APPLICATION: MAJOR SITE PLAN REVIEW

For Office Use Only: File Number: Application Fee Paid:
☐ Approved ☐ Approved with Conditions ☐ Denied Date:

PROJECT LOCATION

Project Street Address:	1010 Meadow Drive, Frisco CO 80424
Legal Description:	Lot 1, Summit Stage Transit Center Subdivision at the SW corner of Meadow Dr and Lusher Ct

PROJECT DESCRIPTION

Lot Size Information:	Acres: 6.2	Sq. Feet: 270,456		**Zoning:** CO - Commercial-Oriented			
Parking Spaces:	Existing: 169	Proposed: 165		**Lot Coverage:**	Existing (Sq. ft. and %): 131,895 (48.8%)	Proposed (Sq. ft. and %): 165,528 (48.8%)	
Residential Units:	# of Units Existing: 0	# of Units Proposed: 0	# of Deed Restricted Units Proposed: 0	**Non-Residential Uses:**	Type of Use(s): Transit Center Boiler Building	Gross Floor Area (Sq. Feet): 3525 400	

Description of Work: Demolition of existing transit center and construction of new transit center and associated improvements. Associated improvements include: new intersecting busway with additional bus bays, enhanced patron waiting areas and plaza, reconstructed parking lot, new shuttle lot. Work will be completed in phases.

PROJECT TYPE		Check all that Apply
Multi-Family	Including additions/accessory buildings that do not qualify as minor site plans	
Mixed-Use	Including additions/accessory buildings that do not qualify as minor site plans	
Non-Residential	Including additions/accessory buildings that do not qualify as minor site plans	X

APPLICANT

Name: Board of County Commissioners of Summit County	Phone #: 970-668-4202
Mailing Address: PO Box 68	City, State: Breckenridge, CO
E-Mail: Tom.Gosiorowski@summitcountyco.gov	Zip Code: 80424

OWNER *(if not the applicant)*

Name: same as applicant	Phone #:
Mailing Address:	City, State:
E-Mail:	Zip Code:

CERTIFICATION

I, the undersigned, authorize the Town of Frisco Community Development Department to proceed with this Major Site Plan Review Application under the requirements set forth by the applicable Town of Frisco Code(s), as they may be amended. I, the undersigned, understand and accept that the accuracy of the information contained within this application is the responsibility of me, the undersigned, and any information found to be incorrect or inaccurate by the Town of Frisco Community Development Department during the processing of this application, will cause this application to be delayed. I, the undersigned, also, understand and accept that only complete applications will be processed. Incomplete applications will be returned to me to fulfill the requirements for my respective application. If the applicant is not the owner of the Property, a statement by the owner consenting to this application shall be submitted with this application.

☐ A statement by the owner(s) consenting to this application is included (required if the applicant is different from the owner).

APPLICANT _____ County Manager April 5, 2018

Signature Title Date

APPLICATION OVERVIEW AND SUBMISSION MATERIALS

The Major Site Plan review and approval procedure is intended to ensure compliance with the development and design standards of the Frisco Unified Development Code (UDC) and to encourage quality development. For projects requiring Major Site Plan review, building or other permits may be issued, only after a Major Site Plan showing the proposed development has been approved in accordance with the procedures and requirements of Section 2.5.2.(D). The site plan review procedures ensure that the Town has the ability to address and mitigate any adverse impacts that may result from development projects.

A pre-application conference shall be held in accordance with Section 2.3.1.

All applications for Major Site Plans shall present an informal sketch plan of the development before a regularly scheduled meeting of the Planning Commission. Materials to be presented in support of the development must be of sufficient nature to allow the Planning Commission and Community Development staff to provide informed feedback on the project. Please reference Section 2.5 in the Code for minimum submission requirements and additional information.

Following the review of the sketch plan but not more than 90 days after such review, the applicant shall submit a full Major Site Plan application. The applicant shall submit the application not less than 52 days prior to an upcoming Planning Commission meeting targeted as the application review date. Town staff and the applicable referral agencies will review the Major Site Plan application and prepare a staff report and recommendation in accordance with Section 2.3.4.

The Major Site Plan application will be scheduled for a public hearing before the Planning Commission and noticed in accordance with Section 2.3.5. The Planning Commission will review the Major Site Plan application and approve, approve with conditions, or deny the Major Site Plan in accordance with Section 2.3.7 and the approval criteria in Subsection 2.5.2.E.

APPLICATION MATERIALS

All applications are required to have an accompanying e-copy with submission and shall include:

(Required for both sketch plan and full application)

1. **Completed Application Form**
2. **Application Fee** (major revisions to the original submittal may require additional fees)
   - **$1,500** non-refundable application fee *and;*
   - **$1,500** Development Review Account (DRA) deposit (see Section 2.3.2.D)
3. **Property Owner Consent:** If the applicant is not the owner of the property, a statement by the owner consenting to this application must be submitted.
4. **Project Narrative** describing the proposal and how it complies with applicable code criteria and standards.
5. **Project Drawings:** Each application shall include two (2) copies of each required plan set. Please refer to attached checklist for specific plan submittal requirements.
   - **Engineered drawings** (Topographic Survey, Site Plan, Landscape Plan, Lighting Plan) shall be dimensioned and have a minimum scale of 1":20' with a minimum paper size of 11" x 17". All plans shall be submitted to the same scale.
   - **Architectural drawings** (Floor Plans, Roof Plans, Elevation Drawings, Building Sections) shall be dimensioned and have a minimum scale of ⅛":1' with a minimum paper size of 11" x 17". All plans shall be submitted to the same scale.

(Required for full application submission)

1. **Public Notice:** The applicant shall be responsible for providing accurate mailing labels as part of the complete project application and for posting the notice of the public hearing on the subject property, and shall bear all costs incurred in connection with giving notice of the public hearing. The Community Development Department shall be responsible for writing the content of notices and mailing. Please refer to Section 2.3.5 for additional information.
2. **Material Samples:** Samples of all exterior colors and materials proposed.
3. **3D Model:** An accurate three-dimensional scale model, computer simulation, or other similar graphical representation.
4. **Drainage Plan:** Prepared by a professional engineer licensed in the State of Colorado (see Section 6.6).
5. **Waste Collection Verification:** Provide a letter from the waste collection provider approving the refuse and recycling collection facility and verification that the facility is adequately sized for the proposed use.
6. **Traffic Report:** Prepared by a professional engineer licensed in the State of Colorado (see Section 6.12).

USE THE CHECKLIST BELOW AS A GUIDE OF ELEMENTS TO INCLUDE IN YOUR APPLICATION

STEP 1: Sketch Plan

☐ **Sketch Plan Materials:**

- ☐ Written project description, including a synopsis of the proposed development program, and how the project will meet the principles of the Master Plan and the standards of the UDC
- ☐ Schematic architectural plans including elevations, floor plans, and roof plans
- ☐ Site plan showing the location of the building(s) and other improvements (retaining walls, berms, dumpster locations, open space, etc.) with dimensions to setbacks, property lines, easements, north arrow, scale, legend, vicinity map
- ☐ Existing and proposed utility lines (main and service)
- ☐ Existing and proposed topography at 2 foot intervals including 50 ft. beyond boundary, existing easements, lot dimensions, lot size in square feet/acreage
- ☐ Existing site characteristics map with parking, vegetation, wetlands, unique natural features
- ☐ Parking space dimensions, locations, and counts
- ☐ Traffic circulation design with driveway dimensions and locations, points of access from right-of-way, preliminary grades, bike and pedestrian improvements
- ☐ Proposed landscaping, post-development grades, snow storage, preliminary stormwater plan showing approach to stormwater handling
- ☐ Samples of all colors and materials proposed

STEP 2: Full Application

☐ **Topographic Survey:**

- ☐ Wet stamp and signature of a licensed surveyor
- ☐ Date of survey
- ☐ Legal description and physical address
- ☐ Lot size and buildable lot area
- ☐ Ties to existing benchmark, either USGS landmark or sewer invert, clearly stated on the survey
- ☐ Property boundaries to the nearest hundredth (.01) of a foot accuracy. Distances and bearings and a basis of bearing must be shown. Show existing pins or monuments found and their relationship to the established corner.
- ☐ Right of way and property lines including bearings, distances and curve information
- ☐ Indicate all easements
- ☐ Topographic conditions at two foot contour intervals
- ☐ Existing trees or groups of trees having trunks with diameters of 6” or more, as measured from a point of one foot above grade
- ☐ Rock outcroppings and other significant natural features (large boulders, intermittent streams, etc.)
- ☐ All existing improvements (including foundation walls, roof overhangs, building overhangs, etc.)
- ☐ Environmental features (e.g. wetlands, floodplain, high water line, steep slopes, etc.)
- ☐ Water quality setbacks
- ☐ All utility meter locations including any pedestals on site or in the right-of-way adjacent to the site. Exact location of existing utility sources and proposed service lines from their source to the structure.
- ☐ Size and type of drainage culverts, swales, etc.

☐ **Site Plan:**

- ☐ A vicinity map showing the location of the site to be developed in relation to surrounding properties
- ☐ Property boundaries as depicted on the submitted topographic survey
- ☐ Topography at 2 ft. contour intervals with reference to mean sea level as depicted on the submitted topographic survey
- ☐ Location and dimensions of all existing streets, alleys, easements, drainage areas, floodplains, floodways, wetlands, steep slopes and other significant features within or adjacent to the site

- ☐ Location of existing trees with a diameter of 6 inches or more measured 1 foot above grade. If the site is heavily wooded, a photograph or graphic indication on the site plan illustrating the density of the trees will suffice.
- ☐ Location and size of all existing and proposed utilities within or adjacent to the site
- ☐ Location, dimensions and setbacks to the exterior wall of the foundation and the outermost edge of the structure, including roof eaves, decks and other projections
- ☐ Location of all roof ridge and eave lines with USGS elevations stated
- ☐ Traffic circulation and parking plan including points of entry, exit, and delivery areas
- ☐ Non-vehicular circulation including size and type (including surface material) of pathway and points of connection
- ☐ Location, type, size and height of fencing, retaining walls and screen planting
- ☐ Snow storage area(s) with dimensions
- ☐ Location of dumpster enclosures
- ☐ Location of streetlights, parking lot lighting, and/or outside lighting
- ☐ Location of all signs
- ☐ Proposed open spaces with an indication as to use and ultimate ownership
- ☐ The number, use and location of construction trailers to be used on site
- ☐ Location of the limit of work area fencing

☐ **Architectural Plans:**

- ☐ Floor plans with square footage, including a breakdown of gross floor area by use, if applicable
- ☐ All building elevations showing the natural grade elevations at all building corners and the elevations of rooflines based on USGS elevations
- ☐ Building materials (type and color)
- ☐ Roof plan and materials (type and color)
- ☐ Dumpster enclosure plans
- ☐ Location, type and intensity of building illumination
- ☐ The number of proposed certified solid-fuel burning devices (maximum 8 devices per acre), with the proposed type and location(s) indicated on the floor plans

☐ **Drainage Plans (see Section 6.6):**

An engineer's report describing and providing evidence of the following:

- ☐ The type, size, and location of existing and proposed drainage structures such as infiltration galleries, dry wells, retention ponds and grassed channels
- ☐ Show the manner in which drainage and runoff will be controlled and confined on-site, including all calculations.
- ☐ Contours must be shown at two foot intervals on the drainage plan. If the slope across the site is four percent or less, the contour interval shall be shown at one foot
- ☐ Cross sections of specific structures and drainage ways to be constructed
- ☐ Provide for the diversion of runoff from snow storage areas, dumpsters and other trash storage areas into detention facilities
- ☐ Provide adequately sized detention facilities where dewatering of excavations may be needed (such facilities may be temporary in nature)
- ☐ Alternate methods shall be accepted only with prior approval by the Town Engineer

☐ **Landscaping and Revegetation Plans (see Section 6.14):**

- ☐ Property lines and dimensions
- ☐ Existing and finished grade
- ☐ North arrow and both graphic and written scales
- ☐ Name of Applicant and landscape consultants, if any
- ☐ A legend indicating all proposed plant materials with common and botanical names, indication of drought tolerant plants, sizes, maximum spacing, caliper size, and quantities
- ☐ Method of irrigation
- ☐ Location of all plant material, other landscape features (including but not limited to wetlands, water bodies, rock outcroppings, detention areas, retaining walls) and buildings and paved areas (both existing and proposed)

- ☐ Ground surfaces and materials by type, such as paving, sod, mulch, edger, seed mixes, shrub and flower beds, etc., shall be clearly indicated with a note as to the percentage of plant coverage
- ☐ Clearly labeled locations and calculations for amounts of all the required landscape vegetation, including the percentage of drought tolerant plantings and any required parking area landscaping
- ☐ A tree survey with the size and location of existing coniferous trees with a diameter of six inches or more and deciduous trees with a diameter of three inches or more measured one foot above the ground. The tree survey shall be prepared by a Colorado licensed surveyor.
- ☐ Identify which existing trees will remain on the property and how they will be protected from damage during construction
- ☐ If snow storage is required, the location of all snow storage areas in relation to proposed landscaped areas must be shown
- ☐ Identify construction debris storage and staging areas

☐ **Lighting Plan (see Section 6.16):**

- ☐ Site plan with location of all light fixtures and a numerical grid of lighting levels (in footcandles) that the fixtures will produce on the ground (photometric report)
- ☐ Area of illumination
- ☐ Lamp type and wattage
- ☐ Mounting height of all fixtures
- ☐ Cut sheet showing the design and finishes of all fixtures and designation as IESNA “cut-off” fixtures
- ☐ Drawings of all relevant building elevations showing the location and aiming points of the fixtures

☐ **Additional Materials May Be Requested:**

- ☐ If deed restricted units are proposed, a signed covenant is required
- ☐ Geological stability data
- ☐ Detailed soils information
- ☐ Fiscal impact analysis
- ☐ Any other special studies or information necessary or desirable for the Community Development Department, Planning Commission, or Town Council to make an informed decision

☐ **Agency Contacts:**

Additional information and permits may be required by the following agencies:

Town of Frisco:

- Building Division: (970) 668-5276
  A building permit application may be required for these types of projects.

- Town Clerk: (970) 668-9122
  A business license is required for all contractors working in the Town of Frisco.

- Frisco Water and Public Works Department: (970) 668-0836
  Additions to the Town of Frisco water distribution system may only be installed between April 15th and October 31. A separate permit, including an excavation permit, may be required.

Frisco Sanitation District: (970) 668-3723

Lake Dillon Fire Protection Authority: (970) 262-5100

Summit County Environmental Health: (970) 668-4070

Xcel Energy: (970) 262-4050

Frisco Transit Center
Major Site Plan Submittal: Response to Town Comments
July 25, 2018

PROJECT NARRATIVE

The Frisco Transit Center sketch plan, dated 9/28/2017, was approved by Planning Commission on 10/19/2017. The applicant is requesting that the current major site plan application be considered under the UDC amendment approved by Town Council in March 2018, which extends validity of the Sketch Plan from 90 to 180 days. Information below focuses on significant project refinements and changes since the Sketch Plan; in cases where project approach has not changed, previous text has been reproduced or summarized.

General Project Description

Site and building programming remain consistent with that described in the September 2017 Sketch Plan. Operational efficiency, patron safety and experience, and flexibility to respond to future transit needs remain primary goals of the Transit Center project.

The proposed project includes six full-size bus bays, one ¾-size bus bay as a backup location, and one bay to be used as a location for bus layovers. An additional location along the south side of Transit Drive, near the BaseCamp Way intersection, has been identified for bus layovers should additional need arise. All bus bays will use a sawtooth configuration, with the exception of the second layover bay, to allow independent arrival and departure of vehicles. There is no increase in general parking spaces, and a new 12-space shuttle lot will separate private shuttle operators from the general public parking lot.

Additional site enhancements include a prominent pedestrian connection between the adjacent Base Camp development and the Transit Center. This connection is specifically aligned to accommodate additional pedestrian connection with the Frisco Station Shopping Mall to the east, if connection through that building becomes possible at some point in the future. The new transit building will also offer covered bike parking, a separate operator restroom, and a 24-hour unisex restroom with exterior access, available when the building is closed.

Site Structures and Materials

The transit center building design has been refined to respond to previous Planning Commission comments, most notably to create a more 'iconic' presence. Significant building refinements include a more dynamic, diagonal footprint and an indoor-outdoor fireplace as key focal point. The change of footprint, combined with an asymmetric use of materials, provides more visual interest to the exterior facade and highlights the building's main western entries. The refined design also adds an exterior fireplace plaza on the west side of the building, responding to Planning Commission's desire for more outdoor seating in proximity to the Transit Drive bus bays.

As noted and approved at Sketch Plan level, the building complies with the previous Town maximum of 38-foot exterior wall lengths without horizontal modulation; also noted and approved at Sketch Plan level, clerestory windows are substituted for the required dormers in order to provide better interior daylighting. Rooflines comply with existing code governing slope and height variation.

The updated building design offers more efficient use of interior space, and at 3525 gross square feet (GSF) is slightly smaller than the 3,773 gross square foot structure shown in the Sketch Plan, but accommodates the same number of patrons. Exterior materials include a mix of cultured stone, wood-pattern fiber cement board, Glulam timber, insulated concrete panel, a standing seam metal roof, and storefront and curtain wall glazing systems.

Per Town code, the building and site structures comply with all applicable building and energy codes, 2012 edition. Exceptions include the following alternate-year codes: The National Electrical Code, 2011 edition; The ICC Electrical Code-Administrative Provisions, 2006 edition; ICC/ANSI A117.1-2009 American National Standard.

Interior spaces include a police office, information area, two rental car counters, vending machine area, restrooms and patron waiting space. The information area represents a change from Sketch Plan, at which time this area was designated as an enclosed ticketing office. Conversations with transit providers indicate that no carriers currently use in-person ticket sales, and have no plans to do so in the future. The area designated for this use has been changed from a walled office space to an open information area to be stocked with brochures, maps and similar materials. Preliminary conversations with the Town Visitors' Center indicate interest in stocking and potentially intermittently staffing this area.

The site includes two boilers to supply the site's heated concrete paving; one boiler is contained within the main transit building and the second boiler will be located in a 400 GSF outbuilding adjacent to the northernmost bus bay on Transit Drive. This building will use the same materials as the main transit building, and will be clad in cultured stone, fiber cement board and standing seam metal roof.

Landscape

Planting Quantities, Size and Species

The project has been determined to serve a public purpose and benefit, and the appropriate landscaping requirements will be determined by the Town, including the number of trees and shrubs required. All proposed trees and shrubs have been determined to be suitable for the arid alpine environment of Frisco, CO and meet the minimum plant size requirements and appropriate spacing for each species. Proposed trees have been placed in key locations on the site in order to provide a visual buffer of the building from the street, enhance the site, and provide a landscape buffer to adjacent properties. Deciduous trees have been located in groups of three or more to achieve a clustered effect, or as a single specimen.

Except for the quaking aspen trees, the maximum percentage of any one tree species does not exceed 25%, meeting the species diversity requirements for projects with 40 or more required trees on site.

The species diversity requirement does not apply to existing trees or trees planted in excess of the minimum number required. However, as this is considered a public project and the minimum number

of trees and shrubs required is determined by the Town, we are not able to determine the number of trees in excess of the requirements at this time

Parking Area Landscaping
The proposed surface parking lot provides a total of 165 parking spaces, with 57,431 SF of total paved area (per civil). The internal parking lot landscape islands are proportionately dispersed to define aisles of parking and vary between 18.5' to 23.5' in width and 18.5' to 35' in length, exceeding the minimum requirement of eight feet in width and length. All parking lot islands contain at least one tree.
Per Section 6.14.3.F, the total area of parking lot landscaping required is at least six percent of the total paved area, or 3,446 sf. In addition, at least 50 percent of the required landscaping (1,723 sf) must be internal to the parking area. The remainder of the required landscaped area (1,723 sf) may be external to the parking area so long as it is within ten feet of the perimeter of the paved area.

As shown on the plans, 3,422 sf of internal parking lot landscape area (5.96% of the total paved area) and 4,958 sf of perimeter landscape area (8.63% of the total paved area) have been provided, for a total of 8,380 sf of parking lot landscape area, or 14.59% of the total paved area. This exceeds the 6% required by Section 6.14.3.F.

In addition, Section 6.14.3.F requires a minimum of one tree and two shrubs for every 150 square feet of landscape area required, or a total of 23 trees and 46 shrubs. As shown on the plans, we have provided a total of 23 trees and 350 shrubs in the parking lot landscape area.

Parking and Shuttle Operations
As noted in the Sketch Plan, the project aims to limit impervious area by replacing parking at approximately the same level as existing: 165 spaces will replace the existing 169 spaces. Parking quantity is based on multi-year observation of utilization, which indicates that the lot does not reach capacity even on high-season ski weekends.

EV charging stations will be located within landscape islands in the parking lot, and will be situated to serve multiple vehicles simultaneously. The applicant is currently working with the Colorado Energy Office to determine the appropriate number and type of stations.

Covered bike parking has shrunk by 4 spaces, due to changes in the building; these spaces have been replaced by four additional uncovered spaces adjacent to southwestern-most bus bay (previously labeled Bus Bay 4), resulting in no net change in number of bike parking spaces (34 total).

Coordination with local shuttle operators indicates that they are in favor of the new, dedicated shuttle lot and are comfortable with the number and location of Kiss-n-Ride (drop-off) spaces to serve the lot. Shuttle operators noted that the majority of their patrons are transfer patrons, and that only 12% of shuttle riders are point-to-point riders (i.e., those who may be picked up by family, friends or other private transport). One ADA-accessible, parallel drop-off space has been added on the north side of BaseCamp Way, to address Planning Commission's desire for KnR closer to the shuttle lot.

Drainage and Utilities

Overall drainage approach remains unchanged from that described in the sketch plan, with the majority of site detention directed to the existing drainage area in the southeastern portion of the site. Pipe cover depth and diameter will result in a discharge elevation for the new storm sewer lower than the existing detention pond outlet pipe; for this reason, a small retention pond is proposed within the footprint of the existing detention pond.

Drainage from the plaza and ADA parking spaces will be conveyed by internal storm sewer and sheet flow to this drainage area. The central parking area will sheet flow to the east and into a new bioswale at the eastern edge of the parking area; this bioswale drains to the south and will be conveyed by storm sewer to the project detention pond. The introduction of the bioswale provides water quality pretreatment of parking lot runoff, and allow for runoff from minor storm events to infiltrate. Finally, a portion of Transit Drive will sheet flow to a shared ditch along the western project boundary, as it does at present; this ditch drains south to a detention pond on the BaseCamp site.

No changes are anticipated to site utilities, which enter the site on the east, from Meadow Drive.

Site Lighting

Site lighting shall be compliant with IECC 2012 and the Frisco Unified Development Code, section 6.16 Outdoor Lighting. The site lighting is designed in coordination with the Town of Frisco's small mountain town character existing lighting. Street pole lights consist of wood poles with decorative downlight heads. The central pedestrian promenade has shorter pole lights with a decorative wood arm to match the wood pole. Bollard fixtures are also a natural wood material to integrate into the landscape and surroundings along other pedestrian pathways. Linear lights are provided for illumination in bus canopies and integrated linear lights are recessed into the bench walls for additional illumination at these locations.

All site lighting fixtures have LED lamps for energy efficiency and high performance optics. All exterior lighting complies with the IESNA criteria for full cut-off fixtures with the exception of the flag pole lighting, which is exempt from this requirement. All exterior fixtures are less than 30 feet high, as required for all street and site lighting. Light distribution for perimeter site lights is directed onto the site to prevent light spillage onto neighboring properties. Building mounted exterior lights are recessed in canopies to comply with the full cut-off requirement. Lighting in the bus canopies is shielded by the canopy angle so that there is no light emitted beyond the canopy above 85 degrees from the fixture. A single, north-facing global photocell shall be mounted to the building roof for dusk to dawn photocell on / off control for all site lighting. The owner will have the ability to program the exterior lighting relays to turn off via timeclock during non-operating hours to further reduce energy consumption if desired.

Traffic

In coordination with the applicant, the Town of Frisco has determined that a full traffic study is not required. A Traffic Memo describing anticipated traffic impacts is included with this application. In summary, this memo notes that the Frisco Transit Center and environs can expect some natural growth to occur over time due to population growth, modal shift and ridership increases, but that the project itself will not have any significant impact to local roadway network operations.

Implementation

The project is anticipated to be implemented in multiple phases. Phasing has yet to be determined, but it is likely that the building, bus parking and sitework, and main parking lot may be phased separately.

Photovoltaic

The project proposes a roof-mounted photovoltaic array on the south face of the transit center roof. This array will comply with all portions of Section 180-5.3.3 of the Frisco Town Code:

A. Array is roof-mounted and will not be located in a front yard
B. Array is located more than 6 feet from all property lines and structures.
C. Array will occupy less than half of the roof area of the structure.
D. Array is not ground mounted, so maximum ground height does not apply.
E. Array will note extend more than ten feet above the roofline of the transit center, which is a non-residential structure.

Project Summary

- Site structures
  - Transit Center: proposed, 3525 GSF (existing 2,165)
  - Boiler outbuilding: proposed, 400 GSF (existing n/a)
- Parking
  - proposed, 165 spaces, including ADA
  - (existing: 169, including ADA)
- Kiss-n-Ride
  - 7 spaces on south side of main parking lot
  - 1 space on north side of BaseCamp Way
  - (existing: undefined)
- Shuttle Lot: 12 spaces (existing: n/a)
  - Separate lot south of building
  - (existing: undefined spaces within main parking lot)
- Bus Bays
  - 6 full-size sawtooth
  - 1 3/4-size sawtooth
  - 2 layover: 1 sawtooth, 1 straight curb
  - (existing: six straight curb)

Frisco Transit Center
Major Site Plan Submittal: Response to Town Comments, Round 2
September 18, 2018

The following notes are in response to the comments received 8/16/2018 and 8/21/2018 from the Town of Frisco, regarding the Major Site Plan Review Re-Submittal for the Frisco Transit Center project.

Engineering

1. ***The plans are a bit unclear on how many parallel parking spaces are being added on Basecamp Way for drop off purposes. The written response from the applicant refer to the addition of spaces (plural). The architectural site plan seems to show at least two spaces, but all other plans seem to show one? Please clarify***

   Page 3, last paragraph of the updated Project Narrative states that "*One ADA-accessible, parallel drop-off space has been added on the north side of BaseCamp Way...*" This statement is correct. A single space on the north side of BaseCamp Way is also noted on page 5, under Kiss-n-Ride. This space is ADA-accessible but is not reserved for ADA-placarded vehicles.

   The plural reference to 'ADA parking spaces' on page 4, second paragraph under Drainage and Utilities refers to the ADA spaces in the main parking lot. These spaces are reserved for ADA-placarded vehicles.

   It is our intent to construct a single drop-off space on Basecamp Way. We will update any discrepancies in the plans. We have updated sheets AS-101 and E-010 to show a single parking space.

2. ***Erosion control has now been provided, primarily in the form of silt fencing on the perimeter of the construction area. Will additional provisions be made to protect storm inlets and culverts to keep sediment out of them?***

   Yes, during the development of the construction documents Erosion Control details will be included in the plan set to address erosion control during Construction, and all final storm water improvements including but not limited to grading, inlets, and culverts.

3. ***The single largest snow storage area is located north of the large public parking lot. However, there is no clearly defined drainage route for water coming off this site to be directed to the storm drainage systems. Perhaps a small swale should be added to the grading in this area to ensure any snowmelt or other runoff reaches the drainage pan at the driveway, rather than flowing back over the parking lot.***

   A small swale will be designed north of the parking lot and added to the construction drawing directing storm water to the east. Please see updated Sheet C3, attached.

4. ***The detail provided for the transition from the snow melted areas to non-snow melted area appears reasonable, however it will be key to keep the joint sealed water tight to***

keep water out of the underneath areas where it can freeze and cause heaving. This will likely be an annual need for maintenance.

The County will commit to periodic inspections of the heated pavement and related joints, and to performing maintenance as required to minimize water infiltration at the joints.

Planning

1. **Confirm that there are no service or loading areas on the property.**

   The applicant confirms that there are no service or loading areas on the property.

2. **Confirm that the attached Design Finishes (dated 4/2/2018) is the most current.**

   The Design Finishes dated 4/2/2018 and included in the submittal are the most current.

3. **Confirm that the attached Renderings are the most current.**

   The renderings attached to the submittal are the most current.

4. **Verify color of limestone (need to verify meets chroma compliance and will not be white).**

   The limestone is not white; it will be a beige color.

5. **Verify that clear glass is proposed for windows. If tinted, colored, or opaque glass is proposed, it may be approved when demonstrated by the applicant to be compatible with the purpose of this section. Mirrored or reflective glass is not permitted.**

   Proposed glass is clear and does not have any tint or color.

6. **Verify metal roofs will be surfaced with a low gloss finish or be capable of weathering to a dull finish in order to not be reflective.**

   Metal roofs will have a low gloss finish.

7. **Verify who will be responsible for maintaining all public pathways on the property**

   The County will be responsible for maintenance of the sidewalks, plazas and public areas associated with the transit center within the property boundary.

8. **With the sketch plan submittal, it was stated that the lease for the existing rental car company allow for a maximum of eighteen (18) rental cars on site. Is this still accurate?**

   Summit County has verified that rental cars are limited to eighteen.

9. **Parking: Verify if one or two parking spaces provided east of shuttle lot along Basecamp Way.**

   There will be one ADA-accessible, parallel parking space provided on the north side of Basecamp Way. Please refer to Question 1 under Engineering comments.

10. **Snow Storage:**
    a. **Matrix on Snow Storage Plan shows Transit Drive as 20,233 sq. ft. although plans show it as 24,061 sq. ft. Please clarify**

       The snow storage matrix on Sheet C1 has been updated to show 24,061 sq. ft. for transit drive.

    b. **What is the square footage of six (6) accessible spaces?**

       The area of the six accessible space is 1188 sq. ft., however the snow storage calculations do not assume deductions for snowmelt of the accessible parking spaces.

    c. **Snow storage calculations do not appear to be adequate. Snowmelt system only can be used to deduct 50% of parking which is the 50% of the area of six accessible spaces. Staff calculations show 167,777 sq. ft. of paving is proposed which requires 47,936 sq. ft. of snow storage. The applicant is proposing 39,934 sq. ft. of snow storage. Please update snowmelt deduction for six parking spaces and show compliance with required snow storage requirements.**

       Sheet C1 has been updated to provide 49,709 sq. ft. of snow storage. To assist the Town in calculations, the snow storage matrix on this sheet has also been expanded to include site-wide totals.

11. **Color/Material Board: Confirm it will it be brought to Planning Commission meeting.**

    The applicant verifies that material samples will be brought to the Planning Commission meeting. At this time, the materials samples are loose and not mounted on a board—which makes it easier for Commissioners to pass the materials among them.

12. **Building Articulation. South elevation does not show compliance with building articulation. Verify how complies:**

    6.21.3.B.3.Building Articulation
    a. ***Building walls and corresponding eaves shall not exceed 27 feet in the same geometric plane.***
    b. ***Building walls over 27 feet in length shall change geometric planes by at least two feet in depth for a minimum length of six feet.***
    c. ***Building walls that exceed 54 feet in total building façade length shall change geometric planes by at least four feet in depth for a minimum length of six feet.***

d. ***Building walls or roof ridgelines over 33 feet in length and facing a front yard or street side yard shall not have more than 66 percent of the length of the wall or roof ridgeline along the same geometric plane.***

All building walls on the proposed structure exceed fifty-four (54) feet in length and are required to change geometric planes by at least four (4) feet in depth for a minimum length of six (6) feet. The application is showing compliance on the north, east and west facades by incorporating a variety of wall and eave variations with some wall breaks a minimum of six (6) feet in depth. Staff does not find compliance with the south elevation.

13. Roof lines. Please illustrate how proposed structure complies with ridgeline requirements: ***6.21.3D.3.c. No more than 66 percent of a ridgeline or roof line shall be on the same elevation.*** **The roof lines are exceeding 66% of the same elevation.**

Understanding that the intent of sections 6.21.3.B.3 and 6.21.3D.3.c requirements are to avoid a monotonous façade or elevation, the proposed design seeks to accomplish scale and interest through alternate design elements in keeping with the form of the building. The proposed design includes clerestory windows on the central, taller portion of the building to provide visual interest and daylight to the interior of the building. The diagonal line of the roof eaves offers a contemporary interpretation of the Town's height requirement, rotating the desired variation 180 degrees. This rotation of the desired modulation carries the viewer's eye in a diagonal line across the building, giving the perception of a varied roofline.

The applicant has designed the building footprint and exterior 'look' of the building to provide a more dynamic, asymmetrical form while still maintaining the previous wall lengths as appropriate. The longer length of the southern façade creates a strong geometry that is a key part of creating an iconic building at a civic, non-residential scale. Retaining the longer southern wall, as proposed in the sketch plan, also offers the following benefits:

- Transparency: indoor-outdoor visibility is critical to efficient operation of the Transit Center, allowing patrons to wait in comfort while maintaining direct line of sight to arriving and departing buses and shuttles. Modulation of the proposed southern elevation would add more corners to the façade, requiring additional framing to support the storefront window system, and ultimately reduce indoor-outdoor sightlines.
- Green energy: as stated elsewhere in the application, the Transit Center is designed to utilize rooftop photovoltaic cells (PVC). Modification of the south façade would result in a reduction of area available for PVC.
- Site Scale and Adjacent Development Context: The Transit Center is consistent in scale, materials and detailing with structures in the BaseCamp development, which at approximately 75 feet to the west, is its closest neighbor. In addition, no other structures are anticipated on the Transit Center property; as a stand-alone building, it will not provide an inappropriate contrast to adjacent buildings, of which there are none.

Frisco Transit Center
Major Site Plan Submittal: Response to Town Comments
July 25, 2018

The following notes are in response to the comments received 4/27/2018 from the Town of Frisco, regarding the Major Site Plan Review Submittal for the Frisco Transit Center project. At the request of the Town, we have provided one (1) 24" x 36" 'Full Set' of drawings that includes all the drawings from the original submittal, as well as updated or additional sheets as described below; and one (1) 24" x 36" set and one (1) 11" x 17" 'Planning Responses' set that includes only sheets with changes AND sheets which were not submitted with the original application but provide information requested in Town comments. On sheets with changes, updates are marked on each individual sheet with a cloud around the change.

Public Works Comments

1. ***I would like a note added that all water line / fire hydrant work will need to be coordinated / planned with Frisco Public Works input.***

   This note has been added to Sheet C2 (not included in original set but included in this response set).

Summit County GIS Comments

1. ***After my initial review it looks like the address of 1010 Meadow DR will work still. Please correct me if I am wrong the only additional building needing to be addressed is the boiler building. If additional addressing is needed, please let me know.***

   The above statement is correct; there are no additional structures requiring addressing.

XCEL Energy Comments

The Frisco Transit Center (FTC) design team reached out directly to Amy Lagace at Xcel Energy on 5/2/2018 to discuss specific requirements of timing of her comments. Pertinent portions of the conversation are noted below.

1. ***Demo: Will need applications to demo the gas & electric service to the building.***

   Amy Lagace at Xcel Energy has been made aware of the project. She has indicated that the application should be made when the drawings are as complete as possible, and that submitting the application during the final design period (approximately 90% completion; the current drawing set is at 65% completion) would be acceptable.

   The applicant, Summit County, confirms that they will coordinate with Xcel to submit the required applications at the appropriate time.

2. ***Plan calls out to remove the existing transformer that currently feeds the building. I was told that would stay in place for use at the new building. If not, an application for removal of distribution will need to be submitted as well.***

Amy Lagace indicated that there are two transformers on site, and that both are needed to provide service to the site. One of these transformers must be removed for overlot grading and replaced in its current location.

The applicant, Summit County, confirms that they will coordinate permits and scheduling for removal and replacement of the affected transformer.

3. ***Meter location: only approved spot on building on the east elevation under the gable edge. Remote location possible – would need to be approved by management.***

   The meter will be located on the east elevation under the gable; this location was verbally discussed with Amy Lagace and she is satisfied with the location. Meter location is shown on plumbing sheets (P-series sheets, not included in original set but included in this response set).

4. ***I did not see a site plan with utilities.***
   Utilities are shown on Sheet C2 (not included in original set but included in this response set).

5. ***To move forward with a plan and estimates Xcel will need the following. Application for perm electric and gas with the following final approved information: Site plans, landscape, utility, etc.; Elevations with preferred meter location; One line diagram and panel schedules with loads; Gas schedule with total building load.***

   As noted in Xcel Comment #1 above, the applicant, Summit County, confirms that they will coordinate with Xcel to submit the required applications at the appropriate time.

<u>Summit Fire & EMS Authority</u>
The Frisco Transit Center (FTC) design team reached out directly to Kim McDonald at Summit Fire & EMS on 5/10/2018 to discuss permitting requirements noted in his comments. Pertinent portions of the conversation are noted below.

1. ***A construction permit through the fire department is required for this project. Please advise the developer/contractor to contact the fire department for details.***

   Summit County understands that two separate building permits are required: one from the Town of Frisco and one from Summit Fire & EMS. The applicant, Summit County, confirms that they will coordinate with Summit Fire & EMS to obtain the required permits at the appropriate time.

2. ***Based on the type of occupancy, this project shall require an approved fire sprinkler system for the building. Please advise the developer/contractor to size the waterline into the building to meet fire sprinkler and domestic water demand accordingly.***

Interior utility spaces and water lines have been sized to accommodate a sprinkler system, as noted on Sheet G-101 (included in previous submittal, not included in this response set).

3. ***An approved fire alarm system is required for the building.***
   The applicant, Summit County, confirms that an approved fire alarm system will be included in the building.

4. ***Advise the developer/contractor to contact the fire department for details on the additional fire department permits required for all fire protection systems***.
   Kim McDonald did not have specifics on any additional permit requirements at the time of this conversation; Summit County will continue to coordinate with Summit Fire & EMS as the design moves towards construction.

5. ***Based on the size of the building, type of construction and radio signal strength in the building, an emergency responder radio amplification system may be required. See fire department for details.***
   Kim McDonald advised the design team that signal strength cannot be tested until the building has been constructed, and that a decision will be made at that time. Kim indicated that an amplification system would typically be placed above the ceiling and may require electrical power. The design team confirms that the spatial and electrical needs of such a system can be accommodated within the existing design.

<u>Engineering</u>

1. ***A couple of things that appear to be missing are a full erosion control plan for construction, and a plan showing proposed traffic related signage including stop signs, directional signs, bus lane signs, etc.***

   Sheet C6 (not included in original set but included in this response set) illustrates perimeter control; additional internal control measures will be enacted based on future construction phasing. Project phasing has not been determined at this time.

   Sheet SS-1 (not included in original set but included in this response set) illustrates signage and striping.

2. ***With regards to traffic, the memo provided appears reasonable and in compliance with past discussions between the Town and the development. I will point out that while the traffic impacts of the FTC will not be dramatically changed, traffic on Lusher Court is likely to become more congested with the construction of the Kum & Go fuel station, and this will likely cause more bus and shuttle traffic to and from the FTC to use Hawn Drive, creating additional impacts there.***

After extensive coordination with the design team and the applicant, Katie Kent stated on behalf of the Town of Frisco in an email dated 7/2/2018 that no additional traffic data is required at this time.

3. ***There are a number of potential conflicts between the areas shown for snow storage and the landscape plan. Have the design team considered plant locations based on the fact they will be buried by snow storage? Should some landscaping be relocated to accommodate this?***

   The original snow storage plan, Sheet C1, indicated snow storage areas well in excess of Town standards. The snow storage plan has been adjusted to provide the Town minimum snow storage required, and avoid both landscape areas as well as drainage infrastructure. Landscape and storm drainage have been added to this plan for coordination of snow storage areas.

   Please refer to the attached letter from professional landscape architect (PLA) Jeff McKelvey, who confirms that plant species shown in or adjacent to the modified snow storage plan are compatible with snow storage.

4. ***Some consideration should also be given to snow storage vs drainage structures. Care needs to be taken to ensure that snow storage is not placed blocking drainage inlets or outlets from culverts, creating backups not anticipated.***

   The original snow storage plan, Sheet C1, indicated snow storage areas well in excess of Town standards. The snow storage plan has been adjusted to provide the Town minimum snow storage required, and avoid both landscape areas as well as drainage infrastructure. Landscape and storm drainage have been added to this plan for coordination of snow storage areas.

5. ***Most of the new bus lanes and staging areas will be snowmelted. Careful consideration should be given to the transition areas between heated and unheated concrete/asphalt areas to ensure they do not collect runoff and heave when frozen (which is a common problem in these situations).***

   This issue was discussed extensively during the design process, and the limits of heated and unheated were designed to minimize this issue. A detail showing the transition from heated to unheated has been added to Sheet C7.1. This detail entails over-excavation of the transition to a depth of 4-feet below pavement surface, installation of course aggregate less susceptible to frost expansion, and sealing of the joint. These joints will require frequent inspection and maintenance to ensure proper function of joint sealants. Each individual snow melt transition will be reviewed by the design team during final design.

6. ***The proposed limits of snowmelted areas should be more clearly identified.***

   A line indicated the limits of snowmelt has been added to Sheet C1.

7. ***The separation between the second shuttle drop driveway and the Transit Drive access point off Basecamp way does not appear to meet code as to separation of driveways. The fact that Transit Drive is a one-way driveway for busses only may alleviate this.***

   The two accesses noted, Transit Drive and the second shuttle drop, are proposed as one-way (northbound and counter-clockwise, respectively) and access-limited facilities restricted to professional operators of commercial shuttles and busses.

8. ***The demolition plan and the landscape plan do not agree on how much of the existing path along Meadow Drive is to be removed and replaced. The condition of the existing path should be assessed, and any damaged areas should be replaced in addition to areas being impacted by this project.***

   The landscape plans (LS100) has been updated to show the intended removal and replacement.

   The Owner has assessed the entire length of the existing pathway adjacent to and paralleling the site and found no damage except typical thermal cracking. The project will repair or replace any paving damaged by construction activities related to the Frisco Transit Center but does not anticipate any additional paving repair or replacement above and beyond those areas identified on the demolition plan noted above.

9. ***The drainage plan appears reasonable, although it does make it clear that as designed regular inspections and maintenance will be necessary for the system to work as designed. Is the County prepared to commit to this maintenance level? Otherwise the system will be subject to sediment clogging various portions of the system.***

   The design approach was discussed at length with Summit County staff and confirmed prior to proceeding with site grading. The design approach was largely driven by the elimination of a severe icing condition on the present site which would be further exacerbated by intersecting an existing drainage chase with Station Road. No drainage system, however well designed and constructed can be exempted from annual inspection and maintenance.

   The applicant, Summit County, confirms that it is committed to providing the level of inspection and maintenance necessary to ensure the system works as designed.

10. ***The drainage plan suggests that additional impacts will occur once drainage leaves this site and enters the Meadow Park property. If so these impacts should also be addressed by this project.***

As required by the Town Code, no offsite impacts are permissible from developed stormwater systems above and beyond pre-developed conditions. For this reason, pre-construction stormwater rates must be met post-development as stipulated by the Frisco Town Code.

At the Sketch Plan review hearing on 10/19/2017, the Frisco Planning Commission requested the addition of parallel parking (providing drop-off/pick-up for the shuttle lot) atop an existing culvert discharging from the south end of the project. The inclusion of these spaces necessitated the removal and replacement of the culvert. The outlet of this culvert falls within Meadow Park, therefore some disturbance within Meadow Park must occur to accommodate the culvert replacement. Appropriate erosion control and revegetation within Meadow Park has been indicated as well.

The original project master plan drainage report, which were included with the Major Site Plan documents, indicated the project would be 84% impervious, while the current Major Site Plan submittal includes only 62% impervious. An impervious value of 84% is the basis of the present detention pond on the site, which has a full capture volume of the 100-year storm, exceeding the Town of Frisco requirements. The proposed Major Site Plan application represents a significant reduction (12% or approximately 30,000 square feet) in the site imperviousness, while approximating the present detention pond area and volume. Therefore, the risk and potential impacts to Meadow Park from a catastrophic rainfall are reduced from the original Town of Frisco approved site plan.

Planning

1. ***The submitted Snow Storage Matrix does not correlate correctly to the plan. Please update and ensure accuracy of matrix.***

   The matrix, shown on Sheet C1, has been updated.

2. ***Various documents are referencing the setbacks incorrectly. Please update and ensure accuracy of all site plans. The north property line is Lusher Court.***

   Katie Kent identified Sheet AS-100 as the incorrectly labelled sheet; this label has been corrected. Offsets are also identified on Sheet LS100 and have been verified for accuracy. Per the Major Site Plan Review submittal checklist, offsets are not required on other sheets in the drawing set. For clarity and to avoid making drawings difficult to read, offsets have been included only on these two sheets.

3. ***Please verify if you are proposing photovoltaic at this time. If so, please add compliance with the Frisco Town Code, Section 180-5.3.3, to your narrative: Solar energy facilities may be ground-mounted or mounted on principal or accessory structures, provided they comply with the following requirements:***

   A. Solar energy facilities shall not be located in the front yard between the principal structure and the public right-of-way;
   B. Solar energy facilities shall be located a minimum of 6 feet from all property lines and other structures except the structure on which it is mounted;
   C. Solar energy facilities shall not exceed the greater of one-half of the footprint of the principal structure;
   D. Ground-mounted solar energy facilities shall not exceed 5 feet in height;
   E. A solar energy facility shall not extend more than 18 inches above the roofline of a one-family or two-family residential structure, or more than ten feet above the roofline of a multi-family or non-residential structure.

   A section titled 'photovoltaic cells' has been added to page 5 of the project narrative. Specifically, the photovoltaic array will be sized and located as follows, in compliance with Town code:

   A. Array is roof-mounted and will not be located in a front yard
   B. Array is located more than 6 feet from all property lines and structures.
   C. Array will occupy less than half of the roof area of the structure.
   D. Array is not ground mounted, so maximum ground height does not apply.
   E. Array will note extend more than ten feet above the roofline of the transit center, which is a non-residential structure.

4. ***Please confirm that no fences are proposed on site.***

   There will be two fences on site, on the north and west edges of the shuttle lot. Both fences will be 42" tall, split rail fences with three rails. The purpose of these fences is to direct pedestrian traffic to the marked crosswalks at the northeast and northwest corners of the shuttle lot.

5. ***Photometric plan is not showing impact to the west property line. Please clarify.***

   Sheet EA101 has been updated to extend calculation to the west property line.

6. ***Does the planting schedule include existing trees or just proposed? Please clarify the number of existing trees and number of proposed trees.***

   A new table has been added to Sheet LP001; this table tabulates existing trees by diameter and type.

7. ***Proposed species are not all found on the Town's list. These include Sand Cherry, Blue Stem Willow, Rocky Mountain Willow, Windwalker Big Blue Stem and Blue Oat Grass. Provide a letter from a landscape architect verifying that the proposed species are recommended plant material suitable to the climate and placement on the site.***

   All instances of sand cherry have been changed to juniper; this species is on the Town's list (p 171 of the *2017 Town of Frisco Unified Development Code (UDC)*). This change is shown on Sheet LP001.

   Blue Stem Willow and Rocky Mountain Willow (AKA Mountain Willow) are both on the Town's list (p 172 of the aforementioned UDC).

   Please see the previously referenced letter (Engineering Comment #3) from PLA Jeff McKelvey. This letter verifies the suitability of Big Blue Stem and Blue Oat Grass. Also note that Blue Oat Grass was used extensively and has performed well at the adjacent BaseCamp Development.

8. ***Snow storage and snow shedding areas may not overlap sensitive landscape areas, such as those which include non-flexible deciduous trees, shrubs and formal planting beds. Provide a letter from a landscape architect verifying that the proposed landscaping in the snow storage areas is compatible with large amounts of snow.***

   The original snow storage plan, Sheet C1, indicated snow storage areas well in excess of Town standards. The snow storage plan has been adjusted to provide the Town minimum snow storage required, and avoid both landscape areas as well as drainage infrastructure. Landscape and storm drainage have been added to this plan for coordination of snow storage areas.

   Please refer to the attached letter from professional landscape architect (PLA) Jeff McKelvey, who confirms that plant species shown in or adjacent to the modified snow storage plan are compatible with snow storage.

9. ***Add notes to Landscape Plan which address compliance with 180-6.14.6, Landscape Maintenance, 180-6.14.5.D, Limit of Work Area and 180-6.14.5.E, Revegetation of Disturbed Land.***

   Notes verifying compliance with the noted sections have been added to Sheet LP001.

10. ***Please provide a plan clearly showing pedestrian access and routes. Staff is having difficulty interpreting all pedestrian connections. Please also verify that the County will be maintaining all pedestrian access, including bikeway, on the property.***

    Please see the attached Pedestrian and Bicycle Circulation diagram.

The applicant, Summit County, verifies that all existing pedestrian and bicycle access to the property will be maintained. The western portion of the multi-use path along Lusher Court will be re-aligned and reconstructed to better align with new paving at the northern-most bus bay on Transit Drive.

FELSBURG HOLT & ULLEVIG

connecting and enhancing communities

January 11, 2018

MEMORANDUM

To: Andrea Springer, RNL
Rhonda Bell, RNL

From: Lyle E. DeVries, PE, PTOE
Rachel S. Ackermann, EI

Re: Frisco Transit Center Transportation Analysis
FHU Reference No. 116385-01

The Frisco Transit Center (FTC) is located in the Town of Frisco, Colorado on the south side of Interstate 70 (I-70) at 1010 Meadow Drive. The facility has been in existence since 1998, providing a centrally located transit hub for multiple public and private entities. FTC patrons board and alight from buses and shuttles that travel throughout Summit County and Colorado's Rocky Mountain Front Range. While the FTC has been a tremendous asset over its 20-year history, needs have stretched its ability to serve demand. Accordingly, the 2016 *Frisco Transit Center Master Plan* developed a comprehensive master plan for the Frisco Transit Center property. The plan identified improvements to "right-size" the development to provide a facility that more efficiently and effectively serves transit operators and patrons.

Plans to construct a new FTC on the current site are in progress, and we have corresponded with the Town of Frisco to ascertain the need for and scope associated with a Traffic Impact Study (TIS) of the proposed new facility. Following phone and email correspondence about the project, the Town's transportation consultant developed a memo dated August 9, 2017 outlining the TIS need. The memo stated that the project is not expected to have any significant impact on the local roadway network and that the TIS should be formulated as a memorandum addressing the following topics:

- Description of the proposed redevelopment
- Current and proposed:
    - site access and circulation
    - site vehicle-trip generation
    - Traffic operations
- Future growth considerations

This memorandum provides the requested information.

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www.fhueng.com info@fhueng.com

PROPOSED DEVELOPMENT

Consistent with the recommendations of the *Master Plan*, the proposed new FTC would maintain the existing program and configuration, with a new building and some site plan modifications. The proposed site plan is shown in **Figure 1**, and the current site layout is depicted in **Figure 2**.

Figure 1. Site Plan

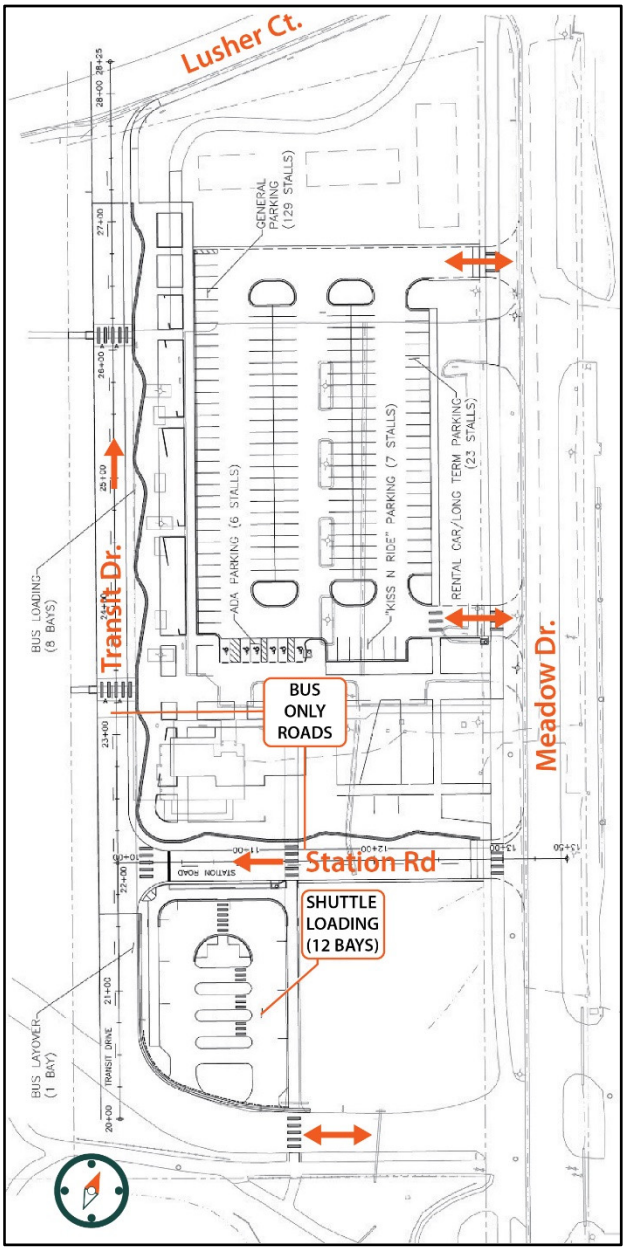
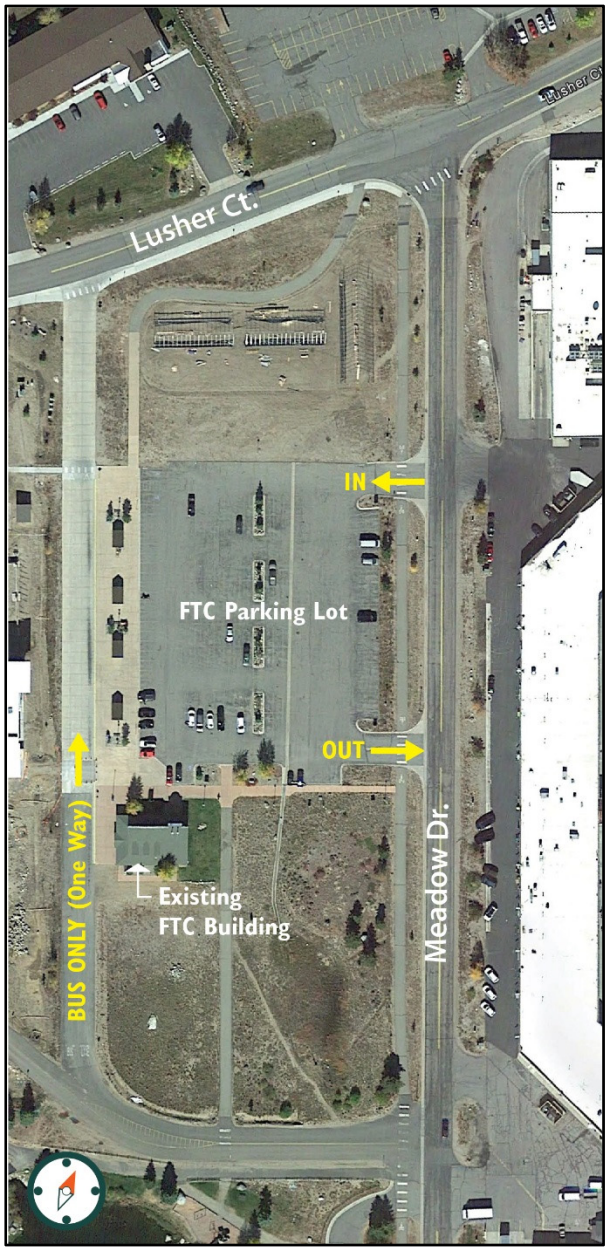


Figure 2. Current FTC Site Layout



The new on-site building will offer roughly 50 percent more square footage than the current facility and will include enhanced amenities such as information and ticketing counters. Other critical elements of the new building include a police/security office and a 24-hour restroom that is accessible from the exterior. The existing site provides six bus bays in a straight configuration and the proposed configuration includes seven sawtooth bays with an eighth bay for bus layovers. A new shuttle lot will provide a separately accessed shuttle loading/unloading area with 12 shuttle bus loading positions separate from bus circulation and the public parking lot. There is no proposed increase in the number of general parking spaces for 165 total patron parking spaces (including 6 ADA, 7 kiss-n-ride and 23 rental car/long-term spaces).

CURRENT AND PROPOSED FACILITIES

A. Site Access, Parking and Circulation

The FTC currently serves three bus providers and four shuttle companies, and houses operations of one car rental company. These users would continue to be accommodated in the new FTC, as documented in the *Master Plan*, which gathered information from each user to influence the design. Current and proposed access and circulation are described as follows by user group.

Private Vehicles

Private vehicles currently access the site via a one-way pair of accesses to Meadow Drive. The north access enters the parking lot and the south access accommodates exiting vehicles. Traffic counts indicate some wrong way traffic on these accesses, which appear to be relatively recent conversions from two-way accesses. The parking lot is configured with east-west lanes to facilitate direct pedestrian access to the bus loading area. The parking lot offers 163 standard and 6 accessible parking spaces. Of those 169 spaces, 25 are reserved for rental car and employee parking. A review of usage levels and input from Summit County Staff indicate that the current parking lot is never full and parking demand is well within capacity.

With the new FTC, the two vehicular accesses to Meadow Drive would be changed to accommodate two-way traffic and shifted slightly from current locations. The proposed number of parking spaces would be roughly equivalent to existing levels based on collective wisdom regarding current demand levels and a reasonable level of parking for the new FTC. The proposed parking configuration includes restriping in a north-south orientation to maximize the number of parking spaces.

Rental Car Operations

The existing FTC accommodates a rental car business and the new FTC is proposed to continue in this function. Rental cars are currently stored within a designated portion of the FTC surface parking lot, a practice anticipated to continue with the new FTC.

Buses

The FTC currently provides transit service from the Summit Stage, Bustang and Greyhound. The Summit Stage is a free public bus service throughout Summit County that provides service to ski areas, resorts, hotels, shopping centers, medical centers and some residential areas. From the FTC the Summit Stage provides service to/from Frisco and Copper Mountain, Leadville,

Breckenridge and Silverthorne/Dillon/ Keystone. CDOT's Bustang service currently runs one round trip through the transit center. Greyhound currently runs two scheduled routes through the transit center, for a total of four trips per day.

Buses and shuttles currently circulate through the site in a one-way, clockwise loop. Approaching the site, buses enter at the southern boundary and turn north to the boarding/alighting area along Transit Drive. The boarding area features an approximately 300-foot long straight curb without defined bus bays, capable of accommodating five 40-foot buses at one time. Patrons boarding the furthest bus have an approximately 300-foot (one block) walk to the transit center building itself.

The new FTC would maintain Transit Drive, include space for up to eight bus bays arranged in a linear configuration along Station and Transit Drives, and maintain the existing one-way, clockwise circulation. Buses would enter the site via a new exclusive access to Meadow Drive and be provided with the opportunity to stop at sawtooth bus bays along the south and west edges of the site. Buses would continue to exit onto Lusher Court. To increase patron safety and enhance transit operation, bus activity would be separate from shuttle buses.

Shuttles

The Colorado Mountain Express (CME), Peak 1 Express, Summit Express and Fresh Tracks Transportation currently provide on-demand transportation to/from Denver International Airport (DIA). Shuttles currently operate in less organized fashion than buses, parking along the west curb of the parking lot or beyond paved boarding areas while dropping off/awaiting passengers. This condition can require bus passengers to walk through waiting shuttles or require shuttle passengers to use unpaved areas without sidewalks to reach vehicles. These conditions introduce safety and efficiency concerns for FTC users.

The new FTC would provide an exclusive 12-bay shuttle pick-up and drop-off area within the south portion of the site, with two accesses to the east-west circulation roadway south of the site.

Pedestrians/Bicycles

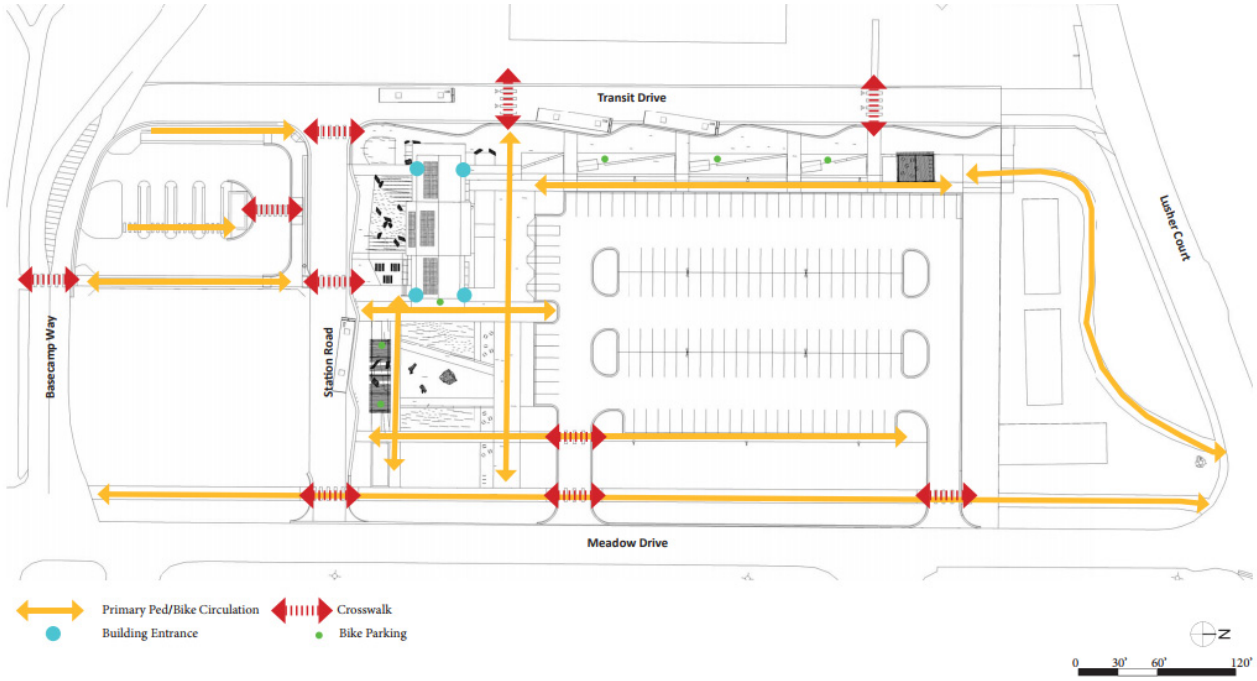
Given the absence of other site uses, the current sole pedestrian circulation pattern on-site is from the parking lot to the bus loading area or the transit center building. Pedestrians may traverse the site edge north-to south on the Meadow Drive bike path. A 10'-wide, asphalt bicycle path/multi-use path runs along the site's eastern edge and provides a connection to a one-block segment of bike path along Lusher Ct. A narrow, bicycle-unfriendly attached sidewalk exists between the gas station driveway and Summit Boulevard. An additional asphalt spur connects Meadow Creek Park, abutting the south edge of the site, to the sidewalk in front of the transit center building. A similar path connects the bus loading area north to Lusher Court.

Bike racks are currently provided adjacent to the bus shelters, but do not meet industry best practices, particularly the ability to provide support at two points on the frame, and the ability to lock both front tire and frame.

The proposed site plan would continue to provide pedestrian access to the bus loading area and transit center through the parking lot. Two new pedestrian connections would be provided to connect the transit center to the adjacent Basecamp development. The new connections would be

aligned to connect with the Basecamp sidewalks and accommodate a future connection to the Frisco Station Shopping Mall to the east, should a path through the existing building become available. The proposed bicycle and pedestrian site circulation is shown on **Figure 3**.

Figure 3. Future Pedestrian & Bicycle Circulation



The new FTC would include parking for 34 bicycles (14 covered spaces on the east side of the transit building and bike racks at each bus shelter).

B. Site Vehicle - Trip Generation

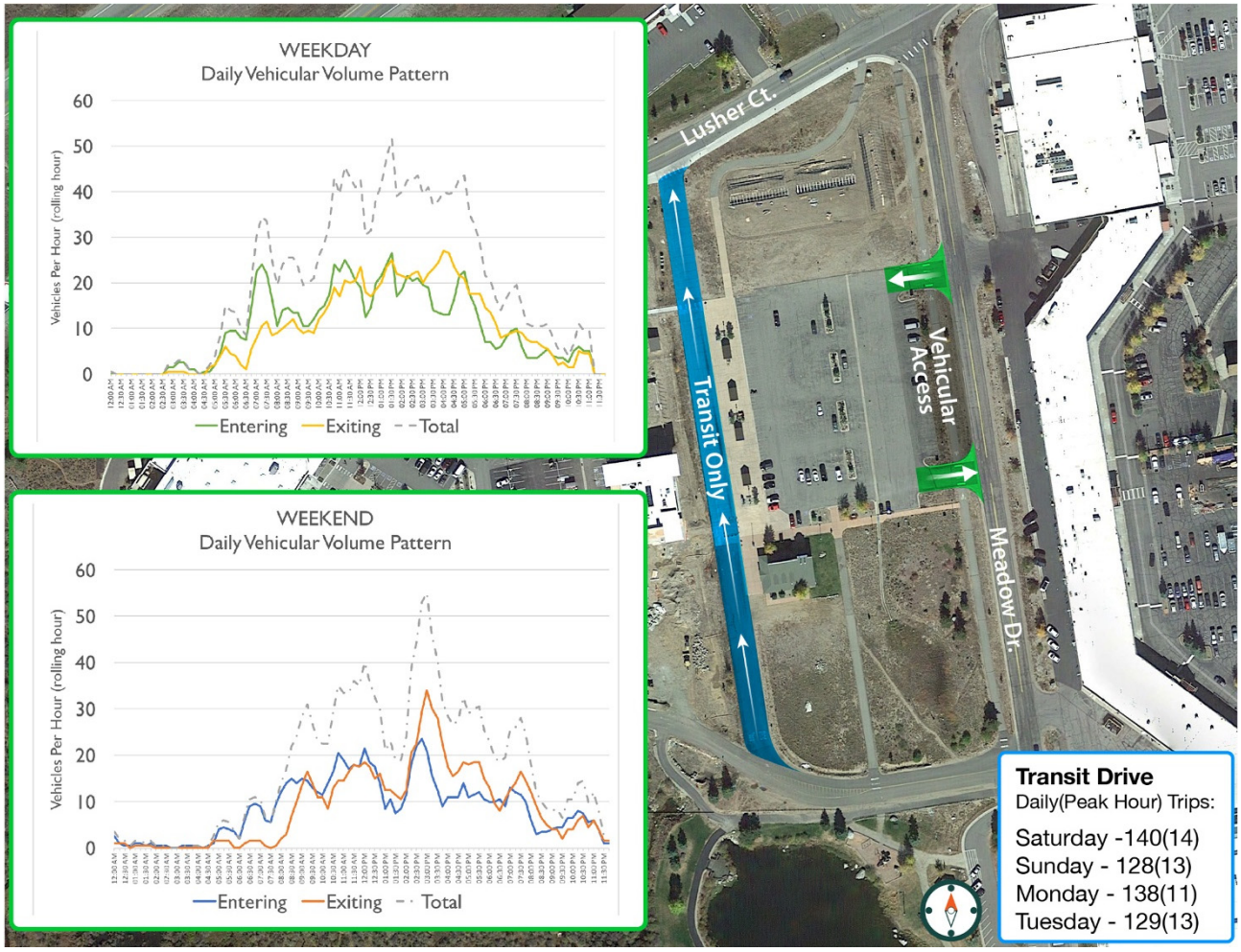
Current Trip Generation

Continuous bus and passenger vehicle traffic counts were recorded from Saturday, October 21, 2017 through Tuesday, October 24, 2017 to gauge current site vehicle-trip generation levels. Counts were recorded at the two vehicular accesses to Meadow Drive and along Transit Drive on the west side of the site. The AM/PM peak hour and daily counts are illustrated on **Figure 4**.

Bus and shuttle traffic levels average approximately 135 vehicles per day (vpd) show steady patterns across the counted days, with a slightly lesser volume recorded on Sunday. Vehicular traffic averages approximately 450 vpd, showing a reduction on Sunday with consistent levels observed on Saturday, Monday and Tuesday. Vehicular hourly traffic peaks at approximately 50 vehicles per hour, around early/mid-afternoon hours. Transit traffic peaks at approximately 12-15 vehicles per hour at various times of day.

The FTC currently generates approximately 585 vehicle-trips per day and 65 vehicles per hour. Though no quantitative traffic operations analyses were performed for this effort, recorded traffic levels indicate that current traffic volumes lie well within capacity of site access intersections and roadways.

Figure 4. Existing Traffic Counts



Proposed Site

As previously discussed, the redevelopment of the FTC is focused on “right-sizing” the redevelopment to provide acceptable facilities to handle rider and transit vehicle traffic that would occur with or without the reconstruction. There is no element newly introduced to the site by the new FTC that is projected to attract additional vehicle-trips.

Nevertheless, there it is possibility that the redevelopment could result in a small increase in transit ridership because the new FTC would be more appealing than the existing facility. For example, a potential rider may recognize that the new facility will provide better lighting, amenities and security and decide to try using transit for their transportation needs. The potential additional ridership due to this would likely be minimal and would not be expected to affect peak hour operations on the adjacent roadways.

If and when future expansion of the FTC occurs, such growth would likely trigger a need for development review and associated traffic analyses, in turn identifying transportation improvements needed.

Of note, it is likely that FTC traffic levels currently vary by season, and this variation will continue with the redevelopment. Furthermore, this trip generation review is focused on a short term time horizon and does not provide long range future forecasts.

C. Traffic Operations

Summit Boulevard

Vehicle-trips to and from the FTC currently utilize and will continue to utilize Summit Boulevard to reach the site via connections to Lusher Court and Hawn Drive. These intersections experience periodic congestion, and future development of the area is anticipated to result in additional delay. While the FTC contributes to traffic volumes at these intersections, it is a minor portion of overall traffic levels. For example, the Summit Boulevard/Lusher Court intersection currently experiences nearly 2,200 PM peak hour entering vehicles, and the FTC likely contributes roughly 2 percent to this overall volume. In addition, the PM peak hour at this intersection does not coincide with the current FTC PM peak hour.

Meadow Drive

Meadow Drive is a north-south two-lane roadway with a 20 MPH posted speed limit and extends south of Lusher Court, and dead ends south of Hawn Drive. The two vehicular accesses to the FTC are located on Meadow Drive. As previously discussed, recorded traffic levels accessing the site to/from Meadow Drive are not indicative of congestion at unsignalized intersections, and reserve capacity is available to accommodate additional future traffic growth with FTC activity.

FUTURE GROWTH CONSIDERATIONS

While little or no growth in traffic is expected to occur because of the FTC project, it is anticipated and hoped that natural growth will occur over time due to population growth, modal shift, and ridership increases.

It is reasonable to assume that most growth related to the FTC would be comprised of both local and regional trips. The influences that will likely play a role in incremental growth include:

- The ability of transit to offer an appealing alternative to travel by personal vehicle – particularly along I-70 during congested periods
- The cost of traveling by car vs. shuttle or bus
- Availability of any new transit services (e.g. shuttle service for new developments)
- Revenues available to fund transit services

Transit providers interviewed for the *Master Plan* indicated that future growth is likely to occur with or without the new FTC. Growth in Summit Stage transit service is projected to coincide with increasing transit demand associated with population growth in Summit County; no demand is projected to occur as a direct result of the redevelopment of the FTC. The Colorado Department of Transportation (CDOT) indicated that Bustang service would only expand to accommodate growth in demand. Greyhound similarly indicated that there are no plans to expand their services through the FTC, but acknowledged that improved ticketing on-site could result in increased demand.

Shuttle services were also interviewed, with similar findings. Colorado Mountain Express (CME) indicated the potential to use larger vehicles to meet potential growth in demand, as opposed to increasing the number of trips to/from the FTC. To accommodate this potential change in vehicle type on-site, CME requested circulation changes consider the use of larger shuttle vehicles. Peak 1 Express indicated that they are trying to grow their business but have no plan to expand their service area; they feel that they are more likely to increase the number of vehicles onsite at a given time than spread out during the day. Summit Express indicated there are no anticipated near-term service changes or expansions-and noted that the current site does not provide opportunity to expand. Fresh Tracks indicated no plans for service changes and/or expansion.

Based on the findings described in this memo (particularly in the trip generation section), it is anticipated that growth in traffic levels can be accommodated with the new FTC.

CONCLUSION

Given the nature of the development and the findings described herein, it is not anticipated that the project will have any significant impact to the local roadway network operations.

Please contact us at (303)721-1440 with any questions.

Stantec

Stantec
1050 17th St, Suite 200A
Denver, CO 80265

July 25, 2018
Reference:
Frisco Transit Center
Major Site Plan Application

Attention:
Katie Kent, Planner
PO Box 4100
1 East Main Street
Frisco, CO 80443

Dear Ms. Kent,

This letter is in response to the Town of Frisco Planning Department's comments on the Frisco Transit Center (FTC) Major Site Plan application.

The Town of Frisco Planning Division has requested verification from a landscape architect that proposed plant species not found on the Town of Frisco approved plant list are recommended plant material suitable to the climate and placement on site, per §180-6.14.4 of the Frisco Town Code.

Proposed plant species not found on the approved plant list include Blue Oat Grass (*Helictotrichon sempervirens*) and Little Bluestem Grass (*Schizachyrium scoparium*).

In verifying the suitability of both species, we have relied on recognized industry sources such as the USDA Plant Hardiness Map, the *Sunset Western Garden Book,* the Plantium online plant database and Plant Select®- a nonprofit collaboration of Colorado State University, Denver Botanic Gardens and professional horticulturists.

The town of Frisco is located within USDA Plant Hardiness Zone 4b and *Sunset* Climate Zone 1A, which is defined in the *Sunset Western Garden Book* as the 'Coldest mountain and intermountain areas of the contiguous states and Southwestern British Columbia'. Unlike the familiar USDA hardiness zone maps which divide most of North America into zones based strictly on winter low temperatures, the *Sunset* climate zone maps take several climatic factors that govern plant performance into account, including length of growing season, timing and amount of rainfall, winter lows, summer highs, wind, and humidity.

Blue Oat Grass (*Helictotrichon sempervirens*) is a perennial grass that grows in Sunset Zones 1-24 and USDA Hardiness Zones 4 - 9. Little Bluestem Grass (*Schizachyrium scoparium*) is a native perennial grass that grows in Sunset Zones 1-24 and USDA Hardiness Zones 3 - 8. The 'Standing Ovation' cultivar was a Plant Select® selection in 2016.

Please note that Blue Oat Grass was used extensively and appears to be performing well at the adjacent BaseCamp development and was selected specifically for use on the project site to create a sense of continuity between the two properties.

Given the preceding, I believe these plant selections will be able to withstand the unique high-altitude climate conditions endemic to the project site and feel confident specifying these plants for use as shown in the landscape site plan.

Relative to the Town's additional query regarding the proposed landscaping in the snow storage areas, I have reviewed the proposed planting and snow storage plans and feel confident that the snow storage and snow shedding areas do not overlap sensitive landscape areas containing non-flexible deciduous trees, shrubs and formal planting beds.

Respectfully,

Jeff McKelvey, PLA, ASLA, ENV SP
Professional Landscape Architect
CO License 0000780
Phone: 303-575-8487
jeff.mckelvey@stantec.com

SUMMIT COUNTY
COLORADO

TRANSIT DEPARTMENT

970.668.0999 ph | 970.668.4165 f
www.SummitStage.com

0222 County Shops Rd. | PO Box 2179
Frisco, CO 80443

TO: Katie Kent, Town of Frisco Planner

FROM: Curtis Garner, Summit Stage Director

DATE: March 28, 2018

SUBJECT: Garbage Collection at the Frisco Transportation Center

Currently, the Summit Stage is responsible for daily garbage collection from the Frisco Transportation Center (FTC). This daily collection entails our internal maintenance staff arriving at the FTC early in the morning to empty each bus shelter trash can along with all trash receptacles inside the building. Summit Stage staff then transports this garbage via our maintenance truck back to our bus barn where it is properly disposed of in our garbage dumpster located on the north side of our operations center. Summit Stage staff also collects recycling from the FTC to then properly dispose of it in the County recycling center located across from the County Commons. These tasks are performed on a daily basis year-round, and sometimes more than once daily depending on garbage demands.

This same daily garbage and recycling collection policy would remain in effect with the reconstruction of the FTC. Summit Stage staff would continue to remain cognizant of garbage can and recycling container capacities and would continue to effectively police the FTC property on a daily basis.

Very respectfully yours,

Curtis Garner
Transit Director
curtis.garner@sumitcountyco.gov
970.668.4161

FRISCO TRANSIT CENTER
PRELIMINARY
DRAINAGE REPORT

MARCH 2018

CIVIL INSIGHT

FRISCO TRANSIT CENTER
PRELIMINARY
DRAINAGE REPORT

MARCH 2018

Owner: Summit County Government, Summit Stage
PO Box 2179
0222 County Shops Road
Frisco, CO 80443
(970) 668-0999

Engineer: Civil Insight, LLC
P. O. Box 7644
235 South Ridge Street, Unit 2-A
Breckenridge, CO 80424
(970) 771-2940

TABLE OF CONTENTS

APPENDIX

PURPOSE

The purpose of this drainage report is to evaluate the impacts of an updated master plan on existing stormwater infrastructure at the Frisco Transit Center. This report evaluates stormwater runoff quantities, infrastructure capacity, and stormwater detention and retention.

INTRODUCTION

The Frisco Transit Center project is location on Lot 1, Summit Stage Transit Center Subdivision, Section 25, Township 5 South, Range 78 West of the 6th PM, in northeast Frisco, Colorado. The site is located on the southwest corner Meadow Drive and Lusher Court, east of the Whole Foods Market shopping center, and north of Meadow Park.

EXISTING CONDITIONS

The 6.2 acre parcel is home to an existing Transit Center developed in the late 1990's and includes a large parking lot with concrete walks, a transit access road along the southern and western boundaries, a small transit building, a number of small bus shelters, and several asphalt recpaths across the property. Several greenhouses occupy the north end of the site.

Much of the project drains internally to a central stormwater detention pond in the southern, vacant area of the site. However, several areas discharge stormwater runoff from the site without reaching this detention pond. These include the entirety of the transit access road along the southern and western boundaries, which drain to the south and west respectively, and portions of the main parking lot and undeveloped northern portion of the site, which drain to the intersection of Meadow Drive and Lusher Court via existing concrete drainage pans.

The remaining, northern portion of the existing project drains to the interior of the central parking lot, then along a drainage pan south to a concrete chase through a concrete sidewalk and into the detention pond. The southern half of the building, an existing recpath and undeveloped areas south of the parking lot sheet flows directly, or into ditches, then to the detention pond.

ORIGINAL 1996 DRAINAGE REPORT

The original project development was accompanied by the *Final Drainage Study for the Summit Stage Transfer Station,* February 26, 1996, prepared by Felsburg, Holt & Ullevig. The report primarily addressed stormwater detention design and hydraulic capacity analysis.

The report utilized the USDA publication *Urban Hydrology for Small Watersheds, Technical Release 55*, (TR55) Graphical Peak Discharge method for estimating peak flows for detention design and capacity analysis. For consistency, this is the basis for updated drainage calculations and stormwater design.

The detention pond design set forth in this report was intended for full build-out of the project as master planned at the time. In addition to the existing development this included an expansion of the main parking lot to the north, into the area currently occupied by greenhouses, and a shuttle parking lot south of the existing Transit Building.

According to the 1996 drainage report, under fully developed conditions the site would be 84% impervious pavement and buildings, and 16% open space.

Several changes in design approach from the 1996 report are proposed with this updated drainage report and are unenumerated below:

1. The original drainage analysis and detention design assumed that the entirety of the project runoff is captured in the detention pond, and runoff volumes, discharge rates, etc. are based upon this assumption. For a preliminary drainage analysis this is acceptable; however, as the project developed, updates should have addressed the areas that did not discharge to the project detention pond. As stated above, the entire western and southern drives, as well as an undeveloped area between the north parking lot and Lusher Court discharge offsite and undetained. It appears from the *Grading Plan* exhibit to the 1996 drainage report that the future, north expansion to the parking lot would have been captured in the project detention pond; however, there is no consideration for the other drives. The western drive does discharge to a detention pond located within the Whole Foods Market project limits, though this project was developed much later. The updated report only considers those areas contributing runoff to the on-site detention pond and stormwater infrastructure, and treats the remaining areas as an existing condition unimpacted by the current, proposed site redesign.
2. The original drainage report utilizes a 25-year, 24-hour rainfall value of 2.20 inches, which is consistent with both past, and current Frisco Town Codes, as well as the online NOAA Precipitation Frequency Data Server tool, a resource not available at the time of the original study. However, the 1996 report also utilized a 100-year, 24-hour rainfall value of 2.65 inches, a fair estimation at the time; but with the improved accuracy of online tools, the 100-year, 24-hour rainfall has been estimated to be 2.91 inches. This value is the basis for updated calculations contained herein.
3. The original drainage report utilized the 100-year, 24-hour storm as the basis for stormwater detention design. While this may appear to be a conservative approach, this actually results in a higher permitted discharge rate (estimated 3 cubic feet per second (cfs)) from the project detention pond than would be permitted if the historic (prior to any land development) 25-year, 24-hour discharge rate (2 cfs) were used. Therefore, the 1996 report does not conform to the Town Code in that the discharge rate from the pond is not the historic 2 cfs from the 2.20 inch, 25-year, 24-hour storm, but 3 cfs from the 2.65 inch, 100-year, 24-hour storm. This updated drainage report will address this incongruity.
4. Runoff coefficient selection: The TR55 Graphical Peak Discharge Method utilizes the Curve Number procedure. The runoff curve number (CN) being a unitless coefficient representing the rainfall losses, or abstractions based upon soil type and vegetation occurring prior to runoff, or simply put describes the soils and vegetations ability to convert rainfall to runoff. The higher value of CN, the greater amount of rainfall will be converted to runoff. The 1996 report utilized the published TR55 tables of the time for pervious and impervious areas, for both pre-, and post-developed conditions. These values were 71, and 90 respectively. These values are adequate for estimating the original discharge rates from the property; however, they are too low for the proposed conditions and therefore would underestimate the post-development runoff rates estimated for this

updated report. A value of 79 has been utilized for all "Open Space" areas, and a value of 98 for all "Impervious" areas in accordance with TR55, Table 2-2a (see appendix).

5. The soil type as defined by the National Resource Conservation Center (NRCS), formally the Soil Conservation Service (SCS) upon which the Frisco Transit Center is sited is defined as map unit 10: "Histic Cryaquolls, nearly level". This is consistent for both the 1996 report and this updated report. Each classification of soil is subdivided into one of four different hydrologic soil groups (HSG), A, B, C, or D which are used along with vegetative cover to define CN, with the A classification producing the least amount of runoff, and the D classification the most. At the time of the initial report, Histic Cryaquolls, nearly level was assigned an HSG value of C by the NRCS (SCS); however, the NRCS mapping has been updated to include dual HSG classes (A/D, B/D, and C/D), where the first letter is for drained areas, and the second letter is for undrained areas. This particular soil, Histic Cryaquolls, nearly level has been reclassified with an HSG value of A/D. For the purpose of this report, and given the presence of imported fill as identified in the original report and an updated geotechnical investigation prepared November 19, 2015 the HSG C value for selection of runoff coefficients for both pre-, and post-developed conditions is appropriate.
6. Use of the south site access road (Basecamp Way) as a spillway from the detention pond as set forth in the 1996 drainage study is not practical given as-constructed site conditions. Were the existing detention pond to backup to the elevation indicated in the 1996 report, runoff would not overtop Basecamp Way, but would rather discharge at the southwest corner of the pond onto Meadow Drive. This updated drainage report and detention pond design mitigate this condition.

PROPOSED REDEVELOPMENT

Proposed redevelopment of the Frisco Transit Center will entail removal of the existing transit building, removal of the north parking lot, and the majority of the western drive (Transit Drive), installation of a new building, installation of a new and larger public parking lot, installation of a new, snow-melted Transit Drive, installation of a new, snow-melted bus driveway (Station Road) to Meadow Drive, installation of extensive, snow-melted plaza areas, installation of a paved shuttle lot, and installation of two "kiss-and-ride" parking spaces on the southern access road (Basecamp Way).

The overall project impervious area with the proposed redevelopment is 3.8 acres, or 62% impervious. This is less than indicated in the original drainage report value of 84% impervious, or 5.2 acres.

To address icing issues present on the existing site where parking lot runoff is directed to a narrow, concrete sidewalk chase, a storm sewer system has been devised. This will function to mitigate icing, provide stormwater pretreatment in the form of a bioswale, and intercept snow-melt runoff prior to discharging onto unheated areas.

A storm sewer, however, provides challenges to the site stormwater detention design in that to achieve minimum pipe diameter, capacity, slope, and cover, sections of the storm sewer system will discharge below the detention pond outfall elevation in a sump or "retention" condition. For

this reason, a soil infiltration rate was provided during geotechnical investigations to assist with retention design. In the event of a design storm, it is likely that stormwater will backup into the storm sewer to an elevation consistent with the detention pond outfall elevations.

HYDROLOGIC AND HYDRAULIC DESIGN CALCULATIONS

Through the TR55 Graphical Peak Discharge method it was determined that the developed, 25-year, 24-hour runoff based upon a design storm of 2.20 inches will be **9.4 cfs**, and a developed 100-year, 24-hour runoff based upon a design storm of 2.91 inches will be **14.1 cfs**. This is based upon an estimated 6-minute (0.10 hour) time of concentration. These rates refer only to the rates routed through the project detention pond, and not areas that historically discharge from the project undetained.

STORMWATER DETENTION

Utilizing an historic, 25-year, 24-hour discharge rate as calculated in the original 1996 drainage report of 2.0 cfs it has been determined that a detention pond volume of at least 0.23 acre-feet is required to meet Town of Frisco standards. Detention storage has also been estimated for the 100-year, 24-hour peak flow utilizing the same discharge rate of 2.0 cfs. An estimated volume of 0.38 acre-feet is needed to capture this entire storm and discharge it at the historic rate.

The existing detention pond area has been regraded, utilizing a slightly lower outlet elevation permissible with the removal and replacement of the current outlet pipe. The revised pond has an outlet (bottom) elevation of 9063.55, utilizing an 8” diameter orifice in a precast concrete drainage inlet. The top of the inlet will have an elevation of 9065.50 and function as a spillway in lieu of roadway overtopping as considered in the 1996 drainage report. A berm with an elevation at least 12” higher shall be constructed around the perimeter of the pond to prevent offsite migration of stormwater in extreme rainfall events.

The proposed regraded pond that has a storage volume of 0.44 acre-feet below the spillway at 9065.50, which will fully contain the design 25-year, 24-hour, and 100-year, 24-hour storms. This is consistent with the design intent of the original drainage report.

STORMWATER RETENTION

The discharge from two culverts into the pond will be below the 9063.55 orifice elevation; one located at the northeast corner of the pond, and one the southwest. Grade at the outlets of these pipes has been sloped to a lower retention area to mitigate ice buildup at the pipe outlet; however, the owner should be aware that these areas will be prone to icing and sediment buildup. Active maintenance is a key component to the success of any drainage system, and the owner should anticipate annual inspection of the entire drainage system.

A soil percolation test was conducted as part of the geotechnical investigation in the site area to be occupied by the detention pond. The rate given was 79 minutes per inch. The capacity for the ground to absorb runoff will diminish with time, therefore it is recommended accumulated

sediment and debris be routinely removed from retention areas, and the ground be scarified to ensure proper functionality.

Two retention areas are proposed for culverts too low to drain via gravity to the detention pond outlet. The first is located on the eastern storm sewer and has a 30" depth. At a percolation rate of 79 minutes per inch, the emptying time for the retention area is approximately 40 hours.

The second retention area is at the culvert outfall near the shuttle parking lot and has an 18" depth and an approximate 24 hour emptying time.

INFRASTRUCTURE CAPACITY

Infrastructure capacity analysis for swales, curbs, inlets and culverts has been estimated using a variety of techniques, including Manning's capacity analysis, and methodology set forth in the U*rban Storm Drainage Criteria* Manual, published by the Denver Urban Flood Control District. The 100-year, 24-hour runoff rates have been estimated for the various contributing catchments, with primary focus being on directly connected impervious areas and are the basis for capacity analysis.

As a check of runoff rate reasonableness, a Rational Method analysis was performed for each contributing drainage catchment. The results are very similar to the TR55 Graphical Peak Discharge Method estimations and are summarized in the appendix to this report.

All proposed drainage infrastructure has carrying capacity for the design, 100-year, 24-hour storm. However, the existing 16" CMP (corrugated metal pipe) culvert in Meadow Park has an insufficient bury depth to impound the design runoff. The result will be some portion of this runoff spilling to the east into the Meadow Park parking lot. Once in the parking lot, runoff will be routed in curb and gutter to a wide concrete pan at the southwest corner of the site.

The results of these computations have been tabulated in the appendix to this report.

MAINTENANCE

As stated above, storm sewers and culverts have been designed throughout the project to mitigate existing icing issues, as well as to intercept heated, snowmelt runoff on heated pavement surfaces. Due to the shallow depth of the existing culverts at the south end of the project, and the flat nature of Meadow Drive, most storm sewer pipes have been designed with extremely flat slopes (0.5%).

Additionally, stormwater outfalls below the detention pond outlet elevation will result in some backup of runoff into the pipelines, causing sediment to accumulate within these pipes. Finally, retention areas will have a limited capacity to infiltrate stormwater, and this will diminish with time.

For these reasons, the storm drainage infrastructure should be inspected frequently: at a minimum at the recession of winter snow pack, and prior to the first snowfalls in the fall. Two inspections a year should be conducted at a minimum. Inspections should note infrastructure condition, presence and approximate depth of sediment, and standing water.

Water standing on the site for periods longer than set forth in the Stormwater Retention section of this report should be addressed immediately.

APPENDIX

WHOLE FOODS MARKET/BASE CAMP SHOPPING CENTER DETENTION POND (APPROXIMATE LOCATION BASED UPON DESIGN PLANS)

BASE CAMP SHOPS AND RESIDENCES (UNDER CONSTRUCTION)

WELLNESS BUILDING (EXISTING)

BASE CAMP SHOPPING CENTER

RESTAURANT AND BREWERY (EXISTING)

EXISTING CULVERT

EXISTING JOINT DRAINAGE DITCH CONTINUOUS ALONG WESTERN PROPERTY LINE

EXISTING CULVERT

SOUTHERN DRAINAGE AREA DRAINS TO EXISTING DRAINAGE DITCH THEN TO PROJECT DETENTION POND VIA CULVERT

EXISTING ONE-STORY BUILDING SMALL SECTION OF ROOF AND WEST PLAZA DRAIN TO TRANSIT DRIVE AND JOINT DRAINAGE DITCH

WESTERN DRAINAGE AREA COMPRISED PRIMARILY OF TRANSIT DRIVE DRAINS TO JOINT DITCH THEN TO BASE CAMP SHOPPING CENTER DETENTION POND

TRANSIT DRIVE

EXISTING 6' CONCRETE CROSS-PAN

EXISTING 3' CONCRETE DRAINAGE PAN CONTINUOUS ALONG LUSHER COURT

MEADOW POND

ALPINE INN

EXISTING DRAINAGE DITCH

ASPHALT BIKE PATH

CENTRAL DRAINAGE AREA COMPRISED OF EXISTING AND BUILDING, WESTERN CONCRETE PLAZA AND CENTRAL PARKING LOT THAT DISCHARGE TO PROJECT DETENTION POND VIA A CONCRETE DRAINAGE PAN WITHIN THE PARKING LOT AND SIDEWALK CHASE EAST OF THE BUILDING

RAISED PLANTERS

EXISTING GREENHOUSE

LUSHER COURT

EXISTING CULVERT

BASECAMP WAY

MEADOW PARK

EXISTING CULVERT AND DETENTION POND OUTLET STRUCTURE

CONCRETE TRENCH DRAIN

APPARENT LOW POINT IN DETENTION POND EMBANKMENT

SIDEWALK CHASE

CONCRETE DRAINAGE PAN

APPARENT RIDGE LINE IN ASPHALT

EXISTING GREENHOUSE

MEADOW DRIVE

EXISTING 3' CONCRETE DRAINAGE PAN CONTINUOUS ALONG MEADOW DRIVE

EXISTING DRAINAGE INLET

SOUTHERN DRAINAGE AREA INCLUDES DETENTION POND AND PORTION OF EXISTING BUILDING AND BIKE PATH THAT SHEET FLOW TO PROJECT DETENTION POND

NORTHERN DRAINAGE AREA COMPRISED PRIMARILY OF UNDEVELOPED LOT AREAS DRAINS TO LUSHER COURT AND/OR MEADOW DRIVE THEN TO AN EXISTING DRAINAGE INLET AT THE INTERSECTION OF THESE TWO STREETS

EASTERN AREA OF EXISTING PARKING LOT AND DRIVEWAYS THAT DRAIN UNDETAINED TO EXISTING 3' PAN ALONG MEADOW DRIVE

SOUTHERN DRAINAGE AREA COMPRISED PRIMARILY OF BASECAMP WAY AND SOUTH RECPATH DRAINS UNDETAINED OFF THE PROPERTY

SAFEWAY

N

0 30 60 Feet

SCALE: 1"=30'

SHEET REVISIONS

REVISION	DATE	COMMENTS	INITIALS

CIVIL INSIGHT
235 So. Ridge St - P.O. BOX 7644
BRECKENRIDGE, CO 80424
(970) 771-2940 / (970) 376-4858
DON@CIVILINSIGHT.NET

BOARD OF COUNTY COMMISSIONERS OF SUMMIT COUNTY

PO BOX 68
BRECKENRIDGE, CO 80424
PHONE: 970-453-3403

AS CONSTRUCTED

NO. OF REVISIONS:	#
REVISED:	#
VOID:	#

FRISCO TRANSIT CENTER

EXISTING STORMWATER PLAN

DRAWN BY:	D. LEINWEBER	DATE:	4/3/2018
CHECK BY:	D. LEINWEBER	ISSUE:	DRAINAGE REPORT
SHEET SUBSET:	#	SUBSET SHEETS:	# OF #

PROJECT NO./CODE

NO:	C610-017
CODE:	22164
SHEET NUMBER:	DRN 1 OF 2

PRELIMINARY - NOT FOR CONSTRUCTION

WHOLE FOODS MARKET/BASE CAMP SHOPPING CENTER DETENTION POND (APPROXIMATE LOCATION BASED UPON DESIGN PLANS)

BASE CAMP SHOPS AND RESIDENCES (UNDER CONSTRUCTION)

WELLNESS BUILDING (EXISTING)

BASE CAMP SHOPPING CENTER

RESTAURANT AND BREWERY (EXISTING)

EXISTING CULVERT

EXISTING JOINT DRAINAGE DITCH CONTINUOUS ALONG WESTERN PROPERTY LINE

PROPOSED STORM SEWER

EXISTING CULVERT

SOUTHERN PARKING LOT DRAINAGE AREA DRAINS TO PROPOSED DRAINAGE CROSS-PANS THEN TO PROJECT RETENTION/DETENTION POND VIA CULVERT

PROPOSED ONE-STORY BUILDING ROOF DRAINS SHALL TIE INTO PROPOSED STORM SEWER DESIGN BY OTHERS

WESTERN DRAINAGE AREA COMPRISED PRIMARILY OF TRANSIT DRIVE DRAINS TO JOINT DITCH THEN TO BASE CAMP SHOPPING CENTER DETENTION POND (PREDEVELOPMENT RUNOFF PATTERN)

MEADOW POND

MEADOW PARK

BASECAMP WAY

STATION ROAD

TRANSIT DRIVE

ALPINE INN

LUSHER COURT

EXISTING 6' CONCRETE CROSS-PAN

EXISTING 3' CONCRETE DRAINAGE PAN CONTINUOUS ALONG LUSHER COURT

WESTERN PLAZA HEATED CONCRETE SHALL DRAIN TO STORM SEWER LOCATED WITHIN PLAZA

NORTH BUILDING DRAINAGE AREA COMPRISED OF SNOWMELTED PLAZA AND BUILDING RUNOFF DISCHARGING TO PROJECT RETENTION/DETENTION POND VIA PROPOSED STORM SEWER

WESTERN PLAZA DRAINAGE AREA COMPRISED OF SNOWMELTED PLAZA RUNOFF DISCHARGING TO RETENTION/DETENTION POND VIA PROPOSED STORM SEWER

RAISED PLANTERS

EXISTING GREENHOUSE

PROPOSED CURB INLET

PROPOSED STORMWATER RETENTION AREA

REMOVE EXISTING CULVERT AND INSTALL NEW CULVERT AND DETENTION POND OUTLET STRUCTURE

PROPOSED STORM SEWER

PROPOSED BIOSWALE STORMWATER RETENTION FINAL CONFIGURATION TO BE COORDINATED WITH PROJECT LANDSCAPE DESIGN

PROPOSED STORMWATER RETENTION AREA

MEADOW DRIVE

PROPOSED 15' CONCRETE CROSS-PAN

PROPOSED STORM SEWER

PROPOSED CURB INLET

PROPOSED 10' CONCRETE CROSS-PAN

EXISTING 3' CONCRETE DRAINAGE PAN CONTINUOUS ALONG MEADOW DRIVE

PROPOSED 10' CONCRETE CROSS-PAN

EXISTING DRAINAGE INLET

SOUTHERN DRAINAGE AREA INCLUDES RETENTION/DETENTION POND AND PORTIONS OF SOUTH PARKING LOT THAT SHEET FLOW TO PROJECT RETENTION/DETENTION POND

CENTRAL DRAINAGE AREA COMPRISED PRIMARILY OF PARKING LOT DRAINS TO BIOSWALE THEN PROJECT RETENTION/DETENTION POND VIA PROPOSED STORM SEWER

NORTHERN DRAINAGE AREA COMPRISED PRIMARILY OF UNDEVELOPED LOT AREAS DRAINS TO LUSHER COURT AND/OR MEADOW DRIVE THEN TO AN EXISTING DRAINAGE INLET AT THE INTERSECTION OF THESE TWO STREETS (PREDEVELOPMENT RUNOFF PATTERN)

SOUTHERN DRAINAGE AREA COMPRISED PRIMARILY OF BASECAMP WAY AND SOUTH RECPATH DRAINS UNDETAINED OFF THE PROPERTY (PREDEVELOPMENT RUNOFF PATTERN)

EASTERN PLAZA DRAINAGE AREA COMPRISED OF SNOWMELTED ROADWAY AND PLAZA RUNOFF DISCHARGING TO RETENTION/DETENTION POND VIA SHEET FLOW

CENTRAL DRAINAGE AREA (SOUTH) COMPRISED OF PARKING LOT DRAINS TO PROPOSED CROSS-PAN THEN PROJECT RETENTION/DETENTION POND VIA PROPOSED STORM SEWER

SAFEWAY

N

0 30 60 Feet

SCALE: 1"=30'

SHEET REVISIONS

REVISION	DATE	COMMENTS	INITIALS

CIVIL INSIGHT
235 So. Ridge St - P.O. BOX 7644
BRECKENRIDGE, CO 80424
(970) 771-2940 / (970) 376-4858
DON@CIVILINSIGHT.NET

SUMMIT COUNTY COLORADO

BOARD OF COUNTY COMMISSIONERS
OF SUMMIT COUNTY
PO BOX 68
BRECKENRIDGE, CO 80424
PHONE: 970-453-3403

AS CONSTRUCTED

NO. OF REVISIONS: #

REVISED: #

VOID: #

FRISCO TRANSIT CENTER

PROPOSED STORMWATER PLAN

DRAWN BY: D. LEINWEBER DATE: 3/23/2018

CHECK BY: D. LEINWEBER ISSUE: 65% DESIGN PROGRESS

SHEET SUBSET: # SUBSET SHEETS: # OF #

PROJECT NO./CODE

NO: C610-017

CODE: 22164

SHEET NUMBER: DRN 2 OF 2

PRELIMINARY - NOT FOR CONSTRUCTION

NOAA Atlas 14, V olume 8, Version 2
Location name: Frisco, Colorado, USA *
Latitude: 39.5889°, Longitude: -106.0979°
Elevation: 9070.58 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) [1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.131 (0.103-0.170)	0.174 (0.136-0.227)	0.248 (0.193-0.324)	0.311 (0.241-0.408)	0.402 (0.302-0.554)	0.474 (0.347-0.664)	0.549 (0.388-0.792)	0.628 (0.425-0.935)	0.735 (0.478-1.13)	0.819 (0.519-1.28)
10-min	0.191 (0.150-0.249)	0.255 (0.200-0.332)	0.363 (0.283-0.474)	0.455 (0.353-0.598)	0.588 (0.442-0.811)	0.694 (0.508-0.972)	0.804 (0.568-1.16)	0.919 (0.622-1.37)	1.08 (0.700-1.66)	1.20 (0.759-1.88)
15-min	0.233 (0.183-0.304)	0.311 (0.244-0.405)	0.442 (0.345-0.578)	0.555 (0.431-0.729)	0.717 (0.539-0.989)	0.847 (0.620-1.19)	0.981 (0.693-1.41)	1.12 (0.759-1.67)	1.31 (0.854-2.02)	1.46 (0.926-2.29)
30-min	0.324 (0.254-0.422)	0.409 (0.321-0.533)	0.561 (0.438-0.733)	0.697 (0.541-0.916)	0.901 (0.682-1.25)	1.07 (0.788-1.51)	1.25 (0.889-1.82)	1.45 (0.985-2.17)	1.73 (1.13-2.67)	1.95 (1.23-3.05)
60-min	0.418 (0.328-0.544)	0.501 (0.393-0.653)	0.654 (0.511-0.855)	0.797 (0.619-1.05)	1.02 (0.774-1.42)	1.21 (0.891-1.71)	1.41 (1.00-2.06)	1.64 (1.12-2.46)	1.96 (1.28-3.04)	2.23 (1.41-3.48)
2-hr	0.512 (0.406-0.659)	0.593 (0.470-0.764)	0.748 (0.590-0.966)	0.898 (0.704-1.17)	1.14 (0.875-1.58)	1.34 (1.00-1.89)	1.57 (1.13-2.27)	1.83 (1.26-2.73)	2.20 (1.46-3.38)	2.51 (1.60-3.88)
3-hr	0.581 (0.463-0.743)	0.654 (0.521-0.836)	0.797 (0.633-1.02)	0.940 (0.742-1.21)	1.17 (0.910-1.62)	1.38 (1.04-1.92)	1.61 (1.17-2.31)	1.87 (1.30-2.77)	2.24 (1.50-3.43)	2.56 (1.65-3.93)
6-hr	0.706 (0.569-0.891)	0.793 (0.638-1.00)	0.958 (0.769-1.22)	1.12 (0.891-1.43)	1.37 (1.07-1.86)	1.59 (1.21-2.18)	1.83 (1.34-2.59)	2.10 (1.47-3.06)	2.48 (1.67-3.75)	2.80 (1.82-4.26)
12-hr	0.864 (0.704-1.08)	0.991 (0.807-1.24)	1.22 (0.992-1.53)	1.44 (1.16-1.81)	1.76 (1.39-2.35)	2.04 (1.56-2.76)	2.34 (1.72-3.26)	2.66 (1.88-3.83)	3.12 (2.12-4.65)	3.50 (2.30-5.27)
24-hr	1.07 (0.883-1.32)	1.23 (1.02-1.53)	1.53 (1.25-1.89)	1.80 (1.46-2.24)	2.20 (1.75-2.90)	2.54 (1.97-3.40)	2.91 (2.17-4.01)	3.31 (2.37-4.72)	3.88 (2.66-5.71)	4.34 (2.88-6.47)
2-day	1.33 (1.11-1.62)	1.51 (1.26-1.84)	1.84 (1.53-2.25)	2.14 (1.77-2.64)	2.60 (2.10-3.39)	3.00 (2.35-3.96)	3.42 (2.58-4.66)	3.88 (2.80-5.47)	4.54 (3.15-6.62)	5.08 (3.41-7.48)
3-day	1.49 (1.25-1.81)	1.70 (1.43-2.06)	2.08 (1.73-2.53)	2.42 (2.01-2.96)	2.93 (2.37-3.78)	3.36 (2.65-4.41)	3.82 (2.90-5.17)	4.32 (3.14-6.04)	5.03 (3.51-7.27)	5.60 (3.78-8.20)
4-day	1.63 (1.37-1.96)	1.86 (1.57-2.25)	2.27 (1.90-2.75)	2.63 (2.20-3.21)	3.18 (2.58-4.08)	3.64 (2.87-4.74)	4.12 (3.14-5.53)	4.64 (3.38-6.45)	5.38 (3.76-7.73)	5.97 (4.05-8.69)
7-day	2.00 (1.70-2.38)	2.25 (1.91-2.69)	2.69 (2.28-3.23)	3.08 (2.60-3.72)	3.67 (3.00-4.64)	4.15 (3.30-5.34)	4.65 (3.58-6.18)	5.20 (3.82-7.14)	5.96 (4.21-8.48)	6.57 (4.50-9.49)
10-day	2.31 (1.98-2.74)	2.58 (2.21-3.06)	3.05 (2.60-3.63)	3.46 (2.93-4.15)	4.07 (3.35-5.12)	4.58 (3.67-5.85)	5.11 (3.95-6.73)	5.67 (4.19-7.74)	6.46 (4.59-9.13)	7.10 (4.88-10.2)
20-day	3.17 (2.75-3.72)	3.52 (3.05-4.13)	4.12 (3.55-4.84)	4.63 (3.97-5.48)	5.38 (4.47-6.65)	5.99 (4.85-7.54)	6.62 (5.16-8.60)	7.28 (5.44-9.80)	8.20 (5.88-11.4)	8.92 (6.21-12.7)
30-day	3.90 (3.40-4.53)	4.33 (3.77-5.04)	5.06 (4.39-5.91)	5.68 (4.90-6.67)	6.55 (5.47-8.02)	7.25 (5.90-9.04)	7.96 (6.25-10.3)	8.70 (6.54-11.6)	9.71 (7.00-13.4)	10.5 (7.35-14.8)
45-day	4.83 (4.25-5.58)	5.39 (4.73-6.23)	6.30 (5.51-7.31)	7.06 (6.13-8.23)	8.10 (6.78-9.80)	8.90 (7.28-11.0)	9.70 (7.65-12.4)	10.5 (7.94-13.9)	11.6 (8.40-15.9)	12.4 (8.75-17.4)
60-day	5.65 (4.99-6.49)	6.32 (5.57-7.27)	7.40 (6.50-8.54)	8.27 (7.22-9.60)	9.44 (7.94-11.3)	10.3 (8.48-12.6)	11.2 (8.86-14.2)	12.0 (9.12-15.8)	13.1 (9.56-17.9)	14.0 (9.89-19.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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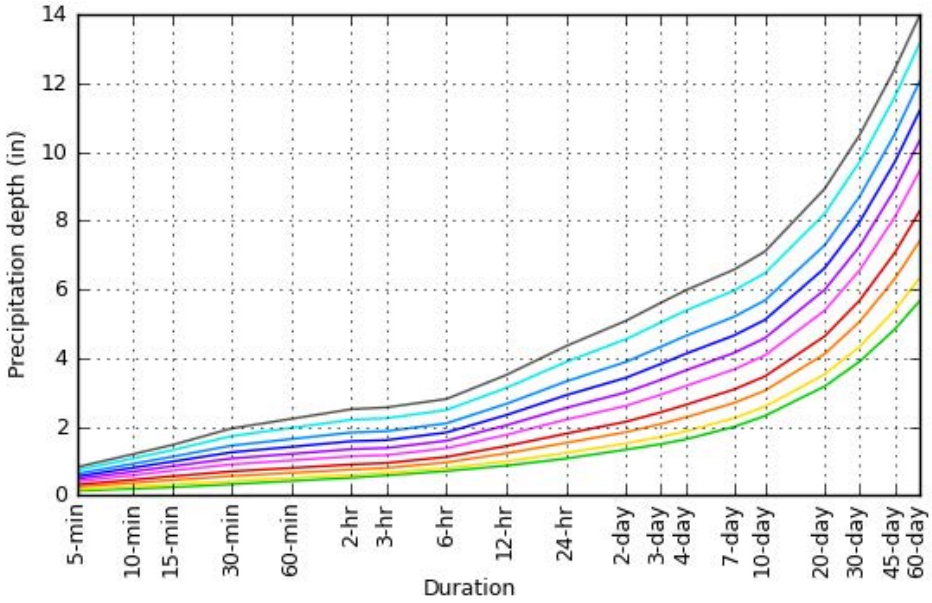
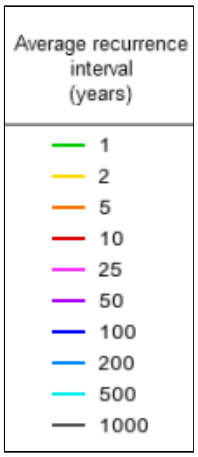
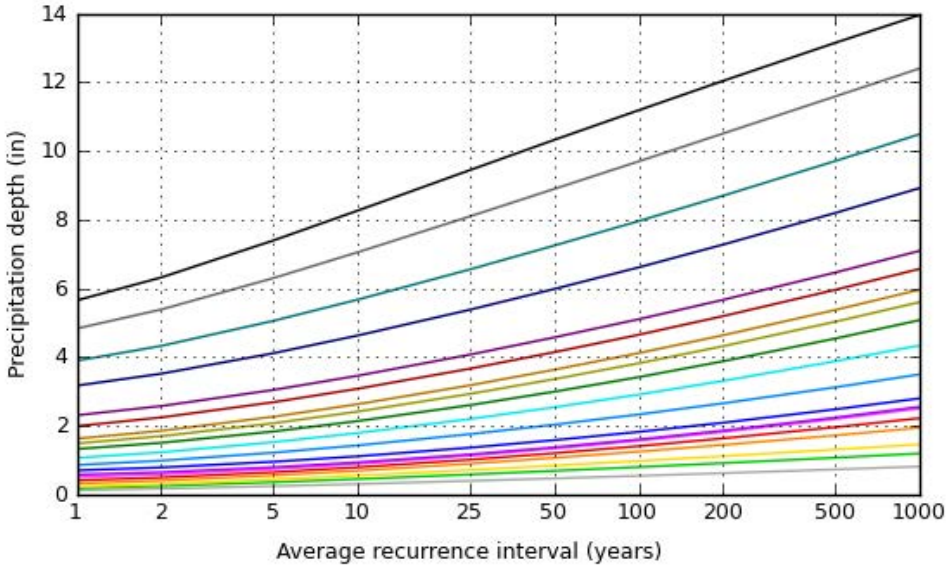
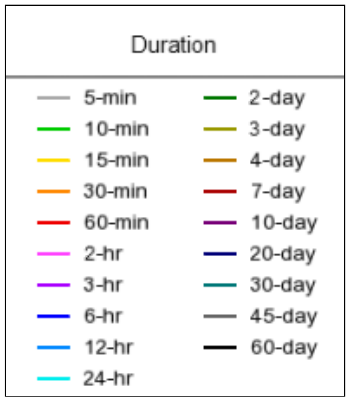
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 39.5889°, Longitude: -106.0979°









NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Mon Mar 19 18:00:28 2018

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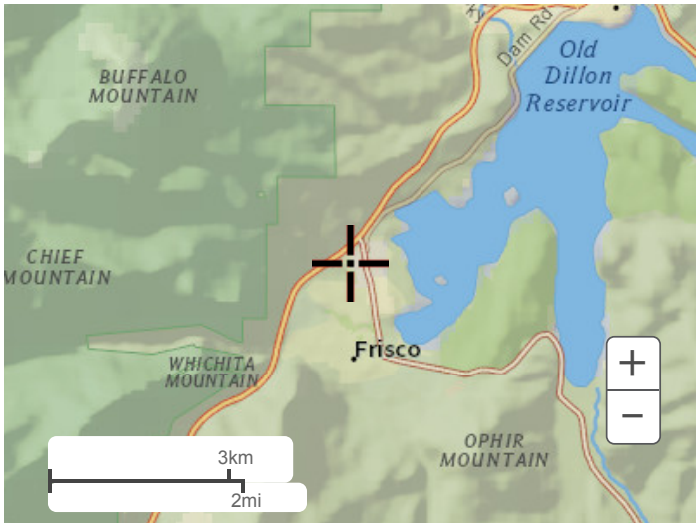
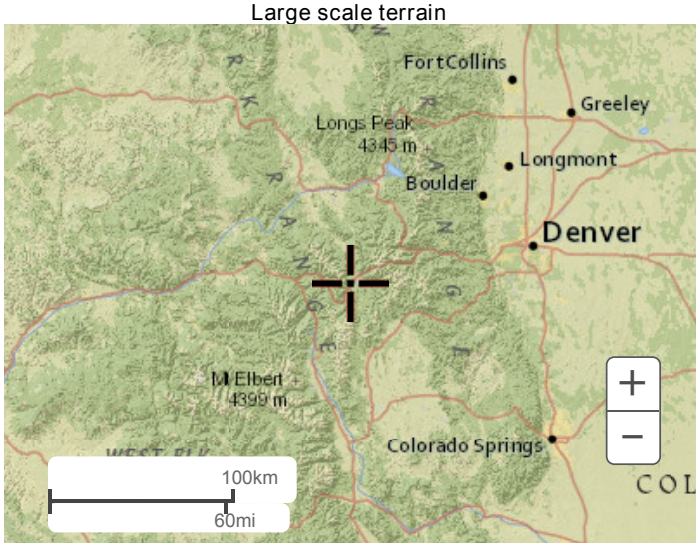
Maps & aerials

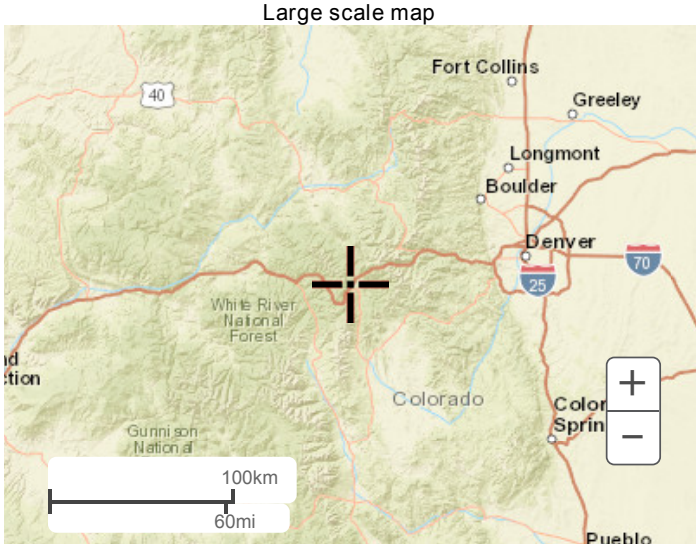
Small scale terrain



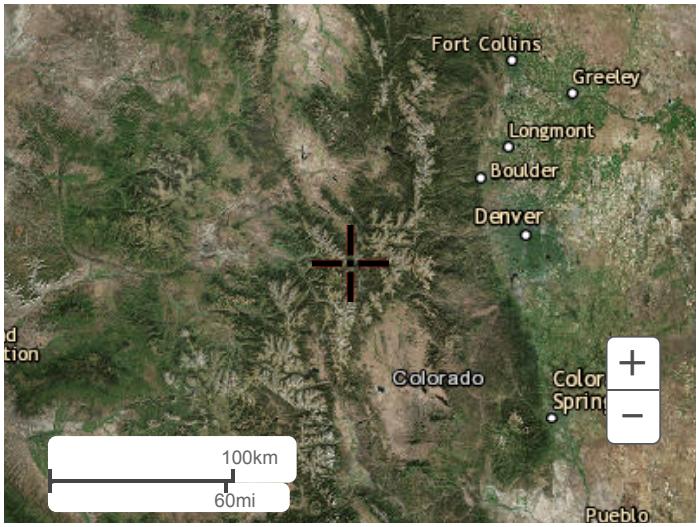
Large scale terrain



Large scale map



Large scale aerial



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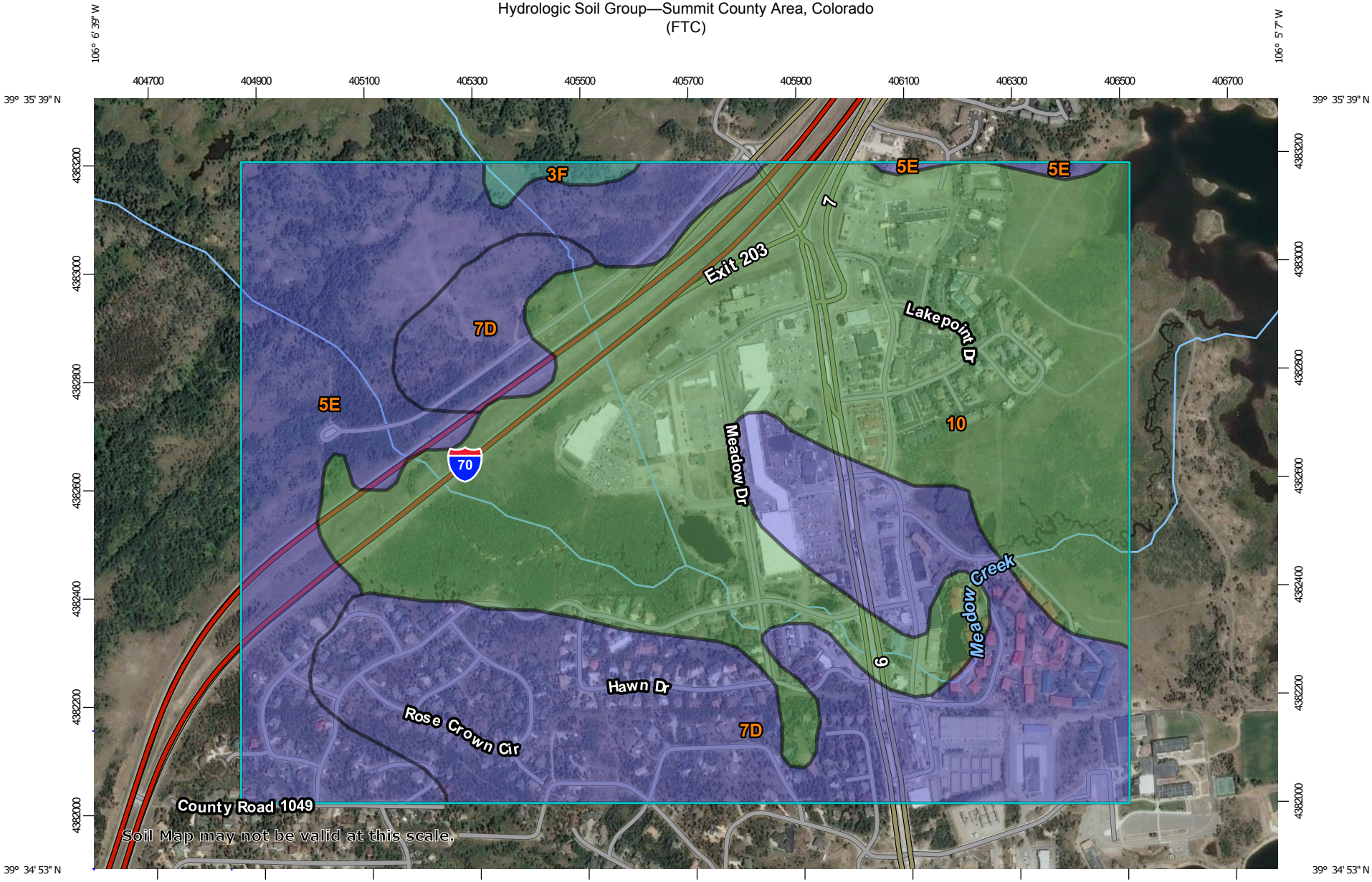
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Hydrologic Soil Group—Summit County Area, Colorado
(FTC)



Map Scale: 1:10,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 100 200 400 600

Feet
0 450 900 1800 2700

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Summit County Area, Colorado
Survey Area Data: Version 9, Oct 12, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 18, 2015—Aug 21, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3F	Cimarron loam, 15 to 35 percent slopes	C	3.1	0.6%
5E	Frisco-Peeler complex, 6 to 25 percent slopes	B	99.1	20.5%
7D	Grenadier gravelly loam, 6 to 15 percent slopes	B	154.2	31.9%
10	Histic Cryaquolls, nearly level	A/D	227.1	47.0%
Totals for Area of Interest			**483.6**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

SOIL SURVEY OF SUMMIT COUNTY AREA, COLORADO

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Colorado Agricultural Experiment Station

Contents

Issued April 1980

TABLE 15.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "none," "brief," and "apparent." The symbol > means greater than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
Anvik: 1D, 1F	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Bucklon: 2F	D	None	---	---	>6.0	---	---	10-20	Rippable	Moderate.
Cimarron: 3D, 3F	C	None	---	---	>6.0	---	---	40-60	Rippable	Moderate.
Cumulic Cryaquolls: 4	C	Common	Brief	May-Jun	1.0-2.0	Apparent	Jun-Jul	>60	---	High.
Frisco: [1]5E, [1]5F: Frisco part	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Peeler part	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Gravel pits: 6.										
Grenadier: 7C, 7D, 7F	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Handran: 8B, 8D, 9F	A	None	---	---	>6.0	---	---	>60	---	Low.
Histic Cryaquolls: 10	C	Common	Long	May-Jun	0-1.0	Apparent	Jun-Jul	>60	---	High.
Leadville: 11F	B	None	---	---	>6.0	---	---	40-60	Rippable	Moderate.
Leavitt: 12C, 12D, 12F	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Mine dumps: 13.										
Muggins: 14C, 14D, 14F	C	None	---	---	>6.0	---	---	>60	---	Moderate.
Placer diggings: 15.										
Quander: 16C, 16D, 16E	B	None	---	---	>6.0	---	---	>60	---	Moderate.
[1]17F: Quander part	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Youga part	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Rock outcrop: [1]18: Rock outcrop part.										
Cryoborolls part	C	None	---	---	>6.0	---	---	10-40	Hard	---

See footnote at end of table.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Worksheet 2: Runoff curve number and runoff

Project	By	Date
Frisco Transit Center	D. Leinweber	3/19/18
Location	**Checked**	**Date**
Frisco, Colorado		

Check one: ☐ Present ☐ Developed

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1/] Table 2-2	CN [1/] Figure 2-3	CN [1/] Figure 2-4	Area ☒ acres ☐ mi^2 ☐ %	Product of CN x area
Histic Cryaquols Group A/D Group C used based on onsite fill	Open Space - Fair Condition	79			1.6	126.4
Histic Cryaquols Group A/D Group C used based on onsite fill	Impervious	98			2.9	284.2
[1/] Use only one CN source per line				**Totals** ➡	4.5	410.6

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{410.6}{4.5} = 91.24$; **Use CN** ➡ 91

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	25	100	
Rainfall, P (24-hour)	in	2.20	2.91	
Runoff, Q	in	1.33	2.00	

(Use P and CN with table 2-1, figure 2-1, or equations 2-3 and 2-4)

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Worksheet 3: Time of Concentration (T_c) or travel time (T_t)

Project	By	Date
Frisco Transit Center	D. Leinweber	3/27/2018
Location	**Checked**	**Date**
Frisco, Colorado		

Check one: ☐ Present ☒ Developed

Check one: ☒ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to Tc only)

	Segment ID		
1. Surface description (table 3-1)	Parking lot		
2. Manning's roughness coefficient, n (table 3-1)	Smooth		
3. Flow length, L (total L † 300 ft) ft	0.011		
4. Two-year 24-hour rainfall, P_2 in	100		
5. Land slope, s ft/ft	1.23		
	0.04		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t hr	0.025	+	= 0.025

Shallow concentrated flow

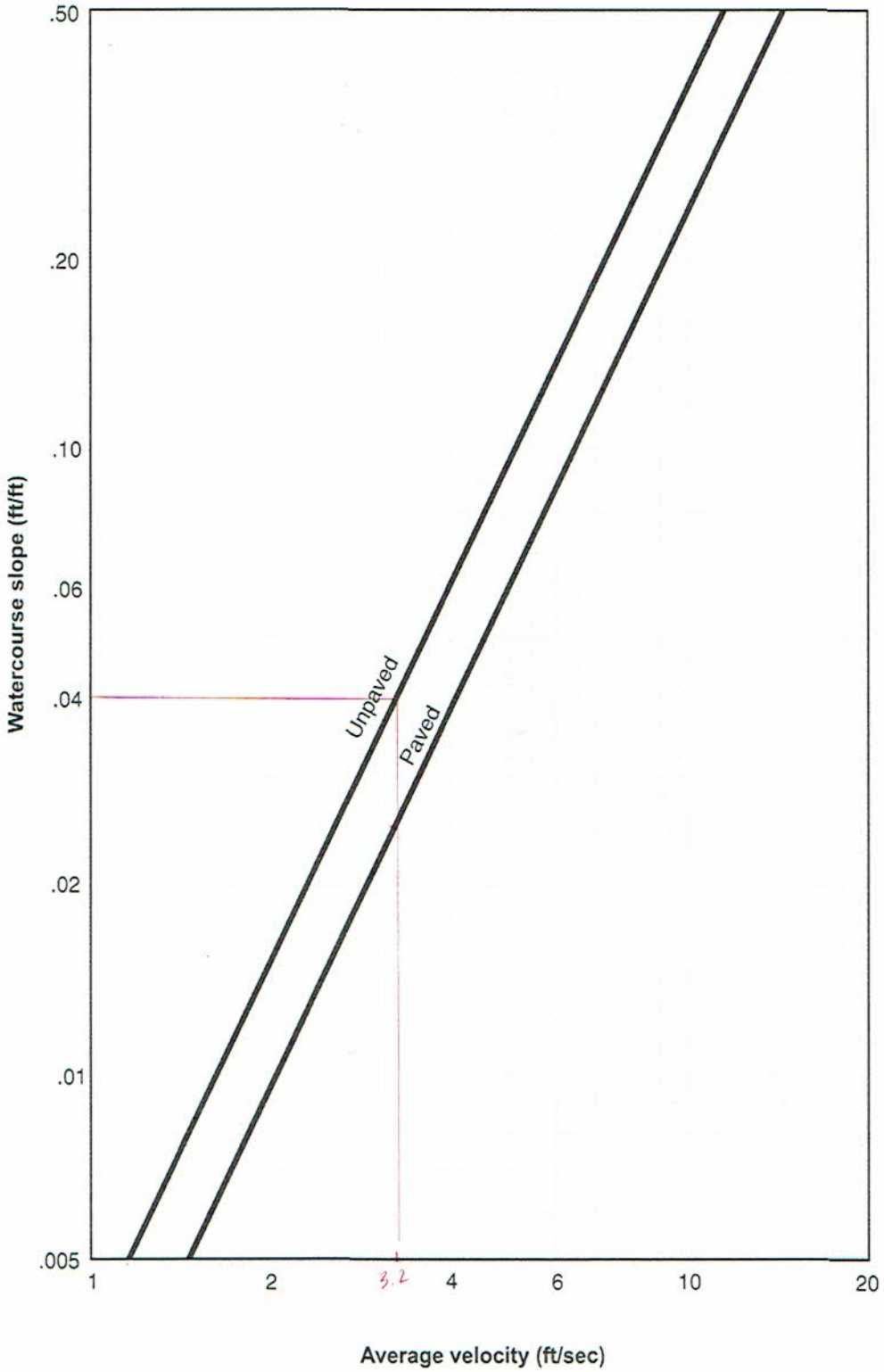
	Segment ID		
7. Surface description (paved or unpaved)	Parking lot		
8. Flow length, L ft	Paved		
9. Watercourse slope, s ft/ft	100		
10. Average velocity, V (figure 3-1) ft/s	0.04		
	3.2		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t hr	0.009	+	= 0.009

Channel flow

	Segment ID		
12. Cross sectional flow area, a ft^2	Bioswale	Storm sewer	
13. Wetted perimeter, p_w ft	3.25	1.8	
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft	8.16		
15 Channel slope, s ft/ft	0.4	0.375	
16. Manning's roughness coefficient, n	0.005	0.005	
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ft/s	0.03	0.01	
18. ~~Flow~~ length, L ft	1.9	5.5	
19. $T_t = \frac{L}{3600\ V}$ Compute T_t hr	250	220	
	0.036	+ 0.01	= 0.046
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) Hr			0.080

Use 0.1

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow



Worksheet 4: Graphical Peak Discharge method

Project	By	Date
Frisco Transit Center	D. Leinweber	3/27/18
Location	**Checked**	**Date**
Frisco, Colorado		

Check one: [x] Present [ ] Developed

1. Data

Drainage area ..... A_m = 4.5/640 mi^2 (acres/640)

Runoff curve number .....CN = 91 (From worksheet 2)

Time of concentration ..... T_c = 0.1 hr (From worksheet 3)

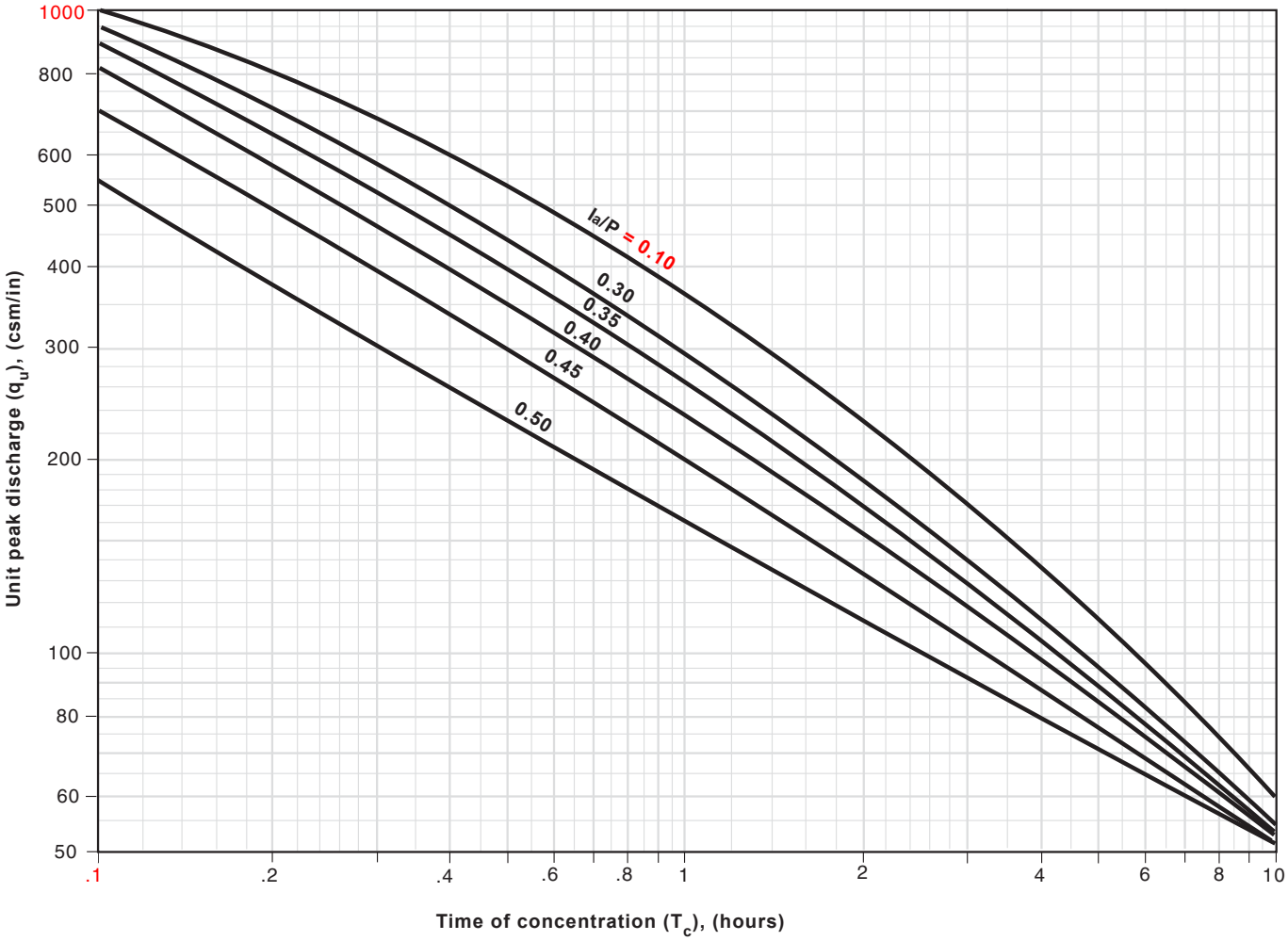
Rainfall distribution ..... = II (I, IA, II III)

Pond and swamp areas sprea throughout watershed ..... = 0 percent of A_m (_____ acres or mi^2 covered)

	Storm #1	Storm #2	Storm #3
2. Frequency ..... yr	25	100	
3. Rainfall, P (24-hour) ..... in	2.20	2.91	
4. Initial abstraction, I_a ..... in (Use CN with table 4-1)	0.2	0.2	
5. Compute I_a / P	0.091	0.068	
6. Unit peak discharge, q_u ..... csm/in (Use T_c and I_a / P with exhibit 4– _____)	1,000	1,000	
7. Runoff, Q ..... in (From worksheet 2) Figure 2-6	1.33	2.00	
8. Pond and swamp adjustment factor, F_p ..... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond ans swamp area.)	1.0	1.0	
9. Peak discharge, q_p ..... ft^3/s	9.4	14.1	

(Where $q_p = q_u A_m Q F_p$)

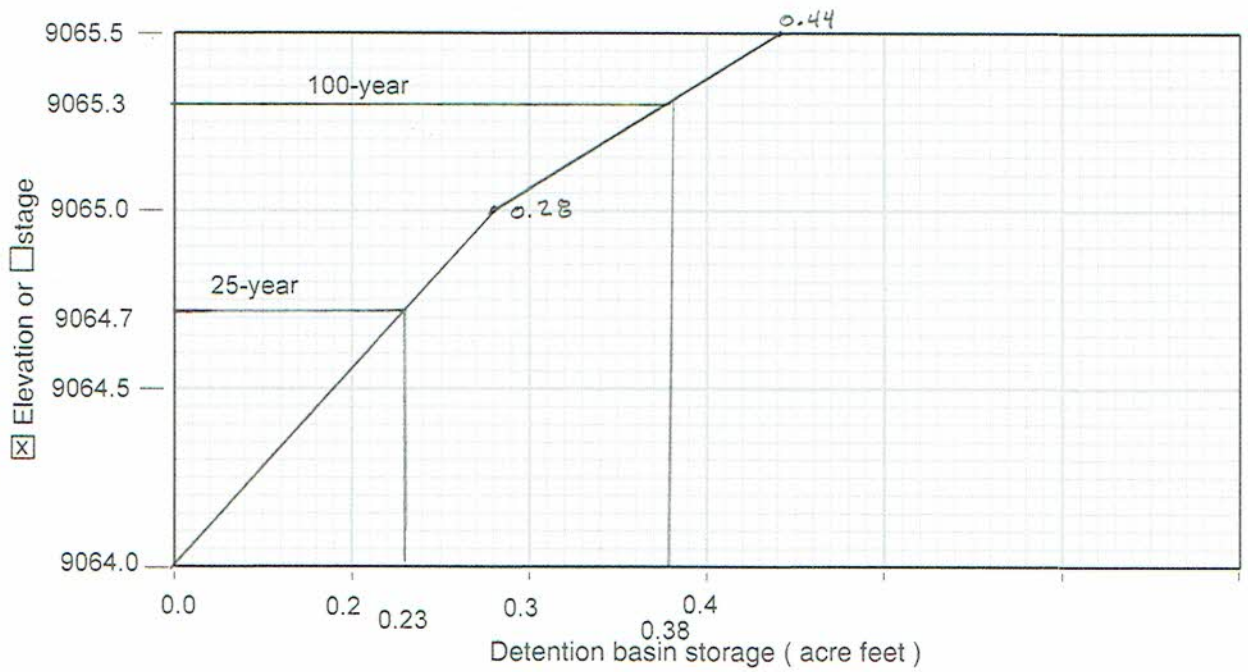
Exhibit 4-II Unit peal discharge (q_u) for NRCS (SCS) type II rainfall distribution



Worksheet 6a: Detention basin storage, peak outflow discharge (q_o) known

Project	By	Date
Frisco Transit Center	D. Leinweber	3/27/18
Location	**Checked**	**Date**
Frisco, Colorado		

Check one: ☐ Present ☒ Developed



1. Data:
   Drainage area ..... A_m = 4.5/640 mi²
   Rainfall distribution type (I, IA, II, III) = II

	1st Stage	2nd Stage
2. Frequency ..... yr	25	100
3. Peak inflow discharge q_i ..... ft³/s (from worksheet 4 or 5b)	10.0	14.1
4. Peak outflow discharge q_u ..... ft³/s	2.0	2.0 [1/]
5. Compute $\frac{q_o}{q_i}$	0.20	0.14
6. $\frac{V_s}{V_r}$ ..... (Use $\frac{q_o}{q_i}$ with figure 6-1)	0.46	0.52
7. Runoff, Q ..... in (From worksheet 2)	1.33	2.00
8. Runoff volume V_r..... ac ft ($V_r = QA_m$ 53.33)	0.50	0.75
9. Storage volume, V_s ..... ac-ft ($V_s = V_r (\frac{V_s}{V_r})$)	0.23	0.38
10. Maximum storage E_{max} (from plot)	9064.7	9065.3

1/ 2nd stage q_o includes 1st stage q_o.

Input requirements and procedures

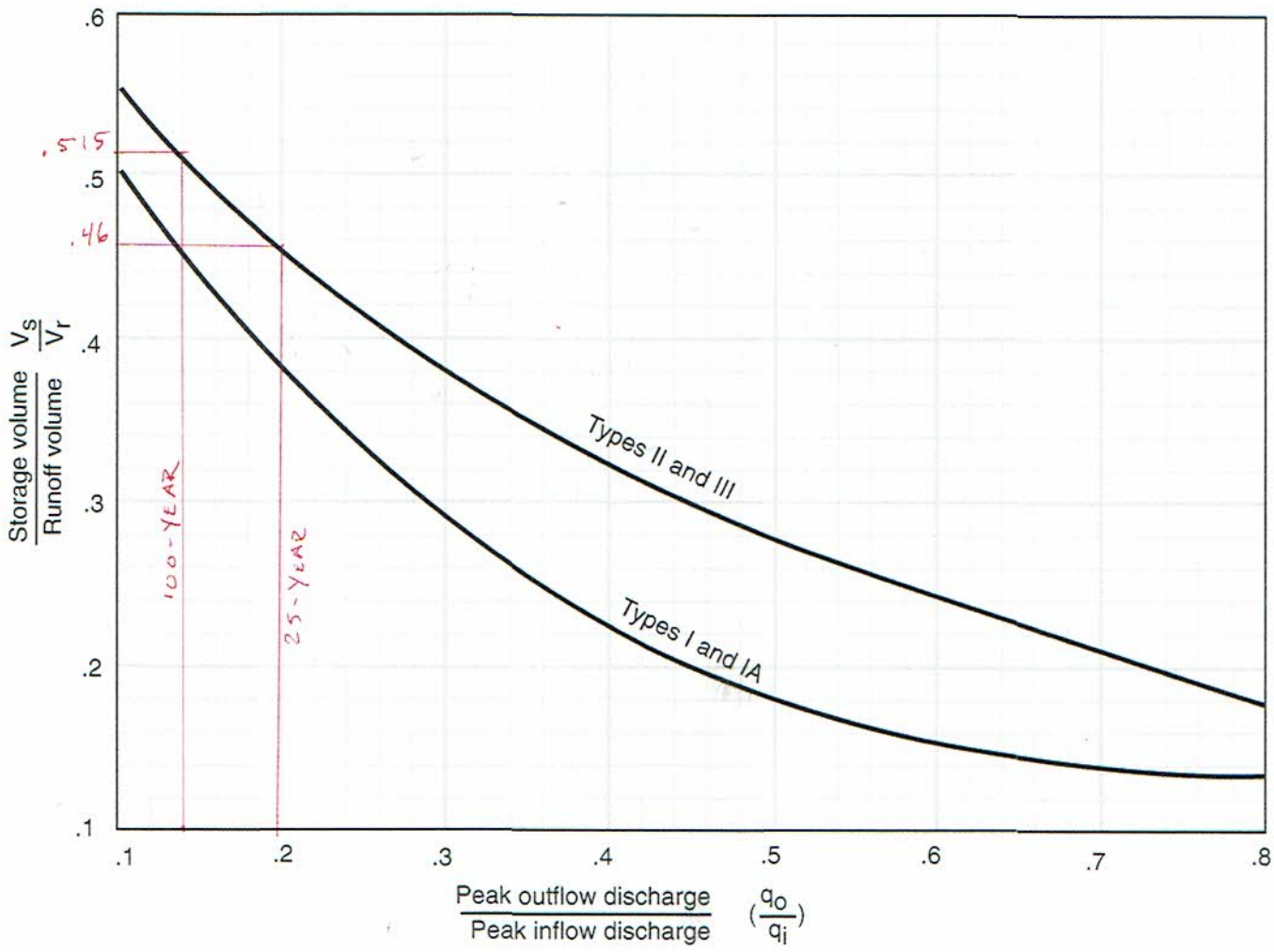
Use figure 6-1 estimate storage volume (V_s) required or peak outflow discharge (q_o). The most frequent application is to estimate V_s, for which the required inputs are runoff volume (V_r), q_o, and peak inflow discharge (q_i). To estimate q_o, the required inputs are V_r, V_s, and q_i.

Estimating V_s

Use worksheet 6a to estimate V_s, storage volume required, by the following procedure.

1. Determine q_o. Many factors may dictate the selection of peak outflow discharge. The most common is to limit downstream discharges to a desired level, such as predevelopment discharge. Another factor may be that the outflow device has already been selected.
2. Estimate q_i by procedures in chapters 4 or 5. Do not use peak discharges developed by other procedure. When using the Tabular Hydrograph method to estimate q_i for a subarea, only use peak discharge associated with $T_t = 0$.

Figure 6-1 Approximate detention basin routing for rainfall types I, IA, II, and III



Frisco Transit Center		
Frisco, Colorado		
Rainfall input for design flow estimates		
Graphical Peak Discharge for design flow		
Runoff curve number-only impervious areas considered for capacity analysis	98	
Potential maximum retention after runoff begins (S)	0.20	inches
25-year, 24-hour rainfall	2.20	inches
100-year, 24-hour rainfall	2.91	inches
25-year, 24-hour runoff (Q-25)	1.97	inches
100-year, 24-hour runoff (Q-100)	2.68	inches
Time of concentration-limiting factor used for all calculations	0.1	hours
Initial Abstraction	0.041	inches
Ia/P 25-year, 24-hour	0.019	
Ia/P 100-year, 24-hour	0.014	
Unit peak discharge (qu)	1000	csm/in
Pond and swamp factor	1.0	
Rational Method Discharge for Reasonableness check		
Q=CiA		
C (Soil types C/D, 25-year) = 0.56i+0.319, where i = 1.0	0.88	
C (Soil types C/D, 100-year) = 0.41i+0.484, where i = 1.0	0.89	
i (5 minute, 25-year) = (28.5*P(1-hour, 25-year)/(10+Td)^0.786	3.46	inches/hour
P (1-hour, 25-year) = 1.02 inches from NOAA, Atlas 14		
i (5 minute, 100-year) = (28.5*P(1-hour, 25-year)/(10+Td)^0.786	4.78	inches/hour
P (1-hour, 100-year) = 1.41 inches from NOAA, Atlas 14		
Td = 5 minutes		

Frisco Transit Center, Frisco, Colorado

Storm Drainage Infrstructure Capacity Analysis

March 28, 2018

				Design Flows		Reasonableness Check Flows				
Item	Description	Contributing Drainage Area Description	Impervious Area (SF)	TR55 Graphical 25-year, 24-hour peak runoff (cfs)	TR55 Graphical, 100-year, 24-hour peak runoff (cfs)	Rational Method 25-year, 24-hour peak runoff (cfs)	Rational Method 100-year, 24-hour peak runoff (cfs)	Capacity (cfs)	% Full - Capacity/ 100-year peak flow	Comments
STORM SEWER										
East Storm Sewer pipe inlet	18" RCP Flared end section	Majority of main asphalt parking lot draining to bioswale initial then to east storm sewer	50,000	3.54	4.80	3.49	4.91	8.00	60%	Headwater depth for concrete pipe culverts with inlet control (Chart 2) namograph with - culvert invert: 9063.25, minimum adjacent grade: 9065.83, HW=65.83-(63.25+1.5/2)=1.83, HW/D=1.22
East Storm Sewer culvert	18" RCP culvert	Majority of main asphalt parking lot draining to bioswale and south parking lot cross-pan then to storm sewer, includes several eastern plaza area drains	60,700	4.30	5.83	4.24	5.95	8.97	65%	Manning's Equation for pipe flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.011, A=1.8 SF, Rh=0.375 FT, SL=0.005FT/FT, Q100/Qfull = 5.8/9.0 = 0.65, D100/Dfull~0.58, D100 ~10.5"
Central Storm Sewer	18" RCP culvert	Area north of building draining to central storm sewer via area drains and accessible parking spaces curb inlet-includes connected gutters and downspouts	12,500	0.88	1.20	0.87	1.23	8.97	13%	Manning's Equation for pipe flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.011, A=1.8 SF, Rh=0.375 FT, SL=0.005FT/FT, Q100/Qfull = 1.2/9.0 = 0.13, D100/Dfull~0.25, D100 ~4.5"
West Storm Sewer	18" RCP culvert	West plaza area drains, connected gutters and downspouts, west half of Station Road and building plaza runoff to curb inlet	23,000	1.63	2.21	1.61	2.26	8.97	25%	Manning's Equation for pipe flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.011, A=1.8 SF, Rh=0.375 FT, SL=0.005FT/FT, Q100/Qfull = 2.2/9.0 = 0.25, D100/Dfull~0.35, D100 ~6.5"
12" Area Drains	12" CPP culvert	Largest area draining to any 12" storm sewer via area drains, and/or building gutters and downspouts - no design completed, utilizing 0.5% conceptual minimum slope	4,000	0.28	0.38	0.28	0.39	3.34	11%	Manning's Equation for pipe flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.01, A=0.8 SF, Rh=0.250 FT, SL=0.005FT/FT, Q100/Qfull = 0.4/3.3 = 0.11, D100/Dfull~0.23, D100 ~3"
CULVERTS										
Shuttle lot culvert pipe inlet	18" RCP Flared end section	Shuttle parking lot	12,000	0.85	1.15	0.84	1.18	7.50	15%	Headwater depth for concrete pipe culverts with inlet control (Chart 2) namograph with - culvert invert: 9063.50, minimum adjacent grade: 9066.00, HW=66.00-(63.50+1.5/2)=1.75, HW/D=1.17
Shuttle lot culvert	18" RCP culvert	Shuttle parking lot	12,000	0.85	1.15	0.84	1.18	11.75	10%	Manning's Equation for pipe flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.011, A=1.8 SF, Rh=0.375 FT, SL=0.009FT/FT, Q100/Qfull = 2.2/9.0 = 0.25, D100/Dfull~0.35, D100 ~6.5"
Detention pond outfall culvert, pipe inlet	18" RCP headwall	Design outfall rate from pond		2.00	2.00			4.60	43%	Headwater depth for concrete pipe culverts with inlet control (Chart 2) namograph with - culvert invert: 9063.55, top of concrete drainage inlet: 9065.50, HW=65.50-(63.55+1.5/2)=1.20, HW/D=0.8
Detention pond outfall culvert	18" RCP culvert	Design outfall rate from pond		2.00	2.00			9.00	22%	Manning's Equation for pipe flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.011, A=1.8 SF, Rh=0.375 FT, SL=0.005FT/FT, Q100/Qfull = 2.0/9.0 = 0.22, D100/Dfull~0.33, D100 ~6.0"
Meadow Park existing culvert pipe inlet	16" CMP culvert projecting from fill	South of Basecamp Way in Meadow Park using a design discharge rate from the detention pond of 2.0 cfs		2.00	2.00			1.80	111%	Headwater depth for c.m. pipe culverts with inlet control (Chart 5) namograph with - culvert invert: 9063.16, minimum adjacent grade: 9064.1, HW=64.1-(63.16+1.33/2)=0.3, HW/D=0.2 - **This culvert will overtop in a design storm event. Stormwater overtopping this culvert will flow into the parking lot to the east, then to the southwest corner of the parking lot into a concrete pan which discharges to Meadow Pond. To contain the runoff in this culvert, a berm of approximately 2'**
Meadow Park existing culvert	16" CMP culvert	South of Basecamp Way in Meadow Park using a design discharge rate from the detention pond of 2.0 cfs		2.00	2.00	0.00	0.00	9.48	21%	Manning's Equation for pipe flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.02, A=1.4 SF, Rh=0.333 FT, SL=0.0358FT/FT, Q100/Qfull = 2.0/9.5 = 0.21, D100/Dfull~0.31, D100 ~5.0"
OPEN CHANNELS										
Bioswale	Trapezoidal ditch, 12" deep, 5' bottom width, 3:1 side slopes - SL=0.5%	Majority of main asphalt parking lot drains to bioswale prior to east storm sewer	50,000	3.54	4.80	3.49	4.91	13.29	36%	Manning's Equation for capacity flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.05, A=8.0 SF, Pw=11.3 FT Rh=0.7 FT, SL=0.005FT/FT
10' Cross-pan, north parking lot entry	10' wide, 3" deep, SL=0.67%	Small segment of north end of main parking lot	3,500	0.25	0.34	0.24	0.34	2.93	11%	Manning's Equation for capacity flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013, A=1.25 SF, Pw=10 FT Rh=0.13 FT, SL=0.0067FT/FT
10' Cross-pan, south parking lot entry	10' wide, 3" deep, SL=0.5%	Small segment of south end of main parking lot	8,500	0.60	0.82	0.59	0.83	2.53	32%	Manning's Equation for capacity flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013, A=1.25 SF, Pw=10 FT Rh=0.13 FT, SL=0.005FT/FT
10' Cross-pan, west shuttle lot entry	10' wide, 3" deep, SL=1.6%	Western segment of shuttle parking lot	1,000	0.07	0.10	0.07	0.10	4.53	2%	Manning's Equation for capacity flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013, A=1.25 SF, Pw=10 FT Rh=0.13 FT, SL=0.016FT/FT
10' Cross-pan, east shuttle lot entry	10' wide, 3" deep, SL=0.5%	Majority of shuttle parking lot	8,600	0.61	0.83	0.60	0.84	2.53	33%	Manning's Equation for capacity flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013, A=1.25 SF, Pw=10 FT Rh=0.13 FT, SL=0.005FT/FT
15' Cross-pan, Station Road	15' wide, 3" deep, SL=3.0%	Small section of Station Road and east plaza	2,500	0.18	0.24	0.17	0.25	9.31	3%	Manning's Equation for capacity flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013, A=1.875 SF, Pw=15 FT Rh=0.13 FT, SL=0.03FT/FT
3' concrete pan main parking lot	3' wide, 1.5" deep, SL=2.8%	Southeastern parking spaces and small southern section of main parking lot	1,900	0.13	0.18	0.13	0.19	0.56	32%	Manning's Equation for capacity flowing full: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013, A=0.19 SF, Pw=3.0 FT Rh=0.06 FT, SL=0.028 FT/FT
2.5' catch curb, main parking lot	2.5' wide, 2" deep, SL=2.8%	All 3' pan discharge and small southern section of main parking lot	2,200	0.16	0.21	0.15	0.22	0.58	36%	Manning's Equation for capacity flowing full of gutter section only: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013, A=0.17 SF, Pw=2.2 FT Rh=0.077 FT, SL=0.028 FT/FT - **Flow is contained in gutter - no**
2.5' catch curb, Station Road	2.5' wide, 2" deep, SL=1.0%	Western section of Station Way above curb inlet, and sections of south building plaza area	4,700	0.33	0.45	0.33	0.46	0.52	87%	**Flow exceeds gutter capacity of 0.35 cfs, therefore some flow will back up onto Station Road (3% cross-slope). Through trial and error it was determined that an additional 1/3" of flow depth would carry the estimated 0.5 cfs design flow. The spread of water onto the pavement will be 1.1 feet. Manning's Equation developed for capacity: Q=(1.49/n)(Rh)^2/3 (SL)^1/2 A, with n=0.013,**
DRAINAGE INLETS										
South parking lot curb inlet	CDOT 5' Type 'R' Inlet in sump condition	Small segment of south end of main parking lot, includes 3' pan and 2.5' curb and gutter discharges	10,600	0.75	1.02	0.74	1.04	10.80	9%	Urban Drainage and Flood Control Criteria Manual Volume 1, Equation 7-31, and 7-32 were reviewed. The curb inlet opening is at 9065.2, the width is 5', the highest elevation without spilling onto Meadow Drive is 9066.1. Orifice equation 7-32 controls capacity.
Accessible parking area curb inlet	CDOT 5' Type 'R' Inlet in sump condition	Accessible parking spaces, small portion of parking lot, and portions of north building plaza.	5,000	0.35	0.48	0.35	0.49	1.20	40%	Urban Drainage and Flood Control Criteria Manual Volume 1, Equation 7-31 used as inlet cannot submerge without discharging stormwater into main parking lot. 2" depth used for estimated
Station Road curb inlet	CDOT 5' Type 'R' Inlet on continuous grade SL=1.0%	Western section of Station Way above curb inlet, and sections of south building plaza area - intercepts 2.5' curb and gutter flow	4,700	0.33	0.45	0.33	0.46	2.8 feet	56%	Urban Drainage and Flood Control Criteria Manual Volume 1, Section 3.2.2 Equations 7-23, 7-24, 7-25 and 7-26. Gutter depression, a = 2", local depression = 4", from trial and error depth above gutter, y = 1/3", solving for ration of gutter flow to total flow (Equation 7-7), Eo = 0.98, Solving equation 7-26 for equivalent slope, Se = 0.27, and solving equation 7-24, the required curb length =
12" Area Drains	ADS Nyloplast 12" Standard Grate Inlet	Generic basin representing largest area contributing to any 12" area drain	2,400	0.17	0.23	0.17	0.24	0.7	33%	Depth of flow in paver "swale" in west plaza by trial and error for a design flow of 0.23 cfs = 0.15 feet. Capacity of Nyloplast drain with 0.15' of head = 0.7 cfs

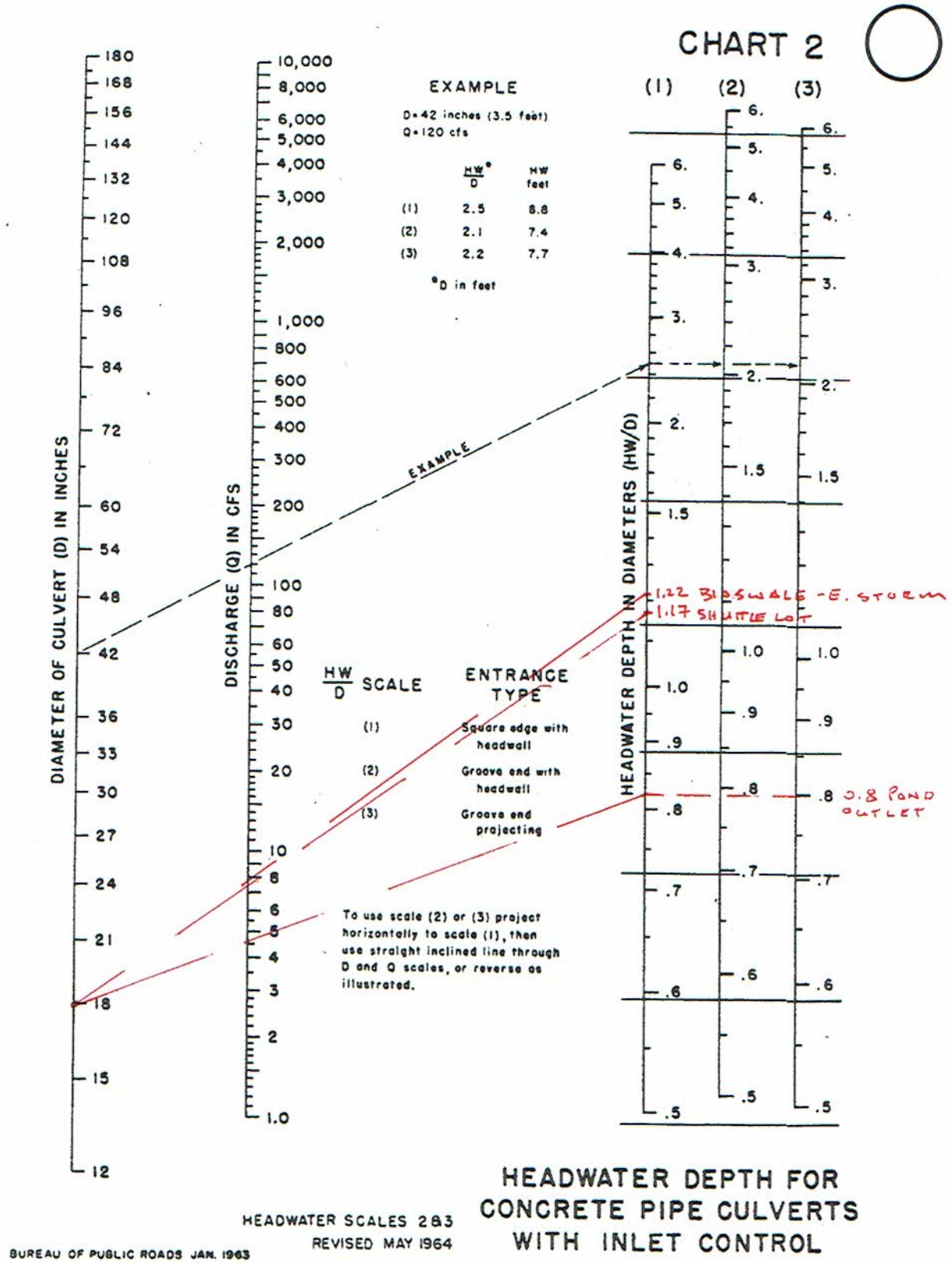
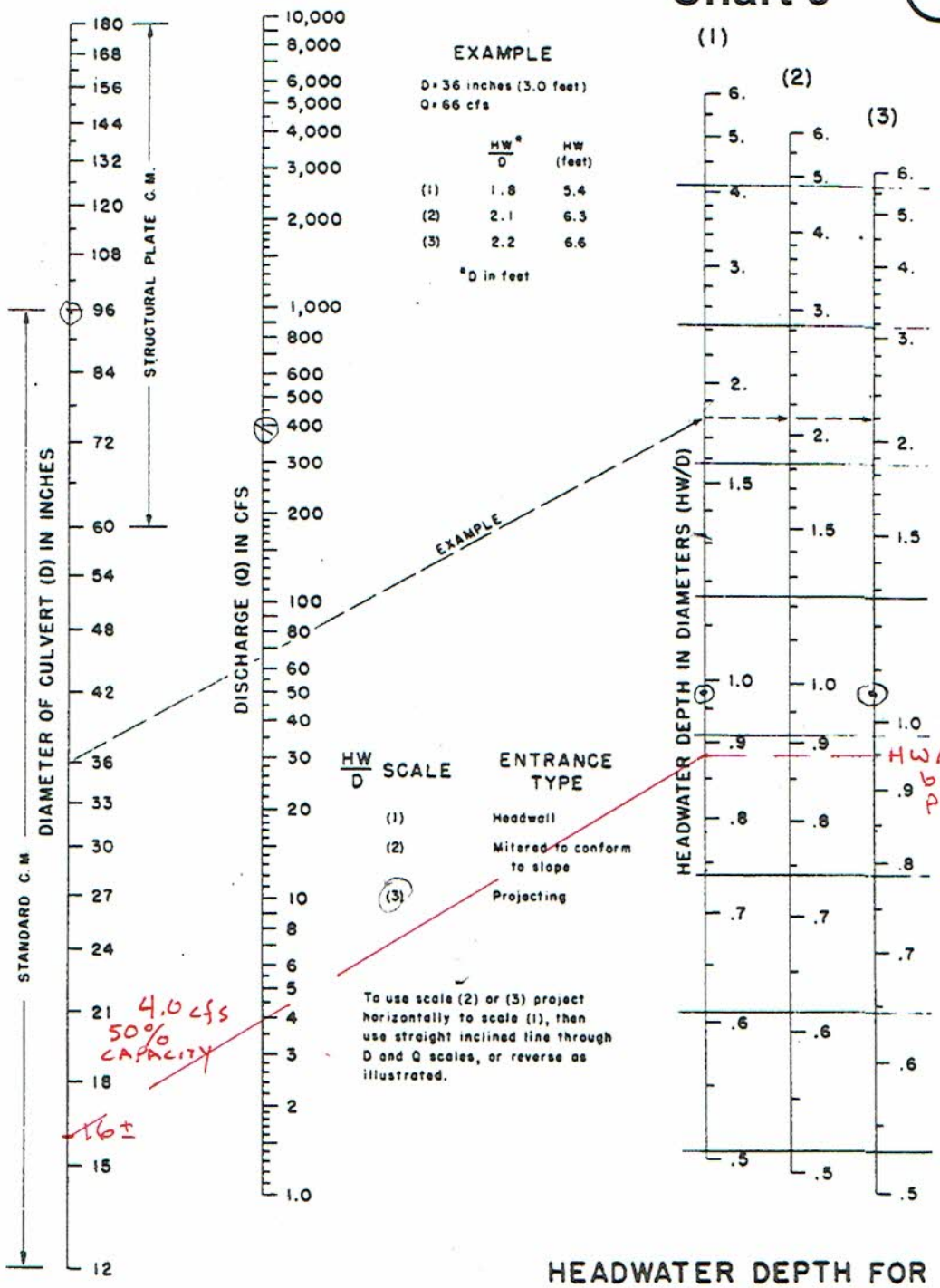


CHART 2
EXAMPLE
D=42 inches (3.5 feet)
Q=120 cfs
HW/D* | HW feet
(1) 2.5 | 8.8
(2) 2.1 | 7.4
(3) 2.2 | 7.7
*D in feet
(1) (2) (3)
DIAMETER OF CULVERT (D) IN INCHES
DISCHARGE (Q) IN CFS
HEADWATER DEPTH IN DIAMETERS (HW/D)
EXAMPLE
HW/D SCALE
ENTRANCE TYPE
(1) Square edge with headwall
(2) Groove end with headwall
(3) Groove end projecting
To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated.
1.22 BIOSWALE - E. STORM
1.17 SHUTTLE LOT
0.8 POND OUTLET
HEADWATER SCALES 2&3
REVISED MAY 1964
BUREAU OF PUBLIC ROADS JAN. 1963
HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

Chart 5



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Meadow Park 16" CMP HW/D = 0.2
CAPACITY < 1.0 cfs
DESIGN FLOW = 2.0 cfs

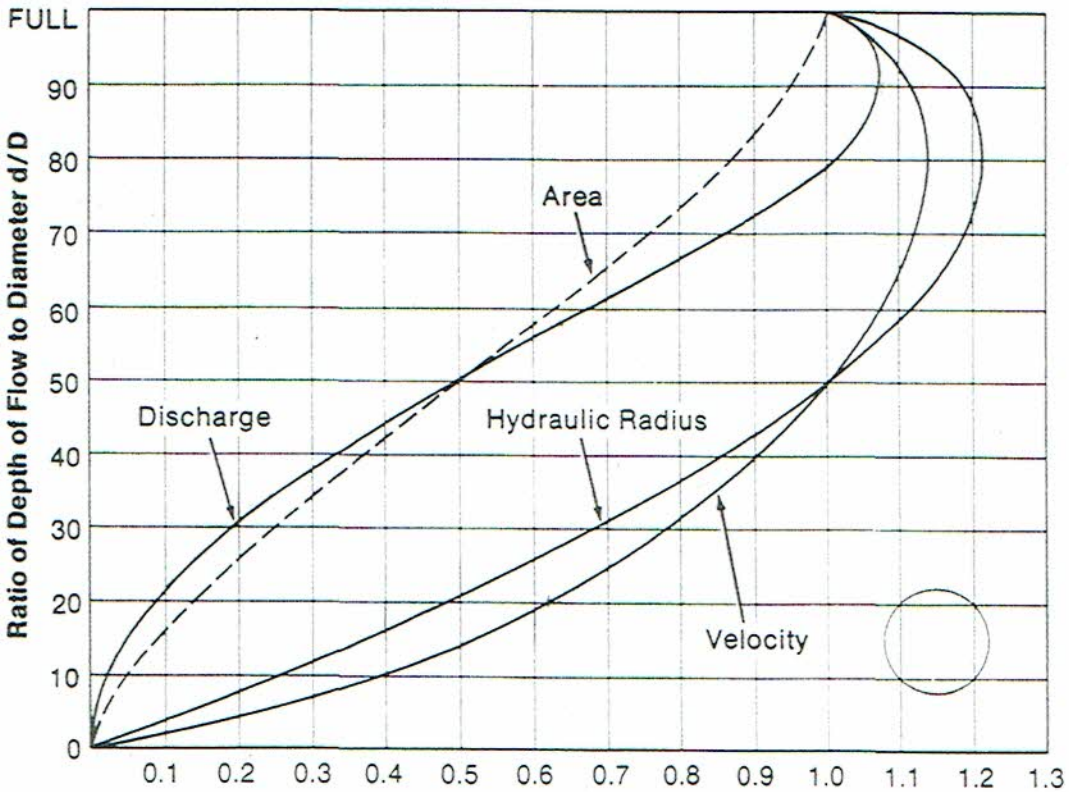


Figure 3.50 Hydraulic elements of circular corrugated steel and structural plate pipe.

Table 3.14 Full Flow Data for Round Pipe

Diameter in.	Area, ft^2	Hydraulic Radius, ft	Diameter, in.	Area, ft^2	Hydrauliic Radius, ft
12	0.8	0.250	156	132.7	3.250
15	1.2	0.312	162	143.1	3.375
18	1.8	0.375	168	153.9	3.500
21	2.4	0.437	174	165.1	3.625
24	3.1	0.500	180	176.7	3.750
30	4.9	0.625	186	188.7	3.875
36	7.1	0.750	192	201.1	4.000
42	9.6	0.875	198	213.8	4.125
48	12.6	1.000	204	227.0	4.250
54	15.9	1.125	210	240.5	4.375
60	19.6	1.250	216	254.5	4.500
66	23.8	1.375	222	268.8	4.625
72	28.1	1.500	228	283.5	4.750
78	33.2	1.625	234	298.6	4.875
84	38.5	1.750	240	314.2	5.000
90	44.2	1.875	246	330.1	5.125
96	50.3	2.000	252	346.4	5.250
102	56.8	2.125	258	363.1	5.375
108	63.6	2.250	264	380.1	5.500
114	70.9	2.375	270	397.6	5.625
120	78.5	2.500	276	415.5	5.750
126	86.6	2.625	282	433.7	5.875
132	95.0	2.750	288	452.4	6.000
138	103.9	2.875	294	471.4	6.125
144	113.1	3.000	300	490.9	6.250

The cross-sectional flow area, *A,* can be expressed as:

$$A = \frac{S_x T^2}{2}$$ Equation 7-4

The gutter velocity at peak capacity may be found from continuity ($V = Q/A$). Triangular gutter cross-section calculations are illustrated in Example 7.1.

Capacity When Gutter Cross Slope is Not Equal to Street Cross Slope (Typical)
Streets with composite cross slopes like that shown in Figure 7-2 are often used to increase the gutter capacity and keep nuisance flows out of the traffic lanes.

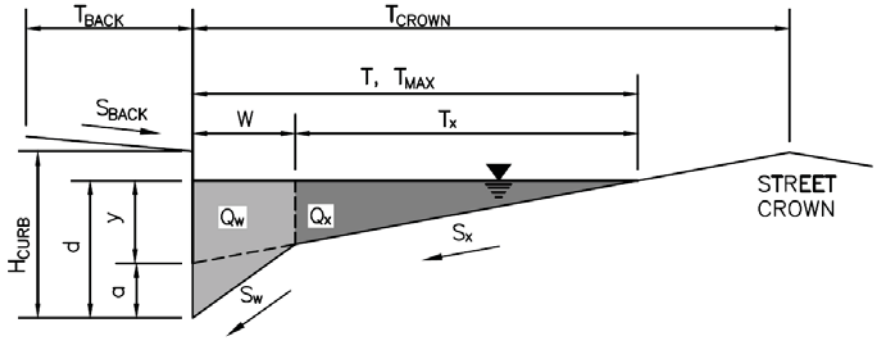


Figure 7-2. Typical gutter section—composite cross slope

For a composite street section:

$$Q = Q_w + Q_x$$ Equation 7-5

Where:

Q_w = flow rate in the depressed gutter section (flow within gutter width, *W*, in Figure 7-2 [cfs])

Q_x = flow rate in the section that is outside the depressed gutter section and within the street width, T_X, in Figure 7-2 (cfs).

In *Hydraulic Engineering Circular No. 22, Third Edition*, the Federal Highway Administration (FHWA 2009) provides the following equations for obtaining the flow rate in streets with composite cross slopes. The theoretical flow rate, *Q*, is:

$$Q = \frac{Q_x}{1 - E_o}$$ Equation 7-6

Where:

$$E_O = \frac{1}{1 + \frac{S_w / S_x}{\left[1 + \frac{S_w / S_x}{(T/W) - 1}\right]^{8/3} - 1}}$$ Equation 7-7

and,

$$S_w = S_x + \frac{a}{W}$$ Equation 7-8

Where:

$E_O = Q_W/Q$, the ratio of gutter flow, Q_W, to total flow Q

W = width of the gutter (typical value = 2 ft)

S_W = the gutter cross slope (typical value = 1/12 or 0.0833 [ft/ft])

a = gutter depression = WS_W - WS_X (typical value for WS_W for a 2-ft gutter section is 0.1667 ft).

Figure 7-2 depicts all geometric variables. From the geometry, it can be shown that:

$$y = a + TS_x$$ Equation 7-9

and,

$$A = \frac{S_x T^2 + aW}{2}$$ Equation 7-10

Where:

y = flow depth above depressed gutter section (ft). Note that the depth of flow at the gutter line is defined as d, where $d = y + a$ (see Figure 7-2).

A = flow area (ft^2)

Due to the complexity of Equation 7-7, care should be taken when calculating E_O. Additionally, E_O cannot be correctly calculated using Equation 7-7 when $T < W$ or when ponding depth exists at the street crown. For these special cases, the principle of similar triangles may be applied in conjunction with Equation 7-1 (see Figure 7-3). Both methods for calculating flow in a composite cross-section are illustrated in the Examples and the end of this chapter (see Examples 7.2 and 7.3).

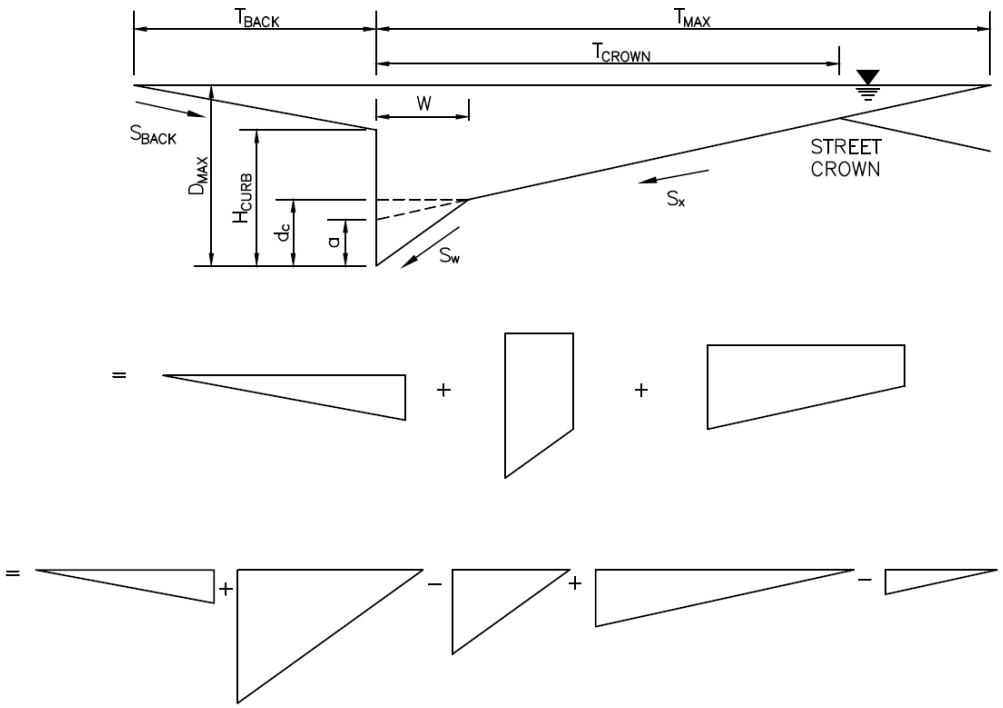


Figure 7-3. Calculation of composite street section capacity: major storm

Allowable Capacity

Stormwater flows along streets exert momentum forces on cars, pavement, and pedestrians. To limit the hazardous nature of large street flows, it is necessary to set limits on flow velocities and depths. As a result, the allowable half-street hydraulic capacity is determined as the lesser of:

$$Q_A = Q_T \qquad \text{Equation 7-11}$$

or

$$Q_A = R\,Q_d \qquad \text{Equation 7-12}$$

Where:

Q_A = allowable street hydraulic capacity (cfs)

Q_T = street hydraulic capacity where flow spread equals allowable spread (cfs)

R = reduction factor (allowable street and gutter flow for safety)

Q_d = street hydraulic capacity where flow depth equals allowable depth (cfs).

There are two sets of safety reduction factors developed for the UDFCD region (Guo 2000b). One is for the minor event, and another is for the major event. Figure 7-4 shows that the safety reduction factor does not apply unless the street longitudinal slope is more than 1.5% for the major event and 2% for the minor event. The safety reduction factor, representing the fraction of calculated gutter flow at maximum depth

that is used for the allowable design flow, decreases as longitudinal slope increases.

It is important for street drainage designs that the allowable street hydraulic capacity be used instead of the calculated gutter-full capacity. Where the accumulated stormwater amount on the street approaches the allowable capacity, a street inlet should be installed.

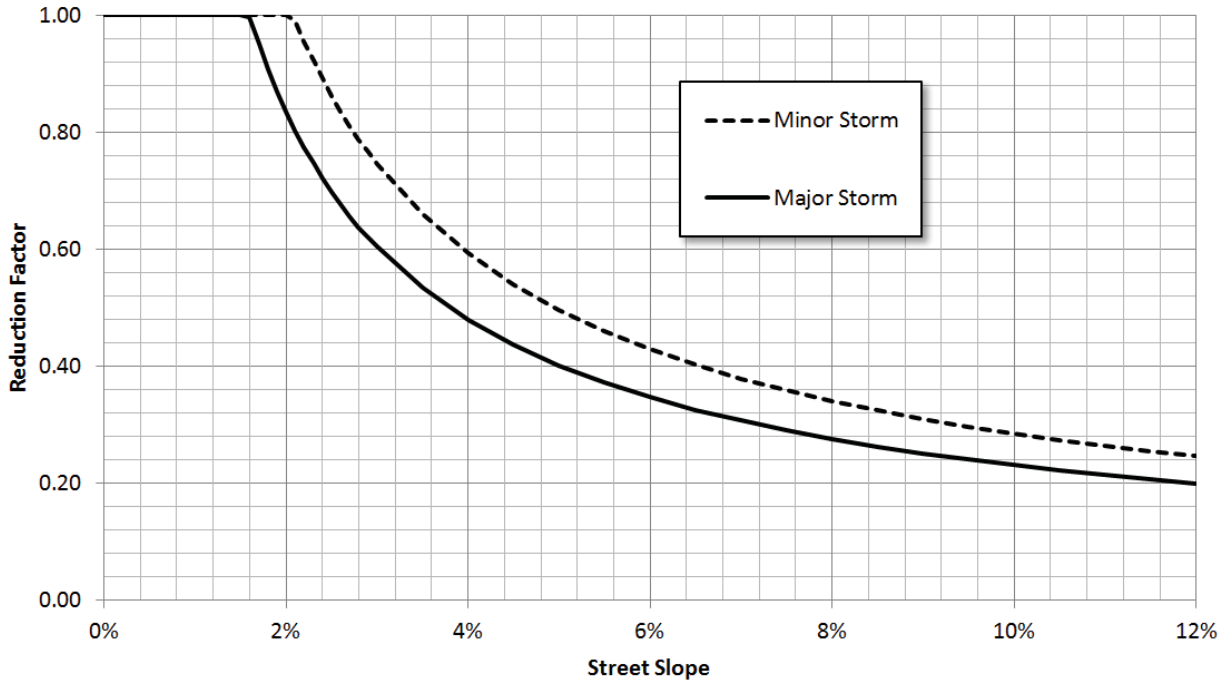


Figure 7-4. Reduction factor for gutter flow (Guo 2000b)

L = length of grate (ft).

The capture efficiency, E, of the grate inlet may now be determined using:

$$E = R_f\left(Q_w/Q\right) + R_x\left(Q_x/Q\right) \qquad \text{Equation 7-22}$$

Example 7.6 shows grate inlet capacity calculations.

3.2.2 Curb-Opening Inlets on a Continuous Grade

The capture efficiency of a curb-opening inlet is dependent on the length of the opening, the depth of flow at the gutter flow line, street cross slope and the longitudinal gutter slope (see Photograph 7-4). If the curb opening is long, the flow rate is low, and the longitudinal gutter slope is small, all of the flow will be captured by the inlet. It is generally uneconomical to install a curb opening long enough to capture all of the flow during the minor (design) storm. Thus, some water gets by the inlet, and the inlet efficiency needs to be determined.

The hydraulics of curb-opening inlets are less complicated than grate inlets. The efficiency, E, of a curb-opening inlet is calculated as:

$$E = 1 - \left[1 - \left(L/L_T\right)\right]^{1.8} \text{ for } L < L_T, \text{ otherwise } E = 1.0 \qquad \text{Equation 7-23}$$

Where:

L = curb-opening length (ft)

L_T = curb-opening length required to capture 100% of gutter flow (ft).

For a curb-opening inlet in a uniform cross slope (see Figure 7-1), L_T can be calculated as:

$$L_T = 0.38Q^{0.51}S_L^{0.058}\left(\frac{1}{nS_x}\right)^{0.46} \qquad \text{Equation 7-24}$$

Where:

Q = total flow (cfs)

S_L = longitudinal street slope (ft/ft)

S_x = street cross slope (ft/ft)

n = Manning's roughness coefficient.

But most curb-opening inlets are in a composite street section and many also have a localized depression, so L_T should then be calculated as:

$$L_T = 0.38Q^{0.51}S_L^{0.058}\left(\frac{1}{nS_e}\right)^{0.46} \qquad \text{Equation 7-25}$$

The equivalent cross slope, S_e, can be determined from:

$$S_e = S_x + \frac{(a + a_{local})}{W} E_o \qquad \text{Equation 7-26}$$

Where:

a = gutter depression (as defined for Equation 7-8)

a_{local} = any additional local depression in the area of the inlet (typically specific to the type of inlet)

W = depressed gutter width as shown in Figure 7-2.

The ratio of the flow in the depressed section to total gutter flow, E_o, can be calculated from Equation 7-7. See Examples 7.6 and 7.7 for curb-opening inlet calculations.

3.2.3 Combination Inlets on a Continuous Grade

Combination inlets take advantage of the debris removal capabilities of a curb-opening inlet and the capture efficiency of a grate inlet. Combination inlets on a continuous grade (i.e., not in a sump location) intercept 18% more than grate inlets alone and are much less likely to clog completely (CSU 2009). A special case combination where the curb opening extends upstream of the grated section is called a sweeper inlet. The inlet capacity is enhanced by the additional upstream curb-opening length, and debris is intercepted there before it can clog the grate. The construction of sweeper inlets is more complicated and costly however, and they are not commonly seen in the UDFCD region. To calculate interception efficiency for a sweeper inlet, the upstream curb-opening efficiency is calculated first and then the interception efficiency for combination section based on the remaining street flow is added to it. To analyze this within UD-Inlet select *user-defined combination*, select a grate type, and check the *sweeper configuration* box.

3.2.4 Slotted Inlets on a Continuous Grade

Slotted inlets can be used in place of curb-opening inlets or can be used to intercept sheet flow that is crossing the pavement in an undesirable location. Unlike grate inlets, they have the advantage of intercepting flow over a wide section. They do not interfere with traffic operations and can be used on both curbed and uncurbed sections. Like grate inlets, they are susceptible to clogging.

Photograph 7-5. Inlets that are located in street vertical sag curves (sumps) are highly efficient.

Slotted inlets placed parallel to flow in the gutter flow line function like side-flow weirs, much like curb-opening inlets. The FHWA (1996) suggests the hydraulic capacity of slotted inlets closely corresponds to curb-opening inlets if the slot openings exceed 1.75 inches. Therefore, the equations developed for curb-opening inlets (Equations 7-23 through 7-26) are appropriate for those slotted inlets.

The recommended values for the coefficients N_w, N_o, C_w, C_m, and C_o are listed in Table 7-7.

In practice, for the given water depth, it is suggested that the interception capacity, Q_i, for the sump grate be the smallest among the weir, orifice, and mixed flows as:

$$Q_i = \min(Q_w, Q_m, Q_o) \qquad \text{Equation 7-30}$$

3.2.6 Curb-Opening Inlets in a Sump (UDFCD-CSU Model)

Like a grate inlet, a curb-opening inlet operates under weir, orifice, or mixed flow. From the UDFCD-CSU physical model study, the HEC-22 procedure was found to overestimate the capacity of the CDOT Type R, the Denver No. 14, and other, similar curb-opening inlets for the minor storm event, and underestimate capacity for the major event. From the UDFCD-CSU study of these inlets, the interception capacity is based on the depression and opening geometry and can be estimated as:

$$Q_w = C_w N_w L_e D^{3/2} \qquad \text{Equation 7-31}$$

$$Q_o = C_o N_o (L_e H_c)\sqrt{2g(D - 0.5H_c)} \qquad \text{Equation 7-32}$$

Where:

H_c = height of the curb-opening throat (ft)

D = water depth at gutter flow line outside the local depression at the inlet (ft).

The recommended values for the coefficients N_w, N_o, C_w, C_m, and C_o are listed in Table 7-7. Once weir and orifice interception rates are calculated, Equations 7-29 and 7-30 must also be applied to curb-opening inlets in sag locations.

Table 7-7. Coefficients for various inlets in sumps

Inlet Type	N_w	C_w	N_o	C_o	C_m
CDOT Type 13 Grate	0.70	3.30	0.43	0.60	0.93
Denver No. 16 Grate	0.73	3.60	0.31	0.60	0.90
Curb Opening for Type 13 / No. 16 Combination	1.0	3.70	1.0	0.66	0.86
CDOT Type R Curb Opening	1.0	3.60	1.0	0.67	0.93

The UDFCD-CSU study demonstrated a phenomenon referred to as weir performance decay, which is a function of the length of the inlet. It was found that inlets become less effective in weir flow as they grow in length, if the intent is to limit ponding to less than or equal to the curb height. This phenomenon can be expressed mathematically by a multiplier in the weir equation. For the CDOT Type R and Denver No. 14 curb-opening inlets, the weir performance reduction factor (WPRF) multiplier is found by:

$$\text{WPRF}_{14,\text{R}} = \text{Min}\left[1, \frac{D_{FL}}{0.67D_{FL} + 0.24\min(15, L)}\right] \qquad \text{Equation 7-33}$$

Where:

$WPRF_{14,R}$ = multiplier to reduce Q_w in Equation 7-31 for the CDOT Type R and the Denver No. 14 inlet

D_{FL} = gutter depth at flow line away from inlet depression (inches)

L = total inlet length (ft)

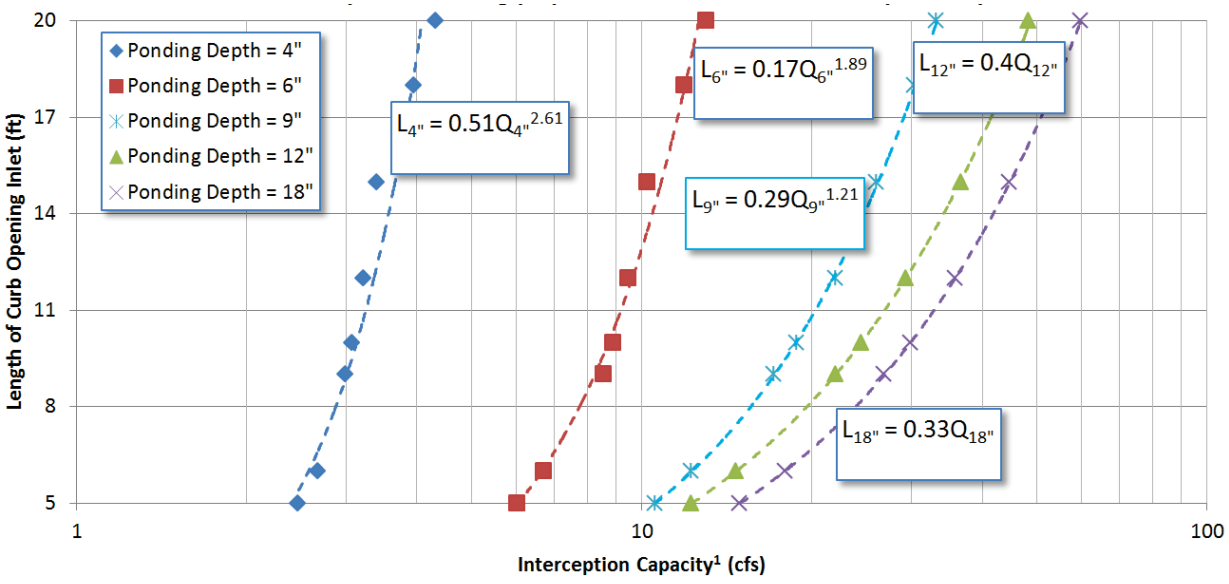
This reduction factor should be applied to weir equations for curb-opening inlet shallow depth interception calculations.

From the UDFCD-CSU study, empirical equations to estimate interception capacity for the CDOT Type R and the Denver No. 14 curb-opening inlets were developed and are shown in Figures 7-5 and 7-6.

Photograph 7-6. Weir performance decay can be observed in this picture as flow appears to enter only the first two inlets while exceeding the height of the upstream curb.

Weir Performance Decay

Inlets become less effective in weir flow as they grow in length. What this means is that adding inlets to reduce the depth of flow will typically not increase total capacity when the inlet is in weir flow. This is important to consider this when designing for the minor event. In an effort to meet minor event depth criteria, the system may need to be extended further upstream.



1 This value assumes inlet clogging per Section 3.2.9.

Figure 7-6. CDOT type r and Denver no. 14 interception capacity in sag

For the CDOT Type 13, the Denver No. 16, and other, similar combination inlets featuring cast iron adjustable-height curb boxes, the curb-opening capacity must be added to the grate capacity as determined in Section 3.3.5. Regardless of how tall the vertical curb opening is, water captured by these curb openings must enter through a narrow horizontal opening under the curb head and in the plane of the grate. Therefore the capacity of the curb opening associated with these combination inlets is estimated based on that horizontal throat opening geometry using Equation 7-31 for the weir condition, and for the orifice condition as:

$$Q_o = C_o N_o (0.W_c L_e)\sqrt{2gD} \qquad \text{Equation 7-34}$$

Where:

W_c = horizontal orifice width (typically 0.44 feet for the CDOT Type 13, the Denver No. 16, and other, similar combination inlets featuring cast iron adjustable-height curb boxes)

Once weir and orifice interception rates are calculated, Equations 7-29 and 7-30 must also be applied to the curb-opening portion of combination inlets in sag locations.

After the controlling interception rate for the grate and for the curb opening have been calculated as the minimum of the weir, orifice, and mixed flows, a reduction factor tied to the geometric mean of the grate and curb-opening capacities should be applied to the algebraic sum of the total interception as:

$$Q_t = Q_g + Q_c - K\sqrt{Q_g Q_c} \qquad \text{Equation 7-35}$$

Where:

Q_t = interception capacity for combination inlet (cfs)

Q_g = interception for grate (cfs)

Q_c = interception for curb opening (cfs)

K = dimensionless reduction factor (= 0.37 for CDOT Type 13 combination inlet, = 0.21 for Denver No. 16 combination inlet).

A higher reduction factor implies higher interference between the grate and the curb opening. The HEC-22 procedure assumes that the grate and curb opening function independently, resulting in a consistent overestimation of the capacity of combination inlets. K is a lumped, average parameter representing the range of observed water depths in the laboratory. During the model tests, it was observed that when the grate surface area is subject to shallow water, the curb opening intercepted the flow only at its two corners, and did not behave as a side weir by collecting flow along its full length. Under deep water, vortex circulation dominates the flow pattern. As a result, the central portion of the curb opening more actively draws water into the inlet box. Equation 7-35 best represents the range of the observed data.

The UDFCD-CSU study demonstrated that the Denver No. 16 and the CDOT Type 13 combination inlets are also subject to weir performance decay, which was described above with regard to the CDOT Type R and Denver No. 14 curb-opening inlets. For the Denver No. 16 and the CDOT Type 13 combination inlets, the WPRF multiplier is found by:

$$WPRF_{13,16} = \text{Min}\left[1, \frac{D_{FL}}{0.7\text{Min}(9, L) + 4.3}\right] \qquad \text{Equation 7-36}$$

Where:

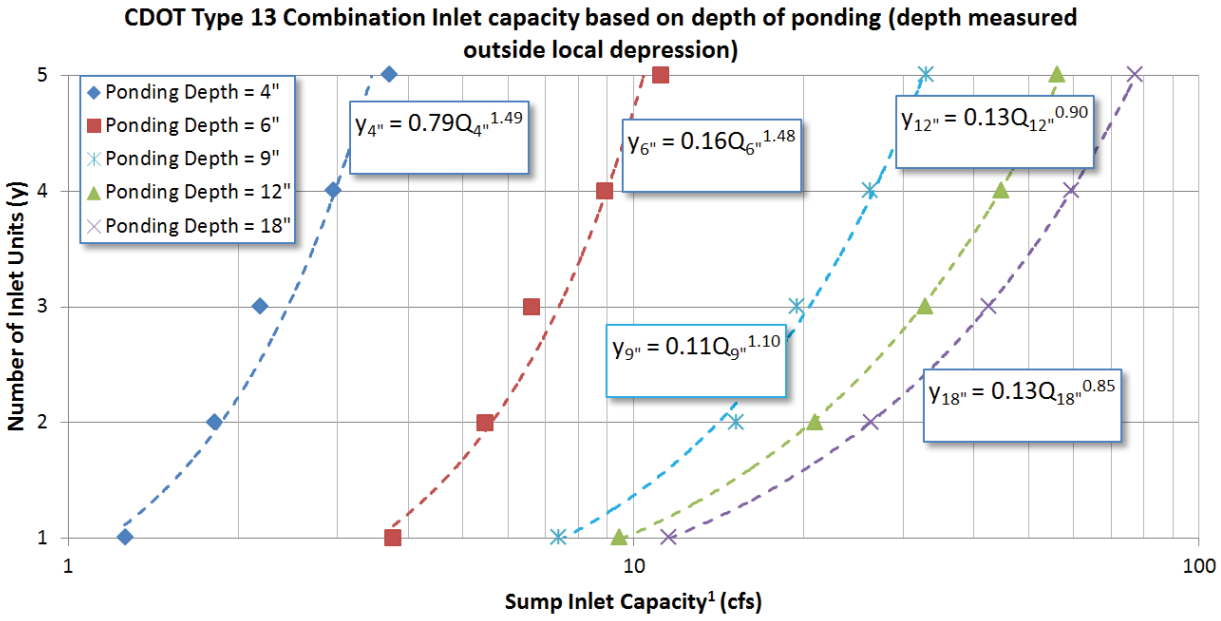
$WPRF_{13,16}$ = multiplier to reduce Q_w in Equation 7-31 for the CDOT Type 13 and the Denver No. 16 inlet

D_{FL} = gutter depth at flow line away from inlet depression (inches)

L = total inlet length (ft).

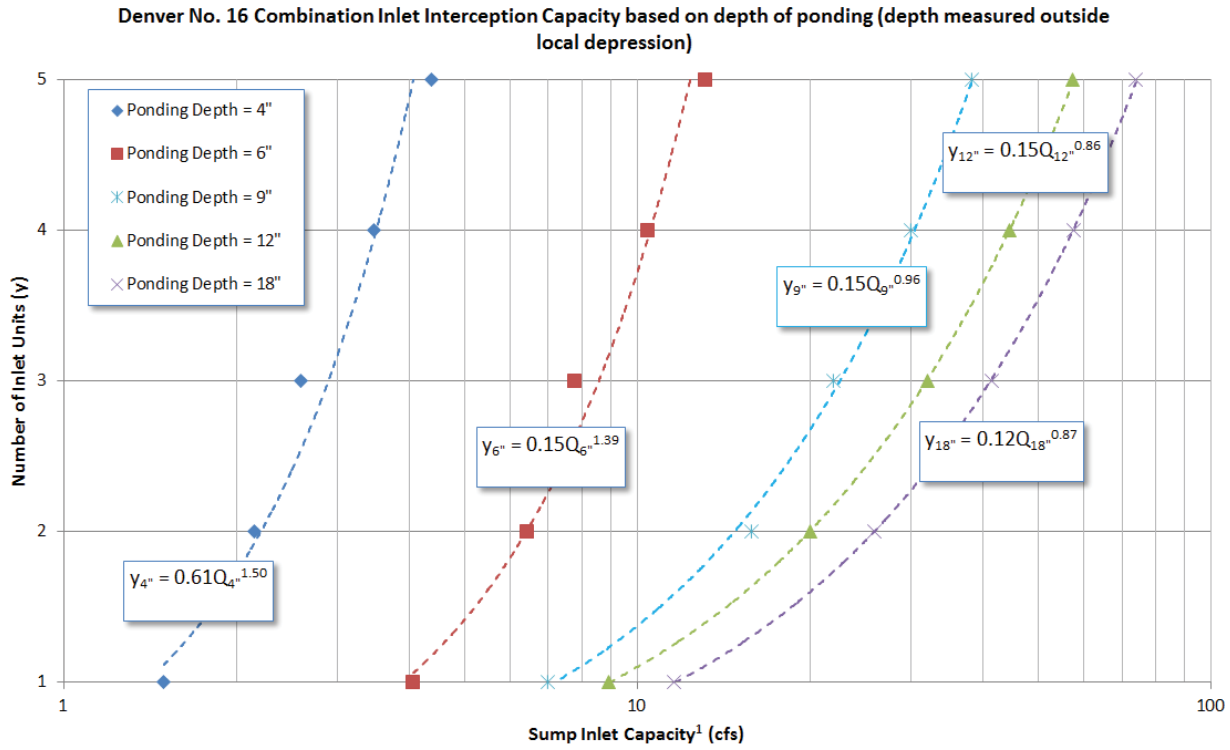
This reduction factor should be applied to both the grate and the curb opening weir equations (Equation 7-31) for combination inlet shallow depth interception calculations.

From the UDFCD-CSU study, empirical equations to estimate interception capacity for the CDOT Type 13 and the Denver No. 16 combination inlets were developed and are shown in Figures 7-7 through 7-10.



[1] This value assumes inlet clogging per Section 3.2.9.

Figure 7-7. CDOT type 13 interception capacity in a sump



[1] This value assumes inlet clogging per Section 3.2.9.

Figure 7-8. Denver no. 16 interception capacity in sump

3.2.7 Other Inlets in a Sump (Not Modeled in the UDFCD-CSU Study)

The hydraulic capacity of grate, curb-opening, and slotted inlets operating as weirs is expressed as:

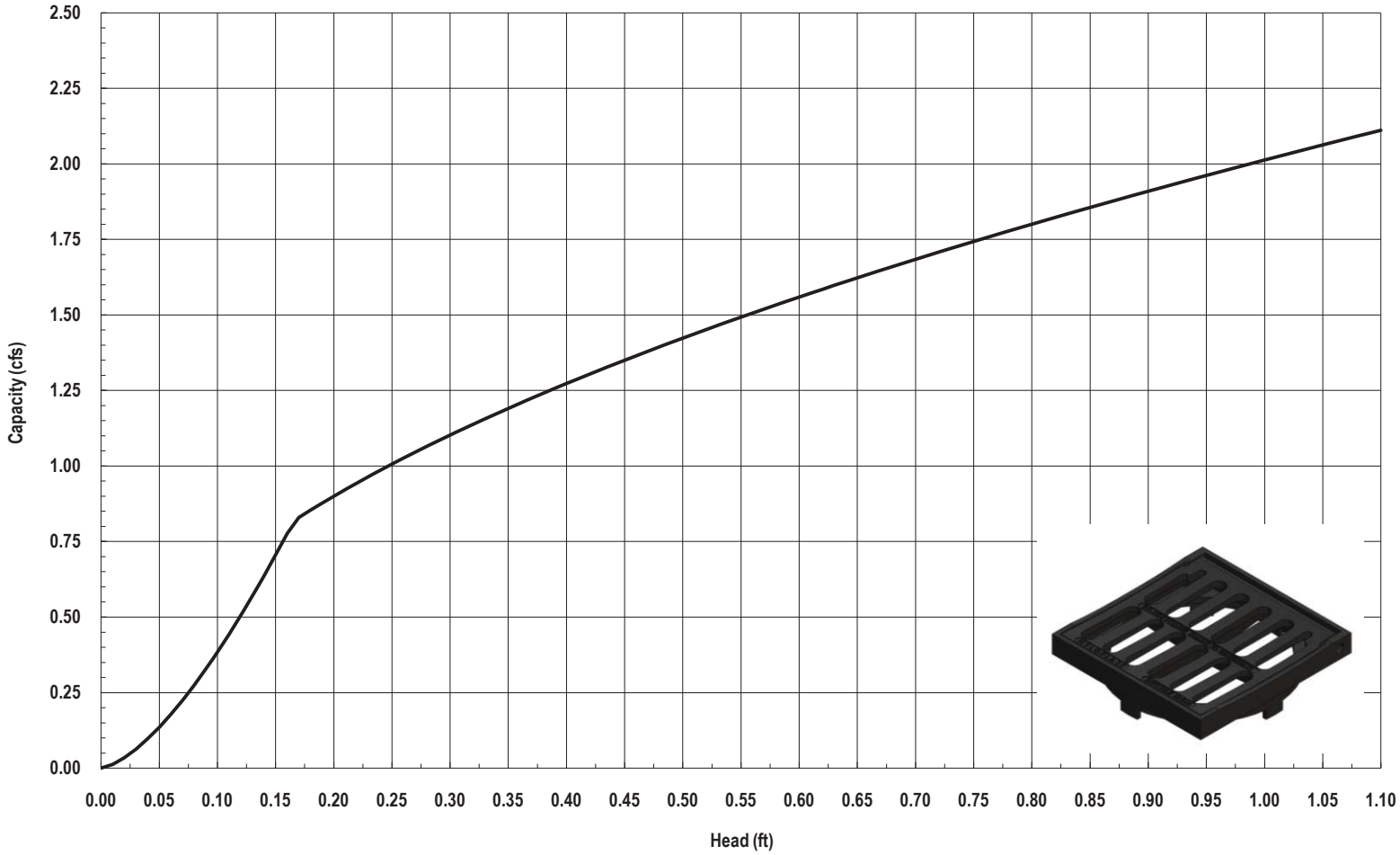
$$Q_i = C_w L_w \, d^{1.5} \qquad \text{Equation 7-37}$$

Where:

Q_i = inlet capacity (cfs)
C_w = weir discharge coefficient
L_w = weir length (ft)
d = flow depth (ft).

Values for C_w and L_w are presented in Table 7-8 for various inlet types. Note that the expressions given for curb-opening inlets without depression should be used for depressed curb-opening inlets if $L > 12$ feet.

Nyloplast 12" Standard Grate Inlet Capacity Chart



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GEOTECHNICAL INVESTIGATION
FRISCO TRANSFER CENTER
1010 MEADOW DRIVE
FRISCO, COLORADO

Prepared For:

Board of County Commissioners of
Summit County
0037 Peak One Drive
Frisco, Colorado 80443

Project No. SU01150-125

November 19, 2015

1790 Airport Road, Unit 2, Breckenridge, Colorado 80424
Telephone: 970-453-2047 www.ctlthompson.com

No free water was encountered in the test holes or pits at the time of drilling/excavation. We placed hand-slotted PVC pipes in TH-1 and TH-3 after drilling to measure water levels. No free water was observed in either test holes when checked 20 days after drilling. The PVC pipes where left in place for future monitoring.

Samples obtained in the field were returned to our laboratory where field classifications were checked and samples were selected for pertinent testing. Results of swell consolidation testing conducted on the clay soils are shown on Figure 5. Proctor Test results of the Fill soil are shown on Figure 6. Results of gradation testing conducted on the fill and natural gravel/sand soils are shown on Figures 7 through 13. Laboratory test results are summarized on Table I.

A percolation (perc) test was conducted on November 1, 2015 in the detention pond area. See Figure 1 for the perc test hole location (labeled P-1). The perc hole was hand-dug 8 inches in diameter and 10 inches deep. The top of the perc hole was 2.5 feet below existing ground surface. The top of the perc hole was in natural gravelly sand soil, approximately 6 inches below the bottom of the topsoil layer. The perc hole was presoaked 24 hours prior to the perc test. The last 30 minute interval of a 4 hour test produced a perc rate of 79 minutes per inch. The results of the percolation data are presented in Table 2.

GEOLOGIC HAZARDS

We reviewed the following geologic mapping showing the site.

1. Geologic Map of the Frisco Quadrangle, Summit County, Colorado, (Map MF-2340) by Karl S. Kellogg, Paul J Bartos and Cindy L. Williams with the U.S. Geologic Survey, 2002.

Surface materials mapped at the project site location include alluvial glacial outwash of the Pinedale period consisting of sand to boulder-sized clasts. Our field investigation and observation at the site support the mapping.

SITE EARTHWORK

Due to the presence of debris and organic material in the man-placed fill and the unknown placement characteristics of the fill, the fill is not suitable to support building foundations in its present condition. The clay soil encountered in the northern portion of the site is also not suitable to support building foundations. Building foundations and floor slabs should be placed on natural sand and gravel soils or properly compacted structural fill after the removal of all existing fill and clay soils. In TH-1 and TP-1 we encountered clay soil to a depth of as much as 7.5 feet below existing

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PERCOLATION TEST DATA

Client: Summit County	Location: Frisco Transfer Ctr.	Job No.: SU01150-125
Date excavated: 10/9/2015	Date Presoaked: 11/1/2015	Date of Tests: 11/2/2015
Diameter of Holes: 8 inches	Scraped? Yes No	Sleeved? Yes No
Water level in Profile: None	Bottom of Profile Hole (ft): 6	Technician: MH

Site Description: 2 feet of topsoil with boulders overlying silty sand
Depth to top of perc hole is 2.5 feet in silty sand. Perc hole is 10 inches deep

Time Interval From To	Time Interval (Min.)	Water Reading Start (in.)	Water Reading End (in.)	Change in Depth (in.)	Perc Rate (mpi)
Hole No. P-1	Water remaining from Presoak?	Yes No		Depth of Hole at Start: 2.5'	
10:14 - 10:44	30	3.25	4.13	0.88	34.1
10:44 - 11:14	30	4.13	4.75	0.62	48.4
11:14 - 11:44	30	4.75	5.25	0.5	60.0
11:44 - 12:14	30	5.25	5.75	0.5	60.0
12:14 - 12:44	30	5.75	6.19	0.44	68.2
12:44 - 13:14	30	6.19	6.63	0.44	68.2
13:14 - 13:44	30	6.63	7.06	0.43	69.8
13:44 - 14:14	30	7.06	7.44	0.38	78.9
Hole No.______	Water remaining from Presoak?	Yes No		Depth of Hole at Start:________	
Hole No.______	Water remaining from Presoak?	Yes No		Depth of Hole at Start:________	
Hole No.______	Water remaining from Presoak?	Yes No		Depth of Hole at Start:________	

Table 2

FINAL
DRAINAGE STUDY
FOR THE
SUMMIT STAGE TRANSFER STATION

A Part of
Section 26, Township 5 South, Range 78 West,
Town of Frisco, Summit County, Colorado

February 26, 1996

Prepared by:
Felsburg, Holt & Ullevig
5299 DTC Boulevard, Suite 400
Englewood, CO 80111
(303) 721-1440

Project No. 96-024

TABLE OF CONTENTS

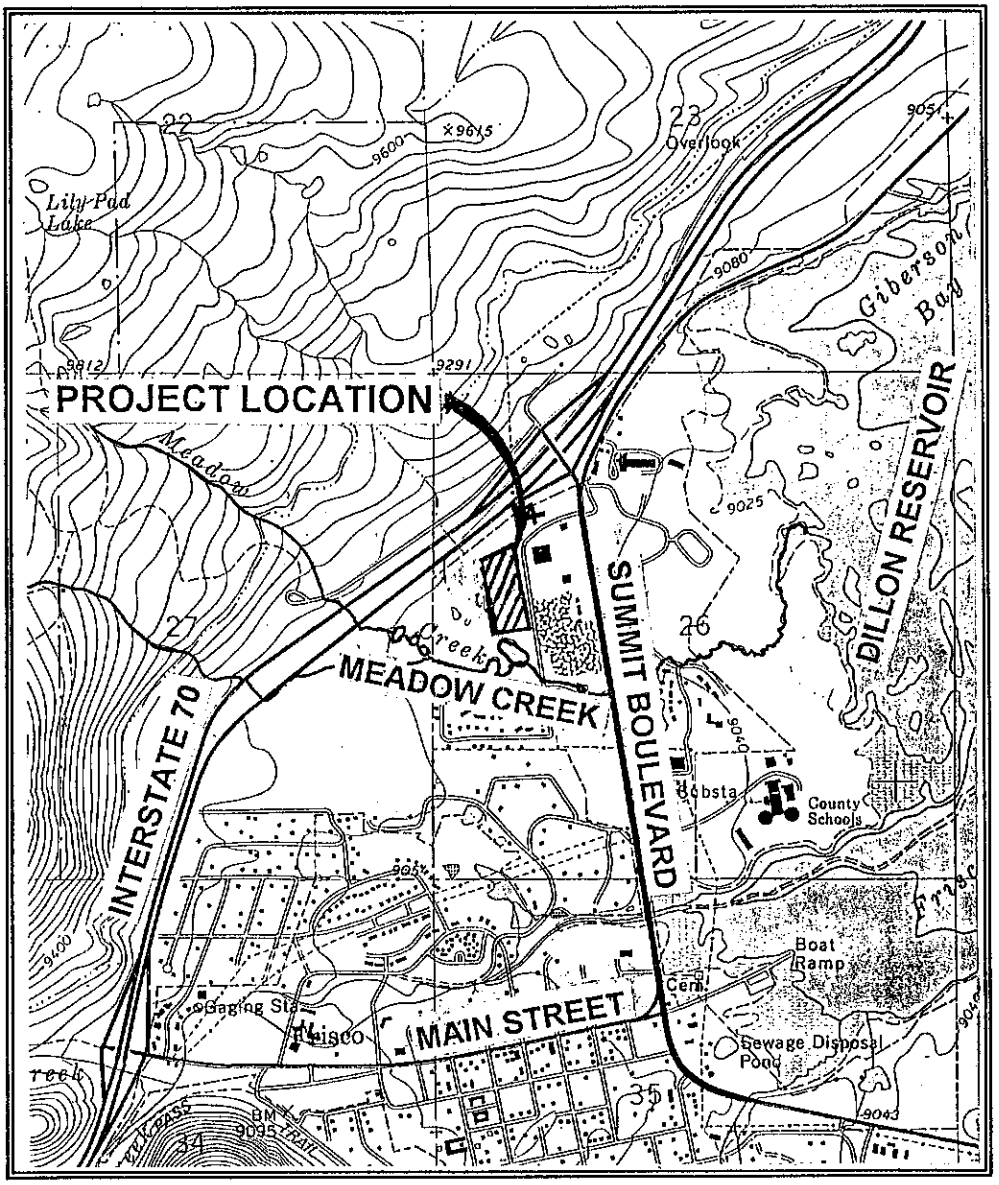
I. GENERAL LOCATION AND DESCRIPTION

A. Location

The Summit Stage Transfer Center is to be located at the southwest corner of Meadow Drive and Lusher Court in Frisco. The site is in a part of Section 26, Township 5 South, Range 78 West, Summit County, Colorado (see Figure 1). The major drainage way for the project area is Meadow Creek, which is located just south of the south property line. The site is bounded by undeveloped land on the west and south, a motel to the north and the back of a Safeway shopping center to the east.

B. Description of Property

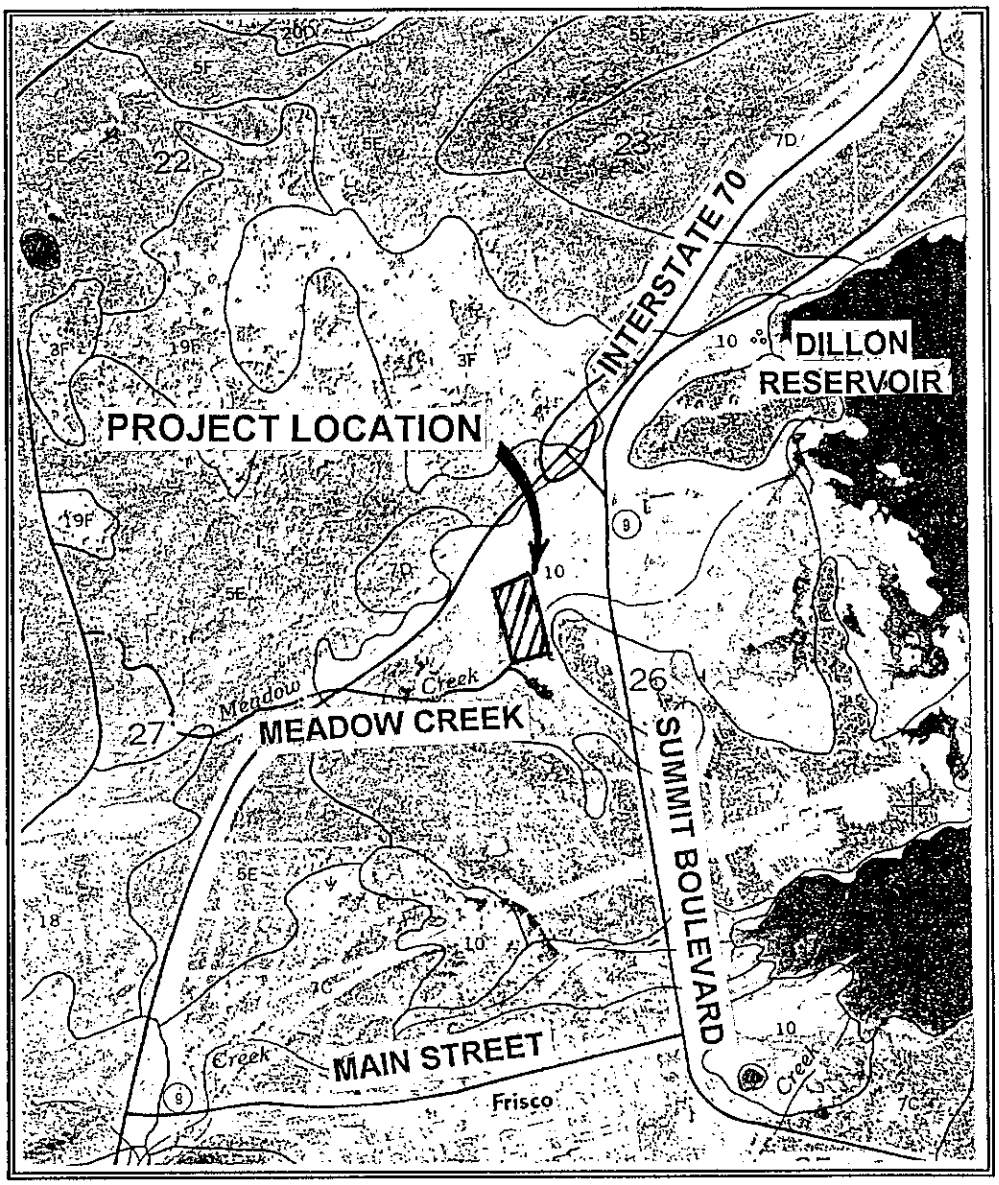
It is proposed to construct a bus transfer station that includes 177 parking spaces, bus lanes, shelters and landscaped areas. Ultimate development of the site will include an additional 122 parking spaces and a shuttle van transfer area. The shuttle van transfer area will probably include additional parking. The transfer station site is 6.2 acres in size. Ground cover currently consists of weeds, native grasses, and pasture. The Soil Conservation Service's Soils Survey of Summit County Area, Colorado has the area mapped as the Histic Cryaquolls (nearly level) soils type. This is a stratified soil of peat, sandy loam, clay, sand and gravel. It is poorly drained and located on flood plains. Permeability of this soil's type varies from rapid to slow, surface runoff is slow and erosion hazards are slight. Figure 2 shows the Soil Conservation Service map for this area. The center of the site has several areas where an imported fill has been placed. Prior to the placing of this fill, the area sloped southward at approximately one to 3 percent toward Meadow Creek.



From Frisco, Colorado 7 ½' quadrangle, USGS, 1970 photo revised 1987

Scale 1" = 2000'

FIGURE 1
VICINITY MAP



#10 = Histic Cryaquolls, nearly level
(hydraulic soils group not available)

Scale: 1" = 2,000'

FIGURE 2
SOIL CONSERVATION SERVICE MAP
FROM SOIL SURVEY OF SUMMIT COUNTY AREA, COLORADO

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The site is located within the Meadow Creek Major Basin. The 100-year flood plain limit for Meadow Creek is located near the site's southwest corner according to the Federal Emergency Management Agency, Flood Insurance Rate Map (Community Panel Number 080245 0001 C, map revised November 2, 1994) (see figure 3). None of the area within the floodplain limits will be disturbed as a part of this project.

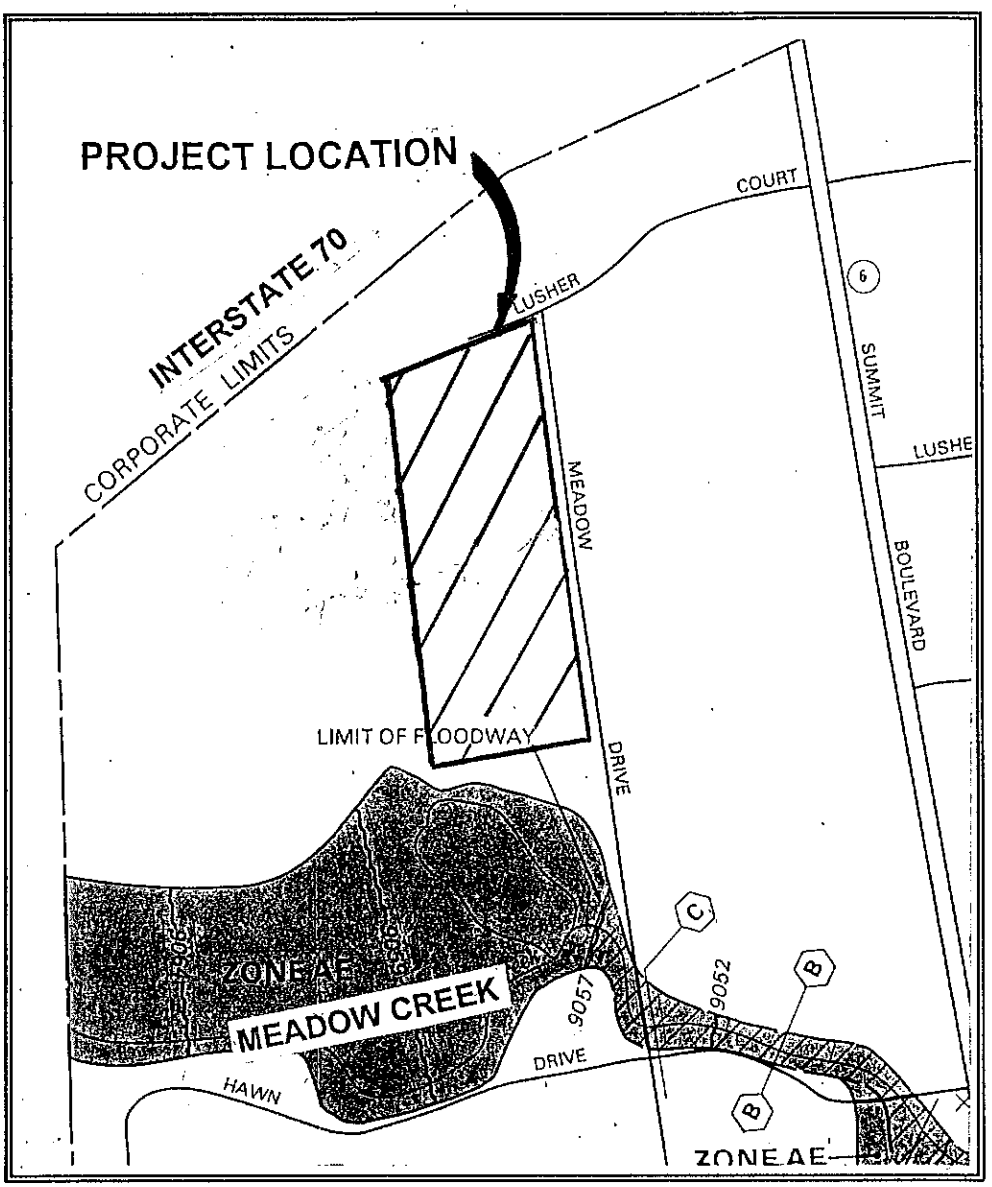
B. Sub-basin Description

1. Offsite Stormwaters

Upstream offsite basin flows from the north, include a portion of Interstate 70 and a motel. These flows are channelized along the north right-of-way of Lusher Court and directed to the east. None of these flows enter the Summit Stage Transfer Center.

2. Onsite Stormwaters

Under fully developed conditions it is estimated that 84% of the site will be pavement and 16% will be open. Developed stormwaters will pass southward via sheet flow, and swales into a proposed detention pond near the parcels southeast side. The proposed flow path will match the historic path through the site prior to the placing of fill material described above. This will lessen the drainage impacts to the intersection at Lusher Court and Meadow Drive and will still maintain the eventual outfall. The pond will have the capacity to detain the required 100-year volume of developed stormwaters for the 6.2 acre area under the fully developed conditions that have been estimated. It may be necessary to update this drainage study if the future improvements vary substantially from this plan.



From Federal Emergency Management Agency Flood Insurance Rate Map
Community Panel Number 080245 0001 C,
Map revised November 2, 1994.

Scale: 1"=400'

FIGURE 3
FEMA FLOOD INSURANCE RATE MAP

III. DRAINAGE DESIGN CRITERIA

A. Regulations

This study complies with the Town of Frisco zoning regulations.

B. Hydrological Criteria

The design storms for this study were the 25-year, 24-hour storm with 2.2 inches of rainfall, and the 100-year, 24-hour storm with 2.65 inches of rainfall. A Type II storm distribution was used (for western Colorado) utilizing the Soil Conservation Service TR 55 method for runoff and detention calculations. Detention will be provided for the 100-year storm and a 100-year historic release rate.

C. Hydraulic Criteria

The detention pond will detain the 0.3 acre feet of developed stormwaters and release at the historic rate of three cubic feet per second. The release will be controlled by an orifice plate at the pond's outlet pipe. A sag in the bus access road will function as an emergency weir spillway to pass the 100-year developed flows in the event that the outlet structure becomes plugged. Released Storm waters will be channelized to the historic concentration point south of the site. Details are located in the plan set.

IV. EROSION CONTROL CRITERIA

During construction, the topsoil will be removed and stockpiled for later use in the proposed landscape areas. The topsoil stockpile areas will be located on high ground and the disturbed soils will be wetted to prevent wind erosion. The construction of the detention pond should occur early in the building phase. The pond outlet structures will be protected from sediment by placing hay bales at the pipe entry. The ponding area is to be seeded and landscaped as early as possible. The exposed ground surfaces should be contour furrowed and mulched. Silt fences will be placed at areas where runoff has the potential to pass silt off the construction site, particularly near the toes of cuts and fills. Hay bales will be placed in swale areas to decrease flow velocities and at all culvert entries until vegetation can be established. The use of broad, flat swales and a flat detention pond bottom will aid the quality of the storm runoff after construction has been completed. Riprap erosion control will be placed at pipe outlets to prevent erosion.

V. REFERENCES

1) Summit County Zoning Regulations Section 180-19D, March 7, 1995

2) Urban Storm Drainage Criteria Manual, prepared for Urban Drainage and Flood Control District by Wright-McLaughlin Engineers, March 1969, with revisions, Volumes I, II, and III

3) Soil Survey, Summit County Area, Colorado U.S.D.A. Soil Conservation Service

4) Soils of Colorado, Loss Factors and Erodibility, Hydraulic Groupings, U.S.D.A., S.C.S., 1983

5) Federal Emergency Management Agency Flood Insurance Rate Map Community Panel Number 080245 0001 C, map revised November 2, 1994

6) Procedures for determining peak flows in Colorado, SCS USDA, 1984

7) SCS computer program TR55 version 2.0, Urban Hydrology for Small Watersheds

FIGURE S-4 RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL-COVER COMPLEXES
(Antecedent moisture condition II, and I_a - 0.2 S)

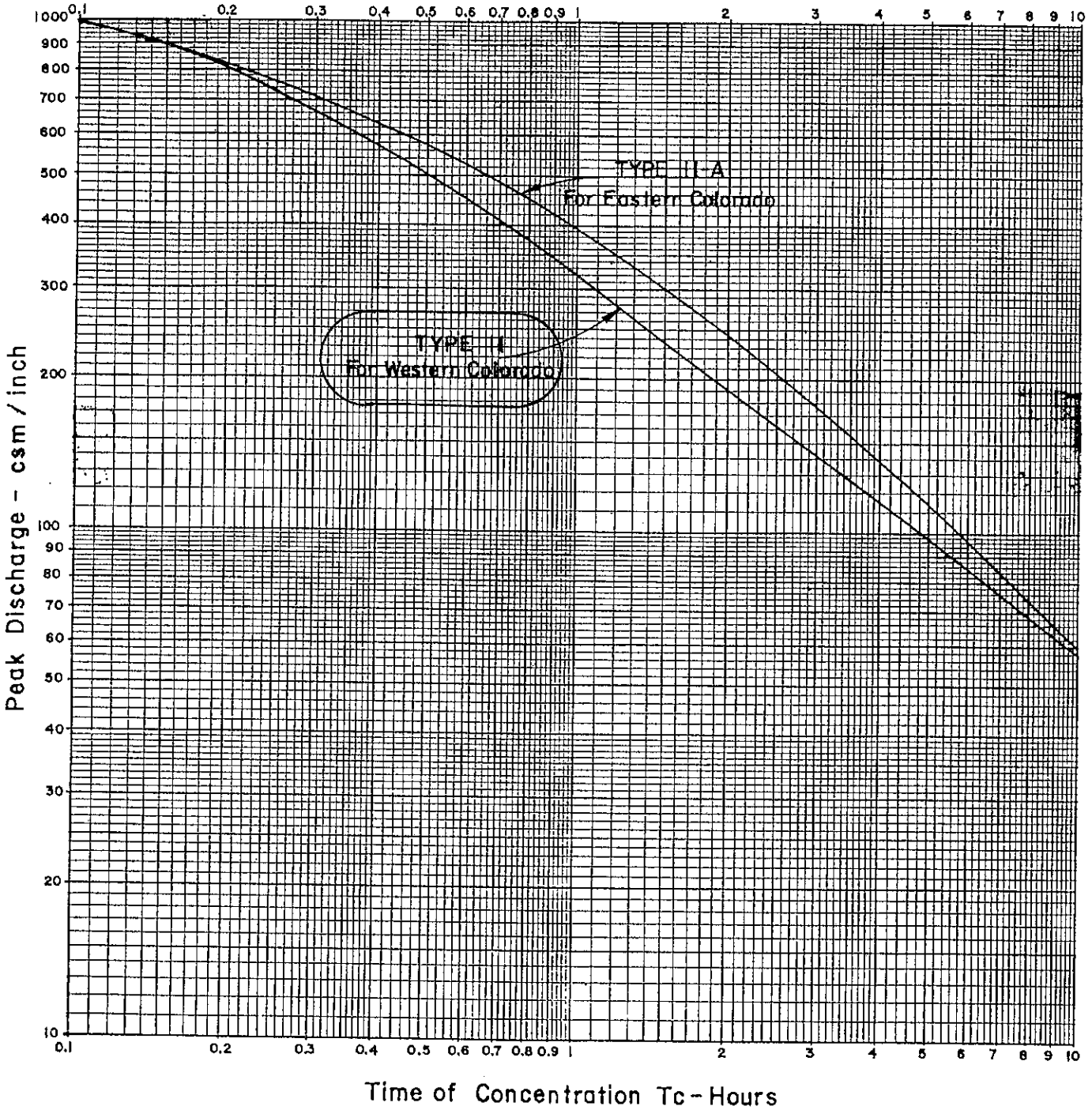
No H.S.G. given for local soil type so assume "C"

Land use	Cover: Treatment or practice	Hydrologic condition	Hydrologic soil group: A	B	C	D
Fallow	Straight row	----	77	86	91	94
Row crops 3/	"	Poor	72	81	88	91
	"	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	"	Good	65	75	82	86
	"and terraced	Poor	66	74	80	82
	" " "	Good	62	71	78	81
Small 3/ grain	Straight row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	"and terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded legumes 1/ or rotation meadow	Straight row	Poor	66	77	85	89
	" "	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	"	Good	55	69	78	83
	"and terraced	Poor	63	73	80	83
	"and terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	"	Fair	25	59	75	83
	"	Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods (Isolated groves on farms & ranches)		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		----	59	74	82	86
Roads (dirt) 2/		----	72	82	87	89
(hard surface) 2/		----	74	84	90	92

1/ Close-drilled or broadcast
2/ Including right-of-way
3/ Do not use adjustments for contoured or terraced treatments with storm frequencies greater than 10 years.

Figure S-1

Peak Discharge in
csm Per inch of Runoff
Versus
Time of Concentration, Tc
Type II Storm Distribution
Type II-A Storm Distribution



FELSBURG HOLT & ULLEVIG

Job Title Summit Stage Transfer By ELL Date Feb. 23, 1996 Job No. 96024

Subject Basin characteristics Checked Sheet 1 of 1

S.C.S. Runoff Curve Numbers

- Reference S.C.S. Figure 5-4 (attached)
- No hydraulic soils group is given for Histic Cryaquolls Soils type. Assume Type "C".

CN for roads (hard surface) = 90

CN for meadow = 71

Areas from site plan

Landscaped & open areas = 1.0 acres

Paved drives & parking Areas (including estimated future parking = 5.2 acres

Total Site Area = 6.2 acres

Weighted CN's

Historic CN = 71 (meadow)

Developed CN = $\frac{(1.0 * 71) + (5.2 * 90)}{6.2} = 87$

Rainfall parameters

1. Type II storm distribution (Western Colorado)
2. 24-hour rainfall per N.O.A.A. Atlas 2 Vol III (attached) is 2.2 inches for the 25 yr storm & 2.65 inches for the 100-year storm.
3. Use Soil Cons. Service TR55 to calculate peak flows for historic and developed conditions and the required detention volume.

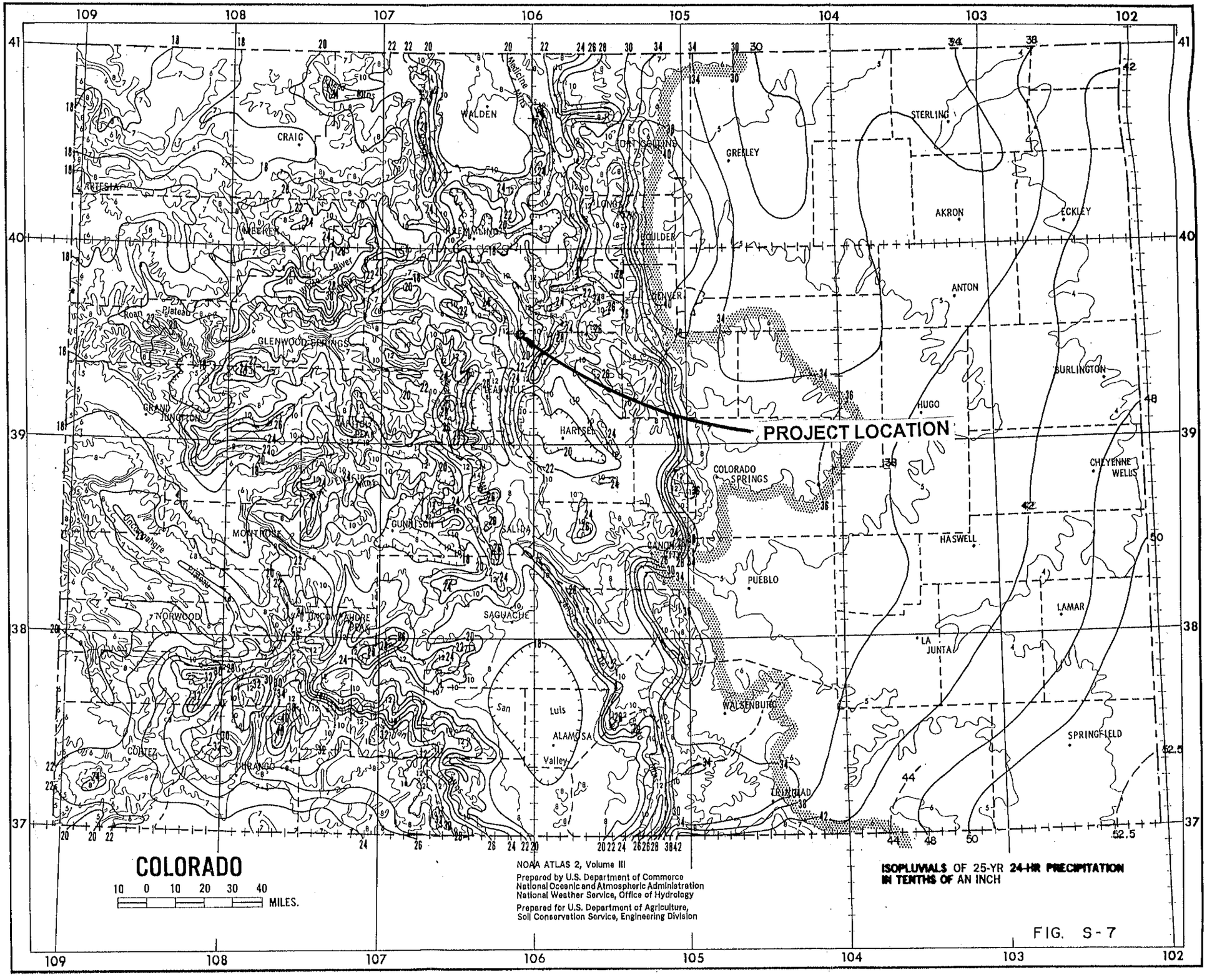

PROJECT LOCATION
COLORADO
10 0 10 20 30 40
MILES.
NOAA ATLAS 2, Volume III
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division
ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH
CRAIG
WALDEN
STERLING
GREELEY
AKRON
ECKLEY
ANTON
BURLINGTON
HUGO
CHEYENNE WELLS
COLORADO SPRINGS
HASWELL
PUEBLO
LAMAR
LA JUNTA
SPRINGFIELD
TRINIDAD
WALSENBURG
ALAMOSA
SAGUACHE
GUNNISON
MONTROSE
NORWOOD
CORTEZ
DURANGO
GLENWOOD SPRINGS
GRAND JUNCTION
LEADVILLE
HARTSEL
BOULDER
DENVER
FORT COLLINS
LONGMONT
RIFLE
RANGELY
ARTESIA
Roan Plateau
Uncompahgre Plateau
San Luis Valley
Medicine Bow Mts.

FIG. S-7

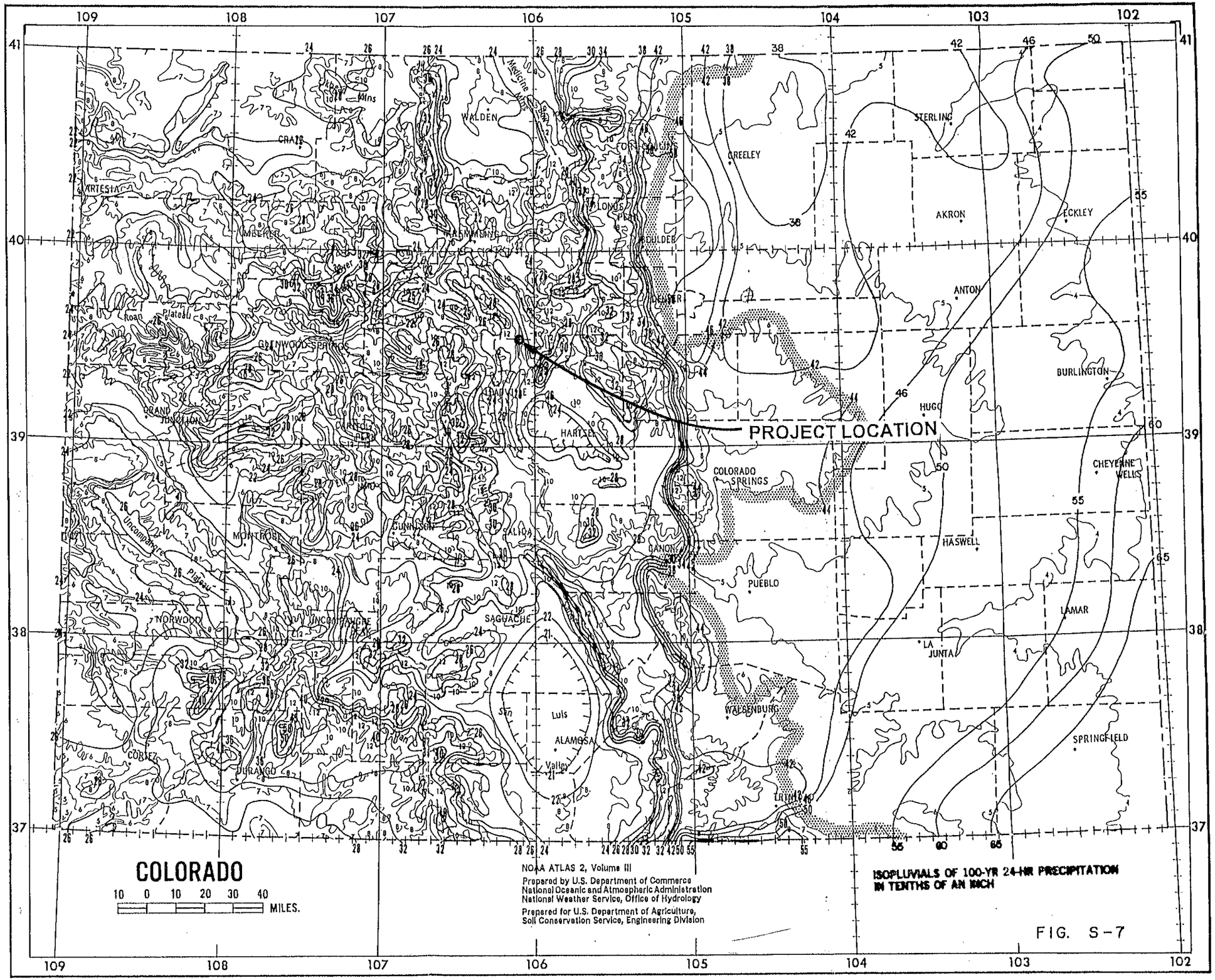

PROJECT LOCATION
COLORADO
10 0 10 20 30 40
MILES.
NOAA ATLAS 2, Volume III
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division
ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

FIG. S-7

TIME OF CONCENTRATION AND TRAVEL TIME Version 2.00

Project : SUMMIT STAGE TRANSFER STATION User: ELL Date: 02-22-96
County : SUMMIT State: CO Checked: ____ Date: _____
Subtitle: HISTORIC DISCHARGE, FILE SMT96H.55

Flow Type	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
~~SHALL~~	~~270~~	~~.022~~	~~E~~					
Shallow Concent'd	620	.005	U					0.151

Time of Concentration = 0.15*

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense
J Range, Natural

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by GRAPHIC method

Historic

GRAPHICAL PEAK DISCHARGE METHOD Version 2.00

Project : SUMMIT STAGE TRANSFER STATION User: ELL Date: 02-22-96
County : SUMMIT State: CO Checked: ____ Date: _____
Subtitle: HISTORIC DISCHARGE, FILE SMT96H.55

Data: Drainage Area : 6.5 Acres
Runoff Curve Number : 71
Time of Concentration: 0.15 * Hours
Rainfall Type : II
Pond and Swamp Area : .15 Acres 2.3 % of Drainage Area

Storm Number	1	2
Frequency (yrs)	25	100
24-Hr Rainfall (in)	2.2	2.65
Ia/P Ratio	0.37	0.31
Runoff (in)	0.35	0.57
Unit Peak Discharge (cfs/acre/in)	1.098	1.224
Pond and Swamp Factor 3.0% Ponds Used	0.75	0.75
Peak Discharge (cfs)	2	3

* - Value(s) provided from TR-55 system routines

Historic

TIME OF CONCENTRATION AND TRAVEL TIME Version 2.00

Project : SUMMIT STAGE TRANSFER STATION User: ELL Date: 02-22-96
County : SUMMIT State: CO Checked: ____ Date: _____
Subtitle: PROPOSED DISCHARGE, FILE SMT96D.55

Flow Type	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Shallow Concent'd	400	.0064	P					0.068
Shallow Concent'd	300	.005	U					0.073
							Time of Concentration =	0.14*

--- Sheet Flow Surface Codes ---

A Smooth Surface
B Fallow (No Res.)
C Cultivated < 20 % Res.
D Cultivated > 20 % Res.
E Grass-Range, Short
F Grass, Dense
G Grass, Burmuda
H Woods, Light
I Woods, Dense
J Range, Natural

--- Shallow Concentrated --- Surface Codes ---

P Paved
U Unpaved

* - Generated for use by GRAPHIC method

Proposed

GRAPHICAL PEAK DISCHARGE METHOD Version 2.00

Project : SUMMIT STAGE TRANSFER STATION User: ELL Date: 02-22-96
County : SUMMIT State: CO Checked: ____ Date: _____
Subtitle: PROPOSED DISCHARGE, FILE SMT96D.55

Data: Drainage Area : 6.5 Acres
Runoff Curve Number : 87
Time of Concentration: 0.14 * Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1	2
Frequency (yrs)	25	100
24-Hr Rainfall (in)	2.2	2.65
Ia/P Ratio	0.14	0.11
Runoff (in)	1.06	1.44
Unit Peak Discharge (cfs/acre/in)	1.395	1.412
Pond and Swamp Factor 0.0% Ponds Used	1.00	1.00
Peak Discharge (cfs)	10	13

* - Value(s) provided from TR-55 system routines

Proposed

STORAGE VOLUME FOR DETENTION BASINS Version 2.00

Project : SUMMIT STAGE TRANSFER STATION User: ELL Date: 02-22-96
County : SUMMIT State: CO Checked: ____ Date: _____
Subtitle: PROPOSED DISCHARGE, FILE SMT96D.55

Drainage Area: 6.5 Acres Rainfall Frequency: 100 years
Rainfall-Type: II
Runoff: 1.4 inches
Peak Inflow: 13.19382 cfs
Peak Outflow: 3 cfs
Detention Basin Storage Volume: 0.62 inches or 0.3 acre feet

Proposed

FELSBURG HOLT & ULLEVIG

Job Title Summit Stage By ELL Date 2/23/96 Job No. 960024

Subject Estimate Peak Flows At Chase 1 in Parking Lot Swale Checked Sheet of

About 60% of the site concentrates at the proposed sidewalk chase drain.

Estimated flows are:

25-yr = (0.60)(10) = 6 cfs

100-yr = (0.60)(13) = 7.8 cfs

Use Q = 7.8 for design of the chase and to determine the affects to the parking lot swale.

PARKING LOT SWALE
Worksheet for Triangular Channel

Project Description	
Project File	f:\home\ed\flowmast\smt96.fm2
Worksheet	Parking Lot Swale
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.016	
Channel Slope	0.006400	ft/ft
Left Side Slope	50.000000	H : V
Right Side Slope	28.000000	H : V
Discharge	7.80	cfs

← Estimated Q_{100} at swale

Results		
Depth	0.31	ft
Flow Area	3.67	ft²
Wetted Perimeter	23.92	ft
Top Width	23.91	ft
Critical Depth	0.30	ft
Critical Slope	0.007013	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	0.38	ft
Froude Number	0.96	
Flow is subcritical.		

← depth is OK

CHASE DRAIN
Worksheet for Rectangular Channel

Project Description	
Project File	f:\home\ed\flowmast\smt96.fm2
Worksheet	Chase Drain
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.005000	ft/ft
Depth	1.00	ft
Bottom Width	2.00	ft

Results		
Discharge	10.18	cfs
Flow Area	2.00	ft²
Wetted Perimeter	4.00	ft
Top Width	2.00	ft
Critical Depth	0.93	ft
Critical Slope	0.006064	ft/ft
Velocity	5.09	ft/s
Velocity Head	0.40	ft
Specific Energy	1.40	ft
Froude Number	0.00	

6.0 cfs ~ 25yr. developed
7.8 cfs ~ 100yr. developed
∴ OK

Notes:

Summit Stage Transfer Center

DETENTION POND RELEASE PIPE CAPACITY
Worksheet for Circular Channel

Project Description	
Project File	f:\home\ed\flowmast\smt96.fm2
Worksheet	Detention Pond Release Pipe Capacity
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.005000	ft/ft
Depth	1.50	ft
Diameter	18.00	in

Results		
Discharge	7.43	cfs
Flow Area	1.77	ft²
Wetted Perimeter	4.71	ft
Top Width	0.37e-7	ft
Critical Depth	1.06	ft
Percent Full	100.00	
Critical Slope	0.007032	ft/ft
Velocity	4.20	ft/s
Velocity Head	0.27	ft
Specific Energy	1.77	ft
Froude Number	0.11e-3	
Maximum Discharge	7.99	cfs
Full Flow Capacity	7.43	cfs
Full Flow Slope	0.005000	ft/ft
Flow is subcritical.		

$Q_{release} = 3$ cfs

$\therefore$ OK

OPEN CHANNEL BELOW POND
Worksheet for Trapezoidal Channel

Project Description	
Project File	f:\home\ed\flowmast\smt96.fm2
Worksheet	Open Channel Below Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.005000	ft/ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	3.00	ft
Discharge	13.00	cfs

Maximum expected undetained Q100 if pond were to fail

Results		
Depth	0.86	ft
Flow Area	5.54	ft²
Wetted Perimeter	10.09	ft
Top Width	9.88	ft
Critical Depth	0.63	ft
Critical Slope	0.017784	ft/ft
Velocity	2.35	ft/s
Velocity Head	0.09	ft
Specific Energy	0.95	ft
Froude Number	0.55	
Flow is subcritical.		

∴ OK

BIKE PATH CROSS CULVERT
Worksheet for Circular Channel

Project Description	
Project File	f:\home\ed\flowmast\smt96.fm2
Worksheet	Bike Path Cross Culvert
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.005000	ft/ft
Depth	2.00	ft
Diameter	24.00	in

Results		
Discharge	16.00	cfs
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.6e-7	ft
Critical Depth	1.44	ft
Percent Full	100.00	
Critical Slope	0.006612	ft/ft
Velocity	5.09	ft/s
Velocity Head	0.40	ft
Specific Energy	2.40	ft
Froude Number	0.12e-3	
Maximum Discharge	17.21	cfs
Full Flow Capacity	16.00	cfs
Full Flow Slope	0.005000	ft/ft
Flow is subcritical.		

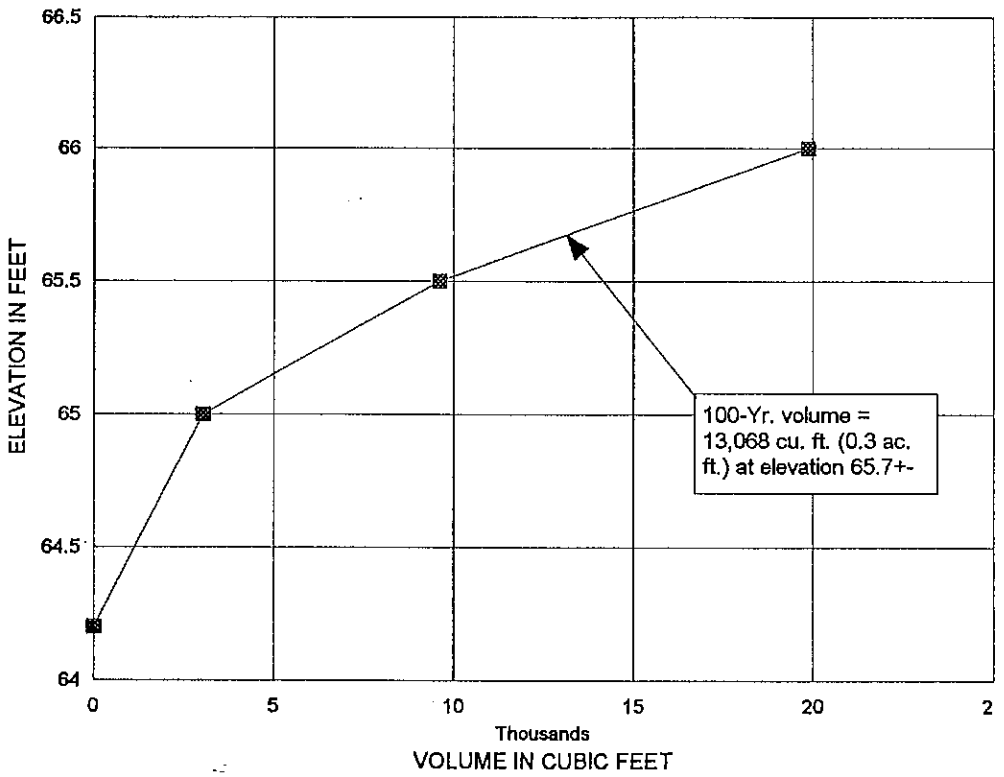
= Capacity ∴ OK

D E T E N T I O N P O N D V O L U M E

SUMMIT STAGE TRANSFER STATION
FRISCO, COLORADO

PROJECT- SUMMIT STAGE TRANSFER STATION
FRISCO. CO
DATE- 26-Feb-96
PROGRAM- VOL2.WK4 FHU # 96024

CONTOUR (FT.)	AREA (SQ.FT.)	VOLUME (CU.FT.)	CUMUL. VOLUME (CU.FT.)	CUMUL. VOLUME (AC.FT.)
64.20	0	0	0	0.00
65.00	11,275	3,007	3,007	0.07
65.50	15,200	6,594	9,601	0.22
66.00	26,400	10,272	19,873	0.46



THE FORMULA USED TO CALCULATE THE POND IS VOLUME IS THAT FOR A FRUSTRUM OF A PYRAMID OR CONE WHER V=b/3(A+B+(A*B)^0.5

b=DEPTH

A=SURFACE AREA

B=BOTTOM AREA

SUMMIT STAGE TRANSFER STATION
FRISCO, COLORADO

FELSBURG HOLT & ULLEVIG

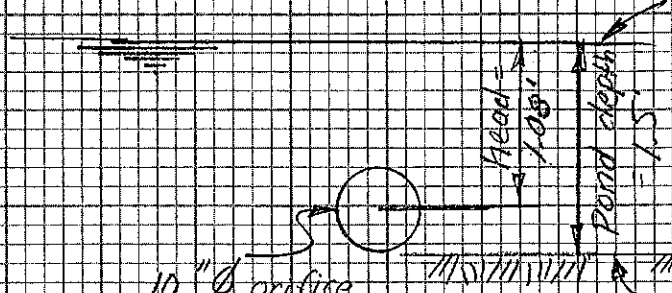
Job Title Summit Stage By ELL Date 2/23/96 Job No. 96024

Subject Detention Pond Release Checked Sheet 1 of 1

RELEASE ORIFICE

$Q_{release}$ = 3 cfs (100-yr historic rate)

Orifice formula $Q = CA\sqrt{2gh}$



$Q = (0.6)\left(\pi\left(\frac{1}{2}\right)^2\frac{10}{12}\right)\sqrt{(2)(32.16)(1.08)}$

$= 2.72$

$2.72 \leq 3$ ∴ ok to use a 10" ∅ orifice Plate on Release Pipe

EMERGENCY OVERFLOW

If Pond outlet plugs, then stormwaters will flow over bus entry at concrete pan.

Weir formula $Q = CLH^{1.5}$

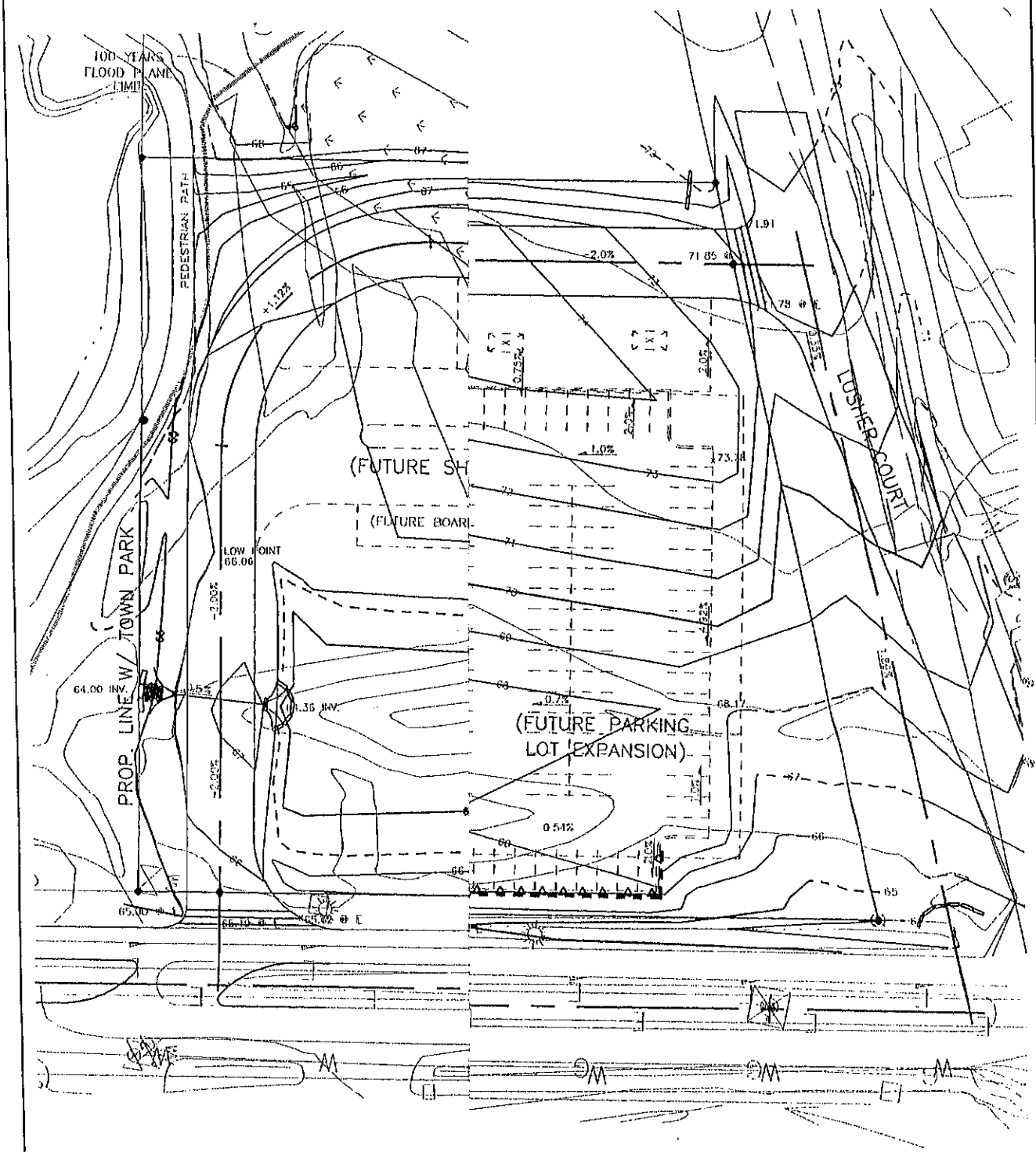
$13 = (3.1)(12')(0.5)^{1.5}$

A 12' break in the berm will allow 13 cfs to pass (Q_{100} developed) with a 0.5' head at elev. = 66.0.

If Information Center finished floor Elev. = 67.5, then 1.5' of freeboard will be available.

FEDERAL RD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	HB 0091-12		

REVISIONS		



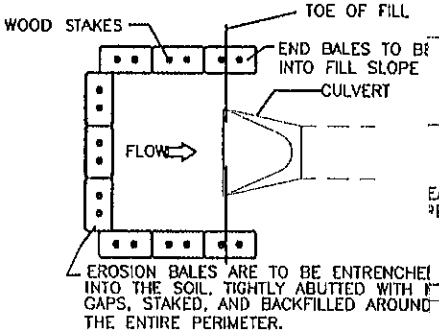
ELSBURG
OLT &
LLEVIG

SUMMIT STAGE TRANSFER CENTER				
GRADING PLAN				
DATE: FEB. 96	PROJECT NO.: 96-024	DESIGNED BY: ____ X DRAWN BY: ____ X CHECKED BY: ____ X	SHEET NO. ____ X ____ OF ____ X ____ SHEETS	DRAWING NO.: X

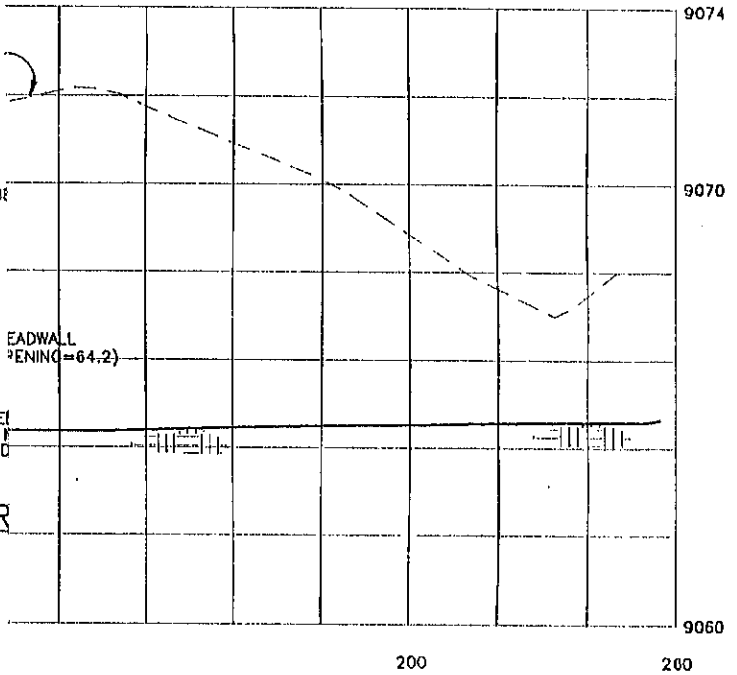
G:\JOBS\ACAD\A0074450.dwg, 1"=1', 02/27/96 at 16:05

AS CONSTRUCTED

NO REVISIONS [ ] REVISED [ ] VOID [ ]

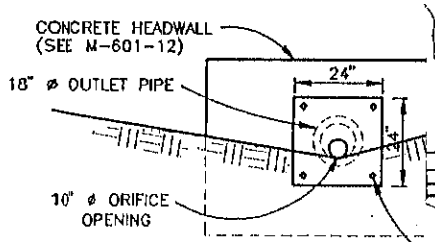


EROSION BALES AT CULVER

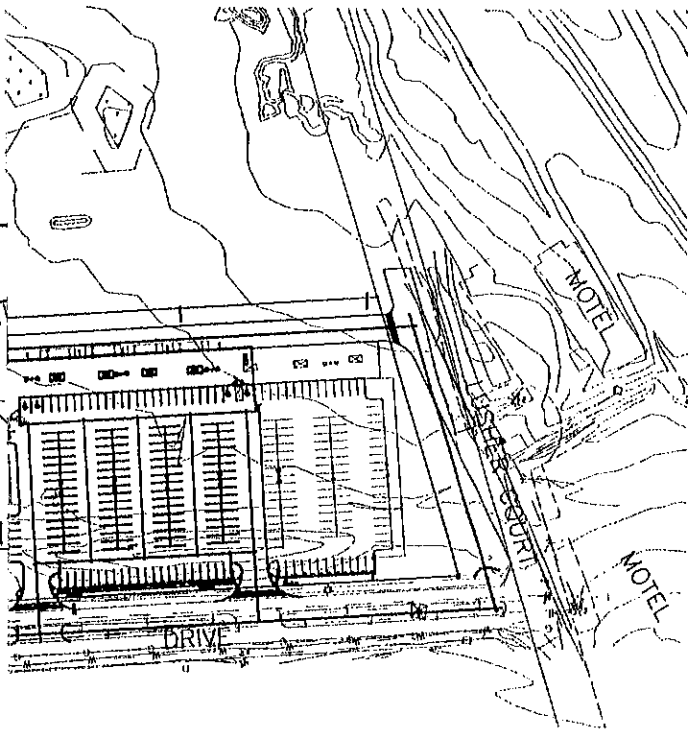


NTION POND RELEASE PIPE

SECTION A – A
SCALE 1"=20' H , 1"=2'V



DETENTION PON



E PLAN

LSBURG
LT &
LEVIG

SUMMIT STAGE TRANSFER CENTER				
DRAINAGE/DETENTION POND CROSS-SECTIONS				
DATE FEB. 96	PROJECT NO. 96-024	DESIGNED BY EL DRAWN BY CHECKED BY JBR	SHEET NO. OF SHEETS	DRAWING NO. X

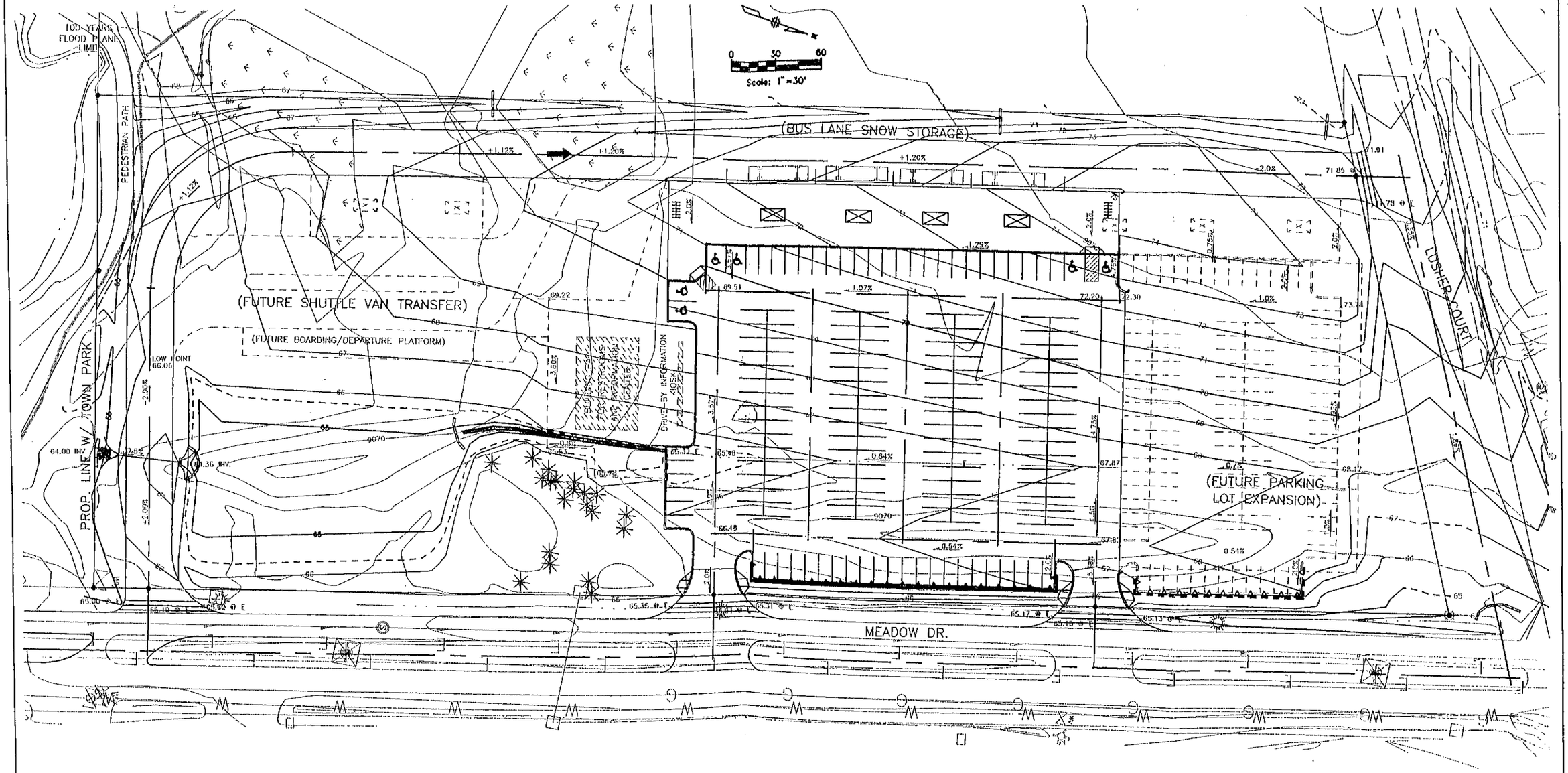
G:\96109\ACAD\A6024401.dwg, 1"=1', 02/27/96 at 11:24

AS CONSTRUCTED

NO REVISIONS ☐ REVISED ☐ VOID ☐

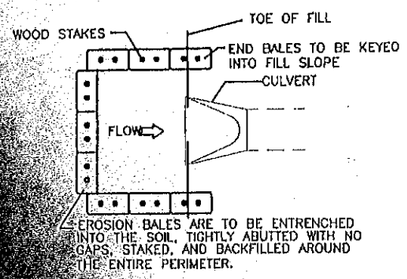
FEDERAL RD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
VIII	COLORADO	HB 0091-12		

REVISIONS		

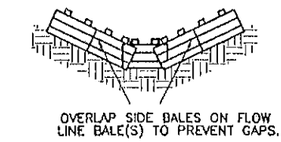


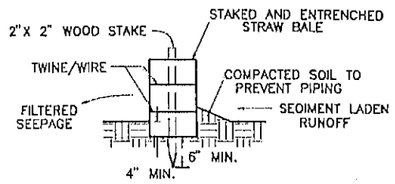
FELSBURG HOLT & ULLEVIG

SUMMIT STAGE TRANSFER CENTER					
GRADING PLAN					
DATE	PROJECT NO.	DESIGNED BY:	SHEET NO. ..X..	DRAWING ID
FEB. 96	96-024	DRAWN BY:	OF ..X.. SHEETS	X
		CHECKED BY:		

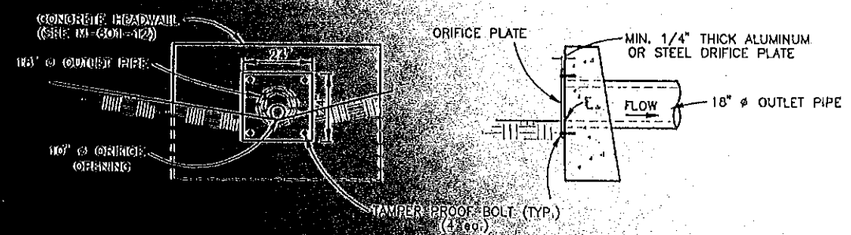


EROSION BALES AT CULVERT INLETS





DITCH EROSION BALES



DETENTION POND ORIFICE PLATE DETAILS

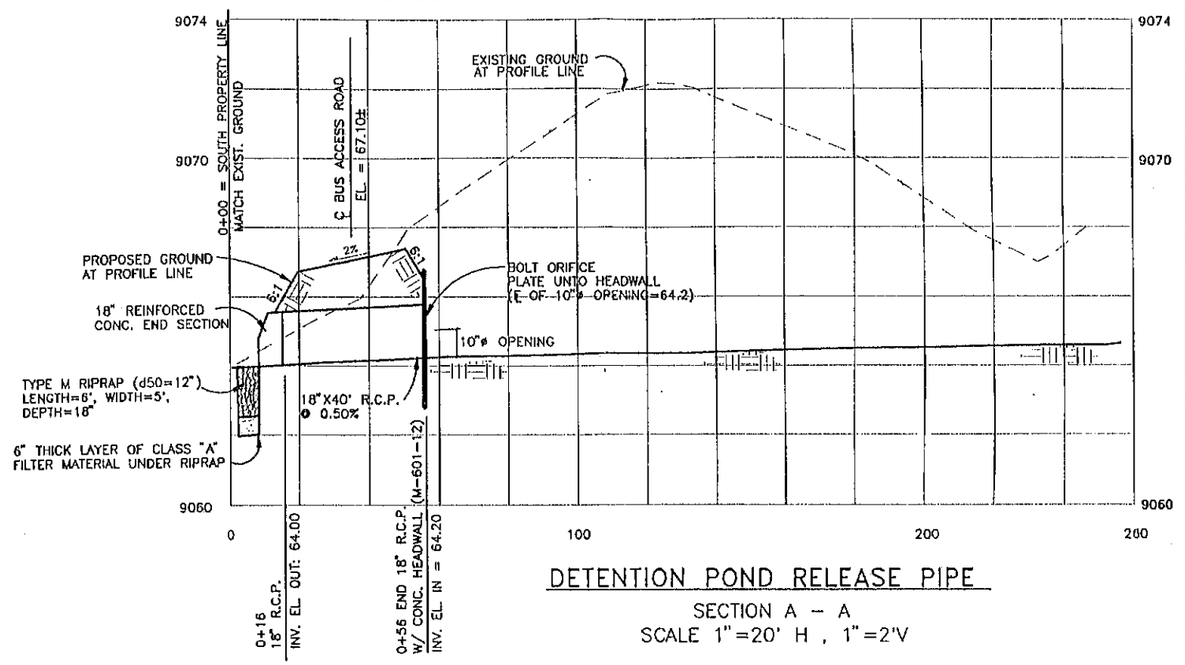
1"=2'

CONTRACT GENERATED DRAWING. DO NOT ALTER MANUALLY

REVISIONS			

AS CONSTRUCTED

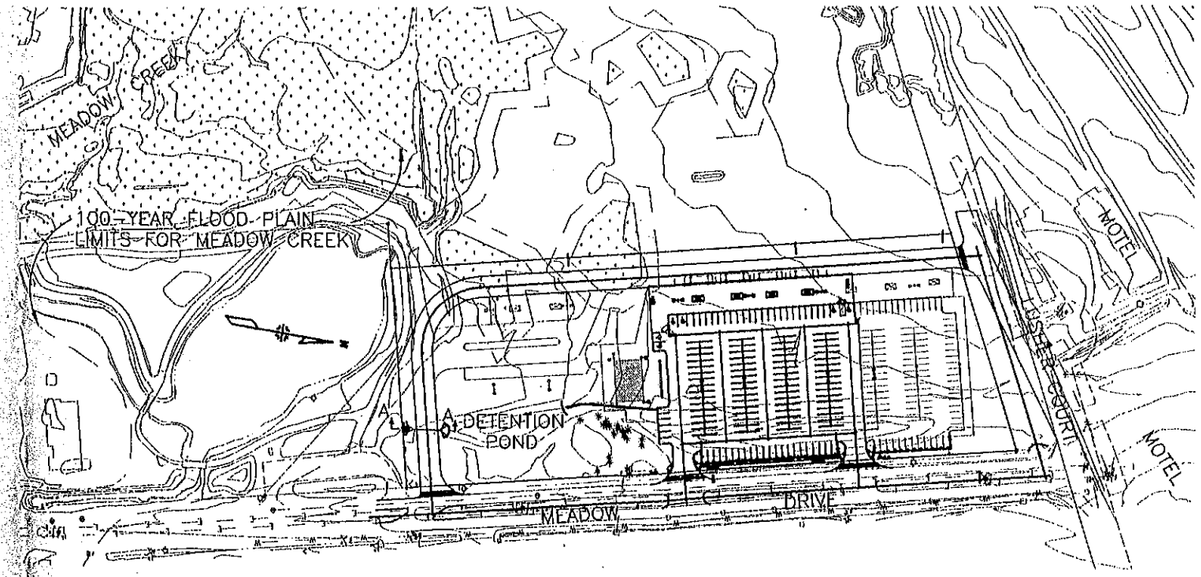
NO REVISIONS ☐ REVISED ☐ VOID ☐



DETENTION POND RELEASE PIPE

SECTION A – A

SCALE 1"=20' H , 1"=2'V



OVERALL VIEW SITE PLAN

SCALE 1"=100'

FELSBURG HOLT & ULLEVIG

SUMMIT STAGE TRANSFER CENTER				
DRAINAGE/DETENTION POND CROSS-SECTIONS				
DATE	PROJECT NO.	DESIGNED BY CL DRAWN BY GR CHECKED BY BGR	SHEET NO. ..2.. OF ..2.. SHEETS	DRAWING NO. X
FEB. 96	96-024			