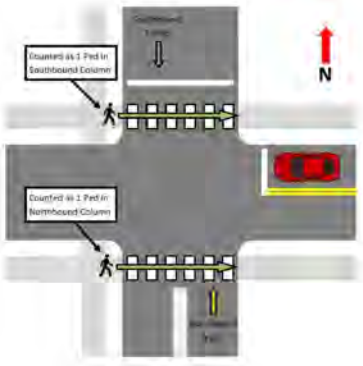
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
North Overflow Driveway

File Name : Overflow Driveway PM REV
Site Code : MUL
Start Date : 7/12/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
North Overflow Driveway

File Name : Overflow Driveway SAT
Site Code : MUL
Start Date : 7/8/2023
Page No : 1

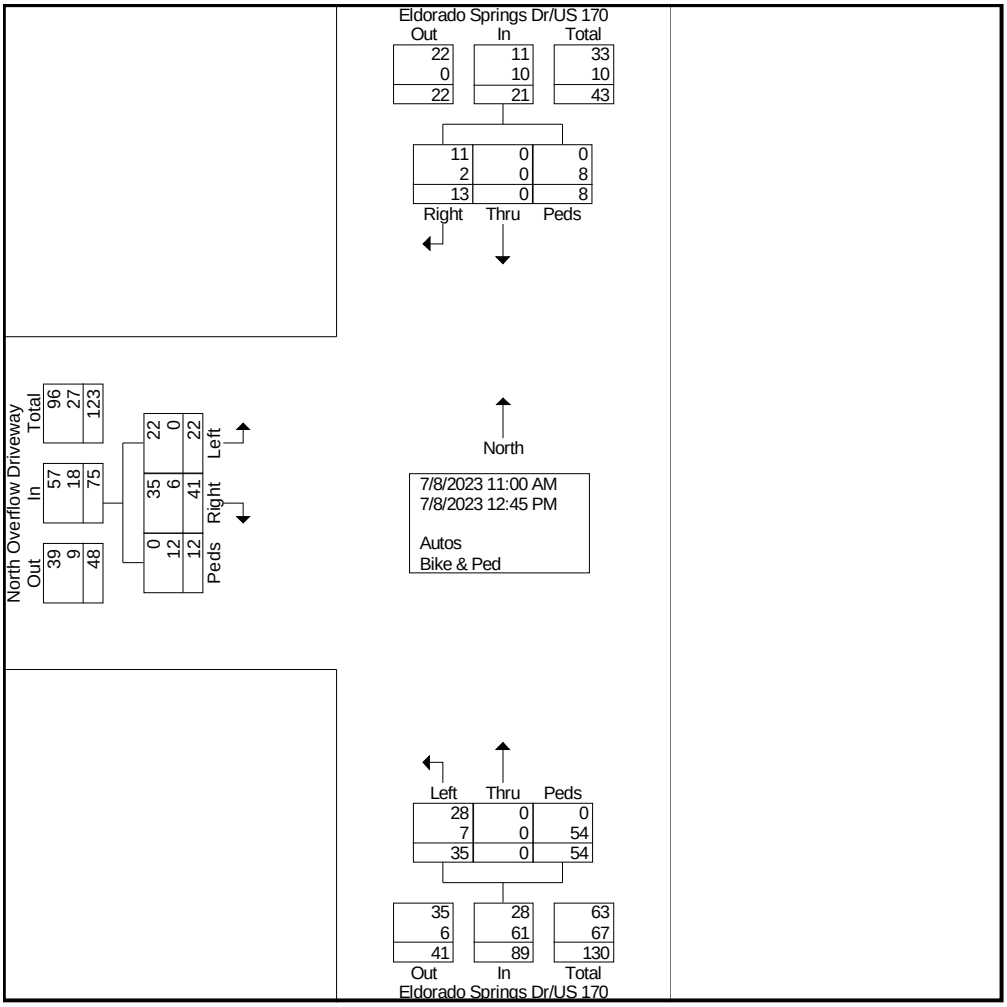
Groups Printed- Autos - Bike & Ped

	North Overflow Driveway Eastbound				Eldorado Springs Dr/US 170 Northbound				Eldorado Springs Dr/US 170 Southbound				
Start Time	Left	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Thru	Right	Peds	App. Total	Int. Total
11:00 AM	2	2	0	4	10	0	10	20	0	2	2	4	28
11:15 AM	2	10	7	19	2	0	10	12	0	0	0	0	31
11:30 AM	2	2	0	4	3	0	11	14	0	1	3	4	22
11:45 AM	6	6	1	13	4	0	6	10	0	4	0	4	27
Total	12	20	8	40	19	0	37	56	0	7	5	12	108
12:00 PM	1	1	2	4	3	0	5	8	0	2	1	3	15
12:15 PM	5	5	0	10	3	0	4	7	0	0	0	0	17
12:30 PM	0	8	2	10	5	0	6	11	0	1	2	3	24
12:45 PM	4	7	0	11	5	0	2	7	0	3	0	3	21
Total	10	21	4	35	16	0	17	33	0	6	3	9	77
Grand Total	22	41	12	75	35	0	54	89	0	13	8	21	185
Apprch %	29.3	54.7	16		39.3	0	60.7		0	61.9	38.1		
Total %	11.9	22.2	6.5	40.5	18.9	0	29.2	48.1	0	7	4.3	11.4	
Autos	22	35	0	57	28	0	0	28	0	11	0	11	96
% Autos	100	85.4	0	76	80	0	0	31.5	0	84.6	0	52.4	51.9
Bike & Ped	0	6	12	18	7	0	54	61	0	2	8	10	89
% Bike & Ped	0	14.6	100	24	20	0	100	68.5	0	15.4	100	47.6	48.1

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
North Overflow Driveway

File Name : Overflow Driveway SAT
Site Code : MUL
Start Date : 7/8/2023
Page No : 2

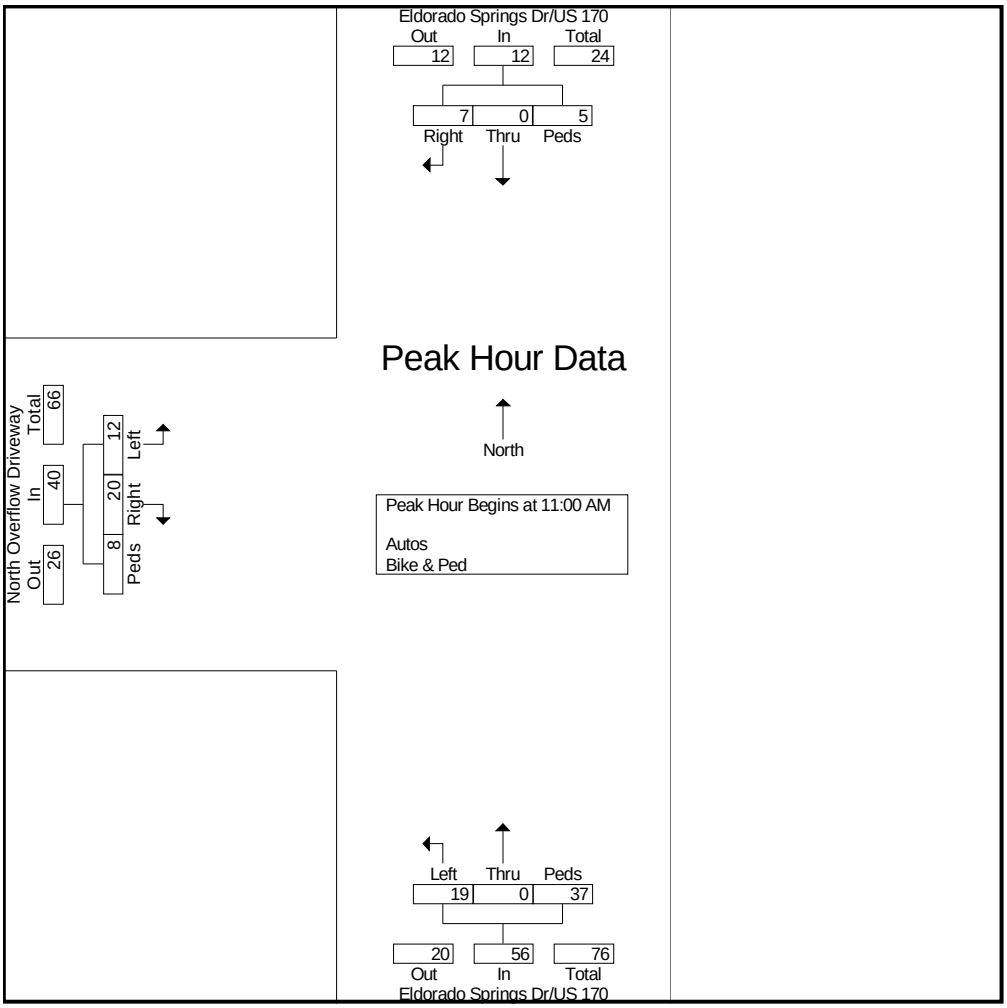


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
North Overflow Driveway

File Name : Overflow Driveway SAT
Site Code : MUL
Start Date : 7/8/2023
Page No : 3

	North Overflow Driveway Eastbound				Eldorado Springs Dr/US 170 Northbound				Eldorado Springs Dr/US 170 Southbound				
Start Time	Left	Right	Peds	App. Total	Left	Thru	Peds	App. Total	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 11:00 AM													
11:00 AM	2	2	0	4	**10**	0	10	**20**	0	2	2	**4**	28
11:15 AM	2	**10**	**7**	**19**	2	0	10	12	0	0	0	0	**31**
11:30 AM	2	2	0	4	3	0	**11**	14	0	1	**3**	4	22
11:45 AM	**6**	6	1	13	4	0	6	10	0	**4**	0	4	27
Total Volume	12	20	8	40	19	0	37	56	0	7	5	12	108
% App. Total	30	50	20		33.9	0	66.1		0	58.3	41.7		
PHF	.500	.500	.286	.526	.475	.000	.841	.700	.000	.438	.417	.750	.871



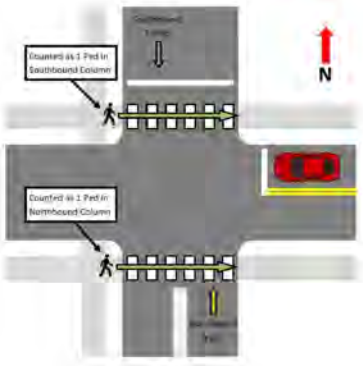
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
North Overflow Driveway

File Name : Overflow Driveway SAT
Site Code : MUL
Start Date : 7/8/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 1

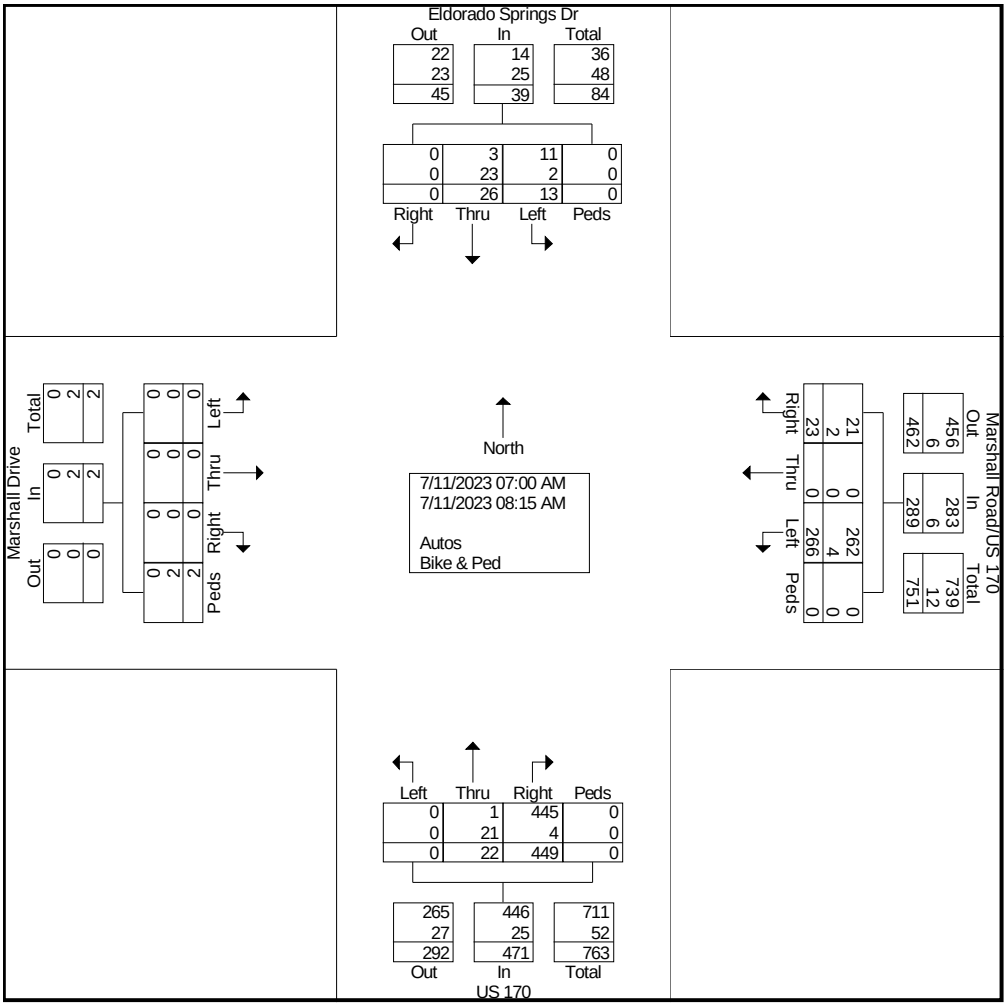
Groups Printed- Autos - Bike & Ped

	Marshall Drive Eastbound					Marshall Road/US 170 Westbound					US 170 Northbound					Eldorado Springs Dr Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	33	0	3	0	36	0	5	50	0	55	0	3	0	0	3	94
07:15 AM	0	0	0	0	0	38	0	4	0	42	0	2	62	0	64	0	5	0	0	5	111
07:30 AM	0	0	0	0	0	42	0	6	0	48	0	4	78	0	82	2	7	0	0	9	139
07:45 AM	0	0	0	0	0	51	0	2	0	53	0	3	74	0	77	7	3	0	0	10	140
Total	0	0	0	0	0	164	0	15	0	179	0	14	264	0	278	9	18	0	0	27	484
08:00 AM	0	0	0	1	1	54	0	5	0	59	0	7	101	0	108	3	1	0	0	4	172
08:15 AM	0	0	0	1	1	48	0	3	0	51	0	1	84	0	85	1	7	0	0	8	145
Grand Total	0	0	0	2	2	266	0	23	0	289	0	22	449	0	471	13	26	0	0	39	801
Apprch %	0	0	0	100		92	0	8	0		0	4.7	95.3	0		33.3	66.7	0	0		
Total %	0	0	0	0.2	0.2	33.2	0	2.9	0	36.1	0	2.7	56.1	0	58.8	1.6	3.2	0	0	4.9	
Autos	0	0	0	0	0	262	0	21	0	283	0	1	445	0	446	11	3	0	0	14	743
% Autos	0	0	0	0	0	98.5	0	91.3	0	97.9	0	4.5	99.1	0	94.7	84.6	11.5	0	0	35.9	92.8
Bike & Ped	0	0	0	2	2	4	0	2	0	6	0	21	4	0	25	2	23	0	0	25	58
% Bike & Ped	0	0	0	100	100	1.5	0	8.7	0	2.1	0	95.5	0.9	0	5.3	15.4	88.5	0	0	64.1	7.2

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 2

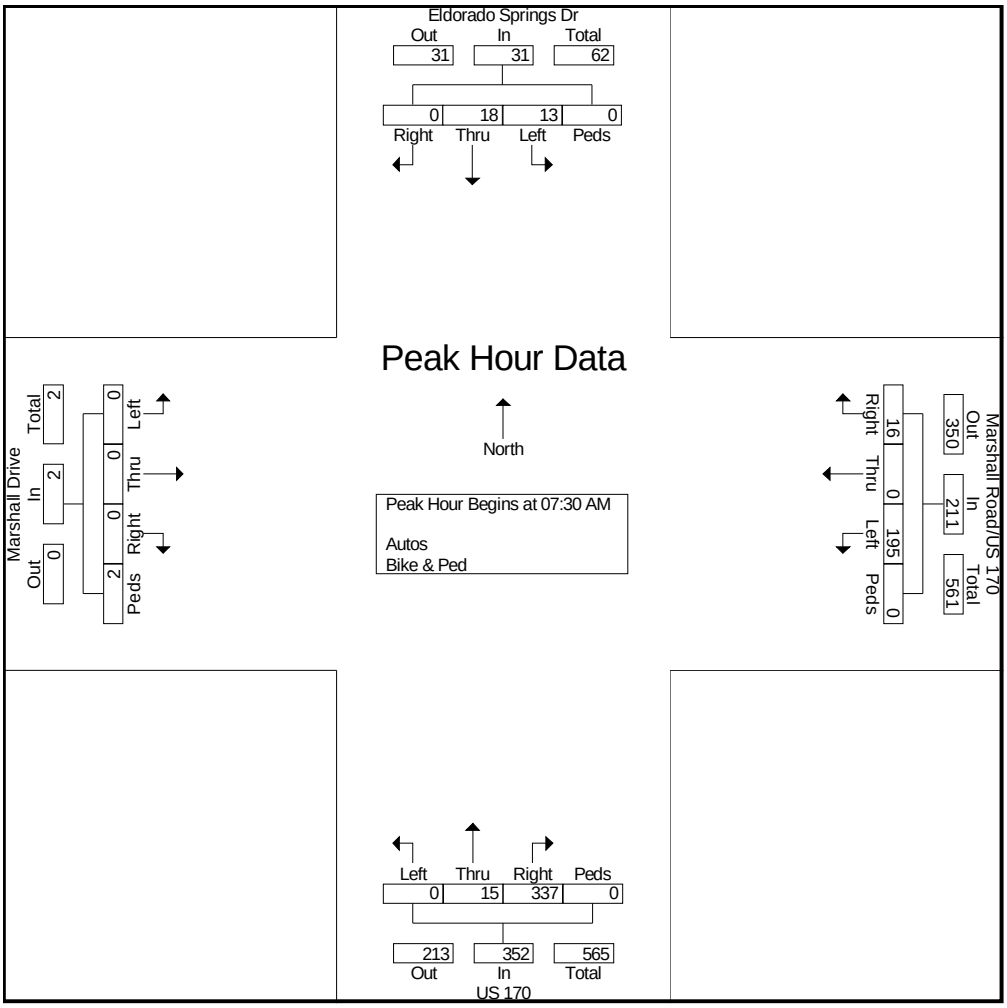


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 3

	Marshall Drive Eastbound					Marshall Road/US 170 Westbound					US 170 Northbound					Eldorado Springs Dr Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:15 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	0	0	0	0	0	42	0	**6**	0	48	0	4	78	0	82	2	**7**	0	0	9	139
07:45 AM	0	0	0	0	0	51	0	2	0	53	0	3	74	0	77	**7**	3	0	0	**10**	140
08:00 AM	0	0	0	**1**	**1**	**54**	0	5	0	**59**	0	**7**	**101**	0	**108**	3	1	0	0	4	**172**
08:15 AM	0	0	0	1	1	48	0	3	0	51	0	1	84	0	85	1	7	0	0	8	145
Total Volume	0	0	0	2	2	195	0	16	0	211	0	15	337	0	352	13	18	0	0	31	596
% App. Total	0	0	0	100		92.4	0	7.6	0		0	4.3	95.7	0		41.9	58.1	0	0		
PHF	.000	.000	.000	.500	.500	.903	.000	.667	.000	.894	.000	.536	.834	.000	.815	.464	.643	.000	.000	.775	.866



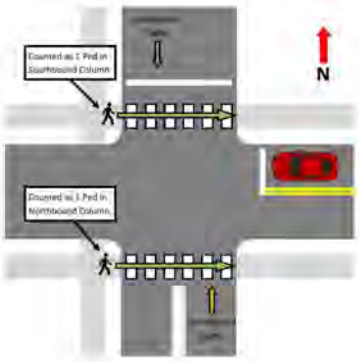
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
AM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd AM
Site Code : MUL
Start Date : 7/11/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 1

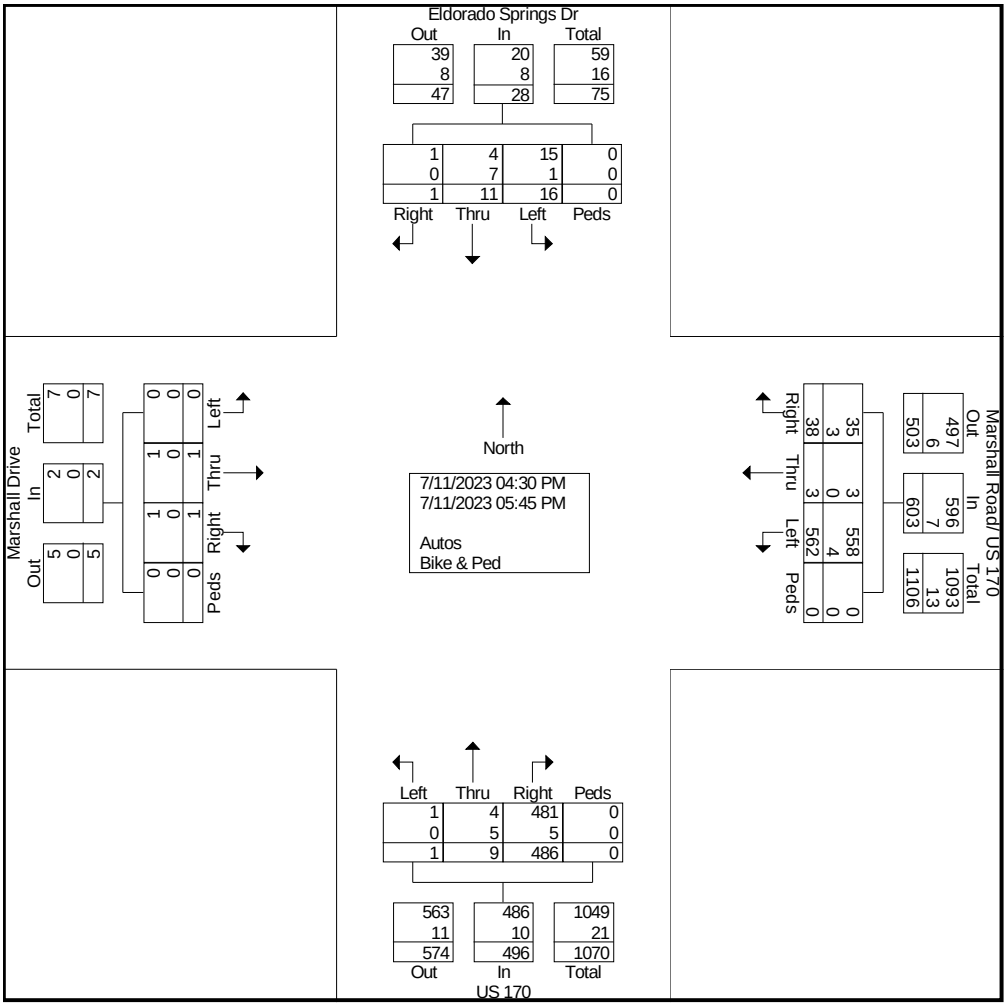
Groups Printed- Autos - Bike & Ped

	Marshall Drive Eastbound					Marshall Road/ US 170 Westbound					US 170 Northbound					Eldorado Springs Dr Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
04:30 PM	0	0	0	0	0	85	0	3	0	88	0	1	88	0	89	5	1	1	0	7	184
04:45 PM	0	0	0	0	0	80	2	7	0	89	0	2	79	0	81	2	3	0	0	5	175
Total	0	0	0	0	0	165	2	10	0	177	0	3	167	0	170	7	4	1	0	12	359
05:00 PM	0	0	0	0	0	108	1	9	0	118	0	3	93	0	96	2	0	0	0	2	216
05:15 PM	0	0	1	0	1	110	0	4	0	114	0	0	73	0	73	1	2	0	0	3	191
05:30 PM	0	0	0	0	0	98	0	7	0	105	0	1	83	0	84	2	3	0	0	5	194
05:45 PM	0	1	0	0	1	81	0	8	0	89	1	2	70	0	73	4	2	0	0	6	169
Total	0	1	1	0	2	397	1	28	0	426	1	6	319	0	326	9	7	0	0	16	770
Grand Total	0	1	1	0	2	562	3	38	0	603	1	9	486	0	496	16	11	1	0	28	1129
Apprch %	0	50	50	0		93.2	0.5	6.3	0		0.2	1.8	98	0		57.1	39.3	3.6	0		
Total %	0	0.1	0.1	0	0.2	49.8	0.3	3.4	0	53.4	0.1	0.8	43	0	43.9	1.4	1	0.1	0	2.5	
Autos	0	1	1	0	2	558	3	35	0	596	1	4	481	0	486	15	4	1	0	20	1104
% Autos	0	100	100	0	100	99.3	100	92.1	0	98.8	100	44.4	99	0	98	93.8	36.4	100	0	71.4	97.8
Bike & Ped	0	0	0	0	0	4	0	3	0	7	0	5	5	0	10	1	7	0	0	8	25
% Bike & Ped	0	0	0	0	0	0.7	0	7.9	0	1.2	0	55.6	1	0	2	6.2	63.6	0	0	28.6	2.2

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 2

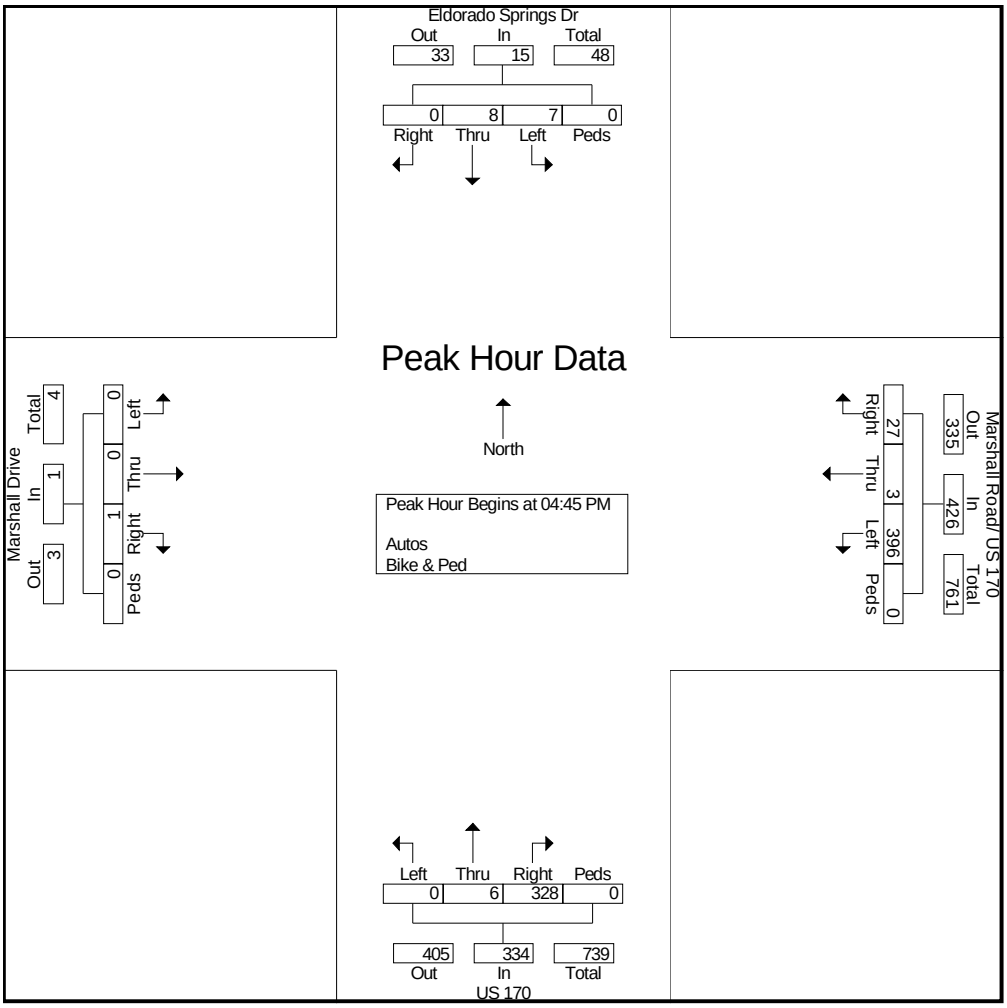


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 3

	Marshall Drive Eastbound					Marshall Road/ US 170 Westbound					US 170 Northbound					Eldorado Springs Dr Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:30 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	0	0	0	0	0	80	**2**	7	0	89	0	2	79	0	81	**2**	**3**	0	0	**5**	175
05:00 PM	0	0	0	0	0	108	1	**9**	0	**118**	0	**3**	**93**	0	**96**	2	0	0	0	2	**216**
05:15 PM	0	0	**1**	0	**1**	**110**	0	4	0	114	0	0	73	0	73	1	2	0	0	3	191
05:30 PM	0	0	0	0	0	98	0	7	0	105	0	1	83	0	84	2	3	0	0	5	194
Total Volume	0	0	1	0	1	396	3	27	0	426	0	6	328	0	334	7	8	0	0	15	776
% App. Total	0	0	100	0		93	0.7	6.3	0		0	1.8	98.2	0		46.7	53.3	0	0		
PHF	.000	.000	.250	.000	.250	.900	.375	.750	.000	.903	.000	.500	.882	.000	.870	.875	.667	.000	.000	.750	.898



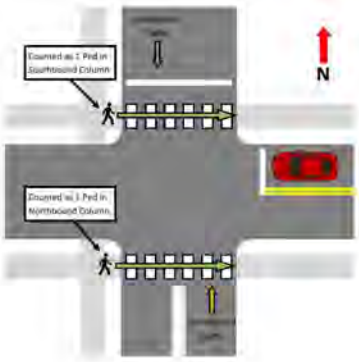
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
PM Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd PM
Site Code : MUL
Start Date : 7/11/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 1

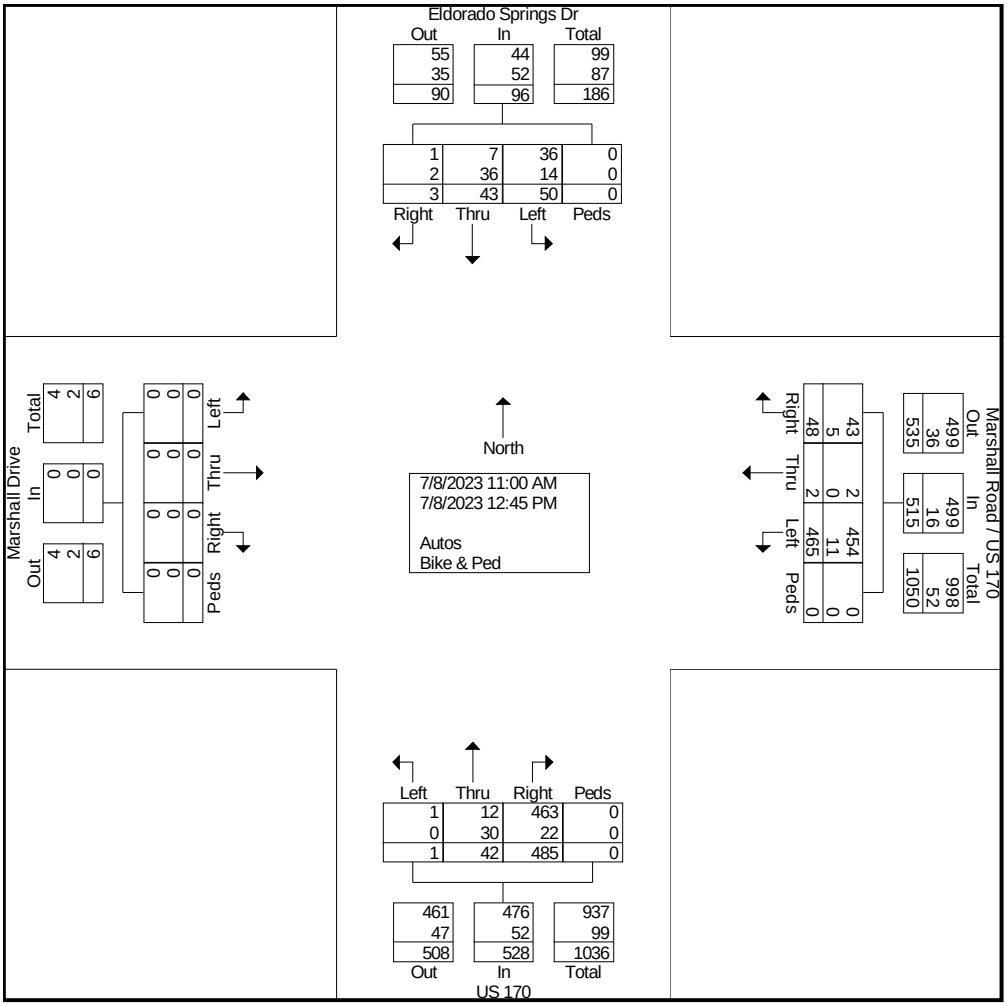
Groups Printed- Autos - Bike & Ped

	Marshall Drive Eastbound					Marshall Road / US 170 Westbound					US 170 Northbound					Eldorado Springs Dr Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
11:00 AM	0	0	0	0	0	45	0	4	0	49	0	4	55	0	59	8	5	1	0	14	122
11:15 AM	0	0	0	0	0	72	0	7	0	79	0	4	69	0	73	5	1	0	0	6	158
11:30 AM	0	0	0	0	0	66	0	6	0	72	0	5	43	0	48	8	10	0	0	18	138
11:45 AM	0	0	0	0	0	71	0	4	0	75	1	2	59	0	62	5	6	0	0	11	148
Total	0	0	0	0	0	254	0	21	0	275	1	15	226	0	242	26	22	1	0	49	566
12:00 PM	0	0	0	0	0	50	0	6	0	56	0	3	67	0	70	6	4	0	0	10	136
12:15 PM	0	0	0	0	0	56	1	8	0	65	0	12	52	0	64	6	2	2	0	10	139
12:30 PM	0	0	0	0	0	40	1	5	0	46	0	3	73	0	76	5	7	0	0	12	134
12:45 PM	0	0	0	0	0	65	0	8	0	73	0	9	67	0	76	7	8	0	0	15	164
Total	0	0	0	0	0	211	2	27	0	240	0	27	259	0	286	24	21	2	0	47	573
Grand Total	0	0	0	0	0	465	2	48	0	515	1	42	485	0	528	50	43	3	0	96	1139
Apprch %	0	0	0	0		90.3	0.4	9.3	0		0.2	8	91.9	0		52.1	44.8	3.1	0		
Total %	0	0	0	0	0	40.8	0.2	4.2	0	45.2	0.1	3.7	42.6	0	46.4	4.4	3.8	0.3	0	8.4	
Autos	0	0	0	0	0	454	2	43	0	499	1	12	463	0	476	36	7	1	0	44	1019
% Autos	0	0	0	0	0	97.6	100	89.6	0	96.9	100	28.6	95.5	0	90.2	72	16.3	33.3	0	45.8	89.5
Bike & Ped	0	0	0	0	0	11	0	5	0	16	0	30	22	0	52	14	36	2	0	52	120
% Bike & Ped	0	0	0	0	0	2.4	0	10.4	0	3.1	0	71.4	4.5	0	9.8	28	83.7	66.7	0	54.2	10.5

Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 2

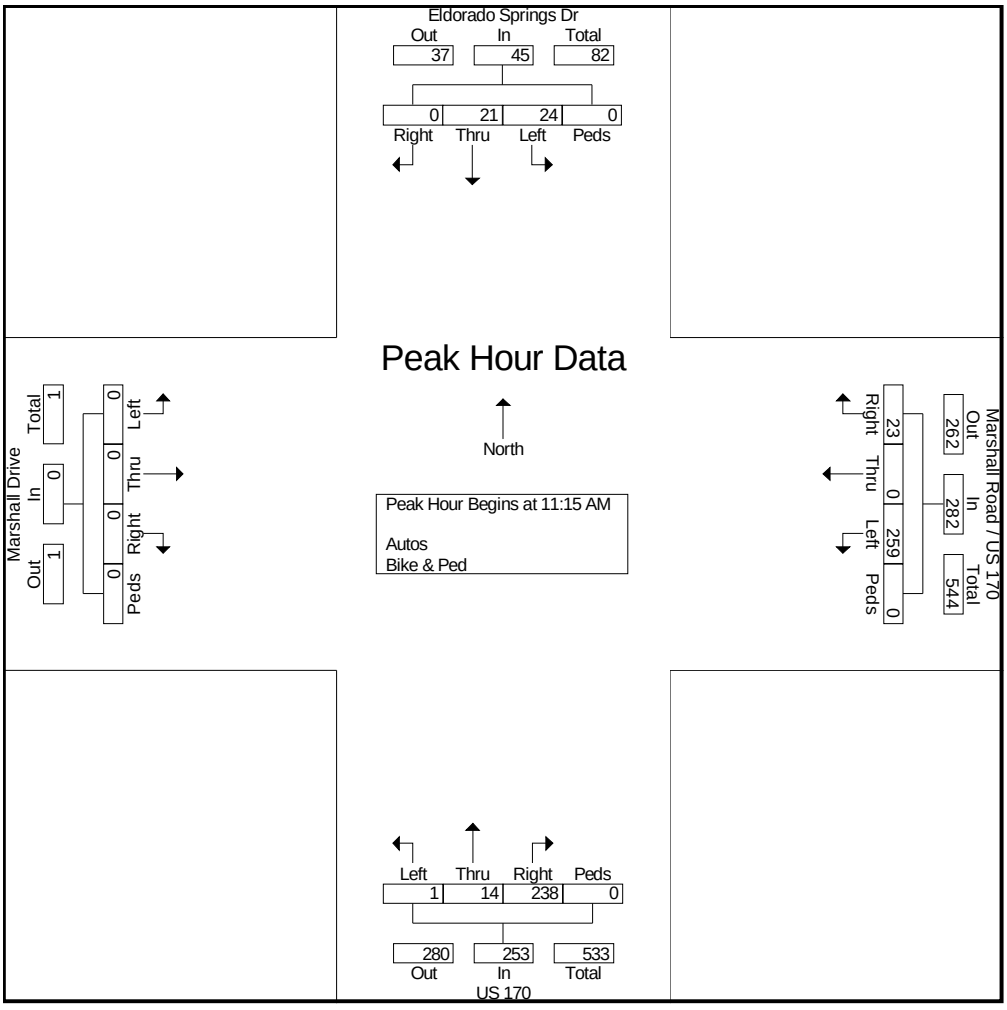


Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 3

	Marshall Drive Eastbound					Marshall Road / US 170 Westbound					US 170 Northbound					Eldorado Springs Dr Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Peak Hour Analysis From 11:00 AM to 12:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 11:15 AM																					
11:15 AM	0	0	0	0	0	**72**	0	**7**	0	**79**	0	4	**69**	0	**73**	5	1	0	0	6	**158**
11:30 AM	0	0	0	0	0	66	0	6	0	72	0	**5**	43	0	48	**8**	**10**	0	0	**18**	138
11:45 AM	0	0	0	0	0	71	0	4	0	75	**1**	2	59	0	62	5	6	0	0	11	148
12:00 PM	0	0	0	0	0	50	0	6	0	56	0	3	67	0	70	6	4	0	0	10	136
Total Volume	0	0	0	0	0	259	0	23	0	282	1	14	238	0	253	24	21	0	0	45	580
% App. Total	0	0	0	0		91.8	0	8.2	0		0.4	5.5	94.1	0		53.3	46.7	0	0		
PHF	.000	.000	.000	.000	.000	.899	.000	.821	.000	.892	.250	.700	.862	.000	.866	.750	.525	.000	.000	.625	.918



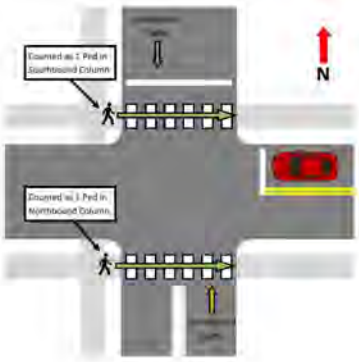
Ridgeview Data Collection

Boulder, CO
MUL Marshall Mesa Trailhead
Sat Peak
US 170 and Marshall Rd

File Name : US 170 and Marshall Rd Sat
Site Code : MUL
Start Date : 7/8/2023
Page No : 4

Image 1

The number of pedestrians shown on this report is representative of the crossing on the approaching leg, i.e. pedestrians crossing the north side of the intersection are counted as pedestrians in the southbound crosswalk, as that is the approaching leg that they are crossing (see figure below). Diagonal crossings are counted on the two legs that will get the pedestrian to the same end point. Diagonals can be counted separately if discussed prior to count.



APPENDIX B

VOLUME WORKSHEETS

AM Peak Period												
Int. 1												
CO 93 (S Foothills Hwy) at CO 170 (Eldorado Springs Dr)												
	CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)			CO 93 (S Foothills Hwy)			CO 93 (S Foothills Hwy)		
	Eastbound			Westbound			Northbound			Southbound		
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
2019 AM Volume Unbalanced	43	25	23	91	23	251	7	957	387	105	450	38
2019 Heavy Vehicle %	4.4	4.4	4.4	2.7	2.7	2.7	0.9	0.9	0.9	3.5	3.5	3.5
2019 PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
2019 Ped Volume	0	0	1	1	0	0	1	0	0	0	0	1
2019 Bike Volume	0	0	0	0	0	0	0	0	0	0	0	0
Volume Adjustment	0	-7	0	-38	-10	-106	0	0	-113	-31	0	0
2023 AM Volume Balanced	43	18	23	53	13	145	7	957	274	74	450	38
2023 AM Build Volume	43	18	23	54	13	149	7	957	279	76	450	38
2043 Growth Factor	1.2	1.2	1.2	1.24	1.24	1.24	1.2	1.2	1.2	1.2	1.2	1.2
Parking Lot Expansion		0		1	0	4			5	2		
2043 AM No Build Volume	52	22	28	66	16	180	8	1148	329	89	540	46
2043 AM Build Volume	52	22	28	67	16	184	8	1148	334	91	540	46
2043 Heavy Vehicle %	4.4	4.4	4.4	2.7	2.7	2.7	0.9	0.9	0.9	3.5	3.5	3.5
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	0	0	1	1	0	0	1	0	0	0	0	1
2043 Bike Volume	0	0	0	0	0	0	0	0	0	0	0	0

PM Peak Period												
Int. 1												
CO 93 (S Foothills Hwy) at CO 170 (Eldorado Springs Dr)												
	CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)			CO 93 (S Foothills Hwy)			CO 93 (S Foothills Hwy)		
	Eastbound			Westbound			Northbound			Southbound		
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
2019 PM Volume Unbalanced	32	36	38	299	35	88	14	554	152	163	990	55
2019 Heavy Vehicle %	1.9	1.9	1.9	0.9	0.9	0.9	1.4	1.4	1.4	0.6	0.6	0.6
2019 PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
2019 Ped Volume	0	0	0	0	0	0	1	0	0	0	0	1
2019 Bike Volume	0	0	0	0	0	0	0	0	0	0	0	0
Volume Adjustment	0	0	0	0	0	0	0	0	0	0	0	0
2023 PM Volume Balanced	32	36	38	299	35	88	14	554	152	163	990	55
2023 PM Build Volume	32	36	38	300	35	88	14	554	154	165	990	55
2043 Growth Factor	1.2	1.2	1.2	1.24	1.24	1.24	1.2	1.2	1.2	1.2	1.2	1.2
Parking Lot Expansion		0		1	0	0			2	2		
2043 PM No Build Volume	38	43	46	371	43	109	17	665	182	196	1188	66
2043 PM Build Volume	38	43	46	372	43	109	17	665	184	198	1188	66
2043 Heavy Vehicle %	1.9	1.9	1.9	0.9	0.9	0.9	1.4	1.4	1.4	0.6	0.6	0.6
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	0	0	0	0	0	0	1	0	0	0	0	1
2043 Bike Volume	0	0	0	0	0	0	0	0	0	0	0	0

Weekend Peak Period												
Int. 1												
CO 93 (S Foothills Hwy) at CO 170 (Eldorado Springs Dr)												
	CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)			CO 93 (S Foothills Hwy)			CO 93 (S Foothills Hwy)		
	Eastbound			Westbound			Northbound			Southbound		
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
2023 Weekend Volume Unbalanced	88	76	43	107	80	75	50	549	112	57	552	78
2023 Heavy Vehicle %	1.5	1.5	1.5	2	2	2	4	4	4	5	5	5
2023 PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
2023 Ped Volume	4					4						
2023 Bike Volume	1	2		1	6				6			
Volume Adjustment	0	0	0	0	0	0	0	0	0	0	0	0
2023 Weekend Volume Balanced	88	76	43	107	80	75	50	549	112	57	552	78
2023 Weekend Build Volume	88	78	43	109	82	77	50	549	115	58	552	78
2043 Growth Factor	1.2	1.2	1.2	1.24	1.24	1.24	1.2	1.2	1.2	1.2	1.2	1.2
Parking Lot Expansion		2		2	2	2			3	1		
2043 Weekend No Build Volume	106	91	52	133	99	93	60	659	134	68	662	94
2043 Weekend Build Volume	106	93	52	135	101	95	60	659	137	69	662	94
2043 Heavy Vehicle %	1.5	1.5	1.5	2	2	2	4	4	4	5	5	5
2043 PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
2043 Ped Volume	4	0	0	0	0	4	0	0	0	0	0	0
2043 Bike Volume	1	2	0	1	6	0	0	0	6	0	0	0

AM Peak Period												
Int. 2												
CO 170 (Eldorado Springs Dr) at Marshall Mesa Trailhead Driveway												
	CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)			Trailhead Driveway			N/A		
	Eastbound			Westbound			Northbound			Southbound		
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
2023 AM Volume Unbalanced	0	345	10	6	195	0	7	0	4			
2023 Heavy Vehicle %	2	2	2	2	2	2	2	2	2			
2023 PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88			
2023 Ped Volume							3		1			
2023 Bike Volume			1	5					5			
Volume Adjustment	0	0	0	0	0	0	0	0	0			
2023 AM Volume Balanced	0	345	10	6	195	0	7	0	4			
2023 AM Build Volume	0	362	0	0	207	0	0	0	0			
2043 Growth Factor	1.0	1.24	1.0	1.0	1.24	1.0	1.0	1.0	1.0			
Parking Lot Expansion			7	4			5		3			
2043 AM No Build Volume	0	428	10	6	242	0	7	0	4			
2043 AM Build Volume	0	445	0	0	254	0	0	0	0			
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2			
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
2043 Ped Volume	0	0	0	0	0	0	3	0	1			
2043 Bike Volume	0	0	1	5	0	0	0	0	5			

PM Peak Period												
Int. 2												
CO 170 (Eldorado Springs Dr) at Marshall Mesa Trailhead Driveway												
	CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)			Trailhead Driveway			N/A		
	Eastbound			Westbound			Northbound			Southbound		
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
2023 PM Volume Unbalanced	0	335	6	0	404	0	1	0	2			
2023 Heavy Vehicle %	2	2	2	2	2	2	2	2	2			
2023 PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91			
2023 Ped Volume							3		1			
2023 Bike Volume			1	5					5			
Volume Adjustment	0	0	0	0	0	0	0	0	0			
2023 PM Volume Balanced	0	335	6	0	404	0	1	0	2			
2023 PM Build Volume	0	345	0	0	406	0	0	0	0			
2043 Growth Factor	1.0	1.24	1.0	1.0	1.24	1.0	1.0	1.0	1.0			
Parking Lot Expansion			4	0			1		1			
2043 PM No Build Volume	0	415	6	0	501	0	1	0	2			
2043 PM Build Volume	0	425	0	0	503	0	0	0	0			
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2			
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
2043 Ped Volume	0	0	0	0	0	0	3	0	1			
2043 Bike Volume	0	0	1	5	0	0	0	0	5			

Weekend Peak Period												
Int. 2												
CO 170 (Eldorado Springs Dr) at Marshall Mesa Trailhead Driveway												
	CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)			Trailhead Driveway			N/A		
	Eastbound			Westbound			Northbound			Southbound		
	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
2023 Weekend Volume Unbalanced	0	236	9	4	253	0	9	0	7			
2023 Heavy Vehicle %	2	2	2	2	2	2	2	2	2			
2023 PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99			
2023 Ped Volume			11	11			3		1			
2023 Bike Volume		11		16	7		2		6			
Volume Adjustment	0	0	0	0	0	0	0	0	0			
2023 Weekend Volume Balanced	0	236	9	4	253	0	9	0	7			
2023 Weekend Build Volume	0	251	0	0	268	0	0	0	0			
2043 Growth Factor	1.0	1.24	1.0	1.0	1.24	1.0	1.0	1.0	1.0			
Parking Lot Expansion			6	3			6		5			
2043 Weekend No Build Volume	0	293	9	4	314	0	9	0	7			
2043 Weekend Build Volume	0	308	0	0	329	0	0	0	0			
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2			
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92			
2043 Ped Volume	0	0	11	11	0	0	3	0	1			
2043 Bike Volume	0	11	0	16	7	0	2	0	6			

AM Peak Period												
Int. 3												
CO 170 (Eldorado Springs Dr) at Eldorado Park-n-Ride												
	Park-n-Ride Driveway			Proposed Driveway (Trailhead)			CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)		
	Southbound			Northbound			Eastbound			Westbound		
	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR
2023 AM Volume Unbalanced	3	0	20				15	334	0	0	181	16
2023 Heavy Vehicle %	2	2	2				2	2	2	2	2	2
2023 PHF	0.88	0.88	0.88				0.88	0.88	0.88	0.88	0.88	0.88
2023 Ped Volume			10				2					2
2023 Bike Volume												
Volume Adjustment	0	0	0				0	0	0	0	0	0
2023 AM Volume Balanced	3	0	20				15	334	0	0	181	16
2023 AM Build Volume	3	0	20	12	0	7	15	330	17	10	175	16
2043 Growth Factor	1.0	1.0	1.0				1.0	1.24	1.0	1.0	1.24	1.0
Parking Lot Expansion								3			4	
2043 AM No Build Volume	3	0	20				15	414	0	0	224	16
2043 AM Build Volume	3	0	20	12	0	7	15	410	17	10	218	16
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	0	0	10				2	0	0	0	0	2
2043 Bike Volume	0	0	0				0	0	0	0	0	0

PM Peak Period												
Int. 3												
CO 170 (Eldorado Springs Dr) at Eldorado Park-n-Ride												
	Park-n-Ride Driveway			Proposed Driveway (Trailhead)			CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)		
	Southbound			Northbound			Eastbound			Westbound		
	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR
2023 PM Volume Unbalanced	4	0	15				14	323	0	0	389	9
2023 Heavy Vehicle %	2	2	2				2	2	2	2	2	2
2023 PHF	0.91	0.91	0.91				0.91	0.91	0.91	0.91	0.91	0.91
2023 Ped Volume			5				1					1
2023 Bike Volume			2									
Volume Adjustment	0	0	0				0	0	0	0	0	0
2023 PM Volume Balanced	4	0	15				14	323	0	0	389	9
2023 PM Build Volume	4	0	15	2	0	3	14	321	10	0	389	9
2043 Growth Factor	1.0	1.0	1.0				1.0	1.24	1.0	1.0	1.24	1.0
Parking Lot Expansion								1			0	
2043 PM No Build Volume	4	0	15				14	401	0	0	482	9
2043 PM Build Volume	4	0	15	2	0	3	14	399	10	0	482	9
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	0	0	5				1	0	0	0	0	1
2043 Bike Volume	0	0	2				0	0	0	0	0	0

Weekend Peak Period												
Int. 3												
CO 170 (Eldorado Springs Dr) at Eldorado Park-n-Ride												
	Park-n-Ride Driveway			Proposed Driveway (Trailhead)			CO 170 (Eldorado Springs Dr)			CO 170 (Eldorado Springs Dr)		
	Southbound			Northbound			Eastbound			Westbound		
	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR
2023 Weekend Volume Unbalanced	11	0	15				11	232	0	0	242	7
2023 Heavy Vehicle %	2	2	2				2	2	2	2	2	2
2023 PHF	0.99	0.99	0.99				0.99	0.99	0.99	0.99	0.99	0.99
2023 Ped Volume	4		32				10					10
2023 Bike Volume			4				1					
Volume Adjustment	0	0	0				0	0	0	0	0	0
2023 Weekend Volume Balanced	11	0	15				11	232	0	0	242	7
2023 Weekend Build Volume	11	0	15	15	0	12	11	225	15	7	238	7
2043 Growth Factor	1.0	1.0	1.0				1.0	1.24	1.0	1.0	1.24	1.0
Parking Lot Expansion								5			3	
2043 Weekend No Build Volume	11	0	15				11	288	0	0	300	7
2043 Weekend Build Volume	11	0	15	15	0	12	11	281	15	7	296	7
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	4	0	32				10	0	0	0	0	10
2043 Bike Volume	0	0	4				1	0	0	0	0	0

AM Peak Period												
Int. 4												
CO 170 (Eldorado Springs Dr) at Marshall Dr												
	Marshall Dr			CO 170 (Marshall Dr)			CO 170 (Eldorado Springs Dr)			Eldorado Springs Dr		
	Southbound			Northbound			Eastbound			Westbound		
	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR
2023 AM Volume Unbalanced	0	0	0	195	0	14	0	1	336	11	2	0
2023 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2023 PHF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
2023 Ped Volume							2					2
2023 Bike Volume				4		2		14	1	2	16	
Volume Adjustment	0	0	0	0	0	0	0	0	0	0	0	0
2023 AM Volume Balanced	0	0	0	195	0	14	0	1	336	11	2	0
2023 AM Build Volume	0	0	0	199	0	14	0	1	339	11	2	0
2043 Growth Factor	1.0	1.0	1.0	1.24	1.24	1.24	1.24	1.24	1.24	1.0	1.0	1.0
Parking Lot Expansion			0	4			0	0	3		0	
2043 AM No Build Volume	0	0	0	242	0	17	0	1	417	11	2	0
2043 AM Build Volume	0	0	0	246	0	17	0.0	1	420	11	2	0
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	0	0	0	0	0	0	2	0	0	0	0	2
2043 Bike Volume	0	0	0	4	0	2	0	14	1	2	16	0

PM Peak Period												
Int. 4												
CO 170 (Eldorado Springs Dr) at Marshall Dr												
	Marshall Dr			CO 170 (Marshall Dr)			CO 170 (Eldorado Springs Dr)			Eldorado Springs Dr		
	Southbound			Northbound			Eastbound			Westbound		
	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR
2023 PM Volume Unbalanced	0	0	1	394	3	25	0	3	324	7	3	0
2023 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2023 PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
2023 Ped Volume												
2023 Bike Volume				2		2		3	4		5	
Volume Adjustment	0	0	0	0	0	0	0	0	0	0	0	0
2023 PM Volume Balanced	0	0	1	394	3	25	0	3	324	7	3	0
2023 PM Build Volume	0	0	1	394	3	25	0	3	325	7	3	0
2043 Growth Factor	1.0	1.0	1.0	1.24	1.24	1.24	1.24	1.24	1.24	1.0	1.0	1.0
Parking Lot Expansion			0	0			0	0	1		0	
2043 PM No Build Volume	0	0	1	489	4	31	0	4	402	7	3	0
2043 PM Build Volume	0	0	1	489	4	31	0.0	4	403	7	3	0
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	0	0	0	0	0	0	0	0	0	0	0	0
2043 Bike Volume	0	0	0	2	0	2	0	3	4	0	5	0

Weekend Peak Period												
Int. 4												
CO 170 (Eldorado Springs Dr) at Marshall Dr												
	Marshall Dr			CO 170 (Marshall Dr)			CO 170 (Eldorado Springs Dr)			Eldorado Springs Dr		
	Southbound			Northbound			Eastbound			Westbound		
	SBL	SBT	SBR	NBL	NBT	NBR	EBL	EBT	EBR	WBL	WBT	WBR
2023 Weekend Volume Unbalanced	0	0	0	256	0	21	1	5	232	15	4	0
2023 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2023 PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
2023 Ped Volume												
2023 Bike Volume				3		2		9	6	9	17	
Volume Adjustment	0	0	0	0	0	0	0	0	0	0	0	0
2023 Weekend Volume Balanced	0	0	0	256	0	21	1	5	232	15	4	0
2023 Weekend Build Volume	0	0	0	259	0	21	1	5	237	15	4	0
2043 Growth Factor	1.0	1.0	1.0	1.24	1.24	1.24	1.24	1.24	1.24	1.0	1.0	1.0
Parking Lot Expansion			0	3			0	0	5		0	
2043 Weekend No Build Volume	0	0	0	317	0	26	1	6	288	15	4	0
2043 Weekend Build Volume	0	0	0	320	0	26	1.0	6	293	15	4	0
2043 Heavy Vehicle %	2	2	2	2	2	2	2	2	2	2	2	2
2043 PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
2043 Ped Volume	0	0	0	0	0	0	0	0	0	0	0	0
2043 Bike Volume	0	0	0	3	0	2	0	9	6	9	17	0

APPENDIX C

SYNCHRO REPORTS

Queues
1: SH 93 & SH 170

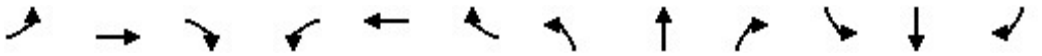
EXISTING 2023 AM
08/09/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	69	26	75	165	8	1088	311	84	511	43
v/c Ratio	0.33	0.09	0.35	0.49	0.01	0.61	0.34	0.28	0.26	0.05
Control Delay	52.1	0.6	51.6	12.6	11.0	24.8	7.9	13.1	14.6	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.1	0.6	51.6	12.6	11.0	24.8	7.9	13.1	14.6	0.1
Queue Length 50th (ft)	47	0	51	0	2	312	38	24	91	0
Queue Length 95th (ft)	95	0	100	59	10	444	107	53	178	0
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	382	439	385	469	606	1784	907	319	1988	924
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.18	0.06	0.19	0.35	0.01	0.61	0.34	0.26	0.26	0.05

Intersection Summary

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

EXISTING 2023 AM
08/09/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	43	18	23	53	13	145	7	957	274	74	450	38
Future Volume (veh/h)	43	18	23	53	13	145	7	957	274	74	450	38
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1841	1841	1841	1856	1856	1856	1885	1885	1885	1841	1841	1841
Adj Flow Rate, veh/h	49	20	26	60	15	165	8	1088	311	84	511	43
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Percent Heavy Veh, %	4	4	4	3	3	3	1	1	1	4	4	4
Cap, veh/h	90	37	111	194	48	213	481	1710	762	279	1851	825
Arrive On Green	0.07	0.07	0.07	0.14	0.14	0.14	0.02	0.48	0.48	0.07	0.53	0.53
Sat Flow, veh/h	1262	515	1554	1427	357	1569	1795	3582	1596	1753	3497	1558
Grp Volume(v), veh/h	69	0	26	75	0	165	8	1088	311	84	511	43
Grp Sat Flow(s),veh/h/ln	1778	0	1554	1784	0	1569	1795	1791	1596	1753	1749	1558
Q Serve(g_s), s	4.1	0.0	1.7	4.1	0.0	11.1	0.2	24.8	13.8	2.4	8.8	1.5
Cycle Q Clear(g_c), s	4.1	0.0	1.7	4.1	0.0	11.1	0.2	24.8	13.8	2.4	8.8	1.5
Prop In Lane	0.71		1.00	0.80		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	127	0	111	242	0	213	481	1710	762	279	1851	825
V/C Ratio(X)	0.54	0.00	0.23	0.31	0.00	0.78	0.02	0.64	0.41	0.30	0.28	0.05
Avail Cap(c_a), veh/h	375	0	328	377	0	331	617	1710	762	322	1851	825
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	48.9	0.0	47.8	42.5	0.0	45.5	14.1	21.4	18.5	15.2	14.1	12.4
Incr Delay (d2), s/veh	12.5	0.0	3.9	2.6	0.0	19.3	0.0	1.8	1.6	0.6	0.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.0	0.8	2.0	0.0	5.4	0.1	10.0	5.1	0.9	3.3	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	61.3	0.0	51.6	45.1	0.0	64.7	14.1	23.2	20.1	15.8	14.5	12.5
LnGrp LOS	E	A	D	D	A	E	B	C	C	B	B	B
Approach Vol, veh/h		95			240			1407			638	
Approach Delay, s/veh		58.7			58.6			22.5			14.5	
Approach LOS		E			E			C			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.4	60.0		14.8	6.7	65.7		21.8				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	52.0		23.0	10.0	52.0		23.0				
Max Q Clear Time (g_c+I1), s	4.4	26.8		6.1	2.2	10.8		13.1				
Green Ext Time (p_c), s	0.1	22.2		0.8	0.0	14.4		1.6				

Intersection Summary			
HCM 6th Ctrl Delay		25.4	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	345	10	6	195	7	4
Future Vol, veh/h	345	10	6	195	7	4
Conflicting Peds, #/hr	0	0	0	0	3	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	392	11	7	222	8	5

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	403	0	637	399
Stage 1	-	-	-	-	398	-
Stage 2	-	-	-	-	239	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1156	-	441	651
Stage 1	-	-	-	-	678	-
Stage 2	-	-	-	-	801	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1156	-	437	650
Mov Cap-2 Maneuver	-	-	-	-	437	-
Stage 1	-	-	-	-	678	-
Stage 2	-	-	-	-	793	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	10.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	650	-	-	1156	-
HCM Lane V/C Ratio	0.007	-	-	0.006	-
HCM Control Delay (s)	10.6	-	-	8.1	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	15	334	181	16	3	20
Future Vol, veh/h	15	334	181	16	3	20
Conflicting Peds, #/hr	2	0	0	2	0	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	17	380	206	18	3	23

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	226	0	-	0	631	227
Stage 1	-	-	-	-	217	-
Stage 2	-	-	-	-	414	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1342	-	-	-	445	812
Stage 1	-	-	-	-	819	-
Stage 2	-	-	-	-	667	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1339	-	-	-	436	803
Mov Cap-2 Maneuver	-	-	-	-	436	-
Stage 1	-	-	-	-	804	-
Stage 2	-	-	-	-	666	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	10.2
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1339	-	-	-	724
HCM Lane V/C Ratio	0.013	-	-	-	0.036
HCM Control Delay (s)	7.7	0	-	-	10.2
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection	
Int Delay, s/veh	9.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	1	336	11	2	0	195	0	14	0	0	0
Future Vol, veh/h	0	1	336	11	2	0	195	0	14	0	0	0
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	86	86	86	86	86	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1	391	13	2	0	227	0	16	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	466	471	1	464	463	10	1	0	0	16	0	0
Stage 1	1	1	-	462	462	-	-	-	-	-	-	-
Stage 2	465	470	-	2	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	507	491	1084	508	496	1071	1622	-	-	1602	-	-
Stage 1	1022	895	-	580	565	-	-	-	-	-	-	-
Stage 2	578	560	-	1021	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	450	422	1084	289	426	1069	1622	-	-	1602	-	-
Mov Cap-2 Maneuver	450	422	-	289	426	-	-	-	-	-	-	-
Stage 1	878	895	-	498	485	-	-	-	-	-	-	-
Stage 2	493	481	-	652	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.2	17.5	7.1	0
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1087	304	1602	-	-
HCM Lane V/C Ratio	0.14	-	-	0.36	0.05	-	-	-
HCM Control Delay (s)	7.6	0	-	10.2	17.5	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.5	-	-	1.7	0.2	0	-	-

Queues
1: SH 93 & SH 170

EXISTING 2023 PM
08/20/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	75	42	367	97	15	609	167	179	1088	60
v/c Ratio	0.38	0.14	1.07	0.23	0.05	0.40	0.21	0.40	0.60	0.07
Control Delay	57.4	1.0	117.2	3.8	13.9	26.0	4.2	16.5	25.3	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.4	1.0	117.2	3.8	13.9	26.0	4.2	16.5	25.3	0.2
Queue Length 50th (ft)	58	0	~341	0	5	181	0	68	299	0
Queue Length 95th (ft)	107	0	#558	19	17	243	44	116	480	0
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	346	412	342	415	310	1537	782	452	1822	860
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.10	1.07	0.23	0.05	0.40	0.21	0.40	0.60	0.07

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

EXISTING 2023 PM
08/20/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	32	36	38	299	35	88	14	554	152	163	990	55
Future Volume (veh/h)	32	36	38	299	35	88	14	554	152	163	990	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1885	1885	1885	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	35	40	42	329	38	97	15	609	167	179	1088	60
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	2	2	2	1	1	1	1	1	1	1	1	1
Cap, veh/h	57	65	105	315	36	311	236	1578	703	414	1733	772
Arrive On Green	0.07	0.07	0.07	0.19	0.19	0.19	0.03	0.44	0.44	0.07	0.48	0.48
Sat Flow, veh/h	853	975	1585	1617	187	1598	1795	3582	1596	1795	3582	1596
Grp Volume(v), veh/h	75	0	42	367	0	97	15	609	167	179	1088	60
Grp Sat Flow(s),veh/h/ln	1828	0	1585	1804	0	1598	1795	1791	1596	1795	1791	1596
Q Serve(g_s), s	4.7	0.0	3.0	23.0	0.0	6.1	0.5	13.5	7.7	6.2	26.6	2.4
Cycle Q Clear(g_c), s	4.7	0.0	3.0	23.0	0.0	6.1	0.5	13.5	7.7	6.2	26.6	2.4
Prop In Lane	0.47		1.00	0.90		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	121	0	105	351	0	311	236	1578	703	414	1733	772
V/C Ratio(X)	0.62	0.00	0.40	1.04	0.00	0.31	0.06	0.39	0.24	0.43	0.63	0.08
Avail Cap(c_a), veh/h	356	0	309	351	0	311	341	1578	703	441	1733	772
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	53.7	0.0	52.9	47.5	0.0	40.7	18.9	22.3	20.6	16.0	22.6	16.3
Incr Delay (d2), s/veh	17.2	0.0	8.7	60.0	0.0	2.0	0.1	0.7	0.8	0.7	1.7	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.7	0.0	1.4	16.1	0.0	2.6	0.2	5.6	2.9	2.4	10.9	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	70.9	0.0	61.6	107.5	0.0	42.8	19.0	23.0	21.4	16.7	24.3	16.5
LnGrp LOS	E	A	E	F	A	D	B	C	C	B	C	B
Approach Vol, veh/h		117			464			791			1327	
Approach Delay, s/veh		67.6			94.0			22.6			22.9	
Approach LOS		E			F			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	13.2	60.0		14.8	8.1	65.1		30.0				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	52.0		23.0	10.0	52.0		23.0				
Max Q Clear Time (g_c+I1), s	8.2	15.5		6.7	2.5	28.6		25.0				
Green Ext Time (p_c), s	0.1	18.8		1.0	0.0	19.4		0.0				

Intersection Summary			
HCM 6th Ctrl Delay		37.0	
HCM 6th LOS		D	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	335	6	0	404	1	2
Future Vol, veh/h	335	6	0	404	1	2
Conflicting Peds, #/hr	0	0	0	0	3	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	368	7	0	444	1	2

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	-	-	819	373
Stage 1	-	-	-	-	372	-
Stage 2	-	-	-	-	447	-
Critical Hdwy	-	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	0	-	345	673
Stage 1	-	-	0	-	697	-
Stage 2	-	-	0	-	644	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	-	-	344	672
Mov Cap-2 Maneuver	-	-	-	-	344	-
Stage 1	-	-	-	-	697	-
Stage 2	-	-	-	-	642	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBT
Capacity (veh/h)	672	-	-	-
HCM Lane V/C Ratio	0.003	-	-	-
HCM Control Delay (s)	10.4	-	-	-
HCM Lane LOS	B	-	-	-
HCM 95th %tile Q(veh)	0	-	-	-

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	323	389	9	4	15
Future Vol, veh/h	14	323	389	9	4	15
Conflicting Peds, #/hr	1	0	0	1	0	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	15	355	427	10	4	16

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	438	0	-	0	818	438
Stage 1	-	-	-	-	433	-
Stage 2	-	-	-	-	385	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1122	-	-	-	346	619
Stage 1	-	-	-	-	654	-
Stage 2	-	-	-	-	688	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1121	-	-	-	339	615
Mov Cap-2 Maneuver	-	-	-	-	339	-
Stage 1	-	-	-	-	642	-
Stage 2	-	-	-	-	687	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	12.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1121	-	-	-	525
HCM Lane V/C Ratio	0.014	-	-	-	0.04
HCM Control Delay (s)	8.3	0	-	-	12.1
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection	
Int Delay, s/veh	8.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	3	324	7	3	0	394	3	25	0	0	1
Future Vol, veh/h	0	3	324	7	3	0	394	3	25	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	3	356	8	3	0	433	3	27	0	0	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	885	897	1	885	884	17	1	0	0	30	0	0
Stage 1	1	1	-	883	883	-	-	-	-	-	-	-
Stage 2	884	896	-	2	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	266	279	1084	266	284	1062	1622	-	-	1583	-	-
Stage 1	1022	895	-	340	364	-	-	-	-	-	-	-
Stage 2	340	359	-	1021	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	208	203	1084	139	207	1062	1622	-	-	1583	-	-
Mov Cap-2 Maneuver	208	203	-	139	207	-	-	-	-	-	-	-
Stage 1	744	895	-	248	265	-	-	-	-	-	-	-
Stage 2	244	261	-	683	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.9	30.2	7.5	0
HCM LOS	A	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1094	154	1583	-	-
HCM Lane V/C Ratio	0.267	-	-	0.328	0.071	-	-	-
HCM Control Delay (s)	8	0	-	9.9	30.2	0	-	-
HCM Lane LOS	A	A	-	A	D	A	-	-
HCM 95th %tile Q(veh)	1.1	-	-	1.4	0.2	0	-	-

Queues
1: SH 93 & SH 170

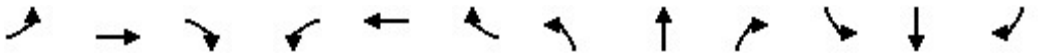
EXISTING 2023 WEEKEND
08/20/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	166	43	189	76	51	555	113	58	558	79
v/c Ratio	0.60	0.12	0.66	0.21	0.12	0.38	0.16	0.14	0.38	0.11
Control Delay	60.1	0.7	61.9	1.3	16.2	27.1	3.6	16.3	27.0	0.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.1	0.7	61.9	1.3	16.2	27.1	3.6	16.3	27.0	0.9
Queue Length 50th (ft)	130	0	148	0	20	168	0	22	170	0
Queue Length 95th (ft)	211	0	238	0	44	237	30	49	237	6
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	341	409	340	404	451	1476	717	446	1467	730
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.11	0.56	0.19	0.11	0.38	0.16	0.13	0.38	0.11

Intersection Summary

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

EXISTING 2023 WEEKEND
08/20/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	76	43	107	80	75	50	549	112	57	552	78
Future Volume (veh/h)	88	76	43	107	80	75	50	549	112	57	552	78
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1841	1841	1841	1826	1826	1826
Adj Flow Rate, veh/h	89	77	43	108	81	76	51	555	113	58	558	79
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	4	4	4	5	5	5
Cap, veh/h	121	105	192	143	107	214	428	1565	681	421	1562	697
Arrive On Green	0.12	0.12	0.12	0.14	0.14	0.14	0.06	0.45	0.45	0.06	0.45	0.45
Sat Flow, veh/h	977	845	1548	1039	779	1550	1753	3497	1521	1739	3469	1547
Grp Volume(v), veh/h	166	0	43	189	0	76	51	555	113	58	558	79
Grp Sat Flow(s),veh/h/ln	1822	0	1548	1818	0	1550	1753	1749	1521	1739	1735	1547
Q Serve(g_s), s	10.2	0.0	2.9	11.6	0.0	5.2	1.7	12.1	5.2	2.0	12.2	3.4
Cycle Q Clear(g_c), s	10.2	0.0	2.9	11.6	0.0	5.2	1.7	12.1	5.2	2.0	12.2	3.4
Prop In Lane	0.54		1.00	0.57		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	226	0	192	251	0	214	428	1565	681	421	1562	697
V/C Ratio(X)	0.74	0.00	0.22	0.75	0.00	0.36	0.12	0.35	0.17	0.14	0.36	0.11
Avail Cap(c_a), veh/h	361	0	307	360	0	307	481	1565	681	469	1562	697
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	49.0	0.0	45.9	48.2	0.0	45.4	15.4	21.1	19.1	15.4	20.9	18.5
Incr Delay (d2), s/veh	15.4	0.0	2.1	15.4	0.0	3.6	0.1	0.6	0.5	0.1	0.6	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.6	0.0	1.2	6.3	0.0	2.2	0.7	4.8	1.8	0.8	4.8	1.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	64.5	0.0	48.0	63.6	0.0	49.0	15.5	21.7	19.7	15.5	21.6	18.8
LnGrp LOS	E	A	D	E	A	D	B	C	B	B	C	B
Approach Vol, veh/h		209			265			719			695	
Approach Delay, s/veh		61.1			59.4			20.9			20.7	
Approach LOS		E			E			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	11.8	60.0		21.4	11.5	60.3		23.0				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	52.0		23.0	10.0	52.0		23.0				
Max Q Clear Time (g_c+I1), s	4.0	14.1		12.2	3.7	14.2		13.6				
Green Ext Time (p_c), s	0.0	16.6		1.6	0.0	15.9		1.9				

Intersection Summary			
HCM 6th Ctrl Delay		30.7	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	236	9	4	253	9	7
Future Vol, veh/h	236	9	4	253	9	7
Conflicting Peds, #/hr	0	11	11	0	3	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	99	99	99	99	99	99
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	238	9	4	256	9	7

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	258	0	521	255
Stage 1	-	-	-	-	254	-
Stage 2	-	-	-	-	267	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1307	-	516	784
Stage 1	-	-	-	-	788	-
Stage 2	-	-	-	-	778	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1293	-	507	775
Mov Cap-2 Maneuver	-	-	-	-	507	-
Stage 1	-	-	-	-	780	-
Stage 2	-	-	-	-	773	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	9.7
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	775	-	-	1293	-
HCM Lane V/C Ratio	0.009	-	-	0.003	-
HCM Control Delay (s)	9.7	-	-	7.8	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	11	232	242	7	11	15
Future Vol, veh/h	11	232	242	7	11	15
Conflicting Peds, #/hr	10	0	0	10	4	32
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	99	99	99	99	99	99
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	11	234	244	7	11	15

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	261	0	-	0	518	290
Stage 1	-	-	-	-	258	-
Stage 2	-	-	-	-	260	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1303	-	-	-	518	749
Stage 1	-	-	-	-	785	-
Stage 2	-	-	-	-	783	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1291	-	-	-	502	719
Mov Cap-2 Maneuver	-	-	-	-	502	-
Stage 1	-	-	-	-	769	-
Stage 2	-	-	-	-	775	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	11.2
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1291	-	-	-	608
HCM Lane V/C Ratio	0.009	-	-	-	0.043
HCM Control Delay (s)	7.8	0	-	-	11.2
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection	
Int Delay, s/veh	8.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	1	5	232	15	4	0	256	0	21	0	0	0
Future Vol, veh/h	1	5	232	15	4	0	256	0	21	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	89	89	89	89	89	89	89	89	89	89	89	89
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	6	261	17	4	0	288	0	24	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	591	601	1	592	589	12	1	0	0	24	0	0
Stage 1	1	1	-	588	588	-	-	-	-	-	-	-
Stage 2	590	600	-	4	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	419	414	1084	418	421	1069	1622	-	-	1591	-	-
Stage 1	1022	895	-	495	496	-	-	-	-	-	-	-
Stage 2	494	490	-	1018	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	357	339	1084	270	345	1069	1622	-	-	1591	-	-
Mov Cap-2 Maneuver	357	339	-	270	345	-	-	-	-	-	-	-
Stage 1	838	895	-	406	407	-	-	-	-	-	-	-
Stage 2	401	402	-	768	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.3	18.8	7.1	0
HCM LOS	A	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1112	283	1591	-	-
HCM Lane V/C Ratio	0.177	-	-	0.24	0.075	-	-	-
HCM Control Delay (s)	7.7	0	-	9.3	18.8	0	-	-
HCM Lane LOS	A	A	-	A	C	A	-	-
HCM 95th %tile Q(veh)	0.6	-	-	0.9	0.2	0	-	-

Queues
1: SH 93 & SH 170

2043 FUTURE NO BUILD AM
08/09/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	81	30	89	196	9	1248	358	97	587	50
v/c Ratio	0.38	0.10	0.39	0.53	0.02	0.75	0.41	0.41	0.30	0.05
Control Delay	53.8	0.6	52.4	12.0	12.1	30.4	10.6	16.6	15.9	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.8	0.6	52.4	12.0	12.1	30.4	10.6	16.6	15.9	0.1
Queue Length 50th (ft)	56	0	62	0	3	397	61	29	112	0
Queue Length 95th (ft)	113	0	118	68	12	588	162	66	224	0
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	365	425	366	479	561	1671	863	258	1979	921
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.07	0.24	0.41	0.02	0.75	0.41	0.38	0.30	0.05

Intersection Summary

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2043 FUTURE NO BUILD AM
08/09/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	52	22	28	66	16	180	8	1148	329	89	540	46
Future Volume (veh/h)	52	22	28	66	16	180	8	1148	329	89	540	46
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1841	1841	1841	1856	1856	1856	1885	1885	1885	1841	1841	1841
Adj Flow Rate, veh/h	57	24	30	72	17	196	9	1248	358	97	587	50
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
Percent Heavy Veh, %	4	4	4	3	3	3	1	1	1	4	4	4
Cap, veh/h	89	38	111	222	52	241	429	1666	742	239	1804	804
Arrive On Green	0.07	0.07	0.07	0.15	0.15	0.15	0.02	0.47	0.47	0.07	0.52	0.52
Sat Flow, veh/h	1251	527	1553	1443	341	1569	1795	3582	1596	1753	3497	1558
Grp Volume(v), veh/h	81	0	30	89	0	196	9	1248	358	97	587	50
Grp Sat Flow(s),veh/h/ln	1778	0	1553	1783	0	1569	1795	1791	1596	1753	1749	1558
Q Serve(g_s), s	5.0	0.0	2.0	5.0	0.0	13.5	0.3	32.0	17.3	2.9	10.9	1.8
Cycle Q Clear(g_c), s	5.0	0.0	2.0	5.0	0.0	13.5	0.3	32.0	17.3	2.9	10.9	1.8
Prop In Lane	0.70		1.00	0.81		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	127	0	111	274	0	241	429	1666	742	239	1804	804
V/C Ratio(X)	0.64	0.00	0.27	0.32	0.00	0.81	0.02	0.75	0.48	0.41	0.33	0.06
Avail Cap(c_a), veh/h	366	0	320	367	0	323	558	1666	742	277	1804	804
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	50.5	0.0	49.1	42.1	0.0	45.7	15.2	24.5	20.6	19.4	15.7	13.5
Incr Delay (d2), s/veh	17.7	0.0	4.7	2.5	0.0	21.4	0.0	3.1	2.2	1.1	0.5	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	0.0	0.9	2.4	0.0	6.7	0.1	13.2	6.5	1.1	4.2	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	68.2	0.0	53.8	44.6	0.0	67.2	15.2	27.7	22.8	20.5	16.2	13.7
LnGrp LOS	E	A	D	D	A	E	B	C	C	C	B	B
Approach Vol, veh/h		111			285			1615			734	
Approach Delay, s/veh		64.3			60.1			26.5			16.6	
Approach LOS		E			E			C			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.6	60.0		15.0	7.0	65.7		24.2				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	52.0		23.0	10.0	52.0		23.0				
Max Q Clear Time (g_c+I1), s	4.9	34.0		7.0	2.3	12.9		15.5				
Green Ext Time (p_c), s	0.1	17.0		0.9	0.0	16.4		1.6				

Intersection Summary			
HCM 6th Ctrl Delay		28.9	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	428	10	6	242	7	4
Future Vol, veh/h	428	10	6	242	7	4
Conflicting Peds, #/hr	0	0	0	0	3	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	465	11	7	263	8	4

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	476	0	751	472
Stage 1	-	-	-	-	471	-
Stage 2	-	-	-	-	280	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1086	-	378	592
Stage 1	-	-	-	-	628	-
Stage 2	-	-	-	-	767	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1086	-	374	591
Mov Cap-2 Maneuver	-	-	-	-	374	-
Stage 1	-	-	-	-	628	-
Stage 2	-	-	-	-	759	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	11.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	591	-	-	1086	-
HCM Lane V/C Ratio	0.007	-	-	0.006	-
HCM Control Delay (s)	11.1	-	-	8.3	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	15	414	224	16	3	20
Future Vol, veh/h	15	414	224	16	3	20
Conflicting Peds, #/hr	2	0	0	2	0	10
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	450	243	17	3	22

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	262	0	-	0	736	264
Stage 1	-	-	-	-	254	-
Stage 2	-	-	-	-	482	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1302	-	-	-	386	775
Stage 1	-	-	-	-	788	-
Stage 2	-	-	-	-	621	-
Platoon blocked, %			-	-	-	
Mov Cap-1 Maneuver	1300	-	-	-	378	766
Mov Cap-2 Maneuver	-	-	-	-	378	-
Stage 1	-	-	-	-	774	-
Stage 2	-	-	-	-	620	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	10.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1300	-	-	-	676
HCM Lane V/C Ratio	0.013	-	-	-	0.037
HCM Control Delay (s)	7.8	0	-	-	10.5
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection	
Int Delay, s/veh	9.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	1	417	11	2	0	242	0	17	0	0	0
Future Vol, veh/h	0	1	417	11	2	0	242	0	17	0	0	0
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1	453	12	2	0	263	0	18	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	539	545	1	537	536	11	1	0	0	18	0	0
Stage 1	1	1	-	535	535	-	-	-	-	-	-	-
Stage 2	538	544	-	2	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	453	446	1084	455	451	1070	1622	-	-	1599	-	-
Stage 1	1022	895	-	529	524	-	-	-	-	-	-	-
Stage 2	527	519	-	1021	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	394	373	1084	231	377	1068	1622	-	-	1599	-	-
Mov Cap-2 Maneuver	394	373	-	231	377	-	-	-	-	-	-	-
Stage 1	854	895	-	442	438	-	-	-	-	-	-	-
Stage 2	438	434	-	593	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.7	20.5	7.1	0
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1087	246	1599	-	-
HCM Lane V/C Ratio	0.162	-	-	0.418	0.057	-	-	-
HCM Control Delay (s)	7.6	0	-	10.7	20.5	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.6	-	-	2.1	0.2	0	-	-

Queues
1: SH 93 & SH 170

2043 FUTURE NO BUILD PM
08/20/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	88	50	450	118	18	723	198	213	1291	72
v/c Ratio	0.43	0.17	1.37	0.29	0.09	0.49	0.26	0.56	0.74	0.09
Control Delay	58.6	1.2	225.2	6.9	14.7	29.1	4.2	21.5	30.6	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.6	1.2	225.2	6.9	14.7	29.1	4.2	21.5	30.6	0.2
Queue Length 50th (ft)	68	0	~486	0	6	226	0	85	393	0
Queue Length 95th (ft)	122	0	#725	40	20	301	48	140	624	1
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	332	400	328	403	233	1473	775	379	1750	831
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	0.13	1.37	0.29	0.08	0.49	0.26	0.56	0.74	0.09

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2043 FUTURE NO BUILD PM
08/20/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	43	46	371	43	109	17	665	182	196	1188	66
Future Volume (veh/h)	38	43	46	371	43	109	17	665	182	196	1188	66
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1885	1885	1885	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	41	47	50	403	47	118	18	723	198	213	1291	72
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
Percent Heavy Veh, %	2	2	2	1	1	1	1	1	1	1	1	1
Cap, veh/h	62	71	115	309	36	305	190	1547	689	380	1727	769
Arrive On Green	0.07	0.07	0.07	0.19	0.19	0.19	0.03	0.43	0.43	0.08	0.48	0.48
Sat Flow, veh/h	852	976	1585	1616	188	1598	1795	3582	1596	1795	3582	1596
Grp Volume(v), veh/h	88	0	50	450	0	118	18	723	198	213	1291	72
Grp Sat Flow(s),veh/h/ln	1828	0	1585	1804	0	1598	1795	1791	1596	1795	1791	1596
Q Serve(g_s), s	5.6	0.0	3.6	23.0	0.0	7.8	0.7	17.3	9.7	7.6	35.1	2.9
Cycle Q Clear(g_c), s	5.6	0.0	3.6	23.0	0.0	7.8	0.7	17.3	9.7	7.6	35.1	2.9
Prop In Lane	0.47		1.00	0.90		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	132	0	115	345	0	305	190	1547	689	380	1727	769
V/C Ratio(X)	0.66	0.00	0.44	1.31	0.00	0.39	0.09	0.47	0.29	0.56	0.75	0.09
Avail Cap(c_a), veh/h	349	0	303	345	0	305	285	1547	689	385	1727	769
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.4	0.0	53.5	48.7	0.0	42.5	21.3	24.3	22.2	17.5	25.2	16.9
Incr Delay (d2), s/veh	18.8	0.0	9.2	156.9	0.0	2.9	0.2	1.0	1.0	1.8	3.0	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.3	0.0	1.7	25.3	0.0	3.3	0.3	7.2	3.7	3.1	14.6	1.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	73.2	0.0	62.6	205.6	0.0	45.4	21.5	25.3	23.2	19.3	28.3	17.1
LnGrp LOS	E	A	E	F	A	D	C	C	C	B	C	B
Approach Vol, veh/h		138			568			939			1576	
Approach Delay, s/veh		69.4			172.3			24.8			26.5	
Approach LOS		E			F			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	14.7	60.0		15.7	8.6	66.0		30.0				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	52.0		23.0	10.0	52.0		23.0				
Max Q Clear Time (g_c+I1), s	9.6	19.3		7.6	2.7	37.1		25.0				
Green Ext Time (p_c), s	0.0	20.7		1.2	0.0	13.7		0.0				

Intersection Summary			
HCM 6th Ctrl Delay		53.6	
HCM 6th LOS		D	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	415	6	0	501	1	2
Future Vol, veh/h	415	6	0	501	1	2
Conflicting Peds, #/hr	0	0	0	0	3	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	451	7	0	545	1	2

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	-	-	1003	456
Stage 1	-	-	-	-	455	-
Stage 2	-	-	-	-	548	-
Critical Hdwy	-	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	0	-	268	604
Stage 1	-	-	0	-	639	-
Stage 2	-	-	0	-	579	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	-	-	267	603
Mov Cap-2 Maneuver	-	-	-	-	267	-
Stage 1	-	-	-	-	639	-
Stage 2	-	-	-	-	577	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	11
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBT
Capacity (veh/h)	603	-	-	-
HCM Lane V/C Ratio	0.004	-	-	-
HCM Control Delay (s)	11	-	-	-
HCM Lane LOS	B	-	-	-
HCM 95th %tile Q(veh)	0	-	-	-

Intersection	
Int Delay, s/veh	0.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	14	401	482	9	4	15
Future Vol, veh/h	14	401	482	9	4	15
Conflicting Peds, #/hr	1	0	0	1	0	5
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	15	436	524	10	4	16

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	535	0	-	0	996	535
Stage 1	-	-	-	-	530	-
Stage 2	-	-	-	-	466	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1033	-	-	-	271	545
Stage 1	-	-	-	-	590	-
Stage 2	-	-	-	-	632	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1032	-	-	-	265	542
Mov Cap-2 Maneuver	-	-	-	-	265	-
Stage 1	-	-	-	-	578	-
Stage 2	-	-	-	-	631	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	13.5
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1032	-	-	-	444
HCM Lane V/C Ratio	0.015	-	-	-	0.047
HCM Control Delay (s)	8.5	0	-	-	13.5
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection	
Int Delay, s/veh	9.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	4	402	7	3	0	489	4	31	0	0	1
Future Vol, veh/h	0	4	402	7	3	0	489	4	31	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	4	437	8	3	0	532	4	34	0	0	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1088	1103	1	1088	1086	21	1	0	0	38	0	0
Stage 1	1	1	-	1085	1085	-	-	-	-	-	-	-
Stage 2	1087	1102	-	3	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	193	211	1084	193	216	1056	1622	-	-	1572	-	-
Stage 1	1022	895	-	262	293	-	-	-	-	-	-	-
Stage 2	262	287	-	1020	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	140	140	1084	83	143	1056	1622	-	-	1572	-	-
Mov Cap-2 Maneuver	140	140	-	83	143	-	-	-	-	-	-	-
Stage 1	679	895	-	174	195	-	-	-	-	-	-	-
Stage 2	171	191	-	606	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.5	47.7	7.7	0
HCM LOS	B	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1095	95	1572	-	-
HCM Lane V/C Ratio	0.328	-	-	0.403	0.114	-	-	-
HCM Control Delay (s)	8.3	0	-	10.5	47.7	0	-	-
HCM Lane LOS	A	A	-	B	E	A	-	-
HCM 95th %tile Q(veh)	1.4	-	-	2	0.4	0	-	-

Queues
1: SH 93 & SH 170

2043 FUTURE NO BUILD WEEKEND
08/20/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	199	53	234	94	61	666	135	69	669	95
v/c Ratio	0.69	0.14	0.77	0.25	0.17	0.46	0.19	0.19	0.47	0.13
Control Delay	64.5	0.8	68.9	3.7	17.3	29.9	5.0	17.5	29.9	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.5	0.8	68.9	3.7	17.3	29.9	5.0	17.5	29.9	2.1
Queue Length 50th (ft)	162	0	193	0	26	224	0	29	225	0
Queue Length 95th (ft)	251	0	#316	16	50	291	43	56	293	17
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	331	401	331	396	383	1435	704	378	1424	712
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.13	0.71	0.24	0.16	0.46	0.19	0.18	0.47	0.13

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2043 FUTURE NO BUILD WEEKEND
08/20/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	106	91	52	133	99	93	60	659	134	68	662	94
Future Volume (veh/h)	106	91	52	133	99	93	60	659	134	68	662	94
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1841	1841	1841	1826	1826	1826
Adj Flow Rate, veh/h	107	92	53	134	100	94	61	666	135	69	669	95
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	4	4	4	5	5	5
Cap, veh/h	136	117	215	163	122	243	359	1485	646	353	1480	660
Arrive On Green	0.14	0.14	0.14	0.16	0.16	0.16	0.06	0.42	0.42	0.06	0.43	0.43
Sat Flow, veh/h	979	842	1550	1041	777	1552	1753	3497	1521	1739	3469	1547
Grp Volume(v), veh/h	199	0	53	234	0	94	61	666	135	69	669	95
Grp Sat Flow(s),veh/h/ln	1821	0	1550	1818	0	1552	1753	1749	1521	1739	1735	1547
Q Serve(g_s), s	12.9	0.0	3.7	15.2	0.0	6.7	2.3	16.6	6.9	2.6	16.8	4.6
Cycle Q Clear(g_c), s	12.9	0.0	3.7	15.2	0.0	6.7	2.3	16.6	6.9	2.6	16.8	4.6
Prop In Lane	0.54		1.00	0.57		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	253	0	215	285	0	243	359	1485	646	353	1480	660
V/C Ratio(X)	0.79	0.00	0.25	0.82	0.00	0.39	0.17	0.45	0.21	0.20	0.45	0.14
Avail Cap(c_a), veh/h	342	0	291	342	0	292	402	1485	646	393	1480	660
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.0	0.0	47.0	50.0	0.0	46.3	18.2	25.0	22.2	18.2	24.9	21.4
Incr Delay (d2), s/veh	18.1	0.0	2.1	20.1	0.0	3.6	0.2	1.0	0.7	0.3	1.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.2	0.0	1.6	8.5	0.0	2.8	0.9	6.8	2.5	1.0	6.8	1.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	69.1	0.0	49.1	70.0	0.0	50.0	18.5	26.0	23.0	18.5	25.9	21.9
LnGrp LOS	E	A	D	E	A	D	B	C	C	B	C	C
Approach Vol, veh/h		252			328			862			833	
Approach Delay, s/veh		64.9			64.3			25.0			24.9	
Approach LOS		E			E			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.2	60.0		24.0	12.0	60.2		26.2				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	52.0		23.0	10.0	52.0		23.0				
Max Q Clear Time (g_c+I1), s	4.6	18.6		14.9	4.3	18.8		17.2				
Green Ext Time (p_c), s	0.0	18.7		1.6	0.0	18.0		1.7				

Intersection Summary			
HCM 6th Ctrl Delay		35.0	
HCM 6th LOS		D	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	293	9	4	314	9	7
Future Vol, veh/h	293	9	4	314	9	7
Conflicting Peds, #/hr	0	11	11	0	3	1
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	318	10	4	341	10	8

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	339	0	686	335
Stage 1	-	-	-	-	334	-
Stage 2	-	-	-	-	352	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1220	-	413	707
Stage 1	-	-	-	-	725	-
Stage 2	-	-	-	-	712	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1207	-	406	699
Mov Cap-2 Maneuver	-	-	-	-	406	-
Stage 1	-	-	-	-	718	-
Stage 2	-	-	-	-	707	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.1	10.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	699	-	-	1207	-
HCM Lane V/C Ratio	0.011	-	-	0.004	-
HCM Control Delay (s)	10.2	-	-	8	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-

Intersection	
Int Delay, s/veh	0.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	11	288	300	7	11	15
Future Vol, veh/h	11	288	300	7	11	15
Conflicting Peds, #/hr	10	0	0	10	4	32
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	313	326	8	12	16

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	344	0	-	0	681	372
Stage 1	-	-	-	-	340	-
Stage 2	-	-	-	-	341	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1215	-	-	-	416	674
Stage 1	-	-	-	-	721	-
Stage 2	-	-	-	-	720	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1203	-	-	-	403	647
Mov Cap-2 Maneuver	-	-	-	-	403	-
Stage 1	-	-	-	-	705	-
Stage 2	-	-	-	-	713	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	12.4
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1203	-	-	-	515
HCM Lane V/C Ratio	0.01	-	-	-	0.055
HCM Control Delay (s)	8	0	-	-	12.4
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.2

Intersection	
Int Delay, s/veh	8.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	1	6	288	15	4	0	317	0	26	0	0	0
Future Vol, veh/h	1	6	288	15	4	0	317	0	26	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	7	313	16	4	0	345	0	28	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	707	719	1	709	705	14	1	0	0	28	0	0
Stage 1	1	1	-	704	704	-	-	-	-	-	-	-
Stage 2	706	718	-	5	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	350	354	1084	349	361	1066	1622	-	-	1585	-	-
Stage 1	1022	895	-	428	440	-	-	-	-	-	-	-
Stage 2	427	433	-	1017	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	288	277	1084	203	283	1066	1622	-	-	1585	-	-
Mov Cap-2 Maneuver	288	277	-	203	283	-	-	-	-	-	-	-
Stage 1	800	895	-	335	345	-	-	-	-	-	-	-
Stage 2	330	339	-	718	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.6	23.4	7.2	0
HCM LOS	A	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1110	216	1585	-	-
HCM Lane V/C Ratio	0.212	-	-	0.289	0.096	-	-	-
HCM Control Delay (s)	7.8	0	-	9.6	23.4	0	-	-
HCM Lane LOS	A	A	-	A	C	A	-	-
HCM 95th %tile Q(veh)	0.8	-	-	1.2	0.3	0	-	-

Queues
1: SH 93 & SH 170

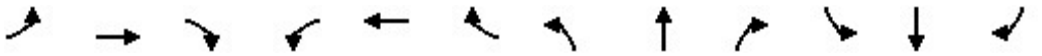
2023 FUTURE BUILD AM
08/11/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	67	25	73	162	8	1040	303	83	489	41
v/c Ratio	0.31	0.08	0.32	0.47	0.01	0.64	0.36	0.27	0.26	0.05
Control Delay	46.3	0.5	45.4	11.6	11.3	26.2	9.5	13.4	15.3	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.3	0.5	45.4	11.6	11.3	26.2	9.5	13.4	15.3	0.1
Queue Length 50th (ft)	40	0	44	0	2	287	42	23	84	0
Queue Length 95th (ft)	88	0	91	59	10	421	121	52	170	0
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	278	357	765	768	596	1625	834	325	1861	873
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.07	0.10	0.21	0.01	0.64	0.36	0.26	0.26	0.05

Intersection Summary

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2023 FUTURE BUILD AM
08/11/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	43	18	23	54	13	149	7	957	279	76	450	38
Future Volume (veh/h)	43	18	23	54	13	149	7	957	279	76	450	38
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1841	1841	1841	1856	1856	1856	1885	1885	1885	1841	1841	1841
Adj Flow Rate, veh/h	47	20	25	59	14	162	8	1040	303	83	489	41
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
Percent Heavy Veh, %	4	4	4	3	3	3	1	1	1	4	4	4
Cap, veh/h	95	40	118	214	51	233	455	1532	682	279	1695	755
Arrive On Green	0.08	0.08	0.08	0.15	0.15	0.15	0.02	0.43	0.43	0.07	0.48	0.48
Sat Flow, veh/h	1247	531	1554	1441	342	1569	1795	3582	1596	1753	3497	1558
Grp Volume(v), veh/h	67	0	25	73	0	162	8	1040	303	83	489	41
Grp Sat Flow(s),veh/h/ln	1778	0	1554	1783	0	1569	1795	1791	1596	1753	1749	1558
Q Serve(g_s), s	3.6	0.0	1.5	3.6	0.0	9.6	0.2	23.0	13.2	2.3	8.2	1.4
Cycle Q Clear(g_c), s	3.6	0.0	1.5	3.6	0.0	9.6	0.2	23.0	13.2	2.3	8.2	1.4
Prop In Lane	0.70		1.00	0.81		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	135	0	118	265	0	233	455	1532	682	279	1695	755
V/C Ratio(X)	0.50	0.00	0.21	0.28	0.00	0.69	0.02	0.68	0.44	0.30	0.29	0.05
Avail Cap(c_a), veh/h	272	0	237	744	0	655	609	1532	682	329	1695	755
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.6	0.0	42.6	37.1	0.0	39.7	15.3	22.7	19.9	15.8	15.2	13.4
Incr Delay (d2), s/veh	9.9	0.0	3.2	2.0	0.0	12.7	0.0	2.4	2.1	0.6	0.4	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	0.0	0.7	1.7	0.0	4.5	0.1	9.3	4.9	0.9	3.1	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	53.5	0.0	45.8	39.1	0.0	52.3	15.3	25.1	21.9	16.4	15.6	13.5
LnGrp LOS	D	A	D	D	A	D	B	C	C	B	B	B
Approach Vol, veh/h		92			235			1351			613	
Approach Delay, s/veh		51.4			48.2			24.3			15.6	
Approach LOS		D			D			C			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.2	50.0		14.5	6.6	55.6		21.6				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	42.0		15.0	10.0	42.0		41.0				
Max Q Clear Time (g_c+I1), s	4.3	25.0		5.6	2.2	10.2		11.6				
Green Ext Time (p_c), s	0.1	15.3		0.5	0.0	12.2		2.8				

Intersection Summary			
HCM 6th Ctrl Delay		25.5	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	15	330	17	10	175	16	12	0	7	3	0	20
Future Vol, veh/h	15	330	17	10	175	16	12	0	7	3	0	20
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	359	18	11	190	17	13	0	8	3	0	22

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	209	0	0	377	0	0	642	631	368	627	632	211
Stage 1	-	-	-	-	-	-	400	400	-	223	223	-
Stage 2	-	-	-	-	-	-	242	231	-	404	409	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1362	-	-	1181	-	-	387	398	677	396	398	829
Stage 1	-	-	-	-	-	-	626	602	-	780	719	-
Stage 2	-	-	-	-	-	-	762	713	-	623	596	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1359	-	-	1181	-	-	366	387	677	383	387	820
Mov Cap-2 Maneuver	-	-	-	-	-	-	366	387	-	383	387	-
Stage 1	-	-	-	-	-	-	617	593	-	767	710	-
Stage 2	-	-	-	-	-	-	727	704	-	607	587	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.4	13.6	10.2
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	441	1359	-	-	1181	-	-	714
HCM Lane V/C Ratio	0.047	0.012	-	-	0.009	-	-	0.035
HCM Control Delay (s)	13.6	7.7	0	-	8.1	0	-	10.2
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.1

Intersection	
Int Delay, s/veh	9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	1	339	11	2	0	199	0	14	0	0	0
Future Vol, veh/h	0	1	339	11	2	0	199	0	14	0	0	0
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1	368	12	2	0	216	0	15	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	444	448	1	442	441	10	1	0	0	15	0	0
Stage 1	1	1	-	440	440	-	-	-	-	-	-	-
Stage 2	443	447	-	2	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	524	506	1084	526	510	1071	1622	-	-	1603	-	-
Stage 1	1022	895	-	596	578	-	-	-	-	-	-	-
Stage 2	594	573	-	1021	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	467	438	1084	311	441	1069	1622	-	-	1603	-	-
Mov Cap-2 Maneuver	467	438	-	311	441	-	-	-	-	-	-	-
Stage 1	884	895	-	516	500	-	-	-	-	-	-	-
Stage 2	511	496	-	673	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10	16.5	7.1	0
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1087	326	1603	-	-
HCM Lane V/C Ratio	0.133	-	-	0.34	0.043	-	-	-
HCM Control Delay (s)	7.6	0	-	10	16.5	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.5	-	-	1.5	0.1	0	-	-

Queues
1: SH 93 & SH 170

2023 FUTURE BUILD PM
08/20/2023

Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	74	41	364	96	15	602	167	179	1076	60
v/c Ratio	0.39	0.14	0.76	0.18	0.06	0.48	0.25	0.47	0.69	0.08
Control Delay	60.6	1.0	52.1	2.5	21.0	34.7	5.9	25.0	34.8	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.6	1.0	52.1	2.5	21.0	34.7	5.9	25.0	34.8	0.2
Queue Length 50th (ft)	58	0	274	0	6	208	0	84	360	0
Queue Length 95th (ft)	113	0	392	15	21	291	52	149	#611	0
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	230	320	623	643	264	1267	674	388	1566	757
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.13	0.58	0.15	0.06	0.48	0.25	0.46	0.69	0.08

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2023 FUTURE BUILD PM
08/20/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	32	36	38	300	35	88	14	554	154	165	990	55
Future Volume (veh/h)	32	36	38	300	35	88	14	554	154	165	990	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1885	1885	1885	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	35	39	41	326	38	96	15	602	167	179	1076	60
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
Percent Heavy Veh, %	2	2	2	1	1	1	1	1	1	1	1	1
Cap, veh/h	59	65	108	410	48	405	193	1310	584	369	1492	665
Arrive On Green	0.07	0.07	0.07	0.25	0.25	0.25	0.03	0.37	0.37	0.08	0.42	0.42
Sat Flow, veh/h	864	963	1585	1616	188	1598	1795	3582	1595	1795	3582	1596
Grp Volume(v), veh/h	74	0	41	364	0	96	15	602	167	179	1076	60
Grp Sat Flow(s),veh/h/ln	1827	0	1585	1804	0	1598	1795	1791	1595	1795	1791	1596
Q Serve(g_s), s	4.5	0.0	2.8	21.7	0.0	5.5	0.6	14.7	8.5	6.9	28.8	2.6
Cycle Q Clear(g_c), s	4.5	0.0	2.8	21.7	0.0	5.5	0.6	14.7	8.5	6.9	28.8	2.6
Prop In Lane	0.47		1.00	0.90		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	124	0	108	458	0	405	193	1310	584	369	1492	665
V/C Ratio(X)	0.60	0.00	0.38	0.79	0.00	0.24	0.08	0.46	0.29	0.48	0.72	0.09
Avail Cap(c_a), veh/h	239	0	207	644	0	571	302	1310	584	387	1492	665
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.0	0.0	51.2	40.0	0.0	34.0	23.7	27.8	25.8	20.2	27.9	20.3
Incr Delay (d2), s/veh	15.5	0.0	7.9	11.1	0.0	1.1	0.2	1.2	1.2	1.0	3.0	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.6	0.0	1.4	10.9	0.0	2.3	0.2	6.2	3.3	2.8	12.2	1.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	67.5	0.0	59.1	51.1	0.0	35.1	23.9	28.9	27.0	21.2	31.0	20.6
LnGrp LOS	E	A	E	D	A	D	C	C	C	C	C	C
Approach Vol, veh/h		115			460			784			1315	
Approach Delay, s/veh		64.5			47.8			28.4			29.2	
Approach LOS		E			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	13.9	50.0		14.8	8.0	55.8		36.1				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	42.0		15.0	10.0	42.0		41.0				
Max Q Clear Time (g_c+I1), s	8.9	16.7		6.5	2.6	30.8		23.7				
Green Ext Time (p_c), s	0.1	14.8		0.6	0.0	9.9		5.5				

Intersection Summary			
HCM 6th Ctrl Delay		33.7	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	14	321	10	0	389	9	2	0	3	4	0	15
Future Vol, veh/h	14	321	10	0	389	9	2	0	3	4	0	15
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	5
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	349	11	0	423	10	2	0	3	4	0	16

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	434	0	0	360	0	0	826	819	355	815	819	434
Stage 1	-	-	-	-	-	-	385	385	-	429	429	-
Stage 2	-	-	-	-	-	-	441	434	-	386	390	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1126	-	-	1199	-	-	291	310	689	296	310	622
Stage 1	-	-	-	-	-	-	638	611	-	604	584	-
Stage 2	-	-	-	-	-	-	595	581	-	637	608	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1125	-	-	1199	-	-	278	304	689	290	304	618
Mov Cap-2 Maneuver	-	-	-	-	-	-	278	304	-	290	304	-
Stage 1	-	-	-	-	-	-	627	601	-	593	583	-
Stage 2	-	-	-	-	-	-	577	580	-	623	598	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0	13.4	12.5
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	433	1125	-	-	1199	-	-	499
HCM Lane V/C Ratio	0.013	0.014	-	-	-	-	-	0.041
HCM Control Delay (s)	13.4	8.2	0	-	0	-	-	12.5
HCM Lane LOS	B	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0	0	-	-	0	-	-	0.1

Intersection	
Int Delay, s/veh	8.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	3	325	7	3	0	394	3	25	0	0	1
Future Vol, veh/h	0	3	325	7	3	0	394	3	25	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	3	353	8	3	0	428	3	27	0	0	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	875	887	1	875	874	17	1	0	0	30	0	0
Stage 1	1	1	-	873	873	-	-	-	-	-	-	-
Stage 2	874	886	-	2	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	270	283	1084	270	288	1062	1622	-	-	1583	-	-
Stage 1	1022	895	-	345	368	-	-	-	-	-	-	-
Stage 2	344	363	-	1021	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	211	207	1084	143	211	1062	1622	-	-	1583	-	-
Mov Cap-2 Maneuver	211	207	-	143	211	-	-	-	-	-	-	-
Stage 1	747	895	-	252	269	-	-	-	-	-	-	-
Stage 2	248	265	-	686	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.9	29.5	7.5	0
HCM LOS	A	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1094	158	1583	-	-
HCM Lane V/C Ratio	0.264	-	-	0.326	0.069	-	-	-
HCM Control Delay (s)	8	0	-	9.9	29.5	0	-	-
HCM Lane LOS	A	A	-	A	D	A	-	-
HCM 95th %tile Q(veh)	1.1	-	-	1.4	0.2	0	-	-

Queues
1: SH 93 & SH 170

2023 FUTURE BUILD WEEKEND
08/20/2023

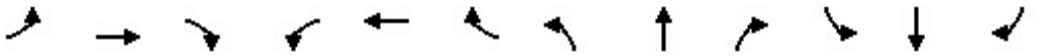
Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	168	43	193	78	51	555	116	59	558	79
v/c Ratio	0.69	0.13	0.58	0.20	0.12	0.41	0.18	0.14	0.42	0.12
Control Delay	63.0	0.8	49.1	1.3	15.8	27.6	4.4	16.0	27.5	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.0	0.8	49.1	1.3	15.8	27.6	4.4	16.0	27.5	1.2
Queue Length 50th (ft)	117	0	129	0	17	153	0	20	155	0
Queue Length 95th (ft)	#238	0	206	2	43	233	33	48	233	7
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	249	336	681	671	436	1338	661	433	1330	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.67	0.13	0.28	0.12	0.12	0.41	0.18	0.14	0.42	0.12

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2023 FUTURE BUILD WEEKEND
08/20/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	78	43	109	82	77	50	549	115	58	552	78
Future Volume (veh/h)	88	78	43	109	82	77	50	549	115	58	552	78
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1841	1841	1841	1826	1826	1826
Adj Flow Rate, veh/h	89	79	43	110	83	78	51	555	116	59	558	79
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	4	4	4	5	5	5
Cap, veh/h	113	100	180	167	126	251	399	1403	610	394	1405	627
Arrive On Green	0.12	0.12	0.12	0.16	0.16	0.16	0.06	0.40	0.40	0.06	0.40	0.40
Sat Flow, veh/h	965	857	1547	1036	782	1552	1753	3497	1520	1739	3469	1547
Grp Volume(v), veh/h	168	0	43	193	0	78	51	555	116	59	558	79
Grp Sat Flow(s),veh/h/ln	1822	0	1547	1819	0	1552	1753	1749	1520	1739	1735	1547
Q Serve(g_s), s	9.4	0.0	2.6	10.4	0.0	4.6	1.7	11.8	5.2	2.0	11.9	3.4
Cycle Q Clear(g_c), s	9.4	0.0	2.6	10.4	0.0	4.6	1.7	11.8	5.2	2.0	11.9	3.4
Prop In Lane	0.53		1.00	0.57		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	213	0	180	294	0	251	399	1403	610	394	1405	627
V/C Ratio(X)	0.79	0.00	0.24	0.66	0.00	0.31	0.13	0.40	0.19	0.15	0.40	0.13
Avail Cap(c_a), veh/h	261	0	222	712	0	608	463	1403	610	451	1405	627
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.0	0.0	42.0	41.2	0.0	38.7	16.4	22.3	20.3	16.3	22.1	19.5
Incr Delay (d2), s/veh	22.0	0.0	2.4	8.8	0.0	2.5	0.1	0.8	0.7	0.2	0.8	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.5	0.0	1.1	5.4	0.0	1.9	0.7	4.7	1.9	0.7	4.7	1.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	66.9	0.0	44.4	49.9	0.0	41.3	16.5	23.1	21.0	16.5	22.9	19.9
LnGrp LOS	E	A	D	D	A	D	B	C	C	B	C	B
Approach Vol, veh/h		211			271			722			696	
Approach Delay, s/veh		62.4			47.4			22.3			22.0	
Approach LOS		E			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	11.6	50.0		19.2	11.2	50.4		23.9				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	42.0		15.0	10.0	42.0		41.0				
Max Q Clear Time (g_c+I1), s	4.0	13.8		11.4	3.7	13.9		12.4				
Green Ext Time (p_c), s	0.0	14.1		0.7	0.0	13.6		3.7				

Intersection Summary			
HCM 6th Ctrl Delay		30.2	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	11	225	15	7	238	7	15	0	12	11	0	15
Future Vol, veh/h	11	225	15	7	238	7	15	0	12	11	0	15
Conflicting Peds, #/hr	10	0	0	0	0	10	0	0	0	4	0	32
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	12	245	16	8	259	8	16	0	13	12	0	16

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	277	0	0	261	0	0	596	570	257	577	574	305
Stage 1	-	-	-	-	-	-	277	277	-	289	289	-
Stage 2	-	-	-	-	-	-	319	293	-	288	285	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1286	-	-	1303	-	-	415	431	782	428	429	735
Stage 1	-	-	-	-	-	-	729	681	-	719	673	-
Stage 2	-	-	-	-	-	-	693	670	-	720	676	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1274	-	-	1303	-	-	388	419	779	410	417	706
Mov Cap-2 Maneuver	-	-	-	-	-	-	388	419	-	410	417	-
Stage 1	-	-	-	-	-	-	721	674	-	705	662	-
Stage 2	-	-	-	-	-	-	652	659	-	697	669	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.2	12.7	12
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	499	1274	-	-	1303	-	-	541
HCM Lane V/C Ratio	0.059	0.009	-	-	0.006	-	-	0.052
HCM Control Delay (s)	12.7	7.9	0	-	7.8	0	-	12
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.2	0	-	-	0	-	-	0.2

Intersection	
Int Delay, s/veh	8.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	1	5	237	15	4	0	259	0	21	0	0	0
Future Vol, veh/h	1	5	237	15	4	0	259	0	21	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	5	258	16	4	0	282	0	23	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	579	588	1	580	577	12	1	0	0	23	0	0
Stage 1	1	1	-	576	576	-	-	-	-	-	-	-
Stage 2	578	587	-	4	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	426	421	1084	426	427	1069	1622	-	-	1592	-	-
Stage 1	1022	895	-	503	502	-	-	-	-	-	-	-
Stage 2	501	497	-	1018	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	365	346	1084	277	351	1069	1622	-	-	1592	-	-
Mov Cap-2 Maneuver	365	346	-	277	351	-	-	-	-	-	-	-
Stage 1	841	895	-	414	413	-	-	-	-	-	-	-
Stage 2	408	409	-	771	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.2	18.4	7.1	0
HCM LOS	A	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1111	290	1592	-	-
HCM Lane V/C Ratio	0.174	-	-	0.238	0.071	-	-	-
HCM Control Delay (s)	7.7	0	-	9.2	18.4	0	-	-
HCM Lane LOS	A	A	-	A	C	A	-	-
HCM 95th %tile Q(veh)	0.6	-	-	0.9	0.2	0	-	-

Queues
1: SH 93 & SH 170

2043 FUTURE BUILD AM
08/11/2023

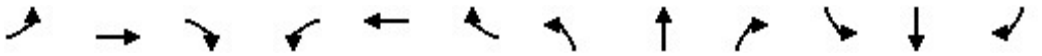
Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	81	30	90	200	9	1248	363	99	587	50
v/c Ratio	0.37	0.10	0.37	0.51	0.02	0.83	0.46	0.43	0.32	0.06
Control Delay	48.5	0.6	46.0	10.9	12.2	34.3	13.0	19.4	16.7	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	48.5	0.6	46.0	10.9	12.2	34.3	13.0	19.4	16.7	0.1
Queue Length 50th (ft)	50	0	56	0	3	392	73	29	110	0
Queue Length 95th (ft)	104	0	108	64	11	#606	177	71	214	0
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	265	346	727	761	544	1503	786	251	1855	871
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.09	0.12	0.26	0.02	0.83	0.46	0.39	0.32	0.06

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2043 FUTURE BUILD AM
08/11/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	52	22	28	67	16	184	8	1148	334	91	540	46
Future Volume (veh/h)	52	22	28	67	16	184	8	1148	334	91	540	46
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1841	1841	1841	1856	1856	1856	1885	1885	1885	1841	1841	1841
Adj Flow Rate, veh/h	57	24	30	73	17	200	9	1248	363	99	587	50
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
Percent Heavy Veh, %	4	4	4	3	3	3	1	1	1	4	4	4
Cap, veh/h	95	40	118	253	59	275	389	1472	656	229	1633	728
Arrive On Green	0.08	0.08	0.08	0.18	0.18	0.18	0.02	0.41	0.41	0.07	0.47	0.47
Sat Flow, veh/h	1251	527	1554	1446	337	1570	1795	3582	1596	1753	3497	1558
Grp Volume(v), veh/h	81	0	30	90	0	200	9	1248	363	99	587	50
Grp Sat Flow(s),veh/h/ln	1778	0	1554	1783	0	1570	1795	1791	1596	1753	1749	1558
Q Serve(g_s), s	4.5	0.0	1.9	4.5	0.0	12.3	0.3	32.2	17.7	3.0	11.0	1.8
Cycle Q Clear(g_c), s	4.5	0.0	1.9	4.5	0.0	12.3	0.3	32.2	17.7	3.0	11.0	1.8
Prop In Lane	0.70		1.00	0.81		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	135	0	118	312	0	275	389	1472	656	229	1633	728
V/C Ratio(X)	0.60	0.00	0.25	0.29	0.00	0.73	0.02	0.85	0.55	0.43	0.36	0.07
Avail Cap(c_a), veh/h	261	0	228	716	0	630	533	1472	656	272	1633	728
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	45.7	0.0	44.5	36.6	0.0	39.8	16.9	27.2	22.9	21.3	17.4	15.0
Incr Delay (d2), s/veh	14.5	0.0	4.0	1.8	0.0	12.5	0.0	6.2	3.3	1.3	0.6	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.0	0.8	2.1	0.0	5.7	0.1	13.9	6.8	1.2	4.2	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	60.2	0.0	48.5	38.4	0.0	52.3	16.9	33.4	26.3	22.6	18.1	15.2
LnGrp LOS	E	A	D	D	A	D	B	C	C	C	B	B
Approach Vol, veh/h		111			290			1620			736	
Approach Delay, s/veh		57.1			48.0			31.7			18.5	
Approach LOS		E			D			C			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.5	50.0		14.8	6.8	55.7		24.9				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	42.0		15.0	10.0	42.0		41.0				
Max Q Clear Time (g_c+I1), s	5.0	34.2		6.5	2.3	13.0		14.3				
Green Ext Time (p_c), s	0.1	7.6		0.6	0.0	14.0		3.4				

Intersection Summary			
HCM 6th Ctrl Delay		30.9	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	15	410	17	10	218	16	12	0	7	3	0	20
Future Vol, veh/h	15	410	17	10	218	16	12	0	7	3	0	20
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	10
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	446	18	11	237	17	13	0	8	3	0	22

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	256	0	0	464	0	0	776	765	455	761	766	258
Stage 1	-	-	-	-	-	-	487	487	-	270	270	-
Stage 2	-	-	-	-	-	-	289	278	-	491	496	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1309	-	-	1097	-	-	315	333	605	322	333	781
Stage 1	-	-	-	-	-	-	562	550	-	736	686	-
Stage 2	-	-	-	-	-	-	719	680	-	559	545	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1307	-	-	1097	-	-	296	323	605	310	323	772
Mov Cap-2 Maneuver	-	-	-	-	-	-	296	323	-	310	323	-
Stage 1	-	-	-	-	-	-	552	541	-	722	676	-
Stage 2	-	-	-	-	-	-	684	670	-	543	536	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.3	15.5	10.8
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	365	1307	-	-	1097	-	-	646
HCM Lane V/C Ratio	0.057	0.012	-	-	0.01	-	-	0.039
HCM Control Delay (s)	15.5	7.8	0	-	8.3	0	-	10.8
HCM Lane LOS	C	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.2	0	-	-	0	-	-	0.1

Intersection	
Int Delay, s/veh	9.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	0	1	420	11	2	0	246	0	17	0	0	0
Future Vol, veh/h	0	1	420	11	2	0	246	0	17	0	0	0
Conflicting Peds, #/hr	2	0	0	0	0	2	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1	457	12	2	0	267	0	18	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	547	553	1	545	544	11	1	0	0	18	0	0
Stage 1	1	1	-	543	543	-	-	-	-	-	-	-
Stage 2	546	552	-	2	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	448	441	1084	449	446	1070	1622	-	-	1599	-	-
Stage 1	1022	895	-	524	520	-	-	-	-	-	-	-
Stage 2	522	515	-	1021	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	388	367	1084	226	372	1068	1622	-	-	1599	-	-
Mov Cap-2 Maneuver	388	367	-	226	372	-	-	-	-	-	-	-
Stage 1	851	895	-	436	433	-	-	-	-	-	-	-
Stage 2	432	429	-	590	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.7	20.9	7.2	0
HCM LOS	B	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1087	241	1599	-	-
HCM Lane V/C Ratio	0.165	-	-	0.421	0.059	-	-	-
HCM Control Delay (s)	7.7	0	-	10.7	20.9	0	-	-
HCM Lane LOS	A	A	-	B	C	A	-	-
HCM 95th %tile Q(veh)	0.6	-	-	2.1	0.2	0	-	-

Queues
1: SH 93 & SH 170

2043 FUTURE BUILD PM
08/20/2023

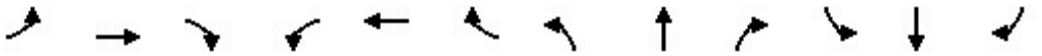
Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	88	50	451	118	18	723	200	215	1291	72
v/c Ratio	0.47	0.18	0.86	0.21	0.11	0.63	0.31	0.73	0.91	0.10
Control Delay	64.7	1.3	61.4	4.5	22.6	41.3	7.1	40.6	48.1	0.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.7	1.3	61.4	4.5	22.6	41.3	7.1	40.6	48.1	0.3
Queue Length 50th (ft)	73	0	367	0	9	287	8	117	529	0
Queue Length 95th (ft)	130	0	#536	33	24	357	65	#207	#817	1
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	209	303	566	597	194	1151	642	293	1425	701
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.17	0.80	0.20	0.09	0.63	0.31	0.73	0.91	0.10

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2043 FUTURE BUILD PM
08/20/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	43	46	372	43	109	17	665	184	198	1188	66
Future Volume (veh/h)	38	43	46	372	43	109	17	665	184	198	1188	66
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1885	1885	1885	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	41	47	50	404	47	118	18	723	200	215	1291	72
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
Percent Heavy Veh, %	2	2	2	1	1	1	1	1	1	1	1	1
Cap, veh/h	58	67	108	470	55	464	132	1221	544	311	1405	626
Arrive On Green	0.07	0.07	0.07	0.29	0.29	0.29	0.03	0.34	0.34	0.08	0.39	0.39
Sat Flow, veh/h	852	976	1585	1616	188	1598	1795	3582	1595	1795	3582	1596
Grp Volume(v), veh/h	88	0	50	451	0	118	18	723	200	215	1291	72
Grp Sat Flow(s),veh/h/ln	1828	0	1585	1804	0	1598	1795	1791	1595	1795	1791	1596
Q Serve(g_s), s	5.8	0.0	3.7	29.1	0.0	7.0	0.8	20.5	11.6	9.4	42.2	3.5
Cycle Q Clear(g_c), s	5.8	0.0	3.7	29.1	0.0	7.0	0.8	20.5	11.6	9.4	42.2	3.5
Prop In Lane	0.47		1.00	0.90		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	125	0	108	524	0	464	132	1221	544	311	1405	626
V/C Ratio(X)	0.71	0.00	0.46	0.86	0.00	0.25	0.14	0.59	0.37	0.69	0.92	0.12
Avail Cap(c_a), veh/h	223	0	193	600	0	532	224	1221	544	311	1405	626
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.2	0.0	55.2	41.3	0.0	33.5	30.1	33.5	30.6	25.3	35.6	23.8
Incr Delay (d2), s/veh	23.2	0.0	10.8	15.2	0.0	1.0	0.5	2.1	1.9	6.5	11.1	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.5	0.0	1.8	15.1	0.0	2.9	0.3	9.0	4.6	4.4	19.6	1.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	79.4	0.0	66.0	56.5	0.0	34.5	30.6	35.6	32.5	31.7	46.7	24.2
LnGrp LOS	E	A	E	E	A	C	C	D	C	C	D	C
Approach Vol, veh/h		138			569			941			1578	
Approach Delay, s/veh		74.6			52.0			34.9			43.6	
Approach LOS		E			D			C			D	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	15.0	50.0		15.4	8.7	56.3		42.8				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	42.0		15.0	10.0	42.0		41.0				
Max Q Clear Time (g_c+I1), s	11.4	22.5		7.8	2.8	44.2		31.1				
Green Ext Time (p_c), s	0.0	14.0		0.7	0.0	0.0		4.7				

Intersection Summary			
HCM 6th Ctrl Delay		43.9	
HCM 6th LOS		D	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	14	399	10	0	482	9	2	0	3	4	0	15
Future Vol, veh/h	14	399	10	0	482	9	2	0	3	4	0	15
Conflicting Peds, #/hr	1	0	0	0	0	1	0	0	0	0	0	5
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	434	11	0	524	10	2	0	3	4	0	16

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	535	0	0	445	0	0	1012	1005	440	1001	1005	535
Stage 1	-	-	-	-	-	-	470	470	-	530	530	-
Stage 2	-	-	-	-	-	-	542	535	-	471	475	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1033	-	-	1115	-	-	218	241	617	222	241	545
Stage 1	-	-	-	-	-	-	574	560	-	533	527	-
Stage 2	-	-	-	-	-	-	525	524	-	573	557	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1032	-	-	1115	-	-	207	236	617	217	236	542
Mov Cap-2 Maneuver	-	-	-	-	-	-	207	236	-	217	236	-
Stage 1	-	-	-	-	-	-	563	549	-	522	526	-
Stage 2	-	-	-	-	-	-	507	523	-	559	546	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0	15.6	14.2
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	344	1032	-	-	1115	-	-	412
HCM Lane V/C Ratio	0.016	0.015	-	-	-	-	-	0.05
HCM Control Delay (s)	15.6	8.5	0	-	0	-	-	14.2
HCM Lane LOS	C	A	A	-	A	-	-	B
HCM 95th %tile Q(veh)	0	0	-	-	0	-	-	0.2

Intersection	
Int Delay, s/veh	9.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		⇕			⇕			⇕			⇕	
Traffic Vol, veh/h	0	4	403	7	3	0	489	4	31	0	0	1
Future Vol, veh/h	0	4	403	7	3	0	489	4	31	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	4	438	8	3	0	532	4	34	0	0	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1088	1103	1	1088	1086	21	1	0	0	38	0	0
Stage 1	1	1	-	1085	1085	-	-	-	-	-	-	-
Stage 2	1087	1102	-	3	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	193	211	1084	193	216	1056	1622	-	-	1572	-	-
Stage 1	1022	895	-	262	293	-	-	-	-	-	-	-
Stage 2	262	287	-	1020	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	140	140	1084	83	143	1056	1622	-	-	1572	-	-
Mov Cap-2 Maneuver	140	140	-	83	143	-	-	-	-	-	-	-
Stage 1	679	895	-	174	195	-	-	-	-	-	-	-
Stage 2	171	191	-	605	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	10.5	47.7	7.7	0
HCM LOS	B	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1095	95	1572	-	-
HCM Lane V/C Ratio	0.328	-	-	0.404	0.114	-	-	-
HCM Control Delay (s)	8.3	0	-	10.5	47.7	0	-	-
HCM Lane LOS	A	A	-	B	E	A	-	-
HCM 95th %tile Q(veh)	1.4	-	-	2	0.4	0	-	-

Queues
1: SH 93 & SH 170

2043 FUTURE BUILD WEEKEND
08/20/2023

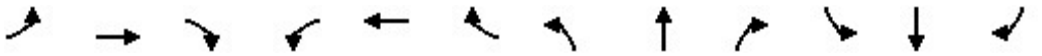
Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	201	53	238	96	61	666	138	70	669	95
v/c Ratio	0.84	0.16	0.63	0.22	0.18	0.52	0.21	0.20	0.52	0.15
Control Delay	78.7	1.1	49.5	3.1	18.1	31.4	5.7	18.4	31.5	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	78.7	1.1	49.5	3.1	18.1	31.4	5.7	18.4	31.5	2.5
Queue Length 50th (ft)	149	0	164	0	23	204	0	26	205	0
Queue Length 95th (ft)	#321	0	252	17	53	304	46	60	307	19
Internal Link Dist (ft)	1141		109			363			385	
Turn Bay Length (ft)		55			205		205	320		325
Base Capacity (vph)	240	329	657	652	366	1291	648	362	1281	654
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.84	0.16	0.36	0.15	0.17	0.52	0.21	0.19	0.52	0.15

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary
1: SH 93 & SH 170

2043 FUTURE BUILD WEEKEND
08/20/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	106	93	52	135	101	95	60	659	137	69	662	94
Future Volume (veh/h)	106	93	52	135	101	95	60	659	137	69	662	94
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1841	1841	1841	1826	1826	1826
Adj Flow Rate, veh/h	107	94	53	136	102	96	61	666	138	70	669	95
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Percent Heavy Veh, %	2	2	2	2	2	2	4	4	4	5	5	5
Cap, veh/h	125	110	199	193	145	289	333	1323	575	329	1321	589
Arrive On Green	0.13	0.13	0.13	0.19	0.19	0.19	0.06	0.38	0.38	0.06	0.38	0.38
Sat Flow, veh/h	970	852	1549	1039	779	1554	1753	3497	1520	1739	3469	1547
Grp Volume(v), veh/h	201	0	53	238	0	96	61	666	138	70	669	95
Grp Sat Flow(s),veh/h/ln	1822	0	1549	1818	0	1554	1753	1749	1520	1739	1735	1547
Q Serve(g_s), s	12.0	0.0	3.4	13.6	0.0	5.9	2.2	16.2	6.9	2.6	16.4	4.5
Cycle Q Clear(g_c), s	12.0	0.0	3.4	13.6	0.0	5.9	2.2	16.2	6.9	2.6	16.4	4.5
Prop In Lane	0.53		1.00	0.57		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	234	0	199	339	0	289	333	1323	575	329	1321	589
V/C Ratio(X)	0.86	0.00	0.27	0.70	0.00	0.33	0.18	0.50	0.24	0.21	0.51	0.16
Avail Cap(c_a), veh/h	246	0	209	671	0	574	384	1323	575	375	1321	589
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	47.4	0.0	43.6	42.3	0.0	39.2	19.4	26.5	23.6	19.3	26.4	22.7
Incr Delay (d2), s/veh	29.2	0.0	2.6	9.3	0.0	2.4	0.3	1.4	1.0	0.3	1.4	0.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.3	0.0	1.5	7.0	0.0	0.2	0.9	6.7	2.5	1.0	6.7	1.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	76.6	0.0	46.2	51.6	0.0	41.6	19.6	27.9	24.6	19.7	27.8	23.3
LnGrp LOS	E	A	D	D	A	D	B	C	C	B	C	C
Approach Vol, veh/h		254			334			865			834	
Approach Delay, s/veh		70.2			48.7			26.8			26.6	
Approach LOS		E			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.1	50.0		21.3	11.8	50.3		27.7				
Change Period (Y+Rc), s	5.0	8.0		7.0	5.0	8.0		7.0				
Max Green Setting (Gmax), s	10.0	42.0		15.0	10.0	42.0		41.0				
Max Q Clear Time (g_c+I1), s	4.6	18.2		14.0	4.2	18.4		15.6				
Green Ext Time (p_c), s	0.0	14.9		0.3	0.0	14.3		4.5				

Intersection Summary			
HCM 6th Ctrl Delay		34.7	
HCM 6th LOS		C	

Notes

User approved pedestrian interval to be less than phase max green.

Intersection	
Int Delay, s/veh	1.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	11	281	15	7	296	7	15	0	12	11	0	15
Future Vol, veh/h	11	281	15	7	296	7	15	0	12	11	0	15
Conflicting Peds, #/hr	10	0	0	0	0	10	0	0	0	4	0	32
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	12	305	16	8	322	8	16	0	13	12	0	16

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	340	0	0	321	0	0	719	693	317	700	697	368
Stage 1	-	-	-	-	-	-	337	337	-	352	352	-
Stage 2	-	-	-	-	-	-	382	356	-	348	345	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1219	-	-	1239	-	-	344	367	724	354	365	677
Stage 1	-	-	-	-	-	-	677	641	-	665	632	-
Stage 2	-	-	-	-	-	-	640	629	-	668	636	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1207	-	-	1239	-	-	320	356	721	338	354	650
Mov Cap-2 Maneuver	-	-	-	-	-	-	320	356	-	338	354	-
Stage 1	-	-	-	-	-	-	669	633	-	651	621	-
Stage 2	-	-	-	-	-	-	600	618	-	646	628	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.3	0.2	14.1	13.2
HCM LOS			B	B

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	425	1207	-	-	1239	-	-	467
HCM Lane V/C Ratio	0.069	0.01	-	-	0.006	-	-	0.061
HCM Control Delay (s)	14.1	8	0	-	7.9	0	-	13.2
HCM Lane LOS	B	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.2	0	-	-	0	-	-	0.2

Intersection	
Int Delay, s/veh	8.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	1	6	293	15	4	0	320	0	26	0	0	0
Future Vol, veh/h	1	6	293	15	4	0	320	0	26	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	Yield	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	7	318	16	4	0	348	0	28	0	0	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	713	725	1	715	711	14	1	0	0	28	0	0
Stage 1	1	1	-	710	710	-	-	-	-	-	-	-
Stage 2	712	724	-	5	1	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	347	352	1084	346	358	1066	1622	-	-	1585	-	-
Stage 1	1022	895	-	424	437	-	-	-	-	-	-	-
Stage 2	423	430	-	1017	895	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	285	275	1084	200	280	1066	1622	-	-	1585	-	-
Mov Cap-2 Maneuver	285	275	-	200	280	-	-	-	-	-	-	-
Stage 1	798	895	-	331	341	-	-	-	-	-	-	-
Stage 2	326	336	-	713	895	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.6	23.7	7.2	0
HCM LOS	A	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1622	-	-	1110	213	1585	-	-
HCM Lane V/C Ratio	0.214	-	-	0.294	0.097	-	-	-
HCM Control Delay (s)	7.8	0	-	9.6	23.7	0	-	-
HCM Lane LOS	A	A	-	A	C	A	-	-
HCM 95th %tile Q(veh)	0.8	-	-	1.2	0.3	0	-	-

APPENDIX D

PEDESTRIAN CROSSING WORKSHEETS

Pedestrian Crossing Installation Request Form

Description of Proposed Crossing Location

☐ **Official School Crossing**[1]

State Highway & Milepost:	**Cross Streets** (if applicable)**:**	**Crossing Location:**
CO 170, MP 2.8	N/A	☐ At Intersection ☐ Mid-Block

Nearest Marked and/or Protected Crossing:	**Distance to Proposed Crossing:**
CO 93 and CO 170	450

Pedestrian Traffic Volumes

AM Pedestrian Counts		***Mid-Day Pedestrian Counts***		***PM Pedestrian Counts***	
Peak Hour:	**Pedestrian Volume:**	**Peak Hour:**	**Pedestrian Volume:**	**Peak Hour:**	**Pedestrian Volume:**
7:30-8:30 AM	10	11:15 AM - 12:15 PM (SAT)	36	5:00 -6:00 PM	5

Please provide the names of businesses and/or other traffic generators at or near the proposed crossing location.

This crosswalk provides access from the Eldorado Park-n-Ride Lot (north of CO 170) to the Marshall Mesa Trailhead (south of CO 170)

Pedestrian Crash History

☐ Crash Reports Attached

Please provide a brief description of the pedestrian crash history at this location.

There were no recorded pedestrian crashes from January 2015 through December 2020 at the existing crosswalk location.

Additional Information

Please provide a brief explanation of why the crosswalk is needed.

Pedestrians and bicyclist frequently use existing marked crosswalk to move from the park-n-ride lot to the trailhead. Without a marked crossing, pedestrians and bicyclists are likely to cross at unmarked locations.

Contact Information

Name of Person Requesting:	**Phone Number:**	**Email:**

Street Address:	**State:**	**Zip:**

[1] An official school crossing must be designated by the school.

Appendix B: Pedestrian Crossing Evaluation Worksheet

Location Description

State Highway & Milepost:	Major Street:	Crossing Location:
CO 170, MP 2.8	CO 170	☐ At Intersection ☐ Mid-Block ☐ Roundabout

Existing Traffic Control:	Existing Crossing Treatments (if any):	Speed Limit:
☐ Stop Sign ☐ Traffic Signal ☐ Uncontrolled	Marked Crosswalk	30

Official School Crossing:	Nearby Pedestrian Generators (schools, transit stops, commercial businesses, etc.):
☐ Yes ☐ No	Marshall Mesa Trailhead

Roadway Configuration:

☑ 2-Lane ☐ 3-Lane w/ Striped Median ☐ 3-Lane w/ Raised Median

☐ 4-Lane ☐ 5-Lane w/ Striped Median ☐ 5-Lane w/ Raised Median

☐ 6-Lane ☐ Other: _____

Crossing Distance by Direction:

Total Distance:	40 ft.	
Dist. to Median:	n/a	☐ N ☐ E ☐ S ☐ W ☐ Other ____
Dist. to Median:	n/a	☐ N ☐ E ☐ S ☐ W ☐ Other ____

Stopping Sight Distance (uncontrolled locations only): WB: 240' EB: 200'

Is the SSD ≥ 8x the speed limit? ☐ Yes ☐ No

If no, are improvements to SSD feasible? ☐ Yes ☐ No

Traffic Volumes and Operations

	AM	MID-DAY	PM	OTHER
Start and End Time:	7:30 to 8:30	to	5:00 to 6:00	11:15 to 12:15
Day of Week:	Wednesday		Wednesday	Saturday
No. of Transit Boardings (if applicable):	not counted		not counted	not counted
No. of Young, Elderly, and Disabled Peds (YED):	not counted		not counted	not counted
No. of Bicyclists:	0		0	0
No. of Non YED Pedestrians:	not counted		not counted	not counted
Total Pedestrians (adjusted for 2x YED):	10		5	36

Major Street Vehicle Volume (Daily): 6200 veh/day

Nearest Intersection (Direction #1)

Cross Street Name: CO 93 and CO 170

Located 450 feet to the ☐ N ☐ E ☐ S ☐ W of the crossing location. Signalized? ☑ Yes ☐ No

	AM	MID-DAY	PM	OTHER
How many times per hour did the downstream vehicle queue back up into the pedestrian crossing?	Synchro 95% queue indicates queue does not reach crosswalk	n/a	Synchro 95% queue indicates queue extends through crosswalk	Synchro 95% queue indicates queue does not reach crosswalk
If multiple lanes per direction, are queue lengths approximately equal?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If no, which lane is longer (inside, outside, middle) and by how much?	n/a	n/a	n/a	n/a

Nearest Intersection (Direction #2)

Cross Street Name: CO 170 and Marshall Dr/Eldorado Springs Dr

Located 850 feet to the ☐ N ☐ E ☐ S ☐ W of the crossing location. Signalized? ☐ Yes ☐ No

	AM	MID-DAY	PM	OTHER
How many times per hour did the downstream vehicle queue back up into the pedestrian crossing?	0	0	0	0
If multiple lanes per direction, are queue lengths approximately equal?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
If no, which lane is longer (inside, outside, middle) and by how much?	n/a	n/a	n/a	n/a

Appendix C. Figures and Tables

Figure C1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways

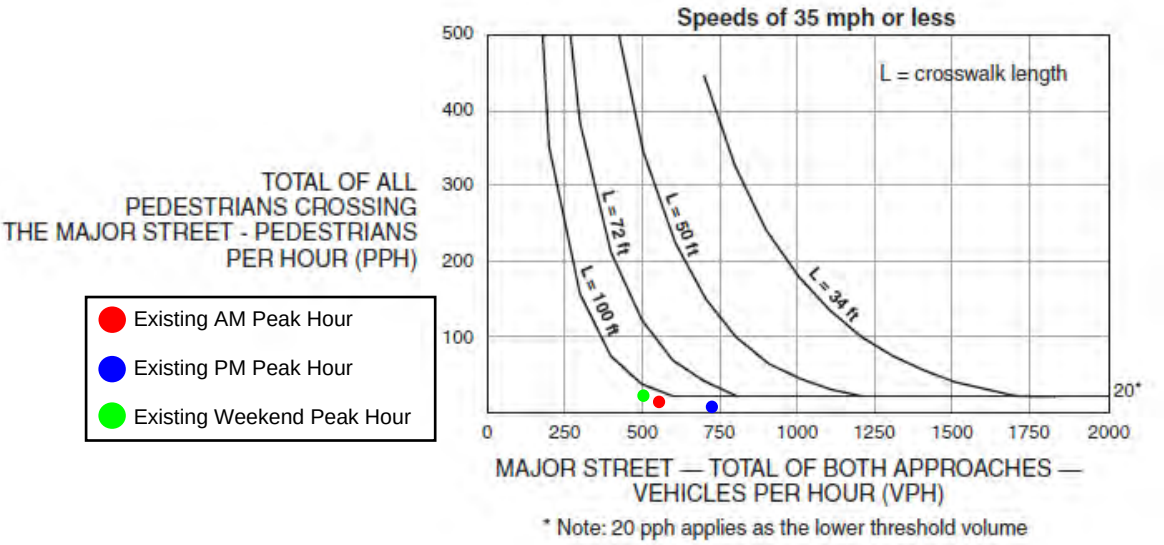


Figure C2. Guidelines for the Installation of Pedestrian Hybrid Beacons on High-Speed Roadways

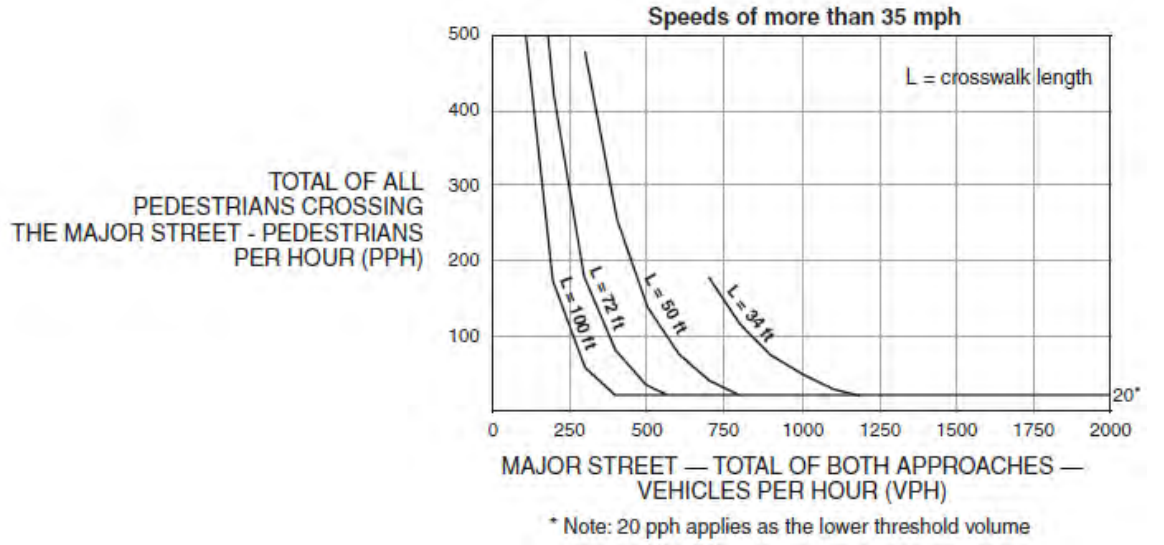
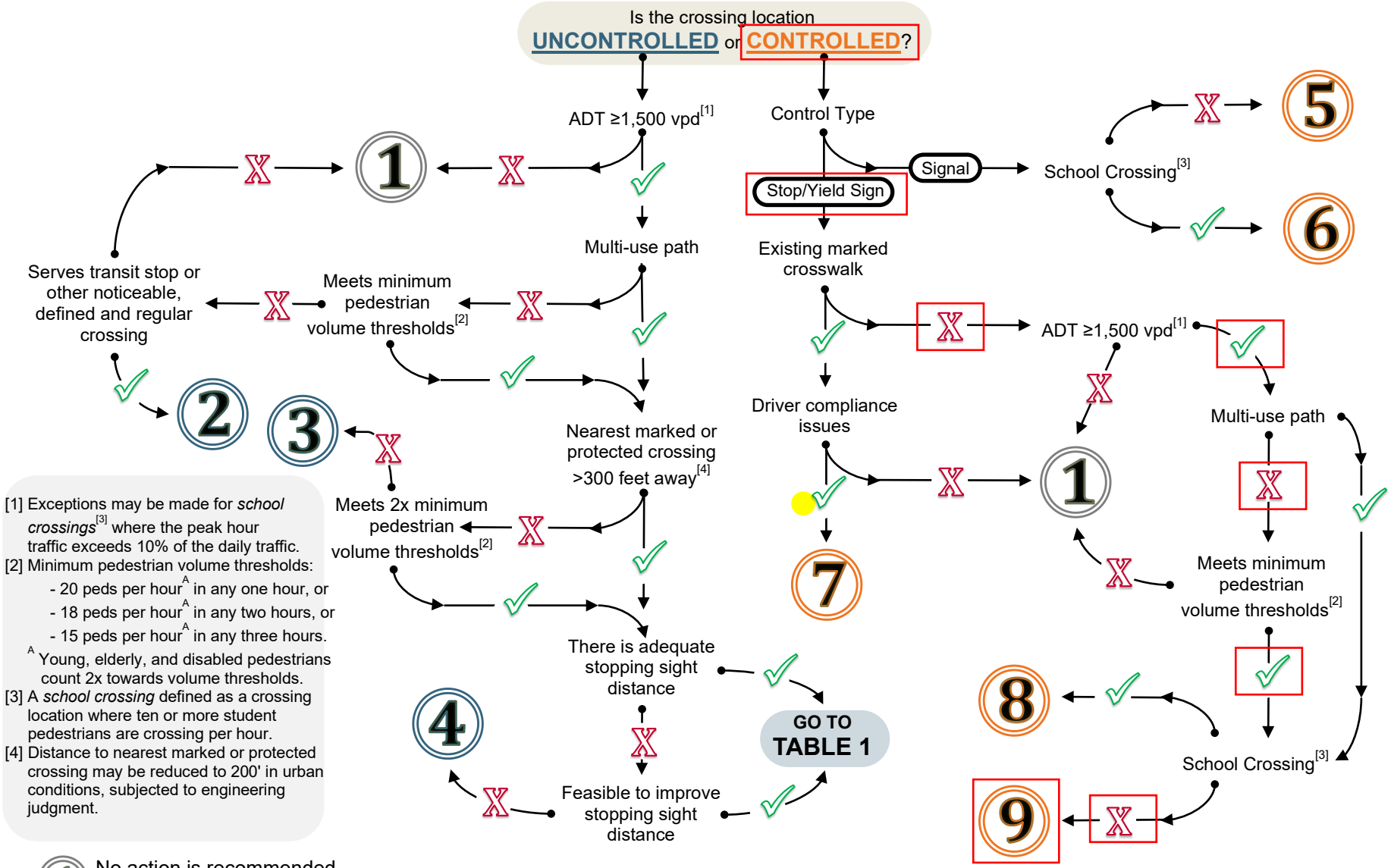


Figure C3. Pedestrian Crossing Evaluation Flowchart



[1] Exceptions may be made for *school crossings*[3] where the peak hour traffic exceeds 10% of the daily traffic.
[2] Minimum pedestrian volume thresholds:
- 20 peds per hour[A] in any one hour, or
- 18 peds per hour[A] in any two hours, or
- 15 peds per hour[A] in any three hours.

[A] Young, elderly, and disabled pedestrians count 2x towards volume thresholds.
[3] A *school crossing* defined as a crossing location where ten or more student pedestrians are crossing per hour.
[4] Distance to nearest marked or protected crossing may be reduced to 200' in urban conditions, subjected to engineering judgment.

1. No action is recommended at this time.
2. Consider installing an unmarked pedestrian crossing facilitation.
3. Direct pedestrians to the nearest marked or protected crossing.
4. Direct pedestrians to the nearest marked or protected crossing, **OR** consider installing a pedestrian hybrid beacon, traffic signal, or grade-separated crossing.
5. Install a marked crosswalk.
6. Install a marked crosswalk with a school crossing sign (S1-1) on a mast arm.
7. Consider neck downs, median refuge, or additional signs to increase drive awareness of pedestrians.
8. Install marked crosswalk with school pedestrian crossing sign (S1-1) and down arrow (16-7p) at the crosswalk plus an advanced (S1-1) signs.
9. Install marked crosswalk with W11-2 advanced pedestrian signs.

Table C1. Criteria for Pedestrian Crossing Treatments at Uncontrolled Locations

The criteria for pedestrian crossing treatments at uncontrolled locations is intended as a general minimum. Engineering judgment should be used on a case-by-case basis. Prevailing speed may be used if significantly different than posted speed.

Roadway Configuration	Roadway ADT and Posted Speed (mph)															
	1,500 – 9,000 vpd				9,001 – 12,000 vpd				12,001 – 15,000 vpd				> 15,000 vpd			
	≤30	35	40	≥45	≤30	35	40	≥45	≤30	35	40	≥45	≤30	35	40	≥45
2 lanes, one-way street	A	B	C	E	A	B	C	E	B	B	C	E	B	C	C	E
2 lanes, two-way street with no median	A	B	C	E	A	B	C	E	B	B	C	E	B	C	C	E
3 lanes with raised median	A	B	D	E	A	C	D	E	B	D	D	E	C	D	D	E
3 lanes without raised median	C	C	D	E	C	C	D	E	C	C	D	E	C	D	D	E
4 lanes with raised median	A	B	C	E	A	B	C	E	B	B	C	E	B	C	C	E
4 lanes, two-way street without raised median	A	D	D	E	B	D	D	E	B	D	D	E	D	D	D	E
5 lanes with raised median	A	B	D	E	B	C	D	E	B	C	D	E	C	C	D	E
5 lanes without raised median	D	D	D	E	D	D	D	E	D	D	D	E	D	D	D	E
6 lanes with or without raised median	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F

Treatment Descriptions:

☐ A. Install marked crosswalk with enhanced roadside signs.

Install a marked crosswalk with a standard W11-2 with a W16-7p plaque mounted on the side of the roadway at the crosswalk location and a standard W11-2 advanced pedestrian warning sign. Use S1-1 signs for school crossing locations. An optional R1-6 may be used in addition.

☐ B. Install marked crosswalk with enhanced roadside and in-roadway signs.

☐ C. Install marked crosswalk with enhanced signs and geometric improvements to increase pedestrian visibility and reduce exposure.

☐ D. Install marked crosswalk with enhanced signs, pedestrian activated RRFBs, and geometric improvements to increase visibility pedestrian and reduce exposure.

☐ E. Do not install marked crosswalk at uncontrolled crossing. Determine if speed limit can effectively be reduced to 40 mph by making geometric or other infrastructure changes (i.e., bulb out, median refuge, etc.). If so, utilize criteria D above. If this is not possible, if pedestrian volume meets warrants, consider a pedestrian hybrid beacon, pedestrian traffic signal, or grade separated crossing.

☐ F. Do not install marked crosswalk at uncontrolled crossings with three (3) or more through lanes per direction or where the speed limit is greater or equal to 45 mph and/or there is not a median refuge on a 5-lane crossing. Consider pedestrian hybrid beacon, pedestrian traffic signal, or separated crossing.

City of Boulder Pedestrian Crossing Treatment Installation Guidelines

Crossing Location Evaluation Worksheet

Rev. 11/2/11

STEP 1 - LOCATION DESCRIPTION

Major Street: SH 170 Crossing Location: 450' east of SH 93

Is this a multi-use path crossing? ☐ Yes ☒ No Posted Speed Limit: 30 mph

Existing Traffic Control: ☐ Stop Sign ☐ Traffic Signal ☒ Uncontrolled

Existing Crossing Treatments (if any): Marked crosswalk

Nearby Pedestrian Generators (School, transit stop, commercial, etc.):

This crosswalk provides access from the Eldorado Park-n-Ride Lot (north of CO 170) to the Marshall Mesa Trailhead (south of CO 170)

STEP 2 - PHYSICAL DATA

Roadway Configuration:
- ☒ 2-Lane
- ☐ 3-Lane w/Striped Median
- ☐ 3 Lane w/Raised Median
- ☐ 4 Lane
- ☐ 5 Lane w/Striped Median
- ☐ 5 Lane w/Raised Median
- ☐ 6 Lane
- ☐ Other:

Crossing Distance By Direction: 40 ft total n/a ft to median *(if applicable + note direction)* n/a ft to median *(if applicable + note direction)*

Nearest Marked or Protected Pedestrian Crossing: CO 93/ CO 170 Distance to: ft

(*For uncontrolled location only*) Stopping Sight Distance (SSD) = WB: 240' EB: 200' ft ft.

Is SSD ≥ 8x Speed Limit? ☐ Yes ☒ No If No, are improvements to SSD feasible? ☐ Yes ☒ No

STEP 3a - TRAFFIC DATA

Pedestrian Crossing Volumes / Bicycle Crossing Volumes:

	AM	Mid-Day	PM	Other
Time:	7:30 AM to 8:30 AM	to	to	to
Date/Day of Week:	7/12/2023 / Wed	/	7/12/2023 / Wed	7/8/2023 / Sat
Major Street Vehicular Volume (**Hourly**):	546		735	499
# of Transit Boardings (if applicable)	Not counted		Not counted	Not counted
# of Young Peds / Bicyclists	Not counted	/	Not counted	Not counted
# of Elderly Peds	Not counted		Not counted	Not counted
# of Disabled Peds	Not counted		Not counted	Not counted
# of Non-Y/E/D Peds / Bicyclists	Not counted	/	Not counted	Not counted
TOTAL PEDS (Actual) (Include All Bicyclists in Total Sum)				
TOTAL PEDS (**Adjusted** for 2x Y/E/D				

Major Street Vehicular Volume (**Daily**): ADT = 6200 veh/day

City of Boulder Pedestrian Crossing Treatment Installation Guidelines

Crossing Location Evaluation Worksheet *(Continued)*

STEP 3b - OPERATIONAL OBSERVATIONS

Nearest Intersection (Direction #1): Cross Street Name: CO 93 and CO 170

Located 450 ft to the ☐N ☐S ☐E ☒W of crossing location

Signalized? ☒Y ☐N Distance from Crossing 300 ft

	AM	Mid-Day	PM	Other
How many times per hour did the downstream vehicle queue back up into pedestrian crossing?	Synchro 95% queue indicates queue does not reach crosswalk		Synchro 95% queue indicates queue extends through crosswalk	Synchro 95% queue indicates queue does not reach crosswalk
If multiple lanes per direction, are queue lengths approximately equal?	Y N	Y N	Y N	Y N
If NO (above),which lane is longer (inside, outside, middle) and by how much (feet)?	n/a	n/a	n/a	n/a

Nearest Intersection (Direction #2): Cross Street Name: CO 170 and Marshall Dr/Eldorado Springs Dr

Located 850 ft to the ☐N ☐S ☒E ☐W of crossing location

Signalized? ☐Y ☒N Distance from Crossing 950 ft

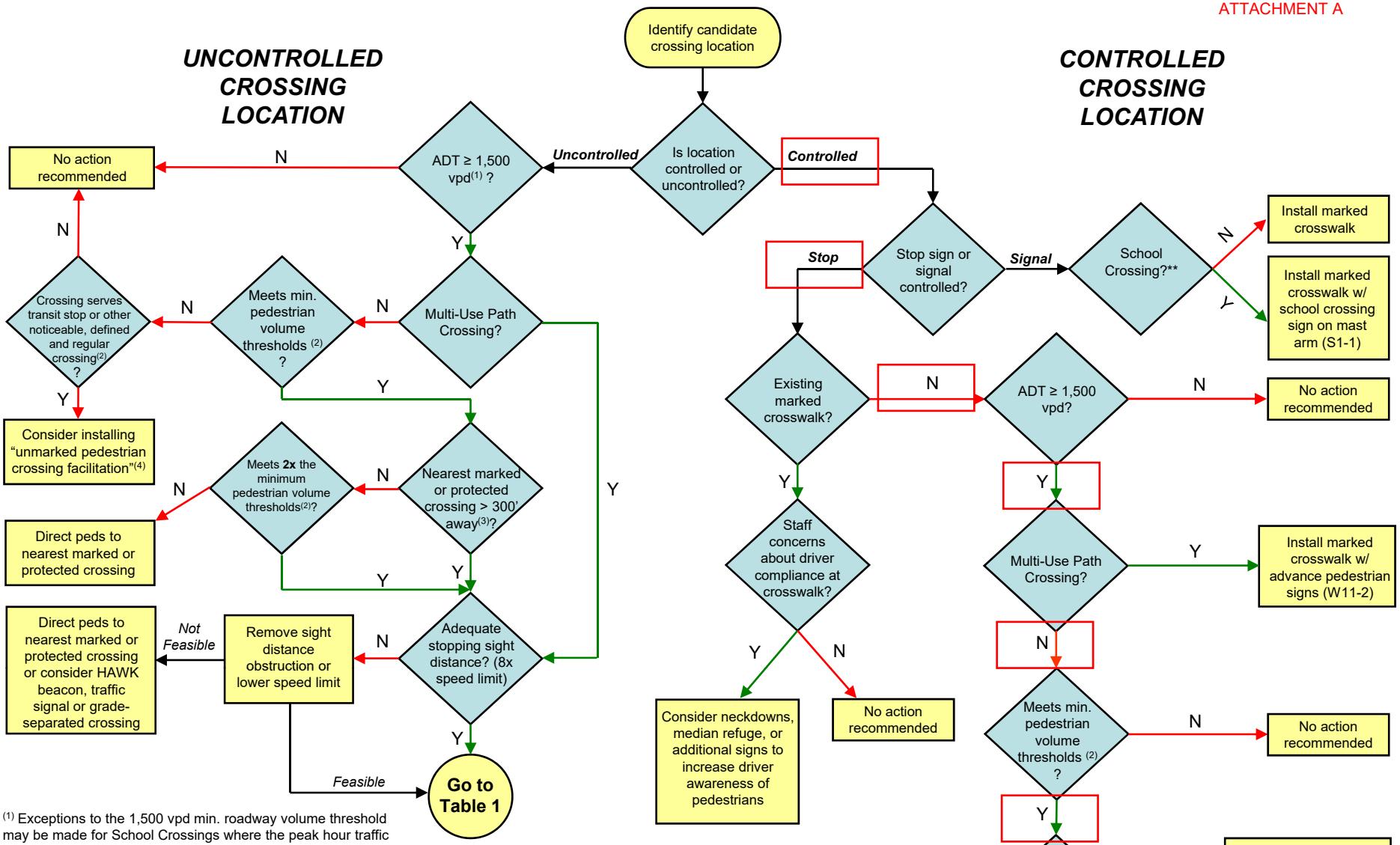
	AM	Mid-Day	PM	Other
How many times per hour did the downstream vehicle queue back up into pedestrian crossing?	0	0	0	0
If multiple lanes per direction, are queue lengths approximately equal?	Y N	Y N	Y N	Y N
If NO (above),which lane is longer (inside, outside, middle) and by how much (feet)?	n/a	n/a	n/a	n/a

STEP 4 - APPLY DATA TO FIGURE 1 and TABLE 1

Recommended Treatment(s): _____

_____

_____



(1) Exceptions to the 1,500 vpd min. roadway volume threshold may be made for School Crossings where the peak hour traffic exceeds 10% of the daily traffic

(2) **Minimum Pedestrian Volume Thresholds**:

- 20 peds per hour* in any one hour, or
- 18 peds per hour* in any two hours, or
- 15 peds per hour* in any three hours

* Young, elderly, and disabled pedestrians count 2x towards volume thresholds

** School Crossing defined as a crossing location where ten or more student pedestrians per hour are crossing.

(3) Distance to nearest marked or protected crossing may be reduced to 200' in urban conditions, subject to engineering judgment, where 1) the crosswalk does cross any auxiliary lanes, and 2) crossing treatments and crossing activity would not create undue restriction to vehicular traffic operations.

(4) An "unmarked pedestrian crossing facilitation" is any treatment that improves a pedestrian's ability to cross a roadway, short of the marked, signed and enhanced crossings detailed in Table 1. Installation of this type of pedestrian facilitation is subject to engineering judgment and may include curb ramps and/or a raised median refuge. However, no effort is made to attract pedestrians or recommend that pedestrians cross at this location. The treatments simply provide an improvement for a low volume pedestrian crossing where pedestrians are already crossing and will like continue to cross.

City of Boulder Pedestrian Crossing Treatment Installation Guidelines

Figure 1 – Pedestrian Crossing Treatment Flowchart

City of Boulder Pedestrian Crossing Treatment Installation Guidelines

Table 1 - Criteria for Crossing Treatments at Uncontrolled Locations

Roadway Configuration	# of lanes crossed to reach a refuge[1]	# of multiple threat lanes[2] per crossing	Roadway ADT and Posted Speed															
			1,500-9,000 vpd				9,000-12,000 vpd				12,000-15,000 vpd				> 15,000 vpd			
			≤ 30 mph	35 mph	40 mph	≥ 45 mph	≤ 30 mph	35 mph	40 mph	≥ 45 mph	≤ 30 mph	35 mph	40 mph	≥ 45 mph	≤ 30 mph	35 mph	40 mph	≥ 45 mph
2 Lanes (one way street)	2	1	A	B	C	E	A	B	C	E	B	B	C	E	B	C	C	E
2 Lanes (two way street with no median)	2	0	A	B	C	E	A	B	C	E	B	B	C	E	B	C	C	E
3 Lanes w/Raised Median	1 or 2	0 or 1	A	B	D	E	A	C	D	E	B	D	D	E	C	D	D	E
3 Lanes w//Striped Median	3	0 or 1	C	C	D	E	C	C	D	E	C	C	D	E	C	D	D	E
4 Lanes (two way street with no median)	4	2	A	D	D	E	B	D	D	E	B	D	D	E	D	D	D	E
5 Lanes w/Raised Median	2 or 3	2	A	B	D	E	B	C	D	E	B	C	D	E	C	C	D	E
5 Lanes w/Striped Median	5	2	D	D	D	E	D	D	D	E	D	D	D	E	D	D	D	E
6 Lanes (two way street with or without median)	3 to 6	4	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F

Notes:

1. Painted medians can never be considered a refuge for a crossing pedestrian. Similarly, a 4 foot wide raised median next to a left turn lane can only be considered a refuge for pedestrians if the left turning volume is less than 20 vehicles per hour (meaning that in most cases the left turn lane is not occupied while the pedestrian is crossing).
2. A multiple threat lane is defined as a through lane where it is possible for a pedestrian to step out from in front of a stopped vehicle in the adjacent travel lane (either through or turn lane).

Treatment Descriptions:

A ***Install marked crosswalk with enhanced road-side signs***

Specific Guidance : Install marked crosswalk with "State Law - Yield to Pedestrian" signs mounted on the side of the roadway with standard (W11-2) advance pedestrian warning signs; use S1-1 signs for School Crossing locations.

B ***Install marked crosswalk with enhanced road-side and in-roadway (bollard mounted) signs***

Specific Guidance : Install marked crosswalk with "State Law - Yield to Pedestrian" signs mounted on the side of the roadway and on in-roadway bollards; use standard (W11-2) advance pedestrian warning signs; use S1-1 signs for School Crossing locations.

C ***Install marked crosswalk with enhanced signs and geometric improvements to increase pedestrian visibility and reduce exposure***

Specific Guidance : For 2 or 3-lane roadways, install marked crosswalk with "State Law - Yield to Pedestrian" signs mounted on the side of the roadway and on in-roadway bollards or median mounted signs; use standard (W11-2) advance pedestrian warning signs; use S1-1 signs for School Crossing locations. Add neckdowns or median refuge islands to shorten the pedestrian crossing distance and increase pedestrian visibility to motorists.

D ***Install marked crosswalk with enhanced signs, pedestrian activated RRFBs, and geometric improvements to increase pedestrian visibility and reduce exposure***

Specific Guidance : Install raised median refuge island (unless it is a one-way street or one already exists) to shorten the pedestrian crossing distance and increase pedestrian visibility to motorists. [If a median refuge can not be constructed on a two-way street, Go To Scenario F]. *Install marked crosswalk with "State Law - Yield to Pedestrian" signs WITH pedestrian activated RRFBs mounted on the side of the roadway and on median mounted signs; use standard (W11-2) advance pedestrian warning signs; use S1-1 signs for School Crossing locations. Consider adding neckdowns at the crossing if on-street parking exists on the roadway and storm drain considerations will allow. [Note: If pedestrian volume falls above the RRFB limit line on Figure 2, consider Hawk beacon, pedestrian traffic signal, or grade-separated crossing.]*

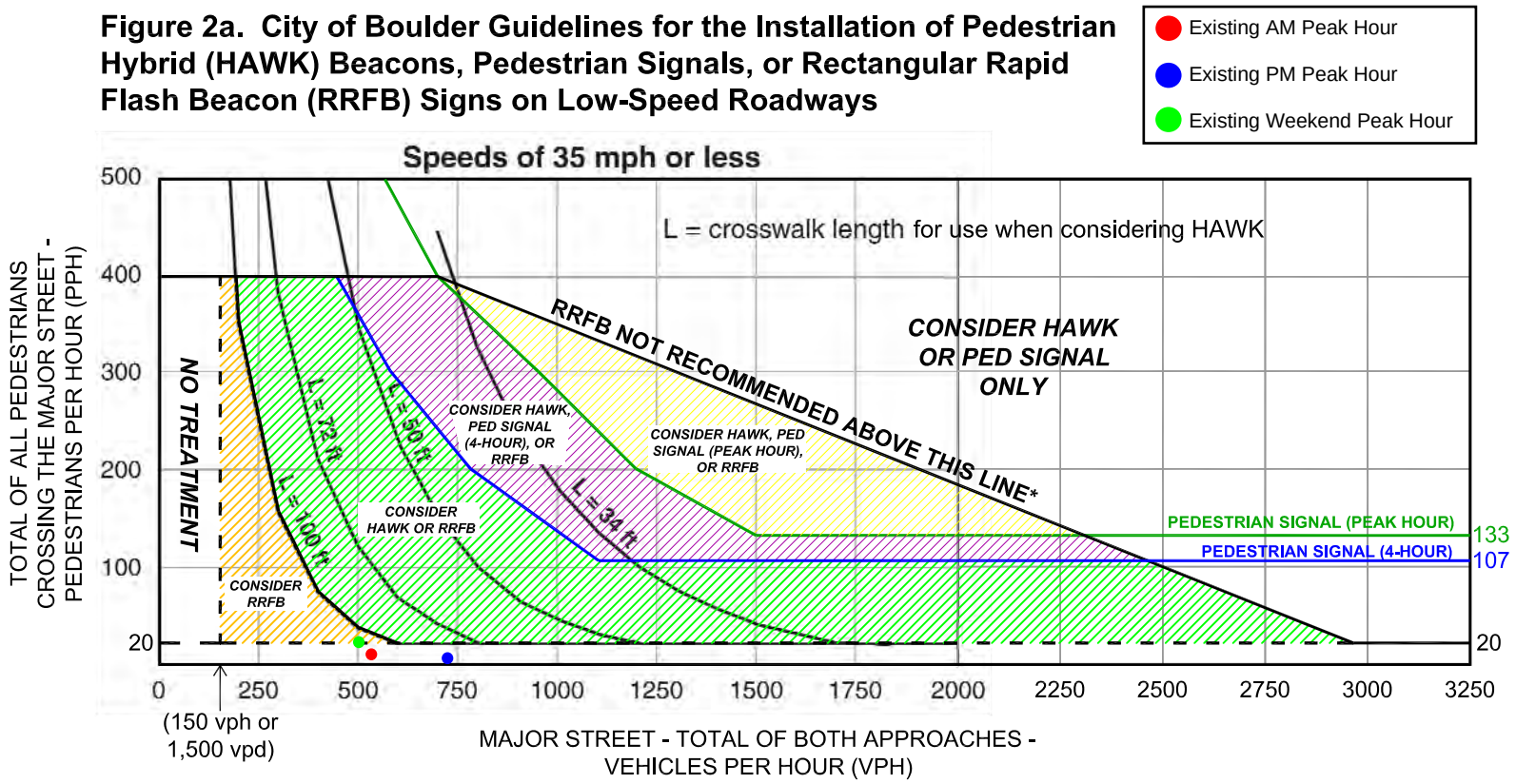
E ***Do not install marked crosswalk at uncontrolled crossing. Determine if the speed limit can be effectively reduced to 40 mph AND a raised refuge median can be installed. If so, utliize Scenario D criteria above. If this is not possible, or if pedestrian volume falls above the RRFB limit line on Figure 2, consider HAWK beacon, pedestrian traffic signal, or grade-separated crossing.***

Specific Guidance : Consider HAWK beacon, pedestrian traffic signal or grade-separated crossing; application of these treatments will consider corridor signal progression, existing grades, phyiscal contraints, and other engieering factors

F ***Do not install marked crosswalk at uncontrolled crossing with 3 or more THROUGH lanes per direction or where the speed limit is ≥ 45 mph and/or there is not a median refuge on a 5-lane crossing. Consider HAWK beacon, pedestrian traffic signal, or grade-separated crossing.***

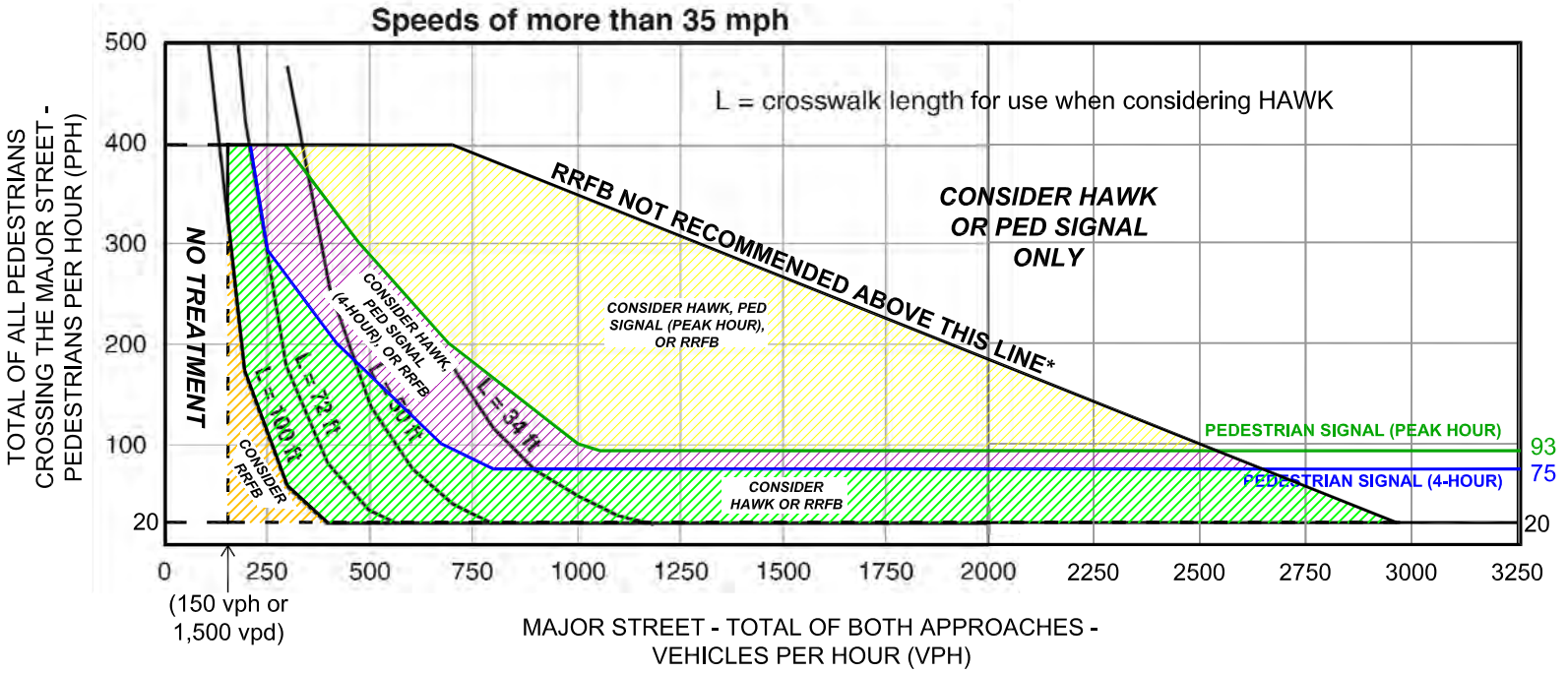
Specific Guidance : Consider HAWK beacon, pedestrian traffic signal or grade-separated crossing; application of these treatments will consider corridor signal progression, existing grades, phyiscal contraints, and other engieering factors

Figure 2a. City of Boulder Guidelines for the Installation of Pedestrian Hybrid (HAWK) Beacons, Pedestrian Signals, or Rectangular Rapid Flash Beacon (RRFB) Signs on Low-Speed Roadways



* RECOMMENDATION BASED ON CITY OF BOULDER SAFETY EVALUATIONS AT EXISTING RRFB SITES AND OBSERVED IMPACTS TO VEHICULAR TRAFFIC OPERATIONS

Figure 2b. City of Boulder Guidelines for the Installation of Pedestrian Hybrid (HAWK) Beacons, Pedestrian Signals, or Rectangular Rapid Flash Beacon (RRFB) Signs on High-Speed Roadways



* RECOMMENDATION BASED ON CITY OF BOULDER SAFETY EVALUATIONS AT EXISTING RRFB SITES AND OBSERVED IMPACTS TO VEHICULAR TRAFFIC OPERATIONS

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302 • Tel: 303.441.3930 • Fax: 303.441.4856
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.bouldercounty.gov**

Building Safety & Inspection Services Team

M E M O

TO: Sam Walker, Planner II
FROM: Michelle Huebner, Plans Examiner Supervisor
DATE: June 5, 2024

RE: Referral Response, LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork. Limited Impact Special Use Review to permit 364,000 cubic yards of earthwork for subsurface coal fire mitigation and redevelopment of the Marshall Mesa trailhead.

Location: 1842 S. Foothills Highway

Thank you for the referral. We have the following comments for the applicants:

1. **Building Permit.** A grading permit, plan review, and inspection approvals are required for the grading, parking lot, sidewalk, curb, and gutter. The construction documents must be Stamped, signed and sealed by the Colorado design.

   Please refer to the county's adopted 2015 editions of the International Codes and code amendments, which can be found via the internet under the link:

   2015 Building Code Adoption & Amendments, at the following URL: https://assets.bouldercounty.org/wp-content/uploads/2017/03/building-code-2015.pdf

2. **Accessibility**. Chapter 11 of the IBC and referenced standard ICC A117.1-09 provide for accessibility for persons with disabilities. Any building permit submittals are to include any applicable accessibility requirements, including accessible parking, signage, accessible routes and accessible fixtures and features.

3. **Grading Permit.** A separate grading permit and plan review and inspections approvals are required for the proposed non-foundational grading. Please refer to the county's adopted 2015 editions of the International Codes and code amendments, including IBC Appendix Chapter J for grading.

4. **Observation Reports.** The design professional responsible for the design or a similarly qualified Colorado-licensed design professional is to observe the grading and submit a stamped report to Building Safety & Inspection Services for review and

approval. The final report is to state that the work has been completed in substantial conformance with the approved engineered plans.

5. **Plan Review.** The items listed above are a general summary of some of the county's building code requirements. A much more detailed plan review will be performed at the time of grading permit application.

If the applicants should have questions or need additional information, we'd be happy to work with them toward solutions that meet minimum building code requirements. Please call (720) 564-2640 or contact us via e-mail at building@bouldercounty.org

Community Planning & Permitting

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Mailing Address: P.O. Box 471 • Boulder, Colorado 80306
303-441-3930 • www.BoulderCounty.gov

MEMO TO: Agencies and Adjacent Property Owners
FROM: Sam Walker, Planner II
DATE: June 4, 2024
RE: Docket **LU-24-0009**

Docket LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork

Request:	Limited Impact Special Use Review to permit 364,000 cubic yards of earthwork for subsurface coal fire mitigation and redevelopment of the Marshall Mesa trailhead.
Location:	1842 S. Foothills Highway, at the southeast corner of the intersection of SH 170 and SH93 in Section 21, Township 1S, Range 70W.
Zoning:	Business (B) and Agricultural (A) Zoning Districts
Applicant:	City of Boulder c/o Adam Gaylord

Limited Impact Special Review is required of proposed uses that may have greater impacts on services, neighborhoods, or the environment than those allowed by right under the Boulder County Land Use Code. This process will review conformance of the proposed use with the Boulder County Comprehensive Plan and the Land Use Code.

This process includes a public hearing before the Board of County Commissioners. Adjacent property owners and holders of liens, mortgages, easements or other rights in the subject property are notified of this hearing.

The Community Planning & Permitting staff and County Commissioners value comments from individuals and referral agencies. Please check the appropriate response below or send a letter to the Community Planning & Permitting Department at P.O. Box 471, Boulder, Colorado 80306 or via email to planner@bouldercounty.gov. All comments will be made part of the public record and given to the applicant. Only a portion of the submitted documents may have been enclosed; you are welcome to call the Community Planning & Permitting Department at 303-441-3930 or email planner@bouldercounty.gov to request more information. If you have any questions regarding this application, please contact me at 720-564-2738 or swalker@bouldercounty.gov.

Please return responses by **June 19, 2024.**

__X__ We have reviewed the proposal and have no conflicts.
_____ Letter is enclosed.

Signed _____ PRINTED Name Jessica Fasick

Agency or Address CP&P Historic Review

Date 6/6/24

COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

Sam Walker
Planner II
Boulder County Community Planning & Permitting
P.O. Box 471, Boulder, CO 80306

VIA EMAIL

RE: Referral Packet for Docket LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork at 1842 S. Foothills Highway

Dear Sam Walker,

The Colorado Department of Public Health and Environment's Air Pollution Control Division (APCD or Division) received a request for conformity review concerning the proposed Marshall Mesa Mitigation and Trailhead Earthwork project as described in your correspondence dated June 4, 2024. The Division has reviewed the project letter and respectfully offers the following comments. Please note that the following Air Quality Control Commission (AQCC) regulations may not be inclusive of the regulations the proposed project will be subject to. It is the responsibility of the involved parties to determine what regulations they are subject to and follow them accordingly.

Odor
All businesses in Colorado are subject to AQCC Regulation Number 2 (Odor Emission) and a permit may be required for the installation of odor control equipment. Please refer to AQCC Number 2 for guidance on odor suppression actions. You may also view the complete regulatory language at https://cdphe.colorado.gov/aqcc-regulations.

Land Development
We also note that projects similar to this proposal often involve land development. Under Colorado air quality regulations, land development refers to all land clearing activities, including but not limited to land preparation such as excavating or grading, for residential, commercial or industrial development. Land development activities release fugitive dust, a pollutant regulation by the Division. Small land development activities are not subject to the same reporting and permitting requirements as large land activities. Specifically, land development activities that are less than 25 contiguous acres and less than 6 months in duration do not need to report air emissions to the Division. It is important to note that even if a permit is not required, fugitive dust control measures including the Land Development APEN Form APCD-223 must be followed at the site. Fugitive dust control techniques commonly included in the plan are included in the table below.

Control Options for Unpaved Roadways	
Watering	Use of chemical stabilizer
Paving	Controlling vehicle speed

Graveling	
Control Options for Mud and Dirt Carry-Out Onto Paved Surfaces	
Gravel entry ways	Washing vehicle wheels
Covering the load	Not overfilling trucks
Control Options for Disturbed Areas	
Watering	Application of a chemical stabilizer
Revegetation	Controlling vehicle speed
Compaction	Furrowing the soil
Wind Breaks	Minimizing the areas of disturbance
	Synthetic or Natural Cover for Slopes

Please refer to the website https://cdphe.colorado.gov/apens-and-air-permits for information on land use APENs and permit forms. Click on "Land Development" to access the land development specific APEN form. Please contact KC Houlden, Construction Permits Unit Supervisor, at 303-692-4092, kenneth.houlden@state.co.us if you have any specific questions about APENs and permit forms.

If you have any other questions or need additional information, please use the contact info listed above, or e-mail or call me directly. Thank you for contacting the Air Pollution Control Division about your project.

Sincerely,
Brendan Cicione
Air Quality and Transportation Planner
General SIP Unit
Air Pollution Control Division
Colorado Department of Public Health and Environment
303-691-4104 // brendan.cicione@state.co.us

Public Health

Environmental Health Division

June 12, 2024

TO: Staff Planner, Land Use Department

FROM: Jessica Epstein, Environmental Health Specialist

SUBJECT: LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork

OWNER: City of Boulder

PROPERTY ADDRESS: 1842 S. Foothills Highway

SEC-TOWN-RANGE: 21 -1S -70

The Boulder County Public Health (BCPH) – Environmental Health division has reviewed the submittals for the above referenced docket and has the following comments.

OWTS Application Needed:

1. Boulder County Public Health issued a new permit for the installation of a vaulted privy on 5/10/06. Boulder County Public Health approved the installation of the vaulted privy on 9/20/06. The parcel number associated with the permit is 157721000023. The updated parcel number for this address is 157721000077.
2. The application mentions a installing a new vaulted restroom. The owner or their agent (e.g., contractor) must apply for an OWTS permit, and the OWTS permit must be issued prior to vaulted pricy installation and before a building permit can be obtained. The vaulted privy be installed, inspected and approved before Final Building Inspection approval will be issued by Community Planning and Permitting (CP&P).

This concludes comments from the Public Health - Environmental Health division at this time. For additional information on the OWTS application process and regulations, refer to the following website: **www.SepticSmart.org**. If you have additional questions about OWTS, please do not hesitate to contact HealthOWS@bouldercounty.org.

Cc: OWTS file, owner, Community Planning and Permitting

Boulder County

Community Planning & Permitting

Courthouse Annex • 2045 13th Street • Boulder, Colorado 80302
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 •
Tel: 303-441-3930 • www.BoulderCounty.gov

June 14, 2024

TO: Sam Walker, Planner II; Community Planning & Permitting, Development Review Team - Zoning

FROM: Brian P. Kelly, Planner II, Community Planning & Permitting, Development Review Team – Access & Engineering

SUBJECT: Docket # LU-24-0009: City of Boulder Marshall Mesa Mitigation and Trailhead Earthwork - 1842 S Foothills Highway

The Development Review Team – Access & Engineering staff has reviewed the above referenced docket and has the following comments:

1. The subject property is accessed from Marshall Drive, also known as State Highway 170, a Colorado Department of Transportation (CDOT) owned and maintained right-of-way (ROW). Legal access has been demonstrated via adjacency to the public ROW.

2. The submitted plans appear to meet the Boulder County Multimodal Transportation Standards (Standards). However, the quality of the submitted plans were not completely legible and the parking lot details and callouts could not always be read.

    a. The negative 5.12% grade at the approach exceeds the negative 2% requirement specified in the Standards and must be revised.

    b. The curve through the grade at Station 11+00 exceeds the maximum allowable of 6% and must be revised.

    c. Parking space dimensions and wheel stop details must meet the Standards.

    d. Given the tight turning radii at the general parking area, staff recommends clear signage directing oversize vehicles to the oversize parking area.

3. The parking plans submitted do not demonstrate provisions for electric vehicle service equipment (Charging Station). Plans must provide adequate number of Charging Station parking in accordance with Article 4-513(D) of the Boulder County Land Use Code.

4. Be aware, if traffic volume has increased by 20% or more, the access permit must be revised. Contact CDOT for more information at Timothy Bilobran (timothy.bilobran@state.co.us), 970-350-2163.

5. Staff noticed in the Traffic Impact Study (TIS) that bookmarked references in the text, displayed “Error! Not a valid bookmark” or something similar (See top of p. 34 of TIS as an example). Staff concurs with the findings of the report but recognizes CDOT approval is necessary to implement the following recommendations:

    - Adjust the signal timing at the intersection of Colorado SH93/SH170
    - Relocate the pedestrian crossing to the new access location
    - Add Rectangular Rapid Flashing Beacons (RRFB) at the pedestrian crosswalk
    - Install advance pedestrian warning signs

At building permit, resubmit report with corrected bookmark links or provide alternative reference notation.

At building permit, submit plans that demonstrate a Boulder County Multimodal Transportation Standards compliant access and parking plan. If designed to the City of Boulder Standards and not the County Standards, please provide the specification standards.

Prior to issuance of a Certificate of Occupancy/At final inspection, the Community Planning & Permitting Department must verify that the access and parking area has been constructed to comply with the Standards.

6. A drainage letter was not submitted that includes calculations demonstrating that the access culvert, cross culvert, detention basin and bioretention drainage facilities have been sized appropriately.

   At building permit, submit hydraulic calculations for the proposed culverts and associated drainage facilities. Revise plans, as necessary.

7. As a part of Boulder County's water quality protection and Municipal Separate Storm Sewer System (MS4) Construction Program, a Stormwater Quality Permit (SWQP) is required for this project based on the disturbance illustrated in the submitted materials.

   At building permit, provide a complete SWQP submittal to stormwater@bouldercounty.gov.

8. During construction, all vehicles, materials, machinery, dumpsters, and other items shall be staged on the subject property; no items shall be stored or staged on Marshall Drive (SH170).

This concludes our comments at this time.

Right of Way & Permits

1123 West 3rd Avenue
Denver, Colorado 80223
Telephone: **303.571.3306**
Facsimile: 303.571.3284
donna.l.george@xcelenergy.com

June 17, 2024

Boulder County Community Planning and Permitting
PO Box 471
Boulder, CO 80306

Attn: Sam Walker

Re: Marshall Mesa Mitigation and Trailhead Earthwork, Case # LU-24-0009

Public Service Company of Colorado's (PSCo) Right of Way & Permits Referral Desk has reviewed the limited impact special use for **Marshall Mesa Mitigation and Trailhead Earthwork**. Please be aware PSCo owns and operates existing natural gas and electric distribution facilities within the proposed project activities. Note that proper clearances must be maintained including ground cover over buried facilities that should not be modified from original depths. In other words, if the original cover is changed (less or more), PSCo facilities must be raised or lowered to accommodate that change. Contact Colorado 811 before excavating. Use caution and hand dig when excavating within 18-inches of each side of the marked facilities. Please be aware that all risk and responsibility for this request are unilaterally that of the Applicant/Requestor.

Additionally, per the National Electric Safety Code, a minimum 10-foot radial clearance must be maintained at all times from all overhead electric facilities including, but not limited to, construction activities and permanent structures.

For any new natural gas or electric service or modification to existing facilities, the property owner/developer/contractor must complete the application process via www.xcelenergy.com/InstallAndConnect.

If additional easements need to be acquired by separate PSCo, a Right-of-Way Agent will need to be contacted.

Donna George
Right of Way and Permits
Public Service Company of Colorado dba Xcel Energy
Office: 303-571-3306 – Email: donna.l.george@xcelenergy.com

Walker, Samuel

From: CGS_LUR <CGS_LUR@mines.edu>
Sent: Tuesday, June 18, 2024 2:40 PM
To: Walker, Samuel
Subject: Re: [EXTERNAL] Referral Packet for Docket LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork at 1842 S. Foothills Highway

Hi Sam,

The Colorado Geological Survey fully supports the Marshall Mesa mitigation and earthwork proposed by the Colorado Division of Reclamation, Mining, and Safety. CGS has no objection to approval of Docket LU-24-0009.

Thanks,
Jill Carlson

_____
Land Use Review Program
Colorado Geological Survey
1801 Moly Road
Golden, CO 80401
cgs_lur@mines.edu
303-384-2655

From: Morgan, Heather <hmorgan@bouldercounty.gov>
Sent: Tuesday, June 4, 2024 9:01 AM
To: !LongRange <longrange@bouldercounty.gov>; Historic <historic@bouldercounty.gov>; #WildfireMitigation <WildfireMitigation@bouldercounty.org>; Ruzzin, Mark <mruzzin@bouldercounty.gov>; #AssessorReferral <AssessorReferral@bouldercounty.org>; #CAreferral <CAreferral@bouldercounty.gov>; #CEreferral <CEreferral@bouldercounty.gov>; Skufca, Erika <eskufca@bouldercounty.gov>; Oehlkers, Jason <joehlkers@bouldercounty.gov>; Allshouse, Alycia <aallshouse@bouldercounty.gov>; Kiepe, Bob <bkiepe@bouldercounty.gov>; Kelly, Allison <akelly@bouldercounty.gov>; nfishbein@tnc.org <nfishbein@tnc.org>; eldocommunity@gmail.com <eldocommunity@gmail.com>; info@eldoradosprings.com <info@eldoradosprings.com>; BDRCO@xcelenergy.com <BDRCO@xcelenergy.com>; Donna.L.George@xcelenergy.com <Donna.L.George@xcelenergy.com>; Ranglos, Chris <ranglosc@bouldercolorado.gov>; bonnellj@bouldercolorado.gov <bonnellj@bouldercolorado.gov>; CollinsB@bouldercolorado.gov <CollinsB@bouldercolorado.gov>; CassidyJ@bouldercolorado.gov <CassidyJ@bouldercolorado.gov>; planning@superiorcolorado.gov <planning@superiorcolorado.gov>; planning@louisvilleco.gov <planning@louisvilleco.gov>; Vanessa McCracken <bldrvalleyandlongmontcds@gmail.com>; cdphe_localreferral@state.co.us <cdphe_localreferral@state.co.us>; CGS_LUR <CGS_LUR@mines.edu>; hc_filesearch@state.co.us <hc_filesearch@state.co.us>; eldorado.park@state.co.us <eldorado.park@state.co.us>; john.carson@state.co.us <john.carson@state.co.us>; stephanie.sisnroy@state.co.us <stephanie.sisnroy@state.co.us>; mike.mchugh@state.co.us <mike.mchugh@state.co.us>; Gill, Lisa <lisa.gill@state.co.us>; david.dixon@state.co.us <david.dixon@state.co.us>; coloradoes@fws.gov <coloradoes@fws.gov>; prevention@mvfpd.org <prevention@mvfpd.org>; Atherton-Wood, Justin <jatherton-wood@bouldercounty.gov>; Moline, Jeffrey <jmoline@bouldercounty.gov>; Flax, Ron <rflax@bouldercounty.gov>; Frederick, Summer <sfrederick@bouldercounty.gov>; HealthWaterQuality-EnvironmentalBP LU <HealthWQ-EnvironBPLU@bouldercounty.gov>; Huebner, Michelle <mhuebner@bouldercounty.gov>; Morgan, Heather <hmorgan@bouldercounty.gov>; Sanchez, Kimberly <ksanchez@bouldercounty.gov>; Transportation Development Review <TransDevReview@bouldercounty.gov>; West, Ron <rowest@bouldercounty.gov>
Cc: Walker, Samuel <swalker@bouldercounty.gov>; Duchi, Trevor <tduchi@bouldercounty.gov>
Subject: [EXTERNAL] Referral Packet for Docket LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork at 1842 S. Foothills Highway

Please find attached the public notice and click here for the referral packet for Docket ***LU-24-0009: Marshall Mesa Mitigation and Trailhead Earthwork*** at ***1842 S. Foothills Highway***.

Please return responses and direct any questions to ***Sam Walker*** by ***June 19, 2024.*** (Boulder County internal departments and agencies: Please attach the referral comments in Accela.)

Heather Morgan | Lead Administrative Technician
Planning Division | Boulder County Community Planning & Permitting
P.O. Box 471, Boulder, CO 80306 | Courthouse Annex—2045 13th St., Boulder, CO 80302
hmorgan@bouldercounty.gov | (720) 864-6510 | www.boco.org/cpp
My usual working hours are Monday – 7:00-11:00 a.m., Tuesday-Friday – 6:30 a.m. – 4:00 p.m.

Boulder County has migrated all email to the .gov domain. Please update your contact lists to reflect the change from hmorgan@bouldercounty.org to hmorgan@bouldercounty.gov. ***Emails sent to both .org and .gov addresses will continue to work.*** *This work is part of the migration to the .gov domain that began in July 2022 when the Boulder County website moved to www.bouldercounty.gov. This move to the .gov domain provides a higher level of cybersecurity protection.*

Parks & Open Space
5201 St. Vrain Road • Longmont, CO 80503
303-678-6200 • POSinfo@bouldercounty.org
www.BoulderCountyOpenSpace.org

TO: Sam Walker, Community Planning & Permitting Department
FROM: Ron West, Natural Resource Planner
DATE: June 24, 2023
SUBJECT: Docket LU-24-0009, OSMP, Marshall Mesa Mitigation and Trailhead

Site Conditions

I have reviewed the submitted materials, and have visited the trailhead and environs many times in the past. Current conditions are well-described in the application and will not be repeated here.

County Comprehensive Plan Designations

The parcel has the following designations in the Boulder County Comprehensive Plan, or from other resource inventories.

- Environmental Conservation Area – Boulder Mountain Park/South Boulder
- High Biodiversity Area – Marshall Mesa, ranked B2, of very high significance
- Public Lands and Trails – City of Boulder OSMP
- Rare Plant Area
- View Protection Corridor – associated with highways 93 and 170
- Major Agricultural Ditch -- Davidson

Discussion

Although a large area would be disturbed, staff supports the proposal as a long-term necessity. Staff estimates the overall disturbance – including the two excavations and work areas, and the entire trailhead – to be about 8 acres total. Some of the above-listed resources, as mapped in the Comprehensive Plan, would be temporarily impacted, but benefitted in the long-term. Restoration of the large subsurface work areas with native species should actually be an improvement over the existing conditions with many non-native species

Staff has the following questions and comments.

The OSMP narrative states that, “The project will not result in excess cut” yet the February 1, 2024, letter from Tetra Tech to the Colorado Division of Reclamation, Mining, and Safety states that, “It is anticipated that *most* of the excavated materials will be blended and placed back in the excavations” (emphasis added). What was the experience with the already-completed coal-fire mitigation work on the south side of the highway – the Lewis project? Was some material hauled away? This could occur if: the engineers determine that some material – unburned coal(?) – should be removed; or post-excavation compaction results in an “expanded” amount of material than that which was excavated; or unexpected material such as concrete waste is encountered.

Tetra Tech's 1/30/2024 Figure 1 in this same letter does not include a legend. Are the three "cobbled" icon areas for stockpiling, and if so are these large enough? (Staff understands, however, the staged nature of the excavation and filling.) Is the "double-X" line a fence, and if so why is it only on one side of the excavation? What are the small boxes and the one bold box next to the highway on the north end? The former might be tracking pads, but the narrative states that access will be via the existing trailhead access.

Although "topsoil" may not exist per se in the excavation areas, would the surface layers be removed and isolated to be replaced on top? Presumably the upper soils would at least be more fertile than lower layers.

All machinery needs to be pressure washed before entering the site to remove mud and possible weed seeds. A spill kit, with written instructions, must be kept on-site at all times. These should be conditions of approval.

How long is it expected that the trailhead will be closed?

As stated in the application, OSMP must comply with the Best Management Practices (BMPs) in their Wetlands Protection Program (1995), and their Ecological Best Management Practices (2013). Grading limits will be clearly marked. Where will refueling take place and what type of BMP's used?

A Revegetation Plan is required that includes: native species to be used, an explanation of the treatment of excavated topsoil, mapped delineation of all disturbance areas (this includes construction staging and stockpiling areas), tree protection details, locations of silt fences or erosion control logs down slope of disturbed areas, and matting requirements on steeper slopes.

The narrative states that, "…restoration areas and areas of temporary impact will be seeded…*and covered with…erosion control blanket*" (emphasis added). This totals about 8 acres. Staff questions whether so much blanket is necessary, not to mention the cost of such. On the other hand, it certainly is a windy site. Though mentioned in the narrative, "cuttings" likely would not be used, and non-native crack willow should not be a problem.

Who is responsible for revegetation of the subsurface work areas – OSMP or the state? Or, the state with oversight of OSMP?

<u>Recommendations</u>

- The above questions and comments should be considered and resolved.

Walker, Samuel

From: Molly Bockmann <mollybockmann@gmail.com>
Sent: Tuesday, June 4, 2024 8:17 AM
To: Levy, Claire; Walker, Samuel; Case, Dale
Subject: [EXTERNAL] LU-24-0009 Marshall Mesa trailhead

I'd like to submit a public comment regarding the crosswalk from the park and ride to the trail correcting it to the main Marshall parking area.

Due to the location of this crosswalk being set back from the intersection at 93 and after a curve, it seems like it should have a blinker. I have on several occasions ridden out this way from town and attempted to cross at this crosswalk. The traffic was backed up from the stoplight, past the crosswalk. In order to cross, I had to go between cars and then put the nose of my bike out in order for the traffic coming east to see me. On two occasions none of the cars stopped for me despite being in the crosswalk.

I'm a coach for Boulder High mountain bike team, and I take riders out this direction when we have permits and have seen Fairview coaches do the same. I also take my own children out here to ride. This crosswalk is very dangerous, especially during rush hours, which is typically when people are riding after school and work. I would highly recommend adding a blinker, either a push button or automatic to this crosswalk.

Thanks for your consideration.
Molly Bockmann

Walker, Samuel

From: Pam Decker <PamDecker@CollegeCounselingService.com>
Sent: Tuesday, June 11, 2024 10:50 AM
To: Walker, Samuel; Case, Dale
Cc: Pam Decker
Subject: [EXTERNAL] Marshall Mesa Reclamation

Dear Boulder County,

I am a resident of the Marshall area and would like to support the following comments regarding the Marshall Mesa reclamation and trailhead improvements (regarding docket: LU-24-0009):

1- It has been brought to our attention that the Federal Infrastructure Bill is funding the reclamation of the underground burning coal fire at the City's trailhead- we understand that a priority of this funding is to repair/replace water supplies that are impacted by some of the very mines that are being reclaimed on the City's property. We ask that the City and County support our community and the Department of Mining with the evaluation of water supplies and replacement of supplies impacted by the abandoned coal mines, aligning with the guidance of the Federal Infrastructure Bill. Furthermore, unless the risk of surface ignition by this underground coal fire will be eliminated by the reclamation, we ask the City and County to do everything possible to ensure the safety of our community, this includes working with the Department of Mining to secure water resources for the community that is impacted.

2- We are aware that in the process to open the Marshall Mesa trailhead in 2006, the City of Boulder stated they would fill a 27,000 gallon cistern as a fire supply point for the Town of Marshall and Eldorado Springs. We understand that this was never completed but are pleased to hear a cistern will be installed by Mountain View Fire District under this current proposal. We ask the County to ensure the cistern is a "condition of approval" of the City's permit to make sure the cistern is installed as proposed this time.

3- The Traffic Report provided by the City states: "Due to the SSD [stopping sight distance] limitations in the eastbound direction that is not feasible to remove, it is recommended an enhanced crosswalk be evaluated, such as an RRFB [rectangular rapid flashing beacon]." (pg 35 of Mueller Report) further, the report states: 'In addition to the RRFB, it is recommended that Advanced Pedestrian Warning Signs be installed in advance of the crosswalk in both the eastbound and westbound direction.' We support the recommendations for a RRFB in addition to pedestrian warning signs at this crosswalk.

Thank you for considering these comments,

Pamela and Daniel Decker
Marshall Area Resident
5608 Marshall Dr
Boulder, CO 80303

Pamela Decker
Senior Consultant /Educational Counselor

College Counseling Service
www.collegecounselingservice.com
720-320-4923 Fax: 303-499-2063

Walker, Samuel

From: Laura Schmonsees <lkschmoo73@gmail.com>
Sent: Wednesday, June 19, 2024 2:12 PM
To: Walker, Samuel; dcase@bouldercounty.gove
Subject: [EXTERNAL] Marshall mesa reclamation and trailhead comments

Dear Boulder County,

I am a resident of the Marshall area just North of the reclamation area, and have some comments regarding the Marshall Mesa reclamation and trailhead improvements (regarding docket: LU-24-0009):

1- It has been brought to our attention that the Federal Infrastructure Bill is funding the reclamation of the underground burning coal fire at the City's trailhead- we understand that a priority of this funding is to repair/replace water supplies that are impacted by some of the very mines that are being reclaimed on the City's property. ***We ask that the City and County support our community and the Department of Mining with the evaluation of water supplies and replacement of supplies impacted by the abandoned coal mines, aligning with the guidance of the Federal Infrastructure Bill.*** *Furthermore, unless the risk of surface ignition by this underground coal fire will be eliminated by the reclamation, we ask the City and County to do everything possible to ensure the safety of our community, this includes working with the Department of Mining to secure water resources for the community that is impacted.*

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3- upon looking at the proposed new trailhead plan, I believe there's not enough parking for the predicted growth of use at these trailheads. Already currently during the weekends people are parking all along the road. This is only going to increase, and since there is such an impacted area due to reclamation, there should be more parking created over this impacted site to account for future use at the trailhead as well as more shuttle driving to Eldorado Canyon.

4- The Traffic Report provided by the City states: "Due to the SSD [stopping sight distance] limitations in the eastbound direction that is not feasible to remove, it is recommended an enhanced crosswalk be evaluated, such as an RRFB [rectangular rapid flashing beacon]." (pg 35 of Mueller Report) further, the report states: 'In addition to the RRFB, it is recommended that Advanced Pedestrian Warning Signs be installed in advance of the crosswalk in both the eastbound and westbound direction.' We support the recommendations for a RRFB in addition to pedestrian warning signs at this crosswalk.

Thank you for considering these comments,

Laura Schmonsees
Marshall Area Resident
Sent from my iPhone
Sent from my iPhone

Walker, Samuel

From: Jeff Giddings <jeffgiddings1@gmail.com>
Sent: Wednesday, June 19, 2024 2:26 PM
To: Walker, Samuel
Cc: Case, Dale
Subject: [EXTERNAL] Marshall Mesa reclamation and trailhead comments

Dear Boulder County,

I am a resident of the Marshall area just North of the reclamation area, and have some comments regarding the Marshall Mesa reclamation and trailhead improvements (regarding docket: LU-24-0009):

1- It has been brought to our attention that the Federal Infrastructure Bill is funding the reclamation of the underground burning coal fire at the City's trailhead- we understand that a priority of this funding is to repair/replace water supplies that are impacted by some of the very mines that are being reclaimed on the City's property. ***We ask that the City and County support our community and the Department of Mining with the evaluation of water supplies and replacement of supplies impacted by the abandoned coal mines, aligning with the guidance of the Federal Infrastructure Bill.*** *Furthermore, unless the risk of surface ignition by this underground coal fire will be eliminated by the reclamation, we ask the City and County to do everything possible to ensure the safety of our community, this includes working with the Department of Mining to secure water resources for the community that is impacted.*

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Thank you for considering these comments,

Jeff Giddings
Marshall Area Resident

Walker, Samuel

From: Bruce Bryant <brucehbryant@gmail.com>
Sent: Wednesday, June 19, 2024 2:56 PM
To: LU Land Use Planner; Walker, Samuel
Subject: [EXTERNAL] LU-24-0009

To CPP regarding Marshall Mesa trailhead -

It seems to me Boulder is proposing modifications to the trailhead at the El Dorado Springs traffic light. How exactly is it that they in intend to proceed with modifications to the trailhead- piggybacking on top of the mine reclamation project? Boulder County is actively preventing our family from doing the very same thing which Boulder proposes here.

Secondarily, this proposal is failing to take into account the actual number of visitors to this trailhead due to the fact that an overwhelming percentage of them park at the DOT property across the street and cross the installed crosswalk and enter the gate into the property. Also, from a fire risk standpoint, these patrons of the trailhead are not being properly accounted for. They need safe road crossing with blinking lights like many other places. Boulder County is simultaneously trying to prevent a water project that would bring clean drinking water to mining affected communities, and unincorporated boulder county as well as provide firefighting water for the city of Marshall as well as the trailhead in question. Why won't Boulder just put emergency water for this trailhead? We need a fire hydrant to deal with the ongoing threat of coal mine fires and overhead power lines.

Given Boulder's track record of failing to follow its own planning laws in maintaining the last water system at this location, which likely would've prevented my home from burning down. It's hard to imagine how Boulder and Boulder County collude, and that the city of Boulder will be held to a different standard than that to which I am being held. I wish you would put some of your planning energy into approving my perfectly reasonable site location for my fire rebuild based on the same criteria rather than Green-lighting a project for the city of Boulder and giving my project a pre-application denial.

Good day.

Bruce Bryant

Walker, Samuel

From: Ellen Berry <urchinchan@yahoo.com>
Sent: Wednesday, June 19, 2024 3:10 PM
To: LU Land Use Planner; Walker, Samuel
Subject: [EXTERNAL] Lu-24-0009 Marshall Mesa Coal fire and trailhead development

CP&P -

I am disappointed at the rushed process for this massive project. It is true that it's important to deal with the burning coal mine fire, but the trailhead development surely needs more time for public comment. Many many people use the trailhead and adjacent park n ride, everyone cares how this is handled and there is NO STAKING NO MARKING NO INFO SIGN and nothing to tell visitors of the giant project/changes planned. As a resident of the marshall community, I want to see that this heavily visited area is treated carefully. Visitors needs somewhere to park and safe road crossing. Everyone knows that they park at the DOT lot and all throughout old Marshall and then cross hwy 170 to the trailhead. What will you do to accommodate safe crossing on this really busy road? The current crosswalk is NOT ENOUGH and cyclists are nearly being hit by cars every day. Do you want another Magnus White memorial crossing? Can we just put in a decent crossing - with lights, barricades and SAFETY?
Another concern is where all of the cars will park during construction. Will they fill up our yard and head for the other trailhead on 170 or park all over 66th st? Are you closing the whole are? What is the plan. We read the docket and can not see the care and handling of the visitor load.

As a Marshall Fire survivor, I would really like to see wildfire treated seriously at the trailhead. I don't trust that a cistern will be enough to fight fires at this location. There is reason and funding to put an emergency water fire hydrant at the trailhead. Please make sure this happens! We cannot get away from the risk of the coal fire and the arcing power lines and the FIREWORKS tent across the street. We need to fight fires so they don't turn into multi-billion dollar disasters.

Please try to do a good and safe and proper job - wildfire risk is ongoing and real.

Thank you,

Ellen Berry

Walker, Samuel

From: Diana Gabriella <dgabriella1976@gmail.com>
Sent: Wednesday, June 19, 2024 3:24 PM
To: Case, Dale; Walker, Samuel
Subject: [EXTERNAL] Marshall Mesa reclamation

Dear Boulder County,

I am a resident of the Marshall area and would like to support the following comments regarding the Marshall Mesa reclamation and trailhead improvements (regarding docket: LU-24-0009):

1- It has been brought to our attention that the Federal Infrastructure Bill is funding the reclamation of the underground burning coal fire at the City's trailhead- we understand that a priority of this funding is to repair/replace water supplies that are impacted by some of the very mines that are being reclaimed on the City's property. We ask that the City and County support our community and the Department of Mining with the evaluation of water supplies and replacement of supplies impacted by the abandoned coal mines, aligning with the guidance of the Federal Infrastructure Bill. Furthermore, unless the risk of surface ignition by this underground coal fire will be eliminated by the reclamation, we ask the City and County to do everything possible to ensure the safety of our community, this includes working with the Department of Mining to secure water resources for the community that is impacted.

2- We are aware that in the process to open the Marshall Mesa trailhead in 2006, the City of Boulder stated they would fill a 27,000 gallon cistern as a fire supply point for the Town of Marshall and Eldorado Springs. We understand that this was never completed but are pleased to hear a cistern will be installed by Mountain View Fire District under this current proposal. We ask the County to ensure the cistern is a "condition of approval" of the City's permit to make sure the cistern is installed as proposed this time.

3- The Traffic Report provided by the City states: "Due to the SSD [stopping sight distance] limitations in the eastbound direction that is not feasible to remove, it is recommended an enhanced crosswalk be evaluated, such as an RRFB [rectangular rapid flashing beacon]." (pg 35 of Mueller Report) further, the report states: 'In addition to the RRFB, it is recommended that Advanced Pedestrian Warning Signs be installed in advance of the crosswalk in both the eastbound and westbound direction.' We support the recommendations for a RRFB in addition to pedestrian warning signs at this crosswalk.

Thank you for considering these comments,

Diana Gabriella
Marshall Area Resident

Walker, Samuel

From: Megan Monroe <megsmonroe@gmail.com>
Sent: Wednesday, June 19, 2024 4:25 PM
To: LU Land Use Planner; Walker, Samuel
Subject: [EXTERNAL] LU-24-0009 Marshall Mesa

It has been brought to my attention that today is the deadline to comment regarding Boulder County LU-24-0009, City of Boulder (City) redevelopment of Marshall Mesa trailhead.

While no one wants to delay reclamation work the State Department of Reclamation and Mine Safety (DRMS) needs to conduct to reduce the risks associated with the underground burning coal fire, this does not mean the City's proposal should be expedited. It is critical for Boulder County to hold the City's redevelopment of this location to the same standards as other Use Reviews- especially since this exact location was an ignition point of the Marshall Fire, the State's largest federally declared disaster, and especially because the City of Boulder has been named a as responsible party by Xcel for failure to maintain this property.

I believe few comments will material change the reclamation work and that most agree this work should absolutely be expedited - however there is concern in the community that the City's proposal should not be attached to reclamation - it should neither expedite or slowing down reclamation. So while I do not want to slow reclamation, I have a number of comments related to the city's proposal.

PARKING: The trailhead proposal seeks to increase parking on the City's parcel, however the proposal doesn't seem to consider to fact the newly established park and ride also functions as overflow parking for the trailhead. It should be noted that this park and ride is operated/supported by Boulder County and is heavily used. Attached photos were taken the weekend of June 8th, 2024 (during this review period), showing use that often (especially during spring/fall weekends) results in a full parking lot and additional cars parked along the side of the Eldorado Springs Drive.

There is concern that the combined use of the two lots well exceeds 150 trips per day (limited impact review standards) and that separating the two locations seems to be skirting the intent of these review limits. (Please clarify to the community if "trips per day" means 150 cars- or if "trips per day" means cars-in and cars-out and therefore the equivalent of 75 cars?)

The lots both serve the Trailhead; even the Boulder County press release of the crosswalk install in 2023 (https://bouldercounty.gov/news/improvements-coming-soon-to-eldorado-park-n-ride-in-boulder/) clearly stated this crosswalk (1) was to serve the trailhead and (2) was temporary while additional improvements would be made to the trailhead to "align with the city's goal of vision zero".

The second concern is that the crosswalk from this park and ride to the trailhead does not align with "vision zero". This is a congested and often dangerous intersection where young mountain bike teams or young families cross to the trailhead. It seems this crosswalk should have a blinker or beacon light- and this appears to be what the City's own traffic study supplied for this use review recommends (see recommendations on page 37 of mueller traffic study, page 415 of pdf)? (Although it appears the City analysis (Figure C3, pg 415) indicates this is a controlled crosswalk, please clarify? And that a blinker isn't necessary? Community members would appreciate clarification or explanation on the traffic report.)

Infrastructure: Finally, the City's past land use approval, the approval that granted trailhead opening at this location, included a cistern for fire supply for the town of Marshall. The fact that this proposal was never accomplished and the Marshall fire ignited at this very location is nothing short of horribly ironic. The City bought this property knowing the hazards located at the site and yet, opened a trailhead without any mitigation of such hazards (as required by boulder

county land use article 4). I will always believe that the Marshall fire would have unfolded differently - that homes and even lives could have been saved if the City had fulfilled its proposal and the cistern had water in it that day.

If the City had properly communicated risks they knew about, I think the public would have wanted those risks addressed and would have supported water supply to a community that desperately needed and deserves it. Instead, the City has denied efforts to support the surrounding community in the name of Area III "preservation"- while it purchased all surrounding land and intensified the use of the area without addressing the need for infrastructure to support such use.

This isn't about zoning, this is about environmental justice and supporting the community that has become an island in the City's green belt.

So pertaining to this proposal, considering the concern that parking is over 150 trips per day- and considering a shuttle service, operated by Boulder County, shuttles people to this trailhead, I feel the City's proposal does not adequately address peak wastewater demands - the facilities before the fire were inadequate and something similar would continue to be inadequate moving forward considering the increased use of the trailhead and park and ride.

Other than the parking and infrastructure pieces, I look forward to using the trailhead and recreating with the droves of trail users out there! :)

Respectfully,
Megan Monroe
Adjacent landowner and Marshall fire total loss

Walker, Samuel

From: ellen berry <cmdanceellen@gmail.com>
Sent: Wednesday, June 19, 2024 4:34 PM
To: LU Land Use Planner; Walker, Samuel; Case, Dale
Subject: [EXTERNAL] LU-24-0009
Attachments: UBCC Comment on Marshall Mesa LU-24-0009_6.2024.docx; ATTACHMENT 1 City of Boulder SPR 2006.pdf; ATTACHMENT 2 BIL_AML_Guidance_7-19-22.pdf

CP&P

This letter is submitted by the Unincorporated Boulder County Committee of Marshall Fire victims. Please include the letter and referenced attachments as comment for this proposal.

Unincorporated Boulder County
MARSHALL FIRE RESTORATION COMMITTEE

To: Boulder County Commissioners
Boulder County Community Planning and Permitting,
City of Boulder Council Members,
City of Boulder Open Space and Mountain Parks
Rep. Joe Neguse,
Sen. Rachel Zenzinger,
Sen. Jeff Bridges,
Rep. Judy Amabile,
Rep. Kyle Brown

Date: June 19, 2024

Re: Boulder County Limited Impact Review #LU-24-0009: Limited Impact Special Use Review to permit 364,000 cubic yards of earthwork for subsurface coal fire mitigation and redevelopment of the Marshall Mesa trailhead.

The City of Boulder (City) has submitted a Limited Impact Special Use permit for review by Boulder County for reclamation of an underground coal fire and trailhead improvements at the City of Boulder Marshall Mesa Trailhead (Trailhead). Considering this proposal encompasses the "Trailhead Ignition Point" of the Marshall Fire, and considering the underground coal fire could not be ruled out as a potential cause of the Marshall Fire, it is important that the wider Marshall Fire community voice be heard during this public review process.

First, the previous Use Review for this location (SPR-06-078 – Attachment 1) included a proposal by the City to fill a 27,000 gallon cistern for a fire supply system for the town of Marshall and Eldorado Springs (Attachment 1). This proposal was never fulfilled and that cistern was empty during the Marshall Fire. We are pleased to learn Mountain View Fire Protection District will be installing a 20,000 gallon cistern as part of the current proposal at the trailhead. We encourage Boulder County Commissioners to make this a "Condition of Approval" to ensure the cistern is *installed and functions* in accordance to the proposal this time.

Secondly, the requested reclamation at the trailhead under this public review is funded by the Federal Infrastructure Investment and Jobs Act (IIJA) which has granted the State of Colorado, Department of Reclamation and Mine Safety (DRMS) an additional $150 million to address abandoned coal mining issues in the state of Colorado. This funding prioritizes water supply to adjacent properties that are impacted by some of the very mines being reclaimed (Attachment 2). This prioritization is because the adjacent communities have not only lived with environmental and public health risks for far too long- but also, because the reclamation will be a disruption to the community's sense of safety, peace and healing. The Marshall community and surrounding mine impacted properties deserve the support the IIJA is intending such communities to have access to.

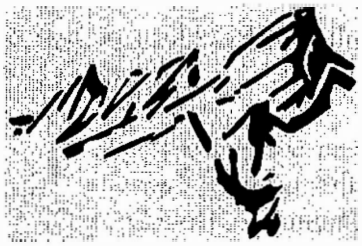
The reclamation this Boulder County Land Use Review addresses is part of the first round of IIJA funding in Colorado in part because of the unfortunate fact that the coal fire could not be ruled out as a cause of the Marshall Fire, but also, because of the coal fire's unique proximity to urban development including Unincorporated Boulder County (UBC), the Town of Superior and the City of Louisville. The rapid spread of the Marshall Fire proved the proximity of this site and the underground burning coal seam fire should be a concern to everyone in the vicinity of the Trailhead. To have this risk close to homes, neighborhoods and urban centers without adequate water supply is no longer acceptable.

As part of this IIJA funding, DRMS is currently evaluating impacts to water quality and options for repair/replacement for properties in the area that impacted by abandoned coal mines. Due to the extent of abandoned coal mine reclamation in this land use proposal (LU-24-0009), not only is the surrounding adjacent community a candidate for these Federal IIJA Funds, but the City of Boulder parcel under this public review is undeniably impacted and a candidate for these Federal funds as well.

Since the underground coal fire could not be ruled out as a potential cause of the Marshall Fire (a two billion dollar federally declared disaster), it is essential for the City of Boulder to work with the State of Colorado and DRMS to utilize Federal IIJA funds to supply a pressurized hydrant at the City of Boulder property. Anything less is ignoring the risks these Federal funds are intended to address and would be minimizing the destruction and loss that occurred because of the Marshall Fire and specifically, the ignition point that occurred at this very trailhead.

In support of our community,

Unincorporated Boulder County Committee (UBCC)



City of Boulder Open Space & Mountain Parks

P.O. Box 791, Boulder, CO 80306; 303-441-3440
www.cl.boulder.co.us/openspace/

Pac-06-095

July 14, 2006

Boulder County Land Use Dept.
Courthouse Annex, 13th & Spruce Street
P.O. Box471
Boulder, Colorado 80306
Attn: Greg Oxenfeld, County Planner
Eric Tkachenko, Planner

Re: Site Plan Review for change in use to Parking
1842 South Foothills Highway

Dear Greg, Eric,

The City of Boulder Open Space and Mountain Parks desires to construct a trailhead on 2.33 acres of land located at 1842 South Foothills Highway, Boulder, Colorado. This property was purchased by the City of Boulder on December 8, 2004. The proposed trailhead will include gravel parking for 6 trucks with horse trailers, 36 vehicles and 4 ADA parking spaces (total of 46 parking spaces), a men and women's vault privy, an interpretive area, several picnic tables, a small horse corral, and native plant restored islands and berms areas. Two new trail connections will extend to the south from this new trailhead in the future. A trailhead identity sign as well as an information board will be installed on this site to inform the public of our trails, information, and regulations.

Existing Conditions-

Currently on the site is a 27,000 gallon underground water storage tank holding water pumps with sufficient capacity to provide sprinkler protection for the previously designed 24,000 square foot commercial office space (never completed), We are working with EXCEL to reconnect the power to these pumps which should occur very soon. Additionally, in cooperation with the Front Range Fire Protection District (former Cherryvale FD), we plan to operate this site as a fire water supply point/system to service this southern Boulder County area, the Towns of Marshall and Eldorado Springs. Front Range Fire has agreed to refill this tank when they are able after any useage.

The previous owner(s) had installed an 8 gallon a minute (gpm) water well and 1000 gallon drinking water storage tank on the site that will be used to provide water for horses and other animals in the new trailhead area. At this time, we are not planning to provided potable water for public use. Signs will be placed to inform the public of this "non-potable water" source for their animals.

We have applied to Boulder County Building inspection and received a building permit #37860 to install a men and women's vaulted privy on this site. Included in this design is a small storage area to store

July 2022

GUIDANCE ON THE BIPARTISAN INFRASTRUCTURE LAW ABANDONED MINE LAND GRANT IMPLEMENTATION

I. OVERVIEW

The Bipartisan Infrastructure Law (BIL) (Pub. L. No. 117-58), also known as the Infrastructure Investment and Jobs Act, was enacted on November 15, 2021. The BIL authorized and appropriated $11.293 billion for deposit into the Abandoned Mine Reclamation Fund administered by the Office of Surface Mining Reclamation and Enforcement (OSMRE). Of the $11.293 billion appropriated OSMRE will distribute approximately $10.873 billion[1] in BIL Abandoned Mine Land (AML) grants to eligible States and Tribes on an equal annual basis—approximately $725 million a year—over a 15-year period.[2] In accordance with Executive Order 14008, States and Tribes are encouraged to prioritize projects that equitably provide funding under the Justice40 Initiative towards meeting the goal that 40 percent of the overall benefits flow to disadvantaged communities.[3] BIL funds will expand the AML Reclamation Program to meet the priorities described in the BIL and the Surface Mining Control and Reclamation Act of 1977 (SMCRA), as amended. States and Tribes may use BIL AML grants to address coal AML problems, including:

- Hazards resulting from legacy coal mining that pose a threat to public health, safety, and the environment within their jurisdictions (including, but not limited to, dangerous highwalls, waste piles, subsidence, open portals, features that may be routes for the release of harmful gases, acid mine drainage, etc.);
- Water supply restoration (infrastructure); and
- Coal AML emergencies.

The purpose of this guidance document is to provide State/Tribal AML Programs with overarching information concerning the interpretation, project eligibility, and priorities for the use of BIL AML

[1] Section 40701 of the BIL authorizes $11.293 billion for deposit into the AML Fund, and Division J, Title VI appropriates and apportions the funds in the following ways: up to 3% for OSMRE Operations, 0.5% for Office of Inspector General (OIG) Operations, and $25 Million for OSMRE to provide States and Tribes financial and technical assistance in making amendments to the inventory system for documenting eligible lands and waters. The remaining funds, approximately $10.873 billion, will be distributed to eligible States and Tribes as BIL AML grants.

[2] Section 40701(c) of the BIL limits the use of BIL AML grants to the activities described in subsections (a) and (b) of section 403 and 410 of SMCRA. OSMRE will ensure that the annual grants provided to a State or Tribe do not exceed its estimated cost to reclaim its remaining coal AML problems and water supply restoration, as documented in the Abandoned Mine Land Inventory System (e-AMLIS).

[3] "Disadvantaged Community" – a community may be considered disadvantaged based on a combination of: low income, high and/or persistent poverty; high unemployment and underemployment; racial and ethnic residential segregation, particularly where the segregation stems from discrimination by government entities; linguistic isolation; high housing cost burden and substandard housing; distressed neighborhoods; high transportation cost burden and/or low transportation access; disproportionate environmental stressor burden and high cumulative impacts; limited water and sanitation access and affordability; disproportionate impacts from climate change; high energy cost burden and low energy access; jobs lost through the energy transition; access to healthcare; and geographic areas within Tribal jurisdictions; or based on the community's inclusion in the Climate and Economic Justice Screening Tool. Definition adapted from OMB and CEQ Interim Implementation Guidance for the Justice40 Initiative (M-21-28) dated July 20, 2021. See Climate and Economic Justice Screening Tool at: Explore the tool - Climate & Economic Justice Screening Tool (geoplatform.gov).

grant funds.[4] It also clarifies how BIL AML grant funding differs from the traditional fee-based AML grant distributions authorized by SMCRA. OSMRE will consider initiating rulemaking to establish requirements and obligations related to application procedures, allowable uses of funds, and reporting program activities and outcomes.

II. ELIGIBLE STATES AND TRIBES

Pursuant to section 40701(b)(2) of the BIL, eligible grant recipients include both certified and uncertified States and Tribes carrying out approved AML Programs. A certified State or Tribe is a State or Tribe that has certified that all coal reclamation projects that are considered a priority under section 403(a)of SMCRA have been completed. An uncertified State or Tribe is a State or Tribe that has not yet made the certification that reclamation of all priority coal reclamation projects in the State or on applicable Indian lands have been completed.

III. ELIGIBLE PROJECTS & PRIORITIZATION

BIL AML funding may only be spent on eligible abandoned coal mine reclamation projects.[5] According to section 40701(c) of the BIL, BIL AML grants may only be used on one or more of the following:

- Priority 1 Projects – These projects protect public health and safety from extreme effects of coal mining practices, including the restoration of adjacent land and water resources and the environment (Section 403(a)(1) of SMCRA).

- Priority 2 Projects – These projects protect public health and safety from adverse effects of coal mining practices, including the restoration of adjacent land and water resources and the environment (Section 403(a)(2) of SMCRA).

- Priority 3 Projects – These projects restore land and water resources and the environment previously degraded by adverse effects of coal mining practices (Section 403(a)(3) of SMCRA). These projects may include the design, construction, operation, maintenance, and rehabilitation of acid mine drainage (AMD) treatment facilities regardless of whether they are part of a qualified hydrologic unit.

- Water Supply Restoration Projects - protection, repair, replacement, construction, or enhancement of facilities relating to water supply, including water distribution facilities and treatment plants, to replace water supplies adversely affected by coal mining practices (Section 403(b) of SMCRA).

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[4] As this is a guidance document, it does not create legally binding requirements and should not be construed to create any rights or benefits, either substantive or procedural, that are enforceable by law. To the extent there is any inconsistency between a provision of this guidance document and any applicable law or regulation, the law or regulation will control.

[5] In general, section 404 of SMCRA describes "[l]ands and waters eligible for reclamation or drainage abatement expenditures" under SMCRA as those lands and waters "which were mined for coal or which were affected by such mining, wastebanks, coal processing, or other coal mining processes . . . and abandoned or left in an inadequate reclamation status prior to" August 3, 1977.

- AML Emergency Projects - Emergency projects that restore, reclaim, abate, control, or prevent adverse effects of coal mining practices, on eligible lands when an emergency exists constituting a danger to the public health, safety, or general welfare and no other person or agency will act expeditiously to restore, reclaim, abate, control, or prevent adverse effects of coal mining practices (Section 410 of SMCRA).

Use of BIL funding differs from the traditional fee-based AML funding in a few important ways:

- Stand-alone projects classified as Priority 3 under SMCRA Title IV are eligible for BIL funding, whether or not the project is in conjunction with other projects classified as Priority 1 and Priority 2 projects under SMCRA Title IV;

- AMD treatment projects that are not part of a qualified hydrologic unit are eligible for BIL funding;

- Eligible states and tribes are not authorized under the BIL to place BIL AML grant funds into AMD set-aside accounts.[6]

Under section 405(e) of SMCRA, State and Tribal AML Reclamation Plans must identify the specific criteria for ranking and identifying projects to be funded. The *overall* State or Tribal AML Program must reflect the priorities listed in section 403(a), and, accordingly, the BIL does not require strict adherence to those priorities when grantees and OSMRE work to evaluate, apply for, and approve particular projects.

OSMRE will consult with each State and Tribe receiving funds under the BIL to identify which updates to the grantee's Reclamation Plan, if any, are necessary to ensure that the Plan's complies with the BIL.

In spending BIL AML funds, as authorized by section 40701(f) of the BIL, States and Tribes should, consistent with State or Tribal applicable law, prioritize providing employment opportunities to current and former employees of the coal industry, when such employees are available to work on projects within the region, State, or local area. OSMRE will work with States and Tribes to incorporate such prioritization into their reclamation plans. Measures to implement these priorities may include: (1) requiring contractors to affirm that they will give preference to current and former employees of the coal industry in any hiring for BIL-funded AML projects; (2) requiring contractors to report on the extent to which current and former employees of the coal industry have been employed in any AML work the contractors perform; (3) requiring contractors to retain data that can substantiate the reported information; and (4) providing to OSMRE the information reported by the contractors as part of the State or Tribe's regular AML reporting processes. To further implement the section 40701(f) prioritization, States and Tribes should engage with other Federal, State, Tribal, and local government agencies, and labor or worker organizations that represent coal industry workers to identify current or former employees of the coal industry who are candidates to be employed by AML reclamation contractors and provide OSMRE with certifications of this engagement.

[6] Section 402(g)(6) of SMCRA authorized the creation and use of AMD set aside accounts, which allow uncertified States to apply for up to 30% of certain fee-based funds received as part of their traditional annual AML grant to be transferred to an interest-bearing account established by the State/Tribe to be used for the abatement of the causes and the treatment of the effects of AMD in a comprehensive manner within qualified hydrologic units affected by coal mining practices.

The Department will commence notice and comment rulemaking, as necessary, to further implement section 40701(f) and to provide additional guidance as to its scope. Such a proposed rule would, if finalized, based on section 40701(f), require that States and Tribes provide employment opportunities to current and former employees of the coal industry, prioritize projects that provide such employment opportunities, and prioritize use of BIL AML funding on AML projects that promote the revitalization of coal communities.

States and Tribes should also prioritize projects that deliver benefits to disadvantaged communities including the reduction of environmental burdens on such communities in alignment with the overall objectives of the Justice40 Initiative.

States with unreclaimed mines on the list of EPA's Methane Coal Mine Opportunities Database (https://www.epa.gov/cmop/coal-mine-methane-abandoned-underground-mines) are encouraged to prioritize the reclamation of such sites where eligible for BIL AML funding in a manner that eliminates methane emissions to the greatest extent possible.

IV. AML PROGRAM MANAGEMENT

In carrying out their programs with BIL AML funding, OSMRE encourages States and Tribes, consistent with State or Tribal applicable law, to:

- Use procurement processes that incentivize AML contractors to hire current and former employees of the coal industry when bidding on BIL-funded AML projects and require the collection of information from AML contractors about the number of current and former coal industry employees they employ;

- Aggregate projects into larger statewide or regional contracts as part of their procurement processes, in order to improve efficiencies in their BIL AML grant funding;[7]

- Prioritize aggregated or larger projects in selecting projects to be funded;

- Support pre-apprenticeship, registered apprenticeship, and youth training programs that open pathways to employment by collaborating with other Federal, State, Tribal, and local government agencies and non-governmental organizations that have the relevant expertise in these areas, including the Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization. While BIL AML grants may not be used to directly fund pre-apprenticeships, apprenticeships and training programs, States and Tribes are encouraged to strengthen existing partnerships with governmental agencies and non-governmental entities that provide these types of services and to strategize on ways to promote these types of opportunities for BIL AML projects, including by identifying workforce needs for AML projects.

[7] Section 40701(b)(3) of the BIL allows states to aggregate bids in this manner.

- Require contractors to support safe, equitable, and fair labor practices by adopting collective bargaining agreements, local hiring provisions (as applicable), project labor agreements, and community benefits agreements.

- When applicable, select project designs that reduce methane emissions from abandoned coal mine sites.

- Incorporate input from disadvantaged communities, communities of color, low-income communities, and Tribal and Indigenous communities[8] into prioritization criteria and the method for selecting projects to be funded. For more information, see the "Public Engagement" section.

If any of the aforementioned activities cannot be reasonably accomplished in carrying out the BIL AML program, States and Tribes should include in their grant application a detailed rationale for why the specified activity(ies) could not be implemented.

OSMRE and the Department of the Interior (DOI) will engage with the Department of Labor (DOL) to determine what information and tools DOL can provide to States and Tribes to support the above efforts.

BIL AML funds may not be used, directly or indirectly, to support or oppose union organizing.

Further, States and Tribes must implement measures to ensure that a bidder for a BIL AML contract cannot be awarded a contract or subcontract or perform any work funded by the BIL AML, if their company, their owners and controllers, their corporate officers and their shareholders own or control mine operations that have any outstanding uncorrected or unabated violations. Consistent with 30 C.F.R. § 874.16 and § 875.20, every successful bidder for an AML contract must be eligible under 30 C.F.R. §§ 773.12, 773.13, and 773.14 at the time of contract award to receive a permit or be provisionally issued a permit to conduct surface coal mining operations. At a minimum, States and Tribes must review the Applicant Violator System, and the System for Award Management and any other available information to verify the eligibility of each bidder before a contract or subcontract is awarded for any work performed and funded under the BIL AML.

V. BIL AML GRANTS

[8] "Low-income communities" are those communities that in the last 12 months had a median household income less than twice the poverty level. This definition is similar to USEPA's EJSCREEN definition at https://www.epa.gov/ejscreen/ejscreen-map-descriptions#category-demographics

"Communities of color" are those communities with a higher than national average percent of individuals in a block group who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino. That is, all people other than non-Hispanic white-alone individuals. The word "alone" in this case indicates that the person is of a single race, not multiracial. A block group is an area defined by the Census Bureau that usually has in the range of 600-3,000 people living in it. This definition is adopted from USEPA's EJSCREEN definitions at: https://www.epa.gov/ejscreen/overview-demographic-indicators-ejscreen#demoindex

"Tribal and Indigenous communities" are communities whose members make up a Federally recognized Indian Tribe, a State-recognized Indian Tribe, an Alaska Native community or organization, a Native Hawaiian organization, or any other community of indigenous people located in a State, including indigenous persons residing in urban communities.

On February 7, 2022, DOI announced the BIL AML grant distribution amounts that each eligible State and Tribe will receive in fiscal year (FY) 2022. The Notice of Funding Opportunity for the BIL AML grants will be available before the end of the 4th quarter of FY 2022.

Annual BIL AML grant amounts are calculated using a congressionally mandated formula based on the number of tons of coal historically produced in the States or from applicable Indian lands before August 3, 1977. Adjustments will be made to ensure the total amount of the distributions to any individual State or Tribe is not less than $20 million over the life of the program to the extent that amount is needed for eligible projects described above and to reconcile the amount of the BIL AML funding with the total unfunded cost of coal problems at the end of the preceding fiscal year, as reflected in the enhanced Abandoned Mine Land Inventory System (e-AMLIS).

BIL AML grants will be awarded to eligible State and Tribal AML Programs on an annual basis and adjustments will be made to these distributions as required and needed to achieve the objectives of the program. For example, adjustments will be made as changes to the number of eligible States and Tribes increase or decrease. The period of performance for BIL grants will be five-years, with an option for a one-time no-cost extension of up to one year, subject to OSMRE's review and approval. BIL AML grants will be disbursed and tracked under the Assistance Listing Numbers (ALN) No. 15.252. [9] In order to receive BIL AML funding in FY22, each eligible State and Tribe will need to submit a separate grant application for BIL AML grants from the traditional AML fee-based grants through GrantSolutions. For FY23 and beyond, due to the differing requirements and timeframes of BIL and fee-based grants, OSMRE expects to require separate grant applications for the two programs, but the agency will continue working with the States and Tribes in order to develop procedures that minimize burdens on applicants. States and Tribes are required to ensure that expenditures for the two programs are tracked separately.

BIL AML grant recipients will be required to comply with all applicable Federal grant award requirements, including but not limited to, the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards (2 C.F.R. part 200). OSMRE anticipates that State and Tribal AML Programs will incur higher staffing and operational costs as they stand up programs to effectively implement their BIL AML programs. In addition, the administrative costs for annual BIL AML grant awards will be available for the entire grant performance period (i.e., five years, with the possibility of a one-year extension).

The BIL AML funded projects are subject to the Build America Buy America (BABA) Act that was enacted as part of the BIL in 2021. As required by Section 70914 of the BIL and consistent with the Office of Management and Budget's (OMB) Made in America's April 18, 2022 guidance for implementing the BABA Act, none of the funds under a federal award that are part of Federal financial assistance for infrastructure may be obligated on or after May 14, 2022, for a project unless all of the iron, steel, manufactured products, and construction materials (excluding concrete and aggregates) used in the project are produced in the United States, unless subject to an approved waiver. The requirements of this section must be included in all subawards, including all contracts and purchase orders for work or products.

[9] The ALN number is a five-digit number assigned in an awarding document for any financial assistance (e.g., grants) funded by the Federal government. Although both the BIL AML Funds and the traditional AML fee-based grants will be disbursed under the same ~~CFDA~~ ALN No. 15.252, separate grant applications via GrantSolutions will be necessary in FY22.

Appendix I, which is entitled, "Subaccounts for BIL AML Financial Assistance," provides guidance on the available subaccount categories that State/Tribal AML Programs can use in the development of their BIL AML grant application. Outlined below are the main subaccounts:

- BIL – Non-Emergency Administrative Costs
- BIL – Non-Water Supply (Coal Project) Costs
- BIL – Water Supply Project Costs
- BIL – Coal Projects Engineering & Design Costs
- BIL – AMD Operational and Maintenance Costs
- BIL – Emergency Project Costs

For FY22, States and Tribes are encouraged, but will not be required, to provide a list of projects expected to be funded in the upcoming year in their application (see Appendix II). Beginning with FY23 grant applications, States and Tribes will be required to include lists of projects to be funded over a one-year timeframe; additional details on this requirement will be provided in future guidance.

When applying for BIL AML grants, State and Tribal AML Programs should include:

- Starting in FY 2023, a description of each proposed projects to be funded during the grant period of performance (see Appendix II).
- A description of the State and Tribe's prioritization process or ranking system for the selection of proposed projects;
- A description of the process the State or Tribe will use to obtain public input to develop the list of projects to be funded;
- A statement of the estimated benefits that will result from proposed projects;
- A statement of how the State or Tribe will prioritize projects employing current or former employees of the coal industry, consistent with State or Tribal applicable law;
- Plans for engaging with other Federal, State, Tribal, or local governmental agencies and non-governmental entities on workforce training and development issues, including how activities encouraged under Section III will be implemented, if applicable, along with the names of potential partners to support recruiting and training efforts, including community colleges, workforce partners, community-based groups, and unions;
- Any known linkages to economic redevelopment opportunities created by carrying out proposed projects;
- A description of how the grantee will address environmental justice issues within coalfield communities;
- Details of how the grantee will engage with relevant State, Tribal, or local governmental agencies or non-governmental organizations to identify and address any disproportionate burden of adverse human health or environmental effects of coal AML problems on disadvantaged communities, communities of color, low-income communities, and Tribal and Indigenous communities;
- A description of whether and to what extent proposed projects may reduce greenhouse gas emissions, particularly methane emissions;
- Estimated costs for each project to be completed using the BIL AML grant funding. If BIL AML funds will be leveraged with other funding sources, such as AML-fee based grants, include this information; and,

- Proposed performance measurement (See Section XI).

OSMRE understands that it will be difficult for States and Tribes to determine or estimate much of this information for projects to be funded with the first year of BIL AML grant funding, but is listing them here to allow States and Tribes to prepare for future application requirements. In FY22, States and Tribes should spell out how their project selection practices will achieve reclamation, remediation, and socio-economic benefits.

When possible, a project's scope or outcome may be expanded or enhanced. States and Tribes are encouraged to identify and leverage additional funding sources (e.g., Clean Energy Demonstration Program under Title III, Section 40341 of the BIL; DOI's Ecosystem Restoration Program under Title VIII, Section 40804 of the BIL; and EPA Brownfield Job Training Grants) and in-kind contributions to be used in conjunction with BIL AML monies.

VI. DAVIS-BACON ACT

The BIL requires that all laborers and mechanics employed by the applicant, recipient, subrecipient, contractors, or subcontractors in the performance of construction, alteration, or repair work on a project that will be assisted in whole or in part by funding made available under the BIL must be paid wages at rates not less than those prevailing on similar projects in the locality, as determined by the Secretary of Labor in accordance with the Davis-Bacon Act (40 U.S.C. §§ 3141-3148). The Davis-Bacon labor standards are applicable to the reclamation projects completed using BIL AML funding and Davis-Bacon clauses must be included in BIL AML work contracts. The Department of Labor Fact Sheet #66A: Bipartisan Infrastructure Law provides additional information on the responsibilities of BIL funding recipients (see Appendix IV).

Technical assistance to States and Tribes to meet the requirements of the Davis Bacon Act is also available through the Department of Labor. Currently, the Department of Labor offers free Prevailing Wage Seminars several times a year that focus on compliance with the Davis Bacon Act, at https://www.dol.gov/agencies/whd/government-contracts/construction/seminars/events. For additional resources on how to comply with DBA provisions and clauses, see https:/www.dol.gov/agencies/whd/government-contracts/construction and https:/www.dol.gov/agencies/whd/government-contracts/protections-for-workers-in construction.

VII. PUBLIC ENGAGEMENT

When selecting and developing eligible projects for the BIL AML Program, State and Tribal AML Programs should ensure public engagement at the local level through engagement with affected communities. The term, "public" includes all stakeholders (e.g., citizens at large, industry, other Federal, State, Tribal, or local agencies, Tribal Nations, unions and worker organizations, non-governmental organizations, community colleges, workforce boards, community-based groups, and environmental groups). Engaging with the public to identify potential projects before the projects are selected will ensure that the projects completed through this program best address the needs of the relevant communities.

States and Tribes are encouraged to use existing best practices for public engagement or develop a process for public outreach and communication with local citizens, agencies, and organizations that best

fits their unique circumstances. For example, States and Tribes could notify local citizens of the intent/purpose of a project via meetings, print media, websites, and social media and/or partner with organizations that facilitate public outreach and communication. OSMRE recommends that public engagement occur as early as possible for each grant cycle, with the public provided at least 60 days to review and provide input on the projects that will be proposed for funding in the State or Tribe's grant application.

VIII. ENHANCED ABANDONED MINE LAND INVENTORY SYSTEM (e-AMLIS)

Pursuant to section 403(c) of SMCRA, OSMRE maintains e-AMLIS, the central electronic database for housing the national inventory of unreclaimed AML problems affecting public health, safety, and the environment and reclaimed sites, along with their associated reclamation costs. Data maintained in e-AMLIS are provided by States and Tribes using standardized procedures approved by OSMRE.

States and Tribes are required to enter all coal AML projects into e-AMLIS and identify them as BIL AML projects when funds are expended. To ensure that States and Tribes are able to update their respective AML inventories in e-AMLIS, the BIL makes $25 million available to the Secretary of the Interior to provide financial and technical assistance to States and Tribes to amend e-AMLIS. OSMRE will provide further guidance on its implementation of this specific requirement of the BIL at a later date.

IX. COMPLIANCE WITH THE NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

OSMRE has determined that all BIL AML funded reclamation projects are major Federal actions[10] subject to review under the NEPA because, in accordance with NEPA regulations,[11] BIL AML projects are federally assisted activities performed using Federal funds.

OSMRE REG-1, Handbook on Procedures for Implementing the National Environmental Policy Act (NEPA Handbook) (Revised 2019), provides additional information on NEPA compliance.

Depending on the significance of the actual and potential impacts of the proposed action, there are three potential analytical approaches under NEPA, including a:

1) Categorical Exclusion (CE);
2) Environmental Assessment (EA), which may result in a Finding of No Significant Impact (FONSI) or a Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS); or
3) Environmental Impact Statement (EIS) and Record of Decision (ROD).

The Department's NEPA regulations make clear that in the absence of an applicable CE, an EA, and, in some cases, an EIS, must be prepared for the proposed Federal action. 43 C.F.R. § 46.205(a) states:

[10] According to 40 C.F.R. § 1508.1, major Federal actions may include, among other things, new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by Federal agencies.

[11] NEPA regulations issued by the White House Council on Environmental Quality (CEQ) are found at Title 40, Parts 1500-1508 of the Code of Federal Regulations (40 C.F.R. § 1500-1508, 42 U.S.C. §§ 4371 *et seq*.).

> If a proposed action does not meet the criteria for any of the listed Departmental categorical exclusions or any of the individual bureau categorical exclusions, then the proposed action must be analyzed in an environmental assessment or environmental impact statement.

In accordance with section 8.5.2.1 of OSMRE's NEPA Handbook, State and Tribal AML programs must ensure that all connected actions, regardless of the funding source or who proposes them, are analyzed in a single NEPA document. Additionally, the impacts of a project that includes multiple phases must be reviewed in a single or programmatic NEPA document. Multi-phase projects may require subsequent additional NEPA. State and Tribal AML Programs are strongly encouraged to look closely at the NEPA analyses outlined above and refer to OSMRE's NEPA Handbook to better understand the NEPA process early and align their proposed projects accordingly.

The three potential analytical approaches under NEPA are defined below.

Categorical Exclusion

A CE is a class of actions that a Federal agency has determined, after review by CEQ, does not individually or cumulatively have a significant effect on the human environment; therefore, neither an EA nor an EIS is normally required unless an extraordinary circumstance is identified.[12] A CE is the threshold NEPA analysis for a proposed Federal action. OSMRE has created and received approval from CEQ for a CE. This CE is contained in the DOI Departmental Manual (DM), Chapter 13 [516 DM 13.5(33)].

Environmental Assessment

If a determination is made that the proposed Federal action cannot be categorically excluded from further NEPA analysis, then an EA is prepared. The EA determines whether a Federal action has the potential to cause significant environmental effects. If no significant environmental effects are found, the decision document will result in a FONSI, and the project may continue without further NEPA analysis. However, if it is determined that an action will have significant effects, then the project must go through the EIS process.

Environmental Impact Statement

For actions with significant impacts, NEPA requires Federal agencies to prepare an EIS that must assess, among other things, the potential environmental impacts of the proposal and alternatives to the proposed action. *See* 42 U.S.C. § 4332; 40 C.F.R. part 1502. Once an agency reaches a final decision on the action it wishes to take (i.e., the proposed action or an alternative), it creates a ROD, which is the conclusion of the EIS process. 40 C.F.R. § 1505.2.

X. PROJECT AUTHORIZATION

OSMRE's regulations require that, before the start of construction on any non-emergency reclamation project, States and Tribes must submit to OSMRE a request for an Authorization to Proceed (ATP) once the NEPA analysis has been completed. 30 C.F.R. §§ 885.15, 886.16. An ATP request for a reclamation project must include: confirmation that the problem area to be reclaimed has been entered into e-

[12] Extraordinary circumstances are described in the Departmental NEPA regulations at 43 C.F.R. § 46.215.

AMLIS; all completed environmental documents, including NEPA documents and other documents demonstrating compliance with relevant environmental laws, such as the Endangered Species Act; an AML eligibility statement; and any additional documentation requested by OSMRE for that particular project.

As discussed above, State and Tribal AML programs should, in compliance with State or Tribal law, engage with other Federal, State, Tribal agencies, and local government agencies and labor and worker organizations that represent coal industry workers to identify current or former employees of the coal industry who are candidates to be employed by AML reclamation contractors consistent with the section 40701(f) prioritization and provide OSMRE with certifications of this engagement. States and Tribes should maintain sufficient records to substantiate this engagement upon request.

OSMRE will provide an ATP letter once the agency has determined that the request satisfies the guidelines for ATP issuance. The ATP letter from OSMRE provides the required approval to use BIL AML grant funding to reclaim the specific project being addressed and allows project construction to begin. Although NEPA documentation is part of the criteria required for an ATP request, the NEPA process and ATP process are two separate processes. An ATP request cannot be completed until OSMRE has completed the NEPA review process and issued a ROD, FONSI, or CE in compliance with the NEPA requirements.

XI. EMERGENCY AUTHORIZATION

According to chapter 4-120 of the Federal Assistance Manual (FAM), States and Tribes are required to submit a request for emergency declaration to OSMRE for emergency reclamation projects. The FAM requirements track the "emergency" definition at 30 C.F.R. § 700.5, identifying the proper amount of emergency reclamation as the amount necessary to stabilize the emergency aspects of the problem—eliminating the immediate danger to public health, safety, and general welfare. Any remaining reclamation should then be accomplished as part of a regular, non-emergency AML project, as necessary.

Upon receipt of a request for emergency declaration, OSMRE will review the information and ensure that the project meets all requirements of the AML emergency program. If all information contained within the request for emergency declaration is complete, OSMRE will declare an emergency by signing a Finding of Fact/ATP. The Finding of Fact certifies that the problem meets the emergency criteria and serves as the point of Federal action, authorizing the State/Tribe to proceed with reclamation work on the site. After the emergency is abated, the States and Tribes are required to comply with all applicable Federal laws and regulations, including NEPA.

XII. BIL AML PERFORMANCE MEASURES & REPORTING

OSMRE is required to submit a report to Congress within six years of the first BIL AML grant allocation to State and Tribal AML Programs. This report will detail the progress made under the BIL AML provisions in addressing outstanding reclamation needs under subsections (a) and (b) of section 403 and section 410 of SMCRA. In preparing this report, OSMRE will solicit input from State and Tribal AML Programs on the progress made in addressing outstanding coal AML problems and use the

information provided in the annual evaluation reports each State and Tribe submits pursuant to section 405(j) of SMCRA.[13] OSMRE intends to provide future guidance on how to prepare the information required in the report to Congress.

OSMRE is evaluating and developing the performance measures and reporting elements to be tracked to ensure accomplishments made by State and Tribal AML Programs under the BIL are captured in these annual reports. Given that AML projects are located in coalfield communities that may also be defined as disadvantaged communities, communities of color, low-income communities, or Tribal or Indigenous communities, State and Tribal AML Programs are encouraged to track and report on the types of benefits and the percentage of benefits that accrue to these communities. State and Tribal AML Programs are also encouraged to engage with stakeholders to help identify metrics that accurately reflect the benefits of BIL AML projects in their reclamation programs. In order to enable complete reporting, States and Tribes are expected to track the following types of benefits that can be measured and reported:

AML Reclamation Environmental Benefits

- Number of acres reforested
- Number of trees planted on AML sites
- Number of bat gates installed
- Number of acres of endangered species habitat re-established
- Number of tons of rare earth elements, metals, or sediment recovered for reuse
- Amount of methane emissions reduced

AMD Remediation Project Benefits

- Quantity of iron, aluminum, manganese, sulfate, etc. removed and/or recovered on annual basis by AMD water reclamation projects
- Quantity of Rare Earth Elements (REE) recovered by AMD water reclamation projects
- Number of AMD passive treatment systems built
- Number of AMD passive treatment systems operated and maintained
- Number of AMD active treatment systems built
- Number of AMD discharges abated
- Miles of waterways improved
- Estimated volume of water treated
- Number of outflows remediated

Socio-economic Benefits of BIL AML Projects

- Percent of overall benefits and types of benefits that accrue to disadvantaged communities, communities of color, low-income communities, or Tribal or Indigenous communities;
- Number of former/current employees of the coal industry employed in AML reclamation;
- Demographics/number of workers from under-represented groups, as defined by Executive Order 13985, “Advancing Racial Equity and Support for Underserved Communities Through the Federal Government”;
- Percentage of workers employed at AML sites that reside in the county in which the AML

[13] Pursuant to section 405(j) of SMCRA, State and Tribal AML programs will be required to submit annual reports to track their progress and accomplishments in addressing outstanding reclamation needs using BIL AML grant funds.

project is located, or in adjacent counties;
- If there is a community benefit agreement as part of the project;
- Number of project partners involved in AML reclamation projects;
- Number of contract(s) awarded that aggregated projects exceeding a value of $1 million at the time of award;
- Number of businesses constructed on reclaimed AML sites, and number of people employed at those sites;
- Number of job hours involved in BIL AML remediation;
- Number of people receiving potable water after completion of water supply restoration projects;
- Number of residents positively impacted by the restoration of previously polluted waterways; and,
- Number of residents within one mile of a BIL-funded project.

Further, for projects or aggregated projects in excess of $1 million, States or Tribes should require that contractors, consistent with State or Tribal applicable law, provide:

1) a certification that the project uses a unionized project workforce;
2) a certification that the project includes a project labor agreement; or
3) a project workforce continuity plan, detailing:

- How the contractor ensured the project had ready access to a sufficient supply of appropriately skilled and unskilled labor to ensure high-quality construction throughout the life of the project, including a description of any required professional certifications and/or in-house training, registered apprenticeships or labor-management partnership training programs, and partnerships like unions, community colleges, or community-based groups;
- How the contractor minimized risks of labor disputes and disruptions that would have jeopardized the timeliness and cost-effectiveness of the project;
- How the contractor provided a safe and healthy workplace that avoids delays and costs associated with workplace illnesses, injuries, and fatalities, including descriptions of safety training, certification, and/or licensure requirements for all relevant workers (e.g., OSHA 10, OSHA 30);
- Whether workers on the project received wages and benefits that secured an appropriately skilled workforce in the context of the local or regional labor market;
- Whether the project had a Community Benefit Agreement, with a description of any such agreement; and
- Whether the project prioritized local hires.

As noted in Section IV, BIL AML funds may not be used to support or oppose union organizing.

* * *

<u>If you have any questions or need additional assistance, please contact your servicing OSMRE Field or Regional Office.</u>

Appendix I: Subaccounts for BIL AML Financial Assistance

Appendix II: Table for BIL AML Eligible Projects

Appendix III: BIL AML Project Flowchart

Appendix IV: Department of Labor Fact Sheet

**-Appendices to be developed as needed.

July 2022

Appendix I: Subaccounts for BIL AML Financial Assistance

I. Authorities

- The Surface Mining Control and Reclamation Act of 1977 (SMCRA), Pub. L. No. 95-87, as amended
- Infrastructure Investment and Jobs Act (IIJA), Pub. L. No. 117-58, also known as the Bipartisan Infrastructure Law (BIL)
- Office of Surface Mining Reclamation and Enforcement (OSMRE) Directive GMT-10, The Federal Assistance Manual (FAM)
- The Federal Grant and Cooperative Agreement Act of 1977, Pub. L. No. 95-224
- Title 2 C.F.R. Part 200, Uniform Administrative Requirements, Cost Principles and AuditRequirements for Federal Awards

II. Purpose

The purpose of this document is to provide guidance and to clarify the available subaccounts (i.e. cost categories) for allocating monies when submitting a BIL AML grant application and expending monies when invoices are submitted for processing through DOI's/OSMRE's financial system. This guidance document outlines the available subaccounts for BIL funds that were created in 2022. The Federal Assistance Manual (FAM) will be updated to reflect these changes.

III. Additional Information

This section contains the following information:

- BIL Subaccounts Table. (Table 1) This table provides a listing of all available subaccounts under the BIL AML Program, which is funded by moneys sourced from the U.S. Treasury.
- Fund Type Descriptions. This section describes the different types of funds listed in Table 1, which are used in the BIL AML Program.

BIL AML Grant Subaccount Table

The table below contains a listing of standard subaccounts currently available for BIL AML Grants:

Table 1: BIL Fund Subaccounts

Subaccount	Bipartisan Infrastructure Law
01	IL
03	IL
04	IL
19	IL
21	IL
23	IL

Listed below is the fund type description.

IL Funds authorized by section 40701 of the BIL that are available to eligible States and Tribes.

Source: U.S. Treasury Funds

Listed below are the subaccount number definitions:

01. Non-Emergency Administrative
These are costs that cannot be tracked to individual reclamation projects and include items, such as travel, rental of vehicles, and any other administrative expenses. Project Design and Engineering costs should not be incorporated into subaccount 01.

03. Coal Project Costs (Non-Water Supply)
These are costs for actual construction, realty work, construction contracting, construction inspection, and other items allocable to a specific project in accordance with the BIL. Please note that project design and engineering coal-related costs and operation and maintenance costs related to AMD projects should not be included under subaccount 03. An engineering and design subaccount 19, as described below, has been created to track these coal-related costs. An operational and maintenance subaccount 21, as described below, has been created to track these AMD related costs.

04. Water Supply Project Costs
These costs are authorized by the BIL, and eligible States and Tribes may expend funds to protect, repair, replace, construct, or enhance facilities related to water supplies adversely affected by coal mining practices. Please note that project design and engineering coal-related costs should no longer be included under subaccount 04. A new engineering and design subaccount 19, as described below, has been created to track these coal-related costs

19. Coal Projects Engineering & Design Costs

These are coal-related engineering and design costs associated with site investigation, public engagement, including identification and mapping of hazards; environmental sample collection and data validation; costs associated with surveying design and engineering of reclamation activities, including development of construction bid packages; costs associated with owner operator searches, eligibility determination, historic and archeological surveys, threatened and endangered species reports and consultation, document preparation related to NEPA, public meetings, and landowner agreements; and any other costs associated with project preparation before the award or initiation of a construction project.

Pursuant to section 403(c) of SMCRA, OSMRE maintains e-AMLIS, the central electronic database for housing the national inventory of unreclaimed AML problems affecting public health, safety, and the environment, and reclaimed sites, along with their associated reclamation costs. BIL funding may be used by State or Tribal AML Programs to amend their inventory of coal problems. Costs associated with the activities necessary to update a State or Tribe's inventory in e-AMLIS should be included under this subaccount.

Please note that this definition does not include construction oversight or long-term monitoring or maintenance. Any cost related to construction oversight or long-term monitoring or maintenance should be included under direct project subaccounts such as 03 and 04. Any BIL costs related to long term AMD operational and maintenance costs should be included under subaccount 21.

21. Acid Mine Drainage (AMD) Operational and Maintenance Costs

These are costs associated with the long-term operation and maintenance of AMD treatment facilities. This category was created as a result of the determination that States and Tribes receiving BIL AML funding may use the grant funds to operate and maintain AMD treatment facilities. Costs related to the construction of AMD treatment facilities should be included under direct project subaccounts such as 03 and 04. Costs related to the design of AMD treatment facilities should be included under subaccount 19.

23. BIL Emergency Projects Costs

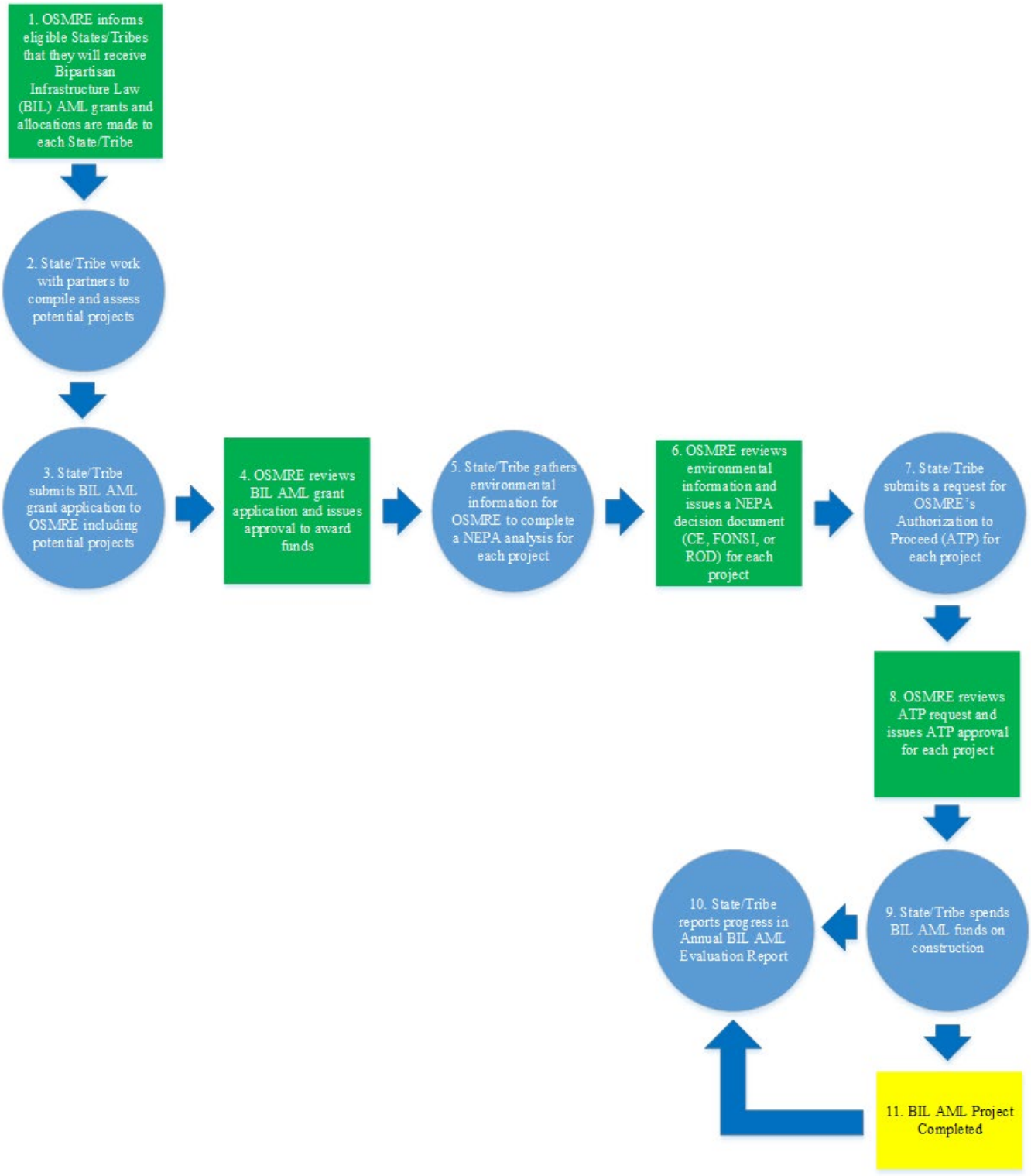
These costs are authorized by the BIL. As defined at 30 C.F.R. § 700.5, an emergency is a sudden danger or impairment that presents a high probability of substantial physical harm to the health, safety, or general welfare of people before the danger can be abated under normal program operation procedures. Emergency project costs cover the emergency restoration, reclamation, abatement, control, or prevention of adverse effects of coal mining practices on eligible lands. Emergency projects must be pre-authorized by OSMRE, directly related to emergency hazard abatement, and are subject to availability of funds

Appendix II: Table for BIL AML Eligible Projects

The following table is an optional template for States and Tribes that choose to submit project lists with their FY22 BIL AML application.

Project or Activity	**Type of Hazard**	**Estimated FY 20*XX* BIL AML Funding for Project**	**Schedule**	**Proposed Project Accomplishments**
Project 1 – Name of Project	*E.g., Dangerous Highwall, Clogged Stream Lands, etc.*	*$XXXX*	*Anticipated Start Date – Anticipated End Date*	*E.g., dangerous highwall reclaimed*

Appendix III: BIL AML Project Flowchart



July 2022

Appendix IV: DOL Fact Sheet #66A: Bipartisan Infrastructure Law

This fact sheet provides general information relating to Davis-Bacon requirements for construction projects funded by the Bipartisan Infrastructure Law (BIL), provided by the Department of Labor's Wage and Hour Division (WHD). The WHD administers and enforces Davis-Bacon labor standards on Federally funded and assisted construction projects, and, as such, is responsible for determining locally prevailing wage rates and ensuring those prevailing wages are paid to construction workers on covered projects.

Davis-Bacon Related Act Coverage of Bipartisan Infrastructure Law Construction Projects

The Davis-Bacon Act requires contractors and subcontractors to pay laborers and mechanics employed on federal construction contracts no less than the locally prevailing wages and fringe benefits for corresponding work on similar projects in the area. Many federal laws that authorize federal assistance for construction projects, such as through grants, loans, loan guarantees, or other similar funding mechanisms, require funding recipients to comply with the prevailing wage and labor standards requirements of the Davis-Bacon Act. Such laws are generally known as Davis-Bacon "Related Acts," or Davis-Bacon Related Acts.

The BIL, which President Biden signed on November 15, 2021, focuses on rebuilding and improving our nation's aging infrastructure through a historic investment of federal funds in state and local infrastructure construction. A vast majority of the federal funding authorized by the BIL requires the payment of Davis-Bacon prevailing wages on covered construction projects. The BIL applies Davis-Bacon labor standards to federally-funded or assisted construction projects in three different ways by:

1. adding funding to programs previously authorized by an existing Davis-Bacon Related Act (such as the Infrastructure for Rebuilding America program and the Drinking Water/Clean Water state revolving loan funds);
2. adding new programs under the umbrella of an existing Davis-Bacon Related Act (such as the new Bridge Investment program and the new Airport Terminal Improvement program); or
3. including provisions which expressly provide that Davis-Bacon labor standards apply to all construction projects receiving funding under particular programs created by or funded through the BIL. For example, construction projects assisted by funding made available under Division D or an amendment made by Division D of the BIL (Energy) are subject to Davis-Bacon requirements

Finally, while the broadband assistance programs under Division F of the BIL do not generally require the payment of Davis-Bacon prevailing wages, the agencies administering those programs may consider the payment of prevailing wages as a positive factor when allocating funding. WHD will be available to provide guidance to funding applicants and funding agencies who are considering the payment of Davis-Bacon prevailing wages as a factor in connection with funding awards under the BIL's broadband assistance programs.

Basic Provisions/Requirements of Davis-Bacon Related Acts

Funding for construction projects authorized by the BIL requires certain actions on the part of federal funding agencies, funding recipients (such as state or local agencies), and construction contractors in order to ensure compliance with Davis-Bacon Related Acts.

Federal Funding Agencies

Among other requirements, the federal funding agency must:

- notify potential funding recipients that the Davis-Bacon labor standards are applicable to any construction projects that receive the relevant BIL funding;
- ensure that the funding recipients require the Davis-Bacon contract clauses, as set forth at 29 C.F.R. § 5.5, and applicable wage determinations be inserted into all contracts for construction projects receiving the federal funding (a wage determination is a schedule of prevailing wage rates determined by the Secretary of Labor that applies to construction subject to Davis-Bacon requirements in a particular geographic area);
- provide guidance to funding recipients as to which construction projects are covered by Davis-Bacon requirements and which wage determinations apply to those projects; and
- take steps to ensure that the Davis-Bacon requirements are met on their funded projects, including receiving and reviewing certified payrolls submitted by contractors (except to the extent that the federal agency has delegated the receipt and review of certified payrolls to the funding recipient).

Funding Recipients

Among other requirements, the funding recipients must:

- ensure that the Davis-Bacon contract clauses and applicable wage determinations are inserted into any construction contracts entered into by themselves or their sub-recipients for projects receiving any federal funding subject to Davis-Bacon labor standards (the required contract clauses are set forth at 29 C.F.R. § 5.5, and general wage determinations and guidance on their application can be found at alpha.sam.gov);
- provide guidance to sub-recipients and contractors as to Related Act coverage, wage determination applicability, and the classifications of work performed on the contract;
- conduct sufficient monitoring of sub-recipients and contractors to ensure that laborers and mechanics are being paid the applicable prevailing wages and fringe benefits;
- receive and review certified payrolls, and, where applicable, forward certified payrolls to the federal funding agency; and
- upon the written request of the Department of Labor, or on their own initiative, both the federal funding agencies and the funding recipients must withhold payments to the prime contractors in an amount sufficient to cover any unpaid prevailing wages owed to workers or suspend any further payments until violations of the Davis-Bacon labor standards have ceased.

Failure to take these actions may result in the loss of the federal funding, in accordance with 29 C.F.R. § 5.6.

Contractors and Subcontractors

Among other requirements, contractors and subcontractors must:

- pay at least the Davis-Bacon prevailing wages listed in the applicable wage determinations included in the contract to laborers and mechanics who work on the site of work—
    - the Davis-Bacon prevailing wage is the combination of the basic hourly rate and any fringe benefits listed in a Davis-Bacon wage determination;
    - contractors can meet this obligation by paying each laborer and mechanic the applicable prevailing wage for the classification of work they perform entirely as cash wages or by a combination of cash wages and employer-provided bona fide fringe benefits;
    - contractors must pay laborers and mechanics the applicable prevailing wages for all hours worked on the site of the work on a weekly basis (except for contributions to bona fide fringe benefit plans, which must be made at least quarterly);
- maintain an accurate record of hours worked and wages paid, including fringe benefit contributions;
- submit certified payrolls to the contracting agency/funding recipient each week, within seven days of the payroll date for that workweek; and
- ensure that the required contract clauses and applicable wage determinations are incorporated into any lower-tier subcontracts.

Where to Obtain Additional Information

For additional information, visit the Wage and Hour Division website: www.dol.gov/agencies/whd or call our toll-free information and helpline, 1-866-4-USWAGE (1-866-487-9243), available 8 a.m. to 5 p.m. in your time zone. This appendix is for general information and is not to be considered in the same light as official statements of position contained in the regulations.

The contents of this appendix do not have the force and effect of law and are not meant to bind the public in any way. This appendix is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

Walker, Samuel

From: Julie Leonard <j.a.leonard@mindspring.com>
Sent: Wednesday, June 19, 2024 4:37 PM
To: LU Land Use Planner; Walker, Samuel
Subject: [EXTERNAL] Docket # LU-24-0009

As plans are finalized for work to mitigate fire danger from the coal seam fire near Hwy 119 and Hwy 93, I ask you as a resident of Marshall to make sure that plans include a water storage cistern for emergency use for any fires that may be ignited in the area, either from the coal seam fire or other causes. Since we all get our water from wells, and the electricity will likely go out in a fire situation, preventing the wells from functioning, this is especially critical to our safety and peace of mind.

Thank you,
Julie Leonard

1534 Marshall Rd
Boulder, CO 80305

Walker, Samuel

From: Heather Forrest <heatherforrest1@gmail.com>
Sent: Wednesday, June 19, 2024 9:09 PM
To: Walker, Samuel; LU Land Use Planner
Subject: [EXTERNAL] Marshall neighborhood

Hi there, I just heard that today is the last day to get our comments in. I live in Marshall. At 1303. I would definitely like to put in my plea for getting fire hydrants in our neighborhood and/or access to water to fight fires. That would really help with making sure that nothing like the Marshall fire happens again. Thank you so much please consider getting water to all of us in Marshall. It's very very important that we keep our homes, families and pets safe.
Thank you,
Heather Forrest
720-568-0300

MARSHALL TOGETHER
SUPERIOR • LOUISVILLE • UBC

To: Boulder County Commissioners
Boulder County Community Planning and Permitting,
City of Boulder Council Members,
City of Boulder Open Space and Mountain Parks
Rep. Joe Neguse,
Sen. Rachel Zenzinger,
Sen. Jeff Bridges,
Rep. Judy Amabile,
Rep. Kyle Brown

Date: June 19, 2024
Re: Boulder County Limited Impact Review #LU-24-0009: Limited Impact Special Use Review to permit 364,000 cubic yards of earthwork for subsurface coal fire mitigation and redevelopment of the Marshall Mesa trailhead.

The City of Boulder (City) has submitted a Limited Impact Special Use permit for review by Boulder County for reclamation of an underground coal fire and trailhead improvements at the City of Boulder Marshall Mesa Trailhead (Trailhead). Considering this proposal encompasses the "Trailhead Ignition Point" of the Marshall Fire, and considering the underground coal fire could not be ruled out as a potential cause of the Marshall Fire, it is important that the wider Marshall Fire community voice be heard during this public review process.

First, the previous Use Review for this location (SPR-06-078 – Attachment 1) included a proposal by the City to fill a 27,000 gallon cistern for a fire supply system for the town of Marshall and Eldorado Springs (Attachment 1). This proposal was never fulfilled and that cistern was empty during the Marshall Fire. We are pleased to learn Mountain View Fire Protection District will be installing a 20,000 gallon cistern as part of the current proposal at the trailhead. We encourage Boulder County Commissioners to make this a "Condition of Approval" to ensure the cistern is *installed and functions* in accordance to the proposal this time.

Secondly, the requested reclamation at the trailhead under this public review is funded by the Federal Infrastructure Investment and Jobs Act (IIJA) which has granted the State of Colorado, Department of Reclamation and Mine Safety (DRMS) an additional $150 million to address abandoned coal mining issues in the state of Colorado. This funding prioritizes water supply to adjacent properties that are impacted by some of the very mines being reclaimed (Attachment 2). This prioritization is because the adjacent communities have not only lived with environmental and public health risks for far too long- but also, because the reclamation will be a disruption to the community's sense of safety, peace and healing. The Marshall community and surrounding mine impacted properties deserve the support the IIJA is intending such communities to have access to.

The reclamation this Boulder County Land Use Review addresses is part of the first round of IIJA funding in Colorado in part because of the unfortunate fact that the coal fire could not be ruled out as a cause of the Marshall Fire, but also, because of the coal fire's unique proximity to urban development including Unincorporated Boulder County (UBC), the Town of Superior and the City of Louisville. The rapid spread of the Marshall Fire proved the proximity of this site and the underground burning coal seam fire should be a concern to everyone in the vicinity of the Trailhead. To have this risk close to homes, neighborhoods and urban centers without adequate water supply is no longer acceptable.

As part of this IIJA funding, DRMS is currently evaluating impacts to water quality and options for repair/replacement for properties in the area that impacted by abandoned coal mines. Due to the extent of abandoned coal mine reclamation in this land use proposal (LU-24-0009), not only is the surrounding adjacent community a candidate for these Federal IIJA Funds, but the City of Boulder parcel under this public review is undeniably impacted and a candidate for these Federal funds as well.

Since the underground coal fire could not be ruled out as a potential cause of the Marshall Fire (a two billion dollar federally declared disaster), it is essential for the City of Boulder to work with the State of Colorado and DRMS to utilize Federal IIJA funds to supply a pressurized hydrant at the City of Boulder property. Anything less is ignoring the risks these Federal funds are intended to address and would be minimizing the destruction and loss that occurred because of the Marshall Fire and specifically, the ignition point that occurred at this very trailhead.

In support of our community,
Marshall Together

Walker, Samuel

From: Marshall Together <hello@marshalltogether.com>
Sent: Thursday, June 20, 2024 6:31 AM
To: Walker, Samuel; LU Land Use Planner
Subject: [EXTERNAL] Marshall Mesa Emergency Water
Attachments: MT Comment on Marshall Mesa LU.pdf

Hello, Please find our letter in support of UBC's need for emergency water at the Marshall Mesa trailhead attached.

Thank you for your consideration,
Marshall Together Community
--
www.marshalltogether.com
Marshall Fire Survivor community

To: Boulder County Commissioners
Boulder County Community Planning and Permitting,
City of Boulder Council Members,
City of Boulder Open Space and Mountain Parks
Rep. Joe Neguse,
Sen. Rachel Zenzinger,
Sen. Jeff Bridges,
Rep. Judy Amabile,
Rep. Kyle Brown

Date: June 19, 2024
Re: Boulder County Limited Impact Review #LU-24-0009: Limited Impact Special Use Review to permit 364,000 cubic yards of earthwork for subsurface coal fire mitigation and redevelopment of the Marshall Mesa trailhead.

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In support of our community,
Marshall Together

Walker, Samuel

From: Laura Schmonsees <lkschmoo73@gmail.com>
Sent: Wednesday, June 19, 2024 2:09 PM
To: LU Land Use Planner
Subject: [EXTERNAL] Comments for reclamation area and trailhead at Marshall Mesa.

Dear Boulder County,

I am a resident of the Marshall area just North of the reclamation area, and have some comments regarding the Marshall Mesa reclamation and trailhead improvements (regarding docket: LU-24-0009):

1- It has been brought to our attention that the Federal Infrastructure Bill is funding the reclamation of the underground burning coal fire at the City's trailhead- we understand that a priority of this funding is to repair/replace water supplies that are impacted by some of the very mines that are being reclaimed on the City's property. ***We ask that the City and County support our community and the Department of Mining with the evaluation of water supplies and replacement of supplies impacted by the abandoned coal mines, aligning with the guidance of the Federal Infrastructure Bill.*** *Furthermore, unless the risk of surface ignition by this underground coal fire will be eliminated by the reclamation, we ask the City and County to do everything possible to ensure the safety of our community, this includes working with the Department of Mining to secure water resources for the community that is impacted.*

2- We are aware that in the process to open the Marshall Mesa trailhead in 2006, the City of Boulder stated they would fill a 27,000 gallon cistern as a fire supply point for the Town of Marshall and Eldorado Springs. We understand that this was never completed but are pleased to hear a cistern will be installed by Mountain View Fire District under this current proposal. ***We ask the County to ensure the cistern is a "condition of approval" of the City's permit to make sure the cistern is installed as proposed this time.***

3- upon looking at the proposed new trailhead plan, I believe there's not enough parking for the predicted growth of use at these trailheads. Already currently during the weekends people are parking all along the road. This is only going to increase, and since there is such an impacted area due to reclamation, there should be more parking created over this impacted site to account for future use at the trailhead as well as more shuttle driving to Eldorado Canyon.

4- The Traffic Report provided by the City states: "Due to the SSD [stopping sight distance] limitations in the eastbound direction that is not feasible to remove, it is recommended an enhanced crosswalk be evaluated, such as an RRFB [rectangular rapid flashing beacon]." (pg 35 of Mueller Report) further, the report states: 'In addition to the RRFB, it is recommended that Advanced Pedestrian Warning Signs be installed in advance of the crosswalk in both the eastbound and westbound direction.' We support the recommendations for a RRFB in addition to pedestrian warning signs at this crosswalk.

Thank you for considering these comments,

Laura Schmonsees
Marshall Area Resident
Sent from my iPhone

Walker, Samuel

From: STEVE JACOBS <stevejacobs83@comcast.net>
Sent: Wednesday, June 19, 2024 3:40 PM
To: LU Land Use Planner
Subject: [EXTERNAL] South Boulder Trailhead coal seam mitigation project

Dear Boulder County Planner, I would like to express my concerns about the impact on the water quality, this projects presents to homes in the vicinity of this project. Is a place plan in to provide safe water to homes adjacent to the project in the Marshall community ? Thank you for your consideration. Steve Jacobs 1600 Marshall rd. Boulder C0 80305

Walker, Samuel

From: Brian Fuentes <brian@fuentesdesign.com>
Sent: Wednesday, June 19, 2024 10:34 PM
To: Walker, Samuel; LU Land Use Planner
Subject: [EXTERNAL] LU-24-0009 Marshall Mesa Redevelopment

Re: LU-24-009: I was at the project area today, june 19, 2024 and besides the yellow sign at the entry to the parking lot, there were no stakes of the proposed improvements that I could find. I was under the impression that LISR also required staking as part of the public process?

The transportation department of Boulder County recommends following the conclusions of the traffic study provided by the city to install a blinking safety traffic signal for pedestrian crossing, which I fully support and think is critical for public safety. However it appears the City is proposing NOT doing a lighted crosswalk?

I also support the County requiring electric car charging infrastructure per the Boulder County Transportation comments. People are taking the shuttle to Eldo from here, RTD stop etc. so this is not some remote trailhead, it's a confluence of a lot of activity and requires infrastructure to meet the demands of the proposed use.

Lastly, since my house burned next door in the Marshall fire, I absolutely support the cisterns being a condition of approval to ensure the public safety on an area where the Sheriff could not rule out the coal mines as a cause of the fire that took everything I owned. The City's 27,000 gallon cistern at the trailhead was empty yet there were burned fire hoses in my yard the day after the fire from valiant fire fighters that tried to save our historic neighborhood but lacked adequate water resources. Firefighters drove 30 min round trip to try to get water to Marshall, this is not acceptable at a heavily used trailhead. I would hope that the town of Superior and Louisville would also feel very strongly about this since they are 'downwind' of this open space area and depend on the City and County of Boulder to make reasonable, adult decisions when it comes to basic infrastructure on a site with known hazards and a history of fires including the grass fire started in 2005 by the coal fires (about a year before the trailhead was approved to open). It should also be noted for the public record that temperatures below ground at the other site recently remediated in the area by the State of Colorado across Cherryvale road were ~650 deg F (as reported by 9 news), much higher than anticipated based on preliminary subsurface evaluations. Unless the State can guarntee this coal fire won't continue to be a risk to the public, the City and County need to support water infrastructure as part of this project for the basic public safety of its local firefighters and adjoining municipal areas, not to mention our local community and the users of this open space itself. Failure to require a water supply to address the known hazards would violate the fundamental intent of the article 4 standards Boulder County, the basis for this review process.

I trust the staff and commisioners will act in good faith and protect the public safety and welfare with their review of this project under the standards.

Brian Andrew Fuentes AIA
f u e n t e s d e s i g n ARCHITECT-led PASSIVE-house DESIGN-build
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brian@fuentesdesign.com | fuentesdesign.com
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