

Stormwater Management Plan for:

INVICTA 3-65-28

OIL & GAS WELL SITE

N 1/2, SECTION 28, T3S, R65W, 6TH P.M.

27300 E. 38TH PKWY, CITY OF AURORA

Owner/Operator(s):

GMT Exploration Company LLC

Maxwell Blair

4949 S Niagara, Suite 250

Denver, CO 80237

(720) 862-4503

mblair@gmtexploration.com

Engineer Contact(s):

Uintah Engineering & Land Surveying (UELS)

Carl Carlson

85 S. 200 E.

Vernal, UT 84078

(435) 789-1017

ccarlson@uintahgroup.com

SWMP Preparation Date: 4/17/2024

Estimated Project Dates:

Project Start Date: Q2-2024

Project Completion Date: Q2-2025

APPROVED FOR ONE YEAR FROM THIS DATE	
City Engineer	Date
Aurora Water Department	Date

“THIS STORMWATER MANAGEMENT PLAN HAS BEEN PLACED IN THE CITY OF AURORA FILE FOR THIS PROJECT AND HAS BEEN DETERMINED TO COMPLY WITH THE APPLICABLE CITY OF AURORA STORMWATER MANAGEMENT CRITERIA. ADDITIONAL STORMWATER MANAGEMENT, EROSION AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED OF THE OWNER OR HIS/HER AGENTS, DUE TO UNFORESEEN EROSION PROBLEMS OR IF THE SUBMITTED PLAN DOES NOT FUNCTION AS INTENDED.”

“REVIEW OF THIS PLAN BY THE CITY OF AURORA SHALL NOT IMPLY THAT IT HAS BEEN REVIEWED FOR COMPLIANCE WITH THE REQUIREMENTS SET FORTH BY THE STATE OF COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT GENERAL PERMIT FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY.”

“SEE APPROVED STORMWATER MANAGEMENT PLAN DESIGN DRAWINGS (SITE PLAN) FOR SITE SPECIFIC BEST MANAGEMENT PRACTICES.”

Project Owner/Developer Signature Block

I have reviewed the information contained within the Stormwater Management Plan and accept responsibility for the requirements set forth.

Permittee/Affiliation
Maxwell Blair

Date

Plan Preparer Signature Block

I acknowledge my responsibility for the preparation of the Stormwater Management Plan.

CO Professional Engineer
Paul Hawkes, PE

Date

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"Pursuant to Sections 138-440 and 138-442 of the Aurora Municipal Code, the Permittee shall locate, install, and maintain all Best Management Practices, including, but not limited to, erosion controls, sediment controls, drainage controls, and water quality BMPs as indicated in the approved Stormwater Management Plan (SWMP). The following notes are a requirement and shall be included in the SWMP narrative developed for this project and submitted for approval by the City. BMP installations shall be installed per the COA Standard Detail in effect at the time of installation or per the approved SWMP design drawing, a COA approved variance, or a COA approved design drawing plan amendment."

COA Stormwater Management Standard Notes

1. A City of Aurora Stormwater Quality Discharge Permit for Construction Activities must be issued by the City and executed by a COA Erosion Control staff prior to any earthwork activities. An on-site inspection will be conducted to verify the correct installation and adequacy of initial BMPs for the site. No earthwork, including clearing and grubbing, or demolition activities are to begin until the project site has passed an inspection and the City of Aurora Stormwater Quality Discharge Permit for Construction Activities has been executed. The Permittee is required to present the project's CDPHE-WQCD Stormwater Discharges Associated with Construction Activity Permit to the Inspector during the initial inspection. The Permittee shall designate a Stormwater Management Plan (SWMP) Administrator on the application for the City of Aurora Stormwater Quality Discharge Permit for Construction Activities. The SWMP Administrator will act as the project representative for any concerns or issues regarding environmental controls and stormwater management.
2. These requirements shall be the obligation of the Permittee, until such time as the Permit is properly closed, or otherwise allowed by the City to be voided, modified, transferred, re-assigned or replaced.
3. This SWMP narrative, the SWMP design drawings, and the Permittee's inspection and maintenance records are all components of required record keeping and shall be kept on site at all times and updated as required. These and any other pertinent records shall be provided to the City when requested.
4. Any discrepancy between this SWMP and any other approved Stormwater Management Plan for this site shall require compliance with the more restrictive valid, approved plan.
5. Streets shall be constructed with Rough Cut Street Control measures, surface roughened or otherwise temporarily stabilized with rough cut street controls within seven (7) days of completion of grading in the appropriate phase. If paving is to occur within fourteen (14) days after final grading, rough cut street controls shall be waived.
6. Inspection and maintenance of erosion and sediment control Best Management Practices (BMPs) are the continuous obligations of the Permittee. BMPs shall be inspected at a minimum every seven (7) days and within 24-hours after the end of a precipitation event that produces run-off, and following snowmelt events. If a site is temporarily idle and no construction activities will occur during the 48 hours following a storm event, the post-precipitation event (including

snowmelt) inspection shall be conducted prior to commencing construction activities on the site, but no later than 72 hours following the storm event. All necessary maintenance and repairs shall be initiated and completed on an on-going basis, as features are required to operate continuously. Inspections may need to be conducted at a greater frequency than noted above, to ensure features and systems are operating adequately. Erosion and sediment control BMPs shall be maintained and functional for the entire duration of the project.

7. Ingress and egress vehicle access points onto disturbed areas shall be stabilized with Vehicle Tracking Control Pads (VTC) and shall be constructed with angular rock, 3" to 6" in size and to a depth of at least 9-inches. The use of recycled asphalt or concrete is not permitted. The VTC shall be installed over a liner of non-woven geotextile with a weight of at least 10 oz/yd² and a grab tensile strength of at least 250 pounds. No dirt or other materials shall be placed on paved surfaces or curb flow lines to act as curb ramps. Only metal ramps or rock wattles may be used in the curb flow line.

8. Fugitive dust emissions resulting from grading activities and/or wind shall be controlled using reasonably available control technology as defined by the Colorado Department of Public Health and Environment.

9. All potential pollution sources on-site shall be identified and control measures installed and practiced to minimize the likelihood of a release. Spill prevention controls shall be developed for the site with BMPs in place to respond to any spills, leaks or other releases.

10. Hydraulic mulching as a means to cover and protect seeding is not an acceptable means of applying mulch in the City of Aurora unless a previously installed irrigation system is used to aid germination and growth and where approved through variance. Hydraulic seeding is not permitted.

11. For all porous landscape detention facilities, in order to prevent clogging of filter medium, installation of the filtration system must be delayed until after the site is fully landscaped.

12. If stockpiles are located within 100 feet of a drainageway or a public storm sewer system, additional sediment controls such as temporary diversion dikes, silt fence, or sediment basin shall be required.

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SECTION 1 SITE DESCRIPTION

In this section, the preparer can gather some basic site information that will be helpful to the permittee later when you file for permit coverage.

- For more information, see *City of Aurora Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities, current revision* (also known as the *Rules and Regs*), Chapter 2
- Detailed information on determining your site's latitude and longitude can be found at www.epa.gov/npdes/stormwater/latlong

i Site Location

- Site location including, Section, township, range, and latitude/longitude to the nearest 15 seconds.
- Project street location or nearest major cross streets
- If applicable, specific acknowledgement that the land is currently, or will ultimately be owned or managed by the Parks, Recreation and Open Space Department.

Project/Site Name: <u>Invicta 3-65-28</u>	
Project Street/Location: <u>27300 E. 38th Pkwy</u>	
City: <u>Aurora</u>	State: <u>CO</u> ZIP Code: <u>80019</u>
County or Similar Subdivision: <u>Adams County</u>	
Latitude/Longitude (Use one of three possible formats, and specify method)	
Latitude:	Longitude:
1. <u>39° 45' 52.12"</u> N (degrees, minutes, seconds)	1. <u>104° 40' 06.88"</u> W (degrees, minutes, seconds)
2. <u> </u> ° <u> </u> ' N (degrees, minutes, decimal)	2. <u> </u> ° <u> </u> ' W (degrees, minutes, decimal)
3. <u> </u> ° N (decimal)	3. <u> </u> ° W (decimal)
Method for determining latitude/longitude:	
<input type="checkbox"/> USGS topographic map (specify scale: <u> </u>)	<input type="checkbox"/> EPA Web site <input checked="" type="checkbox"/> GPS
<input type="checkbox"/> Other (please specify): <u> </u>	

Is this land currently or will it ultimately be owned or managed by COA Parks, Recreation, and Open Space Department? Yes No

CDPS Permit #: COR412020

COA SWQ Permit #: TBD

**(This is the unique identifying number assigned to your project by your permitting authority after you have applied for coverage under the appropriate construction permit.)*

ii Description of Adjacent Areas

- Provide a description of adjacent areas such as residential areas, roads, streams, lakes, etc, which might be affected by the proposed project’s land disturbing activity.

Provide adjacent area information

The Invicta 3-65-28 oil & gas well site is located adjacent to the gas line corridor south of E. 38th Pkwy between Monaghan Rd. and Powhatan Rd. The site is also located within the ATEC Development of Section 28. The site is also being developed by AECOM, known as the ATEC-Invicta Pad-02 (EDN 223288).

a) Nature and Purpose of Construction Activity

Describe of the nature and purpose of the construction activity, note any vertical construction.

SWMP for the Invicta 3-65-28 oil & gas well site covers the construction of the well pad, diversion ditches, culverts, and basins to treat stormwater runoff from the well site, and surfacing of the access road.

- Residential Commercial Industrial Road Construction Linear Utility Overlot Grading Over-excavation Vertical Construction
- Other (please specify): [Oil & Gas Well Site](#)

b) Construction Sequence

The proposed sequence for major activities should be described, including:

- An estimated project start
- An estimated project end date
- The sequence of major construction activities (Initial, interim, final or overlot grading, utilities, vertical, paving, over – excavation, etc.). This is expected to be a brief overview of the project as more detailed phasing information and specific BMPs will be addressed in later sections of the SWMP narrative report.

Estimated Project Start Date: Q2-2024

Estimated Project Completion Date: Q2-2025

Describe the major phases of construction:

[Initial Construction to Drilling Operations:](#)

- Clearing and grubbing the vegetation.
- Stripping and stockpiling the topsoil.
- Placement of Initial and Interim erosion control measures. This includes the construction grading of the well pad, proposed diversion ditches, sediment basin, and surfacing of the access road.
- Seeding & Mulching of all disturbed areas.

Interim Reclamation to Production Operations:

- Placement of Final erosion control measures. This includes reclamation grading of the well pad/site to a smaller pad for long term production operations, construction grading of proposed diversion ditches and extended detention basin.
- Seeding & Mulching of all disturbed areas.

Additional erosion control measures may be added at any time during the construction process if the measures in place are not sufficient. Please refer to the contractor's schedule on site for final detailed schedule of all construction activities.

The extended detention basin will remain in place and functional throughout the long term production operations, and will be privately maintained by GMT Exploration Company LLC.

c) Area

The areas for the site should be described including any grading phasing which will need all of the information by phase, as well as for the overall project. This also includes overlot grading in different phases to achieve the outcome of the project. This may be required to be modified by the contractor with a phasing plan submittal.

- Provide estimates of the total area of the site and the sub area within the site expected to undergo clearing, excavation or grading.
- Include an estimate of the excavation and fill volumes involved during the proposed construction.
- Include an estimate of how excavation and fill will be phased.
- Include an estimate of over-excavation areas and volumes (and type) and an estimate of offsite trucking volume (import and/or export).

Note: If exporting material to an area within the COA limits, the receiving site must have its own SWMP and may be required to have its own COA Stormwater Quality Discharge Permit. If the export site is outside of COA limits, then the requirements of that local jurisdiction must be met and proof of a valid permit for the site will be required.

Total project area:		25.52	acres	
Construction site area to be disturbed:		25.52	acres	
Construction site over excavation area to be disturbed:		0	acres	
Export/Import Volume				
Phase Area		Cut/Fill (cy)	Net (cy)	
Initial Construction to Drilling Operations		6,180 / 1820	+4,360	
Interim Reclamation to Production Operations		2,900 / 97,180	-94,280	

Description of phasing for sites disturbing more than 40 acres.:

N/A

d) Topography, Soils, and Rainfall Data

- Provide a summary describing the soil, the soil type, and hydrologic soil group, permeability, texture, soil erosion potential, depth, soil structure, etc. and potential impacts of the soil type on the quality of any stormwater discharge from the site.
- A description of the topography of the site, existing site conditions, drainage patterns, and existing site slopes should also be included.

Note: A soils map showing the site limits and excerpts regarding the soils information shall be placed in the SWMP narrative report appendices.

Soil type(s):

Site Soil Mapping Units include: AcC (Adena-Colby association, gently sloping, Hydrologic Soil Group C) and PIC (Platner loam, 3 to 5 percent slopes, Hydrologic Soil Group C). See Appendix B for soils information.

Description	Result	Location of Occurrence
Highest Elevation:	5660'	Northern center of Oil & Gas Operations Area.
Lowest Elevation:	5623'	Eastern corner of the site.
Steepest Slope:	~24%	Northern side of site near E. 38 th Pkwy.

Average Slope:	3.5%	Consistent slopes of 3% to 4% on site.

Slopes (describe current slopes and note any changes due to grading or fill activities):

The proposed well pad sits predominately on the southeast side of a ridge. The existing topography east of the site generally drains from northwest to southeast at an existing grade of approximately 3% to 4%. The existing topography west of the site generally drains to the northwest and southwest away from the site at existing grades of approximately 3% to 4%. The well pad is being cut into the southeast side of this ridge and will have a slope of 1% from northwest to southeast.

Drainage Patterns (describe current drainage patterns and note any changes dues to grading or fill activities):

The proposed well pad sits predominately on the southeast side of a ridge, and current drainage patterns begin at the ridge and flow to the southeast across the area of the proposed site. Existing drainage flow patterns will be altered by diverting the historic flows around the site, but eventually discharging into the historic drainage path on the downstream southeast side of the site.

Normal Monthly Precipitation Table in Inches

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.51	0.49	1.28	1.93	2.32	1.56	2.16	1.82	1.14	0.99	0.98	0.63

Adapted from: <http://www.ncdc.noaa.gov/oa/climate/online/ccd/nrmlprcp.html>

Imperviousness and Runoff Coefficients:

- Calculate the percentage of impervious surface area before and after construction
- Calculate the runoff coefficients before and after construction.

Percentage impervious area before construction:	0	%
Runoff coefficient before construction (100 Yr):	0.22	
Percentage impervious area after construction:	48	%
Runoff coefficient after construction (100 Yr):	0.36	

e) Existing Vegetation

- Provide a description of the existing vegetation at the site and an estimate of the percent vegetative cover density prior to disturbance in an average square yard of the site. This requirement does not encompass hard surfaces or damaged areas. The consultant may have to evaluate vegetation from a nearby area if there has already been disturbance. There may also be drastically different vegetation in areas of the project or prairie dog issues, discuss as appropriate.
- A plan showing the existing major trees (4" diameter trunks and larger), tree masses, and shrub masses should be provided.

Existing Vegetation on the site:

The existing land use is cropland agricultural.

Pre-disturbance vegetation density:

Seasonal plantings up to 75%.

Discuss tree protections and removals (reference detail for protection):

There are no dedicated tree protection areas within the project site.

f) Potential Sources of Pollution

- Identify and list the proposed location and description of any potential pollution sources anticipated to be used during the project, such as portable toilets, vehicle fueling, grout/cement mixers, storage of fertilizers, paints or chemicals and stockpiles, etc.
- Materials of concern may include, but are not limited to, raw materials, fuels, metallic products, hazardous substances designated under Section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), any chemical the facility is required to report pursuant to Section 313 of title III of the Superfund Amendments and Reauthorization Act (SARA), fertilizers, pesticides, ash, slag, sludge concrete washout, paints, solvents, and waste piles.

Note: This is expected to be a brief list with detailed information being addressed in later sections of the SWMP narrative report.

Potential pollutants and sources to stormwater runoff:

Disturbed and Stockpiled Soil, Vehicle Tracking Controls, Loading and Unloading Operations, Outdoor Storage Activities, Vehicle and Equipment Maintenance and Fueling, Dust or Particulate Generating Processes or Activities, Routing Maintenance Activities, On-Site Waste Management Practices, Concrete Truck/Equipment Washing, Non-Industrial Waste Sources.

Trade Name, Material, or Operation	Stormwater Pollutants	Potential Location
Bedding Stockpiles	Sediment	Entire site

Trade Name, Material, or Operation	Stormwater Pollutants	Potential Location
Boring Operations, Concrete Cutting Operations or Other Operations that use Water	Sediment, slurry, concrete fines, processed water, etc	Bore sites, site perimeters, pothole locations, etc
Carpentry and Framing	wood, solvents, stains, debris	Building Construction
Concrete Materials and Concrete Waste Management	Concrete	Entire site
Concrete Curing	Curing Compound	Areas of Concrete Construction
Demolition and Debris Disposal	Trash, Sediment, various other contaminants	Existing Building Areas
Dewatering and Poned Water Management	Ground Water and Poned Water containing various other pollutants	Entire site
Form Oil and Concrete Forms	Form Oil	Building Construction
Generators	Oil, Gasoline, etc	Entire site
Grading Operations (clearing, excavating, etc)	Sediment	Entire Site
Hazardous Wastes	Fire Retardant, Acid Wash, Graffiti Prevention Liquid, Processed Water	Building Construction
HVAC	Debris, Glue, etc	Building Construction
Insulation	Fiberglass, other debris	Building Construction
Landscape Products	Fertilizers, Herbicides, pesticides, fungicides, etc.	Entire site
Masonry	Cement, Grout, Masonry Mixers, Sand Stockpiles, etc	Building Construction
Material Delivery	Other Materials	Entire site
Painters	Paint, Primers, Stains, Glue	Building Construction
Paving Operations	Asphalt, Tar, Road Base, Lime	Roadways and Parking areas
Plumbing	Trash, Glue, Solder	Building Construction
Processed Water	Any number of chemicals or other toxins	Entire site
Roofing	Asphalt, Wood, Concrete	Building Construction
Sanitary Waste Management	Sanitary Waste	Building Construction and Staging Areas
Soil Stockpiling	Sediment	Entire site
Stabilized Staging/Haul Routes	Sediment, Fuel, Oil	Entire site
Stucco, Plastering, Drywalling	Drywall, Plaster, Tool Cleaning, etc	Building Construction
Trash	Debris, Bacteria, various chemicals, etc.	Building Construction and Staging Areas
Utility Excavations	Sediment, Fuel, Oil	Entire site

Trade Name, Material, or Operation	Stormwater Pollutants	Potential Location
Vehicle and Equipment Maintenance, Cleaning, or Leaks	Fuel, Oil, Grease, Chemicals, Hydraulic Oil	Entire site

g) Non Stormwater Discharges

Identify and list the location and description of any anticipated non-stormwater components of the discharge, such as springs (State permit required), potable water for dust suppression, landscape irrigation return flow, pipeline dewatering (i.e. waterline flushing and testing) diverted stream flows, flows from wetlands, firefighting activities, hydrant blow-offs, building power-washing where detergents are not used, construction dewatering of groundwater (State permit required), uncontaminated air conditioning or compressor condensate, foundation or footing drains where flows are not contaminated with process materials such as solvents (State permit may be required), or other discharges specifically authorized by a separate National Pollutant Discharge Elimination Systems (NPDES) permit or a separate Colorado Discharge Permit System (CDPS) permit etc. Discharges are those flows that are allowed to leave the site.

- Identify all allowable sources of non-stormwater discharges that are not identified. The allowable non-stormwater discharges identified might include those in the table below.
- Identify measures used to eliminate or reduce these discharges and the BMPs used to prevent those discharges from becoming contaminated.

Check if Applicable to Site	List of Potential Non-Stormwater Discharges	Management of Discharge
<input type="checkbox"/>	Waters used to wash vehicles where detergents are not used	
x	Water used to control dust	Light Sprinkling, no flushing, to prevent runoff. Sediment Control Log if needed.
<input type="checkbox"/>	Potable water including uncontaminated water line flushings	
<input type="checkbox"/>	Routine external building wash down that does not use detergents	

Check if Applicable to Site	List of Potential Non-Stormwater Discharges	Management of Discharge
<input type="checkbox"/>	Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used	
<input type="checkbox"/>	Uncontaminated air conditioning or compressor condensate	
<input type="checkbox"/>	Uncontaminated ground water or spring water	
<input type="checkbox"/>	Foundation or footing drains where flows are not contaminated with process materials such as solvents	
<input type="checkbox"/>	Uncontaminated excavation dewatering	
<input type="checkbox"/>	Landscape irrigation	
<input type="checkbox"/>	Potable water for firefighting activities	
<input type="checkbox"/>	Diverted channels or streams	
<input type="checkbox"/>	Flows from wetlands	
<input type="checkbox"/>	Sanitary sewer/plumbing line testing	
<input type="checkbox"/>		

h) Receiving Waters

List the name of all potential receiving water (s) and the size, type and location of any outfall. If the discharge is to a municipal storm sewer system, then provide the name of that system, the location of the storm sewer discharge, and the ultimate receiving water(s). State whether or not there are wetlands, the 100-year floodplain status (i.e. if the site is within a floodway, near a flood plain or not within a flood zone), if the receiving water is impaired or not, and if there are any stream crossings proposed.

Note: Floodplain maps shall be provided in the SWMP narrative report appendices and shall show the site in relation to the floodplain.

- List the waterbody(s) that would receive stormwater from your site, including streams, rivers, lakes, and wetlands. Describe each as clearly as possible, such as *Murphy Creek, a tributary to the Sand Creek*, and so on. Indicate the location of all waters, including wetlands, on the site map.
- Note any stream crossings or stream diversions, if applicable.

- List the downstream storm inlets, storm sewer system or drainage system that stormwater from your site could discharge to and the waterbody(s) that it ultimately discharges to. It is preferred that the waterbodies are listed to a reservoir, Sand Creek, Cherry Creek or the South Platte.
- If any of the waterbodies above are impaired and/or subject to Total Maximum Daily Loads (TMDLs), please list the pollutants causing the impairment and any specific requirements in the TMDL(s) that are applicable to construction sites. Your SWMP should specifically include measures to prevent the discharge of these pollutants.

The site is within the Cherry Creek Drainage Basin: Yes No

The site is within the Aurora Reservoir Drainage Basin: Yes No

Description of receiving waters:

The existing topography east of the site generally drains from northwest to southeast towards an existing unnamed tributary of Coyote Run. The existing topography west of the site generally drains to the northwest and southwest away from the site towards unnamed tributaries of the First Creek Tributary T. The proposed site is predominately located within the Coyote Run watershed.

Description of storm inlets and storm sewer systems:

There are no existing storm inlets and sewer systems. Existing drainage patterns will be maintained using ditches where necessary.

Description of impaired waters or waters subject to TMDLs:

There are no impaired waters directly tributary from this project.

100- Year Floodplain Status:

The location of the proposed well pad site is not within any mapped FEMA 100-year floodplain.

Description of wetlands:

No indentified wetlands on the site.

Other:

i) Site Features and Sensitive Areas to be Protected

- Describe unique site features including streams, stream buffers, wetlands, specimen trees, natural vegetation, steep slopes, or highly erodible soils that are to be preserved.
- Describe measures to protect these features.
- Include these features and areas on your SWMP design drawings.

There are no sensitive areas on the site to be protected.

j) Other Applicable Federal, State or Local Programs, Regulations or Restrictions

State any other regulations that are affecting the site (i.e. **State CDPHE**, Regulation 72, Consent Decrees, etc).

[Colorado Energy & Carbon Management Commission \(ECMC\), State CDPHE](#)

1) *Endangered Species Certification*

State whether or not there are any endangered species or critical habitats on or near the site. If so, then describe the impacts and the measures being taken to address that impact and supply documentation in the SWMP narrative report appendices.

Are endangered or threatened species and critical habitats on or near the project area?

Yes No

If yes, describe the species and/or critical habitat and provide reference to other documents as appropriate:

2) *Historic Preservation*

State whether or not there are any historic sites on or near the site. If so, then describe the impacts and the BMP measures being taken to address that impact

Are there any historic sites on or near the construction site?

Yes No

If yes, describe or refer to documentation that determines the likelihood of an impact on this historic site and the steps taken to address that impact.

SECTION 2 DESIGN DRAWINGS

Approved design drawings shall be kept with the approved narrative report (this document) in the field and must be kept current. See COA Rules and Regs Chapter 3 for more information regarding Living Documents. For most projects, a series of site maps is recommended. The first should show the undeveloped site and its current features. An additional map or maps should be created to show the developed site or for more complicated sites show the major phases of development.

- SWMP design drawings are required to indicate the types, locations, and extents of BMPs proposed for installation on the project site.
- For more information and requirements, see *Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities, current revision* (also known as the *Rules and Regs*), Chapter 2

SECTION 3 STORMWATER MANAGEMENT CONTROLS

This section shall describe the stormwater management controls that will be used to control pollutants in stormwater discharge during construction activity.

a) SWMP Administrator and Important Contacts

- List Contact names and phone numbers for the SWMP Administrator, alternates, owner, developer, etc that are known
- Copy as needed

Owner/Operator(s):
GMT Exploration Company LLC
Maxwell Blair
4949 S. Niagara, Suite 250
Denver, CO 80237
(720) 862-4503
mblair@gmtexploration.com
Area of Control (if more than 1 operator at site):

Project Manager(s) or Site Supervisor(s):
GMT Exploration Company LLC
Maxwell Blair
4949 S. Niagara, Suite 250
Denver, CO 80237
(720) 862-4503
mblair@gmtexploration.com
Area of Control (if more than 1 operator at site):

SWMP Administrator Contact(s):
GMT Exploration Company LLC
Maxwell Blair
4949 S. Niagara, Suite 250
Denver, CO 80237
(720) 862-4503
mblair@gmtexploration.com
Area of Control (if more than 1 operator at site):

This SWMP was Prepared by (the Colorado Licensed Engineer):
Uintah Engineering & Land Surveying (UELS)
Paul Hawkes, PE
85 S. 200 E.
Vernal, UT 84078
(435) 789-1017
phawkes@uintahgroup.com

Emergency 24-Hour Contact (for site, not 911):
GMT Exploration Company LLC
Maxwell Blair
4949 S. Niagara, Suite 250
Denver, CO 80237
(720) 862-4503
mblair@gmtexploration.com
Area of Control (if more than 1 operator at site):

Subcontractor(s):
Company or Organization Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:
Area of Control (if more than 1 operator at site):

Other:
Company or Organization Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:
Area of Control (if more than 1 operator at site):

Other:
Company or Organization Name:
Name:
Address:
City, State, Zip Code:
Telephone Number:
Fax/Email:

Area of Control (if more than 1 operator at site):

b) Identification of Potential Pollutant Sources

All potential pollutant sources, including materials and activities, at a site must be evaluated for the potential to contribute pollutants to stormwater discharges.

- Identify and describe the sources of potential pollutants to stormwater discharges. At a minimum, each of the following sources and activities shall be evaluated for the potential to contribute pollutants to stormwater discharges.
- Numbers in [] brackets indicate the appropriate section to describe the BMPs to be used to address the potential pollutant source

Applicable to Site (Y, N, Maybe)	Sources of Potential Pollutants to Stormwater Discharges
Y	All disturbed and stored soils (including borrow areas, stockpiles, haul routes, and over-excavation) [Section 3 c) 1, 2, and 3]
Y	Vehicle tracking controls and clean up [Section 3 c) 6]
Y	Management of contaminated soils [Section 3 c) 4]
Y	Loading and unloading operations (including access points and protection of existing BMPs) [Section 3 c) 10]
N	Outdoor storage areas (building materials, fertilizers, chemicals, etc.) [Section 3 c) 4]

Applicable to Site (Y, N, Maybe)	Sources of Potential Pollutants to Stormwater Discharges
N	Routine maintenance activities involving fertilizers, pesticides, detergents, fuels, solvents, oils, etc. [Section 3 c) 4]
Y	On-site waste management practices (waste piles, liquid wastes, dumpsters, etc.) [Section 3 c) 7]
N	Concrete truck/equipment washing, including the concrete truck chute, pump truck primary and associated fixtures and equipment [Section 3 c) 7]
N	Dedicated asphalt and concrete batch plants [Section 3 c) 5]
Y	Non-industrial waste sources such as worker trash and portable toilets [Section 3 c) 7]

Applicable to Site (Y, N, Maybe)	Sources of Potential Pollutants to Stormwater Discharges
Y	Vehicle and equipment maintenance and fueling [Section 3 c) 4]
Y	Significant dust or particulate generating processes (including haul routes, masonry mixing, and silos) [Section 3 c) 2]
N	Power washing of building using detergents or other chemicals/solvents [Section 3 c) 4]
N	Building/vertical construction (including paints, solvents, drywall, fire retardant, etc) [Section 3 c) 4, 7, 10]

Applicable to Site (Y, N, Maybe)	Sources of Potential Pollutants to Stormwater Discharges
N	Other areas or procedures where potential spills can occur [Section 3 c) 4]
N	Stormwater or groundwater dewatering [Section 3 c) 9]

c) **BMPs for Stormwater Pollution Prevention**

This section of the SWMP narrative report shall include a narrative description of the appropriate controls and measures that will be implemented before, during and after construction activities at the project site to manage and control the runoff of pollutants.

The SWMP narrative report shall clearly describe the relationship between the phases of construction, and the implementation and maintenance of BMP controls and measures. For example, the report must indicate which controls will be implemented during each of the following phases of construction: clearing and grubbing for perimeter controls, installation of initial BMPs, clearing and grubbing, overlot grading, installation of interim BMPs, site construction, utility construction, vertical construction, other pertinent construction phases, final grading, stabilization, removal of BMPs, and Permit closeout.

1) *Structural Practices*

- Clearly describe the initial/interim, post-paving, and permanent structural site management practices to control erosion and sediment transport. Practices may

include, but are not limited to: silt fences, diversion dikes, temporary slope drains, inlet protection, outlet protection, check dams, curb/rock socks, sediment control logs, compacted earthen berm, and terracing.

BMP Description: *Vehicle Tracking Control (VTC)*

<i>Intended Use/Purpose:</i>	VTC consists of a pad of 3” to 6” angular rock at the entrance/exit point for the site that is intended to help strip mud from tires prior to vehicles leaving the construction site.
<i>Appropriate Installation Timing:</i>	Initial/Interim
<i>Appropriate Removal Timing:</i>	Upon completion of site grading and stabilization.

BMP Description: *Sediment Control Log (SCL)*

<i>Intended Use/Purpose:</i>	12” diameter SCL shall be used on the downstream perimeter of the spoils and topsoil stockpiles, as well as on graded slopes around the well pad. SCL shall not be used across swales or drainageways.
<i>Appropriate Installation Timing:</i>	Initial/Interim and Post-Paving. Placed on the downstream perimeter of the stockpiles once the stockpiles have been created.
<i>Appropriate Removal Timing:</i>	Once stabilization has been reached. Contractor may also elect to allow the SCL to degrade in place.

BMP Description: *Diversion Ditches (DD)*

<i>Intended Use/Purpose:</i>	DD are small earthen swale used to divert and convey runoff, usually to a sediment basin, trap, or detention basin.
<i>Appropriate Installation Timing:</i>	Initial/Interim and Final/Post-Paving, before grading work begins.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: *Sediment Basin (SB)*

<i>Intended Use/Purpose:</i>	SB are utilized as a runoff detention facility, at the downstream termination of diversion ditches, that capture sediment laden runoff and releases it slowly, providing detention time to facilitate the settling of soil and suspended particles.
<i>Appropriate Installation Timing:</i>	Initial, before grading work begins.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: *Erosion Control Blanket (ECB)*

<i>Intended Use/Purpose:</i>	ECB is a temporary degradable slope protection product that forms a continuous matrix to provide erosion control and facilitate vegetation establishment. ECB shall be placed on all 4:1 and steeper slopes exceeding 5 vertical feet (excluding temporary stockpiles).
<i>Appropriate Installation Timing:</i>	Initial/Interim with seeding and Final/Post-Paving with seeding.
<i>Appropriate Removal Timing:</i>	Degrades.

BMP Description: *Seeding & Mulching (SM)*

<i>Intended Use/Purpose:</i>	SM is applied to help stabilize disturbed areas by establishing temporary cover and protection while reducing both wind and water erosion.
<i>Appropriate Installation Timing:</i>	Initial/Interim and Final/Post-Paving. Shall be applied after grading is complete.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: *Extended Detention Basin (EDB)*

<i>Intended Use/Purpose:</i>	EDB are utilized as a runoff detention facility, at the downstream termination of diversion ditches, that capture sediment laden runoff and releases it slowly, providing detention time to facilitate the settling of soil and suspended particles.
<i>Appropriate Installation Timing:</i>	Final/Post-Paving
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: *Inlet Protection-Culvert (IPC)*

<i>Intended Use/Purpose:</i>	IPC shall be utilized on the upstream side of culverts to filter runoff and remove sediment prior to entering the culvert.
<i>Appropriate Installation Timing:</i>	Initial, after construction of culvert.
<i>Appropriate Removal Timing:</i>	Once stabilization has been reached.

BMP Description: *Outlet Protection (OP)*

<i>Intended Use/Purpose:</i>	OP consists of a rip-rap apron at the discharge points of culverts to protect surfaces and swales from erosion and scour.
<i>Appropriate Installation Timing:</i>	Initial, after construction of culvert.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: *Rip-Rap Apron (RRA)*

<i>Intended Use/Purpose:</i>	RRA consists of a rip-rap apron at the discharge points of diversion ditches or swales to protect surfaces from erosion and scour.
<i>Appropriate Installation Timing:</i>	Initial, after construction of ditches/swales.
<i>Appropriate Removal Timing:</i>	N/A

<i>BMP Description:</i>	
<i>Intended Use/Purpose:</i>	
<i>Appropriate Installation Timing:</i>	
<i>Appropriate Removal Timing:</i>	

<i>BMP Description:</i>	
<i>Intended Use/Purpose:</i>	
<i>Appropriate Installation Timing:</i>	
<i>Appropriate Removal Timing:</i>	

<i>BMP Description:</i>	
<i>Intended Use/Purpose:</i>	
<i>Appropriate Installation Timing:</i>	
<i>Appropriate Removal Timing:</i>	

2) Non-Structural Practices

- Clearly describe initial/interim, post-paving, and permanent stabilization practices, including site specific scheduling of the implementation of these practices. Site plans should ensure that existing vegetation is preserved where possible and that all disturbed areas are stabilized. Non-structural practices may include, but are not limited to: temporary seeding, mulching, temporary sod stabilization, vegetative buffer strips, temporary landscaping, temporary erosion control blankets/matting, temporary soil retention matting, surface roughening, dust suppression, seasonal schedule, and preservation of mature vegetation.

BMP Description: Stockpile Management

<i>Intended Use/Purpose:</i>	To minimize soil erosion and deposition coming from a soil or any other type of stockpile. This can be done using stockpile location, sediment control logs, and pile stabilization measures such as seeding & mulching.
<i>Appropriate Installation Timing:</i>	Plan location before any stockpile is created, pre-construction.
<i>Appropriate Removal Timing:</i>	After stockpile has been completely removed.

BMP Description: Good Housekeeping Practices

<i>Intended Use/Purpose:</i>	To maintain organization, waste management, and keep the site as tidy as possible.
<i>Appropriate Installation Timing:</i>	During all activities on site.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: Scraping and Sweeping (SS)

<i>Intended Use/Purpose:</i>	SS of roadways will occur to remove mud tracking as needed.
<i>Appropriate Installation Timing:</i>	As needed.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: Dust Control (DC)

<i>Intended Use/Purpose:</i>	Water will be used for DC on disturbed areas not yet ready to be seeded, landscaped, or paved to preclude visible dust emissions.
<i>Appropriate Installation Timing:</i>	As needed.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: *Limits of Construction (LOC)*

<i>Intended Use/Purpose:</i>	Define the LOC to minimize unnecessary disturbance to stable areas. LOC may be outlined with a variety of BMPs, such as construction markers, sediment control logs or fencing. Contractor to select the most appropriate BMP and install along the LOC.
<i>Appropriate Installation Timing:</i>	Start of construction.
<i>Appropriate Removal Timing:</i>	End of construction.

BMP Description:

<i>Intended Use/Purpose:</i>	
<i>Appropriate Installation Timing:</i>	
<i>Appropriate Removal Timing:</i>	

BMP Description:

<i>Intended Use/Purpose:</i>	
<i>Appropriate Installation Timing:</i>	
<i>Appropriate Removal Timing:</i>	

3) Phase Construction Activity and BMP Implementation

This section shall describe the relationship between the phases of construction, and the implementation and maintenance of BMP controls and measures. For example, indicate which controls will be implemented during each of the following phases of construction: prior to clearing and grubbing for perimeter controls (installation of initial BMPs), clearing and grubbing, overlot grading, installation of interim BMPs, site construction, utility construction, vertical construction, other pertinent construction phases, final grading, stabilization, removal of BMPs, and Permit closeout.

- Clearly describe the various phases of construction and the implementation of BMPs to be used during each phase. Examples of project phases may include, but are not limited to, demolition, clearing and grubbing, overlot grading, over-excavation, road construction, utility installations, vertical construction, fine grading, and final stabilization. The description for a particular phase may have sub-phases. For example, the overlot grading of an 80 acre site may have to describe multiple sub-phases for the 40 acre disturbance limitation. Another example would be vertical construction phase may describe sub-phases of the construction such as grading, foundations, framing, finishing, and stabilization. For more information, see *Rules and Regs*, Chapter 2, Section 2.2.1)

Note: Some construction information may need to be added once a contractor(s) are involved. See the Manual and below for more information.

Phase Description: Drill Pad and Access Road Construction - Initial/Interim

<i>Duration of phase (start/end dates):</i>	Start Q2-2024. End TBD. Some of the Erosion Control BMP measures proposed in this phase will permeate through to the Final phase. Refer to the SWMP Plans.
<i>BMPs Associated with the Phase:</i>	Limits of Construction (LOC), Vehicle Tracking Control (VTC), Sediment Control Log (SCL), Erosion Control Blanket (ECB), Sediment Basin (SB), Diversion Ditches (DD), Seeding & Mulching (SM), Inlet Protection-Culvert (IPC), Outlet Protection (OP), Rip-Rap Apron (RRA).
<i>Describe Temp/Final Stabilization for Phase:</i>	Prior to commencing grading, the LOC will be defined and the VTC will be installed. The SB and DD will be constructed and RRA installed at ditch outlets downstream. Topsoil will be stripped and stockpiled. Grading will commence for the well pad site. SCL and ECB will be installed. IPC and OP will be installed on the culverts. SM will be applied to disturbed areas.

Phase Description: *Interim Reclamation to Production Operations - Final*

<i>Duration of phase (start/end dates):</i>	Start Q2-2025. End TBD.
<i>BMPs Associated with the Phase:</i>	Limits of Construction (LOC), Vehicle Tracking Control (VTC), Sediment Control Log (SCL), Erosion Control Blanket (ECB), Extended Detention Basin (EDB), Diversion Ditches (DD), Seeding & Mulching (SM).
<i>Describe Temp/Final Stabilization for Phase:</i>	Prior to commencing grading, the LOC will be defined and the VTC will be installed. Grading will commence for the reclamation of the pad site. The EDB will be constructed and DD will tie into existing DD. SCL and ECB will be installed. SM will be applied to disturbed areas.

Phase Description:

<i>Duration of phase (start/end dates):</i>	
<i>BMPs Associated with the Phase:</i>	
<i>Describe Temp/Final Stabilization for Phase:</i>	

Phase Description:

<i>Duration of phase (start/end dates):</i>	
<i>BMPs Associated with the Phase:</i>	
<i>Describe Temp/Final Stabilization for Phase:</i>	

a. **Overlot Grading Specific Practices**

Overlot grading specific practices should address items such as: surface roughening, blanketing, terracing, mulching, temporary seeding, permanent seeding, temporary sediment pond construction and removal, phasing, haul routes, disturbance limits, rough cut street controls, etc.

- Address haul routes may be designated on the SWMP updates and shall take into consideration drainage, erosion and sediment control BMPs, along with interim stabilization measures.

BMP Description: Clearing, Grubbing, and Grading

<i>Intended Use/Purpose:</i>	Refer to the SWMP for Limits of Construction (LOC). Install VTC and sediment control logs (SCL) as indicated on the drawings. Construct SB and DD prior to grading. Disturbed areas shall be stabilized with SM and/or ECB within 30 days of disturbance.
<i>Appropriate Installation Timing:</i>	Initial.
<i>Appropriate Removal Timing:</i>	Once construction activities are complete and stabilization has been established.

BMP Description: Scraping and Sweeping (SS)

<i>Intended Use/Purpose:</i>	SS of roadways will occur to remove mud tracking whenever mud is tracked onto a public or private roadway.
<i>Appropriate Installation Timing:</i>	As needed.
<i>Appropriate Removal Timing:</i>	N/A

- Discuss interim stabilization may be provided via plan amendment by the contractor and the engineer at the Erosion Control Kick Off meeting. These measures shall be provided with timeframes and down gradient controls.

BMP Description: Control Practices for Cleared Vegetation

<i>Intended Use/Purpose:</i>	Remove only what is needed; leave native vegetation in place when possible. Compost vegetation in designated topsoil stockpile areas.
<i>Appropriate Installation Timing:</i>	Initial
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: Erosion and Sediment Control

<i>Intended Use/Purpose:</i>	<p>Soil Stabilization Practices (During Construction): Where significant ground cover exists on-site, it will be left in place, if possible, or removed just prior to grading. Any disturbed areas which are not seeded and mulched within 30 days shall be stabilized with surface roughening. All temporary erosion control measures like SCL and IPC shall be monitored on a periodic basis and after any significant storm event. Any damages incurred to erosion control measures shall be repaired immediately, and any accumulated sediment shall be removed and disposed of properly.</p> <p>Soil Stabilization Practices (Post Construction): Permanent stabilization shall be installed as soon as possible construction is completed. The stabilization will consist of applying SM to the disturbed areas. SCL and ECB shall be kept in place after construction and allowed to degrade naturally.</p>
<i>Appropriate Installation Timing:</i>	Initial/Interim and Final/Post-Paving
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: Revegetation (Stabilization)

<i>Intended Use/Purpose:</i>	Utilize stripped topsoil in order to optimize the chances of seeded and mulched areas to readily revegetate. Final stabilization is achieved once all disturbed areas have been graveled or seeded (stands of vegetation are 70% of pre-construction density).
<i>Appropriate Installation Timing:</i>	Initial/Interim and Final/Post-Paving
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: Control Practices for Wind Erosion

<i>Intended Use/Purpose:</i>	Wind erosion shall be controlled on the site by periodic sprinkling with water and other appropriate means.
<i>Appropriate Installation Timing:</i>	As needed.
<i>Appropriate Removal Timing:</i>	N/A

Temporary drainage BMPs (diversion ditches, sediment traps or sediment basins) shall be maintained at all times.

- Discuss timing and procedural requirements for implementation, maintenance and removal of these items during this period of construction.

BMP Description: Sediment Basin (SB)

<i>Intended Use/Purpose:</i>	SB are utilized as a runoff detention facility, at the downstream termination of diversion ditches, that capture sediment laden runoff and releases it slowly, providing detention time to facilitate the settling of soil and suspended particles.
<i>Appropriate Installation Timing:</i>	Initial, before grading work begins.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description: *Diversion Ditches (DD)*

<i>Intended Use/Purpose:</i>	DD are small earthen swales used to divert and convey runoff, usually to a sediment basin, trap, or detention basin.
<i>Appropriate Installation Timing:</i>	Initial/Interim and Final/Post-Paving, before grading work begins.
<i>Appropriate Removal Timing:</i>	N/A

BMP Description:

<i>Intended Use/Purpose:</i>	
<i>Appropriate Installation Timing:</i>	
<i>Appropriate Removal Timing:</i>	

b. Vertical and General Construction Requirements – See Appendix for Table of Required Information

- Staging areas change during construction regularly. Therefore, if “con/conex” boxes are to be utilized and if they are to include liquid pollutants, then a redundant BMP measure must be provided
- Site drainage will need to be maintained during vertical construction. Review conditions to ensure that it will continue to work as shown during the grading/utility timeframes.
- Provide redundant BMPs for generators and mobile concrete washouts to protect from fuel/hydraulic leaks
- Continuously review the down gradient BMPs within the impervious and disturbed areas to ensure that conveyances, inlets and outlets are protected appropriately during this phase.
- Areas of disturbance outside of the building envelope shall still require BMPs.
- Continuously review the timing/phasing of the project to ensure the appropriate BMPs are implemented as construction continues. Deletion of BMPs shall require different measures to be implemented upon deletion.

- BMPs for keeping impervious surfaces clean may need to be enhanced or added to as construction continues.
- Review and implement BMP measures to control roof drainage. This becomes a point source and may cause extensive erosion on site.

Optional Section – To be included if the items in bullet points cannot be addressed elsewhere in this report.

A Plan Amendment from the contractor shall be required to be submitted to the engineer of record and City of Aurora Water Engineering Plans Reviewer three (3) business days prior to the Erosion Control Kick-Off Meeting. This submittal shall provide narrative information and the associated details required for vertical construction BMPs (structural and non-structural) that will be implemented during this phase of construction.

- Provide a mixing station detail/area for masonry/brick. If the site is going to bring in silos for masonry mixing, wind protection will be required to minimize the maximum extent practicable the dust from impacting adjacent buildings and streets.
- Saw cutting station detail/area
- Options for handling paints, solvents, glues (i.e. utilize the CWS or provide alternative)
- Provide physical and procedural BMPs for clean up along the building during the installation of brick, stone or stucco
- Access may be required around the building, defining a haul route may be necessary and denote stabilization needs on this proposed haul route
- Address waste handling procedures for drywall, painters, carpet layers etc.
- Stream Diversion Method
- Cranes when access is required around the building and may impact BMPs, relocation may be required

4) *Material Handling and Spill Prevention*

This section shall describe any procedures and locations for all practices implemented at the site that will be used to minimize impacts from identified potential pollutant sources. BMPs need to address many different pollutant sources that include, but are not limited to exposed storage of construction materials, liquid contaminants, contaminated soils management, fueling procedures, redundant measures for any spill or leak sources, and equipment maintenance procedures. Activities involving potential for spills shall have spill prevention and spill response procedures identified.

- Identify and describe how the sources of potential pollutants to stormwater discharges identified in Section 3.2 will be controlled through BMP selection and implementation. The

information provided may address frequency, seasonal considerations, characteristics of the area and surface type, primary and secondary containment, proximity to drainageways and stormwater facilities.

BMP Description: MSDS

<i>Intended Use/Purpose:</i>	All chemical substances used in the work place shall be listed with the reportable quantity of each, and the Material Safety Data Sheet (MSDS) obtained for each. The MSDS will be readily available for use; i.e. posted at the location where the materials are stored and handled. All containers shall be labeled to show the name and type of substance, stock number, expiration date, health hazards, including reactivity, corrosivity, ignitability and toxicity, suggestion for handling, and first aid information. (This information can usually be found on the MSDS.)
<i>Location(s)</i>	Instructions and material/equipment for spill cleanup procedures shall be readily available on the construction site. This includes notification of the appropriate agency or department; i.e. downstream water users, SWMP Manager, Colorado Department of Health, etc.

BMP Description: Good Housekeeping Practices

<i>Intended Use/Purpose:</i>	The contractor is responsible to maintain good housekeeping practices on the construction site. This includes the following: <ul style="list-style-type: none">• Garbage/trash/construction debris shall be removed on a regular basis.• Washing of equipment into existing drainageways is prohibited.• Proper cleanup procedures shall be used for spilled materials.• Cleanup of drips or leaks from equipment or machinery at the site.• Minimizing the amount of unneeded material stored on-site.• Mark locations for spill cleanup equipment and materials.• Fertilizers and other chemicals are applied only in the quantity required.• Portable toilet facilities are properly maintained and properly secured.• Storage containers, drums, and bags shall be stored away from direct traffic routes to prevent accidental spills.• Containers shall be stored on pallets or similar devices to prevent corrosion of the containers.
<i>Location(s)</i>	Site Wide.

BMP Description: SPILL RESPONSE -Cleanup and Removal Procedures

NOTE: IN CASE OF FIRE, EVACUATE ALL PERSONNEL FROM THE IMMEDIATE AREA, RENDER FIRST AID TO ANYONE WHO IS INJURED, AND DIAL 911 IMMEDIATELY. TAKE APPROPRIATE STEPS TO PROTECT HUMAN LIFE AND TO CONTROL FIRES FIRST. SPILL CONTROL IS SECONDARY.

- Upon detection of any spill, the first action to be taken is to ensure personal safety. All possible ignition sources, including running engines, electrical equipment (including cellular telephones, etc.), or other hazards will be immediately turned off or removed from the area. The extent of the spill and the nature of the spilled material will be evaluated to determine if remedial actions could result in any health hazards, escalation of the spill, or further damage that would intensify the problem. If such conditions exist, a designated employee will oversee the area of the spill and the construction SWMP Administrator will be notified immediately.

- The source of the spill will be identified and if possible the flow of pollutants stopped if it can be done safely. However, no one should attend to the source or begin cleanup of the spill until **ALL** emergency priorities (fire, injuries, etc.) have been addressed.

Small Spills

Small spills (usually <5 gallons) consist of minor quantities of gasoline, oil, anti-freeze, or other materials that can be cleaned up by a single employee using readily available materials.

The following procedures should be used for clean-up of small spills:

- a. Ensure personal safety, evaluate the spill, and if possible, stop the flow of pollutants.
- b. Contain the spread of the spill using absorbents, portable berms, sandbags, or other available measures.
- c. Spread absorbent materials on the area to soak up as much of the liquid as possible and to prevent infiltration into the soil.
- d. Once the liquids have been absorbed, remove all absorbents from the spill and place the materials in a suitable storage container. On paved areas, wipe any remaining liquids from the surface and place the materials in a storage container. Do not spray or wash down the area using water. For open soil areas, excavate any contaminated soil as soon as possible and place the soil in a suitable storage container. All materials will then be transported off-site for disposal.
- e. If immediate transfer and storage of the contaminated soil is not practical, excavate and place the contaminated soil on a double thickness sheet of 3-mil or higher polyethylene film. In addition, a small berm should be formed around the outer edges of the soil stockpile, underneath the polyethylene film, to ensure that contaminants are not washed from the site during precipitation events and that materials do not seep through the berm.
- f. Record all significant facts and information about the spill, including the following:
 - Type of pollutant
 - Location
 - Apparent source
 - Estimated volume
 - Time of discovery
 - Actions taken to clean up spill
- g. Notify the SWMP Administrator of the spill and provide the information from Item f. The SWMP Administrator will then contact the City of Aurora Erosion Control Staff.

Medium to Large Spills

Medium to large spills consist of larger quantities of materials (usually >5 – 25 gallons) that are used on site that cannot be controlled by a single employee. Generally, a number of facility personnel will be needed to control the spill and a response may require the suspension of other facility activities.

The following procedure shall be used for the cleanup of medium to large spills:

- a. Ensure personal safety, evaluate the spill, and if possible, stop the flow of pollutants.
- b. Immediately dispatch a front-end loader or similar equipment to the spill and construct a berm or berms down gradient of the spill to minimize the spread of potential pollutants. On paved surfaces, portable berms, sandbags, booms, or other measures will be used to control the lateral spread of the pollutants.
- c. When the spread of the spill has been laterally contained, contact the SWMP Administrator or designated facility employee and provide them information on the location, type, and amount of spilled material, and a briefing on the extent of the spread and measures undertaken to contain the contaminants.
- d. Depending on the nature of the spill, mobilize additional resources as needed to contain the contaminants.
- e. Cleanup will commence when the lateral spread has been contained and the notification to the SWMP Administrator has been made.
- f. Freestanding liquid will be bailed or pumped into 55-gallon storage drums, steel tanks, or other suitable storage containers. When all the liquid has been removed from the pavement or soil layer, absorbents will be applied to the surface and transferred to the storage containers when they have soaked up as much of the spill as possible.
- g. On paved surfaces, the remaining contaminants will be removed to the extent possible, with rags, sweeping, or similar measures. The area of the spill will not be sprayed or washed down using water. Any contaminant soaked materials will be placed into the storage containers with the other absorbents.
- h. The remaining contaminated soils will be excavated and loaded into a dump truck(s) for disposal off-site at a designated facility. If transport off-site is not immediately available, the remaining soils will be stockpiled on a double thickness sheet of 3-mil or higher polyethylene film. In addition, a small berm will be formed around the outer edges of the soil stockpile, underneath the polyethylene film, to ensure that contaminants are not washed from the site during precipitation and do not seep through the berm.
- i. Record all significant facts and information about the spill, including the following:
 - Type of pollutant
 - Location
 - Apparent source
 - Estimated volume
 - Time of discovery
 - Actions taken to clean up spill
- j. Provide the SWMP Administrator (or designated employee) with the information from Item i. The SWMP Administrator will then contact the City of Aurora Flow Control Center.

NOTIFICATION

Notification to the Colorado Department of Public Health & Environment (CDPHE) and the City of Aurora is required if there is any release or suspected release of any substance, including oil or other substances that spill into or threaten State waters. Unless otherwise noted, notifications are to be made by the SWMP Administrator and only after emergency responses related to the release have been implemented. This will prevent misinformation and assures that notifications are properly conducted.

The notification requirements are as follows:

1. **Spills into/or Threatens State Waters:** Immediate notification is required for releases that occur beneath the surface of the land or impact or threaten waters of the State of threaten the public health and welfare. Notifications that will be made are:
 - a. For any substance, regardless of quantity, contact CDPHE at 1-877-518-5608. State as follows:
 - a) Give your name.
 - b) Give location of spill (name of city).
 - c) Describe the nature of the spill, type of products, and estimate size of spill.
 - d) Describe type of action taken thus far, type of assistance or equipment needed.
 - b. For any quantity of oil or other fluids, call the National Response Center at 1-800-424-8802. State as follows:
 - a) Give your name.
 - b) Give location of spill (name of city and state).
 - c) Describe the nature of the spill, type of product, and estimate size of spill.
 - d) Describe type of action taken thus far, type of assistance or equipment needed.
2. **Reportable Quantity Spill on Land Surface:** Immediate notification is required of a release upon the land surface of an oil in quantity that exceeds 25 gallons, or of a hazardous substance that equals or exceeds 10 pounds or its reportable quantity under Section 101(14) of the Comprehensive Environmental Response, Compensation Liability Act (CERCLA) of 1980 as amended (40 CFR Part 302) and Section 329 (3) of the Emergency Planning and Community Right to Know Act of 1986 (40 CFR Part 355) whichever is less. This requirement does apply at a minimum to the substances listed in Table A below.

TABLE A

Substances Requiring Notification

SUBSTANCE	REPORTABLE QUANTITY
Motor Oil	25 Gallons
Hydraulic Oil	25 Gallons
Gasoline/Diesel Fuel	25 Gallons

The notification procedures to be followed are:

April 17, 2024

Template Version 1.2

- a) Give your name.
 - b) Give location of spill (name of city and state).
 - c) Describe nature of the spill, type of product, and estimate size of spill.
 - d) Describe type of action taken thus far, type of assistance or equipment needed.
3. Notification is not required for release of oil upon the land surface of 25 gallons or less that will not constitute a threat to public health and welfare, the environment or a threat of entering the waters of the State.
 4. Notification, as required in paragraphs 1 and 2 above, will be made to the CDPHE using the 24-hour telephone number to report environmental spills. All information known about the release at the time of discovery is to be included, such as the time of occurrence, quantity and type of material, location and any corrective or clean-up actions presently being taken. Table B lists these phone numbers.

SPILL RESPONSE CONTACTS

TABLE B

Emergency Notification Contacts

Name/Agency	Number
City of Aurora Fire Department	911
City of Aurora Police Department	911
Ambulance	911
Hospital	911
National Response Center	1-800-424-8802
CDPHE – Report Environmental Spills (24 hrs/day)	1-877-518-5608
City of Aurora – Water Dept Erosion Control Staff	303-326-8645
Colorado Emergency Planning Committee	303-273-1622
Also contact SWMP Administrator and Owner	See Section 3 a) of this report

It is the responsibility of the SWMP Administrator to contact the City of Aurora, CDPHE, and/or the National Response Center.

- **The National Response Center** is to be contacted when a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR 110, 4- DFR 117, or 40 CFR 302 occurs during a 24-hour period.
- Notification to the **CDPHE** and **COA** is required if there is any release or suspected release of any material, including oil or hazardous substances that spill into or threaten state waters.

REPORTS

The CDPHE and COA require written notification of a spill or discharge of oil or other substance that may cause pollution of the waters of the State of Colorado. A written report must be submitted to the Water Quality Control District (WQCD) and the COA Erosion Control Staff within five days after becoming aware of the spill or discharge.

The CDPHE and COA require a written final report within 15 days for all releases of an oil or hazardous substance that require implementation of a contingency plan. The CDPHE and COA may also require additional reports on the status of the clean up until any required remedial action has been complete.

Written notification of reports must contain at a minimum:

1. Date, time, and duration of the release.
2. Location of the release.
3. Person or persons causing and responsible for the release.
4. Type and amount of oil or substance released.
5. Cause of the release.
6. Environmental damage caused by the release.
7. Actions taken to respond, contain, and clean up the release.
8. Location and method of ultimate disposal of the oil or other fluids.
9. Actions taken to prevent a reoccurrence of the release.
10. Any known or anticipated acute or chronic health risks associated with the release.
11. When appropriate advice regarding medical attention necessary for exposed individuals.

5) *Dedicated Concrete or Asphalt Batch Plants*

- Describe measures to control stormwater pollution from dedicated concrete batch plants or dedicated asphalt batch plants covered by the SWMP.

[There are no dedicated concrete or asphalt batch plants for this site.](#)

6) *Vehicle Tracking Control*

- Describe all practices implemented at the site to control potential sediment discharges from vehicle tracking. Practices must be implemented for all areas of potential vehicle tracking, and can include: minimizing site access; street sweeping or scraping; tracking pads; stabilized staging and parking areas; requiring that vehicles stay on paved areas on-site; wash racks; contractor education; and/or sediment control BMPs, etc

BMP Description: Mandatory sweeping of all internal and adjacent external paved areas is required on a weekly basis at a minimum. This applies until Initial Close-Out acceptance. At that time it will be on an as needed basis.

BMP Description: Vehicle Tracking Control (VTC)

<i>Location(s):</i>	At entrance/exit point for the site.
<i>Intended Use/Purpose:</i>	VTC consists of a pod of 3” to 6” angular rock at the entrance/exit point for the site that is intended to help strip mud from tires prior to vehicles leaving the construction site.
<i>Appropriate Installation Timing:</i>	Initial/Interim
<i>Appropriate Removal Timing:</i>	Upon completion of site grading and stabilization.

BMP Description: Scraping and Sweeping (SS)

<i>Location(s):</i>	At entrance/exit point for the site.
<i>Intended Use/Purpose:</i>	SS of roadways will occur to remove mud tracking whenever mud is tracked onto a public or private roadway.
<i>Appropriate Installation Timing:</i>	As needed.
<i>Appropriate Removal Timing:</i>	N/A

7) Waste Management and Disposal, Including Concrete Washout

- Clearly describe the practices implemented at the site to control stormwater pollution from all construction site wastes (liquid and solid), including concrete washout activities and liquid waste washouts, dumpsters, worker trash, and portable toilets.

BMP Description: Good Housekeeping Practices

<i>Locations</i>	Site Wide
<i>Appropriate Installation Timing:</i>	The contractor shall dispose of waste/trash regularly following good housekeeping practices. The contractor shall limit off-site soils tracking through the maintenance of the granular material access road. Solid materials, such as construction waste, shall be disposed of in dumpsters provided at the job site to ensure proper containment and prevention from contaminating downstream receiving waters. If dumpsters are not provided within the LOC, waste may be hauled off in construction vehicles.
<i>Appropriate Removal Timing:</i>	As needed.

8) BMP Specifications

BMP Details for installation and maintenance shall be the City of Aurora Standard Details in Appendix D of the (*City of Aurora Rules and Regulations Regarding Stormwater Discharge Associated with Construction Activities (Rules and Regs)*), latest revision, an approved variance, or an approved plan amendment. All approved variances must be documented in the SWMP. It is understood that not all details in the COA Rules and Regs will be used on this project site, but that all details are available for implementation if unforeseen circumstances warrant their use. Proper procedures must be used to update the living document and get approval as documented in the COA Rules and Regs. All physical BMPs require a detail to show installation and maintenance information. If a detail is not available through the manufacturer, then one must be created by the preparer of this SWMP narrative report.

9) Groundwater and Stormwater Dewatering

- The SWMP shall clearly describe the practices to be implemented at the site to control stormwater pollution from the dewatering of groundwater or stormwater from excavations, wells, etc.
- For any construction dewatering of stormwater from construction areas, describe the BMPs to be used to control additional erosion and transport of sediment.

Note: This City of Aurora Stormwater permit does not authorize dewatering of groundwater. A separate State permit is required for this activity.

Groundwater and Stormwater Dewatering is not anticipated to be necessary for this site.

10) Developer/Builder Specific Practices

Include a description of standard practices of the company for whom this SWMP is being developed. At a minimum it shall include:

- Standard practices for construction operations during wet weather conditions and winter weather conditions
- Methods used to obtain compliance from sub-contractors (i.e. fines, education, etc)
- Stormwater education policies for educating personnel and subcontractors
- Company Standard Operating Procedures as they relate to stormwater management (as appropriate)
- Describe any standard construction practices that will be used on the site such as material loading and unloading practices, lot controls, lot access etc.

Note: Any practices requiring a variance that are discussed here must reference the variance section, and must be requested in the variance section, or they will be considered unapproved and not allowed.

See Appendix G for Operator's Best Management Practices.

Additional Developer/Builder practices not listed herein shall be submitted 3 days prior to the Erosion Control kick-off meeting for review and approval.

SECTION 4 FINAL STABILIZATION AND LONG TERM STORMWATER MANAGEMENT

a) Final Stabilization Measures

Include a description of the proposed measures to be used to achieve final stabilization and long-term stormwater control. Revegetation with seeding and mulching, revegetation with seeding with erosion control blankets, landscaping, green roofs, permeable paving, permanent water quality ponds and permanent outlet protection are examples of final stabilization measures.

b) Seed Mix Information

Provide the name of the City of Aurora standard seed mix(es) that may be appropriate for the site and the soils anticipated for the site and the preferred method(s) for protecting the seed. If the site is not using a COA standard seed mix, then a variance request must be submitted and the preferred seed mix must be provided with the application rates.

c) Final Stabilization Notes

See Chapter 5 of the Rules and Regulations for more information.

- 1) *Final stabilization is reached when all soil disturbing activities at the site have been completed, and uniform vegetative cover has been established with a density of at least 70% of pre-disturbance levels, or equivalent permanent physical erosion reduction methods have been employed.*
- 2) *Vegetative coverage density does not apply to paved areas, walks, buildings, or other hard surface impermeable areas.*
- 3) *Establishment of a vegetative cover capable of providing the erosion control equivalent to pre-existing conditions at the site can be considered final stabilization (i.e. landscape rocks, mulch, shrubs, etc). This determination will be made by the City of Aurora Water Department Erosion Control Program Staff prior to the close-out of the permit.*

Management of storm water after completion of construction shall be accomplished by utilizing the practices listed below:

- Upon completion of well pad construction, the site shall be inspected to ensure that all equipment, waste materials, and debris have been removed.
- The site will be inspected to make certain that all disturbed surfaces have been prepared with amendments and stabilized with appropriate ground cover.
- All inlet protection, erosion control blanket, sediment control log and all other control practices and measures that are to remain after completion of construction will be inspected to ensure they are properly functioning.

- The contractor shall be responsible for maintaining the storm water controls in good working order and shall also be responsible for the costs incurred until such time as they are accepted by the City or no longer required, including removal of measures.
- The stockpiled topsoil shall be utilized in concert with a seeding and mulching application to return the landscape to its pre-existing condition. The contractor shall coordinate with the landowner to re-vegetate with plantings that consist of either native, short grass prairie or another species conducive to grazing.
- Vegetative ground cover is essentially a BMP and will be used as a final and permanent BMP measure. The contractor is required to maintain the new stabilization until vegetation is firmly rooted and a healthy growth has occurred. The State of Colorado Stormwater Division considers final stabilization when vegetative cover has been established with a uniform density of at least 70 percent of pre-disturbance levels or equivalent permanent erosion reduction methods have been installed. The Division may amend final stabilization criteria for specific operations after consultation with the permittee and upon good cause.
- Redistribution of topsoil will be accomplished using standard industry methods. The topsoil will be placed with adequate depth and uniformity. Care will be taken not to compact the topsoil unnecessarily. Care will be taken not to contaminate or mix topsoil with subsoil or other foreign matter during redistribution. Subsoil or subsurface will be prepared to accept topsoil, i.e. ruts, holes, will be bladed out to smooth shape before topsoil is redistributed.
- Standard location seeding will be accomplished following best industry practices. The site will be evaluated for plant community. In placed topsoil will be tilled, ripped, or disked dependent upon need. Recommendations for the seasons to plant, the City of Aurora seed mix to be used, and the re-vegetation method will be followed. Seeding will be accomplished by drilling. Seeding will be performed in conditions and seasons that are conducive to successful re-vegetation.

SECTION 5 INSPECTIONS AND MAINTENANCE

This section shall describe procedures to inspect and maintain, in good effective operating condition, the vegetation, erosion, and sediment control measures and all other protective measures identified in the plan.

The following are the required frequencies of inspections:

- i. *Prior to Initial Closeout Acceptance:* Permittee shall self-inspect the site at least every 7 calendar days and within 24-hours after the end of any precipitation event or snowmelt event that results in runoff and causes surface erosion, except as allowed in Item iii below.
 - ii. *Following Initial Closeout Acceptance and until permit closeout:* Permittee shall self-inspect the site at least every 30 calendar days, and within 24-hours after the end of any precipitation event or snowmelt event that results in runoff and causes surface erosion
 - iii. *Post-Precipitation Event Inspections for Temporarily Idle Sites:* If a site is temporarily idle and no construction activities will occur during the 48 hours following a storm event, the post-precipitation event (including snowmelt) inspection shall be conducted prior to commencing construction activities on the site, but no later than 72 hours following the storm event.
- Describe all other procedures necessary to inspect and maintain all BMPs on this site.

Note: Do not duplicate information that is provided in the COA Standard Details for Maintenance and Inspection.

The project site and the adjacent roads impacted by the construction shall be kept neat, clean and free of debris. The control measures and facilities will be maintained in good working order. Any items that are not functioning properly or are inadequate will be promptly repaired or upgraded. The site will be inspected by responsible personnel who are familiar with the site.

The Fluid Leak Detection Plan (FLDP) has additional guidelines for inspecting the equipment, and storage tanks / containers on the well pad. While those inspections are in addition to these required for stormwater, the FLDP defined inspections may identify potential pollutants to stormwater.

a. Inspection Schedules

Inspections of the construction site shall be conducted by the SWMP Manager (weekly or daily) and after all storm events or any precipitation or snowmelt event that causes surface erosion within twenty-four (24) hours when there is a construction activity. In cases where the well pad site has been constructed and the wells are being fracture stimulated, completed or pumped, post storm inspections can be made up to seventy-two (72) hours after the event. If more frequent inspections are required to ensure that BMPs are properly maintained and functioning, the inspection schedule must be modified to meet this need. This includes inspecting and maintaining all sediment and erosion controls.

b. Inspection Procedures

Inspection and monitoring will follow the procedures outlined below:

- Observation of the construction perimeter and discharge points, all disturbed areas, areas used for material / waste storage that are exposed to precipitation, other areas determined to have a significant potential for stormwater pollution, and site access points, erosion and sediment control measures and BMPs.
- Identification of equipment that should be inspected.
- Appropriate and timely maintenance, repair or replacement of control measures and equipment.
- Maintenance of complete records on inspections, equipment, and systems.
- Potential for pollutants to discharge from the project site.
- Evaluating preventive measures to insure they are adequate, operational and have been properly implemented.
- Determining if additional control measures will need to be implemented.
- Updating this SWMP if new measures are implemented or existing controls are deleted. This may be accomplished by creating hand written markups to the maps by an appropriate authority.

c. BMP Maintenance / Replacement and Failed BMPs

Site inspections shall identify BMPs that are found to no longer function as needed or designed. The SWMP Manager shall develop a preventive maintenance program that proactively maintains and replaces BMPs. Such maintenance practices may include removal of accumulated sediment from sediment control logs, sediment traps and diversion ditches. Said sediment should be moved to a location where it will not be another pollutant source. Sediment control logs that become laden with sediment should be replaced as soon as they are no longer functioning as intended. BMPs that have failed or have the potential to fail without maintenance or modification must be addressed as soon as possible, immediately in most cases, to prevent the discharge of pollutants. Maintenance activities should be logged as described in the following section, or in other appropriate records.

d. Record Keeping and Documenting Inspections

The contractor shall maintain a record keeping system of construction activities with respect to SWMP. The permittee must document inspection results and maintain a record of the results for three (3) years following expiration or inactivation of permit coverage. Each inspection report shall document: the inspection date, name(s) and title(s) of inspector and if applicable, location(s) of discharges of sediment or other pollutants from the site, location(s) of BMPs that need to be maintained, location(s) of BMPs failed to operate as designed or proved to be inadequate for a particular location, location(s) where additional BMPs are needed that were not in place at the time of inspection, deviations from minimum inspection schedule, and description of corrective actions including dates. In cases where the site is in compliance, the report shall indicate that the site does not need corrective action.

The following list of activities and information shall be recorded in a SWMP inspection log book to be kept at the jobsite:

- A record of spills, leaks, or overflows, including time and date, weather conditions, reason for the spill, etc. A release of any chemical, oil, petroleum product, sewage, etc. which may enter

waters of the State of Colorado must be reported to the Water Quality Control Division 1-877-518-5608.

- Implementation of specific items in the SWMP.
- Training events (given or attended).
- Events involving material storage and handling.
- Contacts with regulatory agencies and personnel.
- Notes of employee activities, contact, notifications, etc.
- Maintenance and repair of stormwater management controls.
- Preventive maintenance activities.
- Inspection reports.
- Dated photographs.
- Field notebooks.
- Drawings and maps.

SECTION 6 PROBABLE COST FOR INSTALLATION OF BMPs

The standardized probable cost form shall include costs for required maintenance during the construction phase and shall establish the required Fiscal Security amount.

*Notes: City of Aurora projects do not require Fiscal Security, unless otherwise required.
The Forms should be located in the Appendix of this SWMP narrative report.*

- List the total cost and the Fiscal Security amount, which is equal to the 25% Maintenance Cost amount of the higher of the two forms.

Initial BMP Total Cost:	\$	88810
Initial BMP Maintenance Cost:	\$	17762
Post-Paving BMP Total Cost:	\$	33107
Post-Paving BMP Maintenance Cost:	\$	6622
Fiscal Security amount:	\$	17762

SECTION 7 CALCULATIONS MADE FOR THE DESIGN

Include calculations made in the design of the SWMP, including calculations for sizing of sediment basins, design of erosion control matting, soil retention matting, sediment traps, diversion ditches, temporary stream crossings, weir sizing, or sizing of outlet protection riprap in the appendix with a summary of the results below.

- Address any required additional information below.

[SEE APPENDIX D FOR APPLICABLE CALCULATIONS](#)

SECTION 8 VARIANCE REQUESTS

As may be reasonably required by COA, additional information shall be included here. A listing of variances requested and/or requests for special consideration of innovative BMPs should be provided along with their justification.

Any variance from COA Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities shall be approved by the City of Aurora. If it is not specifically listed within this section of the narrative, then it shall not be considered an approved variance. There are provisions for Variance requests once construction has begun. See Chapter 3 Section 3.3.3 of the Rules and Regulations. In such cases the City of Aurora approved variance shall be added to the field maintained SWMP.

Note: Manufacturer documentation and specifications for requested variances shall be provided in the appendices. If no detail is provided for a physical BMP, the request for variance will automatically be denied.

- List all Variances being requested

1. The proposed development is seeking a variance from the standard requirements of the City of Aurora SDDTC to not include a drainage easement around the EDB. The variance is requested due to adherence to the City of Aurora Oil & Gas Manual, and to provide an alternative to this requirement through detailed maintenance obligations on the part of GMT. Right-of-Way for ingress and egress for service and emergency vehicles and personnel is granted over, across, on and through any and all private roads and ways, now and hereafter established on the Invicta 3-65-28 oil & gas well site.

[Add additional sections here to meet requirements of other regulations]

REFERENCES

References should include the drainage report, the COA Rules and Regs, and the CDPHE permit at a minimum. Other relevant references may be included.

Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities, current revision

Colorado Department of Public Health and Environment CDPS General Permit – Stormwater Discharges Associated with Construction Activity, current revision to expire June 30, 2012.

[Final Drainage Report for Invicta 3-65-28 \(EDN: TBD\)](#)

[COA Rules and Regulations Regarding Stormwater Discharges Associated with Construction Activities, most recent edition](#)

[CDPHE - CDPS General Permit COR400000 Stormwater Associated with Construction Activities, Certification Number COR412020](#)

[City of Aurora – Storm Drainage Design and Technical Criteria, dated September 2010.](#)

[Mile High Flood District \(Urban Drainage and Flood Control District\) – Urban Drainage Criteria Manual, Vols I-III, most recent edition.](#)

[AECOM, \(May 5, 2023\), “Master Drainage Plan”, RSN 1429068](#)

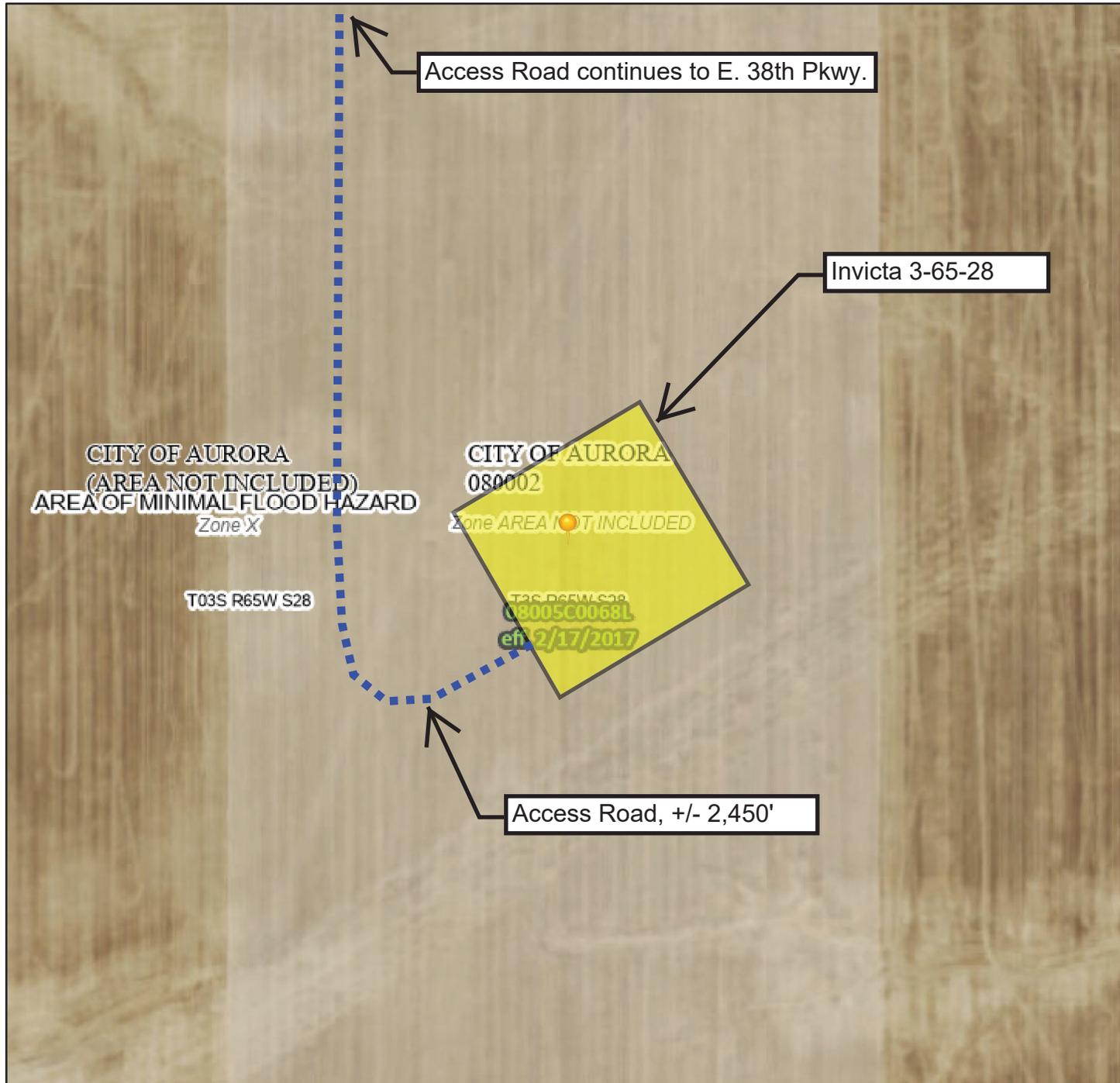
[AECOM, \(November 2, 2023\), “ATEC Invicta Pad SWMP”, EDN 223288](#)

SWMP APPENDIX A – Floodplain Information

National Flood Hazard Layer FIRMMette



104°40'26"W 39°46'6"N



Legend

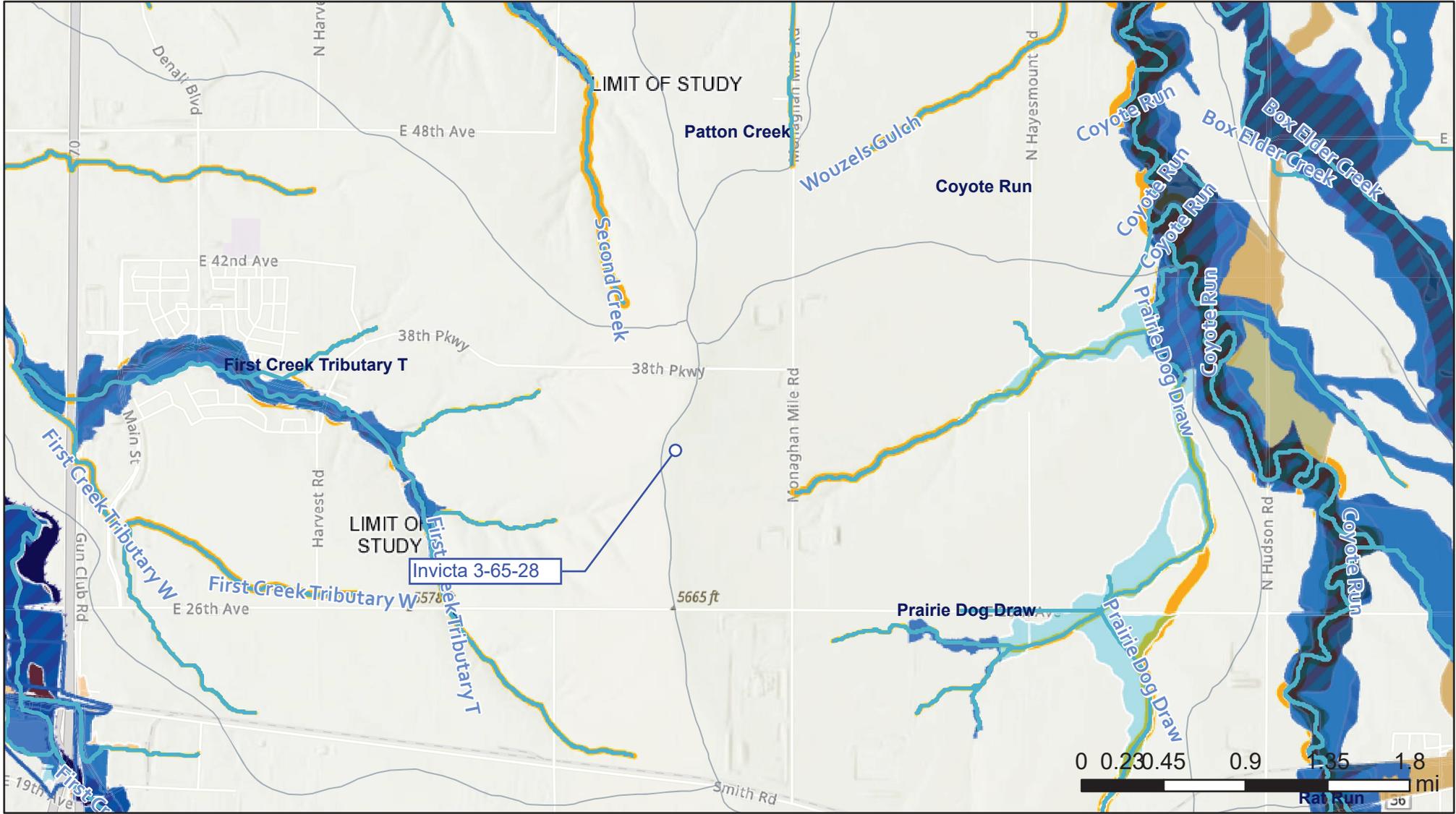
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **2/23/2023 at 8:20 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



Exported from MHFD's
Web Map
on 6/16/2023

- Watershed Delineation
- MHFD Streams

MHFD Floodplains (Non-FEMA)

- Floodway
- 100-Year Shallow Flooding
- 100-Year Floodplain (1% Annual Chance)
- 500-Year Floodplain (0.2% Annual Chance)

- Floodway
- 100-Year Shallow Flooding
- 100-Year Floodplain (1% Annual Chance)
- 500-Year Floodplain (0.2% Annual Chance)

- Effective Effective
- Levees

Flood Hazard Boundaries

- Limit Lines
- SFHA / Flood Zone Boundary

SWMP APPENDIX B – Soils Information



A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Adams County Area, Parts of Adams and Denver Counties, Colorado

INVICTA 3-65-28



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

Custom Soil Resource Report

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

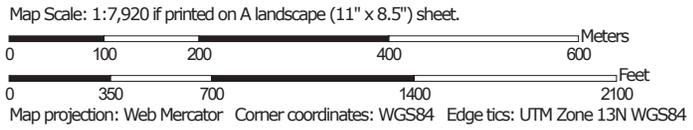
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

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 1:20,000.

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: Adams County Area, Parts of Adams and Denver Counties, Colorado
 Survey Area Data: Version 20, Aug 24, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AcC	Adena-Colby association, gently sloping	18.7	98.2%
PIC	Platner loam, 3 to 5 percent slopes	0.4	1.8%
Totals for Area of Interest		19.1	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

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onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Adams County Area, Parts of Adams and Denver Counties, Colorado

AcC—Adena-Colby association, gently sloping

Map Unit Setting

National map unit symbol: 34vg
Elevation: 4,000 to 5,600 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 48 to 55 degrees F
Frost-free period: 120 to 160 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Adena and similar soils: 40 percent
Colby and similar soils: 30 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Adena

Setting

Landform: Plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from mixed

Typical profile

H1 - 0 to 4 inches: loam
H2 - 4 to 22 inches: silty clay loam
H3 - 22 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Description of Colby

Setting

Landform: Plains

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Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits derived from mixed

Typical profile

H1 - 0 to 5 inches: loam
H2 - 5 to 56 inches: loam
H3 - 56 to 60 inches: sandy clay loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Minor Components

Wiley

Percent of map unit: 25 percent
Ecological site: R067BY002CO - Loamy Plains
Other vegetative classification: LOAMY PLAINS (067XY002CO_1)
Hydric soil rating: No

Platner

Percent of map unit: 3 percent
Hydric soil rating: No

Weld

Percent of map unit: 2 percent
Hydric soil rating: No

PIC—Platner loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2tlmz
Elevation: 3,580 to 5,600 feet

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Mean annual precipitation: 13 to 19 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 140 to 165 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Platner and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Platner

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian deposits over calcareous tertiary alluvium

Typical profile

Ap - 0 to 6 inches: loam
Bt1 - 6 to 11 inches: clay
Bt2 - 11 to 20 inches: clay
Bk1 - 20 to 27 inches: clay loam
Bk2 - 27 to 37 inches: sandy clay loam
C - 37 to 80 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.1 to 1.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Minor Components

Wages

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear

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Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Stoneham

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

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SWMP APPENDIX C – Probable Cost Forms

PROBABLE BMP COST SHEETS

Standardized Probable Cost Spreadsheet for Initial BMPs

Project Name: INVICTA 3-65-28 (RSN 1794905)

Date: 4/11/2024

No.	BMP	ID	Unit	Installation Unit Cost	Initial / Interim Quantity	Initial / Interim Cost
1	Check Dam	CD	LF	\$ 24.00		\$ -
2	Compost Blanket	CB	SF	\$ 0.50		\$ -
3	Compost Filter Berm	CFB	LF	\$ 4.00		\$ -
4	Concrete Washout Area	CWA	EA	\$ 1,000.00		\$ -
5	Construction Fence	CF	LF	\$ 5.00		\$ -
6	Curb Socks	CS	EA	\$ 20.00		\$ -
7	Diversion Channel	DC	EA	\$ 2,000.00		\$ -
8	Diversion Dike	DD	LF	\$ 1.50	4655	\$ 6,982.50
9	Dewatering	DW	EA	\$ 600.00		\$ -
10	Erosion Control Blanket	ECB	SY	\$ 5.00	4625	\$ 23,125.00
11	Inlet Protection - All types	IP	EA	\$ 300.00	4	\$ 1,200.00
12	Outlet Protection	OP	EA	\$ 250.00	7	\$ 1,750.00
13	Reinforced Check Dam	RCD	LF	\$ 36.00		\$ -
14	Rock Socks	RS	LF	\$ 10.00		\$ -
15	Rough Cut Street Control	RCS	EA	\$ 50.00		\$ -
16	Sediment Basin	SB	CY	\$ 3.00	2050	\$ 6,150.00
17	Sediment Control Log	SCL	LF	\$ 3.00	2580	\$ 7,740.00
18	Sediment Trap	ST	EA	\$ 600.00		\$ -
19	Seeding & Mulching (Less than 10 Acres)	SM	AC	\$ 2,500.00		\$ -
	(Greater than 10 Acres)	SM	AC	\$ 1,500.00	10.4	\$ 15,600.00
20	Silt Fence	SF	LF	\$ 2.00		\$ -
21	Silt Fence - Reinforced	SF-R	LF	\$ 4.00		\$ -
22	Stabilized Staging Area	SSA	SY	\$ 2.00	500	\$ 1,000.00
23	Surface Roughening	SR	AC	\$ 600.00		\$ -
24	Temporary Slope Drain	TSD	LF	\$ 25.00		\$ -
25	Temporary Stream Crossing	TSC	EA	\$ 1,500.00		\$ -
26	Terracing	TER		\$ -		\$ -
27	Tree Protection Fencing	TP	LF	\$ 5.00		\$ -
28	Vehicle Tracking Control	VTC	EA	\$ 1,000.00	1	\$ 1,000.00
29	VTC with Wheel Wash	WW	EA	\$ 1,500.00		\$ -
30	Mobilization (required on all projects)	MB	LS	\$ 5,000.00	1	\$ 5,000.00
31	Pond Maintenance/Sediment Removal (Based on area tributary to the pond)	PM	AC	\$ 1,000.00		\$ -
32	Street Maintenance (Based on lane miles of streets within project and adjacent to project)	STM	LM	\$ 1,500.00	1	\$ 1,500.00
33	Other: _____			\$ -		\$ -
Subtotal Cost of Initial BMPs						\$ 71,047.50
34	Maintenance (required on all projects)		%	25% of Subtotal		\$ 17,761.88
Total Cost of Initial & Interim BMPs						\$ 88,809.38
Fiscal Security Amount						\$ 17,761.88

* For Temporary Batch Plant BMPs allow \$5000.00 in line 32.

** Fiscal Security required is the higher amount of either the Initial or the Post-Paving, not both.

PROBABLE BMP COST SHEETS

Standardized Probable Cost Spreadsheet for Post Paving BMPs

Projec INVICTA 3-65-28 (RSN 1794905)

Date: 4/11/2024

No.	BMP	ID	Unit	Installation Unit Cost	Initial / Interim Quantity	Initial / Interim Cost
1	Check Dam	CD	LF	\$ 24.00		\$ -
2	Compost Blanket	CB	SF	\$ 0.50		\$ -
3	Compost Filter Berm	CFB	LF	\$ 4.00		\$ -
4	Concrete Washout Area	CWA	EA	\$ 1,000.00	1	\$ 1,000.00
5	Construction Fence	CF	LF	\$ 5.00		\$ -
6	Curb Socks	CS	EA	\$ 20.00		\$ -
7	Diversion Channel	DC	EA	\$2,000		\$ -
8	Diversion Dike	DD	LF	\$ 1.50		\$ -
9	Dewatering	DW	EA	\$ 600.00		\$ -
10	Erosion Control Blanket	ECB	SY	\$ 5.00		\$ -
11	Inlet Protection - All types	IP	EA	\$ 300.00		\$ -
12	Perimeter Erosion Control BMPs (Lot)	PC	EA	\$ 500.00		\$ -
13	Outlet Protection	OP	EA	\$ 250.00	1	\$ 250.00
14	Reinforced Check Dam	RCD	LF	\$ 36.00		\$ -
15	Rock Socks	RS	LF	\$ 10.00		\$ -
16	Sediment Basin	SB	CY	\$ 3.00		\$ -
17	Sediment Control Log	SCL	LF	\$ 3.00	895	\$ 2,685.00
18	Sediment Trap	ST	EA	\$ 600.00		\$ -
19	Seeding & Mulching (Less than 10 Acres)	SM	AC	\$ 2,500.00		\$ -
	(Greater than 10 Acres)	SM	AC	\$ 1,500.00	10.7	\$ 16,050.00
20	Silt Fence	SF	LF	\$ 2.00		\$ -
21	Silt Fence Reinforced	SF-R	LF	\$ 4.00		\$ -
22	Stabilized Staging Area	SSA	SY	\$ 2.00		\$ -
23	Surface Roughening	SR	AC	\$ 600.00		\$ -
24	Temporary Slope Drain	TSD	LF	\$ 25.00		\$ -
25	Temporary Stream Crossing	TSC	EA	\$ 1,500.00		\$ -
26	Terracing	TER		\$ -		\$ -
27	Tree Protection Fencing	TP	LF	\$ 5.00		\$ -
28	Vehicle Tracking Control	VTC	EA	\$ 1,000.00		\$ -
29	VTC with Wheel Wash	WW	EA	\$ 1,500.00		\$ -
30	Mobilization (required on all projects)	MB	LS	\$ 5,000.00	1	\$ 5,000.00
31	Pond Maintenance/Sediment Removal (Based on area tributary to the pond)	PM	AC	\$ 1,000.00		\$ -
32	Street Maintenance (Based on lane miles of streets within project and adjacent to project)	STM	LM	\$ 1,500.00	1	\$ 1,500.00
33	Other: _____			\$ -		\$ -
Subtotal Cost of Post Paving BMPs						\$ 26,485.00
34	Maintenance (required on all projects)		%	25% of Subtotal		\$ 6,621.25
Total Cost of Post Paving BMPs						\$ 33,106.25
Fiscal Security Amount						\$ 6,621.25

Note: Do not include costs for BMPs carried over from the Initial Plan, only new installations

* For Temporary Batch Plant BMPs allow \$5000.00 in line 32.

** Fiscal Security required is the higher amount of either the Initial or the Post-Paving, not both.

SWMP APPENDIX D – Calculations

UDFCD OPEN CHANNEL DESIGN WORKBOOK

Version 1.05 Released October 2013
Urban Drainage and Flood Control District
Denver, Colorado

HYDRAULIC CALCULATIONS DRILL PHASE DIVERSION DITCHES

Content:

The workbook consists of the following 13 sheets:

Basics Applies Manning's formula to analyze the normal flow condition, and applies Froude Number $Fr = 1.0$ to determine the critical flow condition.

Rating Produces a rating curve for a trapezoidal channel.

SP-Es Produces a specific energy curve for a given flow in a trapezoidal channel.

SP-Fs Produces a specific force curve for a given flow in a trapezoidal channel.

D-Step Applies the Direct Step Method to develop M1, M2, & S2 analyses

S-Step Applies the Standard Step Method to develop M1, M2, & S2 analyses

Channel Design Aids in designing a grass channel with drop structures.

SCS Retardance Employs the SCS vegetal retardance curves for types C and D grass-lined channels.

Riprap Aids in the design of a riprap-lined channel.

Composite Design Aids in designing a composite (two-stage) channel section.

Composite Analysis Aids in analyzing an existing composite (two-stage) channel section.

Steep Channel Aids in the design of concrete lined supercritical-flow channels.

Design Info Provides recommended Manning's n value guidance for low-flow section and overbanks in composite channels.

Acknowledgements: *Spreadsheet Development Team:*

Dr. James C.Y. Guo, P.E.

Professor, Department of Civil Engineering
University of Colorado at Denver

Ken A. MacKenzie, P.E., and Katie Farnum
Urban Drainage and Flood Control District

Wright Water Engineers, Inc.
Denver, Colorado

Comments? Direct all comments regarding this spreadsheet workbook to:

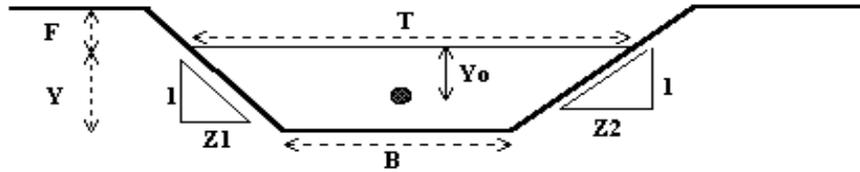
[UDFCD E-Mail](#)

Revisions? Check for revised versions of this or any other workbook at:

[Downloads](#)

Normal Flow Analysis - Trapezoidal Channel

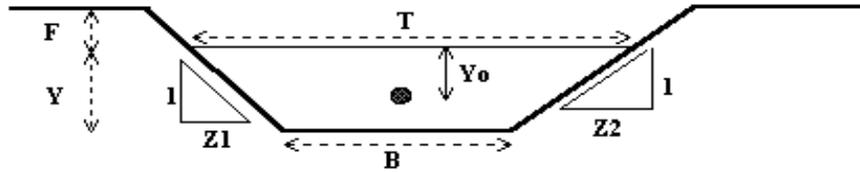
Project: **Invicta 3-65-28**
 Channel ID: **Pad Ditch 1 (Drill Phase) - Q100 = 8.15 cfs (Basin D Flow, DP 4)**



Design Information (Input)	
Channel Invert Slope	So = 0.0050 ft/ft
Manning's n	n = 0.025
Bottom Width	B = 2.00 ft
Left Side Slope	Z1 = 3.00 ft/ft
Right Side Slope	Z2 = 3.00 ft/ft
Freeboard Height	F = 1.25 ft
Design Water Depth	Y = 0.75 ft
Normal Flow Condition (Calculated)	
Discharge	Q = 8.15 cfs
Froude Number	Fr = 0.64
Flow Velocity	V = 2.56 fps
Flow Area	A = 3.19 sq ft
Top Width	T = 6.50 ft
Wetted Perimeter	P = 6.74 ft
Hydraulic Radius	R = 0.47 ft
Hydraulic Depth	D = 0.49 ft
Specific Energy	Es = 0.85 ft
Centroid of Flow Area	Yo = 0.31 ft
Specific Force	Fs = 0.10 kip

Normal Flow Analysis - Trapezoidal Channel

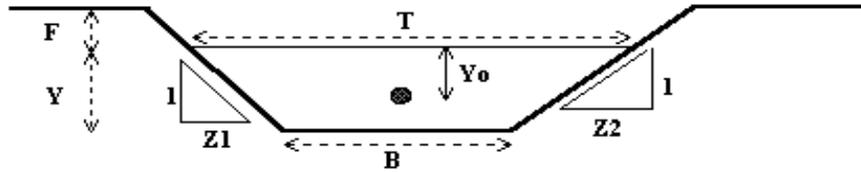
Project: **Invicta 3-65-28**
 Channel ID: **Pad Ditch 2 (Drill Phase) - Q100 = 1.10 cfs (Basin A Flow, DP 1)**



Design Information (Input)	
Channel Invert Slope	So = 0.0050 ft/ft
Manning's n	n = 0.025
Bottom Width	B = 2.00 ft
Left Side Slope	Z1 = 3.00 ft/ft
Right Side Slope	Z2 = 3.00 ft/ft
Freeboard Height	F = 1.73 ft
Design Water Depth	Y = 0.27 ft
Normal Flow Condition (Calculated)	
Discharge	Q = 1.10 cfs
Froude Number	Fr = 0.56
Flow Velocity	V = 1.46 fps
Flow Area	A = 0.75 sq ft
Top Width	T = 3.61 ft
Wetted Perimeter	P = 3.70 ft
Hydraulic Radius	R = 0.20 ft
Hydraulic Depth	D = 0.21 ft
Specific Energy	Es = 0.30 ft
Centroid of Flow Area	Yo = 0.12 ft
Specific Force	Fs = 0.01 kip

Normal Flow Analysis - Trapezoidal Channel

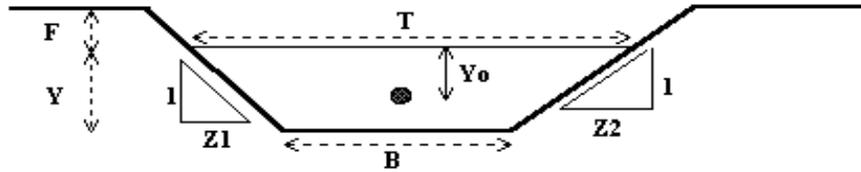
Project: **Invicta 3-65-28**
 Channel ID: **Pad Ditch 3 (Drill Phase) - Q100 = 8.71 cfs (Basin A+B Flow, DP 2)**



Design Information (Input)	
Channel Invert Slope	So = 0.0050 ft/ft
Manning's n	n = 0.025
Bottom Width	B = 2.00 ft
Left Side Slope	Z1 = 3.00 ft/ft
Right Side Slope	Z2 = 3.00 ft/ft
Freeboard Height	F = 1.23 ft
Design Water Depth	Y = 0.77 ft
Normal Flow Condition (Calculated)	
Discharge	Q = 8.71 cfs
Froude Number	Fr = 0.65
Flow Velocity	V = 2.60 fps
Flow Area	A = 3.35 sq ft
Top Width	T = 6.65 ft
Wetted Perimeter	P = 6.90 ft
Hydraulic Radius	R = 0.49 ft
Hydraulic Depth	D = 0.50 ft
Specific Energy	Es = 0.88 ft
Centroid of Flow Area	Yo = 0.32 ft
Specific Force	Fs = 0.11 kip

Normal Flow Analysis - Trapezoidal Channel

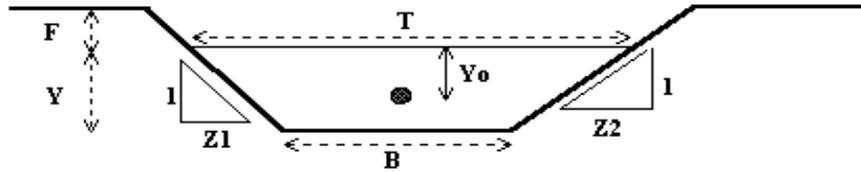
Project: **Invicta 3-65-28**
 Channel ID: **Offsite Ditch 1 (Drill Phase) - Q100 = 4.64 cfs (Basin OS-6 Flow, DP 13)**



Design Information (Input)	
Channel Invert Slope	So = 0.0050 ft/ft
Manning's n	n = 0.025
Bottom Width	B = 2.00 ft
Left Side Slope	Z1 = 4.00 ft/ft
Right Side Slope	Z2 = 4.00 ft/ft
Freeboard Height	F = 1.46 ft
Design Water Depth	Y = 0.54 ft
Normal Flow Condition (Calculated)	
Discharge	Q = 4.64 cfs
Froude Number	Fr = 0.62
Flow Velocity	V = 2.08 fps
Flow Area	A = 2.23 sq ft
Top Width	T = 6.30 ft
Wetted Perimeter	P = 6.43 ft
Hydraulic Radius	R = 0.35 ft
Hydraulic Depth	D = 0.35 ft
Specific Energy	Es = 0.60 ft
Centroid of Flow Area	Yo = 0.22 ft
Specific Force	Fs = 0.05 kip

Normal Flow Analysis - Trapezoidal Channel

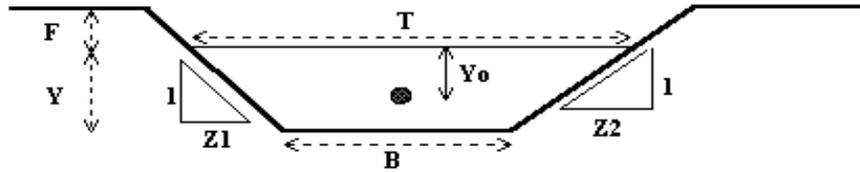
Project: **Invicta 3-65-28**
 Channel ID: **Offsite Ditch 2 (Drill Phase) - Q100 = 2.26 cfs (Basin OS-4 Flow, DP 11)**



Design Information (Input)	
Channel Invert Slope	So = 0.0050 ft/ft
Manning's n	n = 0.025
Bottom Width	B = 2.00 ft
Left Side Slope	Z1 = 4.00 ft/ft
Right Side Slope	Z2 = 4.00 ft/ft
Freeboard Height	F = 1.62 ft
Design Water Depth	Y = 0.38 ft
Normal Flow Condition (Calculated)	
Discharge	Q = 2.26 cfs
Froude Number	Fr = 0.59
Flow Velocity	V = 1.71 fps
Flow Area	A = 1.32 sq ft
Top Width	T = 5.01 ft
Wetted Perimeter	P = 5.11 ft
Hydraulic Radius	R = 0.26 ft
Hydraulic Depth	D = 0.26 ft
Specific Energy	Es = 0.42 ft
Centroid of Flow Area	Yo = 0.16 ft
Specific Force	Fs = 0.02 kip

Normal Flow Analysis - Trapezoidal Channel

Project: **Invicta 3-65-28**
 Channel ID: **Offsite Ditch 3 (Drill Phase) - Q100 = 2.78 cfs (Basin OS-4 + OS-5 Flow, DP 12)**



Design Information (Input)	
Channel Invert Slope	So = 0.0050 ft/ft
Manning's n	n = 0.025
Bottom Width	B = 2.00 ft
Left Side Slope	Z1 = 4.00 ft/ft
Right Side Slope	Z2 = 4.00 ft/ft
Freeboard Height	F = 1.58 ft
Design Water Depth	Y = 0.42 ft
Normal Flow Condition (Calculated)	
Discharge	Q = 2.78 cfs
Froude Number	Fr = 0.60
Flow Velocity	V = 1.81 fps
Flow Area	A = 1.53 sq ft
Top Width	T = 5.34 ft
Wetted Perimeter	P = 5.45 ft
Hydraulic Radius	R = 0.28 ft
Hydraulic Depth	D = 0.29 ft
Specific Energy	Es = 0.47 ft
Centroid of Flow Area	Yo = 0.18 ft
Specific Force	Fs = 0.03 kip

**DRILLING OPERATIONS
CULVERT CALCS**

HY-8 Culvert Analysis Report

Project Data

Project Title: INVICTA 3-65-28

Designer: UELS-cdc

Project Date: Monday, April 15, 2024

Project Notes: DRILLING OPERATIONS

Project Units: U.S. Customary Units

Outlet Control Option: Profiles

Exit Loss Option: Standard Method

Culvert Data: Culvert 1

Table 1 - Culvert Summary Table: Culvert 1

Discharge Names	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D
Q100	2.26 cfs	5637.46	0.75	2-M2c	0.54	0.52	0.52	0.30	3.46	2.41	0.4
EMERGENCY Q100	4.52 cfs	5637.83	1.09	2-M2c	0.78	0.75	0.75	0.42	4.22	2.92	0.6

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 5636.63 ft,

Outlet Elevation (invert): 5635.77 ft

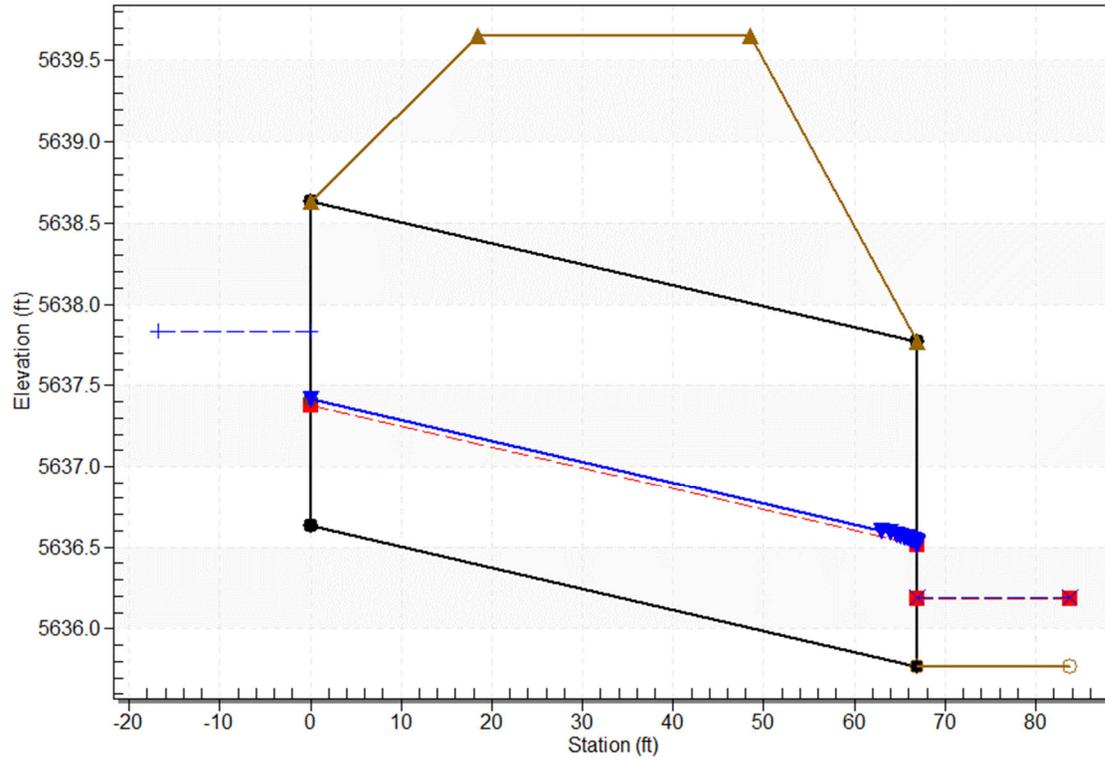
Culvert Length: 67.01 ft,

Culvert Slope: 0.0128

Water Surface Profile Plot for Culvert: Culvert 1

Crossing - CULVERT-1, Design Discharge - 4.5 cfs

Culvert - Culvert 1, Culvert Discharge - 4.5 cfs



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5636.63 ft

Outlet Station: 67.00 ft

Outlet Elevation: 5635.77 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240 (Table 3, COA 2010 SDDTC Manual)

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Tailwater Data for Crossing: CULVERT-1

Table 1 - Downstream Channel Rating Curve (Crossing: CULVERT-1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
2.26	5636.07	0.30	2.41	0.24	0.91
4.52	5636.19	0.42	2.92	0.34	0.96

Tailwater Channel Data - CULVERT-1

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 2.00 ft

Side Slope (H:V): 4.00 (.:1)

Channel Slope: 0.0130

Channel Manning's n: 0.0250

Channel Invert Elevation: 5635.77 ft

Roadway Data for Crossing: CULVERT-1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 18.00 ft

Crest Elevation: 5639.65 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

HY-8 Culvert Analysis Report

Project Data

Project Title: INVICTA 3-65-28

Designer: UELS-cdc

Project Date: Monday, April 15, 2024

Project Notes: DRILLING OPERATIONS

Project Units: U.S. Customary Units

Outlet Control Option: Profiles

Exit Loss Option: Standard Method

Culvert Data: Culvert 2

Table 1 - Culvert Summary Table: Culvert 2

Discharge Names	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D
Q100	1.10 cfs	5634.36	0.51	2-M2c	0.44	0.36	0.36	0.25	2.84	1.64	0.3
EMERGENCY Q100	2.20 cfs	5634.61	0.74	2-M2c	0.63	0.52	0.52	0.36	3.43	2.01	0.4

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 5633.80 ft,

Outlet Elevation (invert): 5633.36 ft

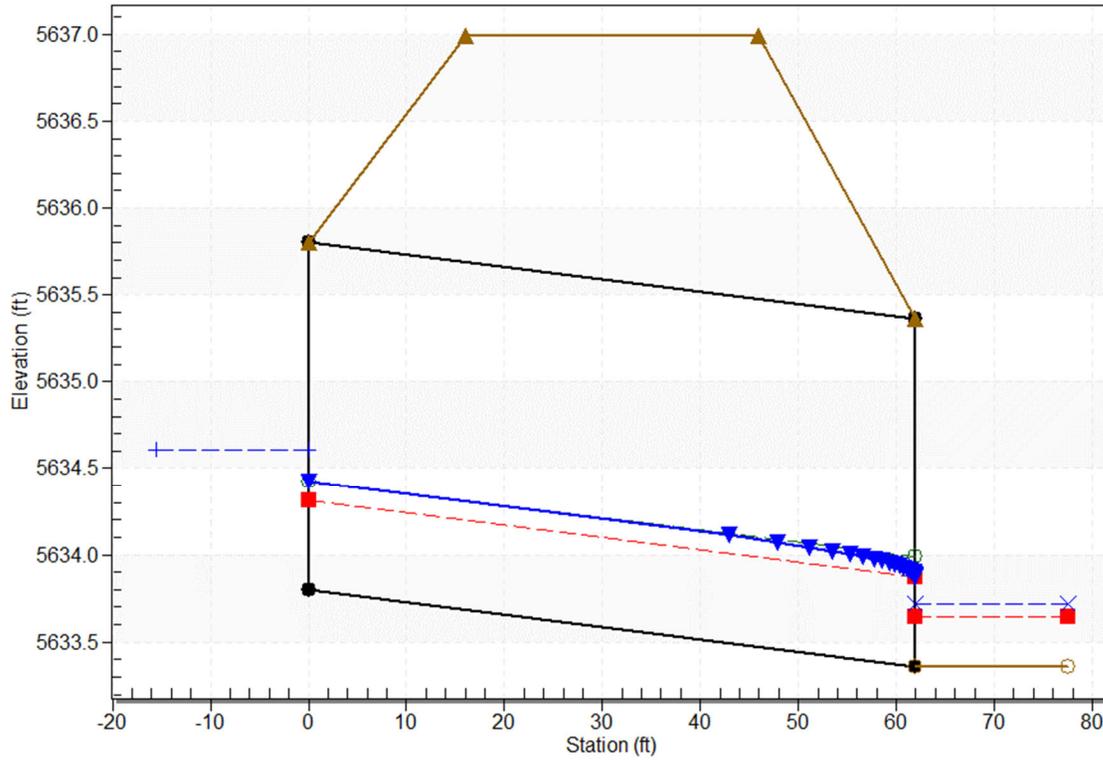
Culvert Length: 62.00 ft,

Culvert Slope: 0.0071

Water Surface Profile Plot for Culvert: Culvert 2

Crossing - CULVERT-2, Design Discharge - 2.2 cfs

Culvert - Culvert 2, Culvert Discharge - 2.2 cfs



Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5633.80 ft

Outlet Station: 62.00 ft

Outlet Elevation: 5633.36 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240 (Table 3, COA 2010 SDDTC Manual)

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope ($K_e=0.7$)

Inlet Depression: None

Tailwater Data for Crossing: CULVERT-2

Table 1 - Downstream Channel Rating Curve (Crossing: CULVERT-2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
1.10	5633.61	0.25	1.64	0.11	0.66
2.20	5633.72	0.36	2.01	0.16	0.69

Tailwater Channel Data - CULVERT-2

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 2.00 ft

Side Slope (H:V): 3.00 (.:1)

Channel Slope: 0.0070

Channel Manning's n: 0.0250

Channel Invert Elevation: 5633.36 ft

Roadway Data for Crossing: CULVERT-2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 14.00 ft

Crest Elevation: 5636.99 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

HY-8 Culvert Analysis Report

Project Data

Project Title: INVICTA 3-65-28

Designer: UELS-cdc

Project Date: Monday, April 15, 2024

Project Notes: DRILLING OPERATIONS

Project Units: U.S. Customary Units

Outlet Control Option: Profiles

Exit Loss Option: Standard Method

Culvert Data: Culvert 3

Table 1 - Culvert Summary Table: Culvert 3

Discharge Names	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D
Q100	4.32 cfs	5630.43	1.06	1-S2n	0.70	0.73	0.70	0.72	4.39	2.08	0.5
EMERGENCY Q100	8.64 cfs	5630.94	1.57	1-S2n	1.03	1.05	1.03	0.93	5.27	2.48	0.8

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 5629.37 ft,

Outlet Elevation (invert): 5628.95 ft

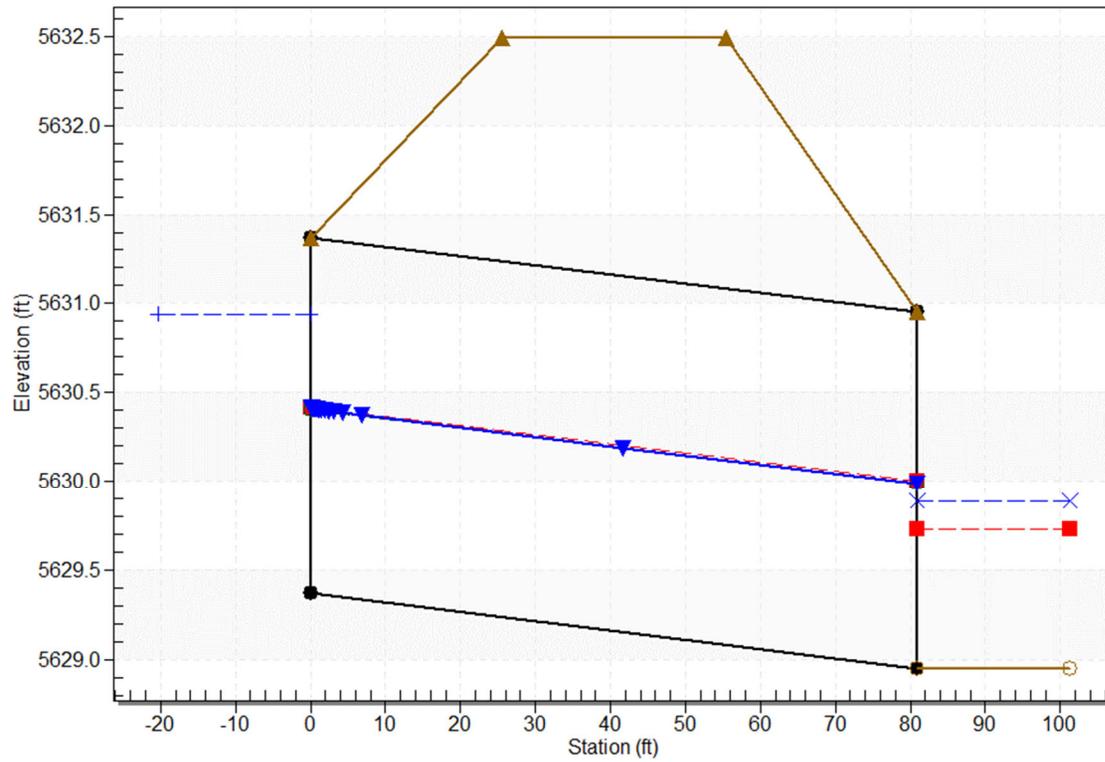
Culvert Length: 81.00 ft,

Culvert Slope: 0.0052

Water Surface Profile Plot for Culvert: Culvert 3

Crossing - CULVERT-3, Design Discharge - 8.6 cfs

Culvert - Culvert 3, Culvert Discharge - 8.6 cfs



Site Data - Culvert 3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5629.37 ft

Outlet Station: 81.00 ft

Outlet Elevation: 5628.95 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 3

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130 (Table 3, COA 2010 SDDTC Manual)

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope ($K_e=0.7$)

Inlet Depression: None

Tailwater Data for Crossing: CULVERT-3

Table 1 - Downstream Channel Rating Curve (Crossing: CULVERT-3)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
4.32	5629.67	0.72	2.08	0.22	0.61
8.64	5629.88	0.93	2.48	0.29	0.64

Tailwater Channel Data - CULVERT-3

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (4:1)

Channel Slope: 0.0050

Channel Manning's n: 0.0250

Channel Invert Elevation: 5628.95 ft

Roadway Data for Crossing: CULVERT-3

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 16.00 ft

Crest Elevation: 5632.49 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

HY-8 Culvert Analysis Report

Project Data

Project Title: INVICTA 3-65-28

Designer: UELS-cdc

Project Date: Monday, April 15, 2024

Project Notes: DRILLING OPERATIONS

Project Units: U.S. Customary Units

Outlet Control Option: Profiles

Exit Loss Option: Standard Method

Culvert Data: Culvert 4

Table 1 - Culvert Summary Table: Culvert 4

Discharge Names	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D
Q100	8.71 cfs	5629.51	1.58	3-M1f	1.24	1.05	2.00	2.09	2.77	0.00	1.0
EMERGENCY Q100	17.42 cfs	5630.76	2.78	4-FFf	2.00	1.50	2.00	2.09	5.54	0.00	1.7

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 5627.43 ft,

Outlet Elevation (invert): 5627.01 ft

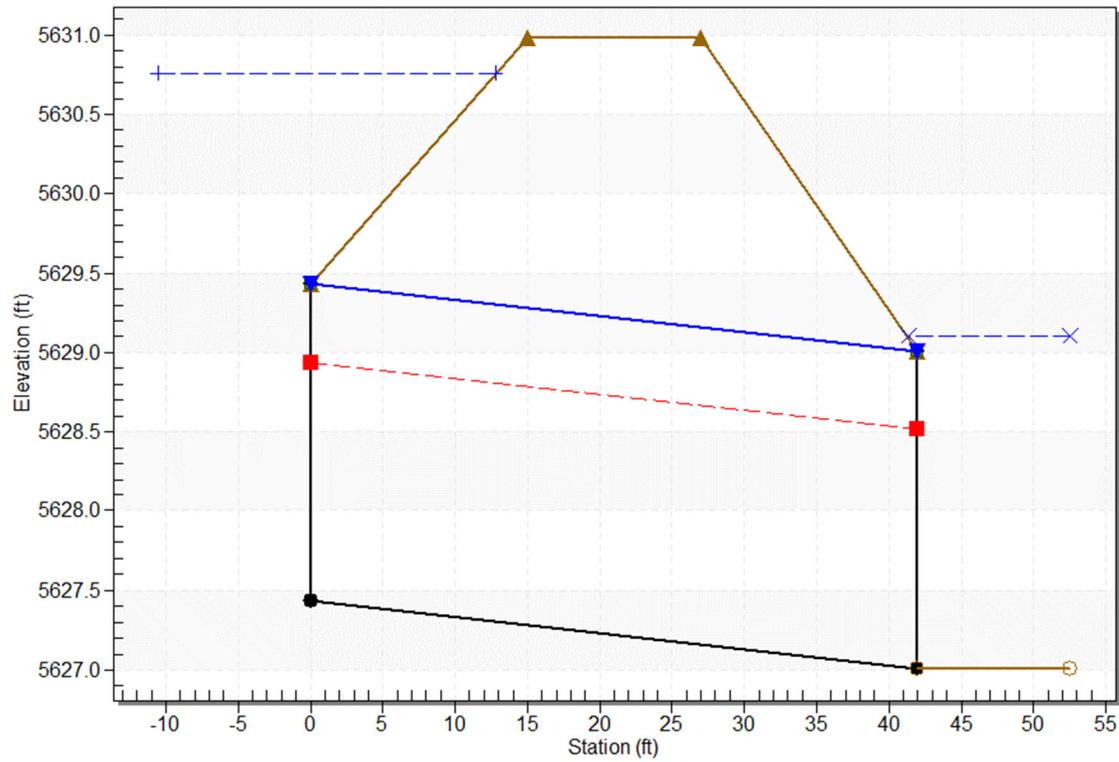
Culvert Length: 42.00 ft,

Culvert Slope: 0.0100

Water Surface Profile Plot for Culvert: Culvert 4

Crossing - CULVERT-4, Design Discharge - 17.4 cfs

Culvert - Culvert 4, Culvert Discharge - 17.4 cfs



Site Data - Culvert 4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5627.43 ft

Outlet Station: 42.00 ft

Outlet Elevation: 5627.01 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 4

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240 (Table 3, COA 2010 SDDTC Manual)

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope ($K_e=0.7$)

Inlet Depression: None

Tailwater Data for Crossing: CULVERT-4

Table 1 - Downstream Channel Rating Curve (Crossing: CULVERT-4)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)
8.71	5629.10	2.09
17.42	5629.10	2.09

Tailwater Channel Data - CULVERT-4

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 5629.10 ft

Roadway Data for Crossing: CULVERT-4

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 18.00 ft

Crest Elevation: 5630.98 ft

Roadway Surface: Gravel

Roadway Top Width: 12.00 ft

Riprap Sizing

Culvert Outlet Protection - Mild Slope Conditions (Sec. 8.1.1) - USDCM Vol. 1

Project Location: City of Aurora in Sec 28. T3S, R65W, 6th P.M.
 Project Name: Invicta 3-65-28
 Outlet Channel Side Slope: 3 : 1

Location	User Inputs						Rip Rap Sizing*			Length of Riprap Apron					RipRap Apron Dims			
	Hydraulic Structure Outlet	Event (yr)	Pipe Dia (ft)	Q (cfs)	Depth (ft)	V (ft/s)	S (ft/ft)	d ₅₀ Calc (ft)	d ₅₀ Design Size (in)	RipRap Designation	RipRap Depth Yn (ft)	A _t (sf)	Yt/D	Q/D ^{2.5}	1 / 2tan(theta)	Lp (ft)	T	L
Culvert-2	100	2	1.44	0.28	3.06	0.0071	0.0504	6	Type VL	12	0.47	0.14	0.3	6.7	6.0	2.9	6	15
Culvert-4	100	2	8.90	1.59	3.32	0.0100	0.0666	6	Type VL	12	2.68	0.80	1.6	6.7	6.0	2.9	6	15
							0.0000	6										
							0.0000	6										
							0.0000	6										
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							0.0000	6										
							0.0000	6										

*Only applicable for channel or outlet slopes of 2% or less. If channel or outlet slopes exceed 2% use a method for sizing riprap for steep slopes
 1-Apron Calculations assume rip rap is placed on side slopes to the height of the culvert.

RipRap Equation for Mild Slope Conditions:

$$d_{50} \geq \left[\frac{VS^{0.17}}{4.5(G_s - 1)^{0.66}} \right]^2 \quad \text{Equation 8-11}$$

Where:
 V = mean channel velocity (ft/sec)
 S = longitudinal channel slope (ft/ft)
 d₅₀ = mean rock size (ft)
 G_s = specific gravity of stone (minimum = 2.50, typically 2.5 to 2.7). Note: In this equation (G_s - 1) considers the buoyancy of the water, in that the specific gravity of water is subtracted from the specific gravity of the rock.

RipRap Gradation (Figure 8-34 USDCM Vol. 1)

RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	d ₅₀ * (INCHES)
TYPE VL	70-100	12	6**
	50-70	9	
	35-50	6	
TYPE L	70-100	15	9**
	50-70	12	
	35-50	9	
TYPE M	70-100	21	12**
	50-70	18	
	35-50	12	
TYPE H	70-100	30	18
	50-70	24	
	35-50	18	
TYPE VH	70-100	42	24
	50-70	33	
	35-50	24	

* d₅₀ = MEAN PARTICLE SIZE (INTERMEDIATE DIMENSION) BY WEIGHT
 ** MIX VL, L AND M RIPRAP AND OTHER RIPRAP SIZES AS NOTED ON PLANS WITH JOE (BY VOLUME), TOPSOIL AND BURY IT WITH 6+ INCHES OF TOPSOIL, ALL VIBRATION COMPACTED AND REVEGETATE.
 (TABLE MD-7: CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP, UDFCD, DRAINAGE CRITERIA MANUAL, VOL. 1)

Expansion Factor:

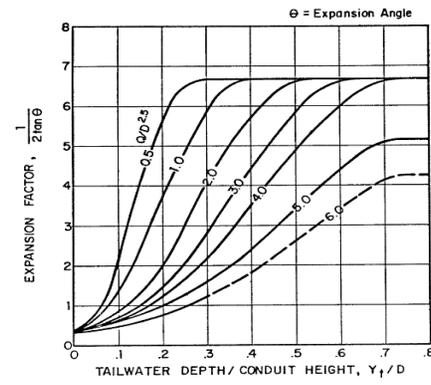


Figure 9-35. Expansion factor for circular conduits

Riprap Apron Details:

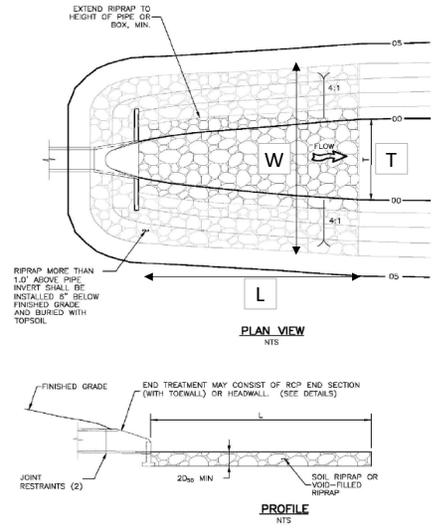


Figure 9-34. Riprap apron detail for culverts in-line with the channel

Riprap Sizing

Culvert Outlet Protection - Mild Slope Conditions (Sec. 8.1.1) - USDCM Vol. 1

Project Location: City of Aurora in Sec 28. T3S, R65W, 6th P.M.
 Project Name: Invicta 3-65-28
 Outlet Channel Side Slope: 4 : 1

Location	User Inputs						Rip Rap Sizing*			Length of Riprap Apron				RipRap Apron Dims				
	Hydraulic Structure Outlet	Event (yr)	Pipe Dia (ft)	Q (cfs)	Depth (ft)	V (ft/s)	S (ft/ft)	d ₅₀ Calc (ft)	d ₅₀ Design Size (in)	RipRap Designation	RipRap Depth Yn (ft)	A _t (sf)	Yt/D	Q/D ^{2.5}	$\frac{1}{2 \tan(\theta)}$	Lp (ft)	T	L
Culvert-1	100	2	3.67	0.38	3.97	0.0130	0.1041	6	Type VL	12	0.92	0.19	0.6	6.7	6.0	2.9	6	19
Culvert-3	100	2	4.32	2.08	4.39	0.0050	0.0920	6	Type VL	12	0.98	1.04	0.8	6.7	6.0	2.9	6	19
							0.0000	6										
							0.0000	6										
							0.0000	6										
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							0.0000	6										
							0.0000	6										

Production Phase flow rates (as shown) have higher flow rates than Drill Phase.

*Only applicable for channel or outlet slopes of 2% or less. If channel or outlet slopes exceed 2% use a method for sizing riprap for steep slopes
 1-Apron Calculations assume rip rap is placed on side slopes to the height of the culvert.

RipRap Equation for Mild Slope Conditions:

$$d_n \geq \left[\frac{VS^{0.17}}{4.5(G_s - 1)^{0.66}} \right]^2 \quad \text{Equation 8-11}$$

Where:
 V = mean channel velocity (ft/sec)
 S = longitudinal channel slope (ft/ft)
 d₅₀ = mean rock size (ft)
 G_s = specific gravity of stone (minimum = 2.50, typically 2.5 to 2.7). Note: In this equation (G_s - 1) considers the buoyancy of the water, in that the specific gravity of water is subtracted from the specific gravity of the rock.

RipRap Gradation (Figure 8-34 USDCM Vol. 1)

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP			
RIPRAP DESIGNATION	% SMALLER THAN GIVEN SIZE BY WEIGHT	INTERMEDIATE ROCK DIMENSION (INCHES)	d ₅₀ * (INCHES)
TYPE VL	70-100	12	6**
	50-70	9	
	35-50	6	
TYPE L	70-100	15	9**
	50-70	12	
	35-50	9	
TYPE M	70-100	21	12**
	50-70	18	
	35-50	12	
TYPE H	100	30	18
	50-70	24	
	35-50	18	
TYPE VH	100	42	24
	50-70	33	
	35-50	24	
	2-10	9	

* d₅₀ = MEAN PARTICLE SIZE (INTERMEDIATE DIMENSION) BY WEIGHT
 ** MIX VL, L AND M RIPRAP AND OTHER RIPRAP SIZES AS NOTED ON PLANS WITH 30% (BY VOLUME) TOPSOIL AND BURY IT WITH 6+ INCHES OF TOPSOIL, ALL VIBRATION COMPACTED AND REVEGETATE.
 (TABLE MD-7: CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP. UDFCD, DRAINAGE CRITERIA MANUAL, VOL. 1)

Expansion Factor:

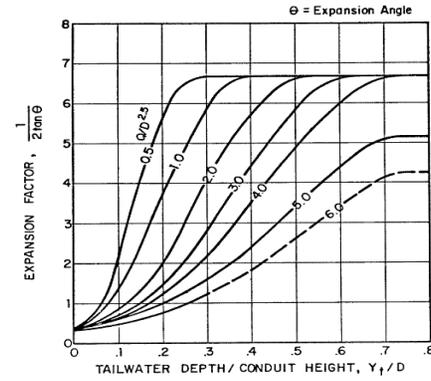


Figure 9-35. Expansion factor for circular conduits

Riprap Apron Details:

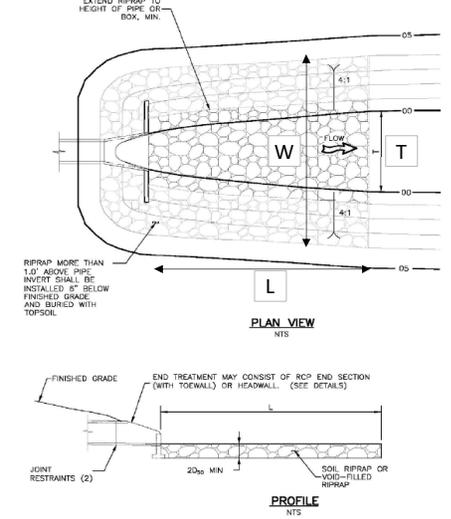


Figure 9-34. Riprap apron detail for culverts in-line with the channel

**DRILLING OPERATIONS
SEDIMENT BASIN-1 CALCS**



WEIGHTED IMPERVIOUS SURFACE CALCULATIONS
 INVICTA 3-65-28
 SEDIMENT BASIN CALCULATIONS (DRILLING OPERATIONS)

COA Lawns/Cut/Fill = 2% Imp. for Soil Types A & B
 COA Lawns/Cut/Fill = 5% Imp. for Soil Types C & D

COA 2010 SDDTC TABLE 1 - RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

	Undeveloped Areas			Streets			Developed Areas			MISC.				Total Area (Ac)	Percent Imperv.
	Historic Flow Analysis	Greenbelts, Agricultural	Off-site flow analysis (Land Use Not Defined)	Paved	Gravel	Recycled Asphalts	Concrete Driveways	Sidewalks	Roofs	Single-Family Res. 0.75-2.5 Acres	Parks	Pond Area	Berms/Cut/Fill Slopes/Landscaping		
% Impervious	2%	2%	45%	100%	40%	75%	90%	90%	90%	20%	10%	100%	5%		
Basin	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)	Area (Ac)		
A													0.55	0.55	5.0%
B					2.97								0.54	3.51	34.6%
C					3.06									3.06	40.0%
D					2.62									1.18	3.81
E												0.51		0.51	100.0%
SB Emerg. Overflow & 100-Yr Trib. Area														0.00	0.0%
A+B+C+D+E					8.66							0.51	2.28	11.45	35.7%
														0.00	0.0%
														0.00	0.0%

SEDIMENT BASIN SIZING

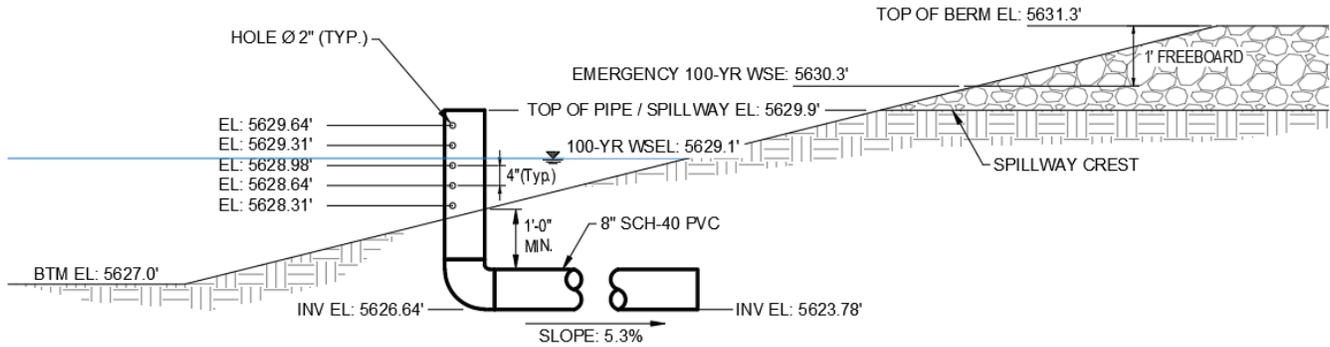
INVICTA 3-65-28

USDCM Volume 3

No.	Drainage Area	Acres	Volume Req'd 3600 CF/Ac. (CF)	Volume Provided (cu. ft.)	Bottom Dimensions
1	Drill Pad	11.45	41,220	55,348	75 x 150
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Notes:

1. Sediment Basin Side Slopes shall be 4:1 (typ).
2. Basin Depth should typically be 4 ft deep with 1ft freeboard (standard basin sizing).
3. Provide location of overflow to discharge to historic drainage outflow.
4. Volume Provided is calculated from Graded Contours using the Average End method.



ORIFICE ELEVATION DETAIL

NO SCALE

SEDIMENT BASIN STAGE STORAGE TABLE						
INVICTA 3-65-28						
CONTOUR (FEET)	CONTOUR AREA (SQFT)	STAGE	POND DEPTH (FT)	CUMULATIVE VOLUME (AC-FT)	CUMULATIVE VOLUME (Bbls)	CUMULATIVE VOLUME (CU-FT)
5,631.3	56,539	CREST	4.3	2.49	19,321	108,482
5,631.2	53,037		4.2	2.36	18,346	103,004
5,631.1	49,742		4.1	2.25	17,430	97,865
5,631.0	46,649		4.0	2.14	16,572	93,045
5,630.9	43,759		3.9	2.03	15,767	88,525
5,630.8	41,071		3.8	1.93	15,011	84,283
5,630.7	38,586		3.7	1.84	14,302	80,300
5,630.6	36,304		3.6	1.76	13,635	76,556
5,630.5	34,204		3.5	1.68	13,007	73,030
5,630.4	32,274		3.4	1.60	12,415	69,706
5,630.3	30,571	EM. 100-YR WSE	3.3	1.53	11,856	66,564
5,630.2	29,094		3.2	1.46	11,324	63,581
5,630.1	27,845		3.1	1.39	10,817	60,734
5,630.0	26,828		3.0	1.33	10,330	58,000
5,629.9	26,216	SPILLWAY	2.9	1.27	9,858	55,348
5,629.8	25,617		2.8	1.21	9,396	52,757
5,629.7	25,029		2.7	1.15	8,945	50,224
5,629.6	24,453	ORIFICE 5	2.6	1.10	8,505	47,750
5,629.5	23,889		2.5	1.04	8,074	45,333
5,629.4	23,336		2.4	0.99	7,654	42,972
5,629.3	22,795	ORIFICE 4	2.3	0.93	7,243	40,665
5,629.2	22,266		2.2	0.88	6,841	38,412
5,629.1	21,749	100-YR WSE	2.1	0.83	6,450	36,211
5,629.0	21,243	ORIFICE 3	2.0	0.78	6,067	34,062
5,628.9	20,749		1.9	0.73	5,693	31,962
5,628.8	20,267		1.8	0.69	5,327	29,911
5,628.7	19,797		1.7	0.64	4,971	27,908
5,628.6	19,339	ORIFICE 2	1.6	0.60	4,622	25,951
5,628.5	18,892		1.5	0.55	4,282	24,040
5,628.4	18,457		1.4	0.51	3,949	22,172
5,628.3	18,033	ORIFICE 1	1.3	0.47	3,624	20,348
5,628.2	17,622		1.2	0.43	3,307	18,565
5,628.1	17,222		1.1	0.39	2,996	16,823
5,628.0	16,834		1.0	0.35	2,693	15,120
5,627.9	16,458		0.9	0.31	2,397	13,456
5,627.8	16,093		0.8	0.27	2,107	11,828
5,627.7	15,740		0.7	0.23	1,823	10,236
5,627.6	15,399		0.6	0.20	1,546	8,679
5,627.5	15,070		0.5	0.16	1,275	7,156
5,627.4	14,753		0.4	0.13	1,009	5,665
5,627.3	14,447		0.3	0.10	749	4,205
5,627.2	14,153		0.2	0.06	494	2,775
5,627.1	13,871		0.1	0.03	245	1,374
5,627.0	13,601	BOTTOM	0	0.00	0	0

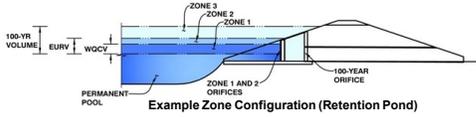
Note: Volumes are calculated from Graded Contours using the Average End method.
Top of Pipe at Spillway Elevation.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **INICTA 3-65-28**

Basin ID: **SEDIMENT BASIN (DRILLING OPERATIONS)**



Watershed Information

Selected BMP Type =	EDB
Watershed Area =	11.45 acres
Watershed Length =	1,338 ft
Watershed Length to Centroid =	538 ft
Watershed Slope =	0.019 ft/ft
Watershed Imperviousness =	35.7% percent
Percentage Hydrologic Soil Group A =	0.0% percent
Percentage Hydrologic Soil Group B =	0.0% percent
Percentage Hydrologic Soil Groups C/D =	100.0% percent
Target WQCV Drain Time =	24.0 hours
Location for 1-hr Rainfall Depths =	User Input

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

Optional User Overrides

Water Quality Capture Volume (WQCV) =	0.160	acre-feet
Excess Urban Runoff Volume (EURV) =	0.376	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.249	acre-feet
5-yr Runoff Volume (P1 = 1.13 in.) =	0.419	acre-feet
10-yr Runoff Volume (P1 = 1.4 in.) =	0.641	acre-feet
25-yr Runoff Volume (P1 = 1.8 in.) =	1.065	acre-feet
50-yr Runoff Volume (P1 = 2.14 in.) =	1.393	acre-feet
100-yr Runoff Volume (P1 = 2.5 in.) =	1.789	acre-feet
500-yr Runoff Volume (P1 = 3.48 in.) =	2.760	acre-feet
Approximate 2-yr Detention Volume =	0.233	acre-feet
Approximate 5-yr Detention Volume =	0.394	acre-feet
Approximate 10-yr Detention Volume =	0.481	acre-feet
Approximate 25-yr Detention Volume =	0.600	acre-feet
Approximate 50-yr Detention Volume =	0.661	acre-feet
Approximate 100-yr Detention Volume =	0.824	acre-feet

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.160	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.216	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.448	acre-feet
Total Detention Basin Volume =	0.824	acre-feet
Initial Surcharge Volume (ISV) =	user	ft ³
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H _{total}) =	user	ft
Depth of Trickle Channel (H _{TC}) =	user	ft
Slope of Trickle Channel (S _{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S _{main}) =	user	H:V
Basin Length-to-Width Ratio (R _{LW}) =	user	
Initial Surcharge Area (A _{ISV}) =	user	ft ²
Surcharge Volume Length (L _{ISV}) =	user	ft
Surcharge Volume Width (W _{ISV}) =	user	ft
Depth of Basin Floor (H _{FLOOR}) =	user	ft
Length of Basin Floor (L _{FLOOR}) =	user	ft
Width of Basin Floor (W _{FLOOR}) =	user	ft
Area of Basin Floor (A _{FLOOR}) =	user	ft ²
Volume of Basin Floor (V _{FLOOR}) =	user	ft ³
Depth of Main Basin (H _{MAIN}) =	user	ft
Length of Main Basin (L _{MAIN}) =	user	ft
Width of Main Basin (W _{MAIN}) =	user	ft
Area of Main Basin (A _{MAIN}) =	user	ft ²
Volume of Main Basin (V _{MAIN}) =	user	ft ³
Calculated Total Basin Volume (V _{total}) =	user	acre-feet

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	13,601	0.312		
5,627.1	--	0.10	--	--	--	13,871	0.318	1,374	0.032
5,627.2	--	0.20	--	--	--	14,153	0.325	2,775	0.064
5,627.3	--	0.30	--	--	--	14,447	0.332	4,205	0.097
5,627.4	--	0.40	--	--	--	14,753	0.339	5,665	0.130
WQCV 5627.5	--	0.50	--	--	--	15,070	0.346	7,156	0.164
5,627.6	--	0.60	--	--	--	15,399	0.354	8,679	0.199
5,627.7	--	0.70	--	--	--	15,740	0.361	10,236	0.235
5,627.8	--	0.80	--	--	--	16,093	0.369	11,828	0.272
5,627.9	--	0.90	--	--	--	16,458	0.378	13,456	0.309
5,628.0	--	1.00	--	--	--	16,834	0.386	15,120	0.347
EURV 5628.1	--	1.10	--	--	--	17,222	0.395	16,823	0.386
5,628.2	--	1.20	--	--	--	17,622	0.405	18,565	0.426
5,628.3	--	1.30	--	--	--	18,033	0.414	20,348	0.467
5,628.4	--	1.40	--	--	--	18,457	0.424	22,172	0.509
5,628.5	--	1.50	--	--	--	18,892	0.434	24,040	0.552
5,628.6	--	1.60	--	--	--	19,339	0.444	25,951	0.596
5,628.7	--	1.70	--	--	--	19,797	0.454	27,908	0.641
5,628.8	--	1.80	--	--	--	20,267	0.465	29,911	0.687
5,628.9	--	1.90	--	--	--	20,749	0.476	31,962	0.734
5,629.0	--	2.00	--	--	--	21,243	0.488	34,062	0.782
100-YR 5629.1	--	2.10	--	--	--	21,749	0.499	36,211	0.831
5,629.2	--	2.20	--	--	--	22,266	0.511	38,412	0.882
5,629.3	--	2.30	--	--	--	22,795	0.523	40,665	0.934
5,629.4	--	2.40	--	--	--	23,336	0.536	42,972	0.986
5,629.5	--	2.50	--	--	--	23,889	0.548	45,333	1.041
5,629.6	--	2.60	--	--	--	24,453	0.561	47,750	1.096
5,629.7	--	2.70	--	--	--	25,029	0.575	50,224	1.153
5,629.8	--	2.80	--	--	--	25,617	0.588	52,756	1.211
SPILLWAY 5629.9	--	2.90	--	--	--	26,216	0.602	55,348	1.271
5,630.0	--	3.00	--	--	--	26,828	0.616	58,000	1.332
5,630.1	--	3.10	--	--	--	27,453	0.630	60,734	1.394
5,630.2	--	3.20	--	--	--	29,094	0.668	63,581	1.460
EM. 100-YR 5630.3	--	3.30	--	--	--	30,571	0.702	66,564	1.528
5,630.4	--	3.40	--	--	--	32,274	0.741	69,706	1.600
5,630.5	--	3.50	--	--	--	34,204	0.785	73,030	1.677
5,630.6	--	3.60	--	--	--	36,304	0.833	76,556	1.757
5,630.7	--	3.70	--	--	--	38,586	0.886	80,300	1.843
5,630.8	--	3.80	--	--	--	41,071	0.943	84,283	1.935
5,630.9	--	3.90	--	--	--	43,759	1.005	88,525	2.032
5,631.0	--	4.00	--	--	--	46,649	1.071	93,045	2.136
5,631.1	--	4.10	--	--	--	49,742	1.142	97,865	2.247
5,631.2	--	4.20	--	--	--	53,037	1.218	103,003	2.365
TOP 5631.3	--	4.30	--	--	--	56,539	1.298	108,482	2.490

The calculations below are for sizing orifices for a basin with a sloped or flat bottom as outlined in a Technical Memorandum by Ken MacKenzie with UDFCD, dated July 13, 2010. (See excerpts below)

WELL PAD: INVICTA 3-65-28

Description: Drill Phase Sediment Basin

Drain Time normally 72-hrs. Reduced to 48-hrs due to site being within 5-miles of Denver Int. Airport.

Solve for Area of each orifice in square inches.

Storage Volume Drain Time, T_D :	48 hrs	
Storage Volume to Drain, Vol:	0.804 acre-ft	Top of Pipe El. (Spillway) - 1st Orifice El.
Depth of Storage Volume to Drain, H:	1.6 ft	Top of Pipe El. (Spillway) - 1st Orifice El.
Slope of Trickle Channel, S:	0.0001 ft/ft	Use 0.0001 for flat bottom

$A_o = 3.2 \text{ in}^2$ Equation 9

Orifice Diameter: 2.01 in (decimal)
2 in (fraction)

Emergency Spillway:	5629.90	
5th Orifice El.:	5629.64	
4th Orifice El.:	5629.31	
3rd Orifice El.:	5628.98	For Tributary Area < 15 acres, the
2nd Orifice El.:	5628.64	1st Orifice to be at the WSE where:
1st Orifice El.:	5628.31	$V = 50\% \text{ of Trib ac} \times 3600 \text{ cf/ac.}$
Sediment Basin Bottom:	5627.00	



URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

Paul A. Hindman, Executive Director
2480 W. 26th Avenue, Suite 156B
Denver, CO 80211-5304

Telephone 303-455-6277
Fax 303-455-7880
www.udfcd.org

TECHNICAL MEMORANDUM

FROM: Ken MacKenzie

SUBJECT: Water quality orifice sizing equation for EURV and WQCV detention basins

DATE: July 13, 2010

The purpose of this memorandum is to document the derivation of the orifice sizing equation developed to drain the urban excess runoff volume (EURV) from full spectrum detention basins and to drain the water quality capture volume (WQCV) from extended detention basins, constructed wetland basins, and water quality retention ponds. It is important to drain these facilities over the proper length of time in order to assure the optimum level of sediment and pollutant removal. This equation is applicable when the individual orifices are spaced four inches on center vertically (for example, a two foot storage depth would have orifices at of 0, 4, 8, 12, 16, and 20 inches from the bottom of the storage volume). To develop this equation, storage volumes were modeled using the USEPA Storm Water Management Model (SWMM) Version 5.0.018. One hundred forty storage volume cases were modeled as 2:1 rectangular basins at five different trickle channel slopes and seven different depths. Side slopes of 4:1 were assumed for the storage above the sloped floor of the basin. The result of the modeling was the development of an equation to size each orifice in the orifice plate column such that the runoff storage volume would drain in roughly the prescribed drain time ($\pm 10\%$). All of the modeling was done using a 72-hour drain time, and the final equation was adapted to allow other drainage times.

This simplified method can serve as a substitute for a more detailed reservoir routing design approach when UDFCD standards regarding the detention basin parameters described above have been met.

The design parameters that influence the area of the individual orifices in the orifice plate are:

- The storage volume to be drained,
- The prescribed drain time,
- The design depth of the storage volume,
- The slope of the bottom of the detention basin (i.e., the trickle channel slope).

The drain time is particularly sensitive to the slope parameter as it has a strong effect on the stage-storage relationship. For each slope, the calculated orifice areas for each of the eight volumes were plotted vs. the design depth, as shown in Figure 1.

A power regression was applied to the data. The equation for this regression takes the form:

A minimum trickle channel slope of 0.0001 feet vertical / feet horizontal was selected to represent the flat bottomed basin, the retention pond, and the constructed wetland pond as a best fit to match the prescribed drain time since a zero percent slope would result in A_O being undefined. The equations presented here were developed by modeling storage volumes from 0.0082 acre-feet to 75.5 acre-feet, slopes from 0.0001 to 0.02 feet vertical / feet horizontal, depths from two feet to eight feet, and an orifice coefficient of 0.60. These equations are valid for this range of input parameters but have not been tested outside this range.

Combining Equations 4, 5, and 8 gives the final form of the orifice sizing equation:

$$A_O = \frac{88Vol^{(0.95/H^{0.085})}}{T_D S^{0.09} H^{2.6} (S^{0.3})} \quad \text{Equation 9}$$

Where:

- A_O is the required orifice area per row in square inches,
- S is slope in feet vertical / feet horizontal (substitute 0.0001 for zero),
- Vol is the storage volume in acre-feet,
- T_D is the prescribed drain time in hours, and
- H is the storage depth at the outlet above the lowest orifice, in feet.

For a storage volume with a flat bottom (e.g. retention pond or constructed wetland pond), this equation can be simplified to:

$$A_O = \frac{201Vol^{(0.95/H^{0.085})}}{T_D H^{0.164}} \quad \text{Equation 10}$$

SWMP APPENDIX E – Variance Request Details

SWMP APPENDIX F – Vertical and General Construction Matrix

Vertical and General Construction Concern	BMP Measures	Information Provided by:	Approved by (COA Employee):
Provide a mixing station detail/area for masonry/brick. If the site is going to bring in silos for masonry mixing, wind protection will be required to minimize the maximum extent practicable the dust from impacting adjacent buildings and streets.			
Saw cutting station detail/area (must address slurry waste)			
Tool Cleanup BMPs and Practices			
Procedural BMPs for clean up in the above areas and clean up if spills should occur as traveling to the building area			
Options for handling paints, solvents, glues (i.e. utilize the CWS or provide alternative)			
Provide physical and procedural BMPs for clean up along the building during the installation of brick, stone or stucco (strike zone and scaffolding impacts to BMPs)			
Access may be required around the building, defining a haul route may be necessary and denote stabilization needs on this proposed haul route (cranes)			

<p>Address access to the building as different stages of vertical construction occur. For example, a VTC may work for the duration of the infrastructure construction but as the grading is fine tuned, different measures may need to be implemented to limit access or be more mobile. Controlling access is important during vertical construction, especially when taking access from an impervious surface (i.e. pavement).</p>			
<p>Staging areas change during construction regularly. Therefore, if “con/conex” boxes are to be utilized and if they are to include liquid pollutants, then a redundant BMP measure must be provided</p>			
<p>Site drainage will need to be maintained during vertical construction. Review conditions to ensure that it will continue to work as shown during the grading/utility timeframes.</p>			
<p>Provide redundant BMPs for generators to protect from fuel/hydraulic leaks</p>			
<p>Utility Installation BMPs</p>			
<p>Waterproofing BMPs and procedures</p>			

Review the down gradient BMPs within the impervious areas to ensure that conveyances, inlets and outlets are protected appropriately during each phase.			
Areas of disturbance outside of the building envelope shall still require BMPs review the timing/phasing of the project to ensure the appropriate BMPs are implemented as construction continues.			
BMPs for keeping impervious surfaces clean may need to be enhanced or added to as construction continues.			
Provide redundant BMPs for mobile concrete washouts and policies for cleanup of blobs of concrete by trades			
Review and implement BMP measures to control roof drainage. This becomes a point source and may cause extensive erosion on site.			
Address waste handling procedures for drywall, painters, carpet layers etc.			
Provide BMPs for delivery trucks – i.e. controlled access points, staging areas, delivery areas, parking area.			
Coordination Plan – required if different phases of work is to be done by different general contractors (i. e. road work vs. building façade)			

Details and BMP measures for form oil and form oil laydown area			
Run on modifications			
Interim lot stabilization techniques			
The methods to be used to address the following issues:			
<ul style="list-style-type: none"> ▪ Irrigation testing 			
<ul style="list-style-type: none"> ▪ Water main/fire line testing 			
<ul style="list-style-type: none"> ▪ Sewer line testing 			
<ul style="list-style-type: none"> ▪ Building washing 			

▪ Graffiti deterrent application			
▪ Fire retardant application			
▪ Fueling			
▪ Process water (paving rollers, boring equipment, wet saws, etc)			

SWMP APPENDIX G - Operator's Best Management Practices



INVICTA 3-65 38

City of Aurora Oil and Gas Permit
N2 of Section 28 T3S R65W
Adams County, Colorado

Best Management Practices

Prepared for GMT Exploration Company LLC
4949 S. Niagara, Suite 250
Denver, CO 80237

By: Upstream Petroleum Management
6494 S. Quebec St.
Englewood, CO 8011
&
Uintah Engineering & Land Surveying
85 South 200 East
Vernal, UT 84078

1.D.3: Drilling Operations Best Management Practices

1. **Anchoring:** During Drilling and Completion phases of the Invicta 3-65 28, all equipment requiring anchoring is anchored using surface anchors or removable anchoring systems, no anchors are left behind for future use. During Production Phase, tanks and separation equipment are secured to the ground using anchors engineered to resist flotation, collapse, lateral movement, or subsidence. The Invicta 3-65 28 location is not in a floodplain.
2. **Automatic Safety Protective Systems and Surface Safety Valves:** Continuous monitoring will be used to track fluid volumes and monitor for leaks. A closed loop system will be used. Fluid storage tanks on the location will be equipped with mechanical (visual) level indicators that are inspected by operation personnel. PVT alarms, automation and other sensory monitoring devices will be utilized to monitor active tank levels at all times. During any transfer operations, visual inspections from inlet and outlet vessels with radio communication will be implemented. Daily visual inspections will be performed on all equipment, hoses and valving to ensure integrity of fluid containment at all times. The automated safety system provides the ability to remotely shut-in wells on demand through operator remote intervention.
3. **Air Quality:** GMT employs policies and procedures used to evaluate, eliminate, capture, or minimize all potentially harmful emissions and compliance with all applicable regulations, including regulations promulgated by Colorado Department of Public Health and Environment, Colorado Energy and Carbon Management Commission (ECMC) and United States Environmental Protection Agency. At least five days prior to oil and gas operations commencing, the background monitoring station(s) will be placed away from and upwind of the emission concern areas. The air quality monitoring stations will provide continuous monitoring throughout the life of the wells.
4. **Closed-Loop Pitless System for the Containment and/or Recycling of Drilling Fluids:** GMT will use a Closed Loop System and no pits will be used on location. The Invicta 3-65 28 wells will be drilled, completed and operated using closed-loop pitless systems for containment and/or reuse of all drilling, completion, flowback and produced fluids. All above ground storage, including tanks and separators, for use during drilling, completion, flowback and other produced fluids will have secondary containment.
5. **Cultural and Historical Resource Protection:** Applicant has not discovered any landmark buildings or sites within the disturbance area for the location.
6. **Electric Equipment:** The Applicant is required to use electric power if electric power is technically and economically feasible as of the date of this application. The applicant plans to use electric power for drilling at this site pending availability.
7. **Events or Incidents:** In the event of a medical, fire, or explosion incident on the Invicta 3-65 28 location, 911 will be called and local emergency services will be dispatched. Any ECMC reportable safety events or OSHA reportable injuries will be reported to the City within 24 hours.

8. **Emergency Response Plan:** A site specific Emergency Response Plan (ERP) has been submitted for this site. The Applicant's emergency response will be uniform and will be executed in the format outlined in the ERP for all emergencies. The ERP provides 24-hour contact information for persons responsible for emergency field operations, information on evacuation routes and locations of healthcare facilities anticipated to be used as well as a detailed plan for response to emergencies that may include any or all of the following: explosions, fires, gas, oil or water pipeline leaks or ruptures. The ERP also provides guidance on training and coordination and communication with City emergency personnel and departments.
9. **Fencing:** A 4 foot, wildlife friendly barb wire will be installed around the location to keep ungulates out of the Location.
10. **Notifications to the City:** (Regarding Commencement of Operations and Phases of Operations/ Notifications to the City Regarding Commencement of Construction at CGF and Pipeline Operations/Notifications to the City) The Applicant will notify the City, through the designated City representative, no less than 30 days prior to the commencement of the Construction for the Invicta 3-65-28 location (unless the Construction Phase commences within 45 days of the approval of the applicable Form 2, Form 2A, or local permit), Drilling, or Completion Phases, and 30 days prior to recompleting, re-drilling, or plugging and abandonment of the well.
11. **Lighting:** Lighting is only used during the Drilling and Completion Phases of operations. All lighting used will be situated so that it is downcast and does not shine beyond the boundary of the oil and gas operations area. A Photometric Light Plan is submitted as part of the Site Plan.
12. **Odor:** Applicant will mitigate odors by routing to closed loop systems to the maximum extent practicable. If the Applicant receives complaints from a Residential Building within 1,320 feet from the site, Applicant will take measures to mitigate the odor within 24 hours, based on the specific circumstances.
13. **Removal of Debris:** The Applicant will ensure that all construction-related debris is removed from the Well Site for proper disposal in a timely manner. The Applicant will ensure that Well Site is reasonably free of debris and excess materials at all times during all phases of operations.
14. **Stormwater Management:** The Applicant will not begin construction of the Invicta 3-65 28 location until a Stormwater Water Management Plan (SWMP) is approved by the City and a stormwater quality discharge permit has been acquired for the Well Site. The Applicant will perform monthly inspections of stormwater BMPs, or after a storm event.
15. **Tree Mitigation:** There will be no tree removal required.
16. **Wastewater and Waste Management:** All fluids and waste will be contained and disposed of at licensed disposal or recycling facilities outside of the City.
17. **Water Protection Requirements:** There are no sensitive water resources in the vicinity of the location.
18. **Water Quality Monitoring Plan/Groundwater Pollution Mitigation:** The site-specific location and water well sampling list will be developed for each drilling pad and included under Section 3.0 in this plan. Up to four water sources (typically water wells) within a half-mile radius of the middle of the planned well drilling location for each of the multi-well pads will be sampled per this water

quality monitoring plan. If more than four Available Water Sources are present within a half-mile radius of a proposed Oil and Gas Well, Multi-Well Site, or Class II UIC Well, up to four sampling locations will be selected based on the following criteria:

- Proximity. Available Water Sources closest to the proposed Oil and Gas Well, Multi-Well Site, or Class II UIC Well are required.
- Type of Water Source. Well-maintained domestic water wells are required over other Available Water Sources.
- Orientation of Sampling Locations. To the extent Groundwater flow direction is known or reasonably can be inferred, sample locations from both down-gradient and up-gradient are preferred over cross gradient locations. Where Groundwater flow direction is uncertain, sample locations should be chosen in a radial pattern from a proposed Oil and Gas Well, Multi-Well Site, or Class II UIC Well.
- Multiple Identified Aquifers Available. Where multiple defined Aquifers are present, sampling the deepest and shallowest identified Aquifers is required.
- Condition of Water Source. Water Sources that are determined to be improperly maintained, nonoperational, or have other physical impediments to sampling that would not allow for a representative sample to be safely collected or would require specialized sampling equipment (e.g., Shut-In Wells, wells with confined space issues, wells with no tap or pump, non-functioning wells, intermittent springs) will not be sampled.

Based on the priority evaluation above, a good faith effort to contact each identified owner will be completed in a timely manner. The owners of identified domestic water source(s) will be interviewed regarding the history and condition of their water source. To the extent possible, the installation date, completion aquifer, well depth, well diameter, operating history, pretreatment, unusual odor, color, and/or other pertinent information and general quality and use history, such as periods of no water or limited water pressure will be recorded. If an owner cannot be reached or does not respond to contact attempts, a variance will be requested to be alleviated of the sampling requirement for that water source. Obtaining a representative water sample from the prioritized wells that are determined to be accessible will be attempted and completed providing suitable well operation exists.

If existing water data including appropriate analytical constituents and procedures is available for an identified well that has been collected within 18 months preceding the scheduled initial sampling event these data may be used to satisfy the initial sampling requirements. For well pads having overlapping areas, a sampled well may be used to satisfy the requirements for multiple drilling pads.

1D.4: Access Road Site Plan Best Management Practices

1. **Access Roads:** Access road and pad construction shall be designed and maintained to support imposed loads of fire apparatus (85,000 lbs) utilizing the CDOT road-base #6 specification to provide for all weather driving capabilities. The access road shall be 23' wide with a 29' inside turning radius. While CDOT #6 is specified, the material used to construct these surfaces may be of any one of, or a combination of several aggregate materials available. Approved materials include premixed road base material, 1-1.5 angular inch river rock, crushed granite, or other aggregate with not less than one-inch nominal size designation and CDOT road base class 6. A solid surface (concrete or asphalt) will be added for the first 100 feet from a paved public ROW the

maintenance of the road will be in good repair at all times, clear of any structures or obstructions, and an all-weather surface allowing for an unobstructed path for emergency apparatus use.

2. **Fugitive Dust Suppression:** Dust associated with Site activities and traffic on roads will be minimized throughout all phases. The following BMPs will be employed:
 - GMT will gravel all working surfaces and perform interim reclamation within six months of well drilling and completion.
 - Utilize existing vegetation, trees slash or brush piles to cover disturbed areas not used for vehicle traffic.
 - Application of fresh water during dry season.
 - Operations will be confined to the wellpad working surface.
 - Continuous monitoring of disturbed areas to evaluate additional BMPs needed.
 - Fresh water application to disturbed areas during construction.
 - Fresh water or magnesium chloride application to graveled surfaced of the Location and associated roads.
 - Speed limit signs will be posted per surface owner agreement.
 - Contractors will be notified of speed limits if no signs are posted.
 - Regular road maintenance such as grading and adding additional gravel as needed.
3. **Mud Tracking:** in lieu of Vehicle Tracking Control (VTC), the contractor shall install an asphalt apron where a proposed access road intersects a paved public roadway. If the public roadway is gravel, a VTC is not necessary. VTC or asphalt apron shall be installed in the initial phase before the pad site grading begins.
4. **Transportation and Circulation:** The Applicant has provided the Traffic Management Plan and Traffic Letter with this application. The Invicta 3-65 28 haul route is depicted on the Haul Route Sheet of the site plan.
5. **Road Maintenance:** Access points to public roads shall be located, improved, and maintained to ensure adequate capacity for efficient movement of existing and projected traffic volumes and to minimize traffic hazards.

1.D.5: Completion Operations Site Plan Best Management Practices

1. **Chemical Disclosure and Storage:** All hydraulic fracturing chemicals will be disclosed to the Aurora Fire Rescue department. Prior to the bringing of such chemicals onto the location, the Operator will make available to the City the storage, containment and disposal method for such chemicals.
2. **Lighting:** Lighting is only used during the Drilling and Completion Phases of operations. All lighting used will be situated so that it is downcast and does not shine beyond the boundary of the oil and gas operations area. A Photometric Light Plan is submitted as part of the Site Plan.

3. **Odor:** Applicant will mitigate odors by routing to closed loop systems to the maximum extent practicable. If the Applicant receives complaints from a Residential Building within 1,320 feet from the site, Applicant will take measures to mitigate the odor within 24 hours, based on the specific circumstances.
4. **Reduced Emission Completions (Commonly known as Green Completions):** The Applicant will comply with the EPA Reduced Emission Completions rules (under 40 CFR 60 Subpart OOOO and OOOOa) for oil and gas wells. The Applicant will apply best management practices to safely maximize program and is committed to reducing emissions from flaring and venting. For resource recovery and minimize releases to the environment.
5. **Removal of Equipment:** At the end of the flowback stage of development (the beginning of the Production Phase), all temporary equipment will be removed from the Invicta 3-65 28 site (within 30 days), leaving only the wellhead(s) and the permanent production facilities, including, separators, storage tanks and emissions control equipment. No permanent storage of removable equipment will occur on any well site.
6. **Water Supply:** The Operator has a site- specific Water Delivery Plan and Method that has been provided to the City with this application. The applicant will use temporary, above-ground water supply lines (“Lay Flat Lines”) that are typically 12” in diameter and made of synthetic rubber or similar “hose” material. They are used for the transfer of water from an identified water source to support hydraulic fracturing operations.

1.D.6: Production Operations Site Plan Best Management Practices

1. **Berms for Fluid Containment:** GMT shall utilize steel-rim berms or lined earthen berms at the Invicta 3-65 38 location with sufficient capacity to contain one and one-half (1.5) times the maximum volume of the largest tank.
2. **Color/Paint Color:** All permanent above ground associated production equipment, structures and stationary equipment for the Invicta 3-65 28 will be painted in a tan or brown matte finish unless a different color is necessary for safety per regulations.
3. **Containment Berms:** Secondary containment will be installed around tanks on location and is designed to contain 150% of the largest tank in the facility. GMT utilizes a steel-walled berm with an impervious poly liner.
4. **Discharge Valves:** Open-ended discharge valves on all storage tanks and other containers within the Invicta 3-65 28 location will be secured, capped, or blind- flanged, and so they will not be accessible to the general public. An exception is made for safety relief valves. Open-ended discharge valves within the Oil and Gas Location or Flowline shall be placed within the interior of the secondary containment area.
5. **Fencing:** Permanent opaque fencing shall be installed around production equipment and shall be secured.
6. **Flammable Material:** The Invicta 3-65 28 location will be maintained in a manner so to ensure that all ground within twenty-five (25) feet of any tank or other structure containing flammable or combustible materials will be kept free of dry weeds, grass, rubbish or landscaping.

7. **Flowlines:** All flowlines (the pipeline connecting the wellhead to the production facility) are contained entirely within the boundary of the well pad. No off-location flowlines will be utilized. Please see Relevant Location and Flowline Plat.
8. **General Maintenance:** All equipment will be operated and maintained pursuant to manufacture specifications consistent with technological limitations and reasonable and customary maintenance practices.
9. **Landscaping:** A Landscaping Plan is not required for this location.
10. **Low Profile Equipment:** All equipment will comply with the Aurora Oil and Gas Manual. No variances will be sought.
11. **Maintenance of Machinery:** Routine field maintenance of vehicles and mobile machinery will not be performed within 500 feet of navigable waters of the United States. All fueling will occur over impervious material.
12. **Noxious Weed Control:** All disturbed ground not needed for subsequent operations for Invicta 3-65 28 location, including stockpiles and cut and fill slopes, are seeded and mulched in accordance with the permits. Approved weed-free seed mix is used, and these areas are monitored and maintained for weed establishment for the life of the well.
13. **Odor:** Applicant will mitigate odors by routing to closed loop systems to the maximum extent practicable. If the Applicant receives complaints from a Residential Building within 1,320 feet from the site, Applicant will take measures to mitigate the odor within 24 hours, based on the specific circumstances.
14. **Plugged and Decommissioned Well Testing:** Pursuant to ECMC regulation, an offset well evaluation for the Invicta 3-65 28 location will be submitted to the ECMC for review.
15. **Reclamation:** Pursuant to ECMC rule 1003(b.), Interim Reclamation will occur within six months of first production. The Applicant will comply with ECMC Rules 1000 series governing the reclamation of sites. An Interim Reclamation Plan has been provided within the Site Plan for this application further detailing site- specific reclamation that will take place following the well(s) being put into production. Additional information regarding Interim reclamation may also be found in the Storm Water Management Plan (SWMP), that will be submitted to the Public Works Department. A Final Reclamation Plan will be submitted to the City concurrently with the Applicant's plugging and abandonment permit submission to the ECMC. Areas reaching substantial completion of grading and topsoil placement operations will be drill seeded and crimp mulched within 14 days of substantial completion of grading and topsoil operations. If an incomplete area is to remain inactive for longer than 30 days, it will be drill seeded and crimp mulched or otherwise landscaped within 14 days from the suspension or completion of land disturbance activities.
16. **Spills:** The Applicant will notify the City of any spill of materials on permeable ground at Invicta 3-65 28 location that has a reportable quantity under any applicable laws. Applicant will provide a copy of the self-reporting submissions that the Applicant provides to the ECMC due to any spill on the Well Site.
17. **Transportation and Storage of Fluids:** GMT is negotiating existing pipeline infrastructure.