MDEQ SUBDIVISION
APPLICATION REPORT

Horse Creek Hills 1 Subdivision

Located in a Portion of Section 31
Township 9 N, Range 2 E, P.M.M.
Broadwater County, MT

Project # 19-072
June 2020

Prepared By:

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June 11, 2020

Montana Department of Environmental Quality
Rachel Clark, Engineering Bureau
1520 E Sixth Avenue
PO Box 200901
Helena, MT 59620
Ph: 406-444-6722
E-Mail: rclark@mt.gov

RE: Horse Creek Hills 1 Subdivision
Located in a Portion of Sec 31, T9N, R2E, P.M.M.
Broadwater County, Montana

Dear Ms. Clark:

This report presents Allied Engineering's wastewater system evaluation for the Horse Creek Hills 1 Subdivision. The proposed project is located approximately 0.25 miles east of Canyon Ferry Reservoir at the location where Lower Confederate Road reaches the lake. The legal description of the approximately 435-acre is Section 31, Township 9 North, Range 2 East, Principal Meridian Montana, Broadwater County, Montana. The subject property is currently used for cattle grazing purposes.

In short, there are four different projects proposed to develop the property. The current projects are proposing to develop the subject property into a 41-lot major subdivision. Horse Creek Hills 1 Subdivision will be one of four projects through MDEQ and will consist of developing the 435-acre parcel into 11 residential lots and 1 commercial lot – ranging in size from 5-acres to 12-acres. The remaining portion of the property is proposed to be developed into residential and commercial lots in Subdivision projects #2-4.

Refer to the Test Well Drilling Program and Summary included in the appendix for details on how site-specific data was gathered in order to determine the groundwater gradient and direction, hydraulic conductivity, background nitrates, and overall subsurface properties. No-degradation was evaluated on lots that did not meet the Categorical Exemption #1 as outlined in Appendix P of the Non-degradation manual. As a result, the non-degradation calculations shown in Appendix D show the worst-case scenario for the entire development as a whole – which includes the lots that were exempt from non-degradation review. However, lots that were exempt from non-degredation were not included in the cumulative effects calculations. Thus, only the lots that did not meet the requirements for exemption under Category #1 were evaluated for cumulative effects. The worst-case scenario for non-exempt lots in cumulative effects were lots 15 & 16 of Horse Creek Hills 2 Subdivision – as they were the closest in distance. Overall, a maximum of two total drainfields line up in the direction of groundwater in the entire development – thus lots 15 & 16 were the worst-case scenario for cumulative effects because they were the closest together of any of the drainfields that overlapped in the direction of groundwater.

Groundwater monitoring has been required by the Broadwater County Sanitarian for lots #1, 2, 3, & lot 41 (Horse Creek Hills 4 Subdivision). Signs of groundwater were not entirely evident during the site evaluation; however, monitoring is being required for these sites due to their proximity to Lower Confederate Creek.

An 8-hour pump test was conducted on a production well that was drilled on lot #13 of the Horse Creek Hills 2 Subdivision. Pumping was conducted at a rate of 15 gallons-per-minute for 8 hours in total. The production well was drilled beyond the upper 15-ft of the aquifer, and will be proposed to be utilized for lot #13 pending subdivision approval. The Razack Huntley equation was used to estimate Hydraulic conductivity based on the 8-hour pump test. This hydraulic conductivity value was used for non-degradation analysis for all four subdivision projects.

Each lot is proposed to be served by an onsite water supply well, and an on-site wastewater treatment system consisting of a septic tank and a subsurface gravity fed drainfield. The enclosed application is seeking approval for 11 lots located in a proposed subdivision with each lot consisting of one (1) single family dwelling with up to 5-bedrooms. Each lot in the proposed development corresponds to 400-gpd according to Circular DEQ-4. This project is also pursuing an approval of a proposed wastewater treatment systems to serve one (1) commercial lot with up-to 24 employees. According to Circular DEQ-4, the design wastewater flow for an employee in a commercial unit is 13-gallons per day, thus a commercial lot will have 312-gallonss per day of effluent flow.

As part of this application, a site evaluation was conducted, an extensive Test Well Drilling Program was completed, a non-degradation analysis has been performed, and a wastewater treatment system consisting of septic tanks and gravity fed drainfields have been proposed where wastewater systems were conservatively over-sized to ensure soils absorption over a larger area. The non-degradation analysis including cumulative effects shows the groundwater impacts will not be significant.

Vicinity maps, soils information, non-degradation analysis, wastewater sizing, etc. has been included in this report.

If you have any questions or comments, please contact the undersigned. Thank you.

Sincerely,

Allied Engineering Services, Inc.

Hunter Morrical, EI
Staff Engineer

cc: 71 Ranch LP (Ownership Entity)
Jesse Merrit (Project Representative)

P:\2019\19-072 71 Ranch - Major Subdivision\04 Permitting & Entitlements\03 - MDEQ Sub Application\Horse Creek Hills 1 Subdivision\Documents\Horse Creek Hills 1 Sub-Cover Letter_2020_04_01.docx

I. INTRODUCTION

This report presents Allied Engineering's wastewater system evaluation for the Horse Creek Hills 1 Subdivision. The proposed project is located approximately 0.25 miles east of Canyon Ferry Reservoir at the location where Lower Confederate Road reaches the lake. The legal description of the approximately 435-acre is Section 31, Township 9 North, Range 2 East, Principal Meridian Montana, Broadwater County, Montana. The subject property is currently used for cattle grazing purposes. The current projects are proposing to develop the subject property into a 41-lot major subdivision.

The Horse Creek Hills 1 Subdivision is proposed to develop the underlying 435-acre property into eleven (11) residential lots and one (1) commercial lot. The rest of the property will be developed into residential and commercial lots in subsequent MDEQ subdivisions (Horse Creek Hills 2-4 Subdivisions). Lots int project #1 range in size from 5-acres to 12-acres. One open space lot will be included as part of the Horse Creek Hills 4 Subdivision.

Several dry gullies are within the extents of the property that show up as "Blue Line Streams" on the USGS 7.5k quad maps. The elevation of the groundwater in the property was measured using three test wells that were drilled into the first aquifer. The elevation of groundwater is considerably lower than the elevation of the dry gullies on site - thus the blue line streams can be shown to be losing streams. The elevation of groundwater is 3795' above sea level at the locations where the lower elevation of the dry gullies is approximately 3840' above sea level. Additionally, these dry gullies were walked by AESI staff and no noticeable springs or visible groundwater seepage into the gullies was observed.

Groundwater monitoring has been required by the Broadwater County Sanitarian for lots #1, 2, 3, & lot 41 (Horse Creek Hills 4 Subdivision). Signs of groundwater were not entirely evident during the site evaluation; however, monitoring is being required for these sites due to their proximity to Lower Confederate Creek.

Each lot is proposed to be served by an onsite water supply well, and an on-site wastewater treatment system consisting of a septic tank and a subsurface gravity fed drainfield.

The enclosed application is seeking approval for 11 residential lots located in a proposed subdivision with each lot consisting of one (1) single family dwelling with up to 5-bedrooms. Additionally, the application is seeking approval for 1 commercial lot that will not serve more than 24 employees utilizing up to 13gpd of wastewater. Each residential lot in the proposed development corresponds to 400-gpd according to Circular DEQ-4. The commercial lot in the subdivision corresponds to 312 -gpd according to Circular DEQ-4.

As part of this application, a site evaluation was conducted, a non-degradation analysis has been performed for Lots #1-4. Lots #5-12 were not evaluated for non-degradation, as they meet the Category

#1 exemption listed in Appendix P of the non-degradation manual. These lots meet this exemption as they: are greater than 1,000 feet from Canyon Ferry in the direction of groundwater; they have a perc rate between 16 and 50 mpi based on the soil type; they have soil profiles that show 6 feet or more of VFS, sCL, CL, or SiCL or finer; they have background nitrate levels in the first aquifer of less than 2 mg/l; the lots are larger than 2 acres; the percolation rate is greater than or equal to 16 mpi based on the soil texture type; the soil beneath the trench is VFS, SCL, or finer material; depth to bedrock was greater than 8-ft; and the separation between the proposed mixing zones and any water supply well is greater than 100-ft. See test pit logs in Appendix B for soil profile data. Wastewater treatment systems consisting of septic tanks and gravity fed drainfields has been proposed. The non-degradation analysis shows the groundwater impacts will not be significant. Please note that although this project was submitted concurrently with Horse Creek Hills 2-4 Subdivisions and presents some of the same information, they are separate projects.

Vicinity maps, soils information, non-degradation analysis, wastewater sizing, etc. has been included in this report.

II. WATER SUPPLY

Each lot is planned to be served by an onsite domestic water supply well. The approximate location of each proposed well is shown on the proposed Lot Layout (see Appendix Table of Contents). A pump test was conducted on a future water supply well that was drilled in November of 2019. The pump test was conducted for 8-hours, and the pump rate from the well was approximately 15gpm. The static water level in the well recovered in less than 8-hours, thus adequate water supply in the aquifer can be anticipated.

As part of our septic evaluation, a water sample was taken from the three on-site test wells that were drilled to the first aquifer, and analyzed for background nitrates, and conductivity. Samples were obtained in the upper 15 ft of the aquifer for each Test Well. The water sample analysis results found the following:

Table 1: Horse Creek Hills 1 Subdivision – Background Water Samples

Sample Location	GWIC ID#	Nitrate and Nitrite as N (mg/L)	Conductivity (uS/cm)
TW #1	304166	0.50	522
TW #2	304169	1.30	380
TW #3	304167	0.97	607

The average background nitrate as outlined by the Non-degradation manual of 0.92 mg/L was used for this application.

III. WASTEWATER SYSTEM

Each of the proposed wastewater systems will consist of one (1) 1,500-gallon double compartment concrete septic tank with effluent filter and an individual sub-surface gravity fed drainfield. Test Pits were conducted in the areas of the proposed absorption areas and have been included in Appendix B.

Site Evaluation:
On February 6th and 10th of 2020, twelve (12) test pits were conducted by personnel from Allied Engineering Services, Inc. in the vicinity of Horse Creek Hills 1 Subdivision. We have also included the

test pits that were conducted as part of the overall development (Horse Creek Hills 2-4 Subdivisions). Overall, forty-four (44) test pits were excavated on the property as part of the overall development plan for wastewater system sizing.

Test pits logs for lots #1-12 are summarized below. The test pit number corresponds to the lot number on which it was excavated – i.e. Test pit #6 was excavated on lot #6. Complete test pit logs for all 4 subdivisions have been included as part of Appendix B. Additionally, hydrometer tests from six locations are included with the Test Pit logs. Hydrometer tests were performed on the material samples that best represented the majority of the test pits on-site - to help confirm on-site findings. Hydrometer test results corresponded with soil textures found in the lab after the test pit samples had been brought into the AESI laboratory. No groundwater, bedrock, or limiting layer was encountered.

Table 2: Horse Creek Hills 1 Subdivision –Test Pit Results

Test Pit	Soil Texture	Percolation Rate (min/inch)	Application Rate – Test Pits (gpd/ft^2)	Application Rate – Perc Tests (gpd/ft^2)	* Required Absorption Area (ft^2)	Type of Wastewater System
TP-1	Silty Loam	16-31	0.4	N/A	780	Gravity-Fed
TP-2	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-3	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-4	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-5	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-6	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-7	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-8	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-9	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-10	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-11	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed
TP-12	Silty Loam	16-31	0.4	N/A	1,000	Gravity-Fed

* Required Absorption for Residential Area based on (1) 5-bdrm home = 400-gpd
* Required Absorption for Commercial Area based on (1) Commercial building with less than or equal to 24 employees = 312-gpd

Soil survey data from the Natural Resources Conservation Service (NRCS) was evaluated as part of this application. Soil map units in the vicinity of the project location include AoB, AoC, Chc, MxE, MwE, and Te. The NRCS Engineering Properties for these map units range from Silt Loam to gravelly loam – as shown on the NRCS soil data included in Appendix B. NRCS data generally correlates with data found during the field investigations.

The proposed gravity fed drainfields have been sized according to the results obtained from test pits performed on-site which provide for an overall conservative application rate of 0.4 gpd/ft^2 for all lots per the sizing criteria of Circular DEQ-4, Chapter 2, Section 2.1.7.

The subject property is located within the FEMA FIRM Map Panel 30007C0350C – Included in Appendix E.

Wastewater System Sizing

A septic site plan has been provided for the proposed wastewater treatment systems (see Appendix Table of Contents). A master table shown on sheet WW3.4 of the design plans shows wastewater sizing for the entire development based on the soil profile corresponding to each lot. The primary and replacement areas are within 25 feet of the test pit locations.

Wastewater Flow. This project is pursuing an approval of a proposed wastewater treatment systems to each serve one (1) single family dwelling with up-to a 5-bedrooms for the residential lots. According to Circular DEQ-4, the design wastewater flow for a 5-bedroom home is 400-gallons per day. This project is also pursuing an approval of a proposed wastewater treatment systems to serve one (1) commercial lot with up-to 24 employees. According to Circular DEQ-4, the design wastewater flow for an employee in a commercial unit is 13-gallons per day, thus a commercial lot will have 312-gallonss per day of effluent flow.

Primary Treatment (Septic Tank Size). According to DEQ-4, a 5-bedroom home requires a 1,500-gallon septic tank. We are proposing to utilize one (1) 1,500-gallon double compartment concrete septic tank for the homes. The commercial lot will utilize one (1) 1,000-gallon double compartment concrete septic tank. The 1,000-gallon tank has more than 2.5 times the design flow, so it will be sufficient for the commercial lot.

Effluent Filter. All septic tank effluent must pass through an effluent filter, thus, an effluent filter will be installed in the septic tank. According to a standard maintenance frequency of 5-years, a 4” Biotube effluent filter is sufficient to accommodate the projected daily sewage flow of the 400-gpd for the proposed single-family home. A high level alarm is recommended to be installed in each septic tank to signal that the filter has clogged and needs maintenance.

Secondary Treatment (Drainfield Size). Wastewater treatment systems in the proposed subdivisions will vary slightly because of varying soil profiles and anticipated effluent flows. Because of this, four different drainfield designs have been established for the overall development and are shown on Sheets WW3.1 and WW3.2 of the design plans in Appendix H. A general table on Sheet WW3.4 outlines which system can be utilized on which lot. Additionally, the system type for each lot is shown on the proposed Subdivision Wastewater Treatment System overview sheets in the design plans.

If the system needs to be replaced, the 100% replacement is designated adjacent to the primary drainfield location and is sized assuming no reduction.

Gravity Distribution Design. The sewage gravity services will consist of 4-inch diameter Schedule 40 PVC solid sewer pipe. The sewage gravity line shall maintain grade (no humps or bellies) in order to allow for proper drainage, which will minimize the potential of freezing of the effluent in the pipe. The 4-inch diameter pipe will gravity to a distribution box. From the box, four or five (depending on the drainfield type) 4-inch Schedule 40 PVC solid sewer pipes will gravity to the proposed trenches. Depending on whether the owner chooses to install the standard trench or gravelless trench, the 4-in line will either run to the end of each lateral or terminate at the beginning of the infiltrator chamber – per manufacturer recommendations.

IV. SOLID WASTE DISPOSAL

Solid waste will be disposed of by individual lot owners at two different locations: – One waste container located and operated by Townsend Solid Waste - located in Townsend, Montana. The other location also operated by Townsend Solid Waste is at the Dry Gulch located – in Broadwater County.

V. DRAINAGE

A storm drainage evaluation has been performed as part of this application. Please see the appendix table of contents.

Non-Degradation Analysis

Based on our analysis, the new wastewater system improvements will have a non-significant impact on surface and ground water supplies. The closest distance to the nearest surface water in the direction of groundwater of greater than 1,000 feet. Lots #5-12 were not evaluated for non-degradation, as they meet the Category #1 exemption listed in Appendix P of the non-degradation manual. These lots meet this exemption as they: are greater than 1,000 feet from Canyon Ferry in the direction of groundwater; they have a perc rate between 16 and 50 mpi based on the soil type; they have soil profiles that show 6 feet or more of VFS, sCL, CL, or SiCL or finer; they have background nitrate levels in the first aquifer of less than 2 mg/l; the lots are larger than 2 acres; the percolation rate is greater than or equal to 16 mpi based on the soil texture type; the soil beneath the trench is VFS, SCL, or finer material; depth to bedrock was greater than 8-ft; and the separation between the proposed mixing zones and any water supply well is greater than 100-ft. When taking cumulative effects into account, the worst-case scenario for lots not meeting the categorical exemption was two drainfields overlapping together in the direction of groundwater. The worst-case scenario for the entire subdivision is two drainfields that are separated by 466 feet – those two lots being lot 15 & lot 16 of Horse Creek Hills 2 Subdivision. For the lot with the most downgradient overlapping wastewater systems (Lot 15), the phosphorous breakthrough is 155 years – accounting for the distance to surface water being the distance between drainfields. The nitrate concentration at the end of the final 200-ft mixing zone for lot 15 is 3.70 mg/L. Each of these values satisfies the non-degradation requirements of 5.0-mg/L for nitrate (maximum) and 50-year breakthrough for phosphorous (minimum). Besides the constant values that are accepted as input for all analyses and the dimensions of the drainfield areas, a few site-specific parameters were entered. A summary of the variables we selected and our reasoning is listed as follows:

- Hydraulic Conductivity = 100.5-ft/day
  The hydraulic conductivity was calculated using the Razack Huntley Equation on data obtained from an 8-hour pump test that was conducted on site. Pump test data has been included in Appendix D. Included are the pump test results from the three test wells that were drilled (TW-1, TW-2, TW-3). These wells were drilled into the first aquifer and pump test data from when they were drilled (11/26/19) was used along with the longer pump test from the production well to determine the average hydraulic conductivity for the aquifer.

- Hydraulic Gradient = 0.0021 ft/ft
  Hydraulic gradient and direction was determined using onsite monitoring wells that were part of an overall comprehensive groundwater monitoring well program and evaluation of the subject property. These wells were drilled to a depth of the first aquifer in November of 2019. The hydraulic gradient was determined to be 0.021 ft/ft with a direction of S38° 34' 40"W. A groundwater direction Exhibit has been included in Appendix A.

- Mixing Zone Length = 200-ft
  The acceptable mixing zone length based on each property size (±2.0 Acres) is 500-ft. However, a source specific mixing zone of 200-ft is being proposed for all lots within the project, as non-degradation calculations show a 200-ft mixing zone being acceptable given the site conditions.

- Background Nitrate = 0.923-mg/L
  Three nitrate concentrations from water samples taken from three onsite monitoring wells, in the top 15 ft of the first aquifer were analyzed – as shown in table 1 of this

report. The three values were averaged together because the values do not differ significantly throughout the site – as outlined by the non-degradation manual.

- Precipitation = 14-in/year
  Based on information from the Western Regional Climate Center (see Appendix A).

- Depth to limiting layer = 9-ft
  No groundwater or limiting layer was observed in the test pits that were performed near the vicinity of the proposed wastewater absorption systems. The Test Pits extended to a depth of at least 12-ft below ground surface throughout the subdivision, and a gravity fed drainfield is proposed with a trench depth of 24”-36” below ground surface.

- Distance to Surface Water = 1,000-ft
  Several dry gullies shown as blue line streams on the 7.5k quad map on-site have closer separations to drainfield than the above distance; however, because of the groundwater elevation related to the bottom of the gullies is significant, those dry gullies have been assumed to be losing. A minimum of 1,000-ft of separation between drainfields and surface water is required for the categorical exemption to remain in effect, thus 1,000 ft was conservatively analyzed as the distance to surface water. Canyon Ferry Reservoir is the closest surface water to any drainfield within the development, and it is greater than 1,000-ft away in the direction of groundwater. An adjacent to state waters calculation was conducted for the development and is shown in Appendix D. The calculation shows that impacts to surface water will be non-significant due to the large conveyance of Canyon Ferry Reservoir in relation to the number of drainfields being constructed.

SUBDIVISION REVIEW JOINT APPLICATION FORM

Montana Department of Environmental Quality
Local Government Joint Application Form
Parts I, II, III, IV, and Checklist

Section 76-4-129, Mont5ana Code Annotated (MCA), provides that this Subdivision Review Joint Application Form may be used to apply for Montana Department of Environmental Quality (DEQ) approval of subdivisions under the Sanitation in Subdivision laws and for subdivision approval by local governments under the Subdivision and Platting Act. The form replaces DEQ Form E.S. 91 and local preliminary plat approval forms. Landowners thus are relieved from the burden of providing similar information on different forms under two separate laws. Please consult with your local planning board, health department, or DEQ regarding the proper submittal of this application and supporting materials.

A. When applying for subdivision review by the planning board and local governing body, the following parts of this form must be completed and submitted to the governing body or its designated agent.

    1. Part I must be completed for all subdivisions required to be reviewed and approved by the local governing body.

    2. Parts I, II, and III must be completed for all subdivisions for which local subdivision regulations require submittal of an environmental assessment.

B. When applying for review of subdivisions by DEQ, Parts I and II of this form must be completed and submitted to DEQ. If the proposed subdivision is located in a county contracted to perform the review of subdivisions, the application must be submitted to the local health department.

C. When applying for concurrent review of the subdivision by the local governing body and by DEQ, the following parts of this form must be completed and submitted to the local governing body or its designated agent, or to DEQ:

    1. Parts I and II must be completed for all subdivisions for which concurrent review is requested.

    2. Parts I, II and III must be completed for all subdivisions for which local subdivision regulations require submittal of an environmental assessment.

D. Although not a requirement of this Joint Application, it is highly recommended that the applicant complete Part IV - Subdivision Checklist and submit the checklist with Part I and the information required by Part II. The checklist identifies the application items (with references to applicable rules and technical circulars) that are typically required by the reviewing authority. Depending on the technical complexity of the proposed subdivision, the checklist may not necessarily identify all of the required application items. However, it does provide general guidance to assist the applicant in preparing a more complete application so as to expedite the review/approval process by the reviewing authority.

Copies of this Joint Application Form are available from:

- Montana Department of Environmental Quality, Permitting and Compliance Division;
- Montana Department of Commerce, Economic and Community Development Division;
- Local health departments and sanitarians; and
- Local planning offices.

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY/
LOCAL GOVERNMENT JOINT APPLICATION FORM

PART I. GENERAL DESCRIPTION & INFORMATION

Name of proposed development: Horse Creek Hills 1 Subdivision

Location:

City: Townsend

County: Broadwater County Geocode: 43-1792-31-1-01-0000

Legal description: ____ ¼ ____ ¼ __________ of Section 31 Township 09N Range 02E

Type of Review

- [x] Division of Land, Boundaries Relocated, or Removal of Restrictions
- [ ] Condominiums/Townhomes/Mobile Homes/Recreational Vehicles
- [ ] Rewrite – No Boundaries Changing, Aggregation, Change of Use
- [ ] Modified Site Plan

Descriptive Data

12 Number of lots

_____ Number of condominiums, townhomes, or spaces

117.98 Total acreage of lots being reviewed

Indicate the proposed/existing use(s)

- [x] Residential, single family
- [ ] Residential, multiple family
- [ ] Type of multiple family structure (e.g. duplex) ______________
- [ ] Planned unit development
- [ ] Condominium/townhomes
- [ ] Mobile home park
- [ ] Recreational vehicle park
- [x] Commercial or industrial
- [ ] Other (please describe)

Type of water supply system

- [x] Individual well
- [ ] Individual surface water supply or spring
- [ ] Cistern
- [ ] Shared well (2 connections)
- [ ] Multiple-user (3-14 connections < 25 people)
- [ ] Service connection to multiple-user system
- [ ] Service connection to public system
- [ ] Extension of public main
- [ ] New public system (15+ connections or serving 25+ people)

Type of wastewater treatment system

- [x] Individual wastewater treatment system
- [ ] Shared wastewater treatment system (2 connections)
- [ ] Multiple-user (3-14 connections < 25 people)
- [ ] Service connection to multiple-user
- [ ] Extension of multiple-user main
- [ ] Service connection to public system
- [ ] Extension of public main
- [ ] New public system (15+ connections or serving 25+ people)

Name of solid waste (garbage) disposal site: ______________________

Designated representative, if any (e.g., engineer, surveyor)

I designate Mark Fasting of Allied Engineering Services, Inc.

Print name Print Company Name

as my representative for purposes of this application.

Address: 32 Discovery Drive, Bozeman MT 59718

Street or P.O. Box, City, State, Zip Code

Email: mfasting@alliedengineering.com Phone: 406-582-0221

Owner

Name: Errol T. Galt 71 Ranch, LP by Errol T. Galt, President

Signature of all owners of record Print name of owner (s)

Address: 40 71 Ranch Lane, Martinsdale, MT 59053

Street or P.O. Box, City, State, Zip Code

Email: errol@71ranch.net Phone: 406 572-3312

Date: 05/22/2020

Reviewer	Applicant		
Yes Missing NA	Initials	Page(s) in Report	ELEMENT DESCRIPTION
General			
	HTM	13	Application form provided & signed by owner, plus contact info for consultant.
	HTM	26	Filled out fee sheet & check made out to DEQ
	HTM	24-25	Completed & signed copy of Part 4 Checklist
	HTM	30-31	Vicinity Map Provided
	HTM	196-200	Copy of plat or COS (or deed if aliquot parts or proposing Aggregation of lots)
	HTM	337-346	4 copies of lot layout sheet(s); Facilities labeled as Existing or Proposed.
	HTM	N/A	Copy of any existing COSA for reviewed lot(s)
	HTM	204-205	Floodplains shown on drawings & any applicable documentation provided (LOMAs).
Onsite Wastewater			
	HTM	N/A	Copy of any existing WWTS permits for reviewed lot(s).
	HTM	N/A	Proof of pumping for septic tanks within last 3 years, unless system less than 5 years old.
	HTM	112-155	Soil profile descriptions
	HTM	3	Seasonal high groundwater addressed (results or letter indicating in process)
Non-degradation			
	HTM	10-11, 171-188	Nondegradation info IF new development proposed, if expansion of existing development proposed, or for change in use (residential to commercial, etc.)
Onsite Water			
	HTM	159-162	Copy of any existing well logs for wells on reviewed lot(s), for wells sampled, & for wells used for hydraulic conductivity estimates
	HTM	157-158	Information about water quality, quantity & dependability (water tests & aquifer well logs)
Public Water or Sewer			
	HTM	N/A	If extensions or connections to existing public water/wastewater proposed, "will serve" letter or copy of current bill from public facility owner if connected
Stormwater			
	HTM	206	Stormwater drainage report & plans
Other documents			
	HTM	N/A	Special Requests - Prior to full design (waivers, deviations, water availability analysis, non-degradation predetermination, etc.)
	HTM	203	Sage Grouse documentation provided
	HTM	201-202	Copy of submittal to DNRC requesting Water Rights review or, if available, review letter from DNRC.
	HTM	N/A	Modified Site Plan

Copy of This checklist AND ***(circle one)***

COMPLETE LETTER or INCOMPLETE LETTER sent on: Complete Letter ____________________

REVIEWED BY: ______________________________ **AGENCY:** ______________________________

PART II REQUIRED INFORMATION FOR A OF SUBDIVISIONS UNDER SANITATION IN SUBDIVISIONS LAWS (e.g., parcels less than 20 acres, trailer courts, RV parks, condominiums)

All applications must include the information required in ARM 17.36.101-805 and the appropriate circulars. In order to facilitate review, the application should be organized in the same manner as this application form and follow closely the submittal requirements in the rules and circulars.

A. Physical Conditions

Provide the following attachments.

1. A vicinity map showing the location of the proposed subdivision in relation to the nearest town, highway(s).
2. Soils survey map and most recent interpretations of soil suitability for the proposed land uses.
3. Topographic map of the development with contour intervals meeting the preliminary plat requirements of the local subdivision regulations.
4. A copy of a preliminary plat* (a minor subdivision plat, if applicable) prepared in accordance with local subdivision regulations, or a final plat, show the location of:
   a. Any rock outcroppings.
   b. Any areas subject to flood hazard or, if available, 100- year floodplain studies. (The local floodplain administrator or the Floodplain Management Section of the Water Resources Division of the Department of Natural Resources and Conservation may be contracted for assistance in determining flood hazard locations.)
   c. Any natural water systems such as streams, rivers, intermittent streams, lakes or wetlands. (Also indicate the names and sizes of each).
   d. Any man-made water systems such as wells, ponds, canals, ditches, aqueducts, reservoirs and irrigation systems. (Also indicate the names, sizes and present use of each).
   e. Any existing or proposed utilities located within or adjacent to the subdivision, including electrical power, natural gas, telephone service, and water and sewer pipelines or facilities.

*Submit a preliminary plat or certificate of survey with complete and accurate legal description adequate for DEQ to initiate and complete its review of the subdivision.

B. Water Supply

1. Where an individual water supply system is proposed or existing for each parcel
   a. For a proposed system, provide all information required in ARM 17.36.328 – 336, indicate the distance to the nearest public water system.
   b. If an existing system will be used, provide all information required in ARM 17.36.335.
   c. Attach four copies of the lot layout showing the proposed or existing location of each water supply source (spring, well, or cistern) and indicating the distance to existing or proposed wastewater treatment systems.

2. Where a multiple user water system is proposed or existing
   a. If an existing system will be used:
      1) Identify the system and the person, firm, or agency responsible for its operation and maintenance.
      2) Indicate the system's capacity to handle additional use and its distance from the development.
      3) Provide evidence that permission to connect has been granted.
      4) Provide three copies of the following attachments:
         a) Map or plat showing location, sizes, and depth of any existing water supply lines and facilities that may directly serve parcels within the proposed development.

b) Provide plans and specifications for all proposed extensions and additional lines and facilities as required by ARM 17.36.335 and DEQ-3.

b. If a new system will be used
   1) Indicate who will install the system, who will bear the costs, when it will be completed and who will own it.
   2) Provide all information required in ARM 17.36.330 - 336 and DEQ-3.

3. Where a public water system is proposed or existing
   a. If an existing system will be used
      1) Identify the system and the person, firm, or agency responsible for its operation and maintenance.
      2) Provide evidence that the system is approved by DEQ and is in compliance with the regulations.
      3) Provide evidence that the managing entity has authorized the connections, the system has adequate capacity to meet the needs of the subdivision, the system is in compliance with department regulations, and the appropriate water rights exist or have been applied for the connections.
      4) Provide three copies of the following as attachments.
         a) A map or plat showing the location, sizes, and depth of any existing water lines and facilities that will directly serve parcels within the proposed development.
         b) Plans and specifications for all proposed extensions and additional lines and facilities as required by ARM 17.36.328 - 330 and DEQ-1 or DEQ-3.
   b. If a new system will be used
      1) Indicate who will install the system, who will bear the costs, when it will be completed, and who will own it.
      2) Provide plans and specifications for all proposed extensions and additional lines and facilities as required by ARM 17.36.328 - 330 and DEQ-1 or DEQ-3.

C. Wastewater Treatment

1. Where individual wastewater treatment systems are proposed for each parcel
   a. Indicate the distance to the nearest public wastewater treatment system.
   b. Provide all information required in ARM 17.36.320 - 345 and in DEQ-4.

2. For a proposed multiple user wastewater treatment system
   a. Where an existing system is to be used
      1) Identify the system and the person, firm, or agency responsible for its operation and maintenance.
      2) Indicate the system's capacity to handle additional use and its distance from the development.
      3) Provide evidence that permission to connect has been granted.
      4) Provide two copies of the following attachments.
         a) A map or plat showing the location, sizes, and depth of any existing sewer lines and facilities that will directly serve parcels within the proposed development.
         b) Provide plans and specifications for all proposed extensions and additional lines and facilities as required by ARM 17.36.320-345 and DEQ-4.
   b. Where a new system is proposed
      1) Indicate who will install the system, who will bear the costs, when it will be completed, and who will own it.
      3) Provide all information required in ARM 17.36.320 - 326 and DEQ-4.

3. For a proposed public wastewater treatment system:

a. Where an existing system is to be used
   1) Identify the system and the person, firm, or agency responsible for its operation and maintenance.
   2) Provide evidence that the system is approved by DEQ and is in compliance with the regulations.
   3) Provide evidence that the managing entity has authorized the connections, the system has adequate capacity to meet the needs of the subdivision, and the system is in compliance with department regulations.
   4) Provide three copies of the following as attachments.
      a) A map or plat showing the location, sizes, and depth of any existing sewer lines and facilities that will directly serve parcels within the proposed development.
      b) Plans and specifications for all proposed extensions and additional lines and facilities as required by ARM 17.36.328 and DEQ-2 or DEQ-4.

b. Where a new system is proposed
   1) Indicate who will install the system, who will bear the costs, when it will be completed, and who will own it.
   2) Provide plans and specifications for all proposed extensions and additional lines and facilities as required by ARM 17.36.320 - 326 and DEQ-2 or DEQ-4. (Also see ARM 17.38.101).

D. Solid Waste

1. Describe the proposed method of collecting and disposing of solid waste.

2. Indicate the name and location of the department-licensed or appropriate out-of-state solid waste disposal site where solid waste will be disposed in accordance with ARM 17.36.309.

E. Drainage

1. Streets, roads, and unvegetated areas.
   a. Describe measures for disposing of storm run-off from streets, roads, parking lots, and other unvegetated areas within the subdivision or onto adjacent property.
   b. Indicate type of road surface proposed.
   c. Describe facilities for stream or drainage crossing (e.g., culverts, bridges).
   d. Describe how surface run-off will be drained or channeled from parcels.
   e. Indicate if storm run-off will enter state waters and describe any proposed treatment measures. (A DEQ storm-water discharge permit may be required)
   f. Describe any existing or proposed streambank or shoreline alteration, any proposed construction or modification of lakebeds or stream channels. Provide information on location, extent, type, and purpose of alternation.
   g. Provide storm drainage plans and specifications as required by ARM 17.36.310 and DEQ-8.

F. Other Permits That May Be Necessary

1. Water Use Permit (Water Rights)

The Montana Water Law requires new water developments (after July 1, 1973) to be filed with the Department of Natural Resources and Conservation to receive a water right. For ground water developments, wells and developed springs, the amount of water to be used will determine which form to file with the department.

Form 602 – Notice of Completion of Ground Water Development This form is to be filed when the ground water development is a well, developed spring or a ground water pit. The amount of water to be used cannot exceed 35 gallons per minute or 10 acre-feet per year. The form is to be filed within 60 days after the well or spring development is completed and the water has been put to the intended beneficial use. Do not file until the well is hooked up and being used.

Form 600 – Application for Beneficial Water Use Permit When the ground water development is a well, developed spring or ground water pit and the intended use will be over 35 gallons per minute and 10 acre-feet per year, a water use permit must be issued before water can be appropriated. A correct and complete application with the criteria supplement and filing fee must be filed with the Department.

Forms are available at the Water Resources Regional Office at the following addresses:

Helena: Water Resources Regional Office, 1424 9th Avenue, PO Box 201601, Helena, MT 59620-1601, 406-444-6999, or the regional office in your area

Billings: Water Resources Regional Office, Airport Industrial Park, 1371 Rimtop Dr., Billings, MT, 59105-1978, 406-247-4415

Bozeman: Water Resources Regional Office, 151 Evergreen Dr., Suite C, Bozeman, MT 59715, 406-586-3136

Glasgow: Water Resources Regional Office, 222 6th St South, Glasgow, MT 59230, 406-228-2561

Havre: Water Resources Regional Office, 210 6th Ave., Havre, MT 59501, 406-265-5516

Kalispell: Water Resources Regional Office, 109 Cooperative Way, Suite 110, Kalispell, MT 59901, 406-752-2288

Lewistown: Water Resources Regional Office, 613 NE Main St., Suite E, Lewistown, MT 59457, 406-538-7459

Missoula: Water Resources Regional Office, Town & Country Shopping Center, 1610 S. Third St. West, Suite 103, Missoula, MT 59806, 406-721-4284

2. For a complete listing of environmental permits required by the state, please reference the *Montana Index of Environmental Permits* from the Legislature Office of Environmental Quality (LEPO) at 406-444-3742 or visit the LEPO Web site: http://www.leg.state.mt.us/css/publications/lepo/permit_index/permit_tofc.asp.
In addition, there may be other permits required by the federal government or local government agencies.

___ Montana Department of Environmental Quality (DEQ), Water Quality web site (deq.state.mt.us/wqinfo)

___ MPDES Wastewater Discharge—All discharges to surface water, including those related to construction dewatering. Contact DEQ, Water Protection Bureau 406-444-3080.

___ Storm Water Discharge—Construction activity greater than 1 acre disturbance. Contact DEQ, Water Protection Bureau 406-444-3080.

___ MGWPCS Discharge—All construction and/or operation of wastewater impoundments or conveyances which may cause pollution of ground water. Also, includes land application of wastewater on a case-by-case basis. Contact DEQ, Water Protection Bureau at 406-444-3080.

___ 318 Authorization—Any activity in any state water that will cause unavoidable short-term violations of water quality standards. Contact DEQ, Water Protection Bureau at 406-444-3080.

___ 310 Permit/SPA (124)—Any activity that physically alters or modifies the bed or banks of a stream. Contact the local Conservation District.

___ 404 Permit—Any activity resulting in the discharge or placement of dredged or fill material into waters of the U.S., including wetlands. Contact U.S. Army Corp of Engineers at 406-441-1375.

___ Montana Land-Use License or Navigable Waters Easement—The construction, placement, or modification of a structure or improvement on land below the low water mark of navigable streams. Contact DNRC at 406-444-2074.

___ Water Right Permit—Required before constructing new or additional diversion, withdrawal, impoundment, or distribution works for appropriation of ground water or surface water. Contact DNRC at 406-444-6614.

___ Lakeshore Protection Act—Any project in or near a body of water within a county's jurisdictional area. Contact county government offices.

___ Public Water Supply—New construction, alteration, extension or operation of a public water supply or non-State Revolving Fund (SRF) public sewage systems requires approval from the Department of Environmental Quality. Contact DEQ, Public Water and Subdivisions Review Bureau at 406-444-4400.

___ Shoreline Protection—Any work in, over, or near any stream, river, lake, or wetland on the Flathead Reservation. Contact the Shoreline Protection Office at 406-883-2888 or 406-675-2700 ext. 7201.

___ UST Permits—Activities involving any type of work related to underground storage tanks (petroleum and hazardous substances). Contact DEQ, Technical Services Bureau at 406-444-1420.

___ RW-20 Permit—A permit is required when work is to be done within a Montana Department of Transportation (MDT) right of way. Contact the local MDT District Office.

___ Floodplain Development Permit—Anyone planning new construction within a designated 100-year floodplain. Contact DNRC, Water Operation Bureau, Floodplain Management at 406-444-0860 or local Floodplain Administrator.

PART III INFORMATION REQUIRED FOR ENVIRONMENTAL ASSESSMENT UNDER THE SUBDIVISION AND PLATTING ACT

Information specified in this Part must be provided in addition to that required in Parts I and II of this application form, when the preparation of an environmental assessment is required by the Montana Subdivision and Platting Act.

A. Geology

1. Locate on a copy of the preliminary plat, or on a plat overlay, any known hazards affecting the development that could result in property damage or personal injury due to:
   a. Falls, slides or slumps — soil, rock, mud, snow; or
   b. Seismic activity.

   Describe any proposed measures to prevent or reduce the danger of property damage or personal injury from any of these hazards.

2. Identify any geological conditions that might affect development, such as areas of bedrock, unsuitable soils, or high ground water. Describe any measures proposed to minimize the problems presented by the identified conditions.

B. Vegetation

1. Locate on a copy of the preliminary plat, or on a plat overlay, the location of the major vegetation types such as marsh, grassland, shrub, and forest.

2. Describe measures to be taken to protect trees and vegetative cover (e.g., design and location of lots, roads, and open spaces).

3. Identify areas containing noxious weed growth. Describe proposed means of weed control, especially to prevent weed growth on areas disturbed by construction.

C. Wildlife

1. Identify any major species of fish and wildlife use the area to be affected by the proposed subdivision.

2. Locate on a copy of the preliminary plat, or on a plat overlay, any known important wildlife areas, such as big game winter range, waterfowl nesting areas, habitat for rare or endangered species, and wetlands.

3. Describe any proposed measures to protect wildlife habitat or to minimize degradation (e.g., keeping buildings and roads away from shorelines or setting aside marshland as undeveloped open space).

D. Historical Features

1. Describe and locate on a copy of the preliminary plat, or on a plat overlay, any known or possible historic, archaeological, or cultural sites that may be affected by the proposed subdivision.

2. Describe any plans to protect such sites or properties.

E. Roads

1. Describe any required construction of new public or private access roads or substantial improvements to existing public or private access roads.

2. Describe the proposed closure or modification of any existing roads.

3. If any of the individual lots is accessed directly from an arterial street or road, explain why access was not provided by means of a frontage road or a road within the subdivision.

4. Indicate who will pay the costs of installing and maintaining dedicated or private roadways.

a. Estimate how much daily traffic the subdivision, when fully developed, will generate on existing streets and arterials.
b. Discuss the capability of existing and proposed roads to safely accommodate this increased traffic.
c. Describe any increased maintenance problems and cost that will be caused by this increase in volume.

5. Describe any potential year-round accessibility concerns for conventional automobiles over legal rights-of-way available to the subdivision and to all lots and common facilities within the subdivision.

6. Identify the owners of any private property over which access to the subdivision will be provided and indicate whether easements for access have been obtained from those landowners.

F. Utilities

1. Identify the utility companies involved in providing electrical power, natural gas, and telephone service. Indicate whether utility lines will be placed underground.

2. Identify on the preliminary plat or overlay the locations of any needed utility easements [as required by 76-3-608(3)(c), MCA].

3. Indicate whether the preliminary plat has been submitted to affected utilities for review.

4. Estimate the completion date of each utility installation.

G. Emergency Services

1. Describe the emergency services available to the residents of the proposed subdivision, including number of personnel and number of vehicles or type of facilities and road distance to facilities for:

   a. Fire protection – Indicate whether the proposed subdivision is in an urban or rural fire district. If not, describe plans to form or extend an existing fire district, or describe other fire protection procedures. Where applicable, provide information regarding subdivisions planned in areas of high fire hazards.
   b. Police protection.
   c. Ambulance service.
   d. Medical services.

2. Indicate whether the needs of the proposed subdivision for each of the above services will be met by present personnel and facilities.

   a. If not, describe the additional expenses necessary to make these services adequate.
   b. Explain who will pay for the necessary improvements.

H. Schools

1. Describe the available educational facilities that would serve this subdivision and the road distance to each.

2. Estimate the number of school children that will be added by the proposed subdivision. Provide a statement from the administrator of the appropriate school system indicating whether the increased enrollment can be accommodated by the present personnel and facilities and by the existing school bus system.

I. Land Use

1. Describe land uses on lands adjacent to the subdivision.

2. Describe any comprehensive plan or other land use regulations covering the area proposed for subdivision or adjacent land. If the subdivision is located near an incorporated city or town, describe any plans for annexation.

3. Where public lands are adjacent to or near the proposed development, describe the present and anticipated uses of those lands (e.g., grazing, logging, and recreation). Describe how the subdivision will affect access to any public lands.

4. Describe any health or safety hazards on or near the subdivision, such as mining activity, high-pressure gas lines, dilapidated structures, high-voltage power lines, or irrigation ditches. Any such conditions should be accurately described and their origin and location identified.

5. Describe any on-site or off-site uses creating a nuisance such as unpleasant odor, unusual noises, dust, or smoke. Any such conditions should be accurately described and the origin and location of each identified.

J. Parks and Recreation Facilities

Describe park and recreation facilities to be provided within the proposed subdivision and other recreational facilities that will serve the subdivision.

Possible Sources of Information to Contact When Completing the Form

Local Agencies

- City or County Health Department
- City Engineer or County Surveyor
- County Road Supervisor
- Conservation District
- County Extension Service
- Planning Board Staff
- Floodplain Administrator
- School District
- Fire District or Department
- Police or Sheriff's Department
- Hospital or Ambulance Service
- Chamber of Commerce
- Telephone, Electrical Power, Gas, and Cable Companies

State Agencies	Information	Location
Dept of Fish, Wildlife, and Parks	Fisheries, vegetation and wildlife	Helena and regional offices
Dept of Environmental Quality	Water quality	Helena
Dept of Transportation	Access to state highways traffic data maps, aerial photographs	Helena
Dept of Natural Resources and Conservation (DNRC)	Surface and ground water, floodplains, well logs, water rights, fire hazards	Helena and regional offices
Bureau of Mines and Geology	Geology, ground water, water quality well logs, topographic maps	Butte and Billings

Federal Agencies	Information	Location
Farm Service Agency	Aerial photographs	County offices
Bureau of Land Management	Vegetation, maps, topography	Billings and district offices
Forest Service	Topography, surface water, soil maps, vegetation, wildlife fire hazards, maps	Missoula regional, national forest and district offices
Geological Survey	Geology, surface and ground water, water quality, floodways, topographic maps	Helena
Natural Resources Conservation Service	Soils, surface water, flood hazards, erosion	Bozeman and county offices

Part IV SUBDIVISION CHECKLIST

Subdivision: Horse Creek Hills 1 Subdivision County: Broadwater

E.Q. Number (provided by DEQ): Date:

Please complete the checklist with your initials or N/A.

Applicant or Representative Initial or N/A	County Initial or N/A	DEQ Initial or N/A	Question	Refer to ARM 17.36 Subsections	Reviewer's Comments
N/A			1. Have deviation or waiver requests been submitted with appropriate fees?	17.36.601	
HTM			2. Is check included with correct fee?	17.36.103 and 17.36.802	
HTM			3. Is application included with owner's signature/address/phone/date?	17.36.102	
HTM			4. Is legible copy of Preliminary Plat or COS included?	17.36.103	
HTM			5. Is legal description included on the Preliminary Plat or COS?	17.36.103	
HTM			6. Are all lots described on survey being reviewed and any exclusions clearly stated on Preliminary Plat or COS?	17.36.103, 17.36.605	
HTM			7. Are state letters of approval included (DNRC water rights permit, Groundwater discharge permit, public water etc.?	17.36.103	
N/A			8. Is local health officer approval included?	17.36.103 , 17.36.106, 17.36.108	
N/A			9. Are Planning Board or County Commissioner comments included?	17.36.103(1)(t)	
HTM			10. Is a clear copy of USGS or other topo map included to show ground slope of property?	17.36.103 and 17.36.322 - subsurface wastewater treatment system (SWTS); 17.36.310 - stormwater;	
HTM			11. Are 4 copies of lot layout included with the subdivision name on each?	17.36.103, 17.36.104, 17.36.112	
HTM			12. Is all required information (e.g., scale, legend, north arrow, etc.) included on the lot layout?	17.36.104	
N/A			13. Are locations of water and sewer lines (extensions and connections) shown?	17.36.104	
HTM			14. Are on-site sewer systems designed in conformance with DEQ 4?	17.36.320	
HTM			15. Is the slope given for drainfield areas?	17.36.104, 17.36.322	
HTM			16. Is sewage treatment system type allowed?	17.36.321	
HTM			17. Are drainfield replacement areas shown?	17.36.104	
HTM			18. Are minimum setback requirements met?	17.36.323	
HTM			19. Are soil pits (test holes) labeled, and adequate soil pit data provided?	17.36.104, 17.36.325	
HTM			20. Are sewage system agreements, easements, O & M plan addressed?	17.36.326	
HTM			21. Is information to verify depth to seasonal high ground water or bedrock provided?	17.36.325	
N/A			22. If conducted, does perc test value(s) correspond to soil type?	17.36.325	
N/A			23. Is gray water reuse system proposed?	17.36.319	
HTM			24. Is adequate water supply quantity substantiated?	17.36.103, 17.36.330	
HTM			25. Are water quality analyses (nitrate, nitrite, specific conductivity, and bac-T (for existing wells) provided, along with well log and well location?	17.36.331 (proposed) 17.36.335 (existing)	

			26. Is existing well over 25 ft. in depth and grouted to 25 feet?	17.36.335	
Applicant or Representative Initial or N/A	**County Initial or N/A**	**DEQ Initial or N/A**	**Question**	**Refer to ARM 17.36 Subsections**	**Reviewer's Comments**
N/A			27. Will alternative water supply be used (cistern, spring)?	17.36.336	
HTM			28. Is nondegradation addressed and supporting data to determine background water quality, hydraulic conductivity and hydraulic gradient provided?	17.36.103, 17.36.312, 17.30.501-518, 17.30.715	
HTM			29. Is nitrate level at end of mixing zone < 5 ppm (< 7.5 ppm, if level 2 provided), and phosphorous breakthrough > 50 years and trigger analysis for n and p addressed?	17.36.103, 17.36.312, 17.30.715	
HTM			30. Are all supporting legal documents included (shared users agreements easements, covenants, HOA,water/sewer districts)?	17.36.103, 17.36.326, 17.36.310, 17.36.334	
N/A			31. Is a copy of the local septic permit (if issued) for an existing septic system provided?	17.36.327	
N/A			32. Is a septic pumper's report stating an existing septic tank has been pumped within the last 3 years provided?	17.36.327	
N/A			33. Is evidence demonstrating proper hydraulic functioning of an existing septic system provided?	17.36.327	
N/A			34. Are wells, drainfields and/or mixing zones within 100 ft. perimeter outside of subdivision boundaries shown?	17.36.103, 17.36.104	
N/A			35. Is proposed subdivision within 500 feet of public water supply and/or sewer system?	17.36.328	
N/A			36. Is authorized statement to connect to existing public water and/or sewer system and statement of adequate capacity provided?	17.36.328	
N/A			37. Is existing public water system approved by DEQ and PWS # provided?	17.36.328	
N/A			38. Do appropriate water rights exist for the public water connection?	17.36.328	
HTM			39. Are subdivisions adjacent to state waters addressed?	17.36.312	
N/A			40. Are plans and specs stamped and signed by PE?	17.36.314	
N/A			41. Is letter from owner stating PE certification of construction and "as-builts" will be submitted included?	17.36.314	
HTM			42. Are 100-year floodplain requirements met, and floodplains and drainages shown?	17.36.104, 17.36.323, 17.36.324	
HTM			43.Is solid waste disposal addressed?	17.36.103, 17.36.309 (waste stored on-site)	
HTM			44. Has storm water drainage been addressed?	17.36.310, DEQ 8	

Notes:

Applicant/representative: Name Mark Fasting, PE Signature ______________________________ Date /

County reviewer: Name ______________________________ Signature ______________________________ Date / /

DEQ reviewer: Name ______________________________ Signature ______________________________ Date / /

Subdivision Review Fee Calculation Checklist

SUBDIVISION NAME: Horse Creek Hills 1 Subdivision **EQ#**

Choose type of lots, water system, wastewater system, nondegradation, and other components as necessary

TYPE OF LOTS

	Unit	Unit cost	Number of Units	Total (unit cost x no. of units)
Subdivision lot or parcel or townhouse	lot or parcel	**$160**	12	$1,920.00
Condominium, trailer court, RV campground unit or space	unit or space	**$60**		$0.00
Resubmittal fee - previously approved lot/boundaries not changed	lot or parcel	**$90**		$0.00

TYPE OF WATER SYSTEM

Individual or shared water supply system (existing/proposed)	unit	**$110**	12.00	$1,320.00
Multiple user water system (non-public)	unit*	**$400**		$0.00
**plus $130 per hour for review in excess of 4 hours*	hour	**$130**	**If Required**	**To be invoiced**
new distributing system	lineal foot	**$0.30**		$0.00
connection to distribution system	lot/unit	**$90**		$0.00
Public water system				
DEQ 1 or DEQ 3 Water System	component		**per 17.38.106**	**To be invoiced**

TYPE OF WASTEWATER SYSTEM

Existing systems	unit	**$90**		$0.00
New gravity fed system	drainfield	**$120**	12	$1,440.00
New dosed systems, elevated sand mound, ET systems,	design*	**$240**		$0.00
intermittent sand filter, ETA system, recirculating sand filter,	drainfield	**$60**		$0.00
recirculating trickling filter, aerobic treatment unit,				
nutrient removal, and whole house subsurface drip irrigation				
**plus $130 per hour for review in excess of 2 hours*	hour	**$130**	**If Required**	**To be invoiced**
Gray water reuse, holding tanks, sealed pit privies,	unit*	**$120**		$0.00
unsealed pit privies, seepage pits, waste segregation systems,				
experimental systems				
**plus $130 per hour for review in excess of 2 hours*	hour	**$130**	**If Required**	**To be invoiced**
New multiple user wastewater system (non-public)	unit*	**Per Type Above**		
**plus $130 per hour for review in excess of 4 hours*	hour	**$130**	**If Required**	**To be invoiced**
new collection system	lineal foot	**$0.30**		$0.00
connection to system	lot/unit	**$90**		$0.00
Public wastewater system				
Treatment System	component		**per 17.38.106**	**To be invoiced**

OTHER

Deviation from Circular	request*	**$250**		$0.00
**plus $130 per hour for review in excess of 2 hours*	hour	**$130**	**If Required**	**To be invoiced**
Waiver from Rules	request*	**$250**		$0.00
**plus $130 per hour for review in excess of 2 hours*	hour	**$130**		**To be invoiced**
Reissuance of original approval statement	request	**$70**		$0.00
Review of revised lot layout document	request	**$160**		$0.00
Municipal Facilities Exemption Checklist	request	**$120**		$0.00
Nondegradation review - nonsignificance determinations				
individual/shared	drainfield*	**$70**	3	$210.00
*plus $130 per hour for review in excess of 2 hours	hour	**$130**	**If Required**	**To be invoiced**
multiple-user	lot/structure*	**$40**		$0.00
*plus $130 per hour for review in excess of 2 hours	hour	**$130**	**If Required**	**To be invoiced**
source specific mixing zone	drainfield	**$250**	1	$250.00
public	drainfield		**If Required**	**To be invoiced**
Storm drainage plan review - DEQ-8 Simple plan review	project	**$130**		$0.00
Storm drainage plan review - DEQ-8 Standard plan review	project	**$220**	1.00	$220.00
	lot*	**$50**	12	$600.00
**plus $130 per hour for review in excess of 30 minutes per lot*	hour	**$130**	**If Required**	**To be invoiced**
Preparation of environmental impact statements/EAs	actual cost		**If Required**	**To be invoiced**
Review for compliance with ARM 17.30.718				
New Level 2 System Approval	approval*	**$900**		$0.00
**plus $130 per hour for review in excess of 6 hours*	hour	**$130**	**If Required**	**To be invoiced**
Total Review Fee				$5,960.00

Revised 03/01/2020

Appendix Table of Contents

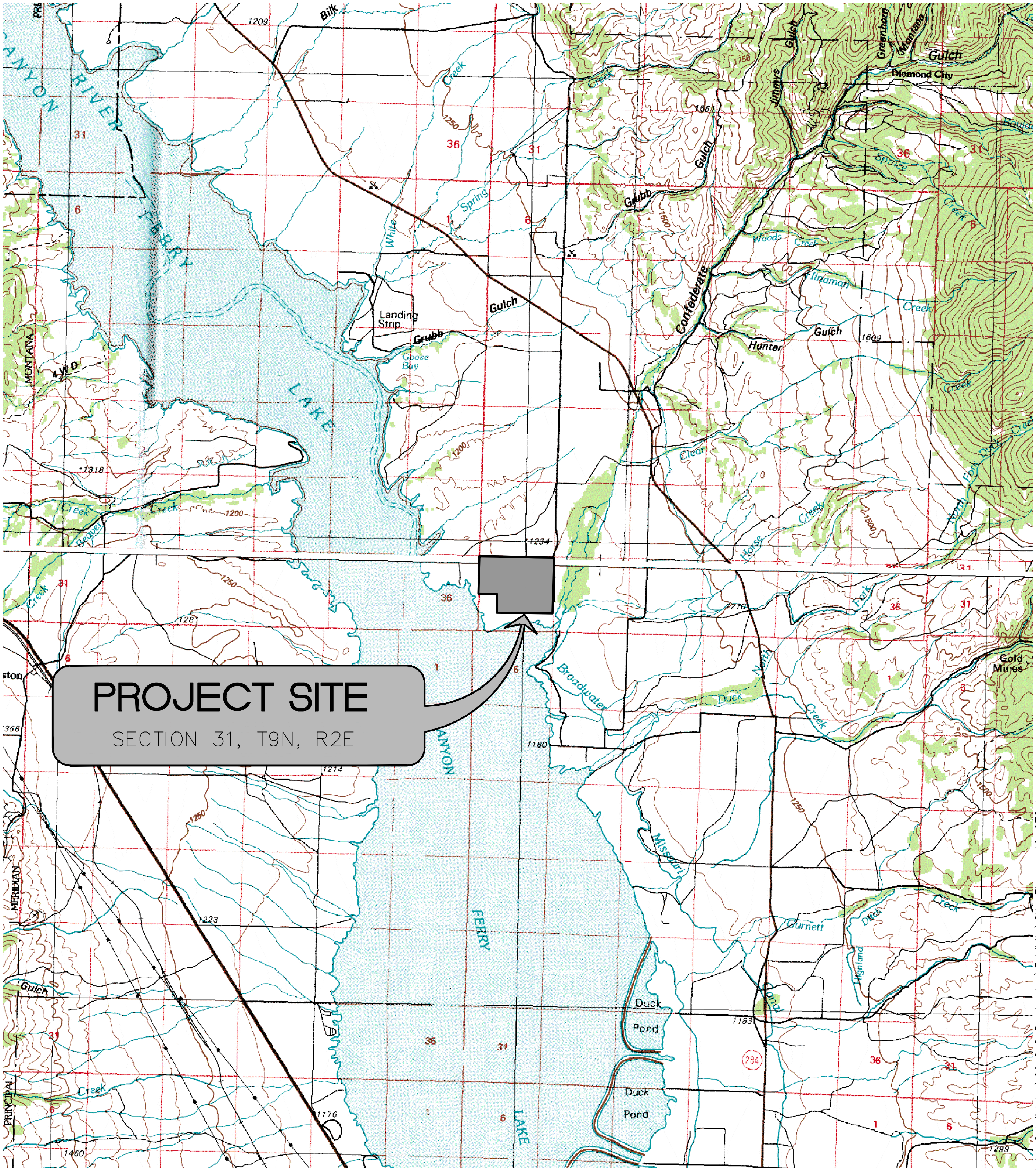
- Draft Road Construction Plans
- Complete set of MDEQ plans for Subdivisions 1-4

Appendix H – Wastewater System
- Drainfield Sizing Calculations
- Biotube Effluent Filter Sizing
- Lot Layout (4 Copies)
- Details (4 Copies)

Appendix A

Vicinity Maps

- Vicinity Map
- USGS Quadrangle Map
- Aerial Photograph Map
- Groundwater Direction Map
- Precipitation Map
- Well Location Map
- Test Pit Map



0 10,000 20,000 30,000

SCALE (FEET)

BASE MAP: 100K QUADRANGLE, BY USGS 1987

N

P:\2019\19-072 71 Ranch – Major Subdivision\09 CAD Production\Exhibits\Site Figures_19-072.dwg

HORSE CREEK HILLS SUBDIVISIONS
VICINITY MAP
SECTION 31, T9N, R2E, PMM, GALLATIN COUNTY, MT

DEQ Page 90

Civil Engineering
Geotechnical Engineering
Land Surveying

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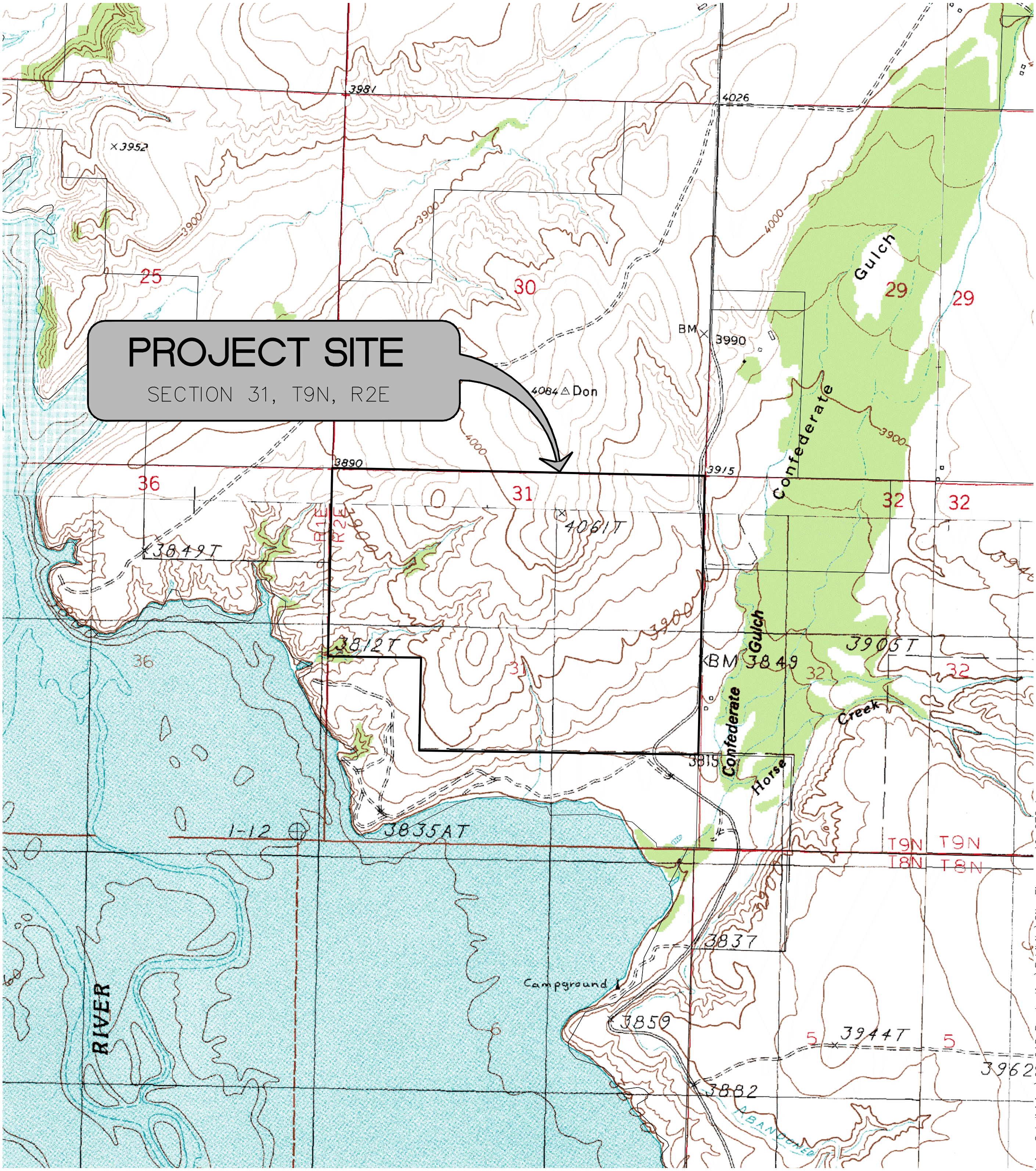
FIGURE 1
DRAWN BY: JDS
DATE: 02/05/2020
PROJECT #:19-072



0 2,000 4,000 6,000

SCALE (FEET)

BASE MAP: 7.5K QUADRANGLE, BY USGS 1987

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HORSE CREEK HILLS SUBDIVISIONS
QUADRANGLE MAP
SECTION 31, T9N, R2E, PMM, GALLATIN COUNTY, MT

DEQ Page 91

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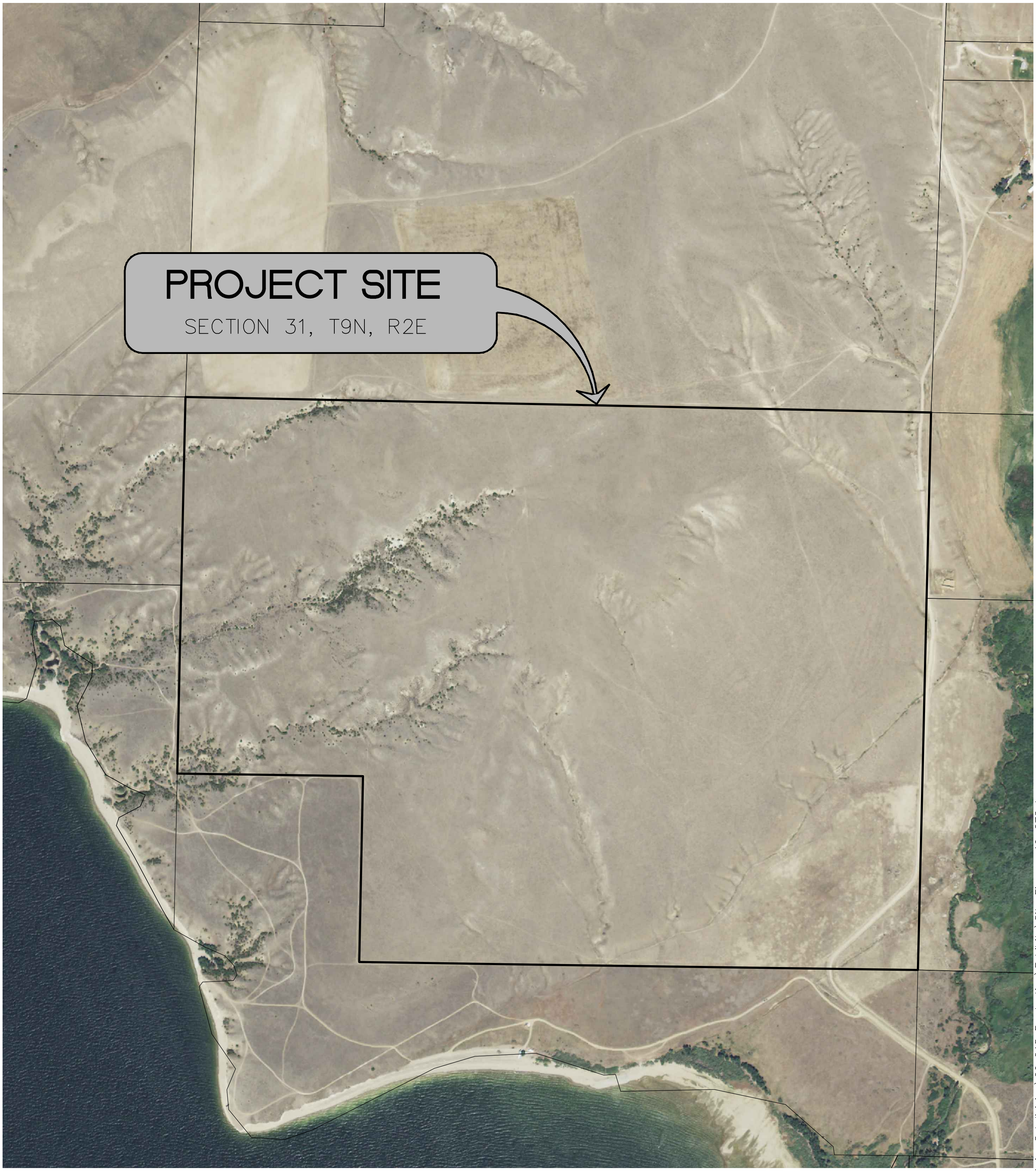
FIGURE 2
DRAWN BY: JDS
DATE: 02/05/2020
PROJECT #:19-072



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SCALE (FEET)

BASE MAP: NAIP ORTHOPHOTO, 2013

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HORSE CREEK HILLS SUBDIVISIONS
AERIAL MAP
SECTION 31, T9N, R2E, PMM, GALLATIN COUNTY, MT

DEQ Page 92

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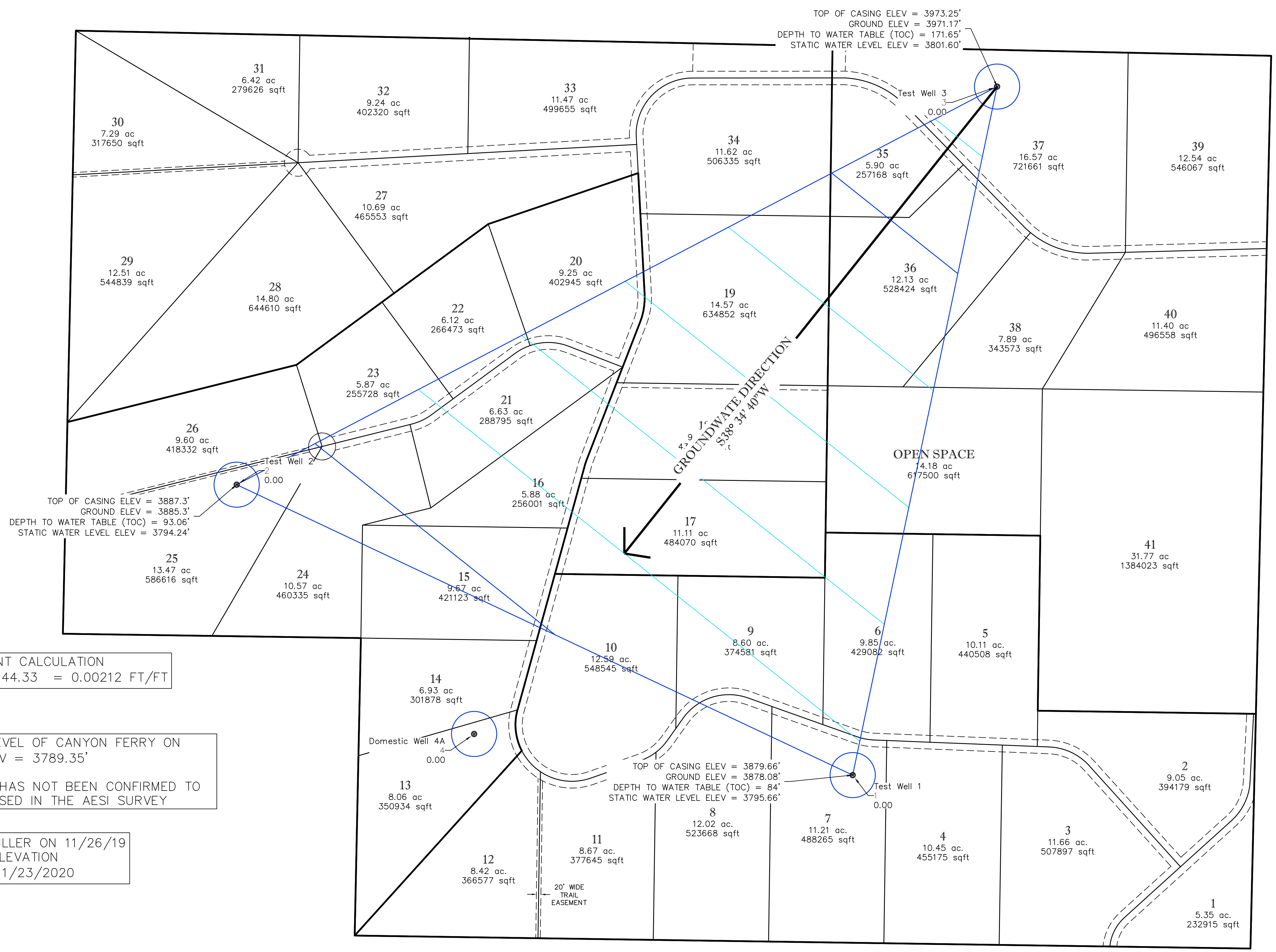
FIGURE	3
DRAWN BY:	JDS
DATE:	02/05/2020
PROJECT #:	19-072



GROUNDWATER GRADIENT CALCULATION
(3801.60 − 3796)/2644.33 = 0.00212 FT/FT

APPROXIMATE WATER LEVEL OF CANYON FERRY ON 11/26/19 PER USBR.GOV = 3789.35'

*DATUM FROM SOURCE HAS NOT BEEN CONFIRMED TO BE THE SAME DATUM USED IN THE AESI SURVEY

WELLS CERTIFIED BY DRILLER ON 11/26/19
GROUNDWATER DEPTH ELEVATION MEASURED BY AESI ON 1/23/2020

C:\aesi_w1\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\Exhibits\Groundwater Direction Map.dwg

NO.	REVISIONS	DRAWN BY	DATE

0 250 500 750
SCALE (FEET)

PROJECT ENGINEER: MAF
DRAWN BY: HTM
DESIGNED BY: HTM
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
GROUNDWATER DIRECTION MAP
BROADWATER COUNTY, MT

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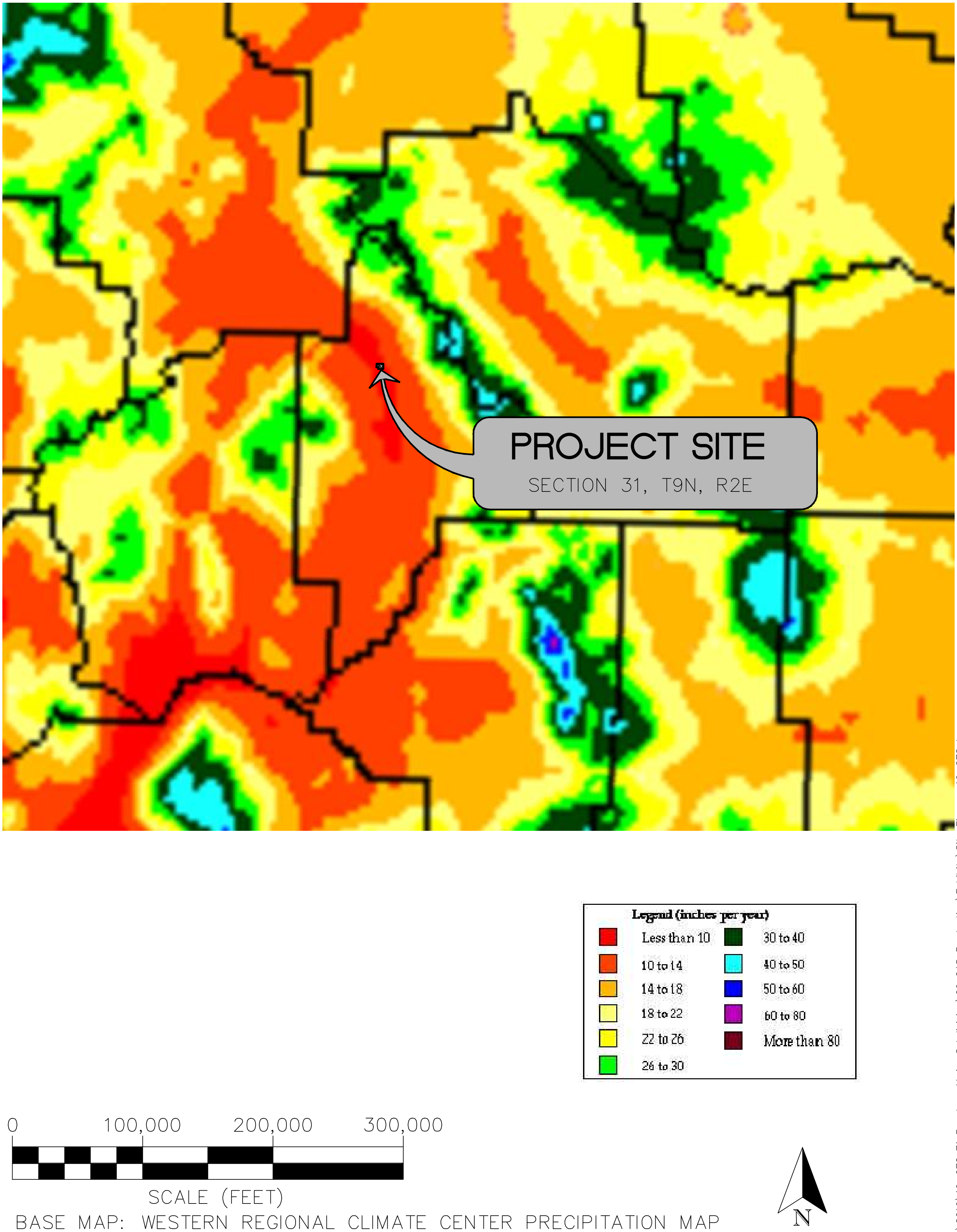
PROJECT #: 19-072
DATE: 3/27/2020
SHEET
FIG-4
GW-1



BASE MAP: WESTERN REGIONAL CLIMATE CENTER PRECIPITATION MAP

P:\2019\19-072 71 Ranch - Major Subdivision\09 CAD Production\Exhibits\Site Figures_19-072.dwg

HORSE CREEK HILLS SUBDIVISIONS
PRECIPITATION MAP
SECTION 31, T9N, R2E, PMM, GALLATIN COUNTY, MT

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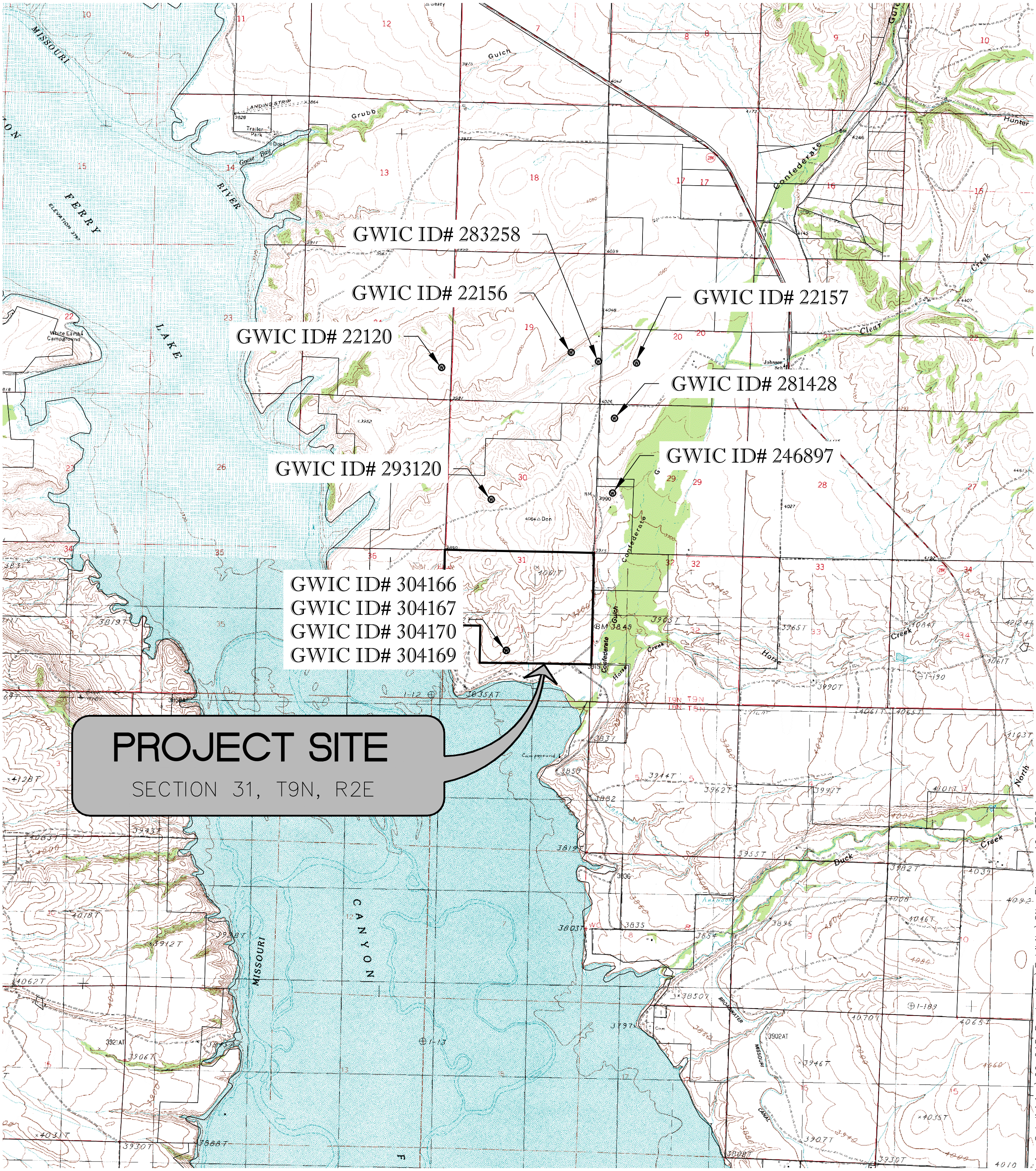
FIGURE 5
DRAWN BY: JDS
DATE: 02/05/2020
PROJECT #:19-072



GROUNDWATER SUPPLY WELL LOCATIONS ARE SHOWN PER NRIS GIS INFORMATION AND ARE APPROXIMATE IN NATURE. ACTUAL WELL LOCATIONS MAY VARY.

0 2,000 4,000 6,000

SCALE (FEET)

BASE MAP: 7.5K QUADRANGLE, BY USGS 1987

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HORSE CREEK HILLS SUBDIVISIONS
WELL LOCATION MAP

SECTION 31, T9N, R2E, PMM, GALLATIN COUNTY, MT

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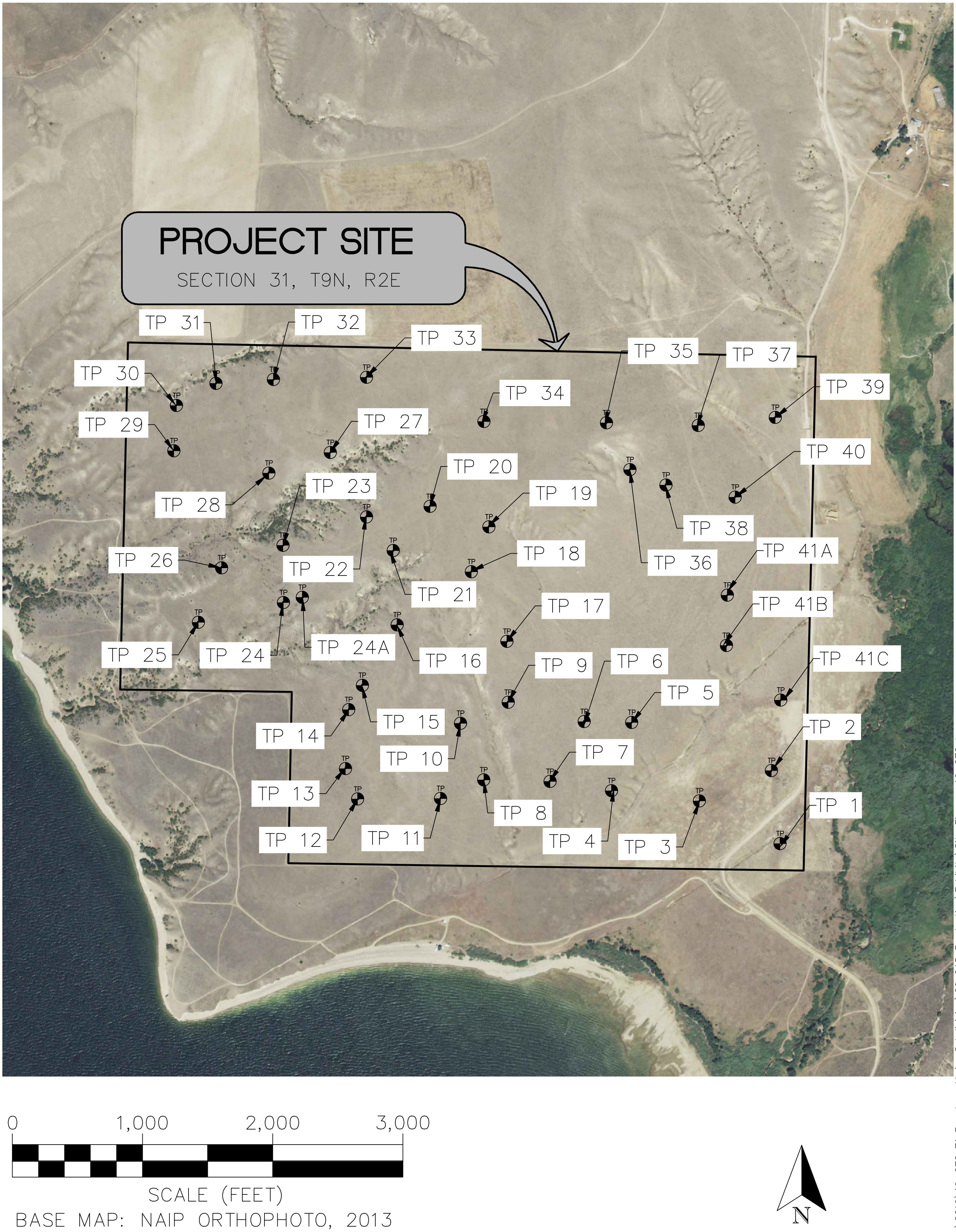
FIGURE 6

DRAWN BY: JDS

DATE: 02/05/2020

PROJECT #:19-072



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HORSE CREEK HILLS SUBDIVISION
TEST PIT MAP
SEC. 31, T9N, R2E, PMM, BROADWATER COUNTY, MT

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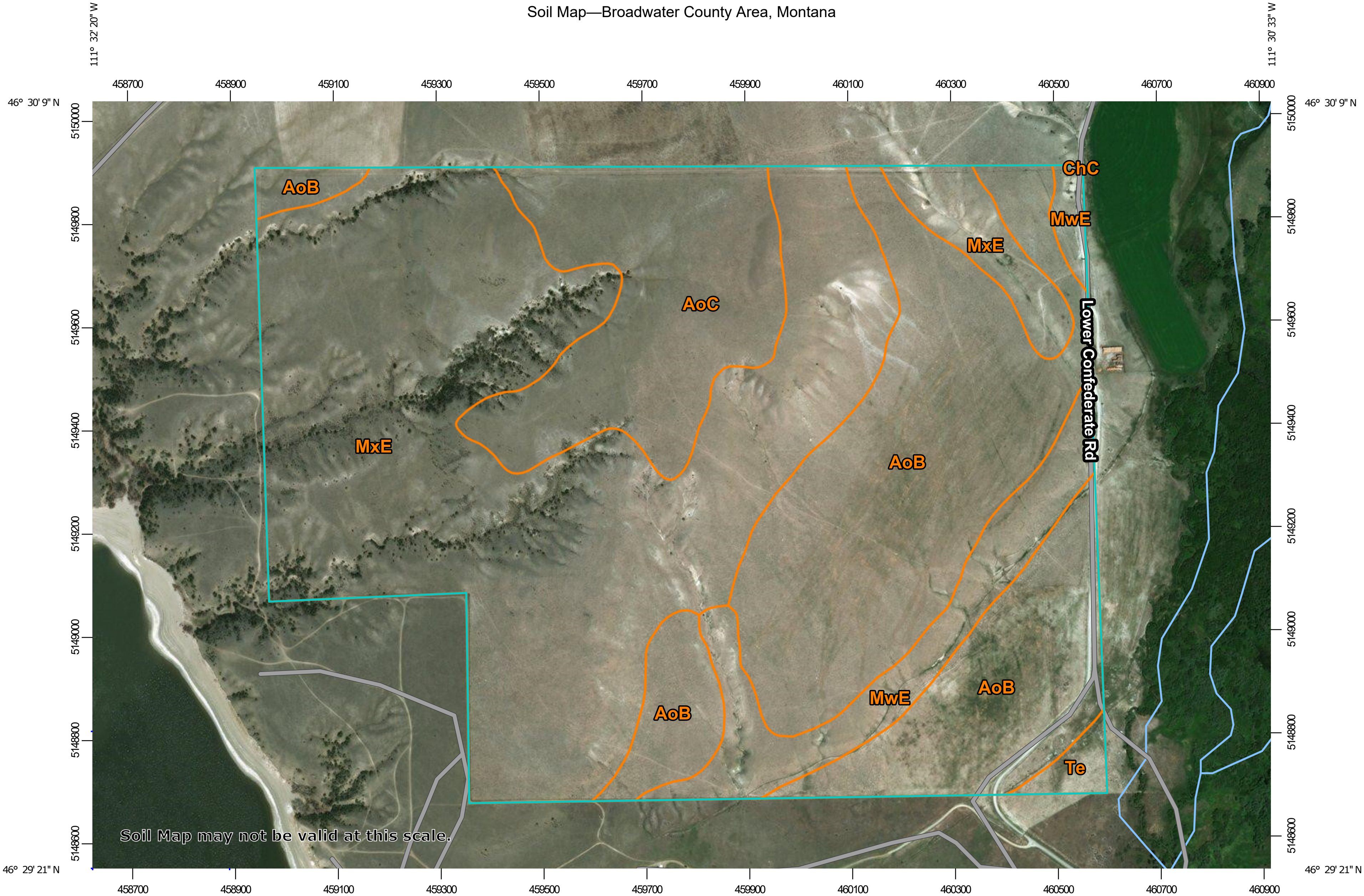
FIGURE 7
DRAWN BY: HTM
DATE: 03/27/2020
PROJECT #:19-072

Appendix B

Soils Information

- NRCS Soils Map
- NRCS Soils Information
- Test Pit Logs



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

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 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	146.3	32.3%
AoC	Amesha loam, 4 to 9 percent slopes	58.4	12.9%
ChC	Chinook sandy loam, 4 to 9 percent slopes	0.0	0.0%
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	31.7	7.0%
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	213.5	47.1%
Te	Thess silt loam	3.4	0.8%
Totals for Area of Interest		**453.4**	**100.0%**

Broadwater County Area, Montana

AoB—Amesha loam, 1 to 4 percent slopes

Map Unit Setting

National map unit symbol: 4ygg
Elevation: 2,700 to 6,500 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 90 to 130 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Amesha and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Amesha

Setting

Landform: Alluvial fans, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 4 inches: loam
Bk - 4 to 49 inches: loam
C - 49 to 74 inches: loam

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 35 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT), Limy Grassland (R044BP804MT)
Hydric soil rating: No

Minor Components

Mussel

Percent of map unit: 5 percent
Landform: Fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty (Si) 10-14" p.z. (R044XC455MT)
Hydric soil rating: No

Musselshell

Percent of map unit: 3 percent
Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT)
Hydric soil rating: No

Amesha

Percent of map unit: 2 percent
Landform: Alluvial fans, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Broadwater County Area, Montana

AoC—Amesha loam, 4 to 9 percent slopes

Map Unit Setting

National map unit symbol: 4ygh
Elevation: 1,900 to 7,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 90 to 135 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Amesha and similar soils: 60 percent
Minor components: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Amesha

Setting

Landform: Alluvial fans, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 4 inches: loam
Bk - 4 to 49 inches: loam
C - 49 to 74 inches: loam

Properties and qualities

Slope: 4 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 35 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT), Limy Grassland (R043BP804MT)
Hydric soil rating: No

Minor Components

Amesha

Percent of map unit: 15 percent
Landform: Alluvial fans, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT)
Hydric soil rating: No

Chinook

Percent of map unit: 15 percent
Landform: Hills, fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy (Sy) 10-14" p.z. (R044XC451MT)
Hydric soil rating: No

Crago

Percent of map unit: 10 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Broadwater County Area, Montana

ChC—Chinook sandy loam, 4 to 9 percent slopes

Map Unit Setting

National map unit symbol: 4ygy
Elevation: 1,900 to 6,500 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 90 to 135 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Chinook and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chinook

Setting

Landform: Hills, fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

Ap - 0 to 8 inches: sandy loam
Bw - 8 to 14 inches: sandy loam
Bk1 - 14 to 34 inches: sandy loam
Bk2 - 34 to 60 inches: sandy loam

Properties and qualities

Slope: 4 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: Sandy (Sy) 10-14" p.z. (R044XC451MT), Upland Grassland (R044BP818MT)
Hydric soil rating: No

Minor Components

Amesha

Percent of map unit: 5 percent
Landform: Stream terraces, alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy (Sy) 10-14" p.z. (R044XC451MT)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Broadwater County Area, Montana

MwE—Musselshell-Crago channery loams, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 4yhw
Elevation: 1,900 to 7,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 90 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Musselshell and similar soils: 50 percent
Crago and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Musselshell

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 5 inches: channery loam
Bk1 - 5 to 26 inches: gravelly loam
Bk2 - 26 to 43 inches: gravelly loam
2C - 43 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT), Limy Sagebrush Shrubland (R044BP805MT)
Hydric soil rating: No

Description of Crago

Setting

Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 4 inches: channery loam
Bk1 - 4 to 27 inches: gravelly loam
Bk2 - 27 to 36 inches: extremely gravelly sandy loam
2C - 36 to 60 inches: extremely gravelly loamy sand, extremely gravelly sandy loam, very gravelly sandy loam
2C - 36 to 60 inches:
2C - 36 to 60 inches:

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 70 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT), Limy Sagebrush Shrubland (R044BP805MT)
Hydric soil rating: No

Minor Components

Mussel

Percent of map unit: 5 percent
Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty (Si) 10-14" p.z. (R044XC455MT)
Hydric soil rating: No

Cabbart

Percent of map unit: 3 percent

Landform: Hills, hills
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Shallow (Sw) 10-14" p.z. (R044XC452MT)
Hydric soil rating: No

Rock outcrop

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

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Broadwater County Area, Montana

MxE—Musselshell-Crago cobbly loams, 8 to 20 percent slopes

Map Unit Setting

National map unit symbol: 4yhx
Elevation: 2,400 to 7,000 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 70 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Musselshell and similar soils: 55 percent
Crago and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Musselshell

Setting

Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 5 inches: cobbly loam
Bk1 - 5 to 26 inches: gravelly loam
Bk2 - 26 to 43 inches: gravelly loam
2C - 43 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 8 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT), Limy Sagebrush Shrubland (R043BP805MT)
Hydric soil rating: No

Description of Crago

Setting

Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 4 inches: cobbly loam
Bk1 - 4 to 27 inches: gravelly loam
Bk2 - 27 to 36 inches: extremely cobbly sandy loam
2C - 36 to 60 inches: extremely cobbly loamy sand

Properties and qualities

Slope: 8 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 70 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT), Limy Sagebrush Shrubland (R043BP805MT)
Hydric soil rating: No

Minor Components

Thess

Percent of map unit: 5 percent
Landform: Fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT)
Hydric soil rating: No

Thess

Percent of map unit: 5 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear

Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT)
Hydric soil rating: No

Sappington

Percent of map unit: 5 percent
Landform: Fans, hills
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty (Si) 10-14" p.z. (R044XC455MT)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Broadwater County Area, Montana

Te—Thess silt loam

Map Unit Setting

National map unit symbol: 4yjh
Elevation: 3,000 to 6,500 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 37 to 45 degrees F
Frost-free period: 70 to 135 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Thess and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Thess

Setting

Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

A - 0 to 5 inches: silt loam
Bk - 5 to 22 inches: loam
2Bk - 22 to 60 inches: very gravelly sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT), Limy Grassland (R044BP804MT)
Hydric soil rating: No

Minor Components

Amesha

Percent of map unit: 5 percent
Landform: Alluvial fans, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Silty-Limy (SiLy) 10-14" p.z. (R044XC457MT)
Hydric soil rating: No

Scravo

Percent of map unit: 5 percent
Landform: Terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Shallow to Gravel (SwGr) 10-14" p.z. (R044XC454MT)
Hydric soil rating: No

Toston

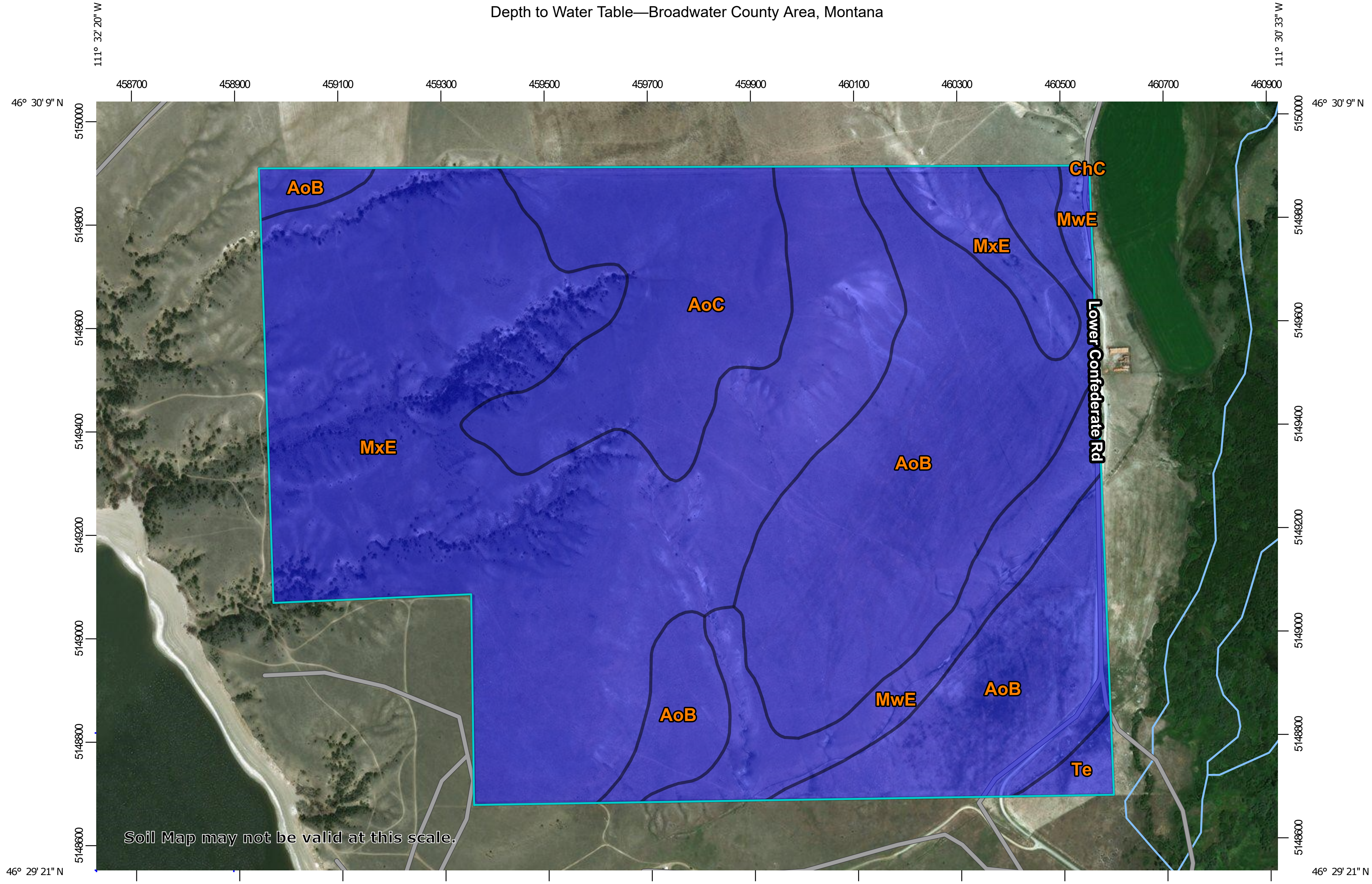
Percent of map unit: 5 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Saline Lowland (SL) 10-14" p.z. (R044XC449MT)
Hydric soil rating: No

Lothair

Percent of map unit: 5 percent
Landform: Fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Clayey (Cy) 10-14" p.z. (R052XN162MT)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

0 150 300 600 900 Meters

0 500 1000 2000 3000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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

Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	>200	146.3	32.3%
AoC	Amesha loam, 4 to 9 percent slopes	>200	58.4	12.9%
ChC	Chinook sandy loam, 4 to 9 percent slopes	>200	0.0	0.0%
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	>200	31.7	7.0%
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	>200	213.5	47.1%
Te	Thess silt loam	>200	3.4	0.8%
Totals for Area of Interest			**453.4**	**100.0%**

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

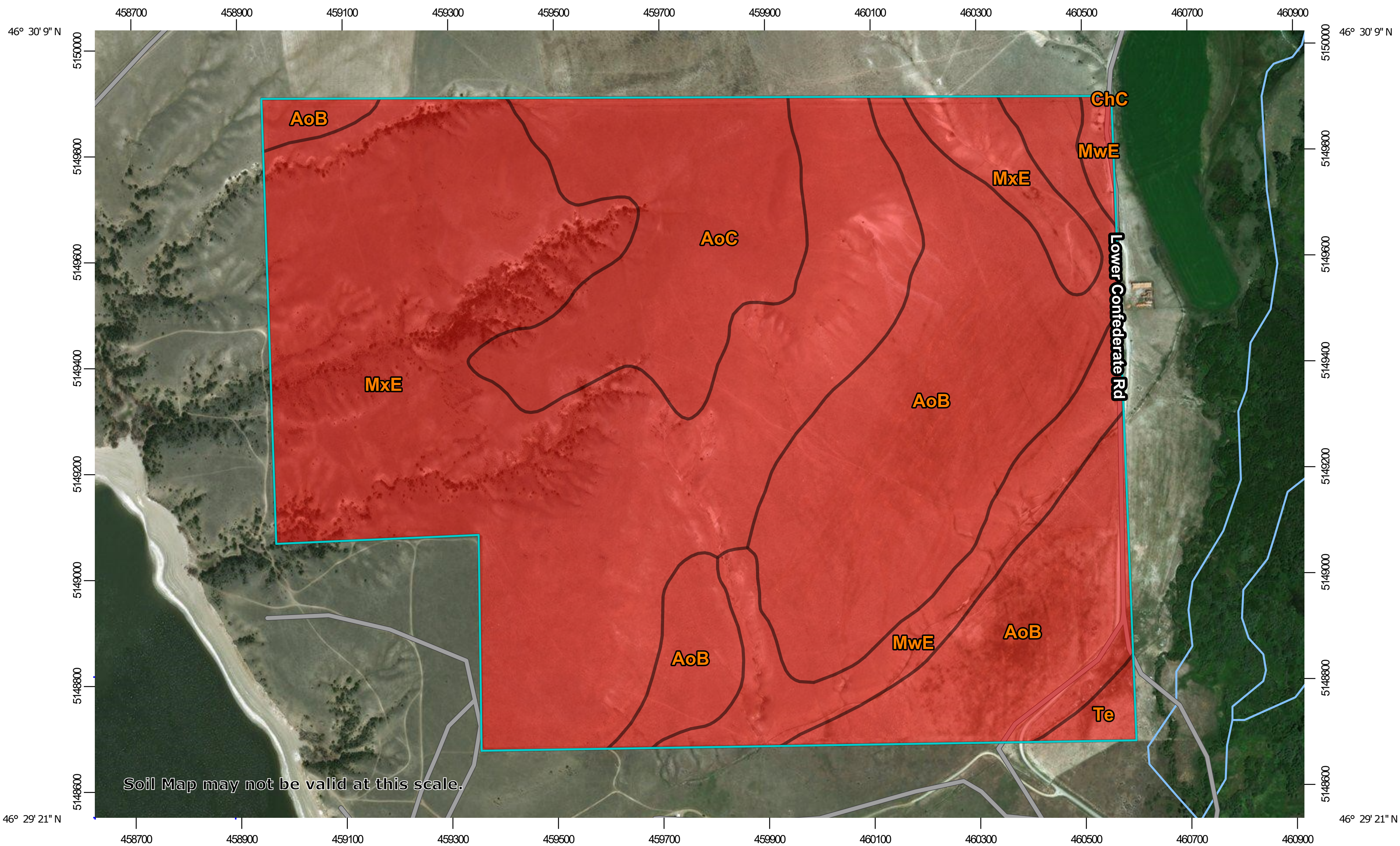
Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

Flooding Frequency Class—Broadwater County Area, Montana



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent
- Not rated or not available

Soil Rating Lines
- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent
- Not rated or not available

Soil Rating Points
- None
- Very Rare
- Rare
- Occasional
- Frequent
- Very Frequent
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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

Flooding Frequency Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	None	146.3	32.3%
AoC	Amesha loam, 4 to 9 percent slopes	None	58.4	12.9%
ChC	Chinook sandy loam, 4 to 9 percent slopes	None	0.0	0.0%
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	None	31.7	7.0%
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	None	213.5	47.1%
Te	Thess silt loam	None	3.4	0.8%
Totals for Area of Interest			**453.4**	**100.0%**

Description

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

"Occasional" means that flooding occurs infrequently under normal weather conditions. The chance of flooding is 5 to 50 percent in any year.

"Frequent" means that flooding is likely to occur often under normal weather conditions. The chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year.

"Very frequent" means that flooding is likely to occur very often under normal weather conditions. The chance of flooding is more than 50 percent in all months of any year.

Rating Options

Aggregation Method: Dominant Condition

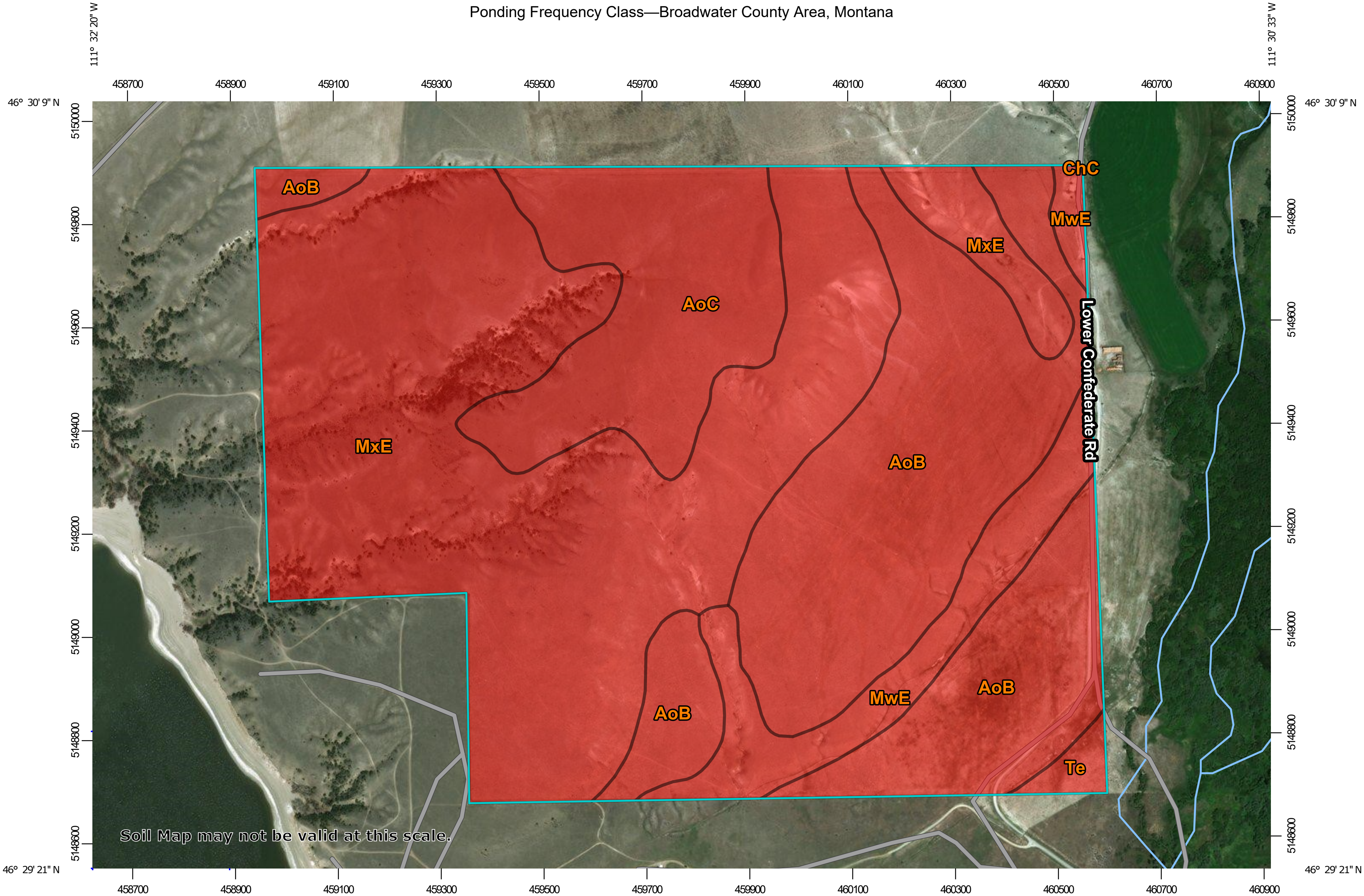
Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Ponding Frequency Class—Broadwater County Area, Montana



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

None

Rare

Occasional

Frequent

Not rated or not available

Soil Rating Lines

None

Rare

Occasional

Frequent

Not rated or not available

Soil Rating Points

None

Rare

Occasional

Frequent

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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

Ponding Frequency Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	None	146.3	32.3%
AoC	Amesha loam, 4 to 9 percent slopes	None	58.4	12.9%
ChC	Chinook sandy loam, 4 to 9 percent slopes	None	0.0	0.0%
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	None	31.7	7.0%
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	None	213.5	47.1%
Te	Thess silt loam	None	3.4	0.8%
Totals for Area of Interest			**453.4**	**100.0%**

Description

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding frequency classes are based on the number of times that ponding occurs over a given period. Frequency is expressed as none, rare, occasional, and frequent.

"None" means that ponding is not probable. The chance of ponding is nearly 0 percent in any year.

"Rare" means that ponding is unlikely but possible under unusual weather conditions. The chance of ponding is nearly 0 percent to 5 percent in any year.

"Occasional" means that ponding occurs, on the average, once or less in 2 years. The chance of ponding is 5 to 50 percent in any year.

"Frequent" means that ponding occurs, on the average, more than once in 2 years. The chance of ponding is more than 50 percent in any year.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: More Frequent

Beginning Month: January

Ending Month: December

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

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

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

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

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

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Broadwater County Area, Montana

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
AoB—Amesha loam, 1 to 4 percent slopes														
Amesha	90	B	0-4	Loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	95-98-100	90-95-100	70-80-90	55-65-75	25-30-35	5-10-15
			4-49	Loam, sandy loam, silt loam	CL-ML, ML	A-4	0- 0- 0	0- 3- 5	95-98-100	90-95-100	70-80-90	55-65-75	20-25-30	NP-5-10
			49-74	Loam, fine sandy loam, gravelly sandy loam	CL-ML, ML, SC-SM, SM	A-2, A-4	0- 0- 0	0- 5- 10	65-83-100	55-78-100	45-65-85	25-45-65	20-25-30	NP-5-10
AoC—Amesha loam, 4 to 9 percent slopes														
Amesha	60	B	0-4	Loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	95-98-100	90-95-100	70-80-90	55-65-75	25-30-35	5-10-15
			4-49	Loam, sandy loam, silt loam	CL-ML, ML	A-4	0- 0- 0	0- 3- 5	95-98-100	90-95-100	70-80-90	55-65-75	20-25-30	NP-5-10
			49-74	Loam, fine sandy loam, gravelly sandy loam	CL-ML, ML, SC-SM, SM	A-2, A-4	0- 0- 0	0- 5- 10	65-83-100	55-78-100	45-65-85	25-45-65	20-25-30	NP-5-10

Engineering Properties–Broadwater County Area, Montana														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
ChC—Chinook sandy loam, 4 to 9 percent slopes														
Chinook	95	A	0-8	Sandy loam	SM	A-2, A-4	0- 0- 0	0- 0- 0	80-90-100	75-88-100	55-65-75	30-40-50	15-20-25	NP-3 -5
			8-14	Fine sandy loam, sandy loam	SM	A-2, A-4	0- 0- 0	0- 0- 0	80-90-100	75-88-100	55-70-85	30-40-50	15-20-25	NP-3 -5
			14-34	Fine sandy loam, sandy loam	SM	A-2, A-4	0- 0- 0	0- 0- 0	80-90-100	75-88-100	55-70-85	30-40-50	15-20-25	NP-3 -5
			34-60	Fine sandy loam, loamy fine sand, sandy loam	SM	A-2, A-4	0- 0- 0	0- 0- 0	80-90-100	75-88-100	60-70-80	25-35-45	15-20-25	NP-3 -5

Engineering Properties–Broadwater County Area, Montana														
Map unit symbol and soil name	**Pct. of map unit**	**Hydrologic group**	**Depth**	**USDA texture**	**Classification**		**Pct Fragments**		**Percentage passing sieve number—**				**Liquid limit**	**Plasticity index**
					Unified	**AASHTO**	**>10 inches**	**3-10 inches**	**4**	**10**	**40**	**200**		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
MwE—Musselshell-Crago channery loams, 15 to 35 percent slopes														
Musselshell	50	B	0-5	Channery loam	CL-ML, GC-GM, SC-SM	A-4	0- 0- 0	5-10- 15	65-75-85	60-70-80	45-55-65	40-50-60	25-28-30	5-8 -10
			5-26	Loam, gravelly loam	CL-ML, GC-GM, SC-SM	A-4	0- 0- 0	0- 5- 10	60-80-100	55-78-100	50-65-80	40-58-75	25-28-30	5-8 -10
			26-43	Gravelly loam, loam	CL-ML, GC-GM, GM, ML	A-4	0- 0- 0	0- 8- 15	65-83-100	60-80-100	45-63-80	40-55-70	15-20-25	NP-5-10

Engineering Properties–Broadwater County Area, Montana														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			43-60	Very gravelly sandy loam, very gravelly fine sandy loam, very gravelly loam	GC-GM, GM	A-1, A-2	0- 0- 0	10-13-15	40-50-60	30-43-55	25-35-45	10-20-30	15-20-25	NP-5-10
Crago	40	B	0-4	Channery loam	CL-ML, GC-GM, GM, SC-SM	A-4	0- 0- 0	0- 4- 8	63-69-76	45-59-76	38-52-72	27-38-54	27-35-43	9-14-18
			4-27	Gravelly loam, gravelly clay loam, very gravelly clay loam	GC, GC-GM	A-2, A-4, A-6	0- 0- 0	0- 6- 11	53-61-72	29-48-72	24-43-71	18-33-55	30-38-45	13-19-25
			27-36	Extremely gravelly loam, very gravelly clay loam, extremely gravelly sandy loam	GC-GM, GM, GP-GM	A-1, A-2	0- 0- 0	0- 6- 10	44-51-59	22-38-59	16-30-50	8-17- 29	27-38-49	12-16-20
			36-60	Extremely gravelly loamy sand, extremely gravelly sandy loam, very gravelly sandy loam	GP, GP-GM, GM	A-1	0- 0- 0	0- 6- 10	49-57-65	24-43-65	17-35-59	4-11- 23	0-27 -41	NP-6-13

Engineering Properties–Broadwater County Area, Montana														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
MxE—Musselshell-Crago cobbly loams, 8 to 20 percent slopes														
Musselshell	55	B	0-5	Cobbly loam	CL-ML	A-4	0- 0- 0	15-28-40	85-90-95	80-85-90	60-70-80	55-65-75	25-28-30	5-8 -10
			5-26	Loam, gravelly loam	CL-ML, GC-GM, SC-SM	A-4	0- 0- 0	0- 5- 10	60-80-100	55-78-100	50-65-80	40-58-75	25-28-30	5-8 -10
			26-43	Gravelly loam, loam	CL-ML, GC-GM, GM, ML	A-4	0- 0- 0	0- 8- 15	65-83-100	60-80-100	45-63-80	40-55-70	15-20-25	NP-5 -10

Engineering Properties–Broadwater County Area, Montana														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			43-60	Very gravelly sandy loam, very gravelly fine sandy loam, very gravelly loam	GC-GM, GM	A-1, A-2	0- 0- 0	10-13-15	40-50-60	30-43-55	25-35-45	10-20-30	15-20-25	NP-5-10
Crago	30	B	0-4	Cobbly loam	CL-ML, ML	A-4	0- 0- 0	15-23-30	75-80-85	70-75-80	60-65-70	50-55-60	20-25-30	NP-5-10
			4-27	Very stony loam, very cobbly clay loam, gravelly loam	CL, GC, GC-GM, SC-SM	A-2, A-4, A-6	0- 0- 0	10-28-45	50-65-80	45-60-75	40-55-70	30-45-60	25-30-35	5-10-15
			27-36	Very cobbly loam, extremely cobbly sandy loam, very gravelly clay loam	GC-GM, GM	A-1, A-2	0- 0- 0	25-40-55	30-40-50	25-35-45	20-30-40	15-25-35	20-25-30	NP-5-10
			36-60	Very cobbly sandy loam, extremely cobbly loamy sand, very gravelly sandy loam	GM	A-1	0- 0- 0	25-40-55	35-45-55	25-35-45	15-25-35	10-18-25	—	NP
Te—Thess silt loam														
Thess	80	B	0-5	Silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 0- 0	95-98-100	90-95-100	80-88-95	60-70-80	20-28-35	5-10-15
			5-22	Loam, silt loam	CL, CL-ML	A-4, A-6	0- 0- 0	0- 3- 5	90-95-100	85-90-95	80-88-95	60-70-80	20-28-35	5-10-15
			22-60	Very gravelly sand, very gravelly loamy sand, extremely gravelly sand	GP, GP-GM	A-1	0- 0- 0	0- 8- 15	20-28-35	15-23-30	10-15-20	0- 5- 10	—	NP

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Physical Soil Properties

This table shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Sand as a soil separate consists of mineral soil particles that are 0.05 millimeter to 2 millimeters in diameter. In this table, the estimated sand content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Silt as a soil separate consists of mineral soil particles that are 0.002 to 0.05 millimeter in diameter. In this table, the estimated silt content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3- or 1/10-bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute linear extensibility, shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates in the table are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity (Ksat) is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In this table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained by returning crop residue to the soil.

Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in the table as the K factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are described in the "National Soil Survey Handbook."

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Reference:

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. (http://soils.usda.gov)

Report—Physical Soil Properties

Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Physical Soil Properties–Broadwater County Area, Montana														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
AoB—Amesha loam, 1 to 4 percent slopes														
Amesha	0-4	-42-	-38-	15-20- 25	1.25-1.35 -1.45	4.00-9.00-14.00	0.16-0.18-0.20	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.28	.28	5	4L	86
	4-49	-45-	-41-	10-14- 18	1.30-1.43 -1.55	4.00-9.00-14.00	0.14-0.16-0.17	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.43	.43			
	49-74	-45-	-41-	10-14- 18	1.35-1.48 -1.60	4.00-9.00-14.00	0.12-0.14-0.15	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.43	.43			
AoC—Amesha loam, 4 to 9 percent slopes														
Amesha	0-4	-42-	-38-	15-20- 25	1.25-1.35 -1.45	4.00-9.00-14.00	0.16-0.18-0.20	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.28	.28	5	4L	86
	4-49	-45-	-41-	10-14- 18	1.30-1.43 -1.55	4.00-9.00-14.00	0.14-0.16-0.17	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.43	.43			
	49-74	-45-	-41-	10-14- 18	1.35-1.48 -1.60	4.00-9.00-14.00	0.12-0.14-0.15	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.43	.43			

Physical Soil Properties–Broadwater County Area, Montana														
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
ChC—Chinook sandy loam, 4 to 9 percent slopes														
Chinook	0-8	-66-	-23-	5-12- 18	1.25-1.38 -1.50	14.00-28.00-42.00	0.12-0.14-0.15	0.0- 1.5- 2.9	1.0- 1.5- 2.0	.24	.24	5	3	86
	8-14	-66-	-23-	5-12- 18	1.40-1.50 -1.60	14.00-28.00-42.00	0.12-0.14-0.15	0.0- 1.5- 2.9	0.0- 0.5- 1.0	.28	.28			
	14-34	-66-	-23-	5-12- 18	1.40-1.50 -1.60	14.00-28.00-42.00	0.12-0.14-0.15	0.0- 1.5- 2.9	0.0- 0.5- 1.0	.28	.28			
	34-60	-67-	-23-	5-10- 15	1.40-1.50 -1.60	14.00-28.00-42.00	0.11-0.12-0.12	0.0- 1.5- 2.9	0.0- 0.5- 1.0	.28	.28			

Physical Soil Properties–Broadwater County Area, Montana														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
MwE—Musselshell-Crago channery loams, 15 to 35 percent slopes														
Musselshell	0-5	-39-	-37-	20-24- 27	1.15-1.25 -1.35	4.00-9.00-14.00	0.14-0.16-0. 18	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.17	.32	2	5	56
	5-26	-43-	-39-	10-19- 27	1.40-1.50 -1.60	4.00-9.00-14.00	0.14-0.16-0. 18	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.20	.37			
	26-43	-45-	-41-	10-14- 18	1.50-1.63 -1.75	4.00-9.00-14.00	0.14-0.16-0. 18	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.24	.43			
	43-60	-67-	-19-	10-14- 18	1.50-1.63 -1.75	14.00-28.00-42. 00	0.06-0.08-0. 10	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.05	.15			
Crago	0-4	-42-	-37-	15-21- 27	1.15-1.25 -1.35	4.00-9.00-14.00	0.10-0.11-0. 12	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.17	.32	2	5	56
	4-27	-37-	-35-	20-28- 35	1.30-1.40 -1.50	4.00-9.00-14.00	0.07-0.08-0. 08	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.10	.32			
	27-36	-62-	-14-	18-24- 30	1.30-1.43 -1.55	4.00-9.00-14.00	0.03-0.04-0. 04	0.0- 1.5- 2.9	0.0- 2.5- 5.0	.05	.17			
	36-60	-81-	- 9-	0-10- 20	1.45-1.58 -1.70	42.00-92.00-14 1.00	0.02-0.03-0. 03	0.0- 1.5- 2.9	0.0- 2.5- 5.0	.05	.10			

Physical Soil Properties–Broadwater County Area, Montana														
Map symbol and soil name	**Depth**	**Sand**	**Silt**	**Clay**	**Moist bulk density**	**Saturated hydraulic conductivity**	**Available water capacity**	**Linear extensibility**	**Organic matter**	**Erosion factors**			**Wind erodibility group**	**Wind erodibility index**
										Kw	**Kf**	**T**		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
MxE—Musselshell-Crago cobbly loams, 8 to 20 percent slopes														
Musselshell	0-5	-39-	-37-	20-24- 27	1.15-1.25 -1.35	4.00-9.00-14.00	0.14-0.16-0. 18	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.17	.32	2	5	56
	5-26	-43-	-39-	10-19- 27	1.40-1.50 -1.60	4.00-9.00-14.00	0.14-0.16-0. 18	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.20	.37			
	26-43	-45-	-41-	10-14- 18	1.50-1.63 -1.75	4.00-9.00-14.00	0.14-0.16-0. 18	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.24	.43			
	43-60	-67-	-19-	10-14- 18	1.50-1.63 -1.75	14.00-28.00-42. 00	0.06-0.08-0. 10	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.05	.15			
Crago	0-4	-42-	-37-	15-21- 27	1.30-1.40 -1.50	4.00-9.00-14.00	0.13-0.15-0. 16	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.17	.32	2	5	56
	4-27	-37-	-37-	20-26- 35	1.40-1.50 -1.60	4.00-9.00-14.00	0.08-0.09-0. 10	0.0- 1.5- 2.9	0.0- 0.0- 1.0	.17	.32			
	27-36	-63-	-18-	15-19- 30	1.50-1.63 -1.75	4.00-9.00-14.00	0.04-0.05-0. 06	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.05	.24			
	36-60	-84-	- 9-	0- 8- 15	1.50-1.60 -1.70	42.00-92.00-14 1.00	0.02-0.03-0. 04	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.15			
Te—Thess silt loam														
Thess	0-5	-26-	-52-	18-22- 25	1.10-1.20 -1.30	4.00-9.00-14.00	0.18-0.20-0. 22	0.0- 1.5- 2.9	1.0- 2.0- 3.0	.37	.37	3	4L	86
	5-22	-42-	-38-	15-20- 25	1.25-1.35 -1.45	4.00-9.00-14.00	0.16-0.18-0. 20	0.0- 1.5- 2.9	0.5- 0.8- 1.0	.37	.37			
	22-60	-96-	- 2-	0- 3- 5	1.50-1.60 -1.70	141.00-141.00-141.00	0.02-0.03-0. 03	0.0- 1.5- 2.9	0.0- 0.3- 0.5	.02	.02			

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Prime and other Important Farmlands

This table lists the map units in the survey area that are considered important farmlands. Important farmlands consist of prime farmland, unique farmland, and farmland of statewide or local importance. This list does not constitute a recommendation for a particular land use.

In an effort to identify the extent and location of important farmlands, the Natural Resources Conservation Service, in cooperation with other interested Federal, State, and local government organizations, has inventoried land that can be used for the production of the Nation's food supply.

Prime farmland is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. The soil quality, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. The water supply is dependable and of adequate quality. Prime farmland is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. Slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

For some of the soils identified in the table as prime farmland, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures.

A recent trend in land use in some areas has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, and other fruits and vegetables. It has the special combination of soil quality, growing season, moisture supply, temperature, humidity, air drainage, elevation, and aspect needed for the soil to economically produce sustainable high yields of these crops when properly managed. The water supply is dependable and of adequate quality. Nearness to markets is an additional consideration. Unique farmland is not based on national criteria. It commonly is in areas where there is a special microclimate, such as the wine country in California.

In some areas, land that does not meet the criteria for prime or unique farmland is considered to be *farmland of statewide importance* for the production of food, feed, fiber, forage, and oilseed crops. The criteria for defining and delineating farmland of statewide importance are determined by the appropriate State agencies. Generally, this land includes areas of soils that nearly meet the requirements for prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some areas may produce as high a yield as prime farmland if conditions are favorable. Farmland of statewide importance may include tracts of land that have been designated for agriculture by State law.

In some areas that are not identified as having national or statewide importance, land is considered to be *farmland of local importance* for the production of food, feed, fiber, forage, and oilseed crops. This farmland is identified by the appropriate local agencies. Farmland of local importance may include tracts of land that have been designated for agriculture by local ordinance.

Report—Prime and other Important Farmlands

Prime and other Important Farmlands–Broadwater County Area, Montana		
Map Symbol	**Map Unit Name**	**Farmland Classification**
AoB	Amesha loam, 1 to 4 percent slopes	Prime farmland if irrigated
AoC	Amesha loam, 4 to 9 percent slopes	Farmland of statewide importance
ChC	Chinook sandy loam, 4 to 9 percent slopes	Prime farmland if irrigated
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	Not prime farmland
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	Not prime farmland
Te	Thess silt loam	Prime farmland if irrigated

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 18, Sep 16, 2019

Water Features

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

The *months* in the table indicate the portion of the year in which a water table, ponding, and/or flooding is most likely to be a concern.

Water table refers to a saturated zone in the soil. The water features table indicates, by month, depth to the top (*upper limit*) and base (*lower limit*) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table. The kind of water table, apparent or perched, is given if a seasonal high water table exists in the soil. A water table is perched if free water is restricted from moving downward in the soil by a restrictive feature, in most cases a hardpan; there is a dry layer of soil underneath a wet layer. A water table is apparent if free water is present in all horizons from its upper boundary to below 2 meters or to the depth of observation. The water table kind listed is for the first major component in the map unit.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. The table indicates *surface water depth* and the *duration* and *frequency* of ponding. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. *None* means that ponding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Duration and *frequency* are estimated. Duration is expressed as *extremely brief* if 0.1 hour to 4 hours, *very brief* if 4 hours to 2 days, *brief* if 2 to 7 days, *long* if 7 to 30 days, and *very long* if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. *None* means that flooding is not probable; *very rare* that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year); *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); *frequent* that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year); and *very frequent* that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

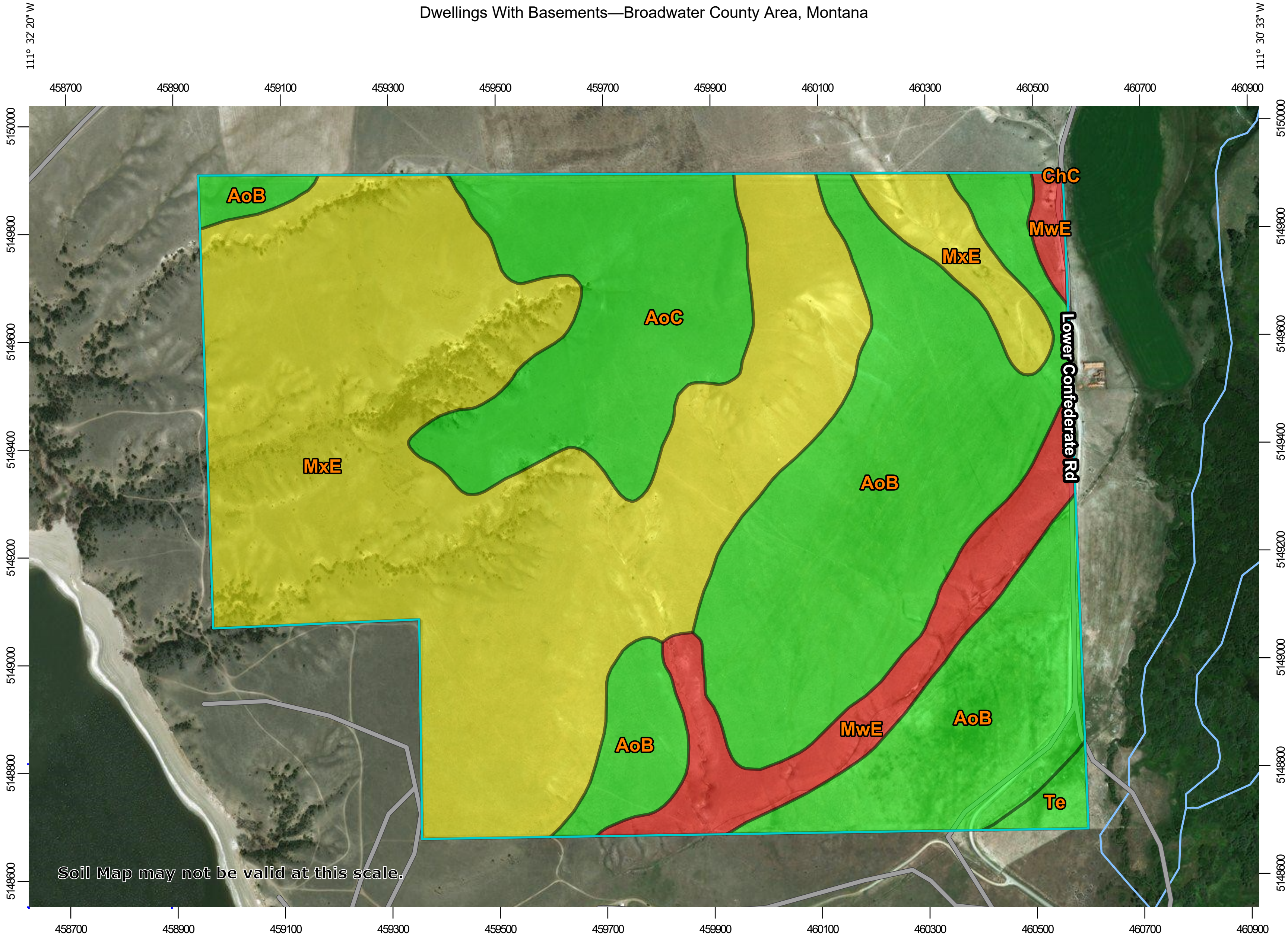
Report—Water Features

Map unit symbol and soil name	Hydrologic group	Surface runoff	Most likely months	Water table			Ponding			Flooding	
				Upper limit	Lower limit	Kind	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*		*Ft*				
AoB—Amesha loam, 1 to 4 percent slopes											
Amesha	B		Jan-Dec	—	—	—	—	—	None	—	None
AoC—Amesha loam, 4 to 9 percent slopes											
Amesha	B		Jan-Dec	—	—	—	—	—	None	—	None
ChC—Chinook sandy loam, 4 to 9 percent slopes											
Chinook	A		Jan-Dec	—	—	—	—	—	None	—	None
MwE—Musselshell-Crago channery loams, 15 to 35 percent slopes											
Musselshell	B		Jan-Dec	—	—	—	—	—	None	—	None
Crago	B		Jan-Dec	—	—	—	—	—	None	—	None
MxE—Musselshell-Crago cobbly loams, 8 to 20 percent slopes											
Musselshell	B		Jan-Dec	—	—	—	—	—	None	—	None
Crago	B		Jan-Dec	—	—	—	—	—	None	—	None
Te—Thess silt loam											
Thess	B		Jan-Dec	—	—	—	—	—	None	—	None

Data Source Information

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

Dwellings With Basements—Broadwater County Area, Montana



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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

Dwellings With Basements

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	Not limited	Amesha (90%)		146.3	32.3%
			Mussel (5%)			
			Musselshell (3%)			
			Amesha (2%)			
AoC	Amesha loam, 4 to 9 percent slopes	Not limited	Amesha (60%)		58.4	12.9%
			Amesha (15%)			
			Chinook (15%)			
			Crago (10%)			
ChC	Chinook sandy loam, 4 to 9 percent slopes	Not limited	Chinook (95%)		0.0	0.0%
			Amesha (5%)			
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	Very limited	Musselshell (50%)	Slope (1.00)	31.7	7.0%
			Crago (40%)	Slope (1.00)		
			Cabbart (3%)	Depth to soft bedrock (1.00)		
				Slope (1.00)		
				Shrink-swell (0.50)		
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	Somewhat limited	Musselshell (55%)	Slope (0.96)	213.5	47.1%
			Crago (30%)	Slope (0.96)		
				Large stones (0.12)		
Te	Thess silt loam	Not limited	Thess (80%)		3.4	0.8%
			Amesha (5%)			
			Scravo (5%)			
Totals for Area of Interest					**453.4**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	213.5	47.1%
Not limited	208.2	45.9%
Very limited	31.7	7.0%
Totals for Area of Interest	**453.4**	**100.0%**

Description

Dwellings are single-family houses of three stories or less. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet.

The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification of the soil. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

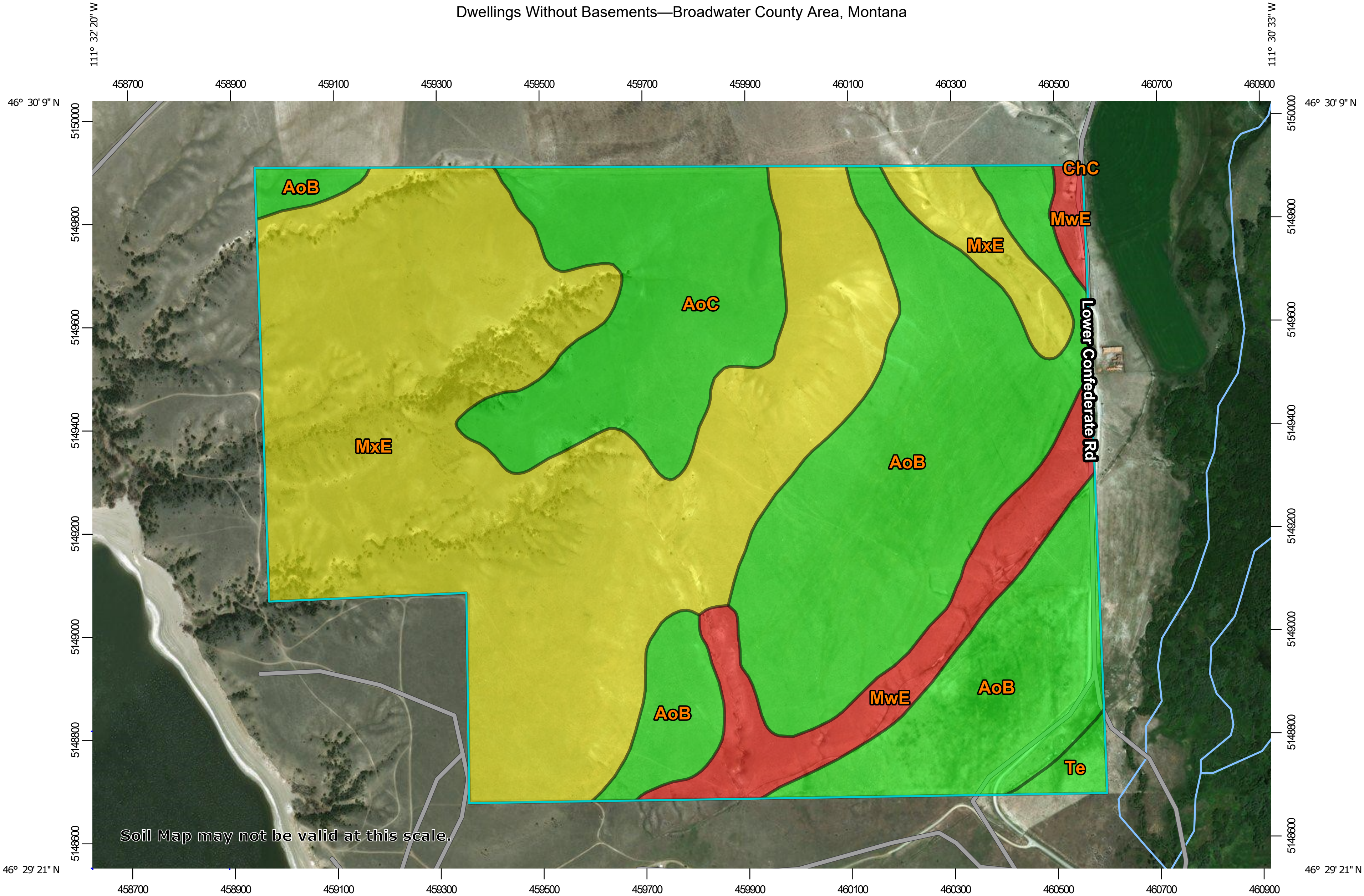
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Dwellings Without Basements—Broadwater County Area, Montana



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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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: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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

Dwellings Without Basements

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	Not limited	Amesha (90%)		146.3	32.3%
			Mussel (5%)			
			Musselshell (3%)			
			Amesha (2%)			
AoC	Amesha loam, 4 to 9 percent slopes	Not limited	Amesha (60%)		58.4	12.9%
			Amesha (15%)			
			Chinook (15%)			
			Crago (10%)			
ChC	Chinook sandy loam, 4 to 9 percent slopes	Not limited	Chinook (95%)		0.0	0.0%
			Amesha (5%)			
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	Very limited	Musselshell (50%)	Slope (1.00)	31.7	7.0%
			Crago (40%)	Slope (1.00)		
			Cabbart (3%)	Slope (1.00)		
				Depth to soft bedrock (0.50)		
				Shrink-swell (0.50)		
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	Somewhat limited	Musselshell (55%)	Slope (0.96)	213.5	47.1%
			Crago (30%)	Slope (0.96)		
				Large stones (0.12)		
Te	Thess silt loam	Not limited	Thess (80%)		3.4	0.8%
			Amesha (5%)			
			Scravo (5%)			
Totals for Area of Interest					**453.4**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	213.5	47.1%
Not limited	208.2	45.9%
Very limited	31.7	7.0%
Totals for Area of Interest	**453.4**	**100.0%**

Description

Dwellings are single-family houses of three stories or less. For dwellings without basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper.

The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification of the soil. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

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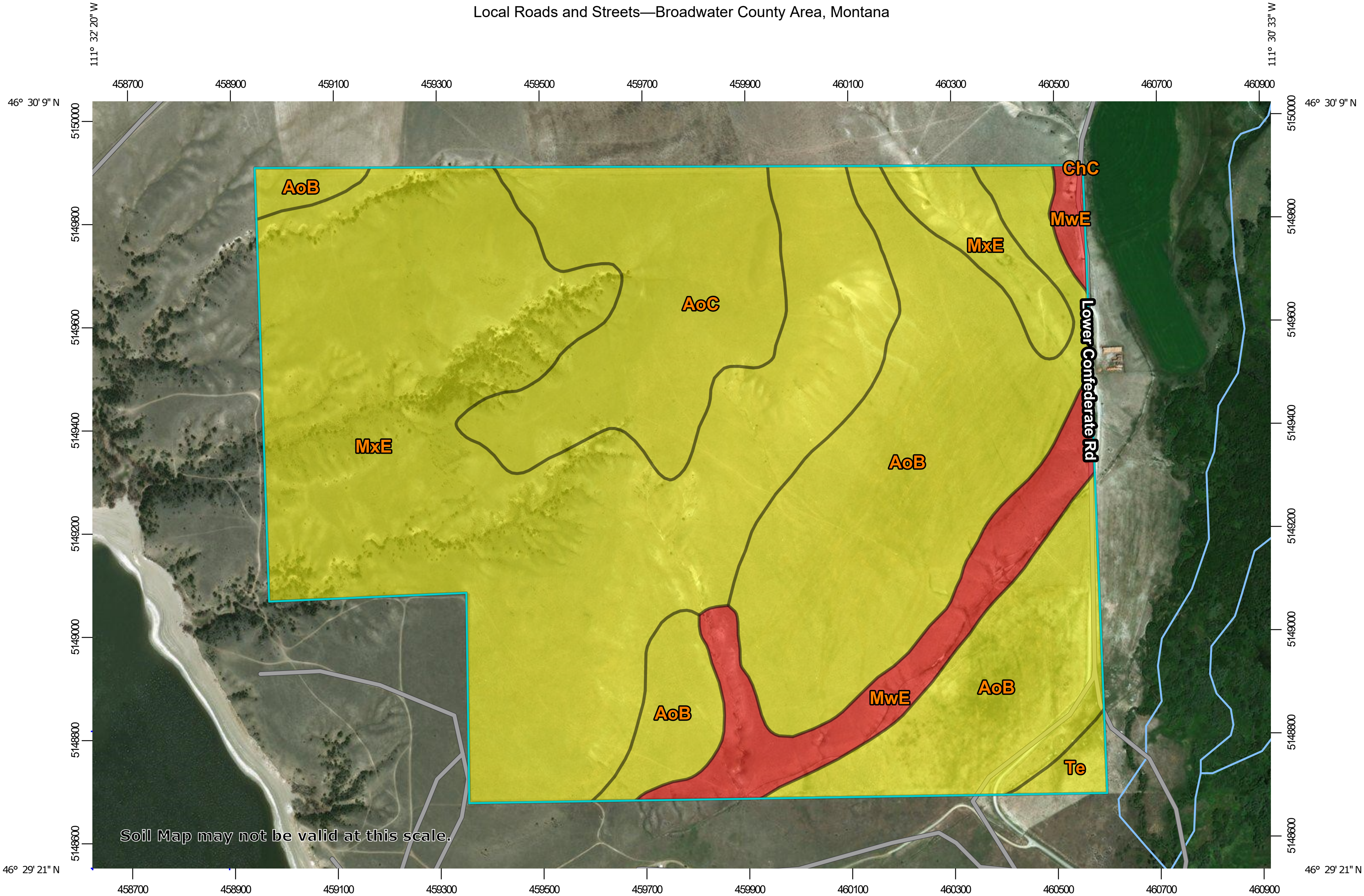
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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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)

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Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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Local Roads and Streets

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	Somewhat limited	Amesha (90%)	Frost action (0.50)	146.3	32.3%
			Mussel (5%)	Frost action (0.50)		
			Musselshell (3%)	Frost action (0.50)		
			Amesha (2%)	Frost action (0.50)		
AoC	Amesha loam, 4 to 9 percent slopes	Somewhat limited	Amesha (60%)	Frost action (0.50)	58.4	12.9%
			Amesha (15%)	Frost action (0.50)		
			Chinook (15%)	Frost action (0.50)		
			Crago (10%)	Frost action (0.50)		
ChC	Chinook sandy loam, 4 to 9 percent slopes	Somewhat limited	Chinook (95%)	Frost action (0.50)	0.0	0.0%
			Amesha (5%)	Frost action (0.50)		
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	Very limited	Musselshell (50%)	Slope (1.00)	31.7	7.0%
				Frost action (0.50)		
			Crago (40%)	Slope (1.00)		
				Frost action (0.50)		
			Cabbart (3%)	Depth to soft bedrock (1.00)		
				Slope (1.00)		
				Frost action (0.50)		
				Shrink-swell (0.50)		
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	Somewhat limited	Musselshell (55%)	Slope (0.96)	213.5	47.1%
				Frost action (0.50)		
			Crago (30%)	Slope (0.96)		
				Frost action (0.50)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Large stones (0.12)		
			Thess (5%)	Frost action (0.50)		
			Thess (5%)	Frost action (0.50)		
			Sappington (5%)	Frost action (0.50)		
Te	Thess silt loam	Somewhat limited	Thess (80%)	Frost action (0.50)	3.4	0.8%
			Amesha (5%)	Frost action (0.50)		
Totals for Area of Interest					**453.4**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	421.8	93.0%
Very limited	31.7	7.0%
Totals for Area of Interest	**453.4**	**100.0%**

Description

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

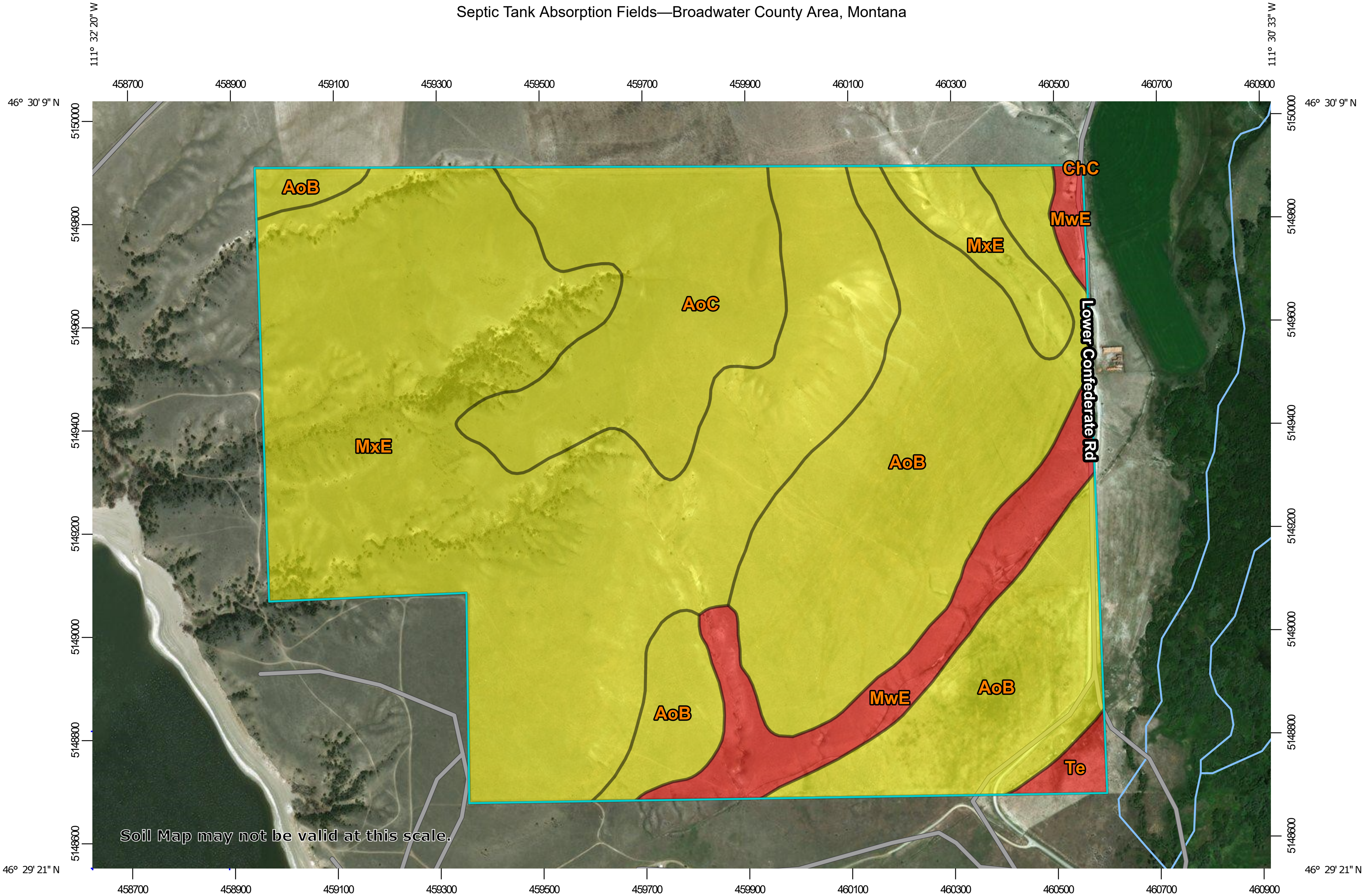
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Septic Tank Absorption Fields—Broadwater County Area, Montana



Map Scale: 1:10,500 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 150, 300, 600, 900

Feet: 0, 500, 1000, 2000, 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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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)

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

Soil Survey Area: Broadwater County Area, Montana
Survey Area Data: Version 17, Sep 5, 2018

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

Date(s) aerial images were photographed: Sep 10, 2012—Feb 15, 2017

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Septic Tank Absorption Fields

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AoB	Amesha loam, 1 to 4 percent slopes	Somewhat limited	Amesha (90%)	Slow water movement (0.50)	146.3	32.3%
			Mussel (5%)	Slow water movement (0.50)		
			Musselshell (3%)	Slow water movement (0.50)		
			Amesha (2%)	Slow water movement (0.50)		
AoC	Amesha loam, 4 to 9 percent slopes	Somewhat limited	Amesha (60%)	Slow water movement (0.50)	58.4	12.9%
			Amesha (15%)	Slow water movement (0.50)		
			Crago (10%)	Slow water movement (0.50)		
ChC	Chinook sandy loam, 4 to 9 percent slopes	Not limited	Chinook (95%)		0.0	0.0%
MwE	Musselshell-Crago channery loams, 15 to 35 percent slopes	Very limited	Musselshell (50%)	Slope (1.00)	31.7	7.0%
				Slow water movement (0.50)		
			Crago (40%)	Slope (1.00)		
				Slow water movement (0.50)		
			Cabbart (3%)	Depth to bedrock (1.00)		
				Slope (1.00)		
MxE	Musselshell-Crago cobbly loams, 8 to 20 percent slopes	Somewhat limited	Musselshell (55%)	Slope (0.96)	213.5	47.1%
				Slow water movement (0.50)		
			Crago (30%)	Slope (0.96)		
				Slow water movement (0.50)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Large stones (0.12)		
			Thess (5%)	Slow water movement (0.50)		
			Thess (5%)	Slow water movement (0.50)		
			Sappington (5%)	Slow water movement (0.50)		
Te	Thess silt loam	Very limited	Thess (80%)	Filtering capacity (1.00)	3.4	0.8%
			Scravo (5%)	Filtering capacity (1.00)		
			Lothair (5%)	Slow water movement (1.00)		
				Slope (0.16)		
Totals for Area of Interest					**453.4**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Somewhat limited	418.3	92.2%
Very limited	35.1	7.7%
Not limited	0.0	0.0%
Totals for Area of Interest	**453.4**	**100.0%**

Description

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Saturated hydraulic conductivity (Ksat), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 1
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 2%
Date: 2/10/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 36"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silt and sand with gravel up to 2" dia. Moist.
36" - 144"	2.5YR 6/2	None	Sand/Gravel	1	sbk	f	mvfr	G	W	1	vf	Pitrun gravel w/ fines and cobbles up to 15" dia. Dry. Some orange type mottling - unclear if it was groundwater mottling
	End at 156". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 2					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 2%					
Date: 2/10/2020							**Vegetation:**	Native Range					
Described By:		HTM					**Land Use:**	Grazing Operation					
Reviewed By:		MF											
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
2" - 45"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silt and sand with gravel up to 2" dia. Moist.	
45" - 144"	2.5YR 6/2	None	Sand/Gravel	1	sbk	f	mvfr	G	W	1	vf	Pitrun gravel w/ fines and cobbles up to 15" dia. Dry. Some orange type mottling - unclear if it was groundwater mottling	
	End at 156". No Groundwater, bedrock, or limiting layer encountered.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 3						
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 2%						
Date: 2/10/2020							**Vegetation:** Native Range						
Described By: HTM							**Land Use:** Grazing Operation						
Reviewed By: MF													
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
3" - 48"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silt and sand with gravel up to 2" dia. Moist.	
48" - 144"	2.5YR 6/2	None	Sand/Gravel	1	sbk	f	mvfr	G	W	1	vf	Pitrun gravel w/ fines and cobbles up to 15" dia. Dry. Some orange type mottling - unclear if it was groundwater mottling	
	End at 156". No Groundwater, bedrock, or limiting layer encountered.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 4					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 3%					
Date: 2/6/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots
2" - 12"	2.5YR 6/2	None	Silty Sand	1	sbk	f	mvfr	G	W	1	vf	Brown sandy silt with fine roots, dry.
12" - 32"	2.5YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, with fewer fine roots, dry.
32" - 60"	2.5YR 4/2	None	Silty Loam with gravel	1	sbk	f	mvfr	G	W	1	vf	Tan silty sandy loam with gravel up to 4"
60" - 144"	2.5YR 4/3	None	Silty Sand with Cobbles	1	sbk	f	mvfr	G	W	1	vf	Very cobbly gravely sandy silt 30% fines. Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client:	71 Ranch	**Location:**	Test Pit 5
Project #:	19-072 71 Ranch - Major Subdivision	**Slope:**	± 4%
Date:	2/6/2020	**Vegetation:**	Native Range
Described By:	HTM	**Land Use:**	Grazing Operation
Reviewed By:	MF		

				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots
4" - 72"	2.5YR 4/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ gravel up to 4". Roots and dry.
72" - 144"	2.5YR 3/2	None	Silt Loam	1	gr	m	mvfr	G	W	1	vf	Same material but with larger cobble up to 12". Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silt loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

ALLIED ENGINEERING SERVICES, INC.
Diverse Projects • Solutions that Last

Client: 71 Ranch							**Location:**	Test Pit 6				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 4%				
Date: 2/6/2020							**Vegetation:**	Native Range				
Described By:	HTM						**Land Use:**	Grazing Operation				
Reviewed By:	MF											
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots
2" - 144"	2.5YR 4/4	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ gravel up to 4". Roots for first 2' and dry.
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silt Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

ALLIED ENGINEERING SERVICES, INC.
Diverse Projects • Solutions that Last

Client: 71 Ranch		**Location:**	Test Pit 7
Project #: 19-072 71 Ranch - Major Subdivision		**Slope:**	± 3%
Date: 2/6/2020		**Vegetation:**	Native Range
Described By:	HTM	**Land Use:**	Grazing Operation
Reviewed By:	MF		

				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 144"	2.5YR 5/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan and sandy silt with roots down to 2' BGS. Dry
144" - 156"	2.5YR 6/4	None	Silty Fine Sand	1	sbk	f	mvfr	G	W	1	vf	Light tan and sandy silt w/ cobbles. Dry
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silt loam or fine sand below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 8						
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 5%						
Date: 2/6/2020							**Vegetation:** Native Range						
Described By: HTM							**Land Use:** Grazing Operation						
Reviewed By: MF													
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
3" - 144"	2.5YR 4/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ some gravel. Some bigger gravels @ 144". Dry	
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of silt loam below proposed trenches.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 9				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 5%				
Date: 2/6/2020							**Vegetation:**	Native Range				
Described By:	HTM						**Land Use:**	Grazing Operation				
Reviewed By:	MF											
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 150"	10YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ gravel up to 4". Roots for first 2' and dry.
	End at 150". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silt Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 10
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 7%
Date: 2/6/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 144"	2.5YR 4/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ some gravel. Some bigger gravels @ 144". Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silt Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 11					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 8%					
Date: 2/6/2020							**Vegetation:**	Native Range					
Described By:	HTM						**Land Use:**	Grazing Operation					
Reviewed By:	MF												
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
3" - 144"	10YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ some gravel. Some bigger gravels @ 144". Dry	
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of silt loam below proposed trenches												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 12					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 4%					
Date: 2/6/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 144"	10YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ some gravel. Some bigger gravels @ 144". Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of silt loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 13					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 8%					
Date: 2/6/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -5"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
5" - 120"	10YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light chalky sandy silt with some gravel, dry. Roots down to 2' bgs.
120" - 144"	2.5YR 7/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Same material but w/some cobbles up to 5" dia.
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of silt loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 14				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 8%				
Date: 2/10/2020							**Vegetation:**	Native Range				
Described By:		HTM					**Land Use:**	Grazing Operation				
Reviewed By:		MF										
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
4" - 18"	2.5YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, with fewer fine roots, dry.
18" - 24"	2.5YR 5/2	None	Fine Sandy Loam	2	bk	f	mvfr	C	S	1	vf	Layer of gravelly sand and loam w/ calcium deposits visible in layer. Dry
24" - 156"	2.5YR 5/2	None	Fine Sandy Loam	2	bk	f	mfr	C	S	1	vf	Sand with some loam w/ gravel and cobbles up to 5" dia., Dry.
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of find sandy loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 15
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 10%
Date: 2/10/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 12"	2.5YR 5/2	None	Fine Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, with fewer fine roots, dry. Calcium deposits visible
12" - 60"	2.5YR 5/2	None	Fine Sandy Loam	2	bk	f	mvfr	G	S	1	vf	Sandy silt w/ some gravel up to 1". Dry
60" - 72"	2.5YR 5/2	None	Gravel	2	bk	f	mfr	C	S	1	vf	Gravel seam - gravel up to 3" dia. Dry
72" - 156"	2.5YR 5/2	None	Sand	2	bk	f	mfr	C	S	1	vf	Sandy silt w/ some gravel up to 3" Dry.
	End at 156". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 16				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 5%				
Date: 2/6/2020							**Vegetation:**	Native Range				
Described By:	HTM						**Land Use:**	Grazing Operation				
Reviewed By:	MF											
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
4" - 24"	2.5YR 4/2	None	Sandy gravel	1	sbk	f	mvfr	G	W	1	vf	Tan/brown sand/pea gravel mix with some fines.
24" - 84"	2.5YR 5/2	None	Fine Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, dry. Calcium deposits visible
84" - 120"	2.5YR 6/3	None	Sandy Gravel	1	sbk	f	mvfr	G	W	1	vf	Pitrun/gravel seam with gravel up to 3" dia. Dry
120" - 144"	2.5YR 6/3	None	Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ gravel.
	End at 144". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 17					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 8%					
Date: 2/6/2020							**Vegetation:**	Native Range					
Described By:		HTM					**Land Use:**	Grazing Operation					
Reviewed By:		MF											
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" -2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
2" - 150"	2.5YR 5/2	None	Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty sand, dry and fine roots down to 3' bgs.	
	End at 150". No Groundwater, bedrock, or limiting layer encountered. Over 6' of loam below proposed trenches.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 18						
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 5%						
Date: 2/10/2020							**Vegetation:** Native Range						
Described By: HTM							**Land Use:** Grazing Operation						
Reviewed By: MF													
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 48"	2.5YR 5/2	None	Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty sand, dry and fine roots down to 3' bgs.
48" - 156"	2.5YR 5/2	None	Loamy Sand	2	bk	f	mfr	C	S	1	vf	Sandy silt w/ fine gravel up to 0.5" dia. Dry
	End at 156". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 19				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 8%				
Date: 2/6/2020							**Vegetation:**	Native Range				
Described By:	HTM						**Land Use:**	Grazing Operation				
Reviewed By:	MF											
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 22"	2.5YR 3/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Brown sandy silt with fine roots. Dry
22" - 72"	2.5YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light chalky colored sandy silt w/ some gravel up to 1" dia. Dry
72" - 144"	2.5YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Darker light chalk w/ some gravel about 50% fines.
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

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Client: 71 Ranch							**Location:**	Test Pit 20				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 3%				
Date: 2/6/2020							**Vegetation:**	Native Range				
Described By:	HTM						**Land Use:**	Grazing Operation				
Reviewed By:	MF											
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -10"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
10" - 96"	2.5YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Tan sandy silt w/ 40% gravel up to 1" dia. Dry
96" - 108"	2.5YR 5/3	None	Sand/gravel	1	sbk	f	mvfr	G	W	1	vf	Pitrun/gravel seam with gravel up to 3" dia. Dry
108" - 144"	2.5YR 6/3	None	Loamy Sand	1	sbk	f	mvfr	G	W	1	vf	Sandy silt/sand with some gravel up to 4" dia. Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 21
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 5%
Date: 2/10/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 48"	2.5YR 5/2	None	Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Sandy silt w/ small gravel up to 1" dia. Dry
48" - 54"	2.5YR 5/2	None	Sand/gravel	2	bk	f	mfr	C	S	1	vf	Gravel seam with gravel up to 2" dia. Dry
54" - 156"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Sandy silt w/ small gravel up to 1" dia. Dry
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch		**Location:**	Test Pit 22
Project #: 19-072 71 Ranch - Major Subdivision		**Slope:**	± 5%
Date: 2/10/2020		**Vegetation:**	Native Range
Described By:	HTM	**Land Use:**	Grazing Operation
Reviewed By:	MF		

				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 5"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
5" - 18"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light graysilt sand w/ gravel up to 1" dia. Dry
18" - 46"	2.5YR 5/2	None	Sand/Gravel	2	bk	f	mvfl	C	S	1	vf	Fractured and weathered sandstone bedrock. Easy to dig through.
46" - 144"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light silty sand w/ some gravel up to 2" dia.
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 23					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 5%					
Date: 2/10/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
4" - 12"	2.5YR 5/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light chalky silty sand, powder. Dry
12" - 48"	2.5YR 5/2	None	Coarse Sand	1	sbk	f	mvfr	G	W	1	vf	Sandy gravel with some loam/fines, loose brown/grey. Dry.
48" - 144"	2.5YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ some gravel up to 2" dia. Dry.
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 24
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 5%
Date: 2/10/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 36"	2.5YR 6/3	None	Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, Dry.
36" - 72"	2.5YR 6/4	None	Sand/Gravel	2	bk	f	mvfl	C	S	1	vf	Sandstone/fractured pieces w/ gravel. Non restrictive layer - similar to TP #22.
72" - 156"	2.5YR 6/3	None	Sand	1	sbk	f	mvfr	G	W	1	vf	Sand w/ some gravel up to 2" dia. Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 24A				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 2%				
Date: 2/10/2020							**Vegetation:**	Native Range				
Described By:	HTM						**Land Use:**	Grazing Operation				
Reviewed By:	MF											
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 48"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, Dry.
48" - 156"	2.5YR 6/3	None	Sand	1	sbk	f	mvfr	G	W	1	vf	Sand w/ some gravel up to 2" dia. Dry
	End at 156". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 25
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 4%
Date: 2/10/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 48"	2.5YR 5/3	None	Fine Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, Dry.
48" - 144"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Lighter tan chalky silt/sand some gravel up to 2" dia. Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 26				
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 5%				
Date: 2/10/2020							**Vegetation:**	Native Range				
Described By:	HTM						**Land Use:**	Grazing Operation				
Reviewed By:	MF											
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 60"	2.5YR 5/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, Dry.
60" - 144"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Lighter tan chalky silt/sand some gravel up to 2" dia. Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 27						
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 5%						
Date: 2/10/2020							**Vegetation:** Native Range						
Described By: HTM							**Land Use:** Grazing Operation						
Reviewed By: MF													
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" -4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots	
4" - 60"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, Dry.	
60" - 156"	2.5YR 6/3	None	Fine Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Sandy silt loam w/ some gravel up to 2" dia. Dry	
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silt Loam or Fine Sandy Loam below proposed trenches.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 28					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 3%					
Date: 2/10/2020							**Vegetation:**	Native Range					
Described By:	HTM						**Land Use:**	Grazing Operation					
Reviewed By:	MF												
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" -4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots	
4" - 30"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Tan silt fairly loose, Dry	
30" - 54"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Darker tan silt and more dense. Dry	
54" - 120"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light chalky silt sand, Dry	
120" - 156"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Darker tan silt and dense, Dry.	
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of silty loam below proposed trenches.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client:	71 Ranch	**Location:**	Test Pit 29
Project #:	19-072 71 Ranch - Major Subdivision	**Slope:**	± 5%
Date:	2/10/2020	**Vegetation:**	Native Range
Described By:	HTM	**Land Use:**	Grazing Operation
Reviewed By:	MF		

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots
4" - 24"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Tan silt fairly loose, Dry
24" - 60"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Darker tan silt and more dense. Dry
60" - 96"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light chalky silt sand, Dry
96" - 144"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Darker tan silt and dense, Dry.
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 30
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 8%
Date: 2/10/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots
3" - 18"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Darker sandy silt w/ calcium deposit visible. Dry
18" - 156"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light Tan Sandy Silt material with some gravel up to 3" dia. Dry
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch		**Location:**	Test Pit 31
Project #: 19-072 71 Ranch - Major Subdivision		**Slope:**	± 10%
Date: 2/10/2020		**Vegetation:**	Native Range
Described By:	HTM	**Land Use:**	Grazing Operation
Reviewed By:	MF		

				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots
2" - 18"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Darker sandy silt w/ calcium deposit visible. Dry
18" - 156"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt w/ some gravel. Gravel seam @ 52" Dry
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 32						
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 10%						
Date: 2/10/2020							**Vegetation:** Native Range						
Described By: HTM							**Land Use:** Grazing Operation						
Reviewed By: MF													
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" -8"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	2	f	Brown topsoil, moist with fine roots	
8" - 30"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	2	f	Fine sandy silt w/ roots, Dry.	
30" - 156"	2.5YR 6/2	None	Sand	1	sbk	f	mvfr	G	W	1	vf	Orange/brown sand w/ pea gravel. Dry.	
	End at 156". No Groundwater, bedrock, or limiting layer encountered.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 33					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 2%					
Date: 2/10/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" -5"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
5" - 24"	2.5YR 5/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Fine sandy silt w/ roots, Dry.
24" - 144"	2.5YR 6/2	None	Fine Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Sandier material w/ gravel w/ some pea gravel, Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Fine Sandy Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 34						
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 10%						
Date: 2/10/2020							**Vegetation:** Native Range						
Described By: HTM							**Land Use:** Grazing Operation						
Reviewed By: MF													
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" -4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
4" - 48"	2.5YR 6/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan sandy silt, Dry with roots down to 2' bgs.	
48" - 96"	2.5YR 5/3	None	Sand	1	sbk	f	mvfr	G	W	1	vf	Sand w/ some silt, Dry.	
96" - 144"	2.5YR 4/2	None	Loamy Sand	1	sbk	f	mvfr	G	W	1	vf	Light Tan Sand with more silt, Dry	
	End at 144". No Groundwater, bedrock, or limiting layer encountered.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 35					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 13%					
Date: 2/6/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 60"	2.5YR 6/3	None	Fine Sandy Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty/sandy gravel up to 1" dia. Dry
60" - 144"	2.5YR 6/2	None	Sand	1	sbk	f	mvfr	G	W	1	vf	Cleaner sand w/ gravel up to 3" dia. Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 36					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 12%					
Date: 2/6/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 144"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty/sand with gravel up to 1" dia. Dry
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 37					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 8%					
Date: 2/6/2020							**Vegetation:**	Native Range					
Described By:		HTM					**Land Use:**	Grazing Operation					
Reviewed By:		MF											
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
3" - 144"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty sand, Dry.	
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:** Test Pit 38					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 5%					
Date: 2/6/2020							**Vegetation:** Native Range					
Described By: HTM							**Land Use:** Grazing Operation					
Reviewed By: MF												
				Structure				**Boundary**		**Roots**		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
3" - 144"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty/sand with gravel up to 1" dia.
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 39					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 10%					
Date: 2/6/2020							**Vegetation:**	Native Range					
Described By:	HTM						**Land Use:**	Grazing Operation					
Reviewed By:	MF												
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
3" - 144"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty sand, Dry	
	End at 144". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch													Location: Test Pit 40
Project #: 19-072 71 Ranch - Major Subdivision													Slope: ± 5%
Date: 2/6/2020													Vegetation: Native Range
Described By: HTM													Land Use: Grazing Operation
Reviewed By: MF													
				Structure				Boundary		Roots			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**		**Comments**
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f		Brown topsoil, moist with fine roots
3" - 156"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf		Sandy silt w/ some gravel. Cobbles near bottom. More gravel up to 3" dia. @ 72", Dry
	End at 156". No Groundwater, bedrock, or limiting layer encountered. Over 6' of Silty Loam below proposed trenches.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

ALLIED ENGINEERING SERVICES, INC.

Diverse Projects • Solutions that Last

Client: 71 Ranch							**Location:** Test Pit 41A						
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:** ± 5%						
Date: 2/6/2020							**Vegetation:** Native Range						
Described By: HTM							**Land Use:** Grazing Operation						
Reviewed By: MF													
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 3"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
3" - 60"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty/sand with some gravel up to 1" dia. Dry	
60" - 144"	2.5YR 6/2	None	Loamy Sand	1	sbk	f	mvfr	G	W	1	vf	Cleaner sand w/ gravel up to 2" dia. Dry	
	End at 144". No Groundwater, bedrock, or limiting layer encountered.												

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch	**Location:** Test Pit 41B
Project #: 19-072 71 Ranch - Major Subdivision	**Slope:** ± 5%
Date: 2/6/2020	**Vegetation:** Native Range
Described By: HTM	**Land Use:** Grazing Operation
Reviewed By: MF	

				Structure				Boundary		Roots		
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**
0" - 2"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots
2" - 48"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan silty/sand with some gravel up to 1" dia. Dry
48" - 144"	2.5YR 6/2	None	Sand/Gravel	1	sbk	f	mvfr	G	W	1	vf	Pitrun type gravel w/ cobbles 6" increasing as depth increases
	End at 156". No Groundwater, bedrock, or limiting layer encountered.											

TEST PIT LOCATION DESCRIPTION AND LOG FORM

Client: 71 Ranch							**Location:**	Test Pit 41C					
Project #: 19-072 71 Ranch - Major Subdivision							**Slope:**	± 1%					
Date: 2/6/2020							**Vegetation:**	Native Range					
Described By:	HTM						**Land Use:**	Grazing Operation					
Reviewed By:	MF												
				Structure				**Boundary**		**Roots**			
Depth (in.)	**Color**	**Mottles**	**Texture**	**G**	**SH**	**S**	**Consistence**	**D**	**T**	**Q**	**S**	**Comments**	
0" - 4"	2.5YR 4/3	None	Loamy Sand	1	sbk	f	mvfr	G	I	1	f	Brown topsoil, moist with fine roots	
4" - 72"	2.5YR 6/3	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan powdery silt w/ sand tiny bit of gravel up to 1" dia. Dry	
72" - 108"	2.5YR 4/2	None	Sand/Gravel	1	sbk	f	mvfr	G	W	1	vf	Cobbles and gravel and pitrun type material, Dry	
108" - 156"	2.5YR 4/2	None	Silty Loam	1	sbk	f	mvfr	G	W	1	vf	Light tan powdery silt w/ sand tiny bit of gravel up to 4" dia.	
	End at 156". No Groundwater, bedrock, or limiting layer encountered. 7' of Silty Loam below proposed trenches.												

Appendix C

Well Information

- Horse Creek Hills Test Well Program and Summary
  - Test Well Logs
- Horse Creek Hills Pump Test Well Log
  - Pump Test Results and Graph

Test Well Program & Summary

This narrative provides for the summary, intent, and results of the Test Well Program & Summary for the Horse Creek Hills Subdivisions, which was used in the evaluation of the proposed wastewater treatment system evaluations of the Horse Creek Hills 1-4 subdivisions.

The proposed project is located approximately 0.25 miles east of Canyon Ferry Reservoir at the location where Lower Confederate Road reaches the lake. The legal description of the approximately 435-acre is Section 31, Township 9 North, Range 2 East, Principal Meridian Montana, Broadwater County, Montana. The subject property is currently used for cattle grazing purposes. The current projects are proposing to develop the subject property into a 41-lot major subdivision.

Three test wells were drilled in the project area to provide for site specific data for evaluation of the proposed wastewater absorption areas to assess site specific groundwater depths, groundwater flow gradient, hydraulic conductivity, and background nitrate concentrations in the first 15 ft of the first aquifer. We sampled nitrates and conductivity on the three TWs for data to be used in our non-degradation analysis.

Additionally, a production well was drilled on Lot #13 to be used for pump testing analysis. This well was drilled to a depth beyond the first 15-ft of the first aquifer. The well was pump tested on January 30th, 2020. The pump testing occurred at a rate of 15 gallons-per-minute for a duration of 8 hours. A pressure transducer was placed in the pump testing well to analyze water depths while pumping. Another pressure transducer was placed in Test Well #1 while the pump test was ran to evaluate any potential drawdown in the aquifer from the pump test. Test Well #1 did not see any abnormal fluctuation of static water level during the pump test of the production well.

Per the attached site plan, the following Test Wells were drilled, as described below. Included are some summary notes.

TW #1 - (GWIC Id: 304166)
TW #1 was installed on November 26, 2019 by H&L Drilling on Lot #7 for testing, sampling and monitoring purposes only (not intended for potable use). Allied Engineering measured the static water level at 82.42 ft below ground surface – at an elevation of 3795.66 feet above sea level. A background nitrate sample was taken by the driller at first water and was found to 0.50 mg/l. A pump test was performed for approximately 1 hrs at a pumping rate of 8.5 gpm. The well was completed on November 26, 2019. Hydraulic Conductivity was found to be 97.06 ft/day (calculations included in the Non-Degradation Report).

TW #2 - (GWIC Id: 304169)
TW #2 was installed on November 26, 2019 by H&L Drilling on Lot #25 for testing, sampling and monitoring purposes only (not intended for potable use). Allied Engineering measured the static water level at 91.06 ft below ground surface – at an elevation of 3794.24 feet above sea level. A background nitrate sample was taken by the driller at first water and was found to 1.30 mg/l. A pump test was performed for approximately 1 hrs at a pumping rate of 9 gpm. The well

was completed on November 26, 2019. Hydraulic Conductivity was found to be 137.87 ft/day (calculations included in the Non-Degradation Report).

TW #3 - (GWIC Id: 304167)

TW #3 was installed on November 26, 2019 by H&L Drilling on Lot #37 for testing, sampling and monitoring purposes only (not intended for potable use). Allied Engineering measured the static water level at 169.57 ft below ground surface – at an elevation of 3801.60 feet above sea level. A background nitrate sample was taken by the driller at first water and was found to 0.97 mg/l. A pump test was performed for approximately 1 hrs at a pumping rate of 11 gpm. The well was completed on November 26, 2019. Hydraulic Conductivity was found to be 87.59 ft/day (calculations included in the Non-Degradation Report).

Pumping Well #1 - (GWIC Id: 304170)

Pumping Well #1 was installed on November 26, 2019 by H&L Drilling on Lot #13 for testing, sampling and monitoring purposes and future potable usage. The pumping well was drilled beyond the first 15 feet of the aquifer to be used to pump test and find if the aquifer had adequate water supply. A pump test was performed for approximately 8.08 hrs at a pumping rate of 15 gpm. The static level of the well recovered in less than 8 hours as shown on the pump testing graph in Appendix C. The pump test was conducted on January 30th of 2020. Hydraulic Conductivity was found to be 79.60 ft/day (calculations included in the Non-Degradation Report).

Summary

The groundwater mapping was based measurements conducted on the three (3) test wells that were drilled into the first aquifer. The depth to first water was recorded for each well and the well heads and existing ground surface were surveyed. A groundwater surface was developed based on the field measurements, and the hydraulic gradient was subsequently determined to be 0.0021 ft/ft with a direction of South 38 degrees, 34 minutes, and 40 Seconds West.

We obtained background nitrate samples from the first aquifer in each the test wells. The background nitrates for TW #1-3 were determined to be 0.50 mg/L, 1.30 mg/L and 0.97 mg/L respectively. For the purpose of this application, we have the three values as outlined in the non-degradation manual and used a background nitrate level of 0.923 mg/L for this application. Hydraulic Conductivity for the TWs #1-3 was found to be 97.06 ft/day, 137.87 ft/day, and 87.59 ft/day, respectively using the Razack and Huntley Method. Those three values were averaged with the results of the 8 hour pump test on Pumping Well #1 that had an estimated hydraulic conductivity of 79.60 ft/day using the Razack & Huntley Method. The average value was 100.5 ft/day was used in the Non-Degradation report.

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report was completed online by the driller. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Site Name: 71 RANCH LP
GWIC Id: 304166

Section 1: Well Owner(s)

1) **GALT, ERROL** (MAIL)
106 71 RANCH RD
MARTINSDALE MT 59053

Section 2: Location

Township	Range	Section	Quarter Sections
09N	02E	31	SE¼ NE¼ SW¼

County	Geocode
BROADWATER	

Latitude	Longitude	Geomethod	Datum

Addition	Block	Lot
HORSE CREEK HILLS		4R

Section 3: Proposed Use of Water

TEST WELL (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Monday, November 25, 2019

Section 6: Well Construction Details

Meta Data Fields

1. Was borehole completed as a well? YES
2. Was well abandoned?

Borehole dimensions

From	To	Diameter
0	108	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	108	6	0.250		WELDED	A53B STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
93	108	6	23	6"X5/16"	TORCH OR PLASMA CUTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	93	BENTONITE	Y

Section 7: Well Test Data

Total Depth: 108
Static Water Level: 84
Water Temperature:

Air Test *

8.5 gpm with drill stem set at 108 feet for 1 hours.
Time of recovery 0.07 hours.
Recovery water level 84 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

TW-1

Section 9: Well Log

From	To	Description
0	8	SILTY CLAY
8	17	SILTY SAND/GRAVEL
17	24	SANDY CLAY
24	50	SAND
50	78	SAND/GRAVEL
78	93	CLAY
93	105	GRAVEL/SAND
105	108	GRAVEL/CLAY

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: SHAWN TONEY
Company: H & L DRILLING
Address: PO BOX 919
City: EAST HELENA MT 59635
License No: WWC-447
Date Certified: 11/26/2019

MONTANA WELL LOG REPORT

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Site Name: 71 RANCH LP
GWIC Id: 304169

Section 1: Well Owner(s)

1) **GALT, ERROL** (MAIL)
106 71 RANCH RD
MARTINSDALE MT 59053

Section 2: Location

Township	Range	Section	Quarter Sections
09N	02E	31	SE¼ NE¼ SW¼

County	Geocode
BROADWATER	

Latitude	Longitude	Geomethod	Datum

Addition	Block	Lot
HORSE CREEK HILLS		18R

Section 3: Proposed Use of Water

TEST WELL (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Thursday, November 21, 2019

Section 6: Well Construction Details

Meta Data Fields

1. Was borehole completed as a well? YES
2. Was well abandoned?

Borehole dimensions

From	To	Diameter
0	135	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	135	6	0.250		WELDED	A53B STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
120	135	6	23	6"X5/16"	SAW SLOTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	120	BENTONITE	Y

Section 7: Well Test Data

Total Depth: 135
Static Water Level: 93
Water Temperature:

Air Test *

9 gpm with drill stem set at 135 feet for 1 hours.
Time of recovery 0.12 hours.
Recovery water level 93 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

TW-2

Section 9: Well Log

From	To	Description
0	10	SILT/CLAY
10	70	SAND/GRAVEL/CLAY
70	128	HARD CLAY
128	135	MED FINE SAND/FINE GRAVEL

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: SHAWN TONEY
Company: H & L DRILLING
Address: PO BOX 919
City: EAST HELENA MT 59635
License No: WWC-447
Date Certified: 11/26/2019

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report was completed online by the driller. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Site Name: 71 RANCH LP
GWIC Id: 304167

Section 1: Well Owner(s)

1) **GALT, ERROL** (MAIL)
106 71 RANCH RD
MARTINSDALE MT 59053

Section 2: Location

Township	Range	Section	Quarter Sections
09N	02E	31	SE¼ NE¼ SW¼

County	Geocode
BROADWATER	

Latitude	Longitude	Geomethod	Datum

Addition	Block	Lot
HORSE CREEK HILLS		39R

Section 3: Proposed Use of Water

TEST WELL (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Tuesday, November 19, 2019

Section 6: Well Construction Details

Meta Data Fields

1. Was borehole completed as a well? YES
2. Was well abandoned?

Borehole dimensions

From	To	Diameter
0	200	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	200	6	0.250		WELDED	A53B STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
185	200	6	23	6	TORCH OR PLASMA CUTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	185	BENTONITE	Y

Section 7: Well Test Data

Total Depth: 200
Static Water Level: 173
Water Temperature:

Air Test *

_11_ gpm with drill stem set at _200_ feet for _1_ hours.
Time of recovery _0.06_ hours.
Recovery water level _173_ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

TW-3

Section 9: Well Log

From	To	Description
0	28	SILTY TAN CLAY
28	42	GRAVEL/SAND
42	118	CLAY/GRAVEL/SAND
118	155	SAND/GRAVEL
155	164	HARD CLAY
164	185	SAND/GRAVEL/CLAY
185	200	SAND/GRAVEL

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: SHAWN TONEY
Company: H & L DRILLING
Address: PO BOX 919
City: EAST HELENA MT 59635
License No: WWC-447
Date Certified: 11/26/2019

PUMPING TEST DATA SHEET

TW 1

Initial Static Water Level: 83.9, Number of Pumping Steps:
Depth to pump intake: 100'
Water measurement device: Well Probe
Total Well Depth: 108', Driller's Production Estimate: 8.5 GPM
Casing Diameter: 6", Depth to screen interval:

Notes: Drawdown = Initial static water level - pumping water level
Initial Static Water Level: 83.9 Pumping Water Level: 100'

STEP ONE 50% of design production	Date 01/21/2020	Start Time 11:00 AM		
Time Since Start (minutes)	Actual Time Since Start (minutes)	Depth to Pumping Water Level (ft.)	Drawdown (ft.)	Pumping Rate (gpm)
1				
2				
3				
4				
5	11:05	87		6
6				
7				
8				
9				
10	11:10	89		8
11				
12				
13				
14				
15	11:15	89.6		9
17				
19				
20	11:20	89.7		9
23				
25	11:25	89.7		9
27				
29				
30	11:30	89.7		9
35	11:35	89.8		9
40	11:40	89.8		9
45	11:45	89.8		9
50				
55				
60	12:00	89.8		9
70				
80				
90				
100				
115				
130				
145				
160				
180				
210				
240				
270				
300				

Field Notes:

RECOVERY TEST DATA SHEET TW1

RECOVERY TEST	Date 01/21/2020	Start Time 12:01 PM	End Time 12:40
Time Since Start (minutes)	Actual Time Since Start (minutes)	Depth to Water Level (ft.)	Residual Drawdown (ft.)
1	12:01	86.8	
2	12:02	85.7	
3	12:03	85.2	
4	12:04	85.1	
5	12:05	85	
6			
7			
8			
9			
10	12:10	84.8 1/2	
11			
12			
13			
14			
15	12:15	84.8	
17			
19			
20	12:20	84.7 1/2	
23			
25	12:25	84.7	
27			
29			
30	12:30	84.6 1/2	
35			
40	12:40	84.6	
45			
50			
55			
60			
70			
80			
90			
100			
115			
130			
145			
160			
180			
210			
240			
270			
300			

Note: Residual drawdown = Initial Static Water Level – Measured Water Level.

PUMPING TEST DATA SHEET TW2

Initial Static Water Level: 93.8, Number of Pumping Steps:
Depth to pump intake: 125'
Water measurement device: Well Probe
Total Well Depth: 135', Driller's Production Estimate: 9
Casing Diameter: 6", Depth to screen interval:

Notes: Drawdown = Initial static water level - pumping water level
Initial Static Water Level: 93.8 Pumping Water Level: 125'

STEP ONE 50% of design production	Date 01/21/2020	Start Time 1:00 PM		
Time Since Start (minutes)	Actual Time Since Start (minutes)	Depth to Pumping Water Level (ft.)	Drawdown (ft.)	Pumping Rate (gpm)
1	1:01	95.9		10
2	1:02	96.2		10
3	1:03	96.4		10
4	1:04	96.6		10
5	1:05	96.7		10
6				
7				
8				
9				
10	1:10	96.9		10
11				
12				
13				
14				
15	1:15	97.0		10
17				
19				
20	1:20	97.0		10
23				
25	1:25	97.0		10
27				
29				
30	1:30	97.5		10
35				
40				
45	1:45	97.5		10
50				
55				
60	2:00	97.5		10
70				
80				
90				
100				
115				
130				
145				
160				
180				
210				
240				
270				
300				

Field Notes:

RECOVERY TEST DATA SHEET TW2

RECOVERY TEST	Date 01/21/2020	Start Time 2:00 P.M	End Time________
Time Since Start (minutes)	Actual Time Since Start (minutes)	Depth to Water Level (ft.)	Residual Drawdown (ft.)
1	2:01	95.1	
2	2:02	94.6	
3	2:03	94.3 1/2	
4	2:04	94.2	
5	2:05	94.1	
6			
7			
8			
9			
10	2:10	93.9	
11			
12			
13			
14			
15	2:15	93.9	
17			
19			
20	2:20	93.9	
23			
25	2:25	93.9	
27			
29			
30	2:30	93.9	
35			
40			
45			
50			
55			
60			
70			
80			
90			
100			
115			
130			
145			
160			
180			
210			
240			
270			
300			

Note: Residual drawdown = Initial Static Water Level – Measured Water Level.

PUMPING TEST DATA SHEET TW3

Initial Static Water Level: 172.5, Number of Pumping Steps: ______
Depth to pump intake: 190'
Water measurement device: Well Probe
Total Well Depth: 200', Driller's Production Estimate: 11
Casing Diameter: 6", Depth to screen interval: ______

Notes: Drawdown = Initial static water level - pumping water level
Initial Static Water Level: 172.5 Pumping Water Level: 190

STEP ONE 50% of design production	Date 01/21/2020	Start Time 2:30 PM		
Time Since Start (minutes)	Actual Time Since Start (minutes)	Depth to Pumping Water Level (ft.)	Drawdown (ft.)	Pumping Rate (gpm)
1	2:31	178.8		10
2	2:32	179.6		10
3	2:33	180		10
4	2:34	180.2		10
5	2:35	180.3		10
6				
7				
8				
9				
10	2:40	180.8		10
11				
12				
13				
14				
15	2:45	181.1		10
17				
19				
20	2:50	181.2½		10
23				
25	2:55	181.2½		10
27				
29				
30	3:00	181.2½		10
35				
40				
45	3:15	181.4		10
50				
55				
60	3:30	181.4		10
70				
80				
90				
100				
115				
130				
145				
160				
180				
210				
240				
270				
300				

Field Notes:

RECOVERY TEST DATA SHEET TW3

RECOVERY TEST	Date 01/21/2020	Start Time 3:31	End Time
Time Since Start (minutes)	Actual Time Since Start (minutes)	Depth to Water Level (ft.)	Residual Drawdown (ft.)
1	3:31	177.2	
2	3:32	175	
3	3:33	173.8	
4	3:34	173.2	
5	3:35	173	
6			
7			
8			
9			
10	3:40	172.6	
11			
12			
13			
14			
15	3:45	172.5	
17			
19			
21			
23			
25			
27			
29			
30			
35			
40			
45			
50			
55			
60			
70			
80			
90			
100			
115			
130			
145			
160			
180			
210			
240			
270			
300			

Note: Residual drawdown = Initial Static Water Level – Measured Water Level.

MONTANA WELL LOG REPORT

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Site Name: 71 RANCH LP
GWIC Id: 304170

Section 1: Well Owner(s)

1) **GALT, ERROL** (MAIL)
106 71 RANCH RD
MARTINSDALE MT 59053

Section 2: Location

Township	Range	Section	Quarter Sections
09N	02E	31	SE¼ NE¼ SW¼

County	Geocode
BROADWATER	

Latitude	Longitude	Geomethod	Datum

Addition	Block	Lot
HORSE CREEK HILLS		14R

Section 3: Proposed Use of Water

DOMESTIC (1)

Section 4: Type of Work

Drilling Method: ROTARY

Section 5: Well Completion Date

Date well completed: Friday, November 22, 2019

Section 6: Well Construction Details

Meta Data Fields

1. Was borehole completed as a well? YES
2. Was well abandoned?

Borehole dimensions

From	To	Diameter
0	180	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	180	6	0.250		WELDED	A53B STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
165	180	6	23	6"X5/16"	TORCH OR PLASMA CUTS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	165	BENTONTIE	Y

Section 7: Well Test Data

Total Depth: 180
Static Water Level: 143
Water Temperature:

Air Test *

18 gpm with drill stem set at 180 feet for 1 hours.
Time of recovery 0.05 hours.
Recovery water level 143 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

PW-1

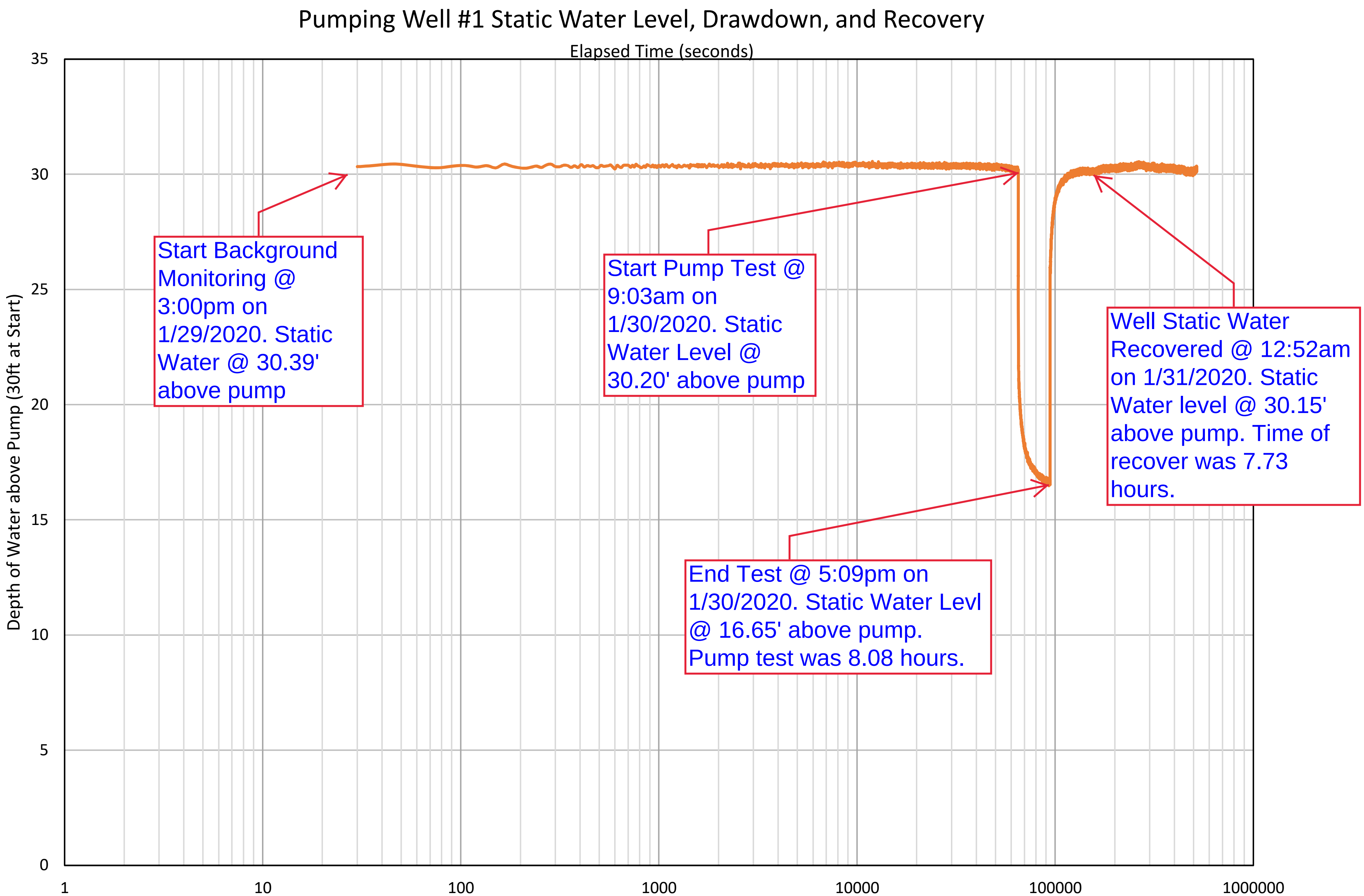
Section 9: Well Log

From	To	Description
0	42	SILT/SAND/CLAY/GRAVEL
42	55	FINE SAND
55	100	CLAY
100	112	SAND/GRAVEL
112	165	CLAY/SAND/GRAVEL
165	180	GRAVEL/SAND

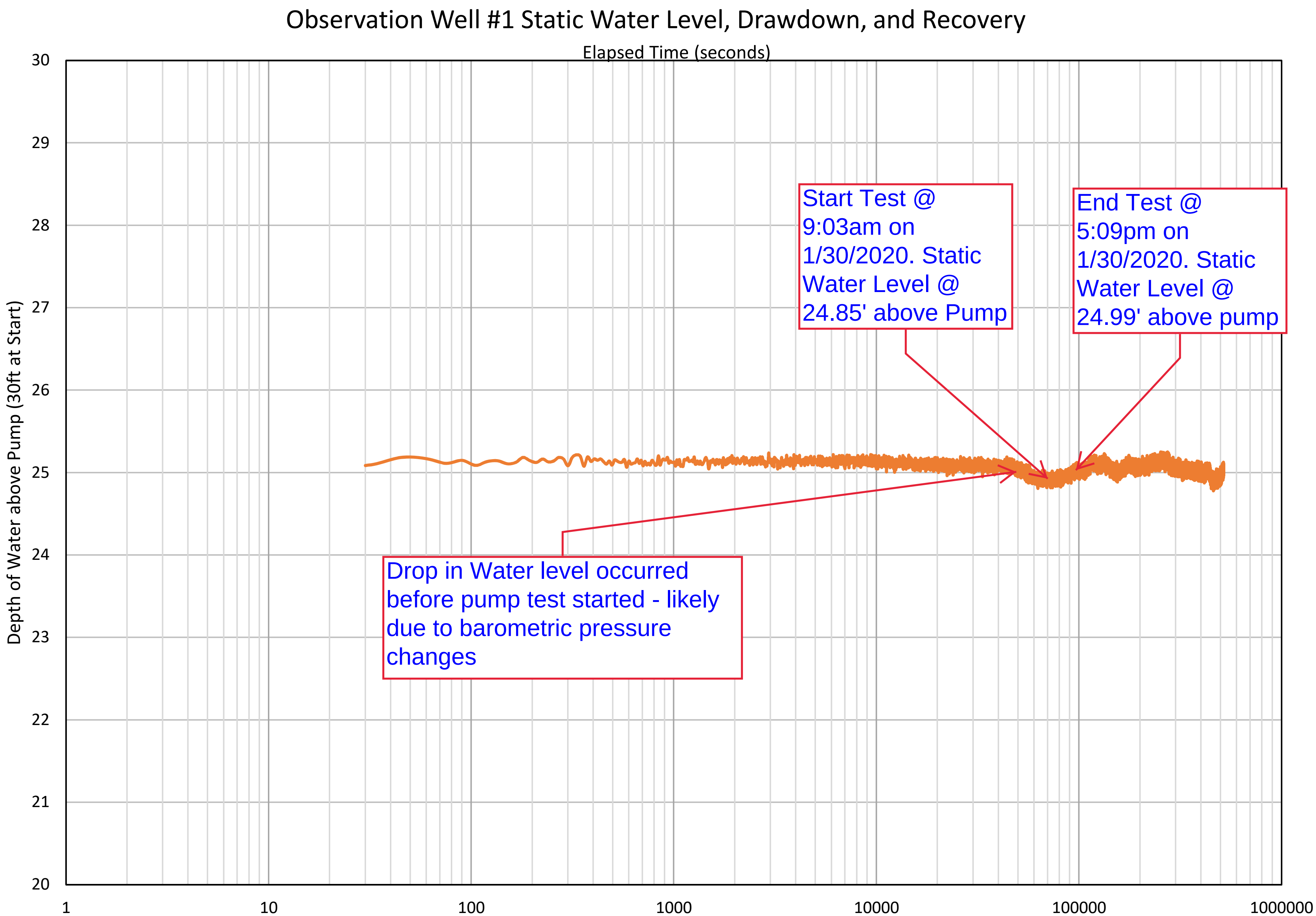
Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: SHAWN TONEY
Company: H & L DRILLING
Address: PO BOX 919
City: EAST HELENA MT 59635
License No: WWC-447
Date Certified: 11/26/2019



Pumping Well #1 Static Water Level, Drawdown, and Recovery
Elapsed Time (seconds)
Depth of Water above Pump (30ft at Start)
35
30
25
20
15
10
5
0
1
10
100
1000
10000
100000
1000000
Start Background Monitoring @ 3:00pm on 1/29/2020. Static Water @ 30.39' above pump
Start Pump Test @ 9:03am on 1/30/2020. Static Water Level @ 30.20' above pump
Well Static Water Recovered @ 12:52am on 1/31/2020. Static Water level @ 30.15' above pump. Time of recover was 7.73 hours.
End Test @ 5:09pm on 1/30/2020. Static Water Levl @ 16.65' above pump. Pump test was 8.08 hours.


Observation Well #1 Static Water Level, Drawdown, and Recovery
Elapsed Time (seconds)
Depth of Water above Pump (30ft at Start)
30
29
28
27
26
25
24
23
22
21
20
1
10
100
1000
10000
100000
1000000
Start Test @ 9:03am on 1/30/2020. Static Water Level @ 24.85' above Pump
End Test @ 5:09pm on 1/30/2020. Static Water Level @ 24.99' above pump
Drop in Water level occurred before pump test started - likely due to barometric pressure changes

Appendix D

Non-degradation Analysis

- Nitrate Sensitivity Analysis
  - Hydraulic Conductivity Calculations
  - Background Nitrate Results
  - Nitrate Sensitivity Analysis for Cumulative Effects (Spreadsheet Calculations)
  - Adjacent to State Waters Calculations
  - Stream Stats Data for Canyon Ferry Flow
- Phosphorous Breakthrough Analysis
  - Phosphorous Breakthrough Analysis (Spreadsheet Calculations)
- Categorical Exemptions – Appendix P of Non-degradation

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
NITRATE SENSITIVITY ANALYSIS

Project: Horse Creek Hills Subdivisions 1-4
Project Number: 19-072
Lot: 38 - Worst-Case-Scenario of Drainfield Width Perp. To GW Flow
Location: Broadwater County, Montana

ALLIED ENGINEERING SERVICES, INC.

VARIABLES	DESCRIPTION	VALUE	UNITS
K	Hydraulic Conductivity	100.53	ft/day
I	Hydraulic Gradient	0.0021	ft/ft
D	Mixing Zone Thickness (usually constant)	30.0	ft
L	Mixing Zone Length (see ARM 17.30.517(1)(d)(viii)	200	ft
Y	Width of Drainfield Perpendicular to Ground Water Flow	33.0	ft
Ng	Background Nitrate (as Nitrogen) Concentration	0.923	mg/L
Nr	Nitrate (as Nitrogen) Concentration in Precipitation (usually constant)	1.0	mg/L
Ne	Nitrate (as Nitrogen) Concentration in Effluent	50.00	mg/L
#I	Number of Single Family Homes on the Drainfield	1.00	
QI	Quantity of Effluent per Single Family Home	26.70	ft3/day
P	Precipitation	14.0	in/year
V	Percent of Precipitation Recharging Ground Water (usually constant)	0.2	

EQUATIONS			
W	Width of Mixing Zone Perpendicular to Ground Water Flow = (0.175)(L)+(Y)	68	ft
Am	Cross Sectional Area of Aquifer Mixing Zone = (D)(W)	2040	ft2
As	Surface Area of Mixing Zone = (L)(W)	13600	ft2
Qg	Ground Water Flow Rate = (K)(I)(Am)	434.7707	ft3/day
Qr	Recharge Flow Rate = (As)(P/12/365)(V)	8.694064	ft3/day
Qe	Effluent Flow Rate = (#I)(QI)	26.7	ft3/day

SOLUTION			
Nt	**Nitrate (as Nitrogen) Concentration at End of Mixing Zone =((Ng)(Qg)+(Nr)(Qr)+(Ne)(Qe)) / ((Qg)+(Qr)+(Qe))**	**3.71**	**mg/L**

REV. 03/2005

HYDRAULIC CONDUCTIVITY ANALYSIS

Project: Horse Creek Hills Subdivisions 1-4
Project Number: 19-072
Location: Broadwater County, Montana

ALLIED ENGINEERING SERVICES, INC.

RAZACK & HUNTLEY METHOD

Well Owner Name	GWIC ID	Well Location	Bottom of Well Casing (ft)	Water Level After Pumping (ft)	Static Water Level Before Pumping (ft)	Yield (gpm)	Length of Test (hours)	Length of Perforated Casing (ft)	Drawdown s (ft)	Transmissivity T (gpd/ft)	b[1]	Hydraulic Conductivity (ft/day)
Pump Well 1	304170	CBD Sec. 31 T 09N R 02E	180	157	143	15	8.08	15	14	1193.94		79.60
Test Well #1	304166	CBD Sec. 31 T 09N R 02E	108	89.8	83.9	8.5	1	15	5.9	1455.95		97.06
Test Well #2	304169	CBD Sec. 31 T 09N R 02E	135	97.5	93.8	9	1	15	3.7	2068.02		137.87
Test Well #3	304167	CBD Sec. 31 T 09N R 02E	200	181.4	172.5	11	1	15	8.9	1313.86		87.59
											Average	***100.5***

[1] Aquifer thickness (b) = static water level - bottom of well casing
If well is perforated, b = depth of perforations
For short duration pump tests (appx 1 hour) in non-screened/perforated wells, b = 10 ft

Alpine Analytical Laboratory

1315 Cherry, Helena, MT 59601
(406)449-6282

Case Narrative

On January 21, 2020, three water samples identified as "Horse Creek" were received by our laboratory for analysis. The chain of custody indicated the samples were to be analyzed for Specific Conductivity and Nitrate + Nitrite as N. The samples were received cool, intact and hand delivered.

Results are sumarized on the following page. Quality control data are available upon request.

Should you have any questions regarding this analysis feel free to give us a call at 449-6282

We appreciate the fact that you have chosen us as your analytical lab.

Sincerely yours,

Chris Erickson
Laboratory Manager

Alpine Analytical Laboratory

1315 Cherry, Helena, MT 59601
(406)449-6282

Client: **H & L Drilling** | **Date Reported:** 22-Jan-20

Sample ID: **Horse Creek TW1**
Project ID: None Given | **Chain of Custody #:** 10971
Site ID: None Given

Laboratory ID: 27A239 | **Date / Time Sampled:** 21-Jan-20 @ 12:10
Sample Matrix: Water | **Date / Time Received:** 22-Jan-20 @ 08:40

Parameter	AR	MCL	SCL	Analyzed Date/Time	Analyzed By	Method Reference
Nitrate + Nitrite as N, mg/L	0.50	10	NR	22-Jan-20 @ 13:28	CE	EPA 300.0
Specific Conductivity, umho/cm	522	NR	NR	22-Jan-20 @ 11:23	CE	EPA 120.1

Comments:
AR - Analytical Result
MCL - Maximum Contaminant Limit for Drinking Water Standards
SCL - Secondary Contaminant Limit for Drinking Water Standards
NR - Not Regulated

References:
Methods for Chemical Analysis of Water and Wastes, US EPA, 600/4-79-020
Method 9223 B - QT, Colilert 18, *Standard Methods for the Examination of Water and Wastewater.*

Reviewed by: CE

Alpine Analytical Laboratory
1315 Cherry, Helena, MT 59601
(406)449-6282

Client: **H & L Drilling** **Date Reported:** 22-Jan-20

Sample ID: **Horse Creek TW2**
Project ID: None Given **Chain of Custody #:** 10971
Site ID: None Given

Laboratory ID: 27A240	**Date / Time Sampled:** 21-Jan-20 @ 14:00
Sample Matrix: Water	**Date / Time Received:** 22-Jan-20 @ 08:40

Parameter	AR	MCL	SCL	Analyzed Date/Time	By	Method Reference
Nitrate + Nitrite as N, mg/L	1.30	10	NR	22-Jan-20 @ 13:39	CE	EPA 300.0
Specific Conductivity, umho/cm	380	NR	NR	22-Jan-20 @ 11:23	CE	EPA 120.1

Comments:
AR - Analytical Result
MCL - Maximum Contaminant Limit for Drinking Water Standards
SCL - Secondary Contaminant Limit for Drinking Water Standards
NR - Not Regulated

References:
Methods for Chemical Analysis of Water and Wastes, US EPA, 600/4-79-020
Method 9223 B - QT, Colilert 18, *Standard Methods for the Examination of Water and Wastewater.*

Reviewed by: CE

Alpine Analytical Laboratory

1315 Cherry, Helena, MT 59601
(406)449-6282

Client: **H & L Drilling** **Date Reported:** 22-Jan-20

Sample ID: **Horse Creek TW3**
Project ID: None Given **Chain of Custody #:** 10971
Site ID: None Given

Laboratory ID: 27A241	**Date / Time Sampled:** 21-Jan-20 @ 15:30
Sample Matrix: Water	**Date / Time Received:** 22-Jan-20 @ 08:40

Parameter	AR	MCL	SCL	Analyzed Date/Time	Analyzed By	Method Reference
Nitrate + Nitrite as N, mg/L	0.97	10	NR	22-Jan-20 @ 13:49	CE	EPA 300.0
Specific Conductivity, umho/cm	607	NR	NR	22-Jan-20 @ 11:23	CE	EPA 120.1

Comments:

AR - Analytical Result
MCL - Maximum Contaminant Limit for Drinking Water Standards
SCL - Secondary Contaminant Limit for Drinking Water Standards
NR - Not Regulated

References:

Methods for Chemical Analysis of Water and Wastes, US EPA, 600/4-79-020
Method 9223 B - QT, Colilert 18, *Standard Methods for the Examination of Water and Wastewater.*

Reviewed by: CE

Appendix E

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

NITRATE SENSITIVITY ANALYSIS

SITE NAME: Horse Creek Hills Subdivisions 1-4

COUNTY: Broadwater county

NOTES:

BY: HTM

DATE: 04/02/20

Nitrate at end of mixing zone(s) with no cumulative effects

Variable	(K)	(I)	(D)	(L)	(Y)	(Ng)	(Nr)	(Ne)	(#I)	(Ql)	(P)	(V)	(W)	(Am)	(As)	(Qg)	(Qr)	(Qe)	Nt
LOT #	Hydr. cond. (ft/day)	Hydr. grad. (ft/ft)	Mix zone thick (feet)	Down grad. distance (feet)	Drain-field width (feet)	Back-ground nitrate (mg/l)	Nitrate in precip (mg/l)	Effluent Nitrate conc. (mg/l)	# of single family homes	Effluent per drain. (ft3/day)	Annual precip. (in/yr)	Percent precip. recharge	Down-grad. width (feet)	Mix zone area (ft^2)	Mix. zone surface area (ft^2)	Ground water flow (ft3/day)	Recharge flow (ft3/day)	Effluent flow (ft3/day)	Resulting nitrate (N) (mg/l)
Lot 16 of HCH Pr. 2	100.50	0.002	30.0	200	92.5	0.92	1.0	50.0	1.0	26.70	16.0	0.2	127.50	3825.00	25500.00	814.95	18.63	26.70	2.45
Lot 15 of HCH Pr. 2	100.50	0.002	30.0	200	80.3	2.02	1.0	50.0	1.0	26.70	16.0	0.2	115.30	3459.00	23060.00	736.97	16.85	26.70	3.64

Nitrate at end of mixing zones with cumulative effects

LOT #	(K)	(I)	(D)	(L)	(Y)	(Ng)	(Nr)	(Ne)	(#I)	(Ql)	(P)	(V)	(W)	(Am)	(As)	(Qg)	(Qr)	(Qe)	Nt
Lot 16 of HCH Pr. 2	100.50	0.002	30.0	466	92.5	0.92	1.0	50.0	1.0	26.70	16.0	0.2	174.05	5221.50	81107.30	1112.49	59.26	26.70	2.02
Lot 15 of HCH Pr. 2	100.50	0.002	30.0	200	80.3	2.02	1.0	50.0	1.0	26.70	0.00	0.00	115.30	3459.00	23060.00	736.97	0.00	26.70	3.70
0																			
0																			
0																			
0																			
0																			
0																			
0																			
0																			
0																			

REV. 03/20005

NOTES:

(yellow) = fill in values in these cells

(grey) = these cells are calculated for you

Hydr. cond. =	K	Hydraulic Conductivity
Hydr. grad. =	I	Hydraulic Gradient
Mix zone thick =	D	Thickness of Mixing Zone up to a Maximum of 15 feet (usually constant at 15 feet)
Down grad. distance =	L	Mixing Zone Length (see ARM 17.30.517(1)(d)(viii), or this may also be the distance to end of last mixing zone when calculating cumulative effects.
Drainfield width =	Y	Width of Drainfield Perpendicular to Ground Water Flow
Background nitrate =	Ng	Background Nitrate (as Nitrogen) Concentration
Nitrate in precip. =	Nr	Nitrate (as Nitrogen) Concentration in Precipitation (usually constant at 1.0 mg/L)
Effluent Nitrate conc. =	Ne	Nitrate (as Nitrogen) Concentration in Effluent (50 for conventional; 24 for level II; 30 for level 1a; 40 for level 1b)
# single family homes =	#I	Number of Single Family Homes on the Drainfield (leave as 1 if effluent volume in next column is adjusted to equal total effluent from drainfield)
Effluent per drain. =	Ql	Quantity of Effluent from drainfield (average rate varies depending on number of bedrooms)
Annual precip. =	P	Annual local Precipitation
Percent precip recharge =	V	Percent of Precipitation Recharging Ground Water (usually constant at 0.2)
Down grad. width =	W	Width of Mixing Zone Perpendicular to Ground Water Flow = (0.175)(L) + (Y)
Mix zone area =	Am	Cross Sectional Area of Aquifer Mixing Zone = (D)(W)
Mix zone surface area =	As	Surface Area of Mixing Zone = (L)(W)
Ground water flow =	Qg	Ground Water Flow Rate = (K)(I)(Am)
Recharge flow =	Qr	Recharge Flow Rate = (As)(P/12/365)(V)
Effluent flow =	Qe	Effluent Flow Rate = (#I)(Ql)
Resulting nitrate (N) =	Nt	Nitrate (as Nitrogen) Concentration at End of Mixing Zone = ((Ng)(Qg) + (Nr)(Qr) + (Ne)(Qe)) / ((Qg) + (Qr) + (Qe))
		(or nitrate concentration to use as background nitrate for next downgradient drainfield when determining cumulative effects)

Appendix Q

TRIGGER VALUE CALCULATION FOR ADJACENT TO SURFACE WATER DILUTION ANALYSIS

"An analysis of the effect of the proposed drainfield system on the quality of any adjacent surface water is required by ARM 17.36.312 and 17.30.715(1c). The increase in the nutrient concentration in the surface water cannot exceed the trigger value (T.V. of 0.01 mg/L nitrate and 0.001 mg/L phosphorous as set forth in Circular DEQ 7."

DILUTION EQUATION: $$\frac{(QD)(CD) + (QL)(CL)}{QD + QL} < \text{T.V.} = \text{non-significant}$$

Note: Effluent flow rate (QD) must be multiplied by the number of drainfields in the subdivision.

NITRATE CALCULATION:

	40.00		Number of drainfields in subdivision
QD =	26.70	ft³/d	Effluent flow rate from drainfield in cubic feet per day (commonly 200 gpd or 26.7 ft³/d for a 2 - 5 bedroom home)
CD =	50.00	mg/L	Nitrate concentration in mg/L (50 mg/L nitrate-N for standard drainfield, 24 mg/L for Level 2 wastewater treatment system)
QL =	301.00	ft³/s	Flow rate in ft³/s into (or out of) surface water determined by stream gauge (usually the 14-day, 5-year low flow or 14Q5)
CL =	0.00	mg/L	Nitrate concentration (in mg/L) in surface water; can typically assume zero since increase, not total, is important

0.0020533 mg/L = final result, must be < 0.01 mg/L to be considered nonsignificant nitrate increase

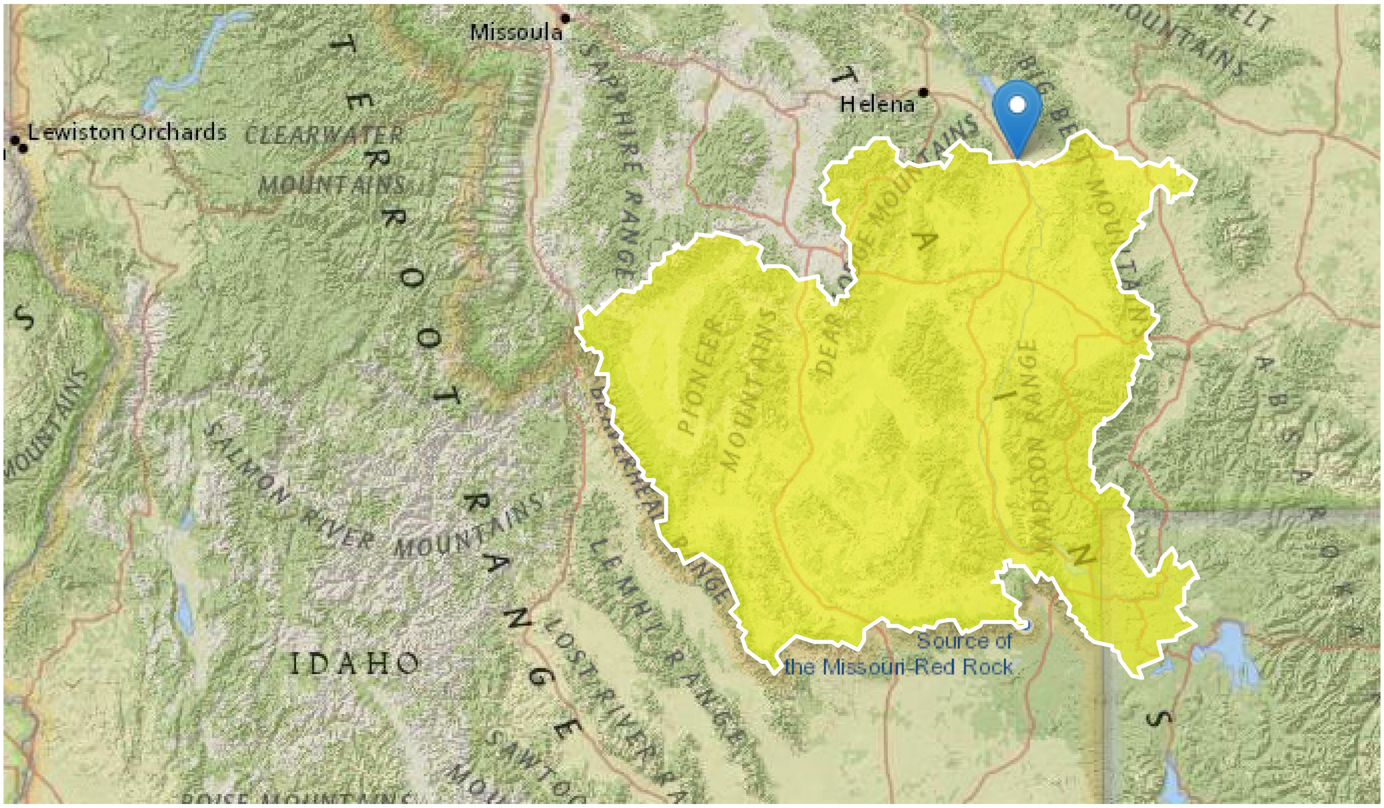
PHOSPHOROUS CALCULATION:

	40		Number of drainfields in subdivision
QD =	26.7	ft³/d	Effluent flow rate from drainfield in cubic feet per day, (commonly 200 gpd or 26.7 ft³/d for a 2 - 5 bedroom home)
CD =	10.6	mg/L	Phosphorous concentration in mg/L (commonly 10.6 mg/L) in effluent
QL =	301	ft³/s	Flow rate in ft³/s into (or out of) surface water determined by stream gauge (usually the 14-day, 5-year low flow or 14Q5)
CL =	0	mg/L	Phosphorous concentration (in mg/L) in surface water; can typically assume zero since increase, not total, is important

0.0004353 mg/L = final result, must be < 0.001 mg/L to be considered nonsignificant for phosphorous increase

StreamStats Report for Horse Creek Hills Subdivision

Region ID: MT
Workspace ID: MT20200303215848128000
Clicked Point (Latitude, Longitude): 46.34053, -111.52323
Time: 2020-03-03 14:59:07 -0700



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CONTDA	Area that contributes flow to a point on a stream	15294.7	square miles
EL6000	Percent of area above 6000 ft	68.3	percent
PRECIP	Mean Annual Precipitation	21.76	inches
SLOP50_30M	Percent area with slopes greater than 50 percent from 30-meter DEM.	7.4	percent

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Peak-Flow Statistics Parameters[14 Percent (2210 square miles) UpYellow CentMount Region BasinC 2015 5019F]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	0.39	2040
EL6000	Percent above 6000 ft	68.3	percent	0	100

Peak-Flow Statistics Parameters[86 Percent (13100 square miles) SW Region BasinC 2015 5019F]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	0.42	2480
EL6000	Percent above 6000 ft	68.3	percent	0	100

Peak-Flow Statistics Disclaimers[14 Percent (2210 square miles) UpYellow CentMount Region BasinC 2015 5019F]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report[14 Percent (2210 square miles) UpYellow CentMount Region BasinC 2015 5019F]

Statistic	Value	Unit
1.5 Year Peak Flood	21800	ft^3/s
2 Year Peak Flood	24400	ft^3/s
2 33 Year Peak Flood	25800	ft^3/s
5 Year Peak Flood	33600	ft^3/s
10 Year Peak Flood	41600	ft^3/s
25 Year Peak Flood	52200	ft^3/s
50 Year Peak Flood	59500	ft^3/s
100 Year Peak Flood	65800	ft^3/s
200 Year Peak Flood	72200	ft^3/s
500 Year Peak Flood	80300	ft^3/s

Peak-Flow Statistics Disclaimers[86 Percent (13100 square miles) SW Region BasinC 2015 5019F]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report[86 Percent (13100 square miles) SW Region BasinC 2015 5019F]

Statistic	Value	Unit
1.5 Year Peak Flood	27500	ft^3/s
2 Year Peak Flood	29000	ft^3/s
2 33 Year Peak Flood	29000	ft^3/s
5 Year Peak Flood	30800	ft^3/s
10 Year Peak Flood	32300	ft^3/s
25 Year Peak Flood	34400	ft^3/s
50 Year Peak Flood	35600	ft^3/s
100 Year Peak Flood	37100	ft^3/s
200 Year Peak Flood	38700	ft^3/s
500 Year Peak Flood	40700	ft^3/s

Peak-Flow Statistics Flow Report[Area-Averaged]

Statistic	Value	Unit
1.5 Year Peak Flood	26700	ft^3/s
2 Year Peak Flood	28400	ft^3/s
2 33 Year Peak Flood	28600	ft^3/s
5 Year Peak Flood	31200	ft^3/s
10 Year Peak Flood	33600	ft^3/s
25 Year Peak Flood	36900	ft^3/s
50 Year Peak Flood	39000	ft^3/s
100 Year Peak Flood	41200	ft^3/s
200 Year Peak Flood	43500	ft^3/s
500 Year Peak Flood	46400	ft^3/s

Peak-Flow Statistics Citations

Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M.,2016, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011: U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p. (https://doi.org/10.3133/sir20155019)

Low-Flow Statistics Parameters[14 Percent (2210 square miles) UpYellow CentMt Region LowFlow GLS 2015 5019G]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	28.1	2620
PRECIP	Mean Annual Precipitation	21.76	inches	16.4	38.9

Low-Flow Statistics Parameters[86 Percent (13100 square miles) SW Region LowFlow GLS 2015 5019G]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	24.4	2480
SLOP50_30M	Slopes_gt_50pct_from_30m_DEM	7.4	percent	0.96	22.6

Low-Flow Statistics Disclaimers[14 Percent (2210 square miles) UpYellow CentMt Region LowFlow GLS 2015 5019G]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report[14 Percent (2210 square miles) UpYellow CentMt Region LowFlow GLS 2015 5019G]

Statistic	Value	Unit
7 Day 10 Year Low Flow	240	ft^3/s

Low-Flow Statistics Disclaimers[86 Percent (13100 square miles) SW Region LowFlow GLS 2015 5019G]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report[86 Percent (13100 square miles) SW Region LowFlow GLS 2015 5019G]

Statistic	Value	Unit
7 Day 10 Year Low Flow	7910	ft^3/s

Low-Flow Statistics Flow Report[Area-Averaged]

Statistic	Value	Unit
7 Day 10 Year Low Flow	6800	ft^3/s

Low-Flow Statistics Citations

McCarthy, P.M., Sando, Roy, Sando, S.K., and Dutton, D.M.,2016, Methods for estimating streamflow characteristics at ungaged sites in western Montana based on data through

water year 2009: U.S. Geological Survey Scientific Investigations Report 2015–5019–G, 19 p. (https://doi.org/10.3133/sir20155019)

Seasonal Flow Statistics Parameters[14 Percent (2210 square miles) UpYellow CentMt Region LowFlow GLS 2015 5019G]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	28.1	2620
PRECIP	Mean Annual Precipitation	21.76	inches	16.4	38.9

Seasonal Flow Statistics Parameters[86 Percent (13100 square miles) SW Region LowFlow GLS 2015 5019G]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	24.4	2480
PRECIP	Mean Annual Precipitation	21.76	inches	16.7	37.1

Seasonal Flow Statistics Disclaimers[14 Percent (2210 square miles) UpYellow CentMt Region LowFlow GLS 2015 5019G]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report[14 Percent (2210 square miles) UpYellow CentMt Region LowFlow GLS 2015 5019G]

Statistic	Value	Unit
Jul_to_Oct_14_Day_5_Yr_Low_Flow	301	ft^3/s

Seasonal Flow Statistics Disclaimers[86 Percent (13100 square miles) SW Region LowFlow GLS 2015 5019G]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Seasonal Flow Statistics Flow Report[86 Percent (13100 square miles) SW Region LowFlow GLS 2015 5019G]

Statistic	Value	Unit
Jul_to_Oct_14_Day_5_Yr_Low_Flow	1030	ft^3/s

Seasonal Flow Statistics Flow Report[Area-Averaged]

Statistic	Value	Unit
Jul_to_Oct_14_Day_5_Yr_Low_Flow	926	ft^3/s

Seasonal Flow Statistics Citations

McCarthy, P.M., Sando, Roy, Sando, S.K., and Dutton, D.M.,2016, Methods for estimating streamflow characteristics at ungaged sites in western Montana based on data through water year 2009: U.S. Geological Survey Scientific Investigations Report 2015–5019–G, 19 p. (https://doi.org/10.3133/sir20155019)

Annual Flow Statistics Parameters[14 Percent (2210 square miles) UpYellow CentMt Region Annual MeanDur 2015 5019G]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	28.1	2620
PRECIP	Mean Annual Precipitation	21.76	inches	16.4	38.9

Annual Flow Statistics Parameters[86 Percent (13100 square miles) SW Region Annual MeanDur 2015 5019G]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
CONTDA	Contributing Drainage Area	15294.7	square miles	24.4	2480
PRECIP	Mean Annual Precipitation	21.76	inches	16.7	37.1

Annual Flow Statistics Disclaimers[14 Percent (2210 square miles) UpYellow CentMt Region Annual MeanDur 2015 5019G]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Annual Flow Statistics Flow Report[14 Percent (2210 square miles) UpYellow CentMt Region Annual MeanDur 2015 5019G]

Statistic	Value	Unit
Median Annual Flow	2220	ft^3/s
Mean Annual Flow	3300	ft^3/s

Annual Flow Statistics Disclaimers[86 Percent (13100 square miles) SW Region Annual MeanDur 2015 5019G]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Annual Flow Statistics Flow Report[86 Percent (13100 square miles) SW Region Annual MeanDur 2015 5019G]

Statistic	Value	Unit
Median Annual Flow	1230	ft^3/s
Mean Annual Flow	4280	ft^3/s

Annual Flow Statistics Flow Report[Area-Averaged]

Statistic	Value	Unit
Median Annual Flow	1380	ft^3/s
Mean Annual Flow	4140	ft^3/s

Annual Flow Statistics Citations

McCarthy, P.M., Sando, Roy, Sando, S.K., and Dutton, D.M.,2016, Methods for estimating streamflow characteristics at ungaged sites in western Montana based on data through water year 2009: U.S. Geological Survey Scientific Investigations Report 2015–5019–G, 19 p. (https://doi.org/10.3133/sir20155019)

Application Version: 4.3.11

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
PHOSPHOROUS BREAKTHROUGH ANALYSIS

ALLIED ENGINEERING SERVICES, INC.

Project: **Horse Creek Hills Subdivisions 1-4**
Project Number: **19-072**
Lot **1 - 41**
Location: **Broadwater County, Montana**

VARIABLES	DESCRIPTION	VALUE	UNITS
Lg	Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow	33.0	ft
L	Length of Primary Drainfield's Long Axis	75.0	ft
W	Width of Primary Drainfield's Short Axis	23.0	ft
B	Depth to Limiting Layer from Bottom of Drainfield Laterals*	9.0	ft
D	Distance from Drainfield to Surface Water	466	ft
T	Phosphorous Mixing Depth in Ground Water (0.5 ft for coarse soils,	1.0	ft
Ne	1.0 ft for fine soils)**		
Sw	Soil Weight (usually constant)	100.0	lb/ft3
Pa	Phosphorous Adsorption Capacity of Soil (usually constant)	200.0	ppm
#I	Number of Single Family Homes on the Drainfield	1.00	

CONSTANTS

Pl	Phosphorous Load per Single Family Home (constant)	6.44	lbs/yr
X	Conversion Factor for ppm to percentage (constant)	1.0E+06	

EQUATIONS

Pt	Total Phosphorous Load = (Pl)(#I)	6.44	lbs/yr
W1	Soil Weight under Drainfield = (L)(W)(B)(Sw)	1552500.0	lbs
W2	Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw)	3437915.0	lbs
P	Total Phosphorous Adsorption by Soils = (W1 + W2)[(Pa)/(X)]	998.1	lbs

SOLUTION

BT	**Breakthrough Time to Surface Water = P / Pt**	**155.0**	**years**

BY:
DATE: April 2, 2020

NOTES: ** Depth to limiting layer is typically based on depth to a limiting layer (such as clay, bedrock or water) in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*
*** Material type is usually based on test pit. A soil that can be described as loam (e.g. gravelly loam, sandy loam, etc.) or finer according to the USDA soil texture classification system is considered a "fine" soil.*

REV. 12/2007

Appendix P

`SUMMARY OF REQUIREMENTS FOR NONDEGRADATION "EXEMPTIONS" IN ARM 17.30.716 FISCAL YEAR 2015 VERSION(1)

NOTE: This is not part of the official rule – it is an informational summary. To ensure compliance with all requirements of the rule, refer to the rule.

REQUIREMENTS	CATEGORY #1	CATEGORY #2	CATEGORY #3	CATEGORY #4(1)	CATEGORY #5
General Requirements [ARM 17.30.716(2)(a)]					
Distance between absorption trench and impacted downgradient high-quality surface water	≥1,000 feet (500 if trench is pressure-dosed)	≥500 feet	≥500 feet	≥400 feet (200 if trench is pressure-dosed)	≥1,000 feet (500 if trench is pressure-dosed)
Perc rate(2) and soil requirement if absorption trench (AT) is not pressure-dosed (if AT is pressured-dosed, these requirements don't apply).	Perc. rate between 16 and 50 min/inch; AND 6 feet of VFS, SCL, CL, or SiCL soil	NOT APPLICABLE	NOT APPLICABLE	Perc. rate between 16 and 50 min/inch; AND 6 feet of VFS, SCL, CL, or SiCL soil	Perc. rate between 16 and 50 min/inch; AND 6 feet of VFS, SCL, CL, or SiCL soil
SWTS designed for ≤ 2 single-family residences, or non-industrial design flow ≤ 700 gal. per day	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
SWTS is on the lot being served and there is only one SWTS on the lot	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
SWTS meets current requirements in DEQ-4 and ARM 17.36 sub-chapter 3	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE	APPLICABLE
Background nitrate concentration limit (does not apply to lots ≥20 acres when the absorption trench is greater than 500 feet from the downgradient property boundary)	<2 mg/L	<2 mg/L	<2 mg/L	<2 mg/L	<2 mg/L
Specific Requirements [ARM 17.30.716(2)(b)]	**ARM 17.36.716(2)(b)(i)**	**ARM 17.36.716(2)(b)(ii)**	**ARM 17.36.716(2)(b)(iii)**	**ARM 17.36.716(2)(b)(iv)**	**ARM 17.36.716(2)(b)(v)**
Lot size	≥2 acres	≥2 acres	≥1 acre	NOT APPLICABLE	≥2 acres
Percolation rate(2)(3)	≥ 16 min/inch	≥ 6 min/inch	≥ 6 min/inch	NOT APPLICABLE	NOT APPLICABLE
Soil type required beneath the absorption trench (minimum thickness of 6 feet)	VFS, SCL or finer material	MS, SL or finer material	MS, SL or finer material	NOT APPLICABLE	NOT APPLICABLE
Depth to bedrock and ground water below ground surface	≥8 feet (*seasonally* high ground water)	≥12 feet (*seasonally* high ground water)	≥100 feet	NOT APPLICABLE	NOT APPLICABLE
Depth to limiting layer below ground surface	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	>6 feet
Pressure-dosing of absorption trench required	NOT APPLICABLE	APPLICABLE	APPLICABLE	NOT APPLICABLE	NOT APPLICABLE
Number of lots in subdivision	NOT APPLICABLE	NOT APPLICABLE	≤ 5	NOT APPLICABLE	NOT APPLICABLE
Distance from subdivision boundaries to any neighboring existing/approved SWTSs	NOT APPLICABLE	NOT APPLICABLE	≥ 500 feet	NOT APPLICABLE	NOT APPLICABLE
Number of subdivision lots created in the county over last 10 fiscal years	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	<150(4)	NOT APPLICABLE
Distance between lot and any town with a population > 500	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	>1 mile	NOT APPLICABLE
Depth of absorption trench below ground surface	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	≤18 inches
Level II SWTS required	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	NOT APPLICABLE	APPLICABLE
Well Setback [ARM 17.30.716(3)]					
Separation between a provisional mixing zone and any existing/approved drinking water supply well	≥100 feet	≥100 feet	≥100 feet	≥100 feet	≥100 feet

NOTES:

(1) Requirements for category 4 include a maximum number of lots subdivided over previous 10 fiscal years. Therefore, this table will be updated at the beginning of each fiscal year.

(2) Percolation rates are only necessary when a percolation test has been conducted on the lot. If no percolation test has been conducted, the soil type will be used to determine compliance with the rule.

(3) The symbol "≥" indicates a percolation rate equal to or greater (i.e. slower) than the value listed.

(4) For fiscal year 2015, the counties that meet this requirement are: Big Horn, Blaine, Carter, Chouteau, Custer, Daniels, Dawson, Deer Lodge, Fallon, Garfield, Glacier, Golden Valley, Hill, Judith Basin, Liberty, McCone, Meagher, Musselshell, Petroleum, Phillips, Pondera, Powder River, Prairie, Roosevelt, Rosebud, Sheridan, Sweetgrass, Teton, Toole, Treasure, Wheatland, Wibaux.

ABBREVIATIONS:

SWTS = SUBSURFACE WASTEWATER TREATMENT SYSTEM
VFS = VERY FINE SAND
SCL = SANDY CLAY LOAM
CL = CLAY LOAM
SiCL = SILTY CLAY LOAM
MS = MEDIUM SAND
SL = SANDY LOAM

Rev. 9/2008

Appendix E

Existing Information

- Montana Cadastral Information
- Bureau of Land Management Survey
- DRAFT Horse Creek Hills Subdivision 2 Plat
- DRAFT Horse Creek Hills Subdivision 1-4 Plat
- DNRC Well Appropriations Letter
- DNRC Sage Grouse Habitat Inquiry
- FEMA Map Panel Index (Panel 3007C0225C)

Not secure | svc.mt.gov/msl/mtcadastral

Montana Cadastral

SEARCH
DATA
TOOLS
LEGEND

Property Record Card
Tax Year 2019
Print

Summary

Primary Information

Property Category: RP
Subcategory: Agricultural and Timber Properties
Geocode: 43-1792-31-1-01-01-0000
Assessment Code: 0007000251
Primary Owner:
71 RANCH LP
40 71 RANCH RD
MARTINSDALE, MT 59053-8705
NOTE: See the Owner tab for all owner information
PropertyAddress:
COS Parcel:
Certificate of Survey:
Subdivision:
Legal Description:
S31, T09 N, R02 E, N2;N2SE4;NE4SW4
Last Modified: 4/14/2019 3:52:24 AM

General Property Information

Neighborhood: 243.001
Property Type: VAC_R - Vacant Land - Rural
Living Units: 0
Levy District: 43-1050-7OUT
Zoning:
Ownership %: 100
Linked Property:
No linked properties exist for this property
Exemptions:
No exemptions exist for this property
Condo Ownership:
General: 0
Limited: 0

Property Factors

Topography: 8
Fronting: 0 - None
Utilities: 0
Parking Type:
Access: 0
Parking Quantity:
Location: 0 - Rural Land
Parking Proximity:

Land Summary

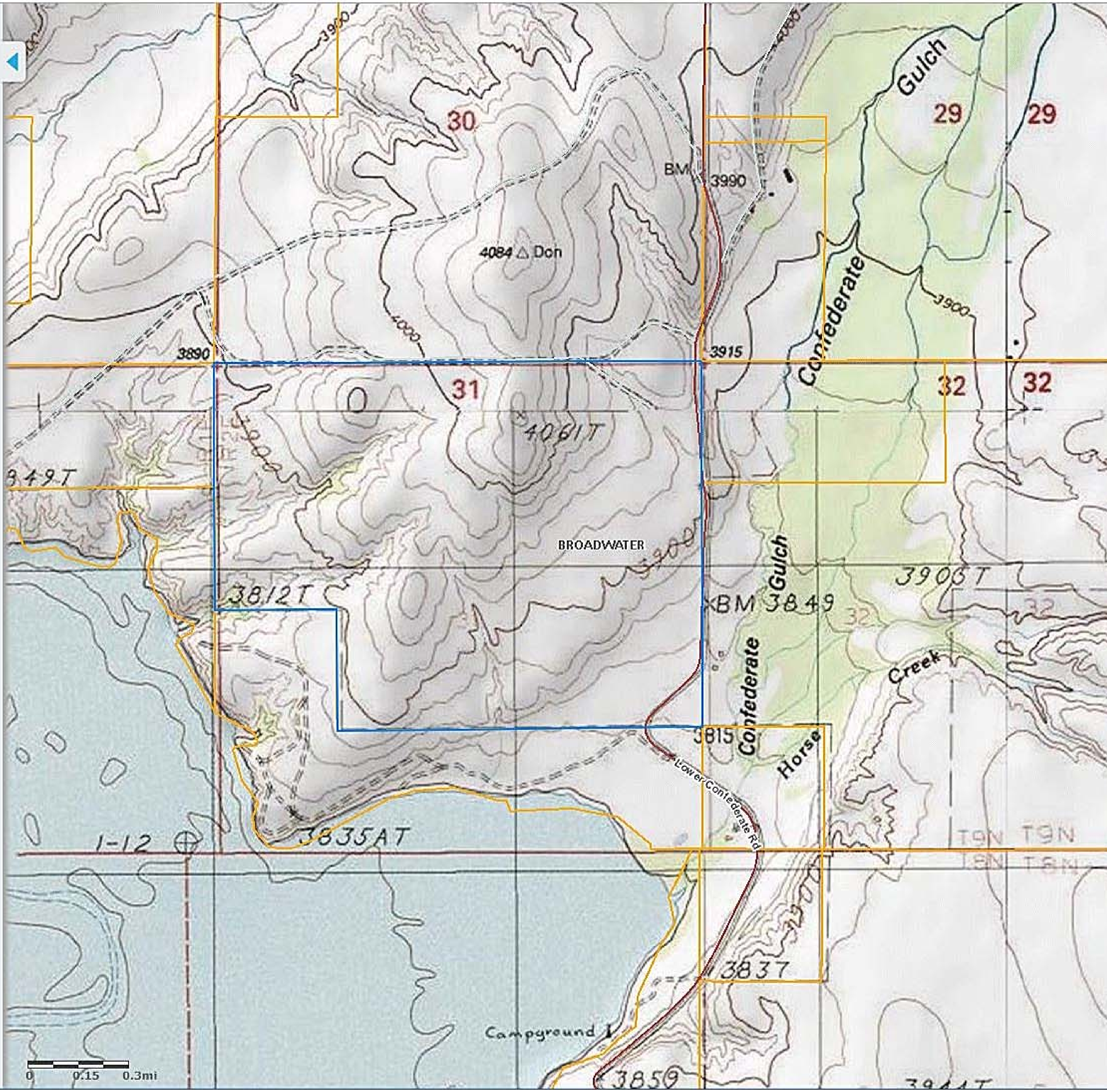
Land Type	Acres	Value
Grazing	435.000	00.00
Fallow	0.000	00.00
Irrigated	0.000	00.00
Continuous Crop	0.000	00.00
Wild Hay	0.000	00.00
Farmsite	0.000	00.00
ROW	0.000	00.00
NonQual Land	0.000	00.00
Total Ag Land	435.000	00.00
Total Forest Land	0.000	00.00
Total Market Land	0.000	00.00

Deed Information:

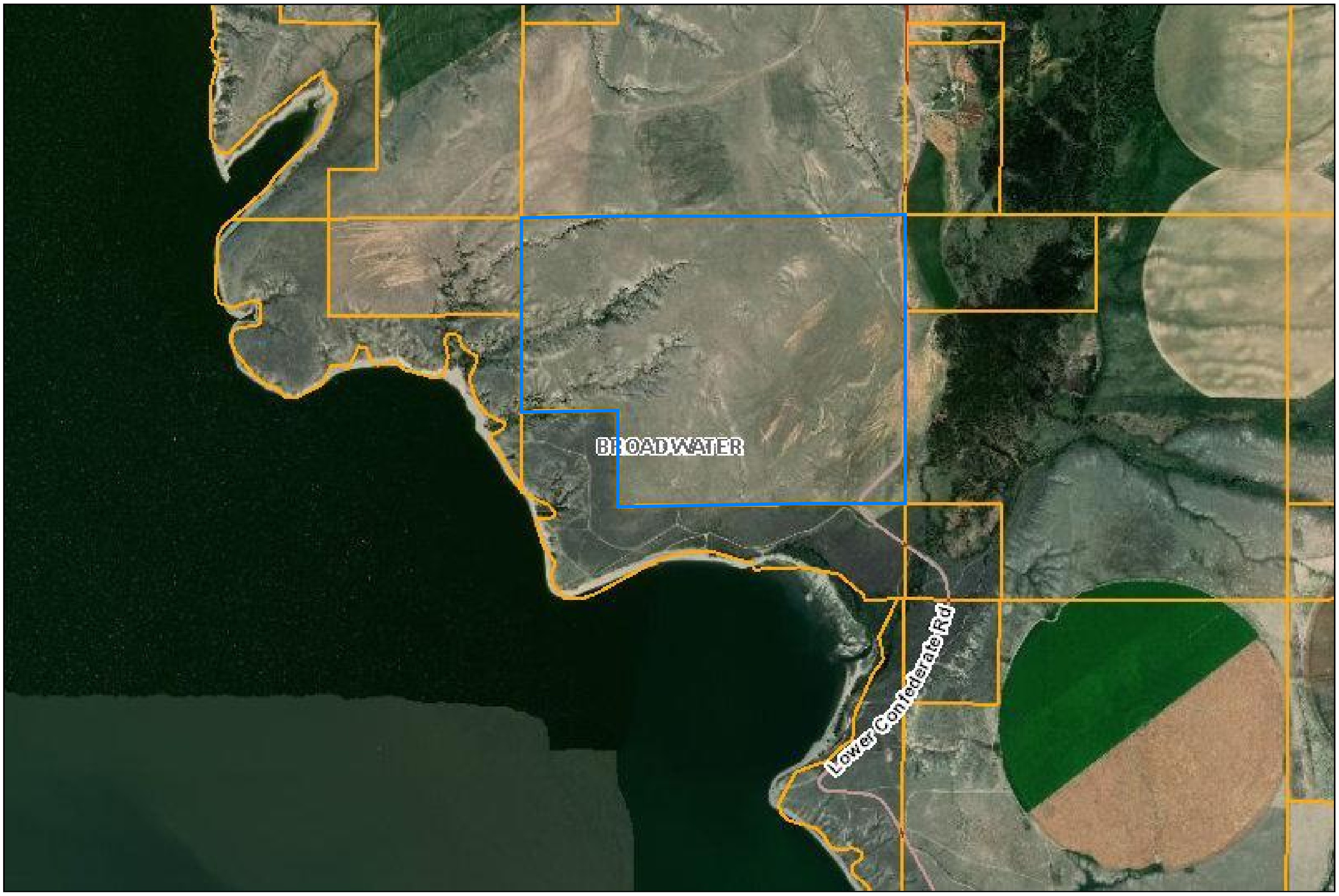
Deed Date	Book	Page	Recorded Date	Document Number	Document Type

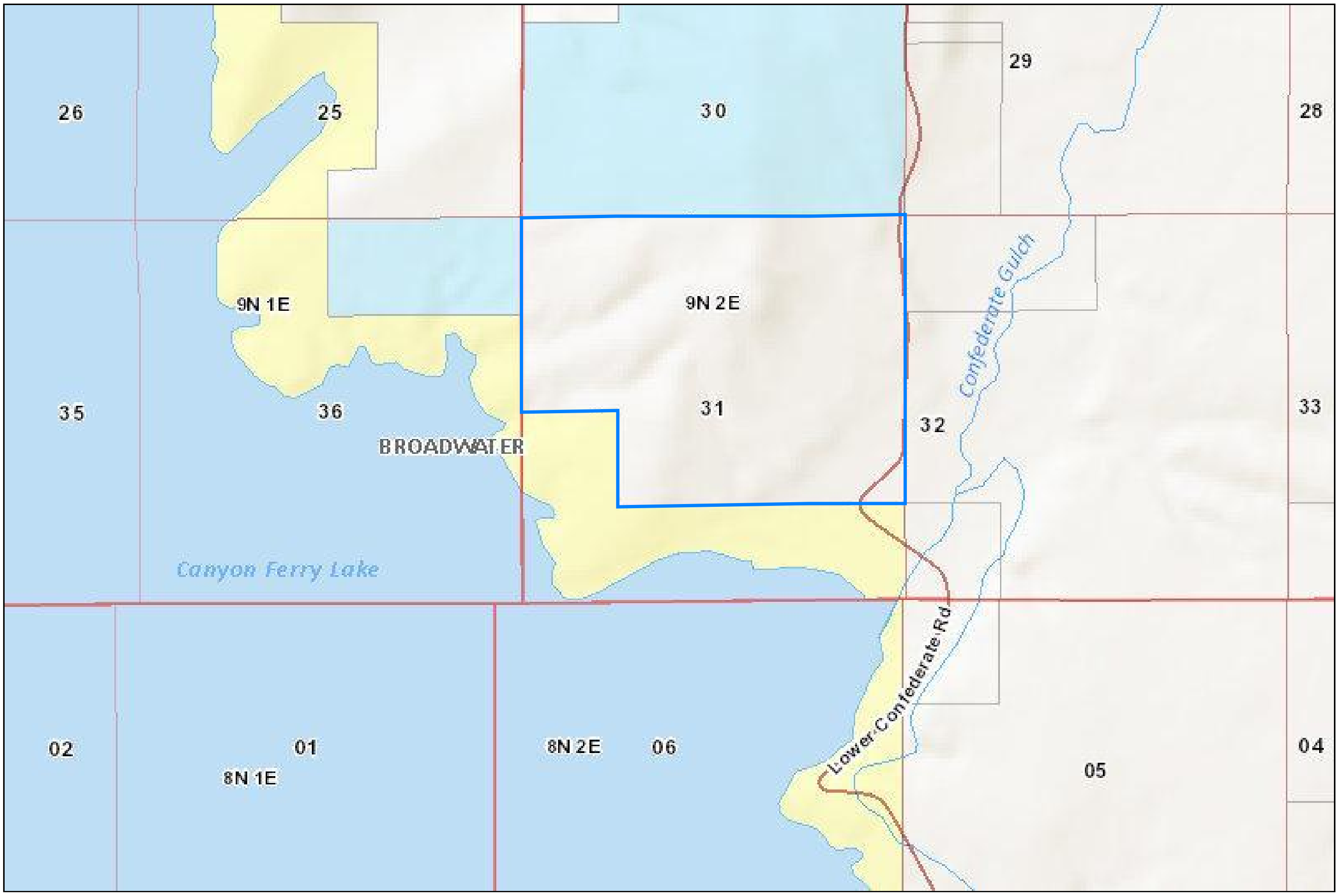
Owners
Appraisals
Market Land Info
Dwellings
Other Buildings/Improvements
Commercial
Ag/Forest Land

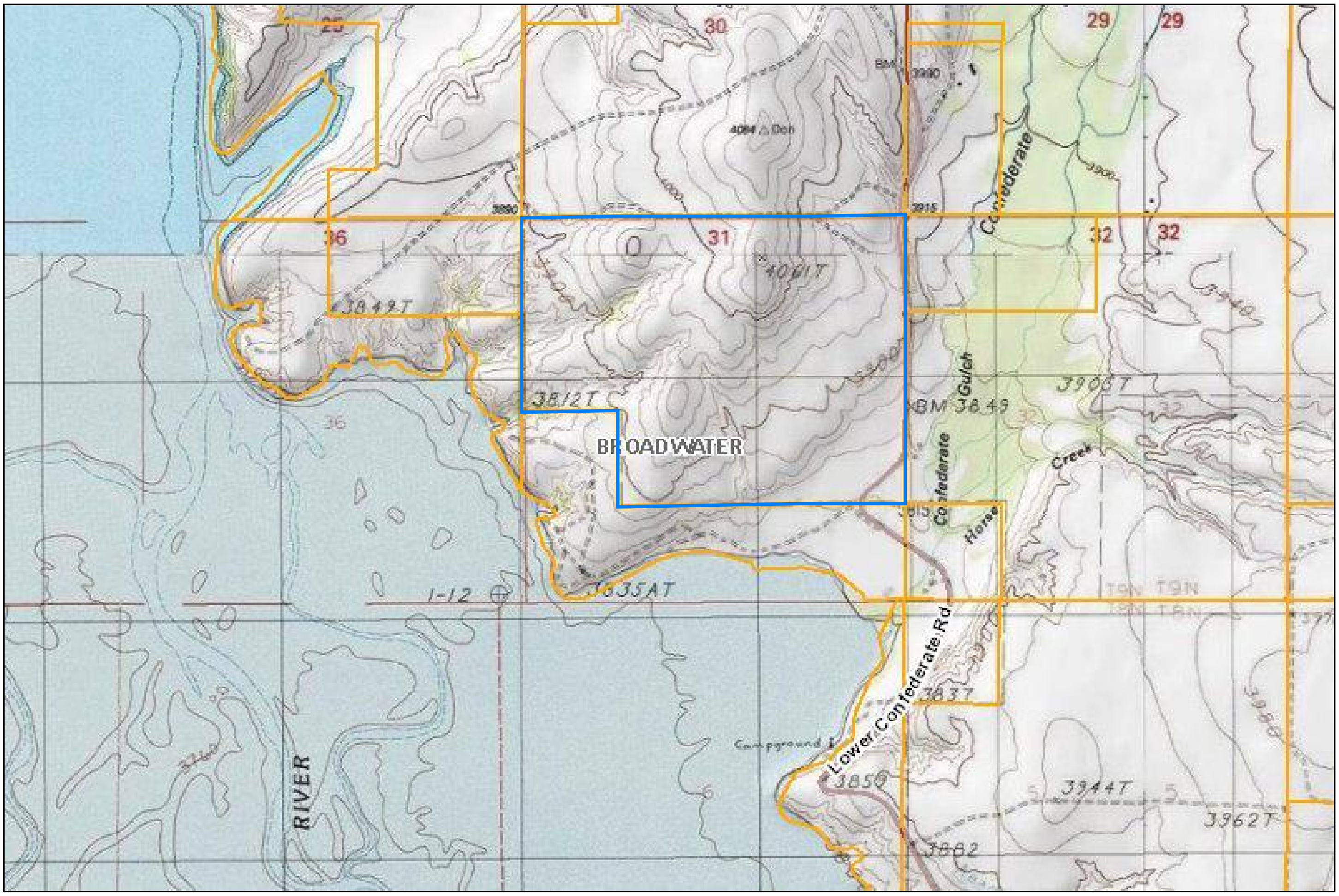
DISCLAIMER
HELP



Street
Aerial
Topo
Prev
Next


BROADWATER
Lower Confederate Rd


26
25
30
29
28
9N 1E
9N 2E
Confederate Gulch
35
36
31
32
33
BROADWATER
Canyon Ferry Lake
Lower Confederate Rd
02
01
8N 1E
8N 2E
06
05
04



25
30
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31
32
32
4001T
3849T
3812T
3906T
BM 3849
BROADWATER
Confederate
Gulch
Confederate
Horse
Creek
3835AT
I-12
Lower Confederate Rd
3837
3850
Campground
3944T
3962T
3882
RIVER
T9N
T8N

DEQ Page 193

Property Record Card

Summary

Primary Information

Property Category: RP
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Geocode: 43-1792-31-1-01-01-0000
Assessment Code: 0007000251
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71 RANCH LP
40 71 RANCH RD
MARTINSDALE, MT 59053-8705
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Legal Description:
S31, T09 N, R02 E, N2;N2SE4;NE4SW4
Last Modified: 4/14/2019 3:52:24 AM

General Property Information

Neighborhood: 243.001
Property Type: VAC_R - Vacant Land - Rural
Living Units: 0
Levy District: 43-1050-7OUT
Zoning:
Ownership %: 100
Linked Property:
No linked properties exist for this property
Exemptions:
No exemptions exist for this property
Condo Ownership:
General: 0
Limited: 0

Property Factors

Topography: 8
Fronting: 0 - None
Utilities: 0
Parking Type:
Access: 0
Parking Quantity:
Location: 0 - Rural Land
Parking Proximity:

Land Summary

Land Type	Acres	Value
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Irrigated	0.000	00.00
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Wild Hay	0.000	00.00
Farmsite	0.000	00.00
ROW	0.000	00.00
NonQual Land	0.000	00.00
Total Ag Land	435.000	00.00
Total Forest Land	0.000	00.00
Total Market Land	0.000	00.00

Deed Information:

Deed Date	Book	Page	Recorded Date	Document Number	Document Type

Owners

Party #1	
Default Information:	71 RANCH LP 40 71 RANCH RD
Ownership %:	100
Primary Owner:	"Yes"
Interest Type:	Conversion
Last Modified:	12/8/2015 4:31:37 PM

Other Names		Other Addresses
Name	**Type**	

Appraisals

Appraisal History

No data available for the parcel selected

Market Land

Market Land Info

No market land info exists for this parcel

Dwellings

Existing Dwellings

No dwellings exist for this parcel

Other Buildings/Improvements

Outbuilding/Yard Improvements

No other buildings or yard improvements exist for this parcel

Commercial

Existing Commercial Buildings

No commercial buildings exist for this parcel

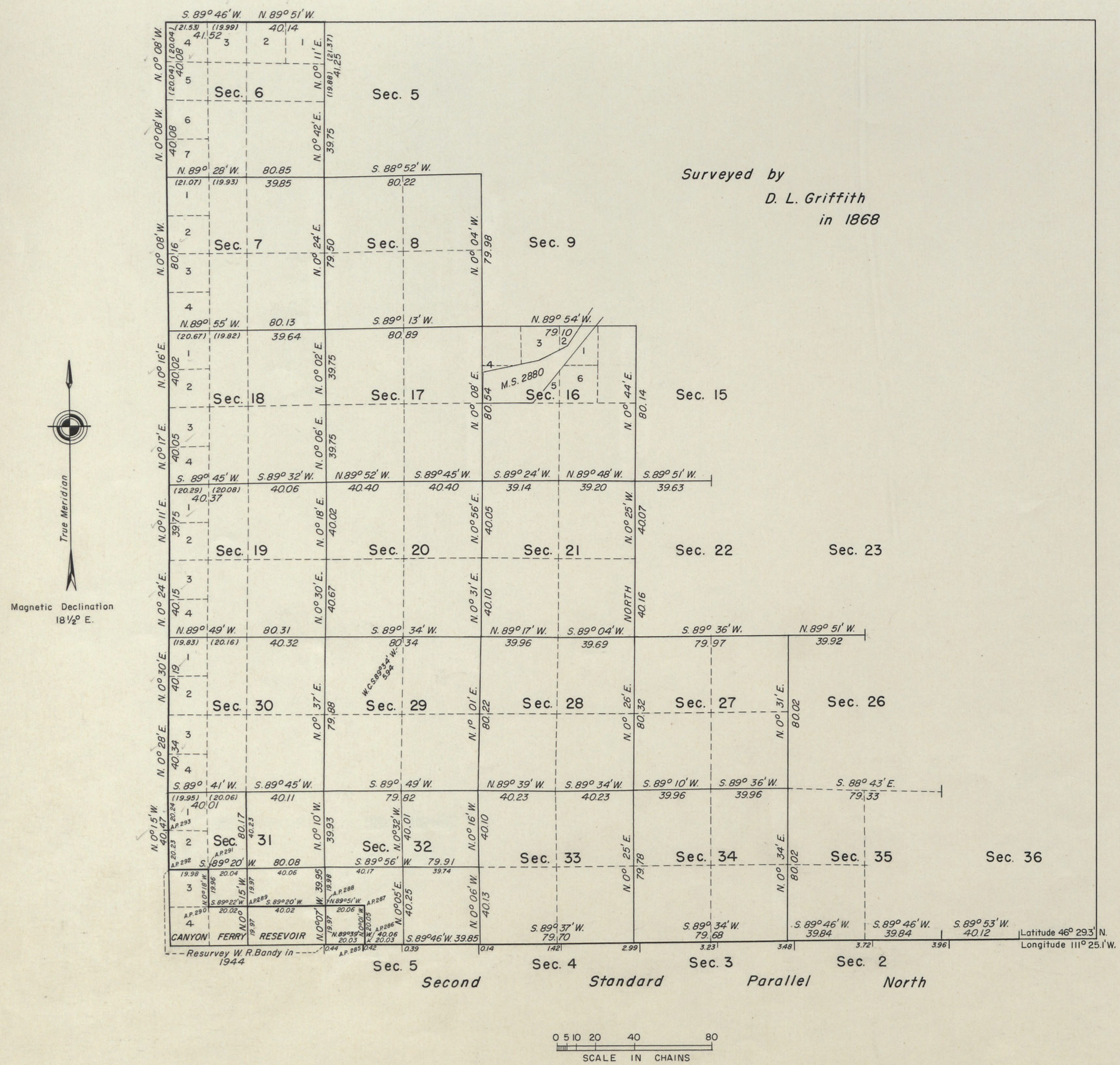
Ag/Forest Land

Ag/Forest Land

No ag/forest land exists for this parcel

TOWNSHIP 9 NORTH, RANGE 2 EAST OF THE PRINCIPAL MERIDIAN, MONTANA

DEPENDENT RESURVEY



Area resurveyed: 10,623.12 Acres

This plat represents a retracement and reestablishment of a portion of the Second Standard Parallel North through Range 2 East and a portion of the subdivisional lines designed to restore the corners in their true original locations according to the best available evidence and the survey of a partial subdivision of sections 31 and 32 and that portion of the Canyon Ferry Reservoir Boundary in Township 9 North, Range 2 East, Principal Meridian, Montana.

The lottings and areas are as shown on the plat approved February 22, 1869. The history of previous surveys and resurveys is contained in the field note record. Portions of the north and west boundaries were resurveyed concurrently with this group.

These surveys were executed by Henry U. Lang, beginning July 12, 1961, and completed September 5, 1961, pursuant to Special Instructions dated June 16, 1961, and Supplemental Special Instructions dated June 30, 1961, for Group No. 525, Montana.

For topography of the area resurveyed, see U. S. Geological Survey "Duck Creek Pass", "Townsend", and "Fort Logan" quadrangles.

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Washington, D. C. November 22, 1963

This plat is strictly conformable to the approved field notes, and the survey, having been correctly executed in accordance with the requirements of law and the regulations of this Bureau, is hereby accepted.

For the Director

E. E. Remington

Chief, Division of Engineering

M.L.L.

5982

T.9N. R.2E.

PRELIMINARY PLAT MAP of HORSE CREEK HILLS 1 SUBDIVISION

LOCATED IN SECTION 31, TOWNSHIP 9 NORTH, RANGE 2 EAST,
PRINCIPAL MERIDIAN MONTANA, BROADWATER COUNTY, MONTANA

OWNER: 71 RANCH LP
PURPOSE: TO CREATE 12 TRACTS

CERTIFICATION OF DEDICATION

I/We, the undersigned property owner(s), do hereby certify that I/We have caused to be surveyed, subdivided and platted into lots, blocks, streets, alleys, as shown be the plat hereto annexed, the following described land in Broadwater County, to-wit:

LEGAL DESCRIPTION

A tract of land being the North One-Half, the North One-Half of the Southeast One -Quarter, and the Northeast One-Quarter of the Southwest One-Quarter of Section 31, Township 9 North, Range 2 East, Principal Meridian Montana, Broadwater County, Montana and being more particularly described as follows:

Beginning at the Northeast Corner of Section 31;
thence South 01°19'49" West, a distance of 3,953.22 feet along the eastern section line of said Section 31 to a 1/16th Corner of Section 31;
thence North 89°10'42" West, a distance of 2,641.57 feet along the eastern section line of said Section 31 to a 1/16th Corner of Section 31;
thence North 89°09'25" West, a distance of 1,321.17 feet to a 1/16th Corner of Section 31;
thence North 01°11'14" East, a distance of 1,317.54 feet to a 1/16th Corner of Section 31;
thence North 89°10'11" West, a distance of 1,318.39 feet to the west One-Quarter Corner of Section 31;
thence North 01°14'10" East, a distance of 1,335.07 feet along the western section line of said Section 31 to a 1/16th Corner of Section 31;
thence North 01°14'32" East, a distance of 1,335.42 feet along the western section line of said Section 31 to the Northwest Section Corner of said Section 31;
thence South 88°49'43" East, a distance of 2,640.43 feet along the northern section line of said Section 31 to the northern One-Quarter Corner of said Section 31;
thence South 88°45'28" East, a distance of 2,647.88 feet along the northern section line of said Section 31 to the Northwest Section corner of said Section 31 and the point of beginning

Said tract of land being 435 acres, along with and subject to any existing easements.

The above described tract of land is to be known and designated as HORSE CREEK HILLS 1 SUBDIVISION and the lands included in all streets, avenues, alleys, and parks or public squares shown on said plat are hereby granted and donated to the use of the public forever.

GRANT OF PUBLIC UTILITY EASEMENT

The undersigned hereby grants unto each and every person or firm, wheter public or privte, providing or offering to provide telephone, internet, electric power, gas, cable television, water or sewer service to the public, the right to the joint use of an easement for the construction, maintenance, repair and removal of their lines and other facilities in, over, under, and across each area designated on this plat as "Utility Easement" to have and to hold forever.

CERTIFICATE OF WAIVER

I/We, the undersigned property owners of HORSE CREEK HILLS 1 SUBDIVISION do hereby waive the right to protest creation of a rural improvements district for improvements to Lower Confederate Road and the internal primary and secondary access subdivision roads. In so doing, we do not waive any right to protest, and/or appeal assessment formula which may be proposed if we believe it to be inequitable. This waiver shall be binding upon the heirs, assigns and purchasers of all tracts within this subdivision.

Dated this ________ day of ______________________, 20_____.

State of Montana)
): ss
County of Gallatin)

On this ______ day of ______________________, 20______, before me, the undersigned, a Notary Public for the State of ______________, personally appeared ______________________, known to me to be the ______________________ of the Corporation executed the within instrument, and acknowledged to me that such Corporation executed the same.
IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notarial Seal the day and year first above written.

____
Notary Public for the State of _________

____
(Printed Name)

Residing at ______________, ________

My commission expires ______________

CERTIFICATION OF COMPLETION OF IMPROVEMENTS

I, 71 Ranch LP, and I, Mark Fasting, a registered professional engineer licensed to practice in the State of Montana hereby certify that the public improvements, required as a condition of approval of HORSE CREEK HILLS 1 SUBDIVISION, have been installed in conformance with the approved specifications and plans, or have been bonded according to the improvements agreement.

________________________________ ________________, 20_____
71 Ranch LP (Date)

________________________________ ________________, 20_____
Mark A. Fasting, P.E. (Date)
Montana Registration No. 12071PE

CONSENT OF MORTGAGEES

We, the undersigned mortgagees, do hereby join in and consent to the described plat, releasing our respective liens, claims or encumbrances as to any portion of said lands now being platted into roads, avenues, parks or other public uses and dedicated to the use of the public forever.

DATED this ______ day of ______________________, 20___.

____
Lending Institution

BY: ________________________________

State of Montana)
): ss
County of Gallatin)

On this ______ day of ______________________, 20______, before me, the undersigned, a Notary Public for the State of ______________, personally appeared ______________________, known to me to be the ______________________ of the Corporation executed the within instrument, and acknowledged to me that such Corporation executed the same.
IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Notarial Seal the day and year first above written.

____
Notary Public for the State of _________

____
(Printed Name)

Residing at ______________, ________

My commission expires ______________

CERTIFICATE OF COUNTY COMMISSIONERS

I, the Chairman of the Board of County Commissioners, Gallatin County, Montana, do hereby certify that the accompanying plat has been duly examined and have found the same to conform to the law, approve it, and hereby accept the dedication to public use.

DATED this ______ day of ______________________, 20______.

____
Chairman, Board of County Commissioners

CERTIFICATE OF COUNTY TREASURER

I, ________________________________, Treasurer of Broadwater County, Montana, pursuant to Section 76-3-611(1)(b) MCA, that all real property taxes assessed and levied on the land described below encompassed by the proposed HORSE CREEK HILLS 1 SUBDIVISION have been paid.

DATED this ______ day of ______________________, 20______.

____
Treasurer of Gallatin County

CERTIFICATE OF CLERK AND RECORDER

I, ________________________________, Clerk and Recorder of Broadwater County, Montana, do hereby certify that the foregoing instrument was filed in my office at ________ o'clock (AM or PM) this ______ day of ______________________, 20______, and recorded as HORSE CREEK HILLS 1 SUBDIVISION, Records of the Clerk and Recorder, Broadwater County, Montana.

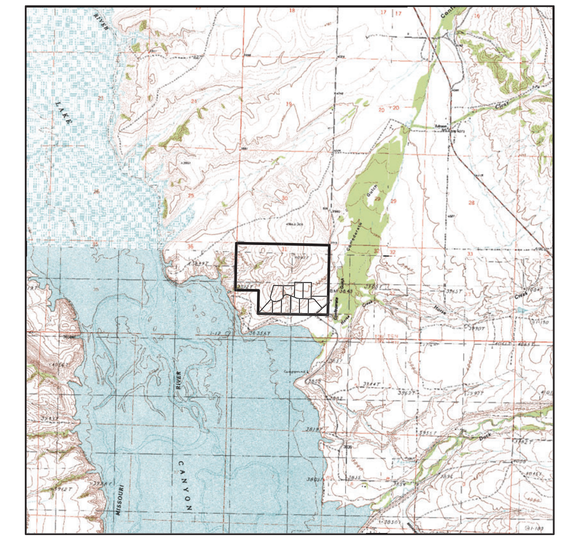
____
Clerk and Recorder

CERTIFICATE OF SURVEYOR

I, the undersigned, Gregory L. Finck, a Professional Land Surveyor, do hereby certify that I have performed the survey shown on the attached plat of HORSE CREEK HILLS 1 SUBDIVISION; that such survey was made on ________ day of ________________, 20_____; that said survey is true and complete as shown and that the monuments found and set are of the character and occupy the positions shown thereon.

Dated this ________ day of ______________________, 20_____.

Gregory L. Finck, P.L.S.
Montana Registration No. 13174 LS



VICINITY MAP
SCALE: 1" = 5,000'

DRAFT

1/4	Sec.	T.	R.
	31	9N	2E

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
www.alliedengineering.com

Civil Engineering
Geotechnical Engineering
Land Surveying

ALLIED ENGINEERING SERVICES, INC.
Diverse Projects • Solutions that Last

PROJECT SURVEYOR: GLF
DRAWN BY: JDS
REVIEWED BY: GLF
DATE: 03/29/2020

SHEET 2 OF 3
PROJECT No. 19-072
Final Plat.dwg

C:\aesi_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\21 C3D-Survey\Z-Prelim Plat_19-072.dwg Mar 30, 2020 - 1:54pm

PRELIMINARY PLAT MAP of HORSE CREEK HILLS 1 SUBDIVISION

LOCATED IN SECTION 31, TOWNSHIP 9 NORTH, RANGE 2 EAST,
PRINCIPAL MERIDIAN MONTANA, BROADWATER COUNTY, MONTANA

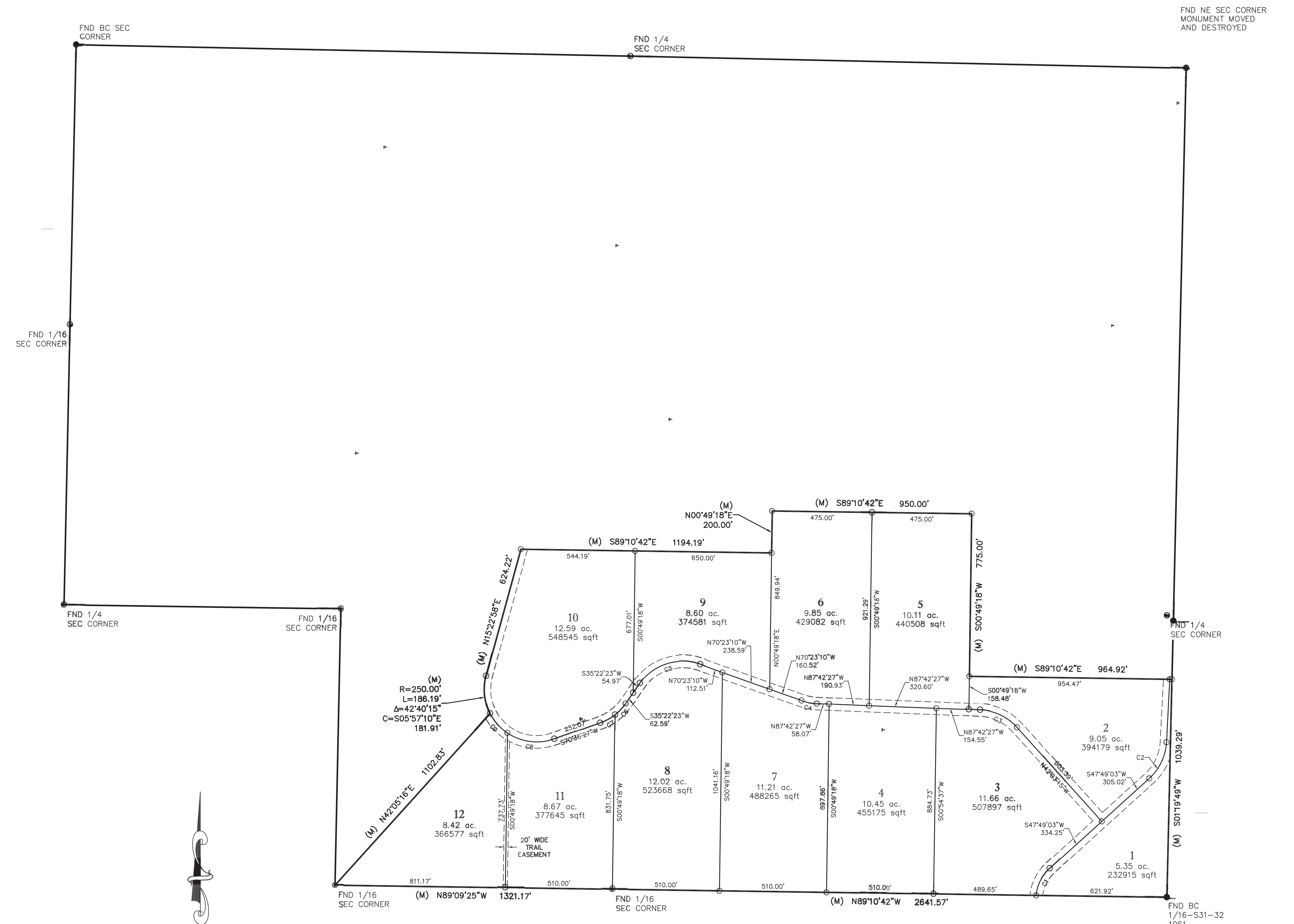
OWNER: 71 RANCH LP
PURPOSE: TO CREATE 12 TRACTS

LEGEND

- PROPERTY LINE
- LOT LINE
- ADJOINING PROPERTY LINE
- EASEMENT LINE
- FENCE LINE
- ROAD CENTERLINE
- TOP BACK OF CURB
- EDGE OF SIDEWALK
- FOUND MONUMENT AS NOTED
- SET ⅝" REBAR W/(YPC 13174LS or RPC 13108LS or ??? 32875LS)
- FOUND SECTION CORNER
- FOUND ONE-QUARTER CORNER
- CENTER ONE-QUARTER CORNER
- FOUND ONE-SIXTEENTH CORNER
- CONTROL POINT
- BENCH MARK
- RED CEDAR FENCE POST
- YPC YELLOW PLASTIC CAP
- (M) MEASURED
- (R) RECORDED

LOT CURVE TABLE					
CURVE	LENGTH	RADIUS	DELTA	CHORD BEARING	CHORD
C1	147.15'	200.00'	42°09'22"	S26°44'22"W	143.86'
C2	195.91'	250.00'	44°53'53"	S25°22'06"W	190.93'
C3	199.23'	250.00'	45°39'37"	N64°52'39"W	194.00'
C4	75.58'	250.00'	17°19'17"	N79°02'49"W	75.29'
C5	323.94'	250.00'	74°14'27"	S72°29'36"W	301.75'
C6	74.08'	250.00'	16°58'38"	S43°51'42"W	73.81'
C7	79.59'	250.00'	18°14'27"	S61°28'14"W	79.25'
C8	232.93'	250.00'	53°23'01"	N82°43'02"W	224.60'
C9	125.39'	250.00'	28°44'14"	N41°39'24"W	124.08'

DRAFT



0 250 500 750
SCALE: 1 INCH = 250 FEET

BASIS OF BEARING, COORDINATES

BEARINGS SHOWN ARE MONTANA STATE PLANE GRID.
DISTANCES ARE GROUND DISTANCES IN INTERNATIONAL FEET.

MONTANA COORDINATE SYSTEM NAD 83
HORIZONTAL DATUM: REFERENCED FROM NGS OPUS SOLUTION; ADJUSTED FROM NGS CORS

PID	DESIGNATION
DG9745	MTEI ENGINC CORS ARP
DK7547	MTSU BOZEMAN CORS ARP
DL7705	NOMT NOMT_EBRY_MT1999 CORS ARP

MONTANA STATE PLANE NAD 83 (2011)(EPOCH: 2010.0000)
NORTH LATITUDE XX°XX'XX.XXXXX"
WEST LONGITUDE XXX°XX'XX.XXXXX"
UNITS: INTERNATIONAL FEET
Convergence angle: XX°XX'XX"

1/4	Sec.	T.	R.
	31	9N	2E

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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PROJECT SURVEYOR: GLF	SHEET 2 OF 3
DRAWN BY: JDS	
REVIEWED BY: GLF	PROJECT No. 19-072
DATE: 03/29/2020	Final Plat.dwg

C:\aesi_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\21 C3D-Survey\Z-Prelim Plat_19-072.dwg Mar 30, 2020 - 11:06am

PRELIMINARY PLAT MAP of HORSE CREEK HILLS 1 SUBDIVISION

LOCATED IN SECTION 31, TOWNSHIP 9 NORTH, RANGE 2 EAST,
PRINCIPAL MERIDIAN MONTANA, BROADWATER COUNTY, MONTANA

OWNER: 71 RANCH LP
PURPOSE: TO CREATE 12 TRACTS

LEGEND

- PROPERTY LINE
- LOT LINE
- ADJOINING PROPERTY LINE
- EASEMENT LINE
- FENCE LINE
- ROAD CENTERLINE
- TOP BACK OF CURB
- EDGE OF SIDEWALK
- FOUND MONUMENT AS NOTED
- SET ⅝" REBAR W/(YPC 13174LS or RPC 13108LS or YPC 32875LS)
- FOUND SECTION CORNER
- FOUND ONE-QUARTER CORNER
- CENTER ONE-QUARTER CORNER
- FOUND ONE-SIXTEENTH CORNER
- CONTROL POINT
- BENCH MARK
- RED CEDAR FENCE POST
- YPC YELLOW PLASTIC CAP
- (M) MEASURED
- (R) RECORDED

BASIS OF BEARING, COORDINATES

BEARINGS SHOWN ARE MONTANA STATE PLANE GRID.
DISTANCES ARE GROUND DISTANCES IN INTERNATIONAL FEET.

MONTANA COORDINATE SYSTEM NAD 83
HORIZONTAL DATUM: REFERENCED FROM NGS OPUS SOLUTION; ADJUSTED FROM NGS CORS

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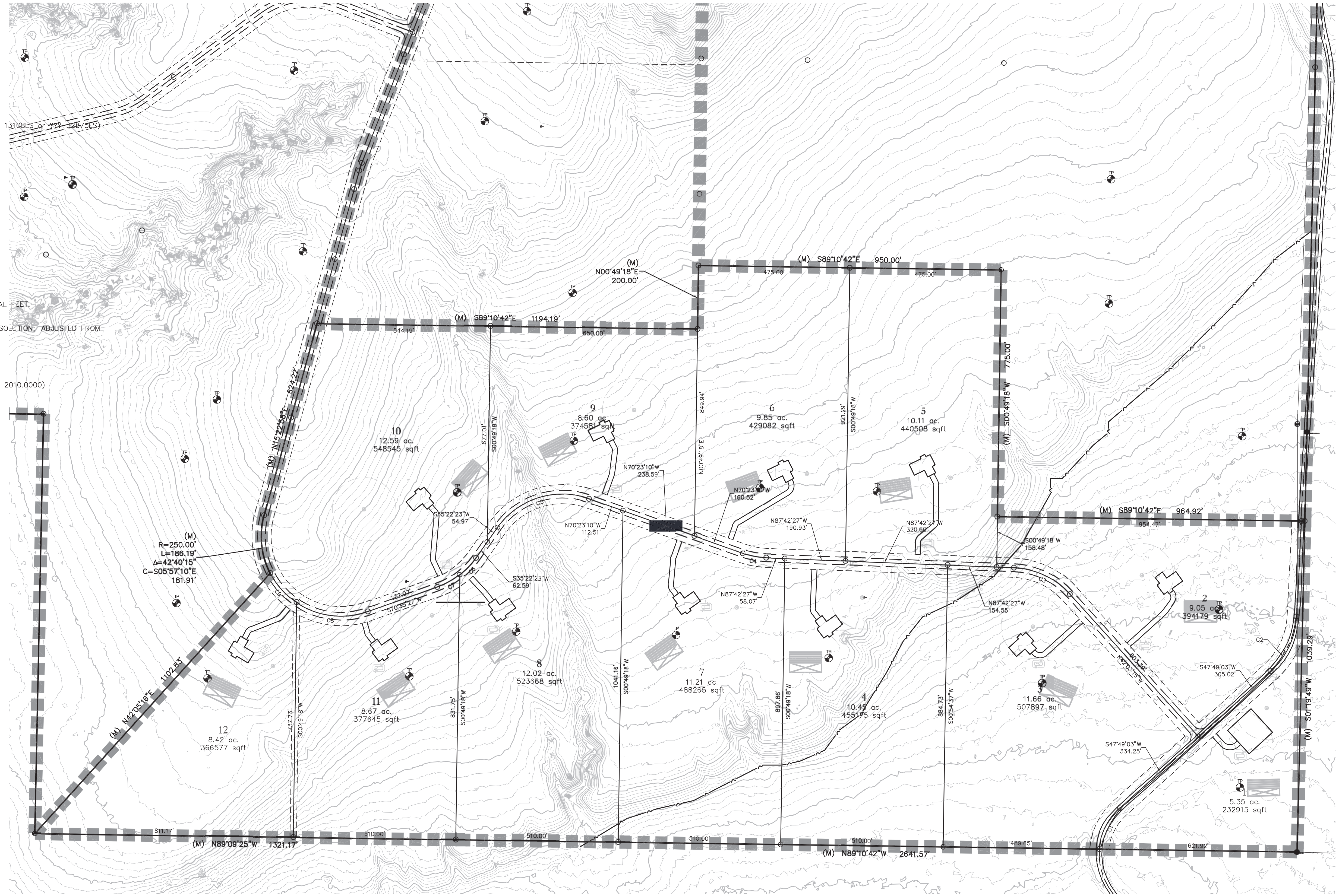
NORTH LATITUDE XX°XX'XX.XXXXX"
WEST LONGITUDE XXX°XX'XX.XXXXX"
UNITS: INTERNATIONAL FEET
Convergence angle: XX°XX'XX"

DRAFT



0 150 300 450
SCALE: 1 INCH = 150 FEET

1/4	Sec.	T.	R.
	31	9N	2E

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FAX (406) 582-5770
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PROJECT SURVEYOR: GLF
DRAWN BY: JDS
REVIEWED BY: GLF
DATE: 03/29/2020

SHEET 3 OF 3
PROJECT No. 19-072
Final Plat.dwg

PRELIMINARY PLAT MAP of HORSE CREEK HILLS 1, 2, 3, & 4 SUBDIVISIONS

LOCATED IN SECTION 31, TOWNSHIP 9 NORTH, RANGE 2 EAST,
PRINCIPAL MERIDIAN MONTANA, BROADWATER COUNTY, MONTANA

OWNER: 71 RANCH LP
PURPOSE: TO CREATE 42 TRACTS

LEGEND

- PROPERTY LINE
- LOT LINE
- ADJOINING PROPERTY LINE
- EASEMENT LINE
- FENCE LINE
- ROAD CENTERLINE
- TOP BACK OF CURB
- EDGE OF SIDEWALK
- FOUND MONUMENT AS NOTED
- SET ⅝" REBAR W/(YPC 13174LS or RPC 13108LS or ??? 32875LS)
- FOUND SECTION CORNER
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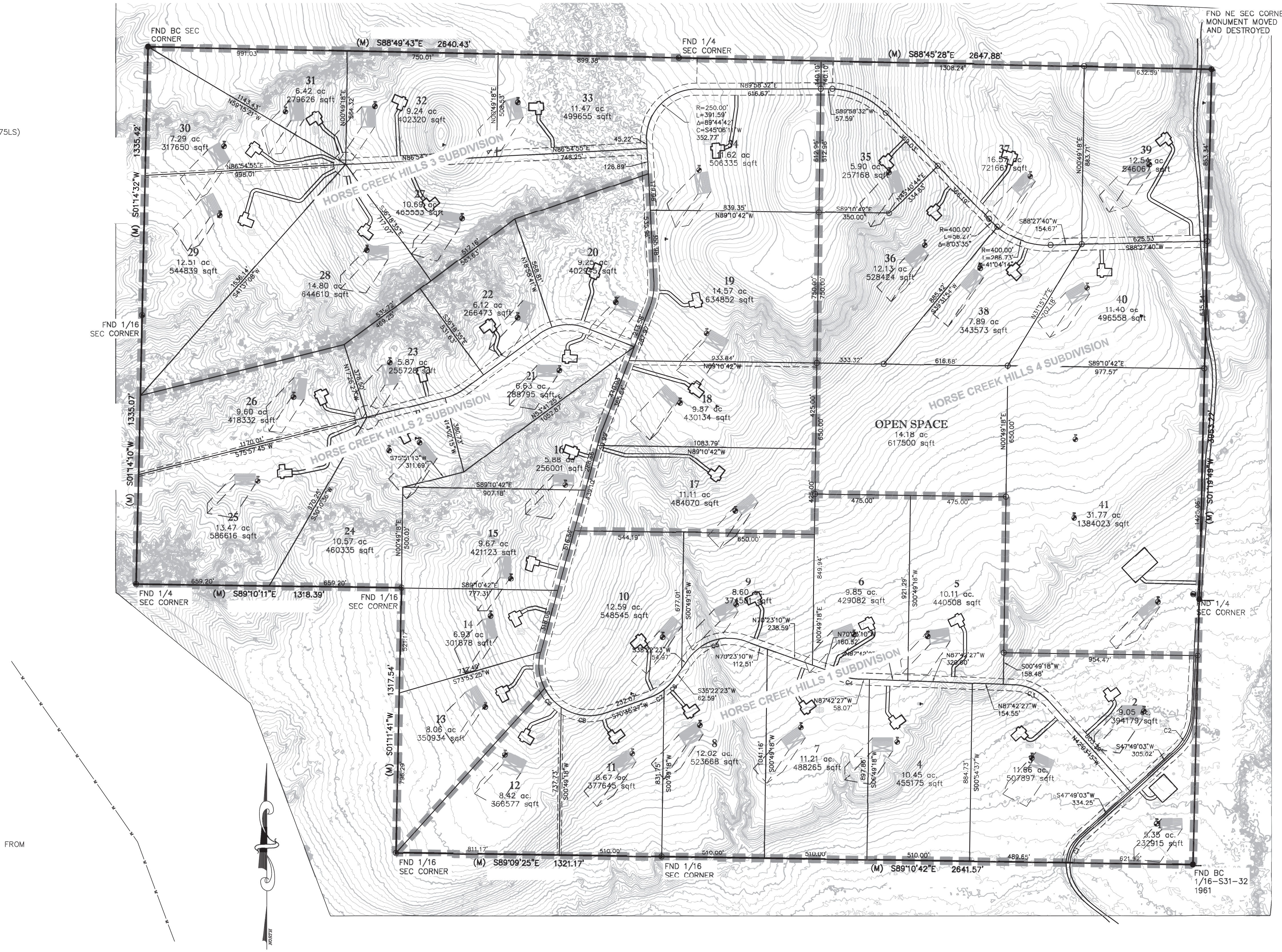
- CONTROL POINT
- BENCH MARK
- RED CEDAR FENCE POST
- YPC YELLOW PLASTIC CAP
- (M) MEASURED
- (R) RECORDED



0 250 500 750
SCALE: 1 INCH = 250 FEET

BASIS OF BEARING, COORDINATES

BEARINGS SHOWN ARE MONTANA STATE PLANE GRID.
DISTANCES ARE GROUND DISTANCES IN INTERNATIONAL FEET.

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HORIZONTAL DATUM: REFERENCED FROM NGS OPUS SOLUTION; ADJUSTED FROM NGS CORS

PID	DESIGNATION
DG9745	MTEI ENGINC CORS ARP
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MONTANA STATE PLANE NAD 83 (2011)(EPOCH: 2010.0000)
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1/4	Sec.	T.	R.
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Geotechnical Engineering
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PROJECT SURVEYOR: GLF	SHEET 1 OF 1
DRAWN BY: JDS	
REVIEWED BY: GLF	PROJECT No. 19-072
DATE: 03/29/2020	Final Plat.dwg

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STEVE BULLOCK
GOVERNOR

STATE OF MONTANA

PHONE: (406) 444-6999
FAX: (406) 444-9317
http://www.dnrc.mt.gov

1424 9TH AVENUE
PO BOX 201601
HELENA, MONTANA 59620-1601

February 4, 2020

Hunter Morrical
Allied Engineering Services, Inc.
32 Discovery Dr.
Bozeman, MT 59718

Re: Horse Creek Hills Subdivision, Phase 1, Broadwater County, HRO 20-4

Dear Mr. Morrical:

The purpose of this letter is to respond to your request for DNRC review of water right permit exceptions under MCA 85-2-306(3)(a)(iii) for the proposed DEQ review in accordance with ARM 17.36.103(1)(s). The proposed project is to split an existing ±435-acre tract, into individual lots in four phases. The project is located in Section 31, T9N, R2E, Broadwater County. The proposed project for Phase 1 is for one domestic dwelling each on eleven lots (0.28 AF x 11 lots = **3.08 AF**) and one commercial lot with water usage estimated to be **0.35 AF** (see submitted calculations). Lawn and garden irrigation would be approximately 0.219 acres on each lot (0.219 acres x 12 lots = 2.62 acres x 2.5 AF/season = **6.57 AF**). The total combined volumetric use for the proposed ten lot project is 10 AF.

Based on the information received January 31, 2020, the proposed appropriation does fit the current rules and laws pertaining to the filing of an exempt water right using a DNRC Form 602, Notice of Completion of Groundwater Development. The proposed appropriation is considered a combined appropriation because the proposed split of the 435 acre tract has not been approved or recorded with Broadwater County prior to October 17, 2014. As noted on Form 602, the appropriations combined, will not exceed a flow rate of 35 GPM or an annual volume of 10 AF in combination, or a water right permit must be applied for on DNRC Form 600, prior to putting the water to a beneficial use. DNRC Form 602, Notice of Completion of Groundwater Development, is to be filed within 60 days of the water being put to a beneficial use.

In Clark Fork Coalition, et. al. v. DNRC, et. al., 2016 MT 229, 384 Mont. 503, 380 P.3d 771, the Montana Supreme Court concluded that the definition of "combined appropriation" in Admin. R. Mont. 36.12.101(13) was invalid. The Court reinstated the Department's 1987 Rule defining "combined appropriation" as: "An appropriation of water from the same source aquifer by means of two or more groundwater developments, the purpose of which, in the department's judgment, could have been accomplished by a single appropriation. Groundwater developments need not be physically connected nor have a common distribution system to be considered a "combined appropriation." They can be separate developed springs or wells to separate parts of a project or development. Such wells and springs need not be developed simultaneously. They can be developed gradually or in increments. The amount of water appropriated from the entire project or development from these groundwater developments in the same source aquifer is the "combined appropriation."

Under this Rule, the Department interprets subdivisions that are pending before the Department of Environmental Quality for approval on October 17, 2014 or filed after that date to be a single project that can be accomplished by a single appropriation. Consequently all wells in such a subdivision will be considered a "combined appropriation" for the purposes of Mont. Code Ann. 85-2-306. The only exception to this interpretation is that a subdivision which has received preliminary plat approval prior to October 17, 2014 will not be considered a project under the "combined appropriation" 1987 Rule; individual lots will still be evaluated under the 1987 Rule at the time of an application to the Department. 2015 Mont. Laws § 1, Ch. 221.

This letter does not serve as a pre-approval for a water right nor does it provide a pre-approval to utilize up to 10 AF of water in the future. This letter only evaluates the amount of water proposed under the current project.

Thank you,

Kristeen Wofford

Kristeen Wofford
DNRC Water Resources Helena Regional Office

Cc: DEQ, Leata English via email

Montana Sage Grouse Habitat Conservation Map

Use this map to view and explore types of sage grouse habitat designated as core (blue), general (green), connectivity (light-blue) habitats or BLM priority areas. To zoom into an area, hold the Shift key and draw a rectangle. Anyone proposing new activities in sage grouse habitat must submit a project application for consultation.

If your project is close to designated sage grouse habitat or BLM Priority area, or if you are unsure your project is within designated sage grouse habitat or BLM Priority area, please submit your project for review as permitting agencies will be checking to see if your project is located within these designated sage grouse habitats. If your permitting agency requires evidence that your project is outside of designated sage grouse habitat, we recommend that you log in and start a project application and take a screenshot of your project's location.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 12. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from NAIP Orthophotography produced with a one meter ground resolution from photography dated 2009.

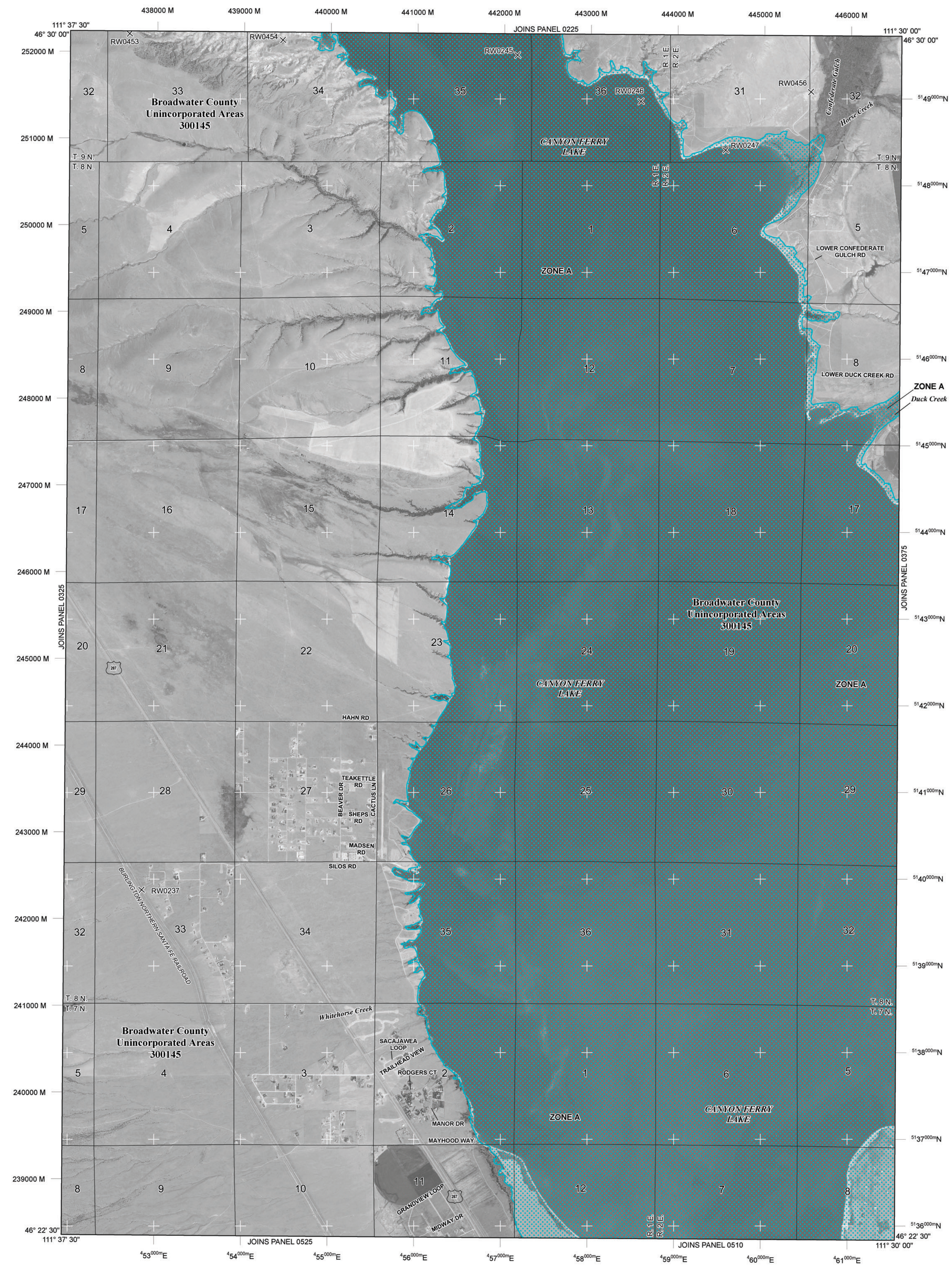
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map,** how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A Cross section line

23 - - - - - 23 Transect line

45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

4989000 M — 1000-meter ticks: Montana State Plane Zone (FIPS Zone 2500), Lambert Conformal Conic projection

$^{49}89^{000m}$ N — 1000-meter Universal Transverse Mercator grid values, zone 12

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 18, 2014

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

600 0 600 1200 METERS

NFIP

PANEL 0350C

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

BROADWATER COUNTY, MONTANA
AND INCORPORATED AREAS

PANEL 350 OF 1050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BROADWATER COUNTY, UNINCORPORATED AREAS	300145	0350	C

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
30007C0350C

EFFECTIVE DATE
AUGUST 18, 2014

Federal Emergency Management Agency

BROADWATER COUNTY
Planning Department
Office 406-266-9211 Fax 406-266-3674
515 BROADWAY
TOWNSEND, MONTANA 59644

TOWNSEND

March 23, 2020

Hunter Morrical, E.I.
Allied Engineering
32 Discovery Drive
Bozeman, MT 59718

Dear Mr. Morrical:

Per your request, WWC Engineering (Broadwater County Contract Floodplain Administrator) has completed a review to determine if the proposed subdivision to be constructed is within the FEMA designated floodplain. The proposed subdivision is located on a parcel owned by the 71 Ranch LP, with a parcel ID #43179231101010000, in the N 1/2, Section 31, Township 9 North, Range 2 East. Per our review, the proposed subdivision does not require a floodplain permit from Broadwater County. If you have any questions or need additional information please do not hesitate to contact us.

Sincerely,

Gary Vert

Gary Vert, P.E., CFM
Broadwater County Floodplain Administrator
(406) 443-3962 Office
gvert@wwcengineering.com

Appendix F

Storm Drainage Calculations

- Storm Drainage Report Horse Creek Hills 1-4 Subdivisions
- Storm Drainage Plans
- Storm Drainage Maintenance Plan

Storm Drainage Report:

Horse Creek Hills Subdivisions 1,2,3, & 4
Broadwater County, MT

Project #19-072

April, 2020

Prepared By:

Allied Engineering Services, Inc.

INTRODUCTION

This report presents the necessary information for MDEQ Subdivision review required per Circular MDEQ-8. Located off Lower Confederate Road, the project is just east of Canyon Ferry Reservoir. The project is to subdivide a single lot into 39 residential lots and two commercial lots. Horse Creek Hills Subdivision #1 will consist of 11 residential lots and 1 commercial lot. Horse Creek Hills Subdivision #2 will consist of 11 residential lots. Horse Creek Hills Subdivision #3 will consist of 11 residential lots. Horse Creek Hills Subdivision #4 will consist of 6 residential lots and 1 commercial lot. All residential and commercial lots will be served by on-site wastewater and water. This report has been addressed to encompass all four subdivisions within the overall development. The overall stormwater management plan for the development is to ensure that all increased runoff from the 2-year, 24-hour storm due to road and infrastructure is captured before it leaves the property. Additionally, the development is designed so that existing runoff patterns will be maintained. Stormwater conveyance structures have been designed to convey the 10-year, 24-hour event without roads and driveways being overtopped. Finally, the 100-year, 24-hour event will not inundate homes and drainfields due to the existing topography of the site and the strategic placement of homes and drainfields.

Existing conditions at the site are native grassland range that has been historically used for grazing purposes. Additionally, there are dry wash gullies on the site that hold true to existing drainage patterns. General topography of the site can be seen on the storm drainage plans included in Appendix 4 (F). The site has slopes that range from 1-75% in some areas. Slopes generally drain towards dry wash gullies that ultimately go in the direction of Canyon Ferry Reservoir. Soils for the site are primarily labeled by the NRCS as hydrologic soil group B. Group B soils have moderately low runoff potential when saturated. This is true for the existing topsoil layer on-site, which varies in thickness from 0 to 6 inches. During the site investigation, silty loam with high infiltration capabilities where found below the topsoil layer. This soil profile is common amongst the test pits excavated within the subdivision. Overall, 43 test pits were excavated within the development – all confirming the above.

The essential storm drainage management plan is for ten retention facilities to be constructed throughout the site to account for the increase in runoff due to road and utility construction only. All individual lot owners will also need to construct a generically sized retention pond and place it on the downstream side of their development to retain the excess stormwater runoff due to home and driveway construction.

PRE-DEVEOPMENT HYDROLOGY

The peak flows and volumes for the required storm events were computed using the MDEQ spreadsheets for DEQ-8 Standard Plans. Additionally, the DEQ-8 IDF spreadsheet was used for calculating intensity data and for sizing on-site culverts. The existing ground was classified as undeveloped area since it has been used for grazing purposes historically. In addition to site visits an aerial drone survey was performed on the site that is included to show pre-development land use conditions. Post development land use will include residential lots, commercial lots, roads, storm ponds, and open space lots. The open space is assumed to have native grasses maintained and will require minimal irrigation to remain established. Rational Method Coefficients for the different land uses are estimated below.

Table 1 – Rational Method Co-Efficient (C)

Land Use	Coefficient (C)
Paved/hard Surfaces	0.90
Gravel Surfaces	0.80
Lawn/Landscaping	0.10
Unimproved Areas	0.20

Pre-development basins were delineated into seven (7) different basins labeled Drainage Basin 1, 2, 3, 4, 5, 6, and 7. The drainage basins Existing 6 and 7 are both basins that have off-site drainage that has been accounted for. Existing drainage basins have historical runoff patterns and directions that will not be altered by this development. The overall layout of the drainage basins is shown on page WW2.0 (see Appendix 4). The development generally will not alter existing drainage paths or patterns; thus the post development basins were analyzed to be the same as the pre-development basins.

Table 2 – Pre-Development Drainage Basins

Drainage Basin	Primary Land Use	Area (acre)	Coefficient (C)
Existing 1	Undeveloped Land	61.10	0.20
Existing 2	Undeveloped Land	60.50	0.20
Existing 3	Undeveloped Land	70.00	0.20
Existing 4	Undeveloped Land	79.70	0.20
Existing 5	Undeveloped Land	90.40	0.20
Existing 6	Undeveloped Land	76.30	0.20
Existing 7	Undeveloped Land	87.60	0.20

Table 3 – Pre-Development Peak Flow for Existing Drainage Basins

Drainage Basin	Design Storm	Peak Run-Off (cfs)	Volume (Cu. Ft.)
DB 1	2-YR 24-HR	4.19	55,004
DB 2	2-YR 24-HR	4.15	54,465
DB 3	2-YR 24-HR	4.79	62,830
DB 4	2-YR 24-HR	5.46	71,713
DB 5	2-YR 24-HR	6.20	83,346
DB 6	2-YR 24-HR	5.23	68,688
DB 7	2-YR 24-HR	6.00	78,877

All analysis was performed using MDEQ spreadsheets available online. The IDF curve used to calculate intensities for peak runoff was found using the IDF spreadsheet from MDEQ. The intensity values used for calculating required retention pond volumes were found in Appendix A from DEQ-8 Circular.

POST-DEVELOPMENT HYDROLOGY

Post-Development conditions for the four proposed subdivisions are going to be residential lots between 5 to 15 acres in size, as well as two commercial lots between 5 and 32 acres in size. The site has been designed so that increased runoff due to road construction will be retained on site and that existing drainage basins are not altered. Run-off will be captured by roadside swales and channelized ten different ponds throughout the site – as seen in the Stormwater plans in Appendix 4. Ponds will generally overtop during events larger than the 2-year, 24-hour event and runoff will flow into existing drainage paths without inundating houses or drainfields. Soil types on the site are primarily Fine Sandy Loam, loam, or coarser, thus infiltration in the ponds can be expected to be 0.7 inches per hour – per DEQ Circular 8. After 72 hours, infiltration levels can be expected to be 4.2 feet or greater. Because the max depth of each retention pond is 3-ft, infiltration should ensure that stormwater is not retained in the retention ponds for longer than 72 hours. Evaporation was not considered to contribute to stormwater loss after storm events.

Post-Development 10-YR, 24-HR peak flow rates for culvert sizing were calculated using the MDEQ IDF spreadsheet calculations attached in Appendix 3. All culverts and swales on site were designed to convey the flow rates calculated. Many culverts and most of the swales on the property will be able to convey the 100-year, 24-hour event as these structures were oversized to account for snow melt potential in conjunction with frozen ground. According to MDEQ-8 standard plan requirements the controlling factor for storm water treatment is now the Initial Storm Water Facility (ISWF) volume. The ISWF for all drainage basins did not exceed they increased runoff volume from the rational method calculation. To satisfy the Standard Plan the 10-YR 24-HR event will be evaluated to make sure roadways and driveways are not overtopped. Also, a general narrative and calculations will be given to demonstrate that drainfields and buildings are not flooded during the 100-YR 24-HR storm.

Table 4 - Post-Development Total Run-Off Values

Drainage Basin	Design Storm	Peak Run-Off (cfs)	Volume (Cu. Ft.)	Increased Volume (Cu. Ft.)
DB 1	2-YR 24-HR	4.19	55,004	0
DB 2	2-YR 24-HR	4.71	61,869	7,404
DB 3	2-YR 24-HR	5.15	67,567	4,738
DB 4	2-YR 24-HR	6.21	81,584	9,871
DB 5	2-YR 24-HR	6.89	90,454	9,108
DB 6	2-YR 24-HR	5.23	68,688	0
DB 7	2-YR 24-HR	6.51	85,432	6,555

The total drainage basin area evaluated is 525.6 acres. Of this area, 435 acres is on-site drainage area, and 90.6 acres is offsite drainage area. A total of 12 acres of impervious area will be added due to road infrastructure. It was conservatively assumed that the roads will be paved for the post development runoff calculations. This volume does not include the impervious area on the residential lots, as residential and commercial lots will be responsible to retain the excess stormwater in individual retention ponds. See below for description of individual lot impervious area run-off capture pond sizing.

Typical Residential Lot Pond Sizing

As described above each lot will be required to capture the first half inch run-off from all impervious area, or the amount of excess stormwater generated during the 2-year, 24-hour event. To estimate the pond size needed for these lots, a typical residential lot was analyzed as having a 3,500-sf house footprint and a 600-ft long driveway being 16-ft wide. Additionally, no lawn/landscaping area was accounted for, as many of the lots will consist of zero scaping given the location. For the commercial lots, the same pond has been shown for conceptual purposes; however, if impervious area for the commercial lots is expected to exceed 13,100-sf, the lot owner will be responsible to size and build a larger retention facility. See table below for the typical lot layout with estimates for proposed driveway area and building size.

Table 5 - Typical Residential Lot Layout

Land Use	Area (sq. ft.)	Coefficient
Driveway	9,600	0.9
House	3,500	0.9

A typical lot will have a total impervious area of 13,100 Sq. Ft. To capture the 2-year, 24-hour stormwater volume of 948 cu. ft. The volume of the first half inch of stormwater is 546 cu. ft., thus the stormwater pond size is enough. Assuming 3:1 side slope and 2.0 feet deep the pond will have a total footprint of 16-ft by 31-ft. The total volume of this pond will hold cu. ft. Each lot owner will need to construct this pond on the downstream side of there lot and grade drainage from the impervious areas to drain to it.

Table 6 –Summary of Initial Storm Water Facilities Required

Basin	Land Use	Area (sq. ft.)	Volume Required (cu. Ft.)
All Subdivision Roads	Impervious Area	522,720	37,676
Individual Lots	Impervious Area	13,100	948

POST-DEVELOPMENT HYDRAULICS

The project storm ponds are designed to retain the stormwater increase from the 2-year, 24 hour storm event. Utilizing a linear pond configuration, the ponds will have a trapezoidal shape with 3:1 side slopes. Once full, the ponds will overtop and flow into existing drainage paths without inundating roads, homes, or drainfields.

Table 7 – Retention Ponds Overview

Pond	Drainage Basin	Top Dimensions (Length x Width)	Pond Depth (ft.)	Storage Volume (Cu. Ft.)	Side Slopes (H:V)
Strawberry Roan Trail Pond – Sta. 92+00	DB-1 & DB-2	39 ft x 79 ft	2.75	8,293	3:1
Strawberry Roan Trail Pond – Sta. 68+00	DB-3	34 ft x 59 ft	2.75	5,389	3:1
Strawberry Roan Trail Pond – Sta. 46+00	DB-4	29 ft x 59 ft	3.0	5,214	3:1
Strawberry Roan Trail Pond – Sta. 35+00	DB-5	29 ft x 59 ft	2.75	4,588	3:1
Strawberry Roan Trail Pond – Sta. 4+00	DB-7	39 ft x 69 ft	2.75	7,241	3:1
Appaloosa Trail Pond – Cul-de-Sac North	DB-4	24 ft x 44 ft	2.75	2,828	3:1
Appaloosa Trail Pond – Cul-de-Sac South	DB-4	24 ft x 44 ft	2.75	2,828	3:1
Buckskin Trail Pond – Sta. 6+00	DB-5	24 ft x 44 ft	2.75	2,828	3:1
Buckskin Trail Pond – Cul-de-Sac North	DB-5	19 ft x 29 ft	2.75	1,480	3:1
Buckskin Trail Pond – Cul-de-Sac South	DB-5	19 ft x 29 ft	2.75	1,480	3:1
Typical Lot Pond	All	19 ft x 34 ft	2.0	1,016	3:1

Stormwater conveyance for the site is primarily by roadside swales and pond swales which are a 12-ft wide triangular swale, with 3:1 side slope making it approximately 2 feet deep – shown in detail 1 on stormwater plan sheet WW4.7. These swales can convey approximately 48-cfs each side of the road at bank full at with 0.5% slope and assuming grass sides.

Subdivision Culvert Overview

Individual lots in project #1 will be responsible for installing a 18-in minimum diameter culvert at each driveway, as that project is on the downstream side of most of the drainage and more stormwater will need to be conveyed through driveway culverts. The 18-in cmp culvert was sized by analyzing the culvert at Sta. 89+00 of Strawberry Roan trail, where a large amount of stormwater from drainage basin #2 will be conveyed. The 18-in culvert at roughly 2% will have capacity to convey the required 7.88 cfs without overtopping the roadway, thus all culverts in project #1 under driveways should be 18-in to conservatively pass the 10-year, 24-hour event – these calculations are shown in Appendix 3. This culvert was also used as the control culvert for all typical culvert road crossings in subdivisions 1-4, as it has the largest drainage area to convey in the subdivision. All other individual driveway culverts in subdivisions #2-4 shall be 15-in diameter cmp culverts. Calculations shown in Appendix 3 show that a 15-in cmp for a worst-case scenario driveway crossing will convey the 10-year, 24-hour event. All typical road culvert crossings are shown as 18-in cmp culverts. All culverts that convey water under the road in existing drainage gullies were sized to be 36-in. The culvert crossing at Strawberry Roan Trail Sta. 3+25 was used as the control culvert for sizing gully drainage, as it has the largest area to convey in the development. Storm swales and culverts are described in Appendix 3 and MDEQ provided spreadsheets show their capacity to handle the design storms for the project. Culverts were sized to account for the increase flow due to increase in impervious area from residential homes and driveways. This is conservative, as lots should retain increased stormwater within individual retention ponds. All storm water conveyance infrastructure will handle the 10-YR 24-HR storm event without any overtopping. During the 100-YR storm the conveyance system will generally overtop some driveway culverts and the intersection of Strawberry Roan Trail and Lower Confederate Road on Lots #1 & 3. The overflow will continue to flow to existing drainage paths that end up flowing to Canyon Ferry Reservoir.

CONCLUSION

The retention facilities on-site have been designed to retain excess runoff from pre to post development during 2-year 24-hour storm. Conveyance structures have been designed to convey the entire runoff flow from the site during the 10-year, 24-hour storm. The site has been designed so that during the 100-year, 24-hour event, no buildings or drainfields are inundated during the event. All residential lots will construct their own ponds to capture the increased runoff for the individual lot. The 10-year storm will safely flow through the project without any overtopping of roads. During the 100-year event a small amount of ponding will occur at the downstream end of the subdivision, (South End) however no buildings or drainfields will be inundated. Stormwater will infiltrate and be completely gone after no more than 72 hours after the last storm event.

Appendix 1 – Drainage Basins - Pre and Post Analysis

Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 1
Lot/Area No.	Drainage Basin 1

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 61.1 acres = 2661516 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 0 ft^3

Pre-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour (volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	61.1 acres	2661516 ft^2	Q= 4.189 ft^3/sec	V= 55004.664 ft^3	Q= 9.365 ft^3/sec	V= 84281.340 ft^3	Q= 16.758 ft^3/sec
Total	61.1 acres	2661516 ft^2	Q_{Total}= **4.189** ft^3/sec	V_{Total}= **55004.664** ft^3	Q_{Total}= **9.365** ft^3/sec	V_{Total}= **84281.340** ft^3	Q_{Total}= **16.758** ft^3/sec

Post-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	61.1 acres	2661516 ft^2	Q= 4.189 ft^3/sec	V= 55004.664 ft^3	Q= 9.365 ft^3/sec	V= 84281.340 ft^3	Q= 16.758 ft^3/sec
Total	61.1 acres	2661516 ft^2	Q_{Total}= **4.189** ft^3/sec	V_{Total}= **55004.664** ft^3	Q_{Total}= **9.365** ft^3/sec	V_{Total}= **84281.340** ft^3	Q_{Total}= **16.758** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.000** ft^3/sec	ΔV= **0.000** ft^3	ΔQ= **0.000** ft^3/sec	ΔV= **0.000** ft^3	ΔQ= **0.000** ft^3/sec

Required Minimum Facility Volume: **0** ft^3

= input field

Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 1
Lot/Area No.	Drainage Basin 2

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 60.5 acres = 2635380 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 4265.2 ft^3

Pre-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour (volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	60.5 acres	2635380 ft^2	Q= 4.148 ft^3/sec	V= 54464.520 ft^3	Q= 9.273 ft^3/sec	V= 83453.700 ft^3	Q= 16.593 ft^3/sec
Total	60.5 acres	2635380 ft^2	Q_{Total}= **4.148** ft^3/sec	V_{Total}= **54464.520** ft^3	Q_{Total}= **9.273** ft^3/sec	V_{Total}= **83453.700** ft^3	Q_{Total}= **16.593** ft^3/sec

Post-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	2.349977043 acres	102365 ft^2	Q= 0.725 ft^3/sec	V= 9519.945 ft^3	Q= 1.621 ft^3/sec	V= 14587.013 ft^3	Q= 2.900 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	58.15002296 acres	2533015 ft^2	Q= 3.987 ft^3/sec	V= 52348.977 ft^3	Q= 8.912 ft^3/sec	V= 80212.142 ft^3	Q= 15.949 ft^3/sec
Total	60.5 acres	2635380 ft^2	Q_{Total}= **4.712** ft^3/sec	V_{Total}= **61868.922** ft^3	Q_{Total}= **10.533** ft^3/sec	V_{Total}= **94799.154** ft^3	Q_{Total}= **18.849** ft^3/sec

Runoff Flow/Volume Change					
	ΔQ= **0.564** ft^3/sec	ΔV= **7404.402** ft^3	ΔQ= **1.261** ft^3/sec	ΔV= **11345.454** ft^3	ΔQ= **2.256** ft^3/sec

Required Minimum Facility Volume: **7404.4** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 1
Lot/Area No.	Drainage Basin 3

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values		
2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 69.79 acres = 3040131 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 2729.2 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	69.79180441 acres	3040131 ft^2	Q= 4.785 ft^3/sec	V= 62829.374 ft^3	Q= 10.697 ft^3/sec	V= 96270.815 ft^3	Q= 19.142 ft^3/sec
Total	69.79180441 acres	3040131 ft^2	Q_{Total}= **4.785** ft^3/sec	V_{Total}= **62829.374** ft^3	Q_{Total}= **10.697** ft^3/sec	V_{Total}= **96270.815** ft^3	Q_{Total}= **19.142** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	1.503673095 acres	65500 ft^2	Q= 0.464 ft^3/sec	V= 6091.500 ft^3	Q= 1.037 ft^3/sec	V= 9333.750 ft^3	Q= 1.856 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	68.28813131 acres	2974631 ft^2	Q= 4.682 ft^3/sec	V= 61475.707 ft^3	Q= 10.466 ft^3/sec	V= 94196.648 ft^3	Q= 18.729 ft^3/sec
Total	69.79180441 acres	3040131 ft^2	Q_{Total}= **5.146** ft^3/sec	V_{Total}= **67567.207** ft^3	Q_{Total}= **11.503** ft^3/sec	V_{Total}= **103530.398** ft^3	Q_{Total}= **20.585** ft^3/sec

Runoff Flow/Volume Change	ΔQ= **0.361** ft^3/sec	ΔV= **4737.833** ft^3	ΔQ= **0.807** ft^3/sec	ΔV= **7259.583** ft^3	ΔQ= **1.443** ft^3/sec

Required Minimum Facility Volume: **4737.8** ft^3

= input field

Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 2
Lot/Area No.	Drainage Basin 4

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 79.66 acres = 3469980 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 5685.9 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	79.65977961 acres	3469980 ft^2	Q= 5.462 ft^3/sec	V= 71712.920 ft^3	Q= 12.209 ft^3/sec	V= 109882.700 ft^3	Q= 21.848 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **5.462** ft^3/sec	V_{Total}= **71712.920** ft^3	Q_{Total}= **12.209** ft^3/sec	V_{Total}= **109882.700** ft^3	Q_{Total}= **21.848** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	3.132713499 acres	136461 ft^2	Q= 0.967 ft^3/sec	V= 12690.873 ft^3	Q= 2.161 ft^3/sec	V= 19445.693 ft^3	Q= 3.866 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	76.52706612 acres	3333519 ft^2	Q= 5.247 ft^3/sec	V= 68892.726 ft^3	Q= 11.729 ft^3/sec	V= 105561.435 ft^3	Q= 20.989 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **6.214** ft^3/sec	V_{Total}= **81583.599** ft^3	Q_{Total}= **13.890** ft^3/sec	V_{Total}= **125007.128** ft^3	Q_{Total}= **24.855** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.752** ft^3/sec	ΔV= **9870.679** ft^3	ΔQ= **1.680** ft^3/sec	ΔV= **15124.428** ft^3	ΔQ= **3.007** ft^3/sec

Required Minimum Facility Volume: **9870.7** ft^3

= input field

Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 3
Lot/Area No.	Drainage Basin 5

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 90.36042241 acres = 3936100 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 5246.7 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	90.36042241 acres	3936100 ft^2	Q= 6.196 ft^3/sec	V= 81346.067 ft^3	Q= 13.849 ft^3/sec	V= 124643.167 ft^3	Q= 24.783 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.196** ft^3/sec	V_{Total}= **81346.067** ft^3	Q_{Total}= **13.849** ft^3/sec	V_{Total}= **124643.167** ft^3	Q_{Total}= **24.783** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	2.890725436 acres	125920 ft^2	Q= 0.892 ft^3/sec	V= 11710.560 ft^3	Q= 1.994 ft^3/sec	V= 17943.600 ft^3	Q= 3.568 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	87.46969697 acres	3810180 ft^2	Q= 5.998 ft^3/sec	V= 78743.720 ft^3	Q= 13.406 ft^3/sec	V= 120655.700 ft^3	Q= 23.990 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.889** ft^3/sec	V_{Total}= **90454.280** ft^3	Q_{Total}= **15.400** ft^3/sec	V_{Total}= **138599.300** ft^3	Q_{Total}= **27.558** ft^3/sec

Runoff Flow/Volume Change	2-year, T_c	2-year, 24-hour	10-year, T_c	10-year, 24-hour	100-year, T_c
	ΔQ= **0.694** ft^3/sec	ΔV= **9108.213** ft^3	ΔQ= **1.551** ft^3/sec	ΔV= **13956.133** ft^3	ΔQ= **2.775** ft^3/sec

Required Minimum Facility Volume: **9108.2** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 3
Lot/Area No.	Drainage Basin 6

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 76.3 acres = 3323628 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 0 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	76.3 acres	3323628 ft^2	Q= 5.232 ft^3/sec	V= 68688.312 ft^3	Q= 11.694 ft^3/sec	V= 105248.220 ft^3	Q= 20.927 ft^3/sec
Total	76.3 acres	3323628 ft^2	Q_{Total}= **5.232** ft^3/sec	V_{Total}= **68688.312** ft^3	Q_{Total}= **11.694** ft^3/sec	V_{Total}= **105248.220** ft^3	Q_{Total}= **20.927** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	76.3 acres	3323628 ft^2	Q= 5.232 ft^3/sec	V= 68688.312 ft^3	Q= 11.694 ft^3/sec	V= 105248.220 ft^3	Q= 20.927 ft^3/sec
Total	76.3 acres	3323628 ft^2	Q_{Total}= **5.232** ft^3/sec	V_{Total}= **68688.312** ft^3	Q_{Total}= **11.694** ft^3/sec	V_{Total}= **105248.220** ft^3	Q_{Total}= **20.927** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.000** ft^3/sec	ΔV= **0.000** ft^3	ΔQ= **0.000** ft^3/sec	ΔV= **0.000** ft^3	ΔQ= **0.000** ft^3/sec

Required Minimum Facility Volume: **0** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 4
Lot/Area No.	Drainage Basin 7

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 87.62 acres = 3816614 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 3776 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	87.61740129 acres	3816614 ft^2	Q= 6.008 ft^3/sec	V= 78876.689 ft^3	Q= 13.429 ft^3/sec	V= 120859.443 ft^3	Q= 24.031 ft^3/sec
Total	87.61740129 acres	3816614 ft^2	Q_{Total}= **6.008** ft^3/sec	V_{Total}= **78876.689** ft^3	Q_{Total}= **13.429** ft^3/sec	V_{Total}= **120859.443** ft^3	Q_{Total}= **24.031** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	2.080440771 acres	90624 ft^2	Q= 0.642 ft^3/sec	V= 8428.032 ft^3	Q= 1.435 ft^3/sec	V= 12913.920 ft^3	Q= 2.568 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	85.53696051 acres	3725990 ft^2	Q= 5.865 ft^3/sec	V= 77003.793 ft^3	Q= 13.110 ft^3/sec	V= 117989.683 ft^3	Q= 23.460 ft^3/sec
Total	87.61740129 acres	3816614 ft^2	Q_{Total}= **6.507** ft^3/sec	V_{Total}= **85431.825** ft^3	Q_{Total}= **14.545** ft^3/sec	V_{Total}= **130903.603** ft^3	Q_{Total}= **26.028** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.499** ft^3/sec	ΔV= **6555.136** ft^3	ΔQ= **1.116** ft^3/sec	ΔV= **10044.160** ft^3	ΔQ= **1.997** ft^3/sec

Required Minimum Facility Volume: **6555.1** ft^3

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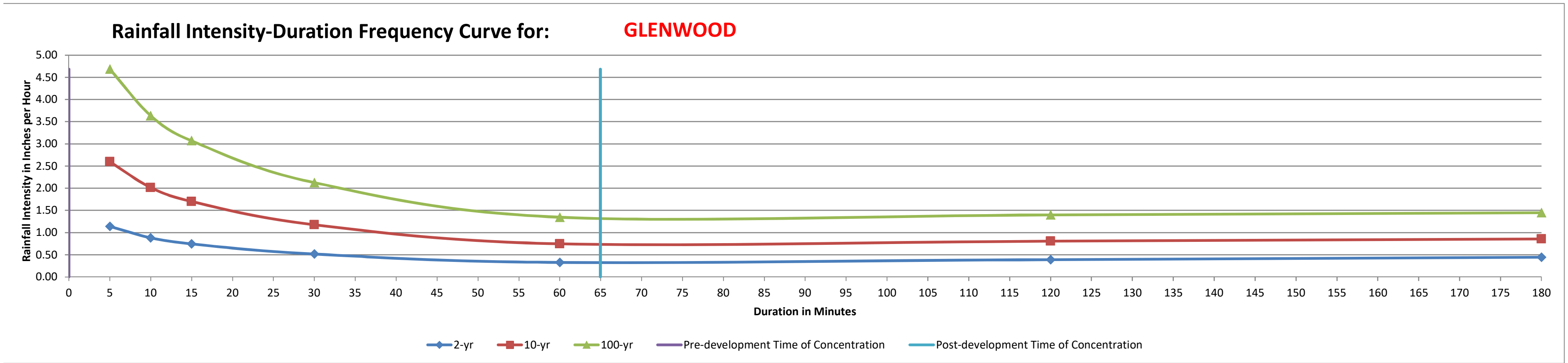

Rainfall Intensity-Duration Frequency Curve for:
GLENWOOD
Rainfall Intensity in Inches per Hour
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180
Duration in Minutes
2-yr
10-yr
100-yr
Pre-development Time of Concentration
Post-development Time of Concentration

Appendix 2 – Pond Sizing Calculations

Appendix 2 – Pond Size Overview Table

Pond No.	Pond Name	Storage Types				Bottom Elevation (ft)	Pond Depth (ft)	Top Elevation (ft)	Available Storage (cuft)
		Contours	Trapezoid	UG Chambers	Manual				
1	Strawbeery Roan Pond - Sta. 68+00		X			100.00	2.75	102.75	5,389
2	Strawberry Roan Pond - Sta. 92+00		X			100.00	2.75	102.75	8,293
3	Lot Pond Typ.		X			100.00	2.00	102.00	1,016
4	Strawberry Roan Trail Pond - Sta. 46+00		X			100.00	3.00	103.00	5,214
5	Strawberry Roan Pond - Sta. 35+00		X			100.00	2.75	102.75	4,588
6	Buckskin Trail Pond - Sta 6+00		X			100.00	2.75	102.75	2,828
7	Bucksin Trail Ponds - Cul-de-Sac North & south		X			100.00	2.75	102.75	1,480
8	Strawberry Roan Pond - Sta. 4+00		X			100.00	2.75	102.75	7,241
9	Appaloosa Trail Ponds - Cul-de-Sac North & South		X			100.00	2.75	102.75	2,828

Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills 1	
EQ#		
County	Broadwater County	
Location	Project 1 - SRT Pond Sta. 92+00	
Lot/Area No.	Drainage Basins 1 & 2	

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

	Intensity Values	
2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 121.57 acres = 5295530 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 4265.2 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	121.568641 acres	5295530 ft^2	Q= 8.336 ft^3/sec	V= 109440.953 ft^3	Q= 18.632 ft^3/sec	V= 167691.783 ft^3	Q= 33.342 ft^3/sec
Total	121.568641 acres	5295530 ft^2	Q_{Total}= **8.336** ft^3/sec	V_{Total}= **109440.953** ft^3	Q_{Total}= **18.632** ft^3/sec	V_{Total}= **167691.783** ft^3	Q_{Total}= **33.342** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	2.349977043 acres	102365 ft^2	Q= 0.725 ft^3/sec	V= 9519.945 ft^3	Q= 1.621 ft^3/sec	V= 14587.013 ft^3	Q= 2.900 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	119.2186639 acres	5193165 ft^2	Q= 8.174 ft^3/sec	V= 107325.410 ft^3	Q= 18.272 ft^3/sec	V= 164450.225 ft^3	Q= 32.698 ft^3/sec
Total	121.568641 acres	5295530 ft^2	Q_{Total}= **8.900** ft^3/sec	V_{Total}= **116845.355** ft^3	Q_{Total}= **19.893** ft^3/sec	V_{Total}= **179037.238** ft^3	Q_{Total}= **35.598** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.564** ft^3/sec	ΔV= **7404.402** ft^3	ΔQ= **1.261** ft^3/sec	ΔV= **11345.454** ft^3	ΔQ= **2.256** ft^3/sec

Required Minimum Facility Volume: **7404.4** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 1 - SRT Pond Sta. 68+00
Lot/Area No.	Drainage Basin 3

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 69.79 acres = 3040131 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 2729.2 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	69.79180441 acres	3040131 ft^2	Q= 4.785 ft^3/sec	V= 62829.374 ft^3	Q= 10.697 ft^3/sec	V= 96270.815 ft^3	Q= 19.142 ft^3/sec
Total	69.79180441 acres	3040131 ft^2	Q_{Total}= **4.785** ft^3/sec	V_{Total}= **62829.374** ft^3	Q_{Total}= **10.697** ft^3/sec	V_{Total}= **96270.815** ft^3	Q_{Total}= **19.142** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	1.503673095 acres	65500 ft^2	Q= 0.464 ft^3/sec	V= 6091.500 ft^3	Q= 1.037 ft^3/sec	V= 9333.750 ft^3	Q= 1.856 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	68.28813131 acres	2974631 ft^2	Q= 4.682 ft^3/sec	V= 61475.707 ft^3	Q= 10.466 ft^3/sec	V= 94196.648 ft^3	Q= 18.729 ft^3/sec
Total	69.79180441 acres	3040131 ft^2	Q_{Total}= **5.146** ft^3/sec	V_{Total}= **67567.207** ft^3	Q_{Total}= **11.503** ft^3/sec	V_{Total}= **103530.398** ft^3	Q_{Total}= **20.585** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.361** ft^3/sec	ΔV= **4737.833** ft^3	ΔQ= **0.807** ft^3/sec	ΔV= **7259.583** ft^3	ΔQ= **1.443** ft^3/sec

Required Minimum Facility Volume: **4737.8** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 2 - SRT Pond Sta. 46+00
Lot/Area No.	Drainage Basin 4

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 79.66 acres = 3469980 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 2931.4 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	79.65977961 acres	3469980 ft^2	Q= 5.462 ft^3/sec	V= 71712.920 ft^3	Q= 12.209 ft^3/sec	V= 109882.700 ft^3	Q= 21.848 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **5.462** ft^3/sec	V_{Total}= **71712.920** ft^3	Q_{Total}= **12.209** ft^3/sec	V_{Total}= **109882.700** ft^3	Q_{Total}= **21.848** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	1.615105601 acres	70354 ft^2	Q= 0.498 ft^3/sec	V= 6542.922 ft^3	Q= 1.114 ft^3/sec	V= 10025.445 ft^3	Q= 1.993 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	78.04467401 acres	3399626 ft^2	Q= 5.351 ft^3/sec	V= 70258.937 ft^3	Q= 11.962 ft^3/sec	V= 107654.823 ft^3	Q= 21.405 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **5.850** ft^3/sec	V_{Total}= **76801.859** ft^3	Q_{Total}= **13.076** ft^3/sec	V_{Total}= **117680.268** ft^3	Q_{Total}= **23.398** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.388** ft^3/sec	ΔV= **5088.939** ft^3	ΔQ= **0.866** ft^3/sec	ΔV= **7797.568** ft^3	ΔQ= **1.550** ft^3/sec

Required Minimum Facility Volume: **5088.9** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 3 - SRT Pond Sta. 35+00
Lot/Area No.	Drainage Basin 5

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 90.36 acres = 3936100 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 2466.7 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	90.36042241 acres	3936100 ft^2	Q= 6.196 ft^3/sec	V= 81346.067 ft^3	Q= 13.849 ft^3/sec	V= 124643.167 ft^3	Q= 24.783 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.196** ft^3/sec	V_{Total}= **81346.067** ft^3	Q_{Total}= **13.849** ft^3/sec	V_{Total}= **124643.167** ft^3	Q_{Total}= **24.783** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	1.359044995 acres	59200 ft^2	Q= 0.419 ft^3/sec	V= 5505.600 ft^3	Q= 0.937 ft^3/sec	V= 8436.000 ft^3	Q= 1.677 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	89.00137741 acres	3876900 ft^2	Q= 6.103 ft^3/sec	V= 80122.600 ft^3	Q= 13.641 ft^3/sec	V= 122768.500 ft^3	Q= 24.410 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.522** ft^3/sec	V_{Total}= **85628.200** ft^3	Q_{Total}= **14.578** ft^3/sec	V_{Total}= **131204.500** ft^3	Q_{Total}= **26.087** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.326** ft^3/sec	ΔV= **4282.133** ft^3	ΔQ= **0.729** ft^3/sec	ΔV= **6561.333** ft^3	ΔQ= **1.305** ft^3/sec

Required Minimum Facility Volume: **4282.1** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 4 - SRT Sta. 4+00
Lot/Area No.	Drainage Basin 7

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 87.62 acres = 3816614 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 3776 ft^3

Pre-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour (volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	87.61740129 acres	3816614 ft^2	Q= 6.008 ft^3/sec	V= 78876.689 ft^3	Q= 13.429 ft^3/sec	V= 120859.443 ft^3	Q= 24.031 ft^3/sec
Total	87.61740129 acres	3816614 ft^2	Q_{Total}= **6.008** ft^3/sec	V_{Total}= **78876.689** ft^3	Q_{Total}= **13.429** ft^3/sec	V_{Total}= **120859.443** ft^3	Q_{Total}= **24.031** ft^3/sec

Post-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	2.080440771 acres	90624 ft^2	Q= 0.642 ft^3/sec	V= 8428.032 ft^3	Q= 1.435 ft^3/sec	V= 12913.920 ft^3	Q= 2.568 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	85.53696051 acres	3725990 ft^2	Q= 5.865 ft^3/sec	V= 77003.793 ft^3	Q= 13.110 ft^3/sec	V= 117989.683 ft^3	Q= 23.460 ft^3/sec
Total	87.61740129 acres	3816614 ft^2	Q_{Total}= **6.507** ft^3/sec	V_{Total}= **85431.825** ft^3	Q_{Total}= **14.545** ft^3/sec	V_{Total}= **130903.603** ft^3	Q_{Total}= **26.028** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.499** ft^3/sec	ΔV= **6555.136** ft^3	ΔQ= **1.116** ft^3/sec	ΔV= **10044.160** ft^3	ΔQ= **1.997** ft^3/sec

Required Minimum Facility Volume: **6555.1** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name Horse Creek Hills
EQ#
County Broadwater County
Location Project 2 - APT Cul-de-Sac Pond North
Lot/Area No. Drainage Basin 4

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 79.66 acres = 3469980 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 1377.2 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	79.65977961 acres	3469980 ft^2	Q= 5.462 ft^3/sec	V= 71712.920 ft^3	Q= 12.209 ft^3/sec	V= 109882.700 ft^3	Q= 21.848 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **5.462** ft^3/sec	V_{Total}= **71712.920** ft^3	Q_{Total}= **12.209** ft^3/sec	V_{Total}= **109882.700** ft^3	Q_{Total}= **21.848** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0.758803949 acres	33053.5 ft^2	Q= 0.234 ft^3/sec	V= 3073.976 ft^3	Q= 0.523 ft^3/sec	V= 4710.124 ft^3	Q= 0.937 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	78.90097567 acres	3436926.5 ft^2	Q= 5.410 ft^3/sec	V= 71029.814 ft^3	Q= 12.093 ft^3/sec	V= 108836.006 ft^3	Q= 21.640 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **5.644** ft^3/sec	V_{Total}= **74103.790** ft^3	Q_{Total}= **12.616** ft^3/sec	V_{Total}= **113546.130** ft^3	Q_{Total}= **22.576** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.182** ft^3/sec	ΔV= **2390.870** ft^3	ΔQ= **0.407** ft^3/sec	ΔV= **3663.430** ft^3	ΔQ= **0.728** ft^3/sec

Required Minimum Facility Volume: **2390.9** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 2 - APT Cul-de-Sac Pond South
Lot/Area No.	Drainage Basin 4

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

	Intensity Values	
2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 79.66 acres = 3469980 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 1377.2 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	79.65977961 acres	3469980 ft^2	Q= 5.462 ft^3/sec	V= 71712.920 ft^3	Q= 12.209 ft^3/sec	V= 109882.700 ft^3	Q= 21.848 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **5.462** ft^3/sec	V_{Total}= **71712.920** ft^3	Q_{Total}= **12.209** ft^3/sec	V_{Total}= **109882.700** ft^3	Q_{Total}= **21.848** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0.758803949 acres	33053.5 ft^2	Q= 0.234 ft^3/sec	V= 3073.976 ft^3	Q= 0.523 ft^3/sec	V= 4710.124 ft^3	Q= 0.937 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	78.90097567 acres	3436926.5 ft^2	Q= 5.410 ft^3/sec	V= 71029.814 ft^3	Q= 12.093 ft^3/sec	V= 108836.006 ft^3	Q= 21.640 ft^3/sec
Total	79.65977961 acres	3469980 ft^2	Q_{Total}= **5.644** ft^3/sec	V_{Total}= **74103.790** ft^3	Q_{Total}= **12.616** ft^3/sec	V_{Total}= **113546.130** ft^3	Q_{Total}= **22.576** ft^3/sec

Runoff Flow/Volume Change	ΔQ= **0.182** ft^3/sec	ΔV= **2390.870** ft^3	ΔQ= **0.407** ft^3/sec	ΔV= **3663.430** ft^3	ΔQ= **0.728** ft^3/sec

Required Minimum Facility Volume: **2390.9** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 3 - BST Pond Sta. 6+00
Lot/Area No.	Drainage Basin 5

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 90.36 acres = 3936100 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 1523.1 ft^3

Pre-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour (volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	90.36042241 acres	3936100 ft^2	Q= 6.196 ft^3/sec	V= 81346.067 ft^3	Q= 13.849 ft^3/sec	V= 124643.167 ft^3	Q= 24.783 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.196** ft^3/sec	V_{Total}= **81346.067** ft^3	Q_{Total}= **13.849** ft^3/sec	V_{Total}= **124643.167** ft^3	Q_{Total}= **24.783** ft^3/sec

Post-Development Characteristics			**2-year, T_c (flow rate)**	**2-year, 24-hour volume)**	**10-year, T_c (flow rate)**	**10-year, 24-hour (volume)**	**100-year, T_c (flow rate)**
Paved/House Area	0.839187328 acres	36555 ft^2	Q= 0.259 ft^3/sec	V= 3399.615 ft^3	Q= 0.579 ft^3/sec	V= 5209.088 ft^3	Q= 1.036 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	89.52123508 acres	3899545 ft^2	Q= 6.138 ft^3/sec	V= 80590.597 ft^3	Q= 13.721 ft^3/sec	V= 123485.592 ft^3	Q= 24.553 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.397** ft^3/sec	V_{Total}= **83990.212** ft^3	Q_{Total}= **14.299** ft^3/sec	V_{Total}= **128694.679** ft^3	Q_{Total}= **25.588** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.201** ft^3/sec	ΔV= **2644.145** ft^3	ΔQ= **0.450** ft^3/sec	ΔV= **4051.513** ft^3	ΔQ= **0.806** ft^3/sec

Required Minimum Facility Volume: **2644.1** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 3 - BST Cul-de-Sac Pond North
Lot/Area No.	Drainage Basin 5

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values		
2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 90.36 acres = 3936100 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 628.44 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	90.36042241 acres	3936100 ft^2	Q= 6.196 ft^3/sec	V= 81346.067 ft^3	Q= 13.849 ft^3/sec	V= 124643.167 ft^3	Q= 24.783 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.196** ft^3/sec	V_{Total}= **81346.067** ft^3	Q_{Total}= **13.849** ft^3/sec	V_{Total}= **124643.167** ft^3	Q_{Total}= **24.783** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0.346246556 acres	15082.5 ft^2	Q= 0.107 ft^3/sec	V= 1402.673 ft^3	Q= 0.239 ft^3/sec	V= 2149.256 ft^3	Q= 0.427 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	90.01417585 acres	3921017.5 ft^2	Q= 6.172 ft^3/sec	V= 81034.362 ft^3	Q= 13.796 ft^3/sec	V= 124165.554 ft^3	Q= 24.688 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.279** ft^3/sec	V_{Total}= **82437.034** ft^3	Q_{Total}= **14.035** ft^3/sec	V_{Total}= **126314.810** ft^3	Q_{Total}= **25.115** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.083** ft^3/sec	ΔV= **1090.968** ft^3	ΔQ= **0.186** ft^3/sec	ΔV= **1671.644** ft^3	ΔQ= **0.332** ft^3/sec

Required Minimum Facility Volume: **1091** ft^3

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Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Project 3 - BST Cul-de-Sac Pond South
Lot/Area No.	Drainage Basin 5

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

Intensity Values

2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 90.36 acres = 3936100 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 628.44 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	90.36042241 acres	3936100 ft^2	Q= 6.196 ft^3/sec	V= 81346.067 ft^3	Q= 13.849 ft^3/sec	V= 124643.167 ft^3	Q= 24.783 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.196** ft^3/sec	V_{Total}= **81346.067** ft^3	Q_{Total}= **13.849** ft^3/sec	V_{Total}= **124643.167** ft^3	Q_{Total}= **24.783** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0.346246556 acres	15082.5 ft^2	Q= 0.107 ft^3/sec	V= 1402.673 ft^3	Q= 0.239 ft^3/sec	V= 2149.256 ft^3	Q= 0.427 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	90.01417585 acres	3921017.5 ft^2	Q= 6.172 ft^3/sec	V= 81034.362 ft^3	Q= 13.796 ft^3/sec	V= 124165.554 ft^3	Q= 24.688 ft^3/sec
Total	90.36042241 acres	3936100 ft^2	Q_{Total}= **6.279** ft^3/sec	V_{Total}= **82437.034** ft^3	Q_{Total}= **14.035** ft^3/sec	V_{Total}= **126314.810** ft^3	Q_{Total}= **25.115** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.083** ft^3/sec	ΔV= **1090.968** ft^3	ΔQ= **0.186** ft^3/sec	ΔV= **1671.644** ft^3	ΔQ= **0.332** ft^3/sec

Required Minimum Facility Volume: **1091** ft^3

= input field

Appendix G: Standard Storm Drainage Plan

DEQ Montana Department of Environmental Quality

Sudivision Name	Horse Creek Hills
EQ#	
County	Broadwater County
Location	Individual Stormwater Ponds
Lot/Area No.	All Lots

Rational Method Co-Efficients (C)	
0.9	Paved/hard surfaces
0.8	Gravel surfaces
0.1	Lawn/landscaping
0.2	Unimproved areas

Q=C*i*A

	Intensity Values	
2-year, T_c	0.34	inches/hour
2-year, 24-hour	1.24	inches
10-year, T_c	0.76	inches/hour
10-year, 24-hour	1.9	inches
100-year, T_c	1.36	inches/hour
100-year, 24-hour	2.66	inches

Total Area/Lot Size 5.35 acres = 233046 ft^2

Initial Stormwater Facility Volume (0.5" x Impervious Area) = 545.83 ft^3

Pre-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour (volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Gravel Area	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	5.35 acres	233046 ft^2	Q= 0.367 ft^3/sec	V= 4816.284 ft^3	Q= 0.820 ft^3/sec	V= 7379.790 ft^3	Q= 1.467 ft^3/sec
Total	5.35 acres	233046 ft^2	Q_{Total}= **0.367** ft^3/sec	V_{Total}= **4816.284** ft^3	Q_{Total}= **0.820** ft^3/sec	V_{Total}= **7379.790** ft^3	Q_{Total}= **1.467** ft^3/sec

Post-Development Characteristics			2-year, T_c (flow rate)	2-year, 24-hour volume)	10-year, T_c (flow rate)	10-year, 24-hour (volume)	100-year, T_c (flow rate)
Paved/House Area	0.300734619 acres	13100 ft^2	Q= 0.093 ft^3/sec	V= 1218.300 ft^3	Q= 0.207 ft^3/sec	V= 1866.750 ft^3	Q= 0.371 ft^3/sec
Gravel Area	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Lawn/Landscaping	0 acres	0 ft^2	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec	V= 0.000 ft^3	Q= 0.000 ft^3/sec
Unimproved Area	5.049265381 acres	219946 ft^2	Q= 0.346 ft^3/sec	V= 4545.551 ft^3	Q= 0.774 ft^3/sec	V= 6964.957 ft^3	Q= 1.385 ft^3/sec
Total	5.35 acres	233046 ft^2	Q_{Total}= **0.439** ft^3/sec	V_{Total}= **5763.851** ft^3	Q_{Total}= **0.981** ft^3/sec	V_{Total}= **8831.707** ft^3	Q_{Total}= **1.756** ft^3/sec
Runoff Flow/Volume Change			ΔQ= **0.072** ft^3/sec	ΔV= **947.567** ft^3	ΔQ= **0.161** ft^3/sec	ΔV= **1451.917** ft^3	ΔQ= **0.289** ft^3/sec

Required Minimum Facility Volume: **947.57** ft^3

= input field

Appendix 3 – Culvert and Swale Sizing Calculations

Flow Data for SRT Culverts @ Sta. 93+50

(2) Two 18-in cmp culverts in parallel

1. Total Drainage Area Size

Drainage Area Size (sq. ft.)	2,661,025.00

2. Pre-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	0.00	0.00
Structures	0.00	0.00
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	2,661,025.00	61.09
Total lot size	2,661,025.00	61.09

3. Post-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	33,500.00	0.77
Structures	7,000.00	0.16
Graveled Area		0.00
Landscape		0.00
Unimproved	2,620,525.00	60.16
Total lot size	2,661,025.00	61.09

4. Required Initial Stormwater Facility Volume (Retained on Site)

	Cubic Feet	Acre-Feet
Retained First 0.5 inch runoff volume	1,687.50	0.04

5. Weighted Coefficient

Surface Type	Pre-Development	Post-Development
Paved Areas	0.00	0.69
Structures	0.00	0.14
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	12.22	12.03
Total Weighted Coef.	12.22	12.87
Cw	0.20	0.211

6. Flow Calculation (cfs)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	4.29	#NUM!
10-year	#NUM!	9.68	
100-year	#NUM!	17.40	

Flow used to size

7. Volume Calculation (cf)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	15,443.83	#NUM!
10-year	#NUM!	34,854.31	#NUM!
100-year	#NUM!	62,624.43	#NUM!

8. Final Required Volume

3. Post-development Hydraulic Path:

Flow Type	Surface Description	Flow Length (ft)	Land Slope (ft/ft)	Culvert Diameter (in)	Depth of Flow in Channel (in) or Culvert (in)	Channel - Top Width (ft.)	Channel - Bottom Width (ft.)	Cross Sectional Flow Area (ft^2)	Wetted Perimeter (ft)	n	Average Velocity (ft/s)	Tt (hr)	Tt (min)
Sheet	Short Grass Prairie	300	0.037							0.15	n/a	0.55	33.00
Shallow	Short-grass pasture	3184	0.064906832							0.073	1.71	0.52	31.03
Channel_Triangular	Bare Soil	303	0.01980198		24	12		12.00	24.33	0.02	6.54	0.01	0.77

Appendix F: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/:

4. Time of Concentration and Rainfall Intensity (24-hour storm event):

Pre-development Path

Total Time of Concentration (min)	0.00
Rainfall Intensity (in/hr), 2 Year	#NUM!
Rainfall Intensity (in/hr), 10 Year	#NUM!
Rainfall Intensity (in/hr), 100 Year	#NUM!

Post-development Path

Total Time of Concentration (min)	64.81
Rainfall Intensity (in/hr), 2 Year	0.33
Rainfall Intensity (in/hr), 10 Year	0.75
Rainfall Intensity (in/hr), 100 Year	1.35

Culvert Report

SRT Culverts @ Sta. 93+50

Invert Elev Dn (ft)	=	3830.25
Pipe Length (ft)	=	36.00
Slope (%)	=	0.61
Invert Elev Up (ft)	=	3830.47
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	2
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Capacity

Embankment

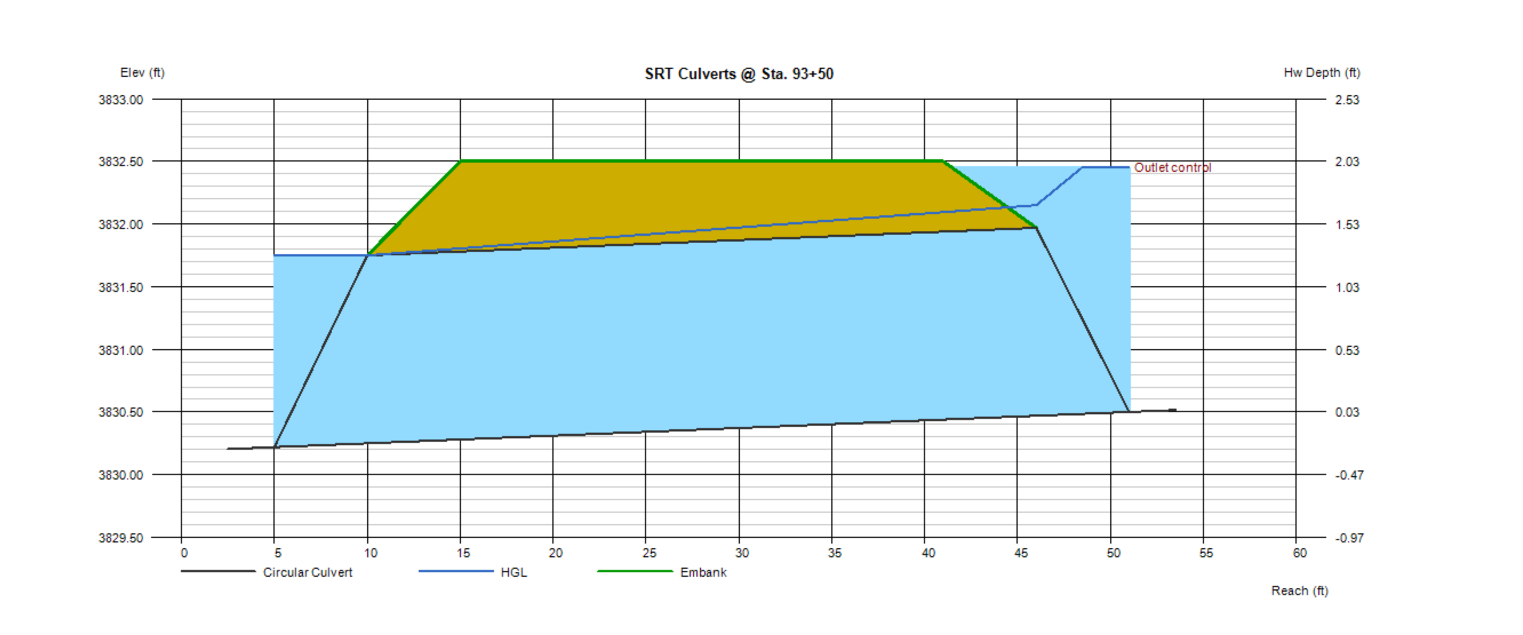
Top Elevation (ft)	=	3832.50
Top Width (ft)	=	26.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	1.00
Qmax (cfs)	=	20.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	12.00
Qpipe (cfs)	=	12.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.40
Veloc Up (ft/s)	=	3.40
HGL Dn (ft)	=	3831.75
HGL Up (ft)	=	3832.15
Hw Elev (ft)	=	3832.46
Hw/D (ft)	=	1.32
Flow Regime	=	Outlet Control



Flow Data for SRT Culvert @ Sta. 89+00

(1) One 18-in cmp culvert (Controlling Culvert for all Typical Culverts under roads in Projects 1-4, and Driveway crossings in Project 1)

1. Total Drainage Area Size

Drainage Area Size (sq. ft.)	2,023,380.00

2. Pre-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	0.00	0.00
Structures	0.00	0.00
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	2,023,380.00	46.45
Total lot size	2,023,380.00	46.45

3. Post-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	55,400.00	1.27
Structures	14,000.00	0.32
Graveled Area		0.00
Landscape		0.00
Unimproved	1,953,980.00	44.86
Total lot size	2,023,380.00	46.45

4. Required Initial Stormwater Facility Volume (Retained on Site)

	Cubic Feet	Acre-Feet
Retained First 0.5 inch runoff volume	2,891.67	0.07

5. Weighted Coefficient

Surface Type	Pre-Development	Post-Development
Paved Areas	0.00	1.14
Structures	0.00	0.29
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	9.29	8.97
Total Weighted Coef.	9.29	10.41
Cw	0.20	0.224

6. Flow Calculation (cfs)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	3.52	#NUM!
10-year	#NUM!	$\boxed{7.88}$	
100-year	#NUM!	14.11	

Flow Used for Sizing

7. Volume Calculation (cf)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	12,674.12	#NUM!
10-year	#NUM!	28,358.26	#NUM!
100-year	#NUM!	50,797.20	#NUM!

3. Post-development Hydraulic Path:

Flow Type	Surface Description	Flow Length (ft)	Land Slope (ft/ft)	Culvert Diameter (in)	Depth of Flow in Channel (in) or Culvert (in)	Channel - Top Width (ft.)	Channel - Bottom Width (ft.)	Cross Sectional Flow Area (ft^2)	Wetted Perimeter (ft)	n	Average Velocity (ft/s)	Tt (hr)	Tt (min)
Sheet	Short Grass Prairie	300	0.037	15	10	12				0.15	n/a	0.55	33.00
Shallow	Short-grass pasture	3220	0.049689441							0.073	1.50	0.60	35.87
Channel_Triangular	Bare Soil	660	0.060606061		24	12		12.00	24.33	0.02	11.45	0.02	0.96

Appendix F: http://www.nrcs.usda.gov/Internet/FSE_

4. Time of Concentration and Rainfall Intensity (24-hour storm event):

Pre-development Path

Total Time of Concentration (min)	0.00
Rainfall Intensity (in/hr), 2 Year	#NUM!
Rainfall Intensity (in/hr), 10 Year	#NUM!
Rainfall Intensity (in/hr), 100 Year	#NUM!

Post-development Path

Total Time of Concentration (min)	69.83
Rainfall Intensity (in/hr), 2 Year	0.34
Rainfall Intensity (in/hr), 10 Year	0.76
Rainfall Intensity (in/hr), 100 Year	1.36

Culvert Report

SRT Culvert @ Sta. 89+00

Invert Elev Dn (ft)	=	3836.56
Pipe Length (ft)	=	48.00
Slope (%)	=	2.17
Invert Elev Up (ft)	=	3837.60
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

Top Elevation (ft)	=	3840.00
Top Width (ft)	=	30.00
Crest Width (ft)	=	100.00

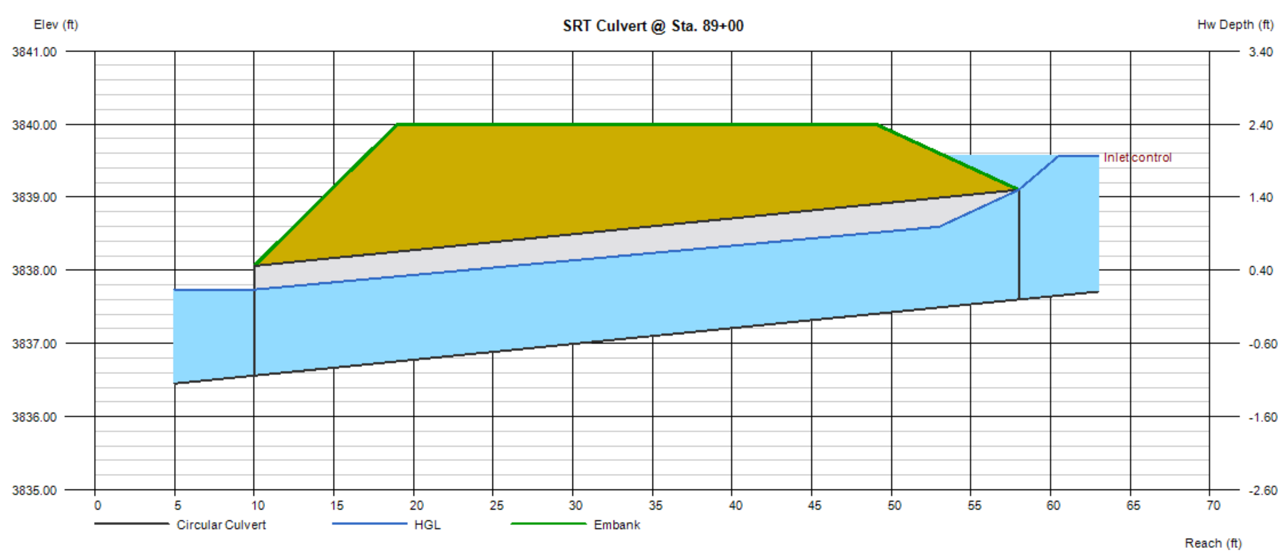
Capacity

Calculations

Qmin (cfs)	=	1.00
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	8.00
Qpipe (cfs)	=	8.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.38
Veloc Up (ft/s)	=	5.79
HGL Dn (ft)	=	3837.74
HGL Up (ft)	=	3838.70
Hw Elev (ft)	=	3839.56
Hw/D (ft)	=	1.31
Flow Regime	=	Inlet Control



Flow Data for APT Driveway Culvert @ Sta. 11+50

(1) One 15-in CMP Culvert (Controlling Driveway Culvert for Projects #2-4)

1. Total Drainage Area Size

Drainage Area Size (sq. ft.)	143,401.00

2. Pre-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	0.00	0.00
Structures	0.00	0.00
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	143,401.00	3.29
Total lot size	143,401.00	3.29

3. Post-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	16,780.00	0.39
Structures	0.00	0.00
Graveled Area		0.00
Landscape		0.00
Unimproved	126,621.00	2.91
Total lot size	143,401.00	3.29

4. Required Initial Stormwater Facility Volume (Retained on Site)

	Cubic Feet	Acre-Feet
Retained First 0.5 inch runoff volume	699.17	0.02

5. Weighted Coefficient

Surface Type	Pre-Development	Post-Development
Paved Areas	0.00	0.35
Structures	0.00	0.00
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	0.66	0.58
Total Weighted Coef.	0.66	0.93
Cw	0.20	0.282

6. Flow Calculation (cfs)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	0.46	#NUM!
10-year	#NUM!	$\boxed{1.05}$	
100-year	#NUM!	1.90	

Flow used for Sizing

7. Volume Calculation (cf)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	1,662.09	#NUM!
10-year	#NUM!	3,792.98	#NUM!
100-year	#NUM!	6,841.60	#NUM!

8. Final Required Volume

3. Post-development Hydraulic Path:

Flow Type	Surface Description	Flow Length (ft)	Land Slope (ft/ft)	Culvert Diameter (in)	Depth of Flow in Channel (in) or Culvert (in)	Channel - Top Width (ft.)	Channel - Bottom Width (ft.)	Cross Sectional Flow Area (ft^2)	Wetted Perimeter (ft)	n	Average Velocity (ft/s)	Tt (hr)	Tt (min)
Sheet	Short Grass Prairie	300	0.046666667							0.15	n/a	0.50	30.08
Shallow	Short-grass pasture	150	0.066666667							0.073	1.73	0.02	1.44
Channel_Triangular	Bare Soil	890	0.039325843		24	12		12.00	24.33	0.02	9.22	0.03	1.61

Appendix F: http://www.nrcs.usda.gov/Internet/FSE_

4. Time of Concentration and Rainfall Intensity (24-hour storm event):

Pre-development Path

Total Time of Concentration (min)	0.00
Rainfall Intensity (in/hr), 2 Year	#NUM!
Rainfall Intensity (in/hr), 10 Year	#NUM!
Rainfall Intensity (in/hr), 100 Year	#NUM!

Post-development Path

Total Time of Concentration (min)	33.13
Rainfall Intensity (in/hr), 2 Year	0.50
Rainfall Intensity (in/hr), 10 Year	1.14
Rainfall Intensity (in/hr), 100 Year	2.06

Culvert Report

APT Driveway Culvert @ Sta. 11+50

Invert Elev Dn (ft)	=	100.00
Pipe Length (ft)	=	28.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	100.14
Rise (in)	=	15.0
Shape	=	Circular
Span (in)	=	15.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

Top Elevation (ft)	=	102.00
Top Width (ft)	=	16.00
Crest Width (ft)	=	100.00

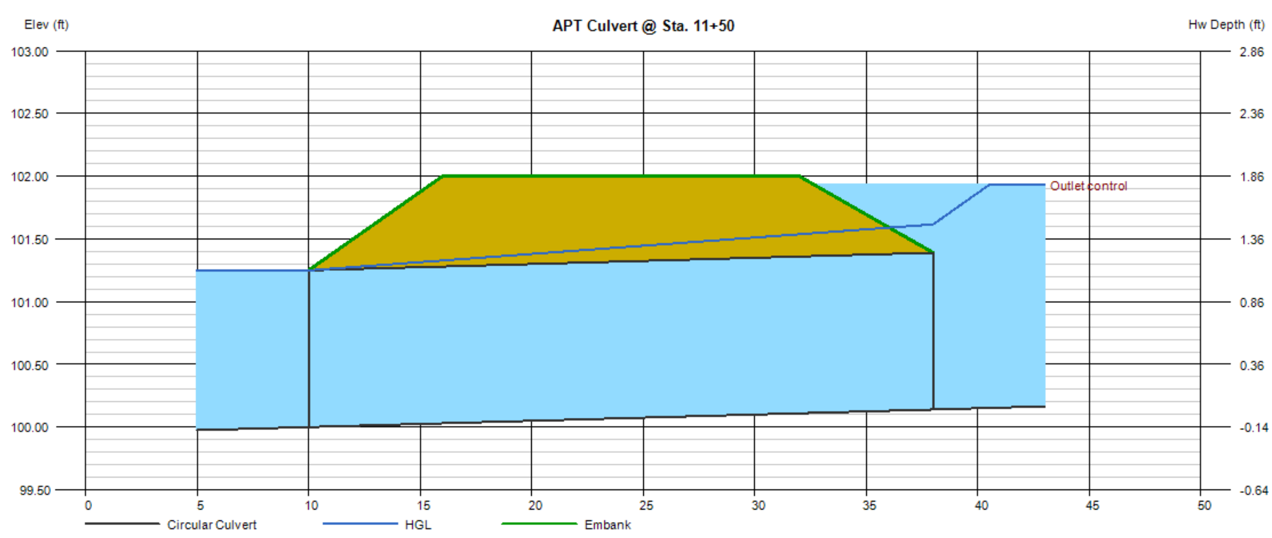
Calculations

Qmin (cfs)	=	1.00
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	Normal

Capacity

Highlighted

Qtotal (cfs)	=	4.00
Qpipe (cfs)	=	4.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.26
Veloc Up (ft/s)	=	3.26
HGL Dn (ft)	=	101.25
HGL Up (ft)	=	101.62
Hw Elev (ft)	=	101.93
Hw/D (ft)	=	1.43
Flow Regime	=	Outlet Control



Flow Data for SRT Culvert @ Sta. 3+25

(1) One 36-in cmp culvert (Controlling Culvert for all Existing drainage gully crossings in Projects 1-4)

1. Total Drainage Area Size

Drainage Area Size (sq. ft.)	2,612,765.00

2. Pre-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	0.00	0.00
Structures	0.00	0.00
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	2,612,765.00	59.98
Total lot size	2,612,765.00	59.98

3. Post-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	138,624.00	3.18
Structures	21,000.00	0.48
Graveled Area		0.00
Landscape		0.00
Unimproved	2,453,141.00	56.32
Total lot size	2,612,765.00	59.98

4. Required Initial Stormwater Facility Volume (Retained on Site)

	Cubic Feet	Acre-Feet
Retained First 0.5 inch runoff volume	6,651.00	0.15

5. Weighted Coefficient

Surface Type	Pre-Development	Post-Development
Paved Areas	0.00	2.86
Structures	0.00	0.43
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	12.00	11.26
Total Weighted Coef.	12.00	14.56
Cw	0.20	0.243

6. Flow Calculation (cfs)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	5.22	#NUM!
10-year	#NUM!	11.91	
100-year	#NUM!	$\boxed{21.49}$	

Flow used for Sizing

7. Volume Calculation (cf)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	18,795.02	#NUM!
10-year	#NUM!	42,891.23	#NUM!
100-year	#NUM!	77,365.11	#NUM!

3. Post-development Hydraulic Path:

Flow Type	Surface Description	Flow Length (ft)	Land Slope (ft/ft)	Culvert Diameter (in)	Depth of Flow in Channel (in) or Culvert (in)	Channel - Top Width (ft.)	Channel - Bottom Width (ft.)	Cross Sectional Flow Area (ft^2)	Wetted Perimeter (ft)	n	Average Velocity (ft/s)	Tt (hr)	Tt (min)
Sheet	Short Grass Prairie	300	0.05	15	10	12				0.15	n/a	0.49	29.26
Shallow	Short-grass pasture	2264	0.065812721							0.073	1.72	0.37	21.91

Appendix F: http://www.nrcs.usda.gov/Internet/FSE_

4. Time of Concentration and Rainfall Intensity (24-hour storm event):

Pre-development Path

Total Time of Concentration (min)	0.00
Rainfall Intensity (in/hr), 2 Year	#NUM!
Rainfall Intensity (in/hr), 10 Year	#NUM!
Rainfall Intensity (in/hr), 100 Year	#NUM!

Post-development Path

Total Time of Concentration (min)	51.17
Rainfall Intensity (in/hr), 2 Year	0.36
Rainfall Intensity (in/hr), 10 Year	0.82
Rainfall Intensity (in/hr), 100 Year	1.48

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 24 2020

SRT Culvert @ Sta. 3+25

Invert Elev Dn (ft)	=	3912.43
Pipe Length (ft)	=	80.00
Slope (%)	=	4.96
Invert Elev Up (ft)	=	3916.40
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

Top Elevation (ft)	=	3925.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	300.00

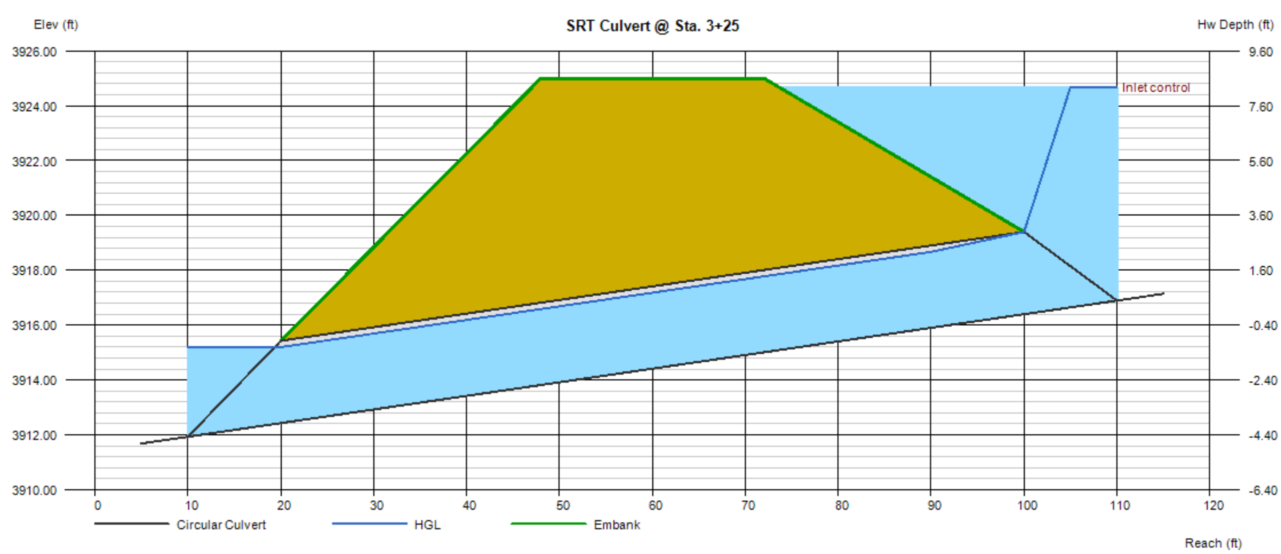
Calculations

Qmin (cfs)	=	5.00
Qmax (cfs)	=	100.00
Tailwater Elev (ft)	=	Normal

Capacity

Highlighted

Qtotal (cfs)	=	80.00
Qpipe (cfs)	=	80.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	11.73
Veloc Up (ft/s)	=	11.73
HGL Dn (ft)	=	3915.20
HGL Up (ft)	=	3919.17
Hw Elev (ft)	=	3924.69
Hw/D (ft)	=	2.76
Flow Regime	=	Inlet Control



Flow Data for Lower Confederate Road Crossing

(2) Two 24-in cmp culverts in parallel - sized for existing crossing

1. Total Drainage Area Size

Drainage Area Size (sq. ft.)	3,816,615.00

2. Pre-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	0.00	0.00
Structures	0.00	0.00
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	3,816,615.00	87.62
Total lot size	3,816,615.00	87.62

3. Post-development Drainage Area Characteristics:

Surface Type	Square Footage	Acres
Paved Areas	138,624.00	3.18
Structures	21,000.00	0.48
Graveled Area		0.00
Landscape		0.00
Unimproved	3,656,991.00	83.95
Total lot size	3,816,615.00	87.62

4. Required Initial Stormwater Facility Volume (Retained on Site)

	Cubic Feet	Acre-Feet
Retained First 0.5 inch runoff volume	6,651.00	0.15

5. Weighted Coefficient

Surface Type	Pre-Development	Post-Development
Paved Areas	0.00	2.86
Structures	0.00	0.43
Graveled Area	0.00	0.00
Landscape	0.00	0.00
Unimproved	17.52	16.79
Total Weighted Coef.	17.52	20.09
Cw	0.20	0.229

6. Flow Calculation (cfs)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	6.63	#NUM!
10-year	#NUM!	15.06	
100-year	#NUM!	27.10	

Flow used for Sizing

7. Volume Calculation (cf)

Frequency of Storm Event	Pre-Development	Post-Development	Change (Post-Pre)
2-year	#NUM!	23,884.40	#NUM!
10-year	#NUM!	54,198.40	#NUM!
100-year	#NUM!	97,567.93	#NUM!

8. Final Required Volume

3. Post-development Hydraulic Path:

Flow Type	Surface Description	Flow Length (ft)	Land Slope (ft/ft)	Culvert Diameter (in)	Depth of Flow in Channel (in) or Culvert (in)	Channel - Top Width (ft.)	Channel - Bottom Width (ft.)	Cross Sectional Flow Area (ft^2)	Wetted Perimeter (ft)	n	Average Velocity (ft/s)	Tt (hr)	Tt (min)
Sheet	Short Grass Prairie	300	0.05							0.15	n/a	0.49	29.26
Shallow	Short-grass pasture	3080	0.055194805							0.073	1.58	0.54	32.55

Appendix F: http://www.nrcs.usda.gov/Internet/FSE_

4. Time of Concentration and Rainfall Intensity (24-hour storm event):

Pre-development Path

Total Time of Concentration (min)	0.00
Rainfall Intensity (in/hr), 2 Year	#NUM!
Rainfall Intensity (in/hr), 10 Year	#NUM!
Rainfall Intensity (in/hr), 100 Year	#NUM!

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Tuesday, Mar 24 2020

Lower Confederate Road Culvert Crossing

Invert Elev Dn (ft)	=	3890.65
Pipe Length (ft)	=	78.00
Slope (%)	=	0.80
Invert Elev Up (ft)	=	3891.27
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

Top Elevation (ft)	=	3896.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	400.00

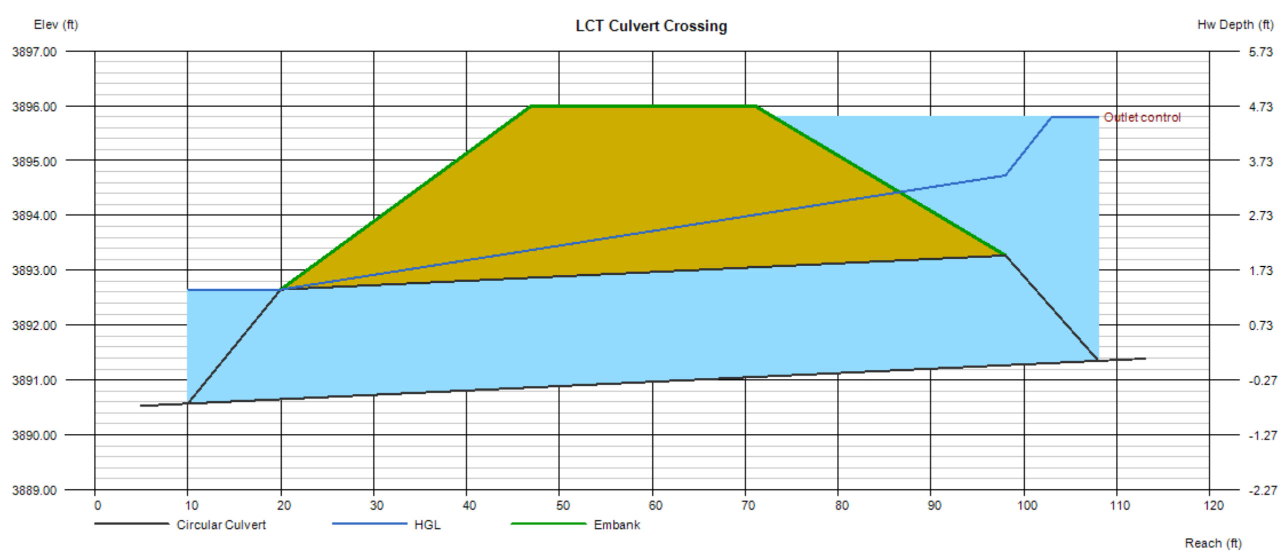
Capacity

Calculations

Qmin (cfs)	=	5.00
Qmax (cfs)	=	100.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	40.00
Qpipe (cfs)	=	40.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.37
Veloc Up (ft/s)	=	6.37
HGL Dn (ft)	=	3892.65
HGL Up (ft)	=	3894.73
Hw Elev (ft)	=	3895.80
Hw/D (ft)	=	2.27
Flow Regime	=	Outlet Control

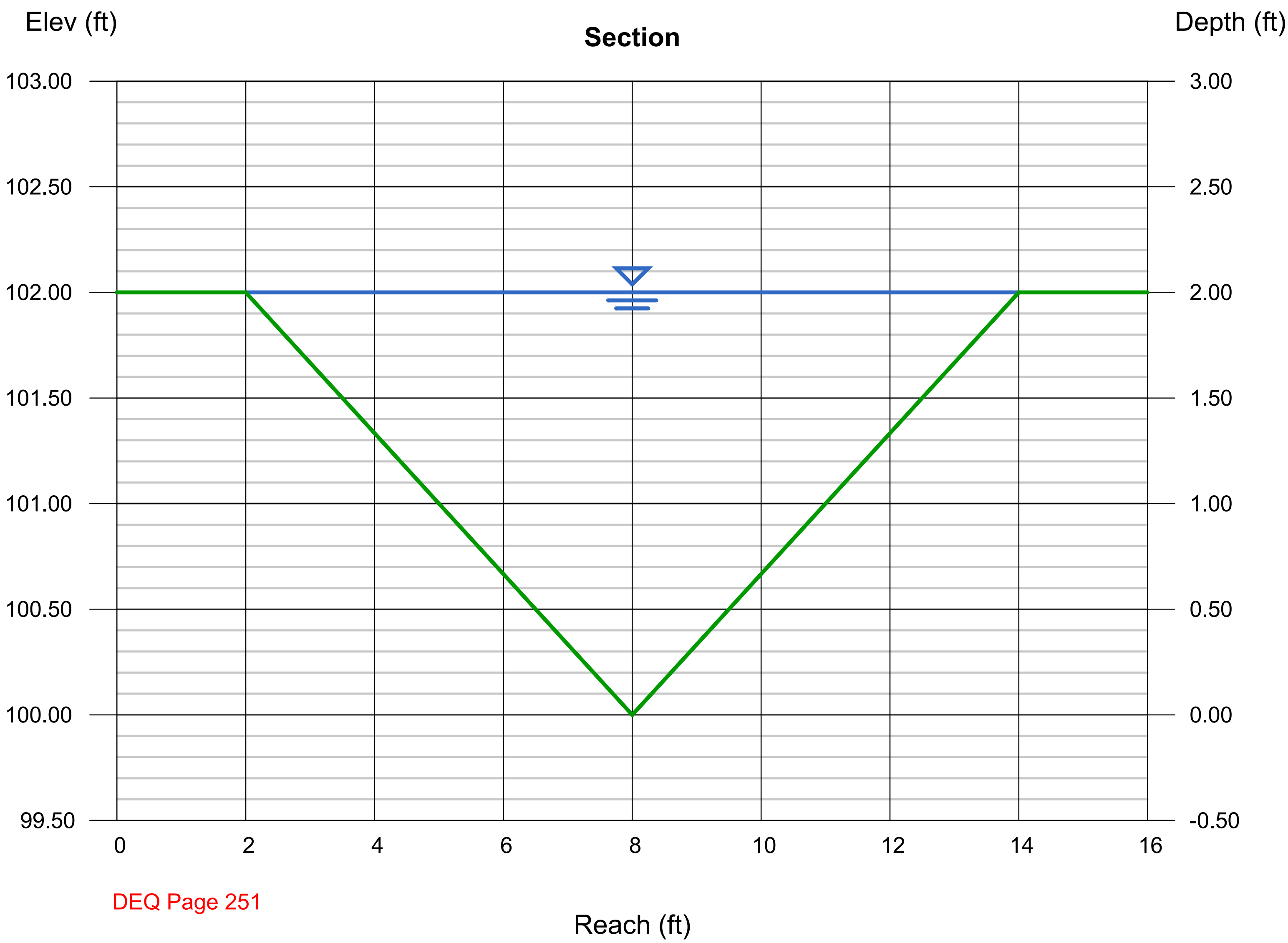


Channel Report

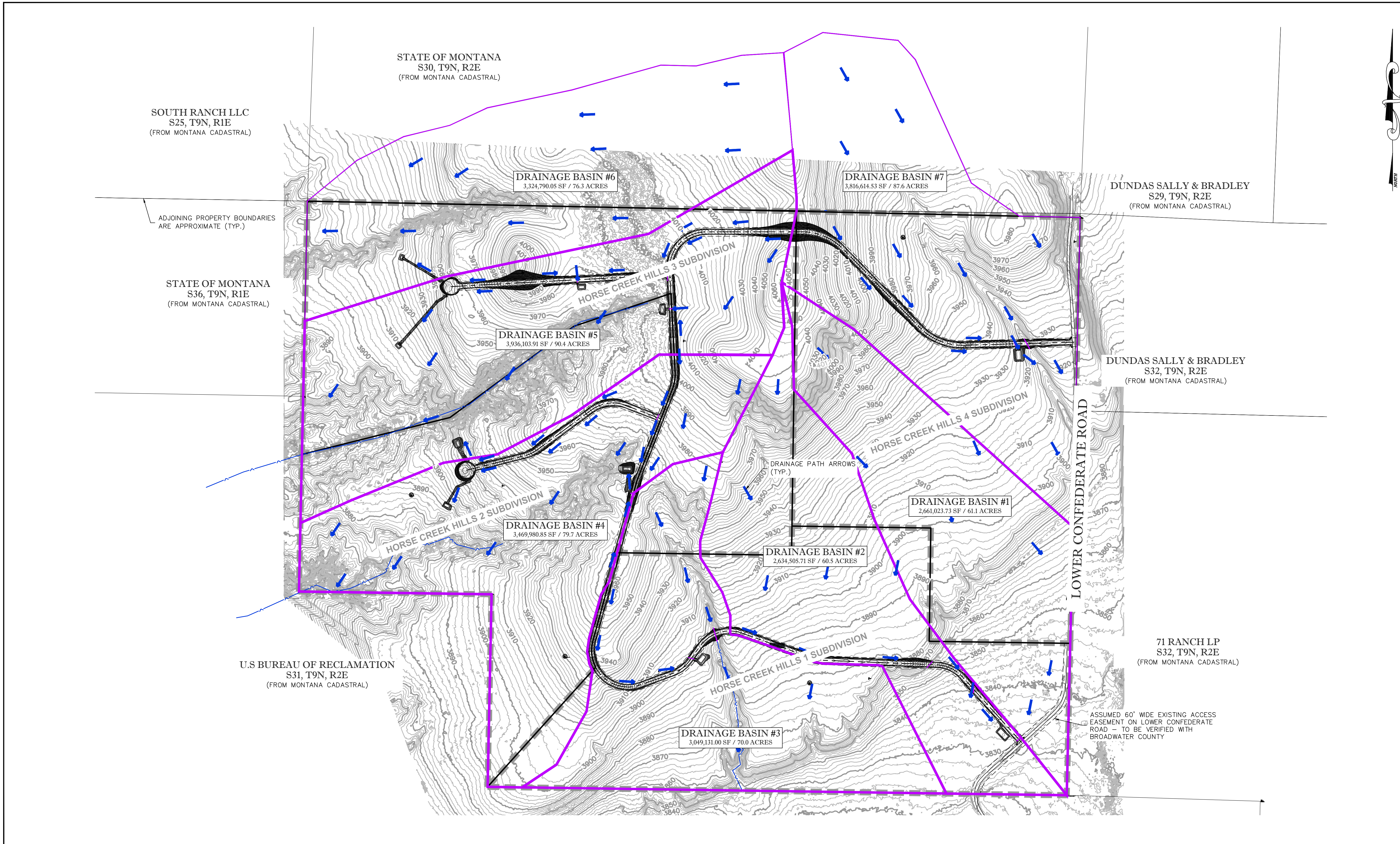
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 24 2020

Typical Swale

Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.00	Depth (ft)	= 2.00
Total Depth (ft)	= 2.00	Q (cfs)	= 48.70
		Area (sqft)	= 12.00
Invert Elev (ft)	= 100.00	Velocity (ft/s)	= 4.06
Slope (%)	= 0.50	Wetted Perim (ft)	= 12.65
N-Value	= 0.025	Crit Depth, Yc (ft)	= 1.75
		Top Width (ft)	= 12.00
Calculations		EGL (ft)	= 2.26
Compute by:	Known Depth		
Known Depth (ft)	= 2.00		



Appendix 4 – Stormwater Plans



NO.	REVISIONS	DRAWN BY	DATE

0 300 600 900
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - STORMWATER
STORM DRAINAGE PLAN OVERVIEW
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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Civil Engineering
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ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW3.0

HORSE CREEK HILLS
STORMWATER OVERVIEW

STRAWBERRY ROAN TRAIL

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L189	0+00.00	826,482.1902; 1,461,639.8195	N/A	755.72	S88° 27' 40.34"W	N/A	7+55.72	826,461.8963; 1,460,884.3754
C1	7+55.72	826,461.8963; 1,460,884.3754	400.00	342.99	N66° 58' 24.92"W	N/A	10+98.71	826,591.9879; 1460578.2912
L190	10+98.71	826,591.9879; 1,460,578.2912	N/A	735.22	N44° 19' 15.89"W	N/A	18+33.93	827,117.9894; 1,460,064.6099
C2	18+33.93	827,117.9894; 1,460,064.6099	400.00	298.01	N65° 39' 52.42"W	N/A	21+31.94	827,237.9727; 1459799.3139
L191	21+31.94	827,237.9727; 1,459,799.3139	N/A	674.27	S89° 58' 32.43"W	N/A	28+06.21	827,237.6864; 1,459,125.0454
C3	28+06.21	827,237.6864; 1,459,125.0454	250.00	391.59	S45° 06' 11.21"W	N/A	31+97.80	826,988.6924; 1458875.1535
L192	31+97.80	826,988.6924; 1,458,875.1535	N/A	708.07	S3° 00' 48.58"E	N/A	39+05.86	826,281.6037; 1,458,912.3774
C4	39+05.86	826,281.6037; 1,458,912.3774	300.00	127.11	S9° 03' 11.56"W	N/A	40+32.97	826,157.0147; 1458892.5259
L193	40+32.97	826,157.0147; 1,458,892.5259	N/A	653.61	S21° 11' 28.51"W	N/A	46+86.58	825,547.6048; 1,458,656.2583
C5	46+86.58	825,547.6048; 1,458,656.2583	250.00	25.34	S18° 17' 13.31"W	N/A	47+11.93	825,523.5509; 1458648.3093
L194	47+11.93	825,523.5509; 1,458,648.3093	N/A	1,123.31	S15° 22' 58.11"W	N/A	58+35.23	824,440.4879; 1,458,350.3337
C6	58+35.23	824,440.4879; 1,458,350.3337	250.00	544.51	S47° 00' 47.37"E	N/A	63+79.74	824,138.3787; 1458674.4553
L195	63+79.74	824,138.3787; 1,458,674.4553	N/A	232.07	N70° 35' 27.16"E	N/A	66+11.81	824,215.4972; 1,458,893.3338
C7	66+11.81	824,215.4972; 1,458,893.3338	250.00	153.67	N52° 58' 54.92"E	N/A	67+65.47	824,306.5655; 1459014.1063
L196	67+65.47	824,306.5655; 1,459,014.1063	N/A	117.56	N35° 22' 22.69"E	N/A	68+83.03	824,402.4253; 1,459,082.1623
C8	68+83.03	824,402.4253; 1,459,082.1623	250.00	323.94	N72° 29' 36.32"E	N/A	72+06.97	824,493.1952; 1459369.9324
L197	72+06.97	824,493.1952; 1,459,369.9324	N/A	511.62	S70° 23' 10.05"E	N/A	77+18.59	824,321.4557; 1,459,851.8638
C9	77+18.59	824,321.4557; 1,459,851.8638	250.00	75.58	S79° 02' 48.73"E	N/A	77+94.17	824,307.1498; 1459925.7840
L198	77+94.17	824,307.1498; 1,459,925.7840	N/A	777.91	S87° 42' 27.42"E	N/A	85+72.08	824,276.0342; 1,460,703.0703
C10	85+72.08	824,276.0342; 1,460,703.0703	250.00	199.23	S64° 52' 38.91"E	N/A	87+71.31	824,193.6704; 1460878.7185
L199	87+71.31	824,193.6704; 1,460,878.7185	N/A	605.19	S42° 03' 14.75"E	N/A	93+76.50	823,744.3085; 1,461,284.0946

APPALOOSA TRAIL

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L200	0+00.00	825,957.8812; 1,458,815.3220	N/A	254.84	N68° 48' 31.49"W	N/A	2+54.84	826,050.0031; 1,458,577.7099
L203	0+00.00	825,957.8812; 1,458,815.3220	N/A	254.84	N68° 48' 31.49"W	N/A	2+54.84	826,050.0031; 1,458,577.7099
C11	2+54.84	826,050.0031; 1,458,577.7099	250.00	250.90	S82° 26' 26.76"W	N/A	5+05.74	826,018.3653; 1458339.3019
C13	2+54.84	826,050.0031; 1,458,577.7099	250.00	250.90	S82° 26' 26.76"W	N/A	5+05.74	826,018.3653; 1458339.3019
L201	5+05.74	826,018.3653; 1,458,339.3019	N/A	458.59	S53° 41' 25.01"W	N/A	9+64.33	825,746.8117; 1,457,969.7578
L204	5+05.74	826,018.3653; 1,458,339.3019	N/A	458.59	S53° 41' 25.01"W	N/A	9+64.33	825,746.8117; 1,457,969.7578
C12	9+64.33	825,746.8117; 1,457,969.7578	250.00	97.18	S64° 49' 34.78"W	N/A	10+61.51	825,705.7345; 1457882.3601
C14	9+64.33	825,746.8117; 1,457,969.7578	250.00	97.18	S64° 49' 34.78"W	N/A	10+61.51	825,705.7345; 1457882.3601
L202	10+61.51	825,705.7345; 1,457,882.3601	N/A	408.49	S75° 57' 44.56"W	N/A	14+70.00	825,606.6509; 1,457,486.0664
L205	10+61.51	825,705.7345; 1,457,882.3601	N/A	408.49	S75° 57' 44.56"W	N/A	14+70.00	825,606.6509; 1,457,486.0664

APT POND 1 SWALE NORTH

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L207	0+00.00	825,638.2166; 1,457,536.3127	N/A	2.86	N82° 46' 27.03"W	N/A	0+02.86	825,638.5769; 1,457,533.4707
L208	0+02.86	825,638.5769; 1,457,533.4707	N/A	3.09	N59° 05' 34.29"W	N/A	0+05.95	825,640.1618; 1,457,530.8234
L209	0+05.95	825,640.1618; 1,457,530.8234	N/A	12.89	N43° 59' 30.64"W	N/A	0+18.84	825,649.4369; 1,457,521.8690
L210	0+18.84	825,649.4369; 1,457,521.8690	N/A	3.41	N43° 59' 30.64"W	N/A	0+22.25	825,651.8888; 1,457,519.5019
L211	0+22.25	825,651.8888; 1,457,519.5019	N/A	0.44	N90° 00' 00.00"W	N/A	0+22.69	825,651.8888; 1,457,519.0603
L212	0+22.69	825,651.8888; 1,457,519.0603	N/A	19.42	N57° 58' 04.11"W	N/A	0+42.12	825,662.1907; 1,457,502.5944
L213	0+42.12	825,662.1907; 1,457,502.5944	N/A	106.03	N35° 14' 27.11"W	N/A	1+48.15	825,748.7927; 1,457,441.4109
L214	1+48.15	825,748.7927; 1,457,441.4109	N/A	86.24	N17° 26' 26.64"W	N/A	2+34.39	825,831.0663; 1,457,415.5637

APT POND 2 SWALE SOUTH

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L215	0+00.00	825,608.4328; 1,457,567.4019	N/A	12.52	S70° 26' 48.72"W	N/A	0+12.52	825,604.2412; 1,457,555.6000
L216	0+12.52	825,604.2412; 1,457,555.6000	N/A	28.25	S27° 40' 18.04"W	N/A	0+40.77	825,579.2224; 1,457,542.4806
L217	0+40.77	825,579.2224; 1,457,542.4806	N/A	19.89	S28° 26' 49.91"W	N/A	0+60.66	825,561.7344; 1,457,533.0062
L218	0+60.66	825,561.7344; 1,457,533.0062	N/A	16.83	S40° 09' 35.39"W	N/A	0+77.50	825,548.8707; 1,457,522.1510
L219	0+77.50	825,548.8707; 1,457,522.1510	N/A	19.21	S39° 58' 28.96"W	N/A	0+96.70	825,534.1519; 1,457,509.8116
L220	0+96.70	825,534.1519; 1,457,509.8116	N/A	54.21	S64° 59' 00.52"W	N/A	1+50.92	825,511.2259; 1,457,460.6836
L221	1+50.92	825,511.2259; 1,457,460.6836	N/A	44.40	S66° 03' 31.98"W	N/A	1+95.32	825,493.2081; 1,457,420.1029
L222	1+95.32	825,493.2081; 1,457,420.1029	N/A	175.28	S30° 10' 36.13"W	N/A	3+70.60	825,341.6834; 1,457,331.9958

C:\pwwork\...\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\H & H\WW2.0 STORM PROJECT OVERVIEW.dwg

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF — DRAWN BY: HTM
DESIGNED BY: MAF, HTM — REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - STORMWATER ALIGNMENT COORDINATE TABLES

SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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Civil Engineering
Geotechnical Engineering
Land Surveying

ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW3.01

HORSE CREEK HILLS COORDINATE TABLES

BUCKSKIN TRAIL

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L206	0+00.00	826,943.5358; 1,458,877.5307	N/A	1,500.00	S86° 54' 54.60"W	N/A	15+00.00	826,862.8140; 1,457,379.7043

BST POND 1 SWALE NORTH

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L223	0+00.00	826,916.6624; 1,457,395.0411	N/A	8.39	N78° 12' 17.64"W	N/A	0+08.39	826,918.3775; 1,457,386.8280
L224	0+08.39	826,918.3775; 1,457,386.8280	N/A	11.53	N90° 00' 00.00"W	N/A	0+19.92	826,918.3775; 1,457,375.2971
L225	0+19.92	826,918.3775; 1,457,375.2971	N/A	21.41	S73° 52' 32.96"W	N/A	0+41.33	826,912.4322; 1,457,354.7319
L226	0+41.33	826,912.4322; 1,457,354.7319	N/A	25.82	S70° 28' 32.42"W	N/A	0+67.14	826,903.8045; 1,457,330.4009
L227	0+67.14	826,903.8045; 1,457,330.4009	N/A	16.40	S83° 03' 39.63"W	N/A	0+83.54	826,901.8231; 1,457,314.1204
L228	0+83.54	826,901.8231; 1,457,314.1204	N/A	84.22	N59° 15' 21.41"W	N/A	1+67.77	826,944.8775; 1,457,241.7354
L229	1+67.77	826,944.8775; 1,457,241.7354	N/A	207.23	N59° 15' 21.41"W	N/A	3+74.99	827,050.8137; 1,457,063.6305
L230	3+74.99	827,050.8137; 1,457,063.6305	N/A	51.57	N59° 15' 21.41"W	N/A	4+26.57	827,077.1785; 1,457,019.3048

BST POND 2 SWALE SOUTH

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L231	0+00.00	826,810.9266; 1,457,400.7388	N/A	7.82	S70° 49' 15.53"W	N/A	0+07.82	826,808.3590; 1,457,393.3570
L232	0+07.82	826,808.3590; 1,457,393.3570	N/A	9.05	S82° 41' 22.27"W	N/A	0+16.87	826,807.2071; 1,457,384.3780
L233	0+16.87	826,807.2071; 1,457,384.3780	N/A	40.98	S77° 54' 37.00"W	N/A	0+57.85	826,798.6231; 1,457,344.3023
L234	0+57.85	826,798.6231; 1,457,344.3023	N/A	65.90	S55° 49' 18.34"W	N/A	1+23.75	826,761.6045; 1,457,289.7866
L235	1+23.75	826,761.6045; 1,457,289.7866	N/A	444.76	S41° 37' 08.04"W	N/A	5+68.51	826,429.1084; 1,456,994.3865

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - STORMWATER ALIGNMENT COORDINATE TABLES

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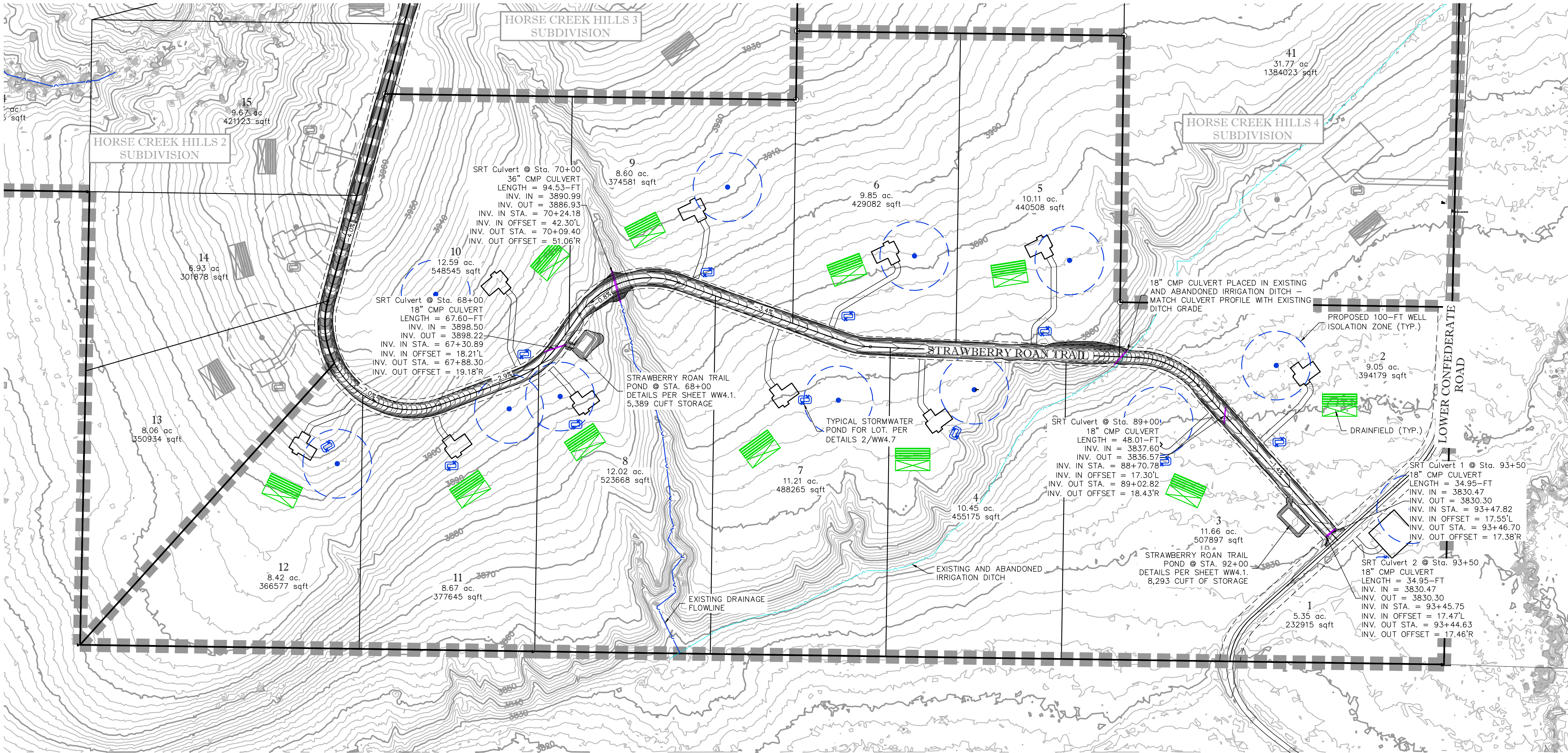
ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW3.02

HORSE CREEK HILLS
COORDINATE TABLES



NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16–FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #1–12 ARE PROJECT #1 OF THE HORSE CREEK HILLS SUBDIVISION.
3. LOT #1 IS A PROPOSED COMMERCIAL LOT – RE–SIZING OF RETENTION POND FOR COMMERCIAL LOTS WILL BE REQUIRED IF IMPERVIOUS AREA WILL EXCEED 13,100 SF.
4. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE–SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
5. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2–YEAR, 24–HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10–YEAR, 24–HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100–YEAR, 24–HOUR STORM – PER CIRCULAR DEQ–8 STANDARDS.
6. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 1 SUBDIVISION SHALL BE 18" MIN. CMP CULVERTS.
7. SEE WASTEWATER SHEETS WW2X SERIES FOR WWTS DETAILS.
8. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT
9. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON–SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

INDIVIDUAL LOT STORMWATE POND

DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE

DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE

PROPOSED WELL AND 100–FT ISOLATION ZONE

ROAD DIRECTION SLOPE XX%

CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET) 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 1 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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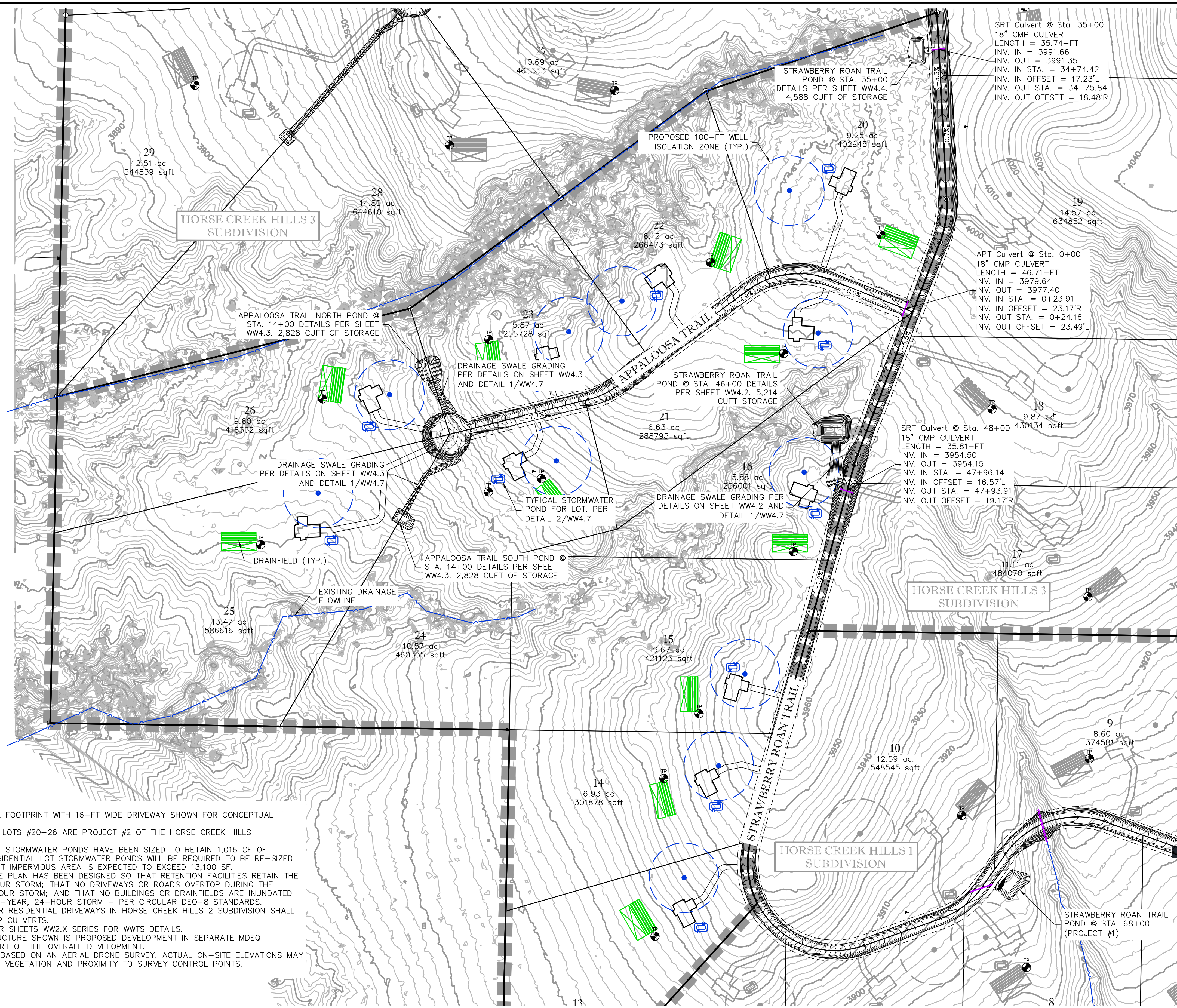
PROJECT #: 19–072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW3.1

HORSE CREEK HILLS STORMWATER PLANS



NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #13-16 & LOTS #20-26 ARE PROJECT #2 OF THE HORSE CREEK HILLS SUBDIVISION.
3. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE-SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
4. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2-YEAR, 24-HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10-YEAR, 24-HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100-YEAR, 24-HOUR STORM - PER CIRCULAR DEQ-8 STANDARDS.
5. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 2 SUBDIVISION SHALL BE 15" MIN. CMP CULVERTS.
6. SEE WASTEWATER SHEETS WW2.X SERIES FOR WWTS DETAILS.
7. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS - PART OF THE OVERALL DEVELOPMENT.
8. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

- INDIVIDUAL LOT STORMWATE POND
- DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE
- DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE
- PROPOSED WELL AND 100-FT ISOLATION ZONE
- ROAD DIRECTION SLOPE — XX%
- CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

0 150 300 450
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 2 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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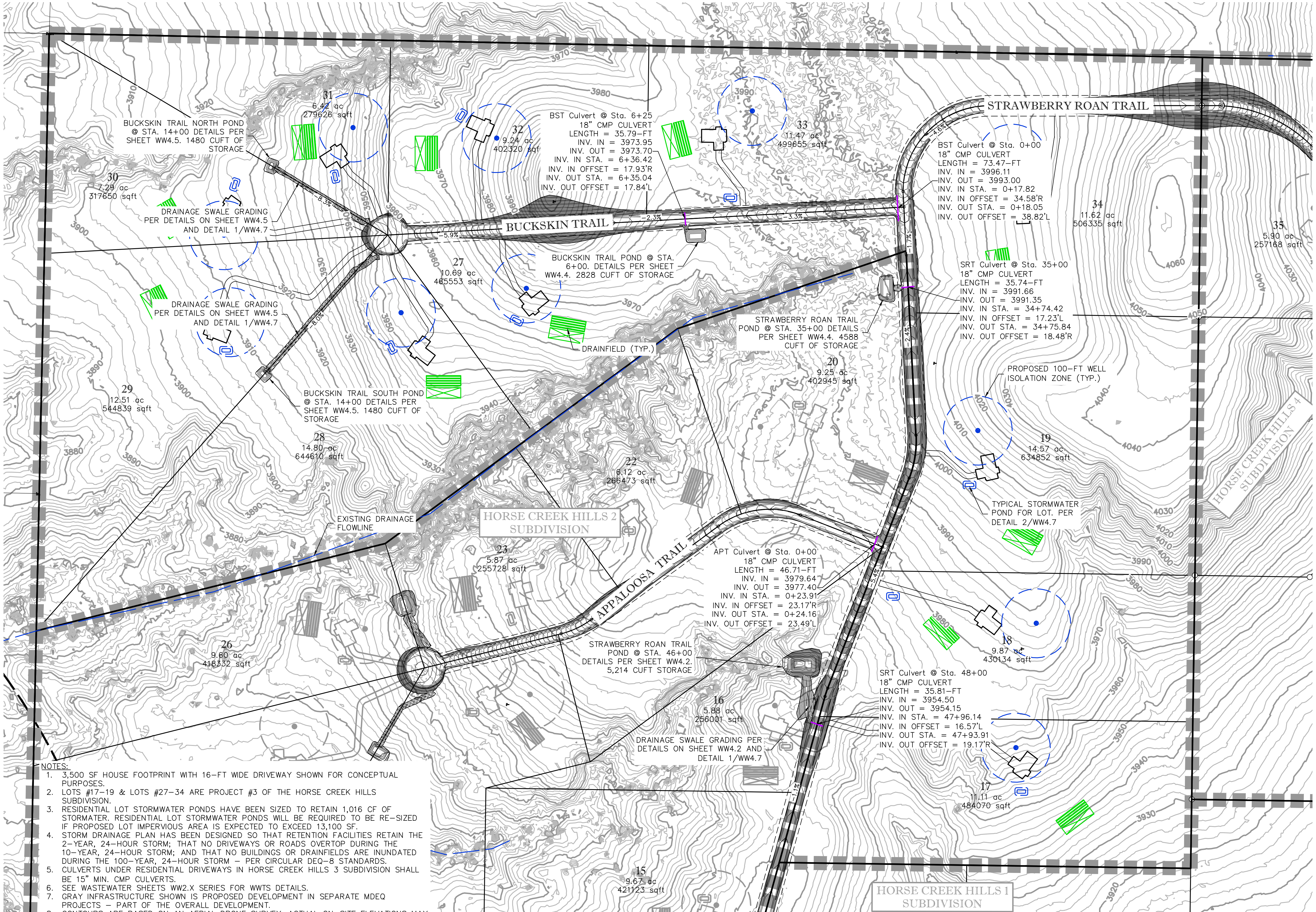
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW3.2

HORSE CREEK HILLS STORMWATER PLANS



NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16–FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #17–19 & LOTS #27–34 ARE PROJECT #3 OF THE HORSE CREEK HILLS SUBDIVISION.
3. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE–SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
4. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2–YEAR, 24–HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10–YEAR, 24–HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100–YEAR, 24–HOUR STORM – PER CIRCULAR DEQ–8 STANDARDS.
5. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 3 SUBDIVISION SHALL BE 15" MIN. CMP CULVERTS.
6. SEE WASTEWATER SHEETS WW2.X SERIES FOR WWTS DETAILS.
7. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT.
8. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON–SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

- INDIVIDUAL LOT STORMWATE POND
- DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE
- DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE
- PROPOSED WELL AND 100–FT ISOLATION ZONE
- ROAD DIRECTION SLOPE (XX%)
- CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 3 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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PROJECT #: 19–072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW3.3

HORSE CREEK HILLS
STORMWATER PLANS

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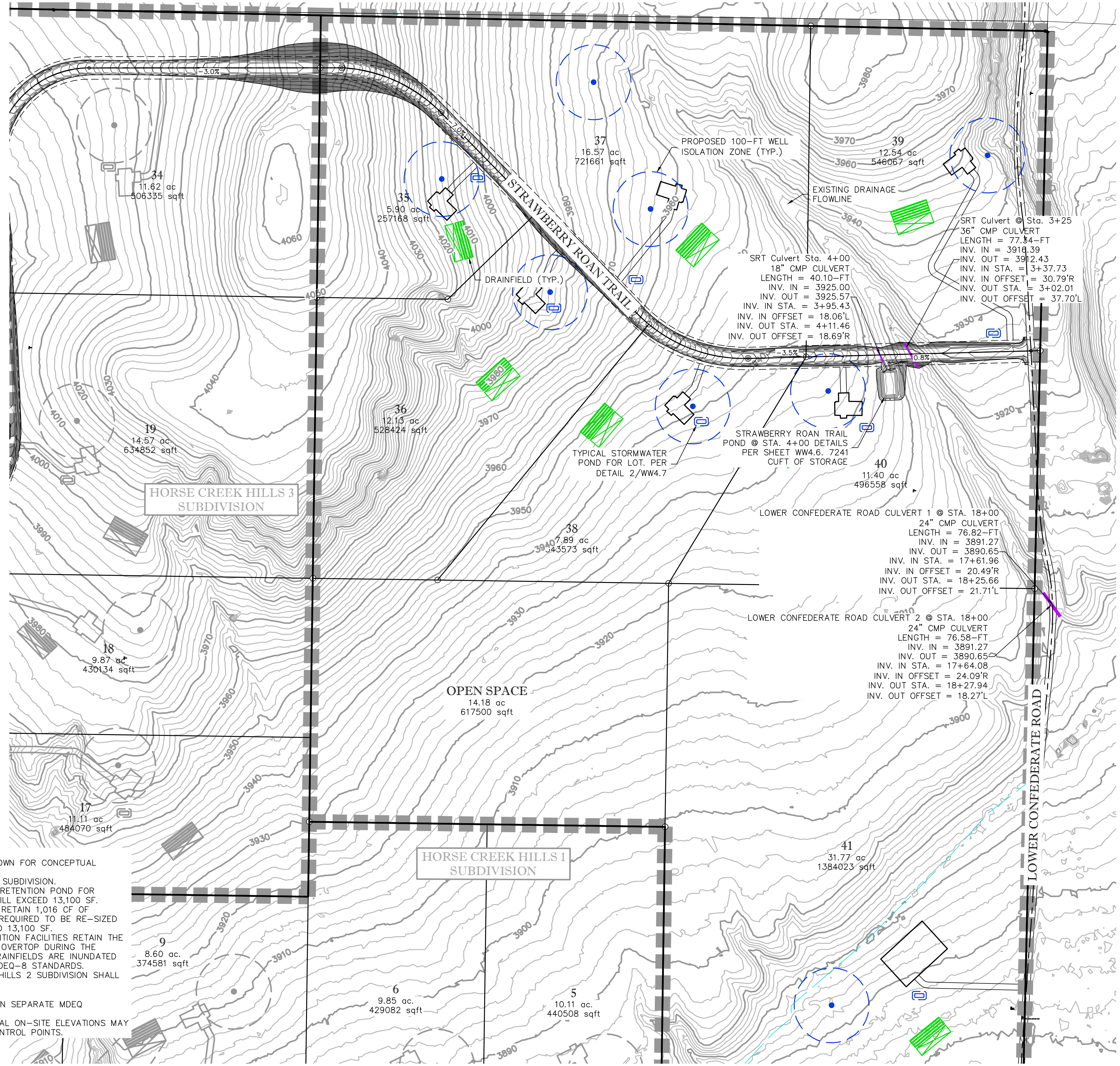

NOTES:
1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #35-41 ARE PROJECT #4 OF THE HORSE CREEK HILLS SUBDIVISION.
3. LOT #41 IS A PROPOSED COMMERCIAL LOT – RE-SIZING OF RETENTION POND FOR COMMERCIAL LOTS WILL BE REQUIRED IF IMPERVIOUS AREA WILL EXCEED 13,100 SF.
4. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE-SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
5. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2-YEAR, 24-HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10-YEAR, 24-HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100-YEAR, 24-HOUR STORM – PER CIRCULAR DEQ-8 STANDARDS.
6. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 2 SUBDIVISION SHALL BE 15" MIN. CMP CULVERTS.
7. SEE WASTEWATER SHEETS WW2.X SERIES FOR WWTS DETAILS.
8. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT.
9. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

INDIVIDUAL LOT STORMWATE POND

DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE

DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE

PROPOSED WELL AND 100-FT ISOLATION ZONE

ROAD DIRECTION SLOPE — XX%

CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NORTH

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NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 4 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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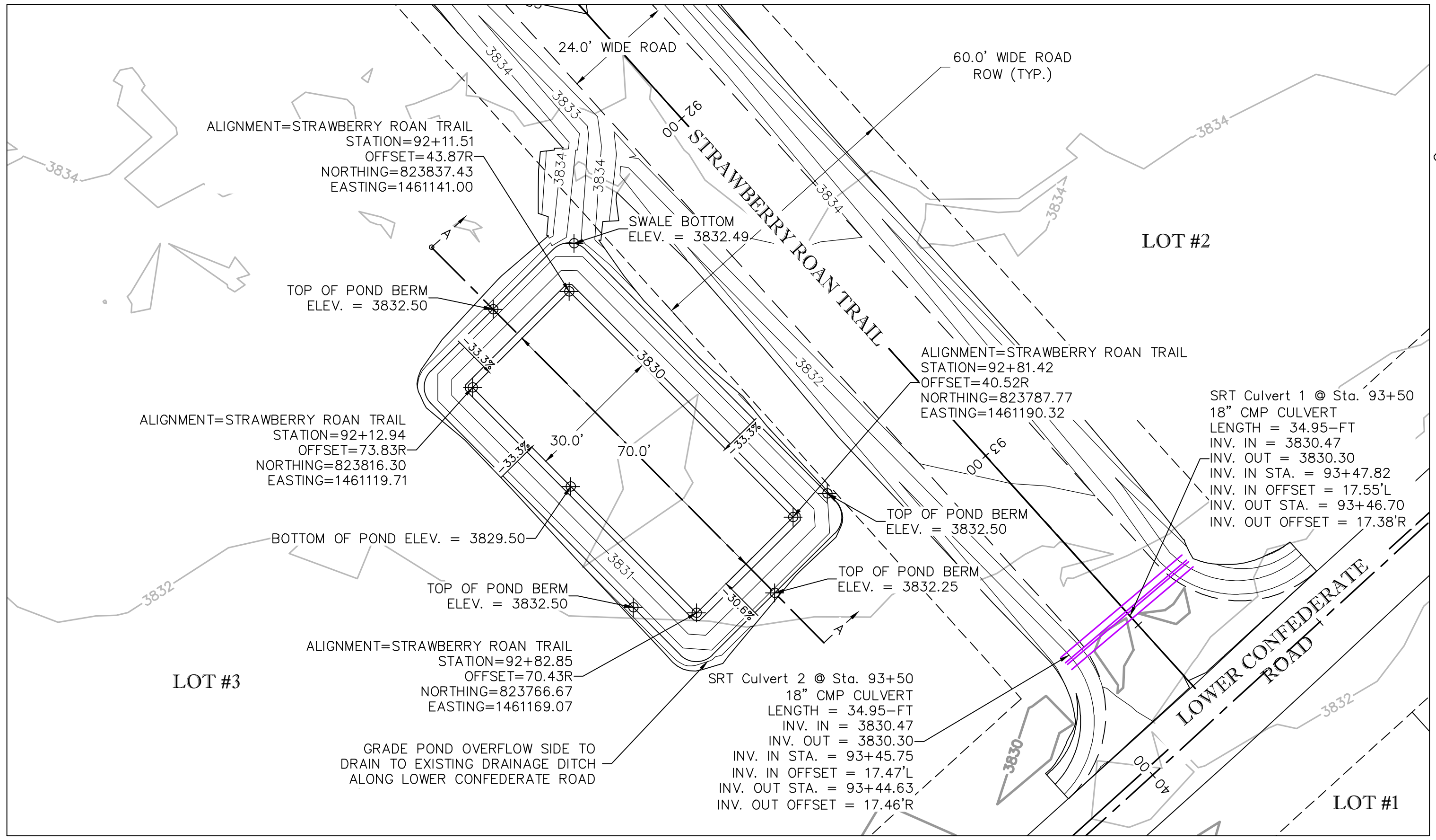
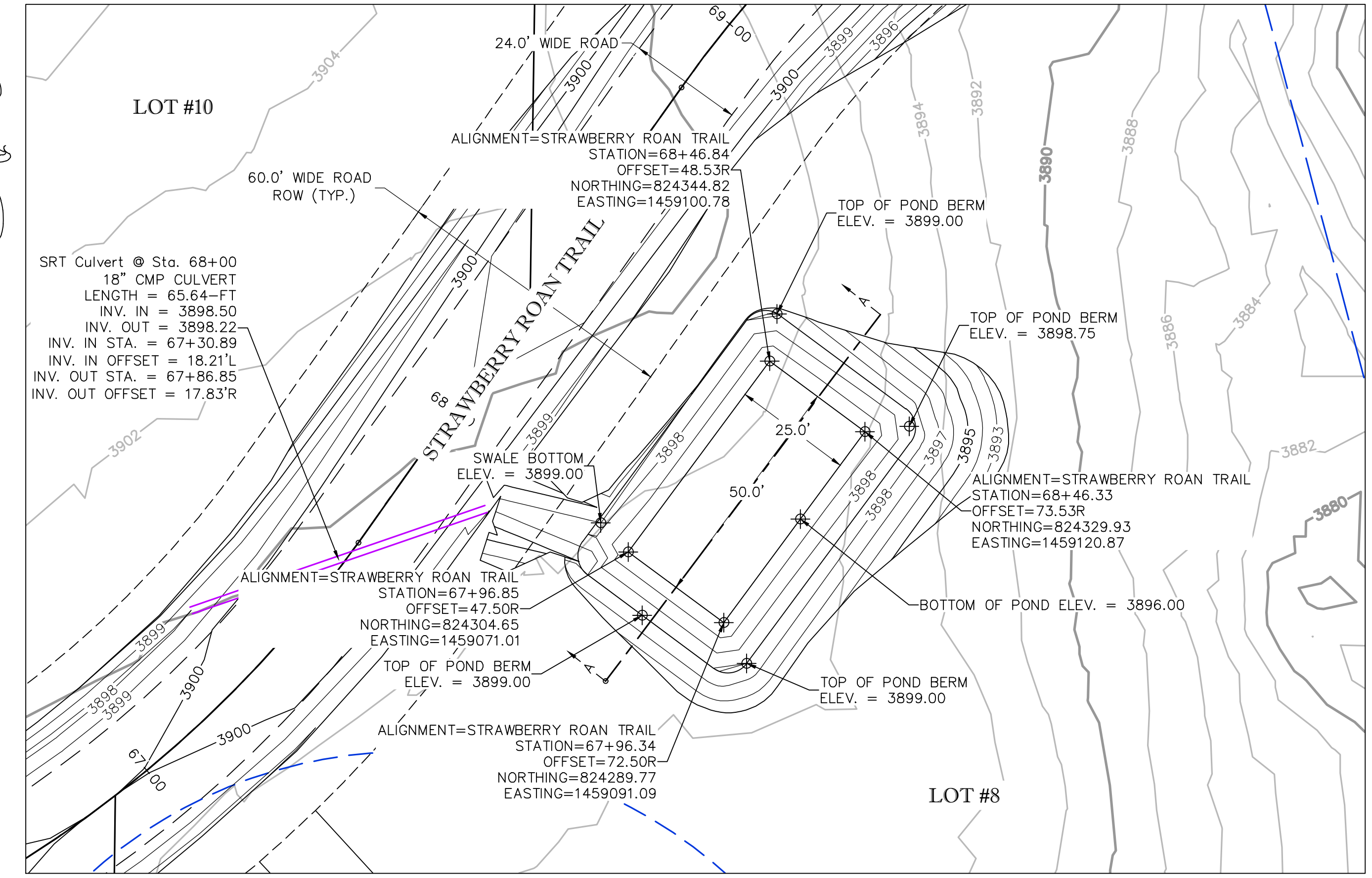
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW3.4

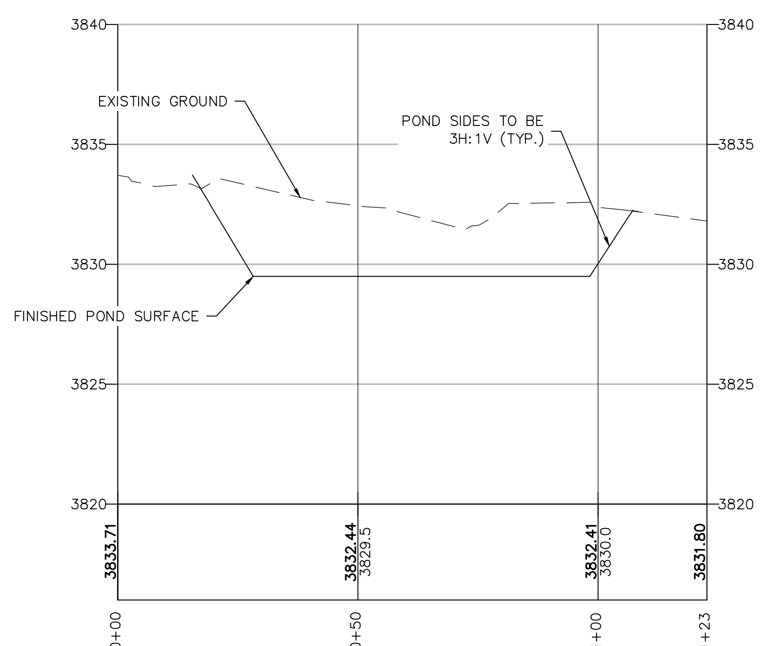
HORSE CREEK HILLS
STORMWATER PLANS



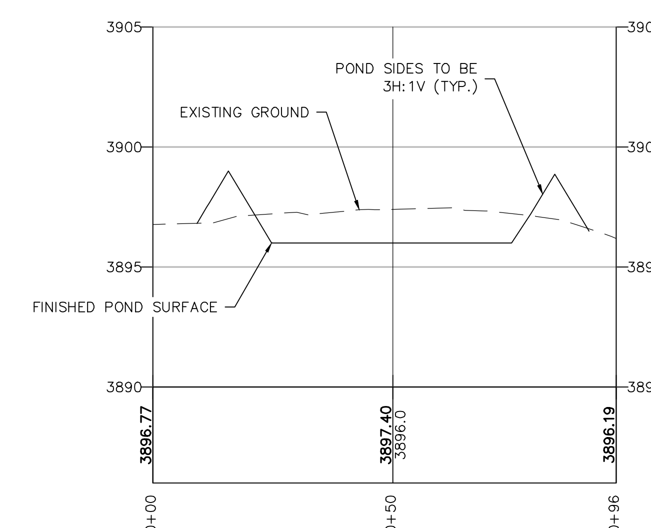
PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 92+00



PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 68+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 92+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 68+00

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 20 40
VERTICAL SCALE FEET: 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 1 SUBDIVISION
POND GRADING DETAILS
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PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW4.1

HORSE CREEK HILLS
DRAINAGE DETAILS

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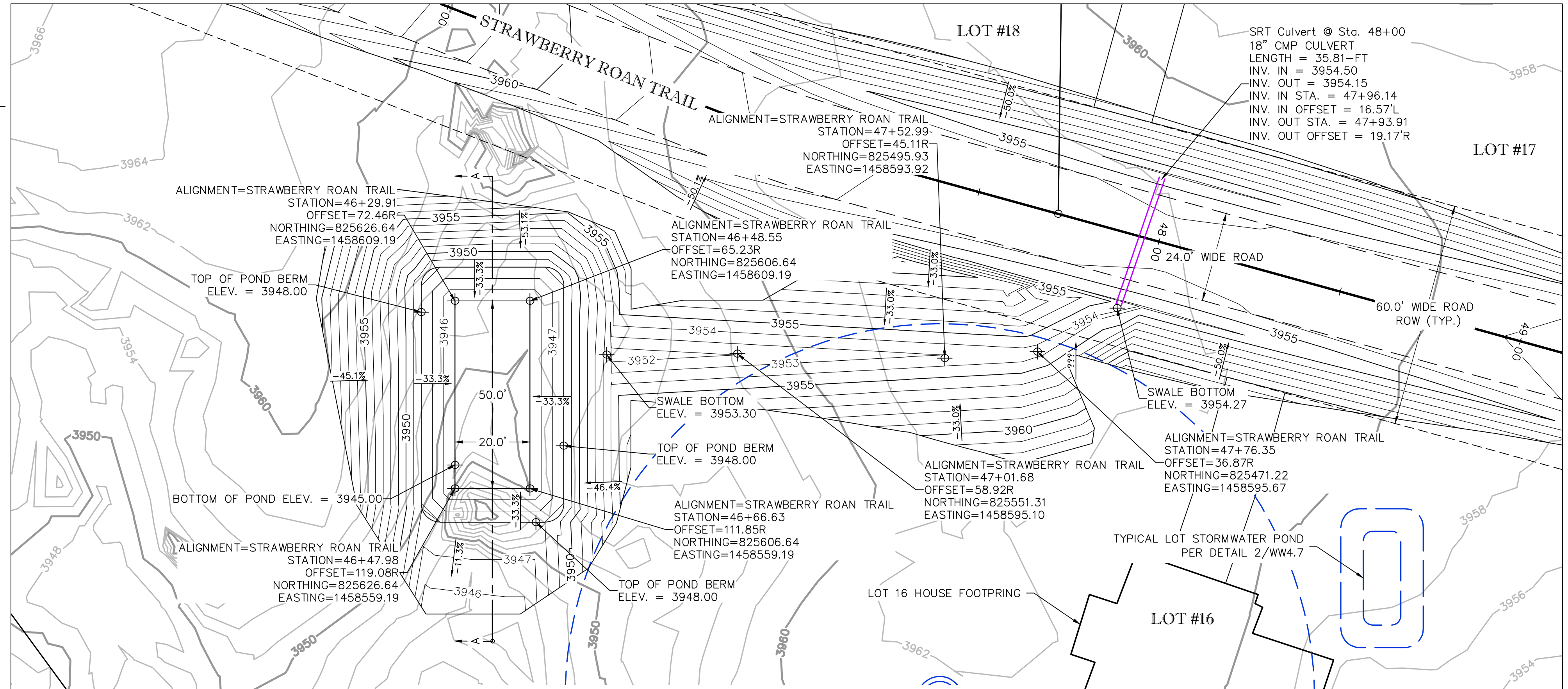
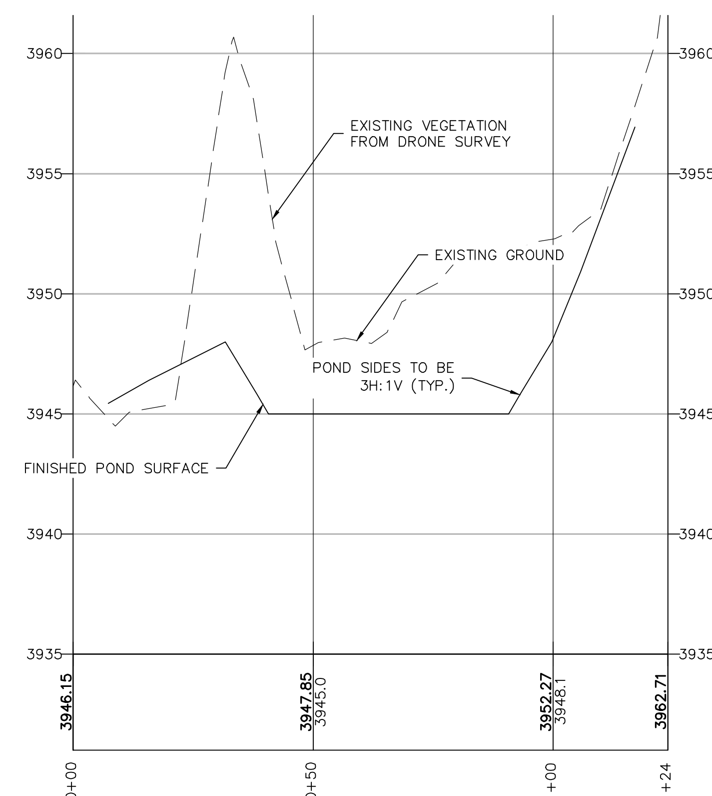


PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 46+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 46+00

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 261

HORIZONTAL SCALE FEET 0 20 40
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF — DRAWN BY: HTM
DESIGNED BY: MAF, HTM — REVIEWED BY: MAF

HORSE CREEK HILLS 2 SUBDIVISION
POND GRADING DETAILS
SECTION 31, TOWNSHIP 9 NORTH, RANGE 2 EAST, P.M.M.

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PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE
SHEET WW4.2
HORSE CREEK HILLS DRAINAGE DETAILS

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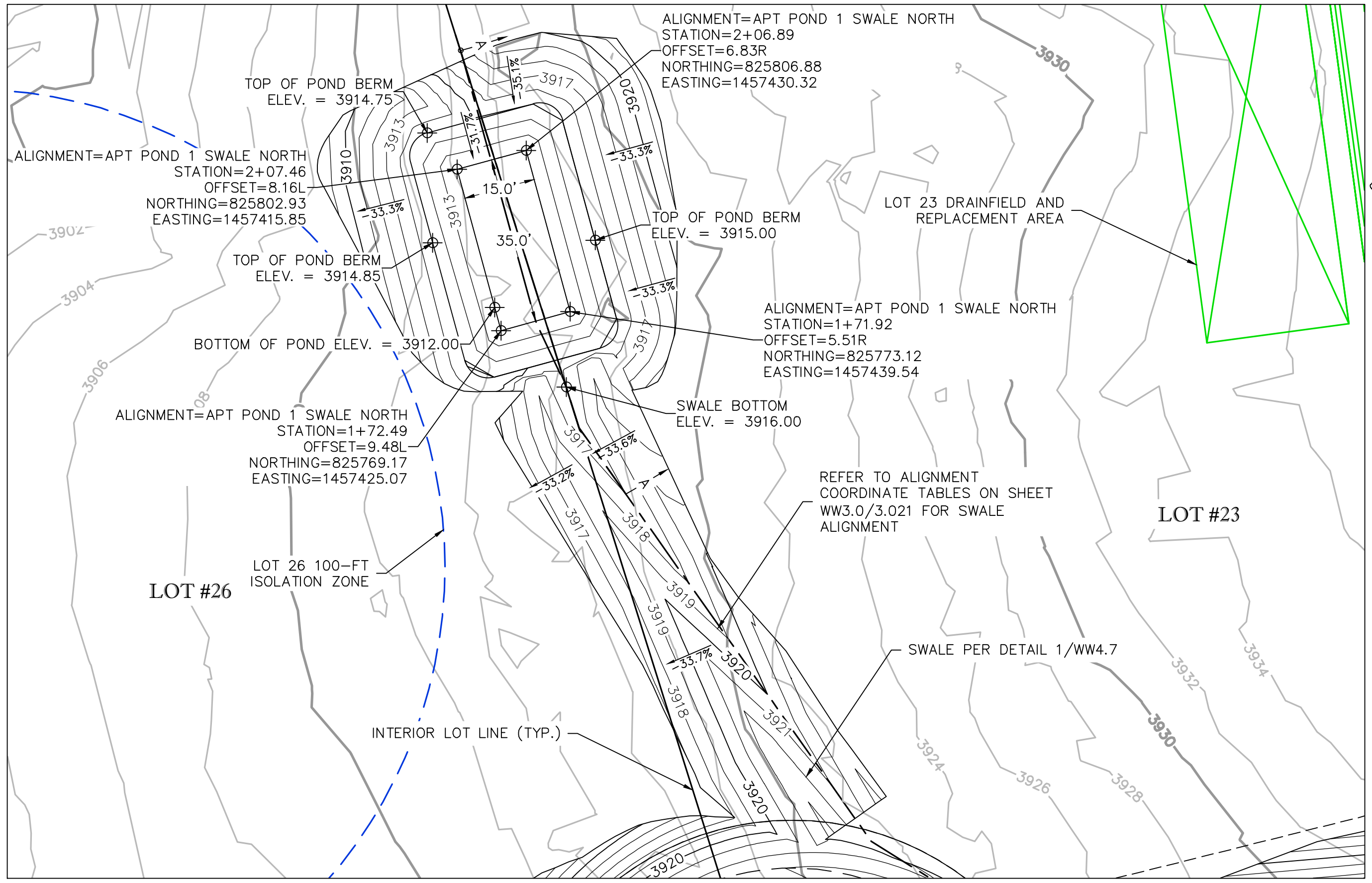
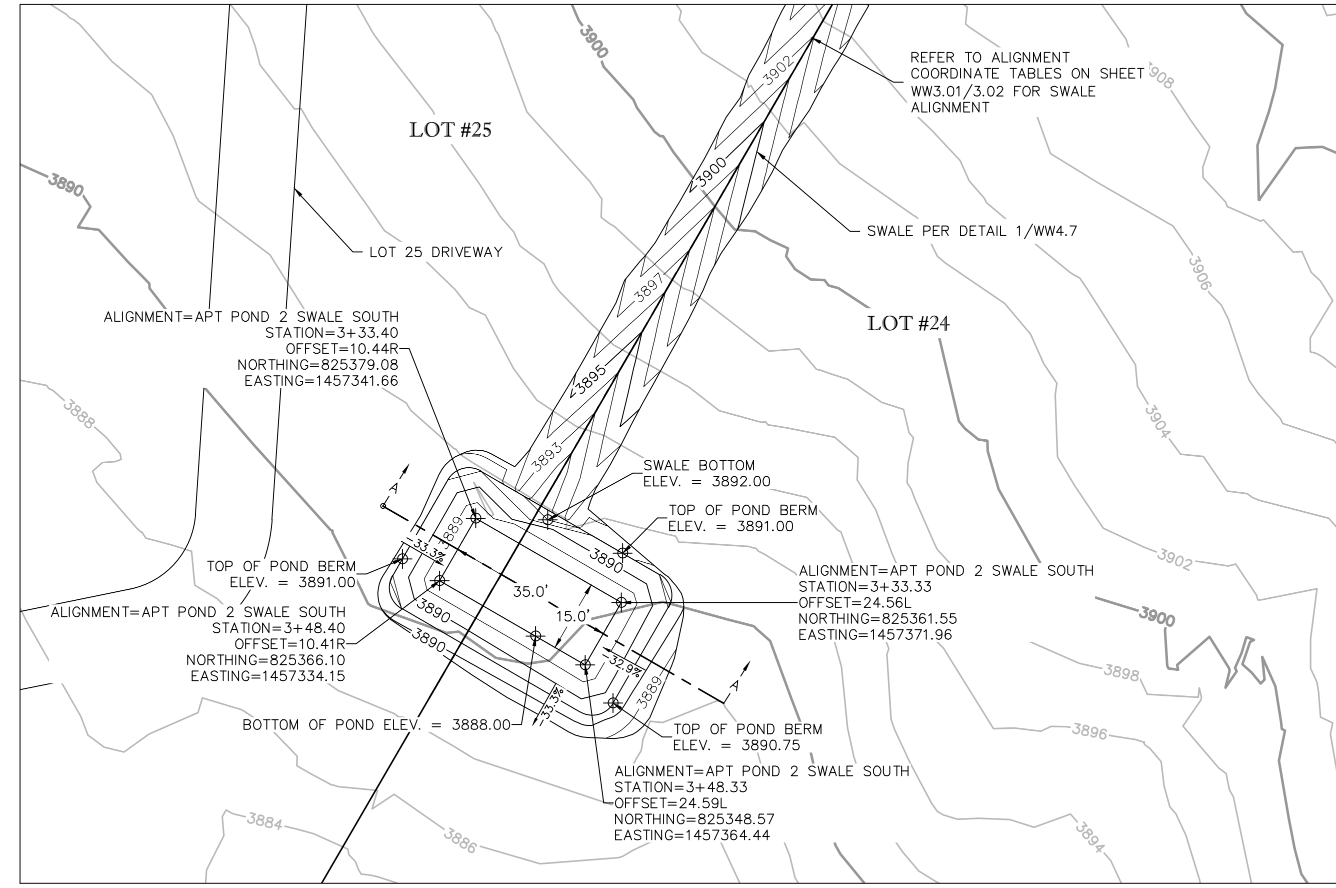
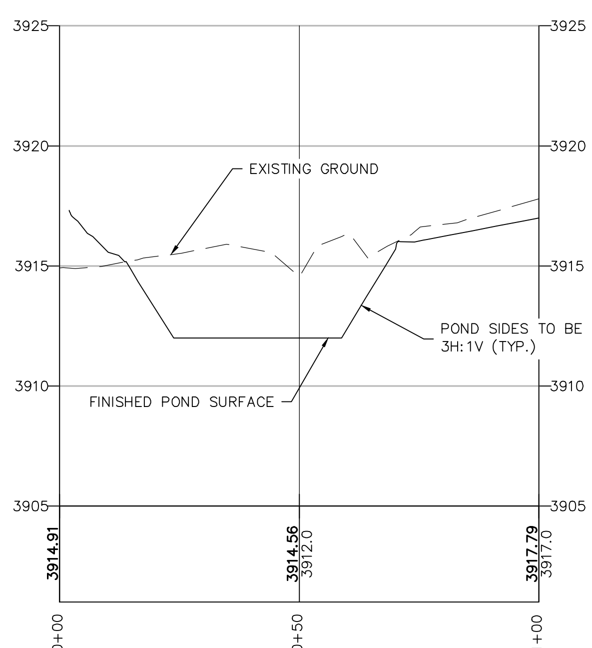


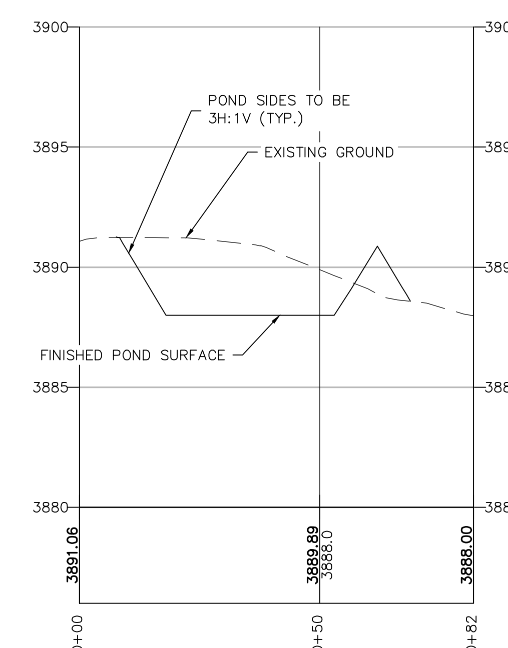
PLAN VIEW - APPALOOSA TRAIL POND NORTH



PLAN VIEW - APPALOOSA TRAIL POND SOUTH



SECTION A-A - APPALOOSA TRAIL POND NORTH



SECTION A-A - APPALOOSA TRAIL POND SOUTH

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 262

HORIZONTAL SCALE FEET 0 20 40
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 2 SUBDIVISION
POND GRADING DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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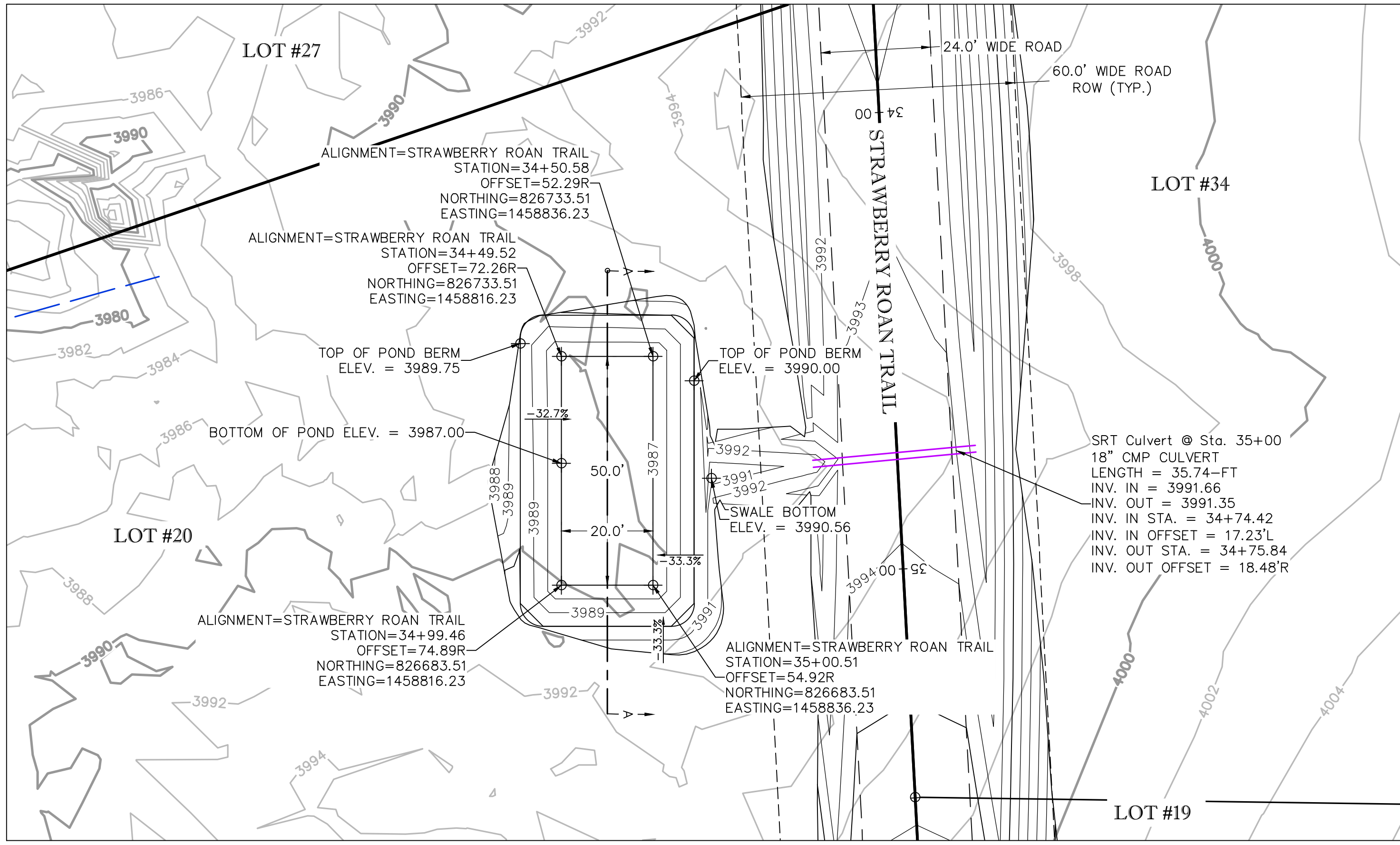
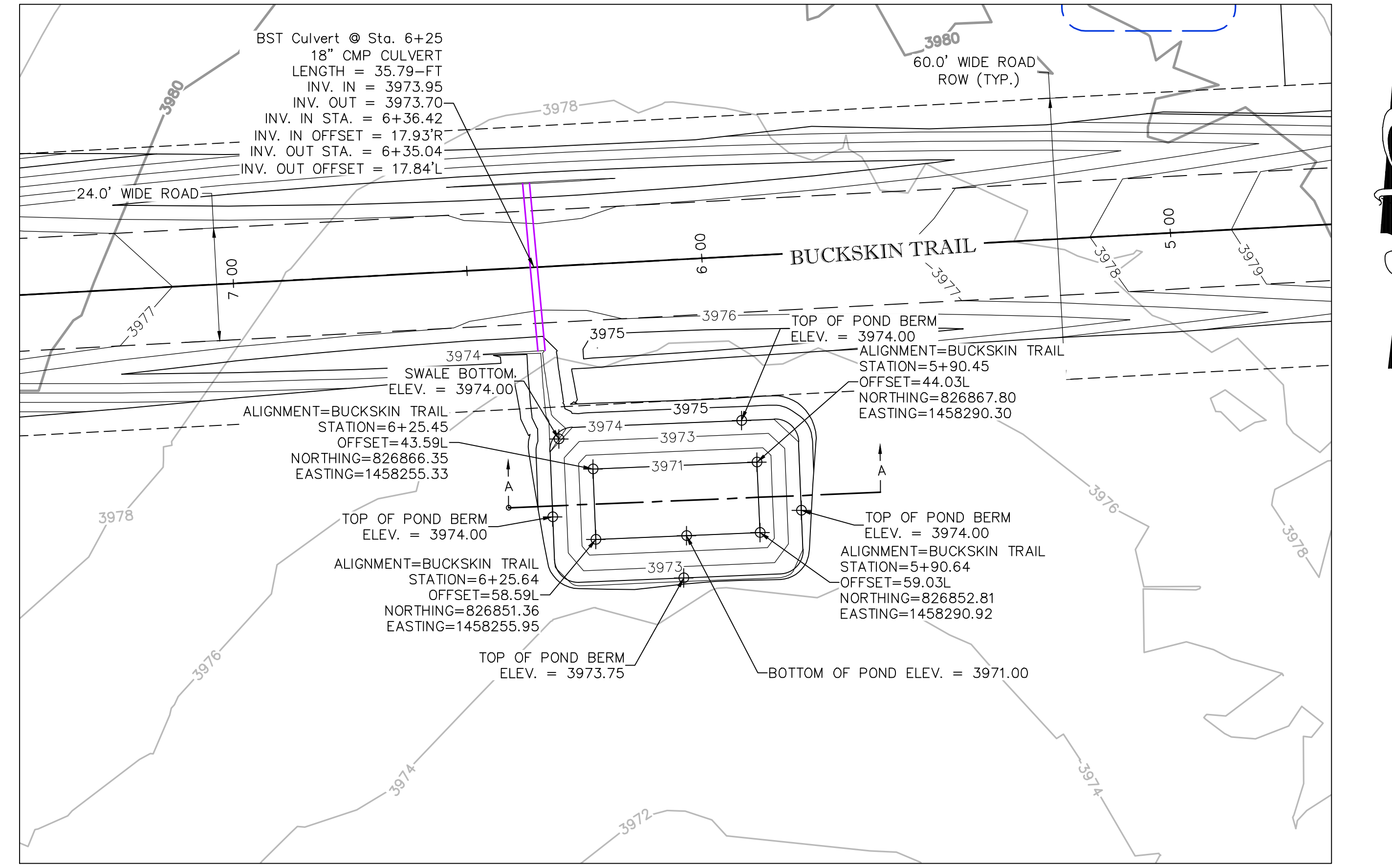
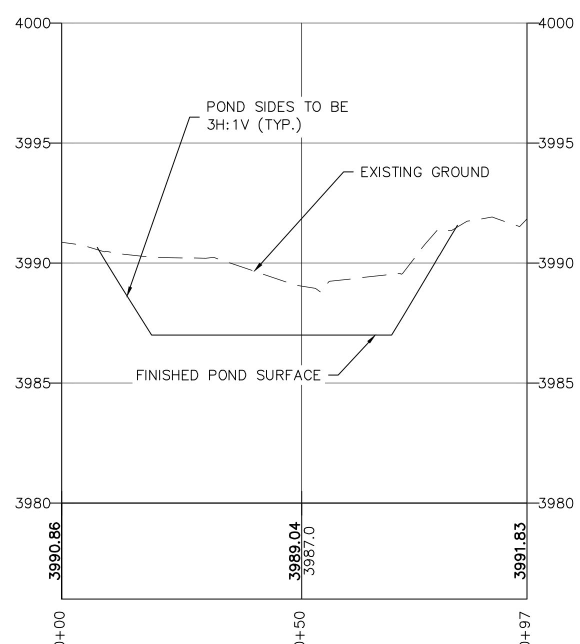
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE
SHEET WW4.3
HORSE CREEK HILLS
DRAINAGE DETAILS



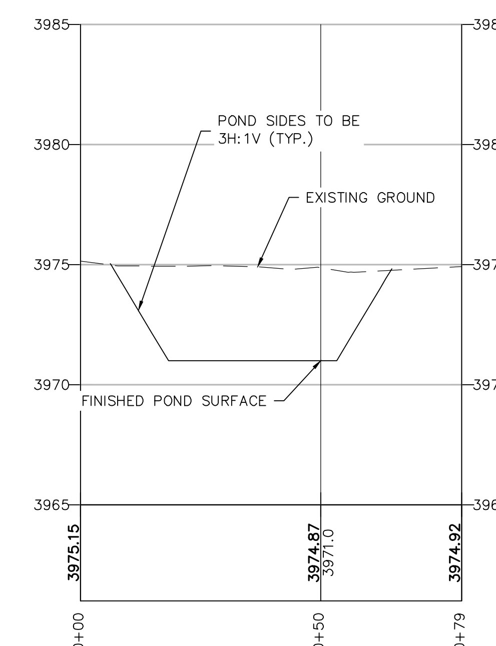
PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 35+00



PLAN VIEW - BUCKSKIN TRAIL POND @ STA. 6+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 35+00



SECTION A-A - BUCKSKIN TRAIL POND @ STA. 6+00

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NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 20 40
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 2 & 3 SUBDIVISION
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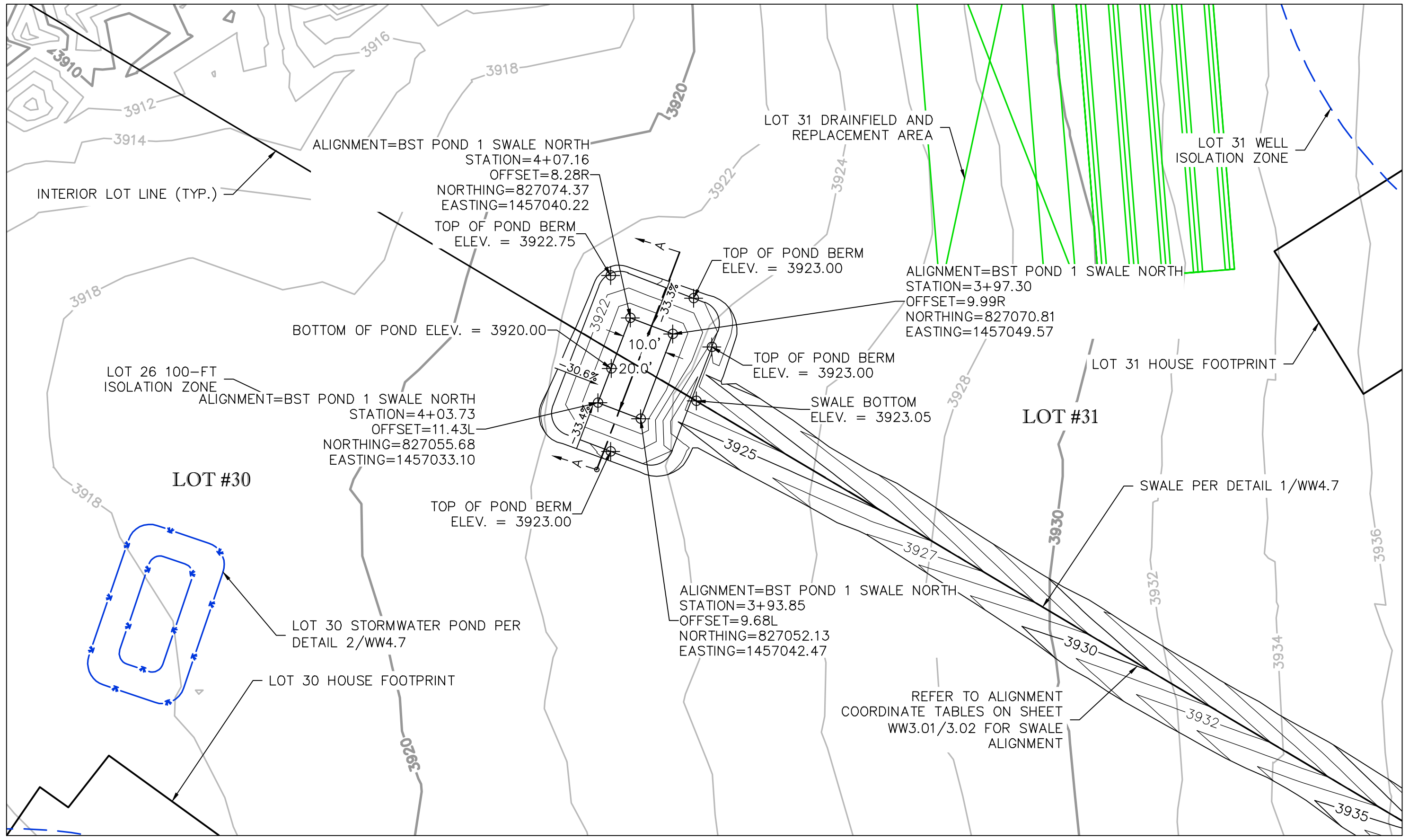
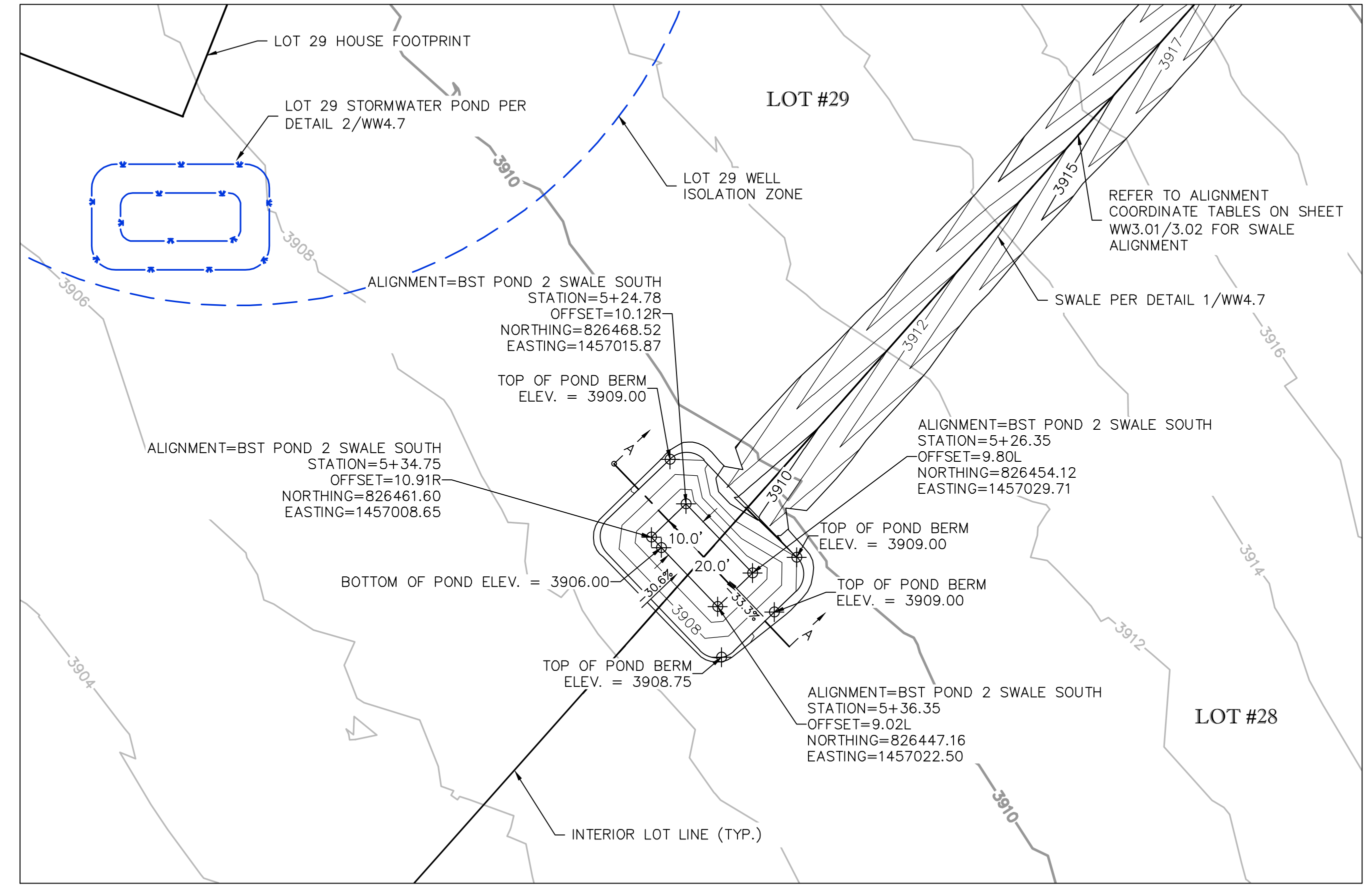
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW4.4

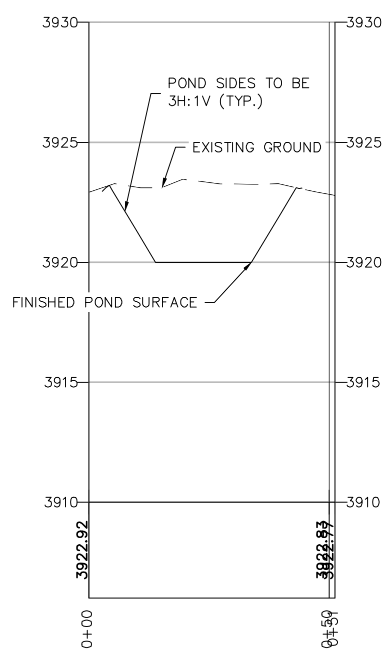
HORSE CREEK HILLS
DRAINAGE DETAILS



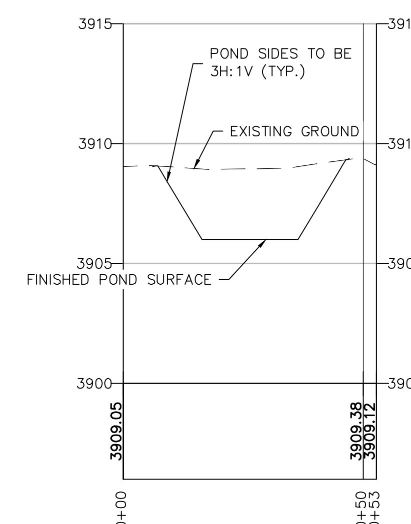
PLAN VIEW - BUCKSKIN TRAIL POND NORTH



PLAN VIEW - BUCKSKIN TRAIL POND SOUTH



SECTION A-A - BUCKSKIN TRAIL POND NORTH



SECTION A-A - BUCKSKIN TRAIL POND SOUTH

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 264

HORIZONTAL SCALE FEET 0 20 40
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 3 SUBDIVISION
POND GRADING DETAILS
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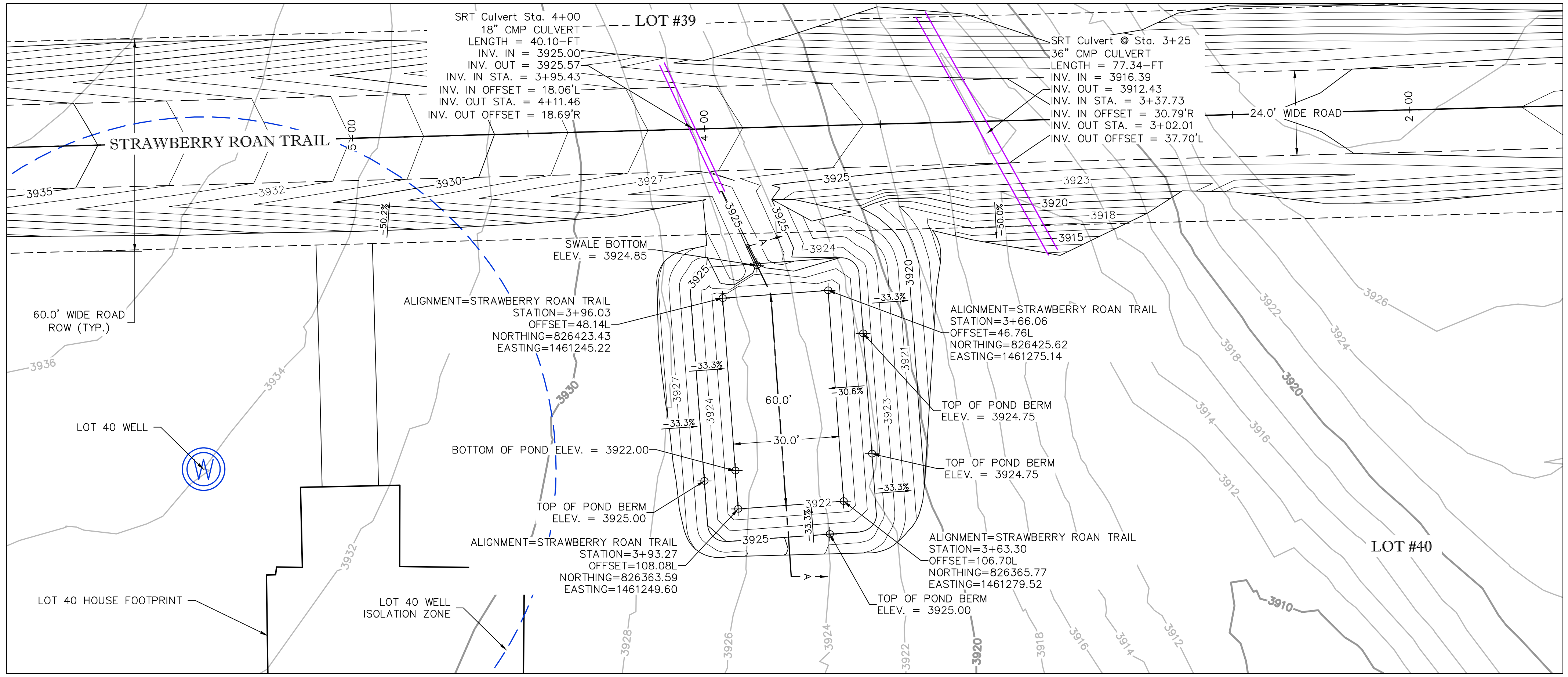
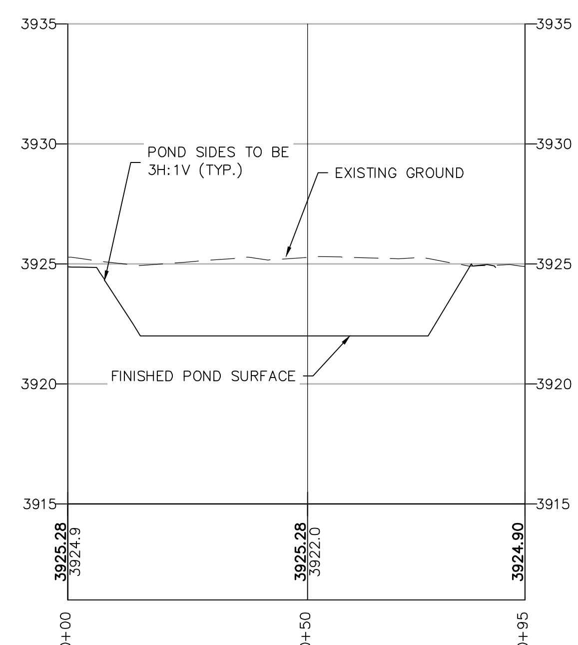
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW4.5

HORSE CREEK HILLS
DRAINAGE DETAILS



PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 4+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 4+00

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 20 40
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF
DRAWN BY: HTM
DESIGNED BY: MAF, HTM
REVIEWED BY: MAF

HORSE CREEK HILLS 4 SUBDIVISION
POND GRADING DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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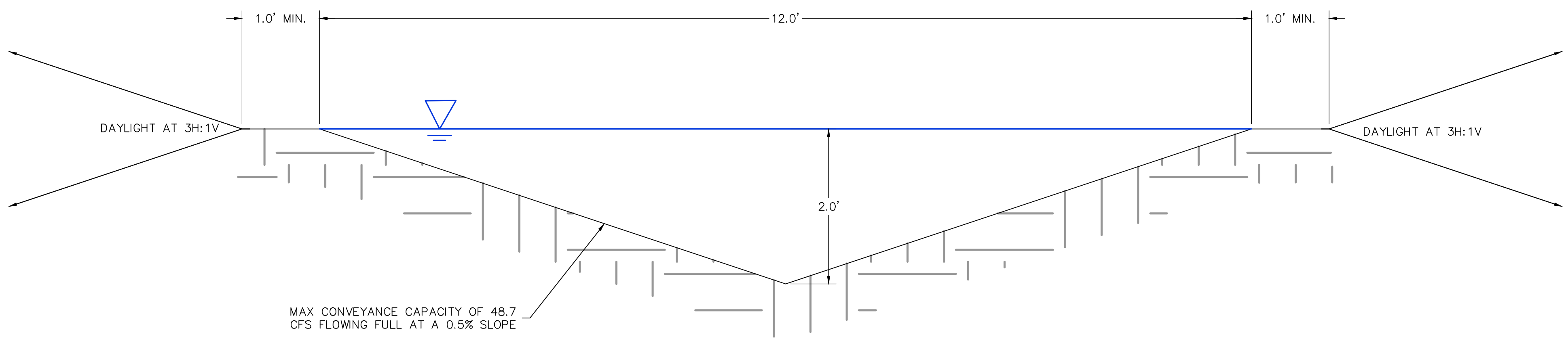
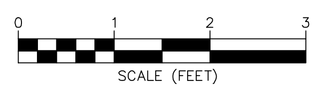
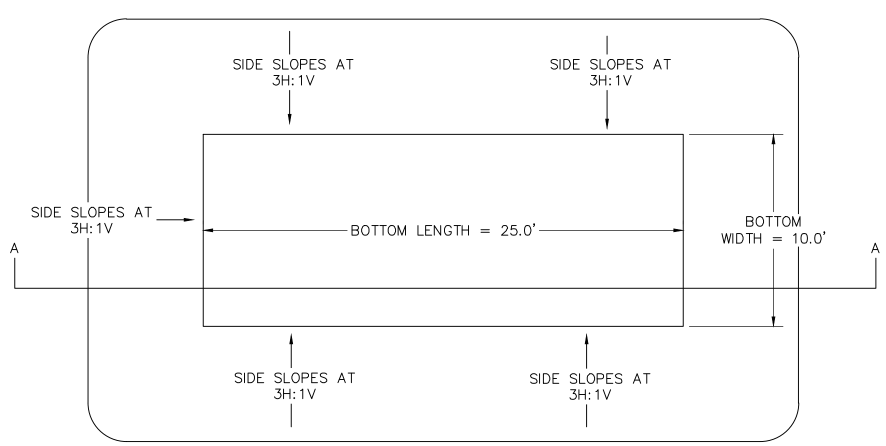
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE
SHEET
WW4.6

HORSE CREEK HILLS
DRAINAGE DETAILS

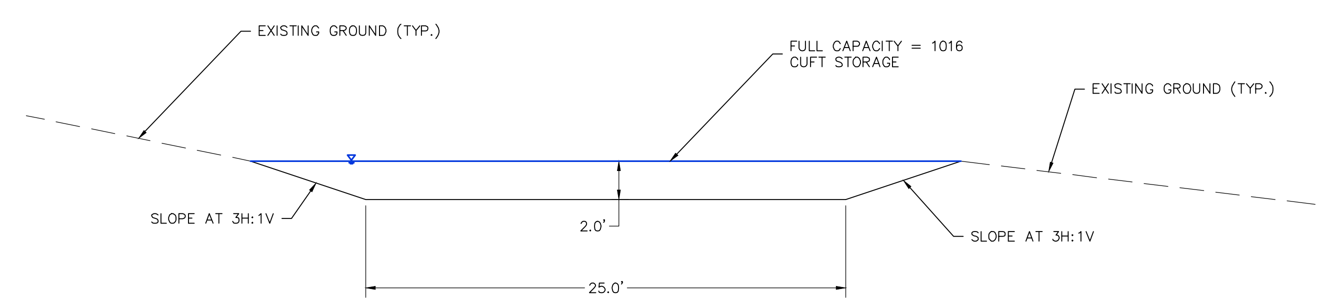


1 DETAIL
WW4.7 TYPICAL DRAINAGE SWALE





PLAN VIEW



PROFILE VIEW – SECTION A–A

2A DETAIL
WW4.7 TYPICAL RETENTION POND FOR LOTS

2B DETAIL
WW4.7 TYPICAL RETENTION POND FOR LOTS

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NO.	REVISIONS	DRAWN BY	DATE
	DEQ Page 266		

PROJECT ENGINEER: MAF
DRAWN BY: HTM
DESIGNED BY: MAF, HTM
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STORM DRAINAGE DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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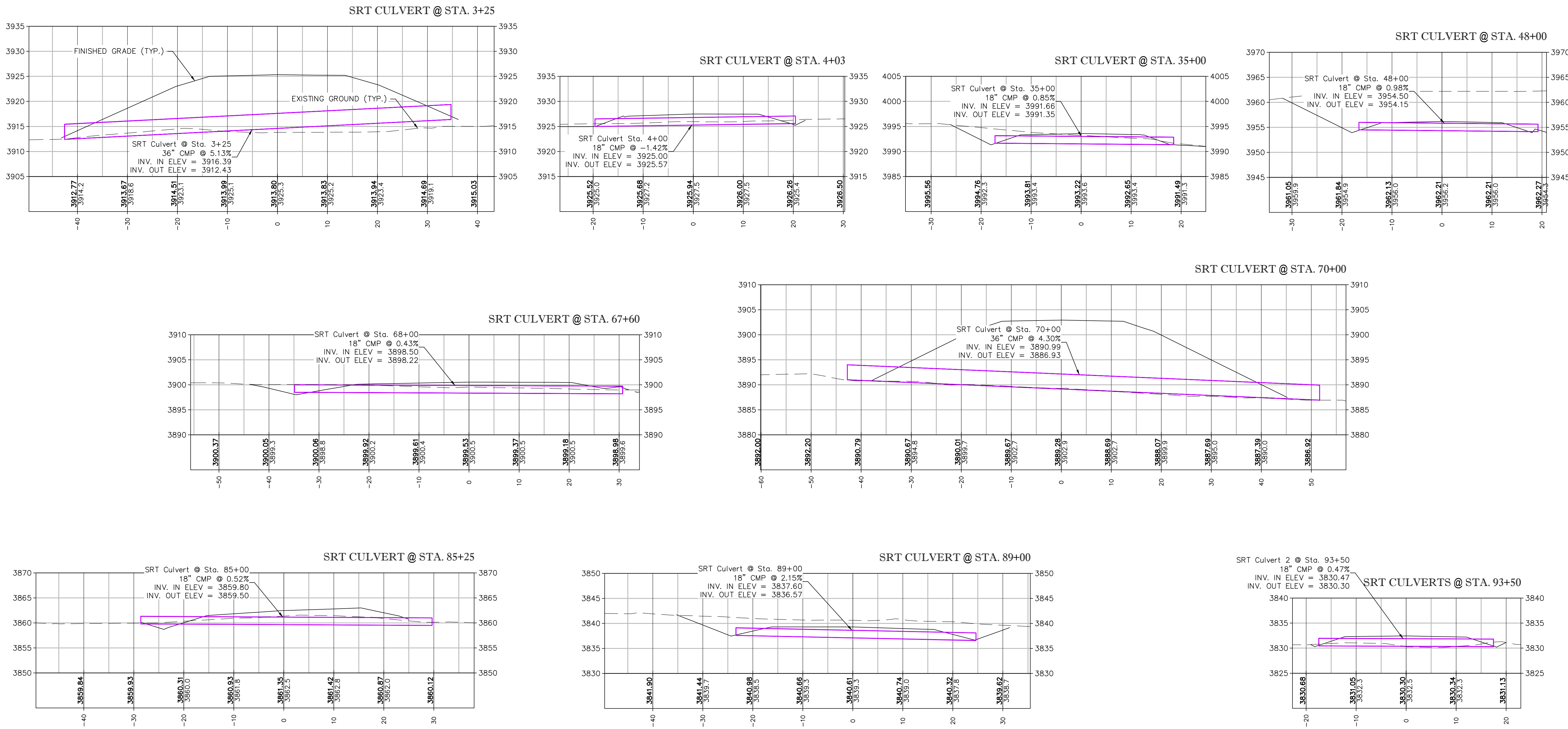
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW4.7

HORSE CREEK HILLS
DRAINAGE DETAILS



NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 267

0 150 300 450

SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM

DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STORMWATER - CULVERT PROFILES
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
www.alliedengineering.com

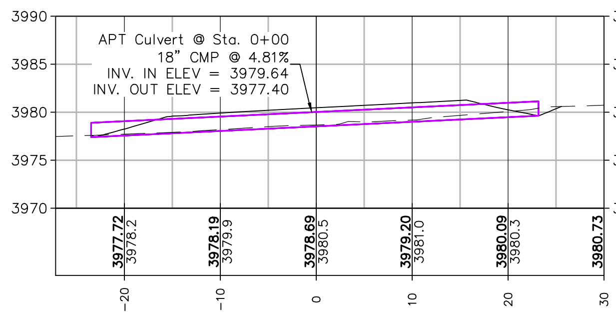
Civil Engineering
Geotechnical Engineering
Land Surveying

PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

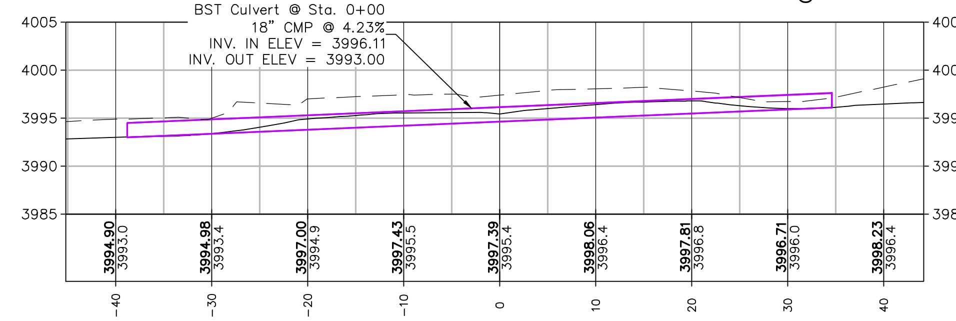
SHEET
WW4.8

HORSE CREEK HILLS
CULVERT PROFILES

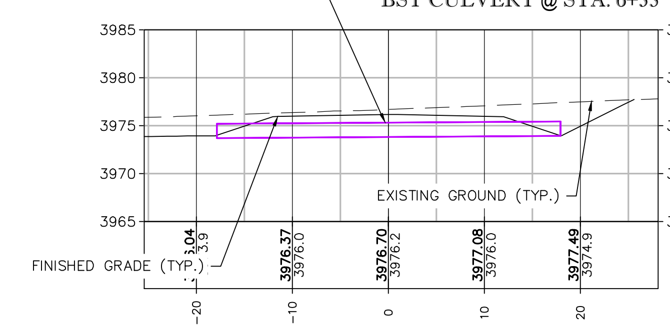
APT CULVERT @ STA. 25+00



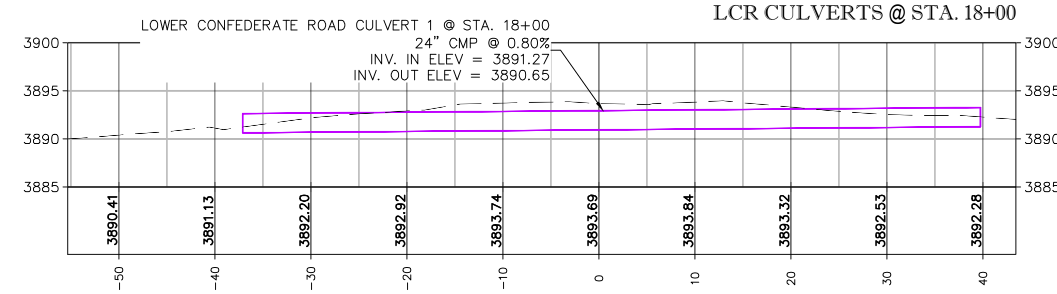
BST CULVERT @ STA. 17+00



BST CULVERT @ STA. 6+35



LCR CULVERTS @ STA. 18+00



C:\pesl_w\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\H & H\WW4.8 CULVERT CROSS SECTIONS.dwg

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STORMWATER - CULVERT PROFILES
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW4.9

HORSE CREEK HILLS
CULVERT PROFILES

HORSE CREEK HILLS 1-4 SUBDIVISIONS
STORM DRAINAGE MAINTENANCE PLAN

The Horse Creek Hills Subdivisions (HOA) shall be responsible for adequate maintenance and operation of all storm drainage facilities (including roadside ditches, ponds, swales, culverts, etc.) located within the “storm drainage” easements and “utility” easements as shown on the Final Plat of Horse Creek Hills 1-4 Subdivisions. The individual lot Owners shall be responsible for adequate maintenance and operation of all storm facilities (including ponds, swales, culverts, etc.) that are only serving their individual needs of their respective lots.

All trash and debris shall be removed from the storm drainage facilities by no later than May 1st of each year. If the HOA fails to remove the trash or debris from the shared storm drainage facilities as described, individual lot owners may cause trash or debris to be removed and proportionately bill the Owners of the subdivision for such efforts. Similarly, if individual lot Owners fail to remove trash or debris from their lot specific storm drainage facilities as described, the HOA may cause trash or debris to be removed and bill the Lot Owner for such efforts.

The Homeowners’ Association shall ensure that yearly maintenance is conducted to remove sediment or debris as needed from the storm water swales, ponds, and culverts so that the aforementioned facilities function properly. Until such time that the Association assumes the maintenance responsibilities of the storm drainage facilities, such requirements shall be the responsibility of the Developer.

The control of noxious weeds by the Homeowners’ Association on those areas for which the HOA is responsible, including storm drainage easements, roadside ditches, etc. shall comply with the Weed Management and Revegetation Plan as approved by the Broadwater County Weed Control District.

Lawns shall be maintained at a height of 2 ½” – 3 ½” and shall be irrigated/water, fertilized, controlled for noxious weeds, and otherwise properly cared for. If each individual lot owner fails to properly maintain their lawn area, the HOA may cause the lawn to be maintained at the Owner’s expense.

Appendix G

Road Plans & Complete Set of MDEQ Plans for Subdivisions 1-4

- Draft Road Construction Plans
- Complete set of MDEQ plans for Subdivisions 1-4

HORSE CREEK HILLS SUBDIVISION

ROAD DESIGN

LOCATION: N ½, N ½ of the SE ¼, & NE ¼ of the SW ¼, SEC 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MONTANA

LATITUDE: 46°29'45.6" LONGITUDE: -111°31'13"

DEVELOPER: 71 RANCH LP

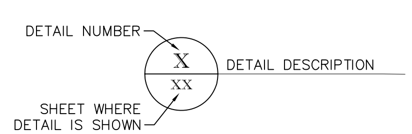
February 12, 2020 SET NO. ________

PROJECT MANAGER: MARK FASTING, PE
DESIGN ENGINEER: JOSH SMITH, EI
PROJECT SURVEYOR: GREG FINCK, PLS

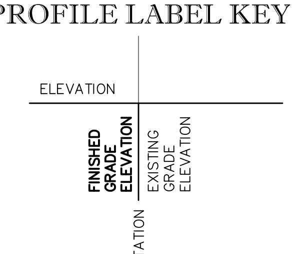
PRELIMINARY NOT FOR CONSTRUCTION

SHEET INDEX

PLAN SHEET DETAIL CALLOUTS



PROPOSED ROADWAY PROFILE LABEL KEY



299 PRAIRIE DRIVE, PO BOX 1251, STANLEY, ND 58784, PHONE (701) 628-0221
32 DISCOVERY DRIVE, BOZEMAN, MT 59718, PHONE (406) 582-0221, FAX (406) 582-5770
www.alliedengineering.com
Civil Engineering
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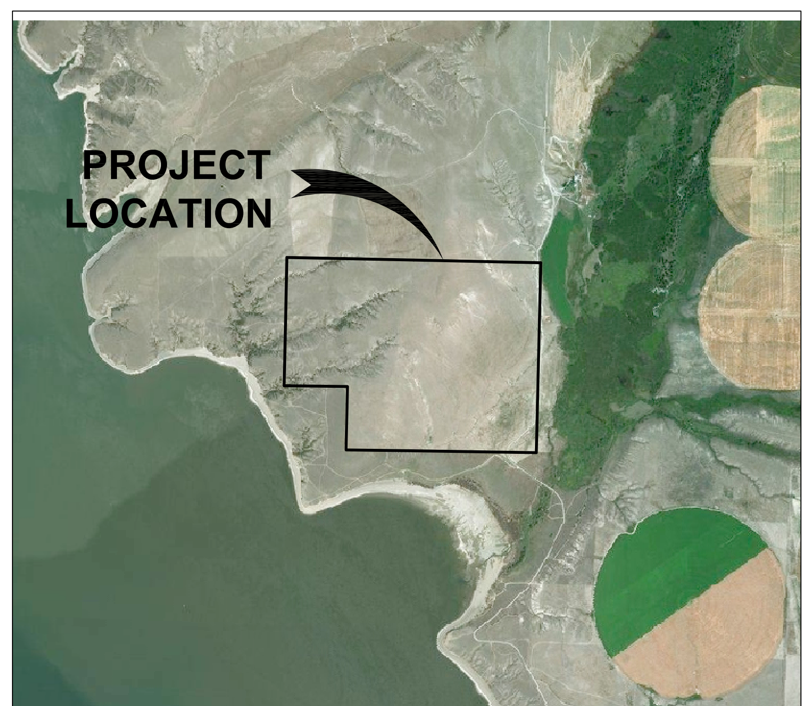
Land Surveying
ALLIED ENGINEERING SERVICES, INC.

CIVIL ABBREVIATIONS:

AESI	ALLIED ENGINEERING SERVICES, INC.
AC	ACRE
AVE	AVENUE
BLDG	BUILDING
BM	BENCHMARK
BOG	BACK OF GRATE (GUTTER)
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CONC	CONCRETE
COB	CITY OF BELGRADE
CY	CUBIC YARD
DI	DUCTILE IRON
DIA	DIAMETER
DWG	DRAWING
E	EAST
EA	EACH
EG	EXISTING GRADE
ELEV	ELEVATION
EOG	EDGE OF GRAVEL
EOP	EDGE OF PAVEMENT
EX	EXISTING
FETS	FLARED END TERMINAL SECTION
FG	FINISHED GRADE
FHYD	FIRE HYDRANT
FL	FLANGE
FL	FLOWLINE
FM	SEWER FORCE MAIN
FT	FEET
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
HORZ	HORIZONTAL
HP	HIGH POINT
HWY	HIGHWAY
IE	INVERT ELEVATION
IN	INCH
INV	INVERT
LF	LINEAR FEET
LP	LOW POINT
LT	LEFT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MP	MID POINT
MPWSS	MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS
N	NORTH
PC	POINT OF CURVATURE
PE	PLAIN END
PE	POLYETHYLENE
PI	POINT OF INTERSECTION
PL	PROPERTY LINE
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
R	RADIUS
RP	RADIUS POINT
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT-OF-WAY
RT	RIGHT
S	SOUTH
SCH	SCHEDULE
SD	STORM DRAIN
SECT	SECTION
SG	SUBGRADE
S	SANITARY SEWER MAIN
SS	SANITARY SEWER SERVICE
ST	STREET
STA	STATION
STD	STANDARD
SY	SQUARE YARD
TBM	TEMPORARY BENCH MARK
TBC	TOP BACK OF CURB
TDH	TOTAL DYNAMIC HEAD
TYP	TYPICAL
UG	UNDERGROUND
VERT	VERTICAL
W	WATER MAIN
W	WEST
W/	WITH
W/O	WITHOUT
WS	WATER SERVICE



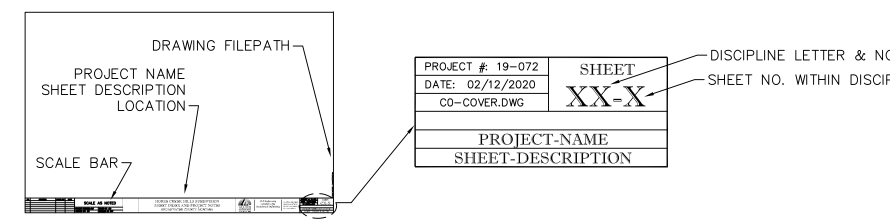
AERIAL MAP

0 1,000 2,000 3,000
SCALE (FEET)

LEGEND

PROPERTY LINE	PROPOSED LOT LINE
FOUND MONUMENT	PROPOSED RIGHT-OF-WAY LINE
CONTROL POINT	PROPOSED MAJOR CONTOUR (5' INTERVAL)
EX. MAJOR CONTOUR (5' INTERVAL)	PROPOSED MINOR CONTOUR (1' INTERVAL)
EX. MINOR CONTOUR (1' INTERVAL)	PROPOSED ROAD CENTERLINE
EX. EDGE OF ROAD	PROPOSED CURB AND GUTTER
EX. DRAINAGE CULVERT	PROPOSED SIDEWALK
EX. FENCE	PROPOSED WATER MAIN
EX. TREE ROW	PROPOSED WATER SERVICE
EX. PINE TREE	PROPOSED GATE VALVE
EX. WATER MAIN	PROPOSED FIRE HYDRANT
EX. GATE VALVE	PROPOSED SEWER MAIN
EX. FIRE HYDRANT	PROPOSED SEWER FORCE MAIN
EX. WELL	PROPOSED SEWER SERVICE
EX. SEWER MAIN	PROPOSED SEWER MANHOLE
EX. SEWER MANHOLE	PROPOSED STORM DRAIN LINE
EX. OVERHEAD POWER LINE	PROPOSED STORM DRAIN CURB INLET
EX. OVERHEAD POWER POLE	PROPOSED DRAINAGE CULVERT
EX. ELECTRIC METER	PROPOSED DRAINAGE DIRECTION
EX. UNDERGROUND FIBER OPTICS LINE	PROPOSED DRAINAGE ARROW
EX. TELEPHONE/FIBER OPTICS PEDESTAL	PROPOSED SIGN POST

AESI STANDARD BORDER FORMAT



GENERAL NOTES AND SPECIFICATIONS:

1. THE CONTRACTOR MUST ADHERE TO THE PROJECT PLANS AND SPECIFICATIONS. THE CONSTRUCTION COMPANY MUST BE A LICENSED CONTRACTOR WITH THE STATE OF MONTANA AND BE COVERED BY LIABILITY INSURANCE. A TWO-YEAR WRITTEN WARRANTY FROM THE PROJECT CONTRACTOR TO GALLATIN COUNTY IS REQUIRED FOR ALL ONSITE AND OFFSITE ROAD IMPROVEMENTS
2. THE EXISTING UNDERGROUND UTILITIES SHOWN ON THE PLAN ARE BASED ON A STANDARD UTILITY LOCATE WITH NO FIELD EXPLORATIONS CONDUCTED TO CONFIRM THEIR LOCATIONS & DEPTHS. THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES BY CALLING THE NATIONAL 811 "CALL BEFORE YOU DIG" TELEPHONE NUMBER PRIOR TO CONSTRUCTION ACTIVITIES.
3. ALL ROAD AND STORM DRAINAGE IMPROVEMENTS SHALL BE CONSTRUCTED PER THE ALIGNMENT AND GRADE AS SHOWN ON THE PLANS.
4. CONTRACTOR SHALL FIELD VERIFY LOCATION AND DEPTH OF ALL EXISTING UTILITIES AND STRUCTURES WHERE NEW FACILITIES CROSS OR CONNECT. CONTRACTOR SHALL BE RESPONSIBLE FOR EXPOSING POTENTIAL UTILITY CONFLICTS FAR ENOUGH AHEAD OF CONSTRUCTION TO MAKE NECESSARY GRADE MODIFICATIONS WITHOUT DELAYING THE WORK. ALL UTILITY CROSSINGS SHALL BE POTHOLED OR VACUUMED AS NECESSARY PRIOR TO EXCAVATING OR BORING TO ALLOW THE CONTRACTOR TO PREVENT GRADE OR ALIGNMENT CONFLICTS.
5. AT LEAST 10 BUSINESS DAYS BEFORE BEGINNING ANY EXCAVATION, THE CONTRACTOR SHALL NOTIFY THE OWNER AND ENGINEER OF UNDERGROUND FACILITIES AND COORDINATE THE WORK WITH THE OWNERS OF SUCH UNDERGROUND FACILITIES. THE INFORMATION SHOWN OR INDICATED IN THE CONTRACT DOCUMENTS WITH RESPECT TO EXISTING UNDERGROUND FACILITIES IS BASED ON INFORMATION AND DATA OBTAINED FROM THE OWNERS OF THE FACILITIES WITHOUT FIELD EXPLORATION, AND AS SUCH, OWNER AND ENGINEER ARE NOT RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SUCH INFORMATION OR DATA.
6. NO TRENCHES IN ROADS OR DRIVEWAYS SHALL BE LEFT IN AN OPEN CONDITION OVERNIGHT. ALL SUCH TRENCHES SHALL BE BACKFILLED, COMPACTED AND CLOSED BEFORE THE END OF EACH WORK DAY AND NORMAL TRAFFIC FLOWS RESTORED.
7. IF THE ENGINEER IS CONTRACTED FOR CONSTRUCTION STAKING, ENGINEER SHALL BE CONTACTED PRIOR TO STAKING. PROVIDE ADVANCED NOTICE SUFFICIENT TO ACCOMMODATE CONSTRUCTION, 7 WORKING DAYS IS MINIMUM, AND MAY VARY DEPENDING UPON AVAILABILITY.
8. LIGHTING, ELECTRICAL, NATURAL GAS, COMMUNICATIONS, LANDSCAPING, ETC. ARE TO BE DESIGNED BY OTHERS.
9. FINAL QUANTITIES MAY BE HIGHER OR LOWER THAN THOSE ESTIMATED, PENDING FIELD FINDINGS, SITE CONDITIONS, ETC.
10. STRIP THE EMBANKMENT FOUNDATION AREA, BORROW AREAS AND ALL AREAS TO RECEIVE FILL TO A MINIMUM DEPTH OF 6 INCHES AND AS REQUIRED TO REMOVE ALL ORGANIC SOILS, VEGETATIVE MATTER, ROOTS, AND OTHER PERISHABLE, LOOSE OR OBJECTIONABLE MATERIAL INCLUDING FROZEN SOIL THAT MIGHT INTERFERE WITH COMPACTION OF EMBANKMENT LIFT OR THE BONDING OF EMBANKMENT TO FOUNDATION. OBJECTIONABLE MATERIAL WILL BE AS DETERMINED BY THE ENGINEER. PERFORM STRIPPING OPERATIONS IN A MANNER TO CONSERVE ALL TOPSOIL THAT CONTAINS ORGANICS.
11. TRANSPORT STRIPPED MATERIALS TO STOCKPILE AREAS OUTSIDE OF WATERWAYS AND WETLANDS, SUBJECT TO APPROVAL. COORDINATE WITH OWNER TO IDENTIFY STOCKPILE AREAS. LOCATE PILES SO AS NOT TO AFFECT THE OPERATION OF THE EXISTING OPERATIONS, OR INTERFERE WITH THE WORK.
12. TAKE PRECAUTIONS TO PRESERVE, IN A SOUND CONDITION, THE MATERIAL BELOW AND BEYOND THE LINES OF ALL EXCAVATIONS.
13. PERFORM OPERATIONS SO THAT THE EXCAVATIONS WILL YIELD AS MUCH SUITABLE MATERIAL FOR CONSTRUCTION PURPOSES AS PRACTICABLE.
14. REUSE, AS MUCH AS IS PRACTICABLE, ALL SUITABLE MATERIALS FROM REQUIRED EXCAVATION IN THE PERMANENT CONSTRUCTION. SEPARATE UNSUITABLE MATERIALS AND REMOVE THEM FROM THE WORK AREA AS SOON AS PRACTICABLE.
15. SPREAD OUT AND ALLOW MATERIALS TO DRY THAT ARE TOO WET FOR IMMEDIATE COMPACTION UNTIL THE WATER CONTENT IS REDUCED SUFFICIENTLY FOR PLACEMENT IN THE EMBANKMENT. AERATING AND DRYING IS INCIDENTAL TO THE WORK.
16. WATER-CONDITION MATERIALS THAT ARE TOO DRY FOR IMMEDIATE COMPACTION. MOISTURE CONDITIONING IS INCIDENTAL TO THE WORK.
17. LEVEL AND TRIM WASTE PILES TO REASONABLY REGULAR LINES, AND SLOPE TO DRAIN.
18. REMOVE SOFT, WET, OBJECTIONABLE, OR OTHERWISE UNSUITABLE MATERIALS AS DETERMINED BY THE ENGINEER.
19. DE-WATER AS NECESSARY TO PREVENT THE ACCUMULATION AGAINST OR THE INTERMINGLING OF WATER WITH THE FILL.
20. PERFORM EXCAVATION AND PLACEMENT OPERATIONS SUCH THAT THE EMBANKMENT MATERIALS ARE MIXED AND BLENDED TO PROVIDE THE MOST HOMOGENEOUS SECTION AND BEST DEGREE OF COMPACTION AND STABILITY PRACTICAL. ALL FILL SHOULD BE PLACED IN HORIZONTAL LIFTS AND COMPACTED TO AT LEAST 95% OF ASTM D-698. PROVIDE PRIMARY WATER CONDITIONING, MIXING AND BLENDING IN STOCKPILES AS NEEDED. DISTRIBUTE THE FILL IN A LIFT SUCH THAT IT IS FREE FROM LENSES, POCKETS, STREAKS, OR LAYERS DIFFERING MATERIALLY IN TEXTURE OR GRADATION FROM THE SURROUNDING FILL.
21. CONTROL AND CONDUCT ALL TRANSPORTING, STOCKPILING, EXCAVATION, PRODUCTION, AND PLACEMENT OPERATIONS TO MINIMIZE CONTAMINATION, SEGREGATION, AND PARTICLE BREAKDOWN.
22. CARRY OUT COVERAGES OF COMPACTION EQUIPMENT SO THAT THE COMPACTIVE EFFORT IS DISTRIBUTED UNIFORMLY AND IN A SYSTEMATIC MANNER OVER THE ENTIRE LIFT.
23. ALL CONSTRUCTION ASSUMES A STABLE COMPACTED SUBGRADE IS ACHIEVED PRIOR TO PLACEMENT OF NEW FACILITIES.
24. COORDINATE WITH UTILITY COMPANIES REGARDING ALL UTILITY CROSSINGS AND ANY POTENTIAL UTILITY CONFLICTS.
25. CONTRACTOR SHALL COORDINATE DRY UTILITY CONDUIT LOCATIONS, DEPTHS, MATERIAL, QUANTITY, ETC. WITH APPLICABLE UTILITY SERVICE PROVIDERS PRIOR TO CONSTRUCTION.
26. IF APPLICABLE, CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT ALL STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS ARE MET.
27. ADDITIONAL MAILBOX PULL-OUT MAY BE REQUIRED, WHICH IS NOT SHOWN ON THESE PLANS. CONTRACTOR SHALL COORDINATE WITH ENGINEER AND USPS AS NECESSARY.
28. PROJECT SITE DEVELOPMENT MAY REQUIRE ADDITIONAL STORM WATER FACILITY IMPROVEMENTS (SWALES, PONDS, ROADSIDE DITCH BLOCKS, ETC.), THAT ARE NOT SHOWN ON THESE PLANS.

HORSE CREEK HILLS SUBDIVISION - ROAD DESIGN
BROADWATER COUNTY, MONTANA

NO.	REVISIONS	DATE

HORSE CREEK HILLS SUBDIVISION
C-0 COVER SHEET

UTILITY NOTE:
UNDERGROUND UTILITIES SHOWN HEREON ARE BASED ON ONE–CALL UTILITY LOCATIONS, PRIVATE LINES ARE NOT LOCATED BY ONE–CALL.

EASEMENT NOTE:
THE SHOWN EASMENTS MAY NOT BE ALL INCLUSIVE AND MAY NOT REFLECT ANY EASEMENT VACATIONS/ABANDONEMENTS THAT MAY HAVE TAKEN PLACE.

CONDITIONS NOTE:
CONDITIONS SHOWN ARE AS THEY EXISTED WHEN FIELD SURVEY WAS PERFORMED ON ______ . 20____

DATUM NOTE:
VERTICAL DATUM IS NAVD88.

BASIS OF BEARING, COORDINATES
BEARINGS SHOWN ARE MONTANA STATE PLANE GRID.
DISTANCES ARE GROUND DISTANCES IN INTERNATIONAL FEET.

MONTANA COORDINATE SYSTEM NAD 83
HORIZONTAL DATUM: BOZEMAN CONTINUOUSLY OPERATING REFERENCE STATION

PID	DESIGNATION
DP4103	IDDU DUBOIS CORS ARP
DM7133	MTLW LEWISTOWN CORS ARP
DG9745	MTEI ENGINC CORS ARP

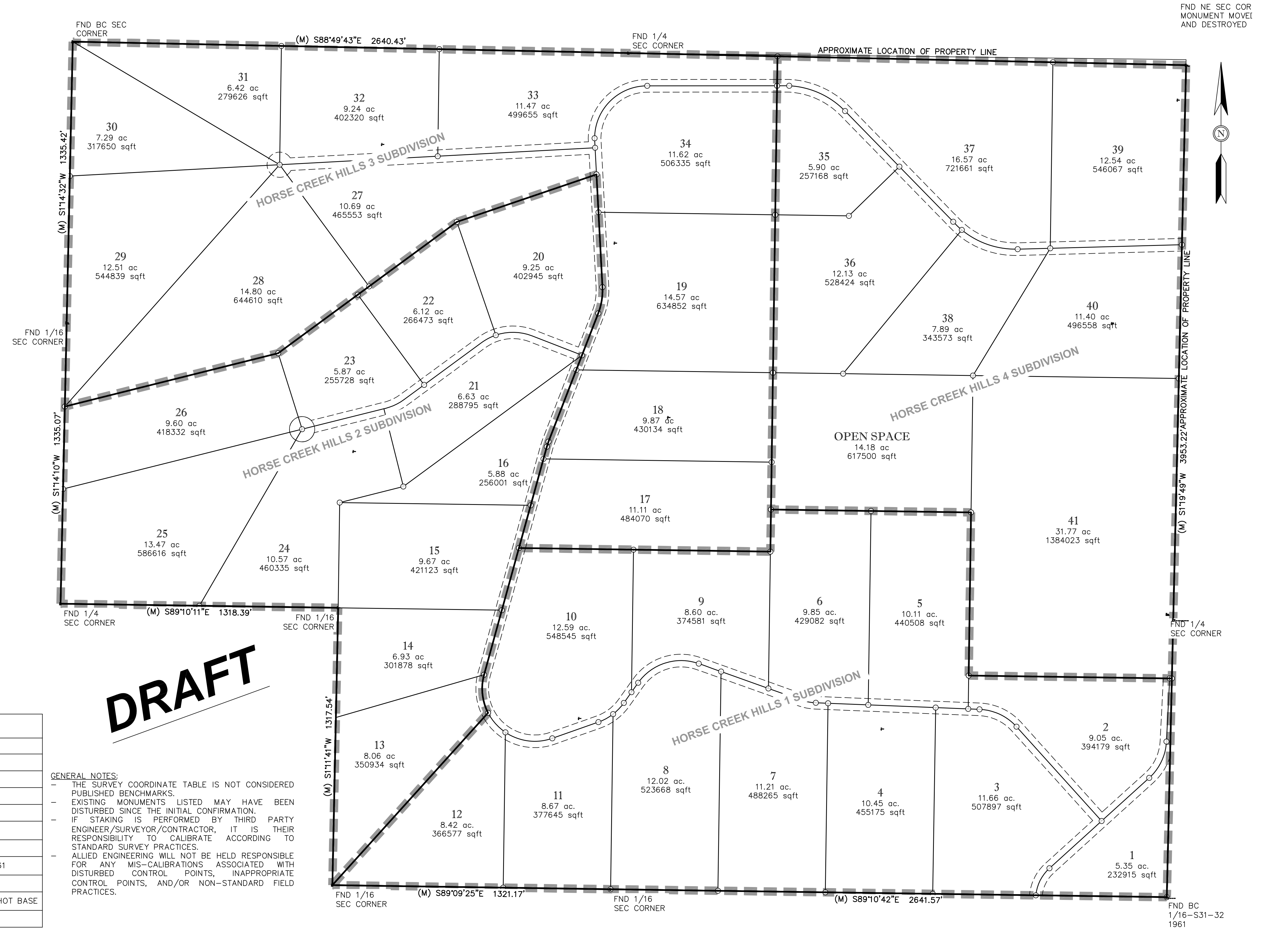
MONTANA STATE PLANE NAD 83 (2011)(EPOCH: 2010.0000)
NORTH LATITUDE 45°46'36.41912"
WEST LONGITUDE 111°04'57.06703"
UNITS: INTERNATIONAL FEET
Convergence angle: –01°09'27"

LEGEND

- INDEX CONTOUR
- CONTOUR MINOR (1' INTERVALS)
- PROPERTY LINE
- EASEMENT LINE
- BARB WIRE FENCE
- WOOD FENCE
- OVERHEAD POWER
- UNDERGROUND GAS
- UNDERGROUND PHONE
- UNDERGROUND ELECTRIC
- ROAD CENTERLINE
- EDGE OF PAVEMENT
- EDGE OF GRAVEL
- EDGE OF BUILDING
- FOUND MONUMENT AS NOTED
- CONTROL POINT
- BENCHMARK
- WATER WELL
- STREET SIGN
- POWER POLE
- GUY ANCHOR
- ELECTRICAL PEDESTAL
- ELECTRICAL METER
- TELEPHONE PEDESTAL
- GAS METER
- GAS VALVE
- TEST PIT
- TREE, CONIFER
- TREE, DECIDUOUS

SURVEY CONTROL COORDINATE TABLE

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
83	823,421.69	1,458,951.04	3,857.89	6007
84	823,441.13	1,457,630.01	3,889.45	6006
85	824,758.38	1,457,657.48	3,905.52	6005
86	824,777.48	1,456,339.22	3,816.10	6004
87	826,112.24	1,456,368.03	3,880.19	1/16 COR
88	827,393.36	1,459,036.85	4,016.18	6002
714	823,383.80	1,461,592.33	3,825.13	BC S1/16–S31–32–1961
755	827,447.34	1,456,396.97	3,897.86	BC SEC COR N T6
810	824,702.23	1,461,623.47	3,851.96	BC 1/4 COR 31/32 N BENT SHOT BASE
1000	827,335.96	1,461,684.10	3,970.62	CALC POINT



GENERAL NOTES:
- THE SURVEY COORDINATE TABLE IS NOT CONSIDERED PUBLISHED BENCHMARKS.
- EXISTING MONUMENTS LISTED MAY HAVE BEEN DISTURBED SINCE THE INITIAL CONFIRMATION.
- IF STAKING IS PERFORMED BY THIRD PARTY ENGINEER/SURVEYOR/CONTRACTOR, IT IS THEIR RESPONSIBILITY TO CALIBRATE ACCORDING TO STANDARD SURVEY PRACTICES.
- ALLIED ENGINEERING WILL NOT BE HELD RESPONSIBLE FOR ANY MIS–CALIBRATIONS ASSOCIATED WITH DISTURBED CONTROL POINTS, INAPPROPRIATE CONTROL POINTS, AND/OR NON–STANDARD FIELD PRACTICES.

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 272

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
SURVEY CONTROL
SEC. 31, T9N, R2E, PMM, BROADWATER COUNTY, MONTANA

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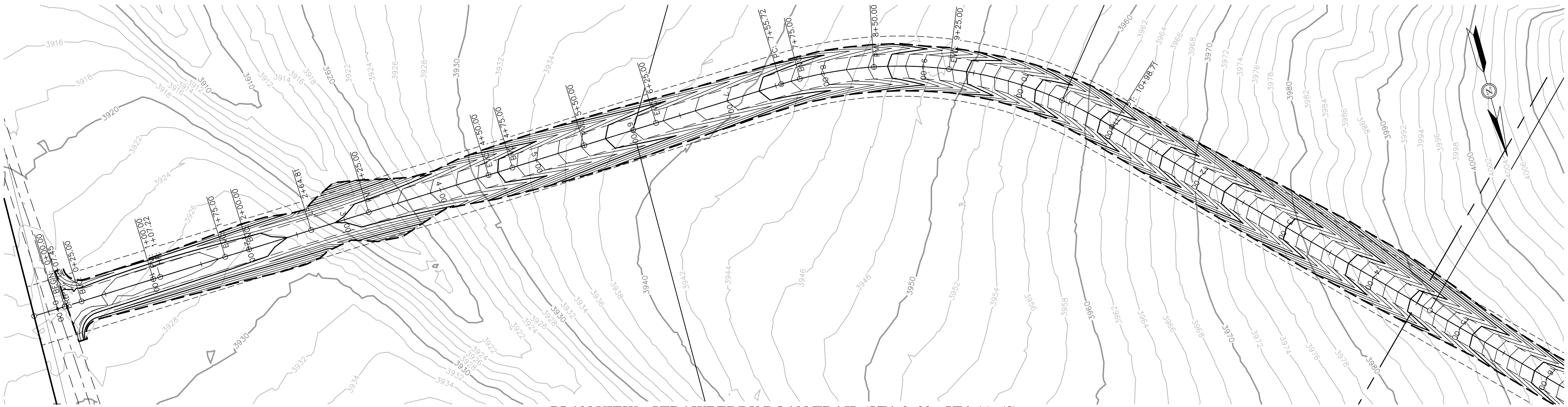
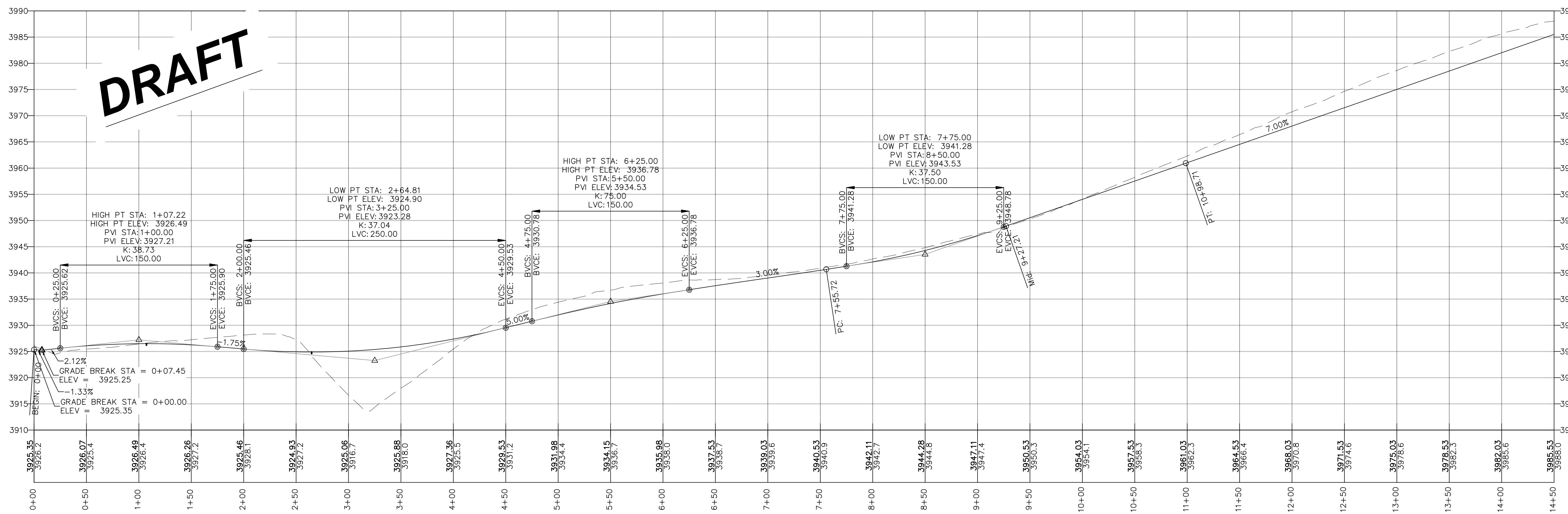
Civil Engineering
Geotechnical Engineering
Land Surveying

ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19–072
DATE: 02/12/2020
SHEET C0-1
HORSE CREEK HILLS SUB
SURVEY CONTROL



PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 0+00 - STA 14+50)



PROFILE VIEW - STRAWBERRY ROAN TRAIL (STA 0+00 - STA 14+50)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 50 100
VERTICAL SCALE FEET 0 10 20

PROJECT ENGINEER: MAF
DRAWN BY: JDS
DESIGNED BY: JDS
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STRAWBERRY ROAN TRAIL PLAN & PROFILE
SEC. 31, T9N, R2E, PMM, BROADWATER COUNTY, MONTANA

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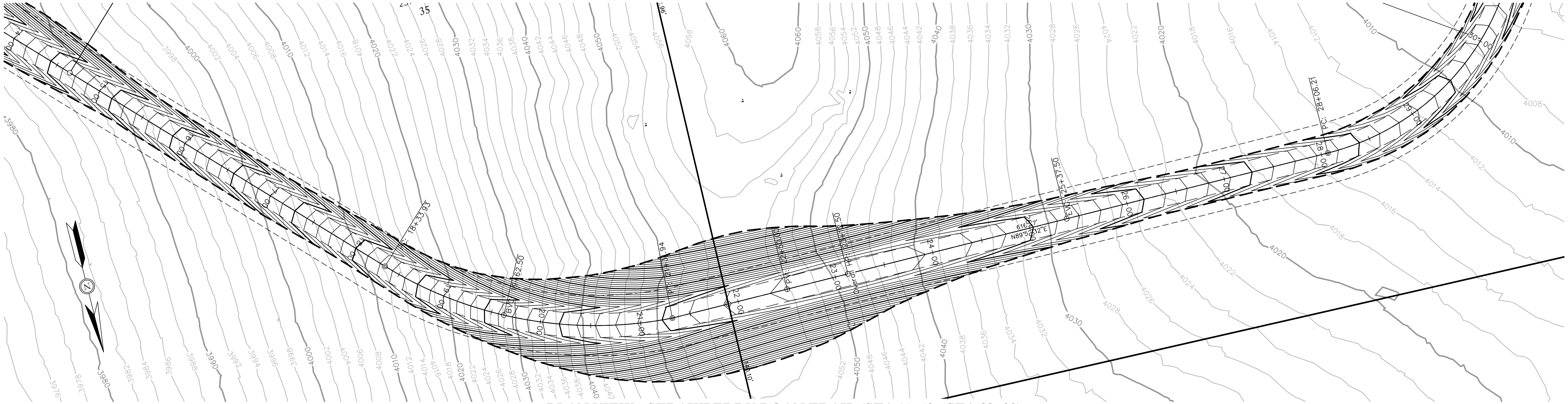
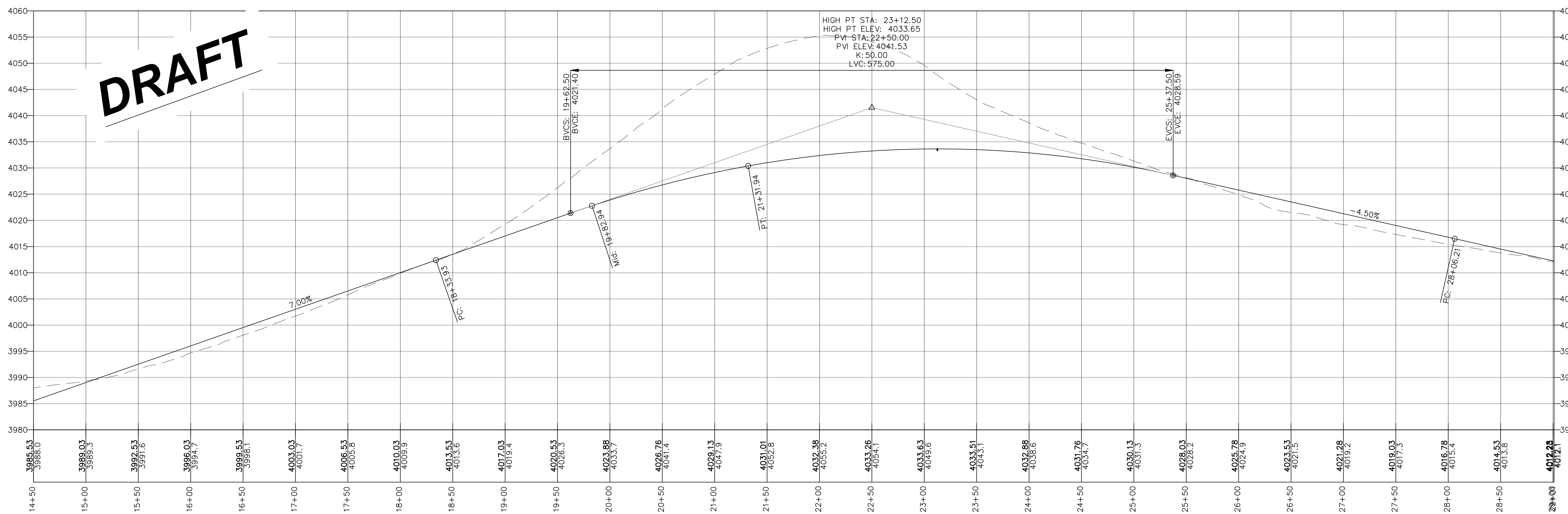
Civil Engineering
Geotechnical Engineering
Land Surveying

PROJECT #: 19-072
DATE: 02/12/2020
SHEET C1-1

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL P&P



PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 14+50 - STA 29+00)



PROFILE VIEW - STRAWBERRY ROAN TRAIL (STA 14+50 - STA 29+00)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 50 100

VERTICAL SCALE FEET 0 10 20

PROJECT ENGINEER: MAF | DRAWN BY: JDS

DESIGNED BY: JDS | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STRAWBERRY ROAN TRAIL PLAN & PROFILE
SEC. 31, T9N, R2E, PMM, BROADWATER COUNTY, MONTANA

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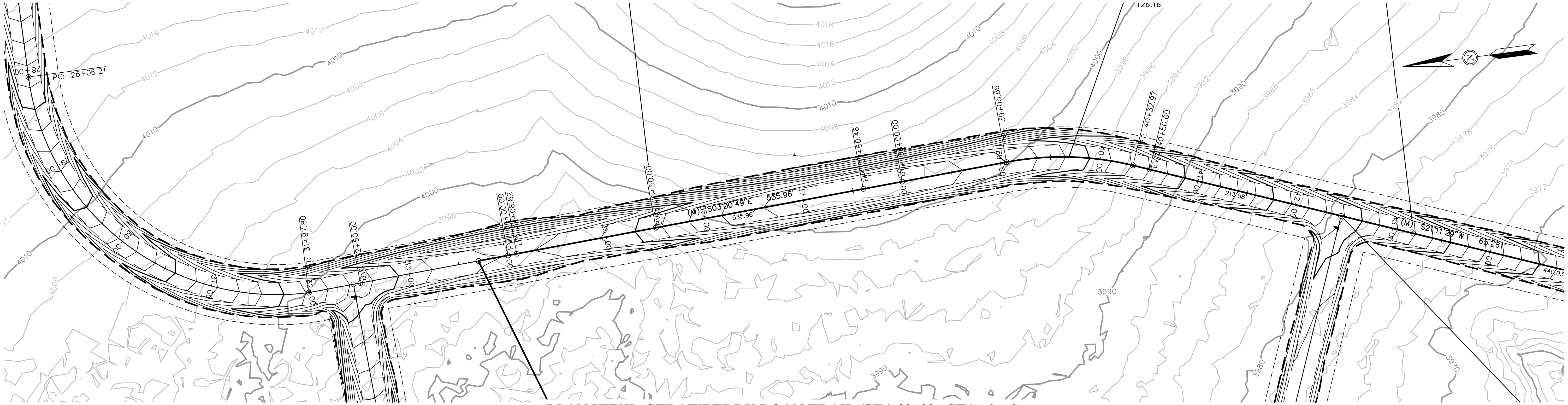
PROJECT #: 19-072
DATE: 02/12/2020

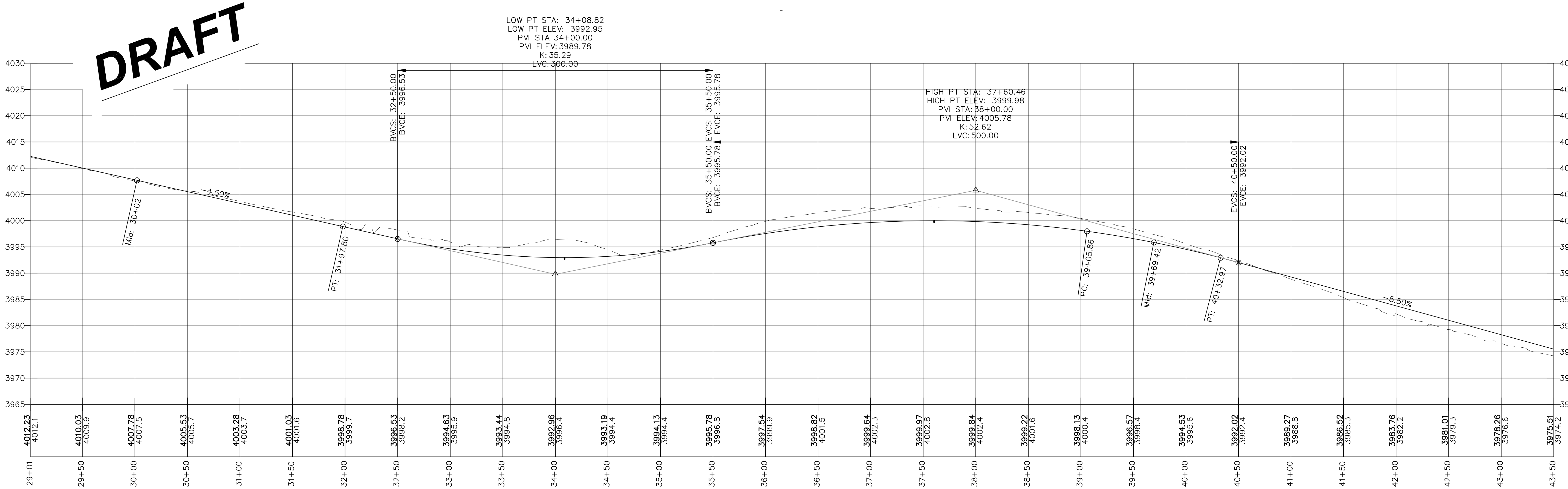
SHEET C1-2

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL P&P



PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 29+00 - STA 43+50)

DRAFT



PROFILE VIEW - STRAWBERRY ROAN TRAIL (STA 29+00 - STA 43+50)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0, 50, 100
VERTICAL SCALE FEET: 0, 10, 20

PROJECT ENGINEER: MAF
DRAWN BY: JDS
DESIGNED BY: JDS
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
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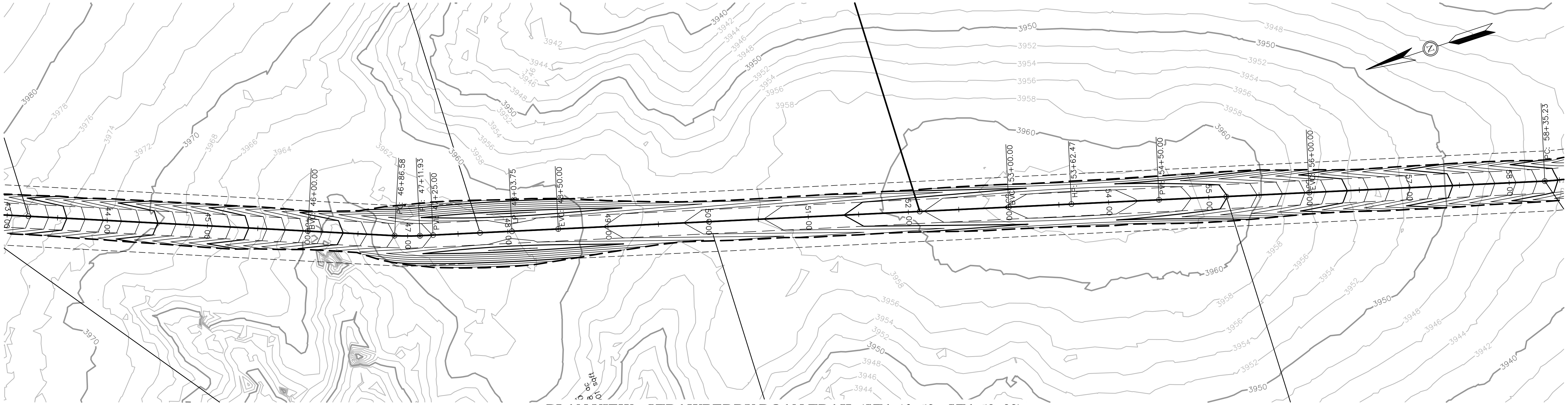
PROJECT #: 19-072
DATE: 02/12/2020

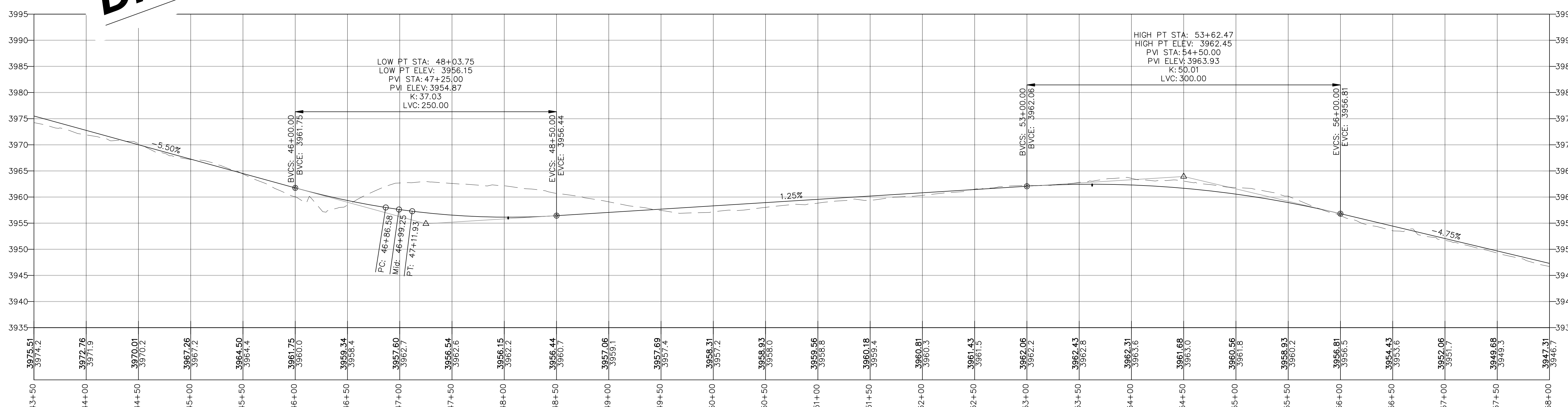
SHEET
C1-3

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL P&P



PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 43+50 - STA 58+00)

DRAFT



PROFILE VIEW - STRAWBERRY ROAN TRAIL (STA 43+50 - STA 58+00)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0, 50, 100

VERTICAL SCALE FEET: 0, 10, 20

PROJECT ENGINEER: MAF | DRAWN BY: JDS

DESIGNED BY: JDS | REVIEWED BY: MAF

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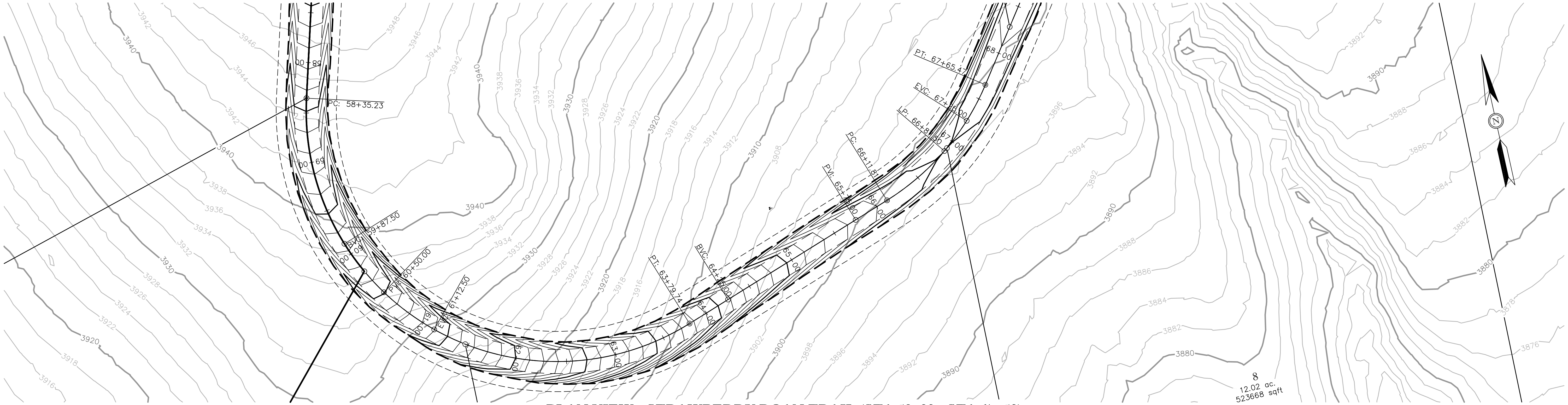
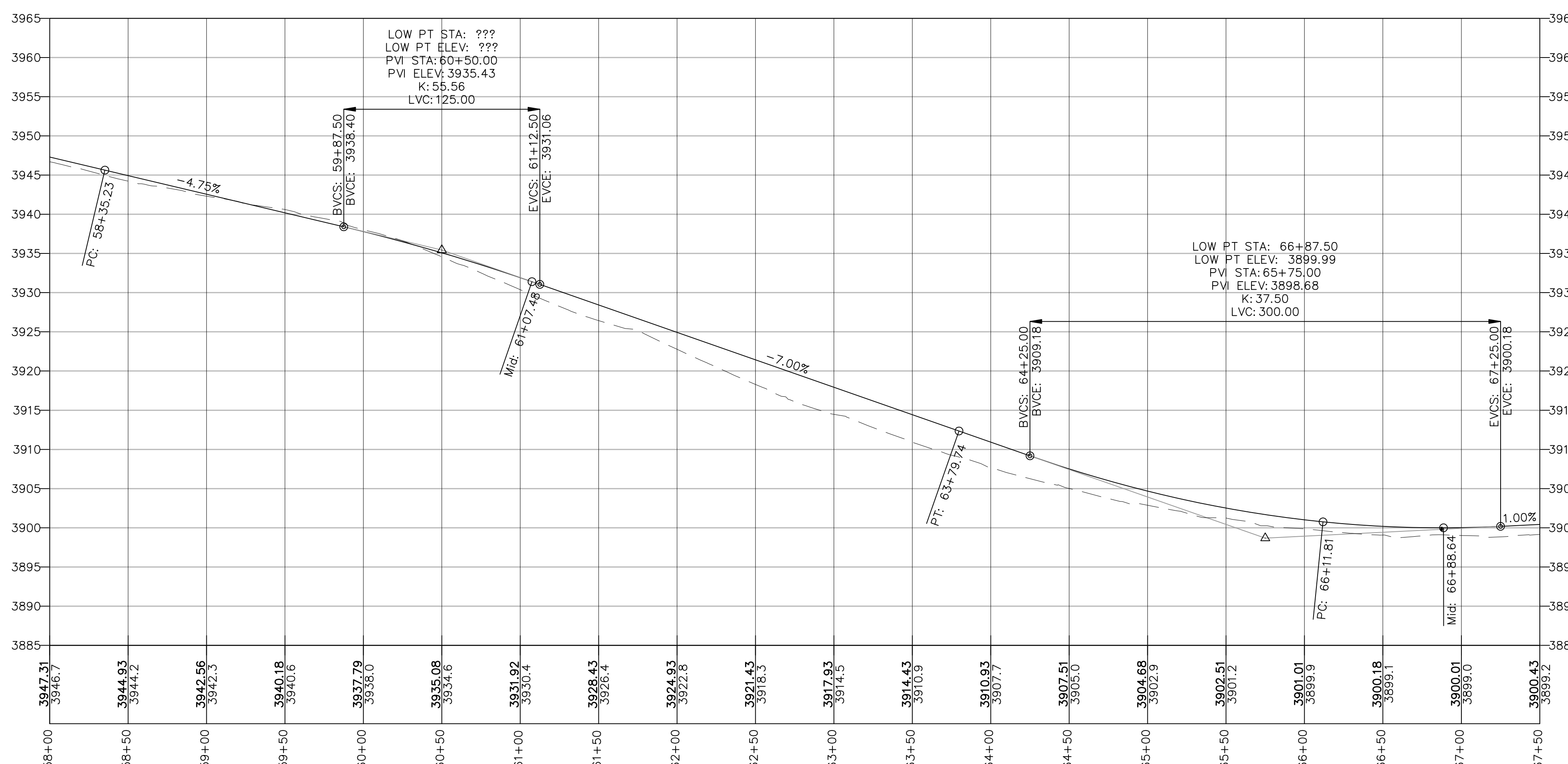
SHEET C1-4

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL P&P

DRAFT



PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 58+00 - STA 67+50)



PROFILE VIEW - STRAWBERRY ROAN TRAIL (STA 58+00 - STA 67+50)

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 277

HORIZONTAL SCALE FEET 0 50 100

VERTICAL SCALE FEET 0 10 20

PROJECT ENGINEER: MAF
DRAWN BY: JDS
DESIGNED BY: JDS
REVIEWED BY: MAF

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DATE: 02/12/2020

SHEET C1-5

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL P&P

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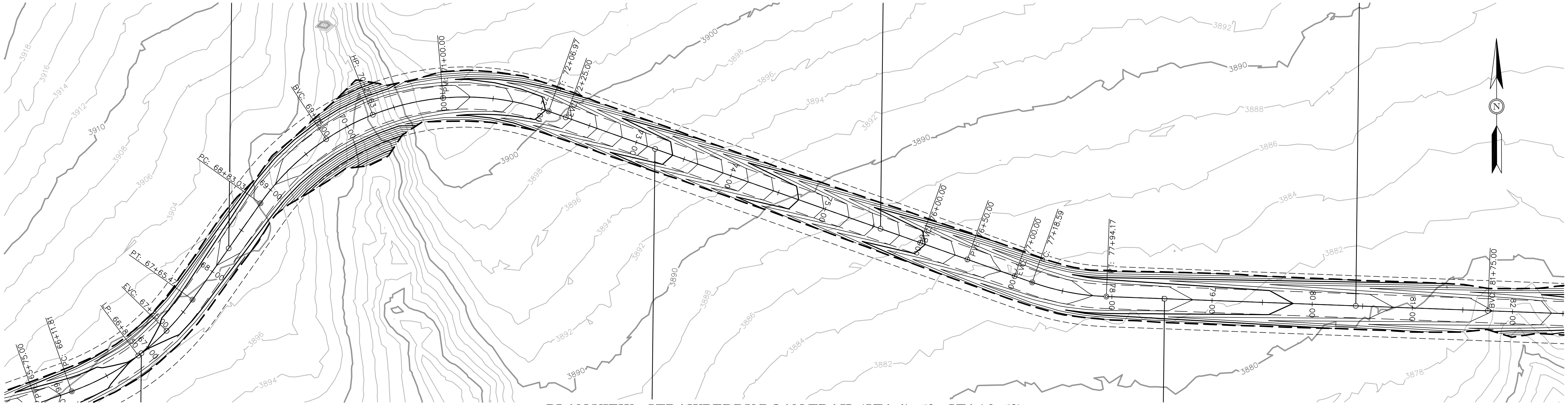
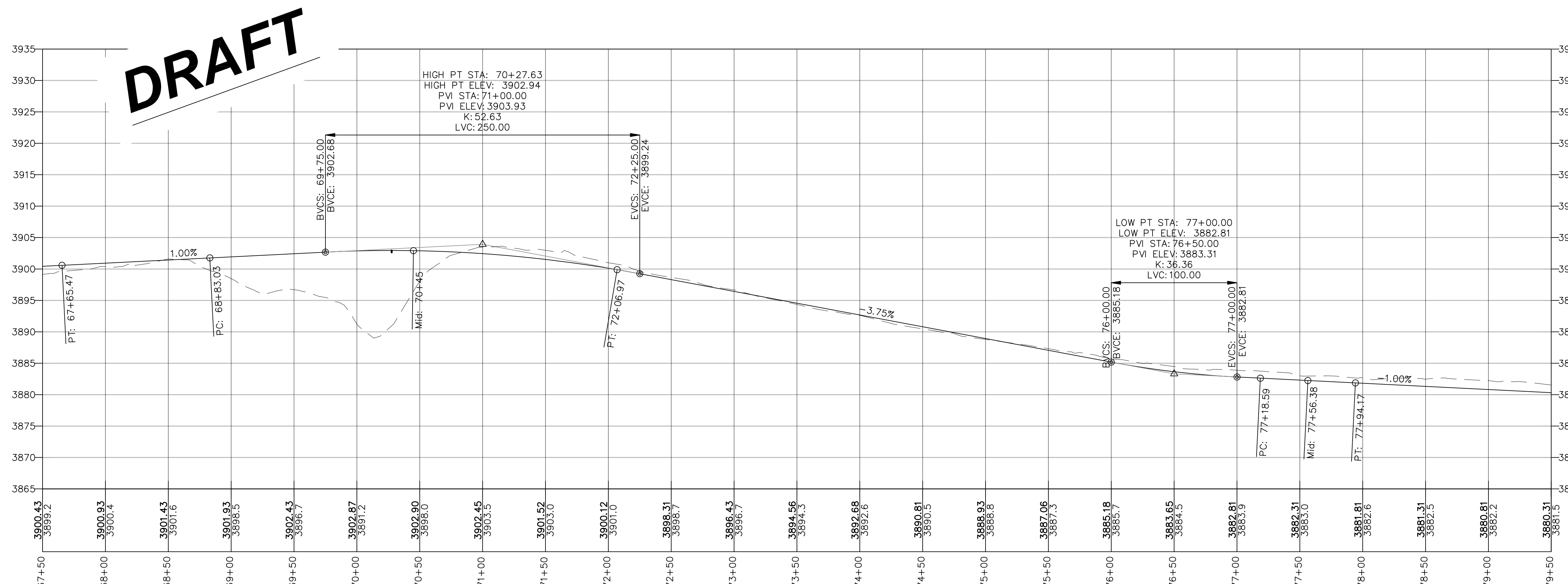


PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 67+50 - STA 79+50)



PROFILE VIEW - STRAWBERRY ROAN TRAIL (STA 67+50 - STA 79+50)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0, 50, 100
VERTICAL SCALE FEET: 0, 10, 20

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

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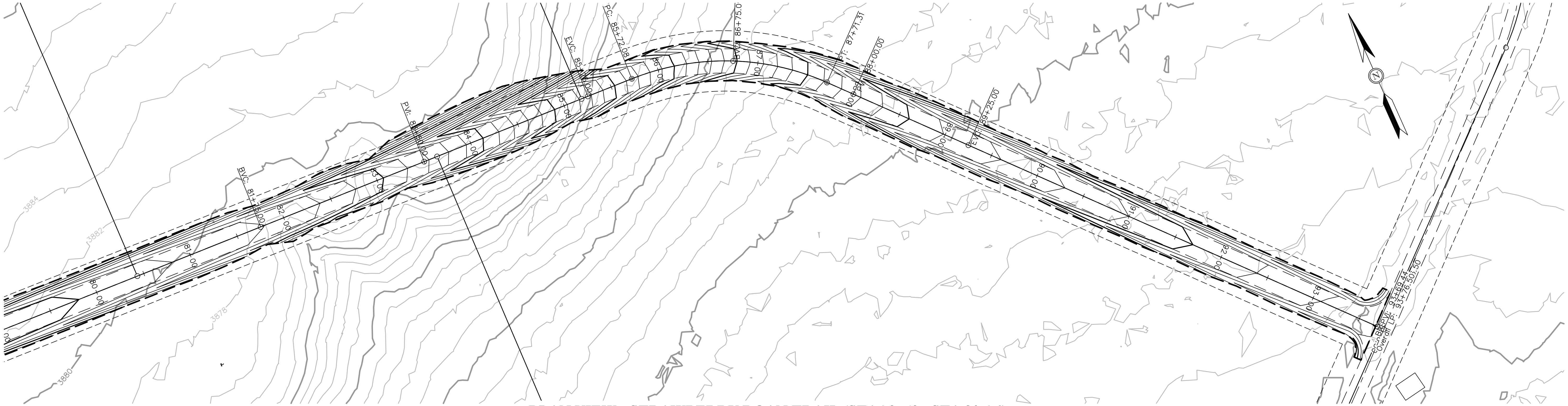
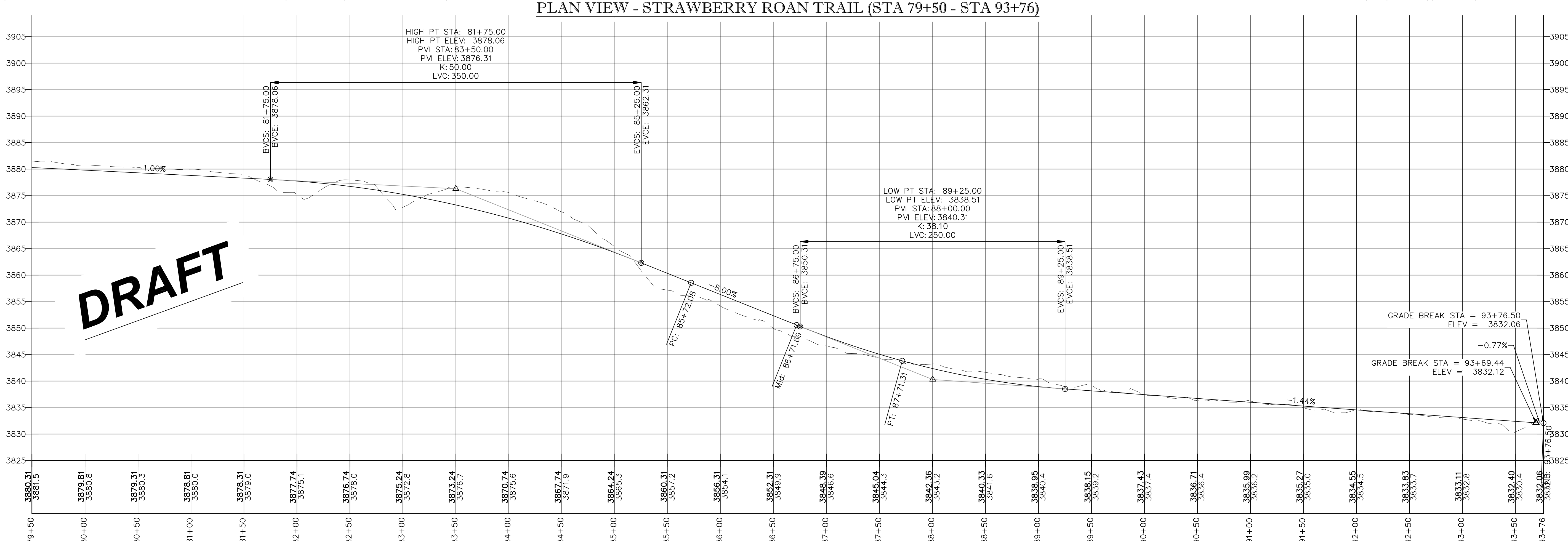
DATE: 02/12/2020

SHEET
C1-6

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL P&P



PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 79+50 - STA 93+76)



PROFILE VIEW - STRAWBERRY ROAN TRAIL (STA 79+50 - STA 93+76)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 50 100
VERTICAL SCALE FEET 0 10 20

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

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DATE: 02/12/2020

SHEET C1-7

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL P&P

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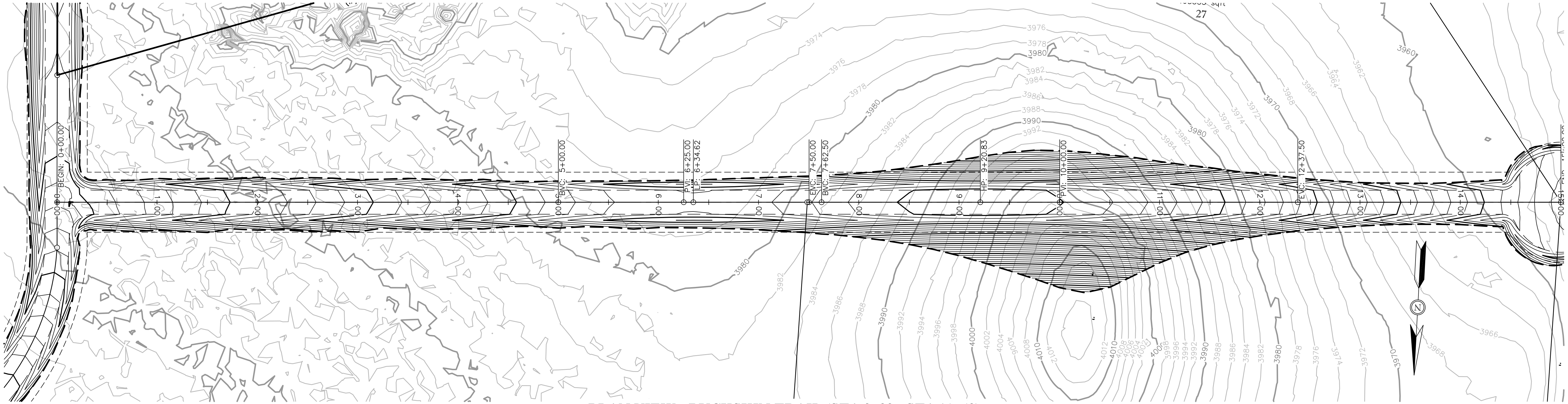
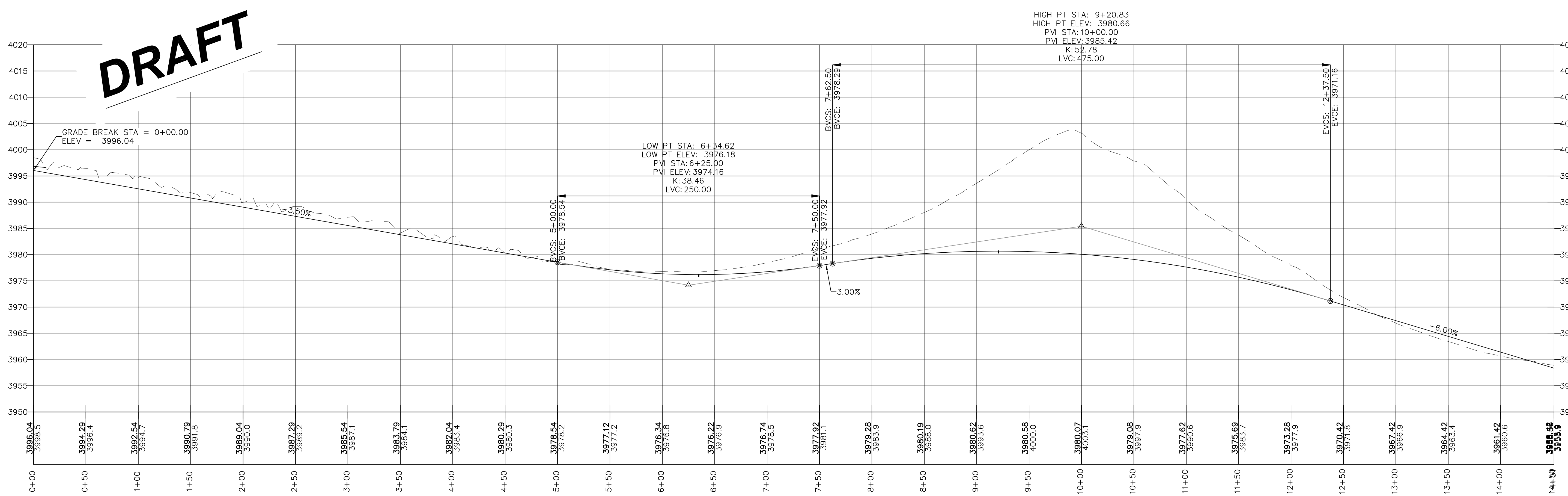


PLAN VIEW - BUCKSKIN TRAIL (STA 0+00 - STA 14+50)



PROFILE VIEW - BUCKSKIN TRAIL (STA 0+00 - STA 14+50)

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 50 100

VERTICAL SCALE FEET 0 10 20

PROJECT ENGINEER: MAF — DRAWN BY: JDS

DESIGNED BY: JDS — REVIEWED BY: MAF

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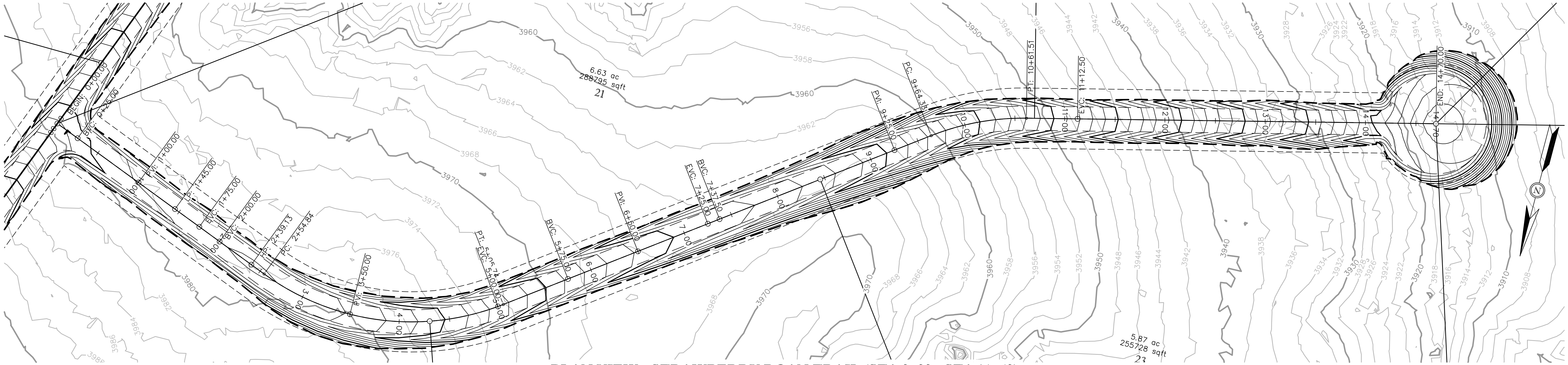
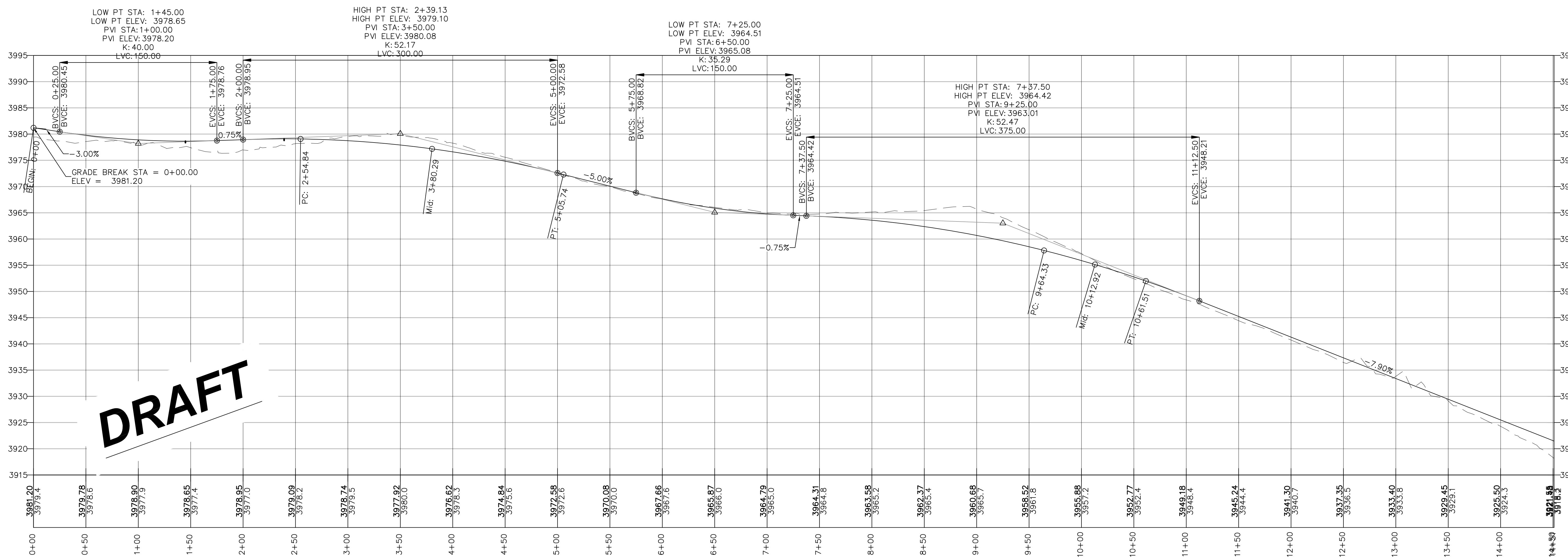
PROJECT #: 19-072
DATE: 02/12/2020

SHEET C1-8

HORSE CREEK HILLS SUB
BUCKSKIN TRAIL P&P



PLAN VIEW - STRAWBERRY ROAN TRAIL (STA 0+00 - STA 14+50)



PROFILE VIEW - APPALOOSA TRAIL (STA 0+00 - STA 14+50)

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 281

HORIZONTAL SCALE FEET: 0 50 100
VERTICAL SCALE FEET: 0 10 20

PROJECT ENGINEER: MAF
DRAWN BY: JDS
DESIGNED BY: JDS
REVIEWED BY: MAF

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PROJECT #: 19-072
DATE: 02/12/2020
SHEET C1-9
HORSE CREEK HILLS SUB
APPALOSSA TRAIL P&P

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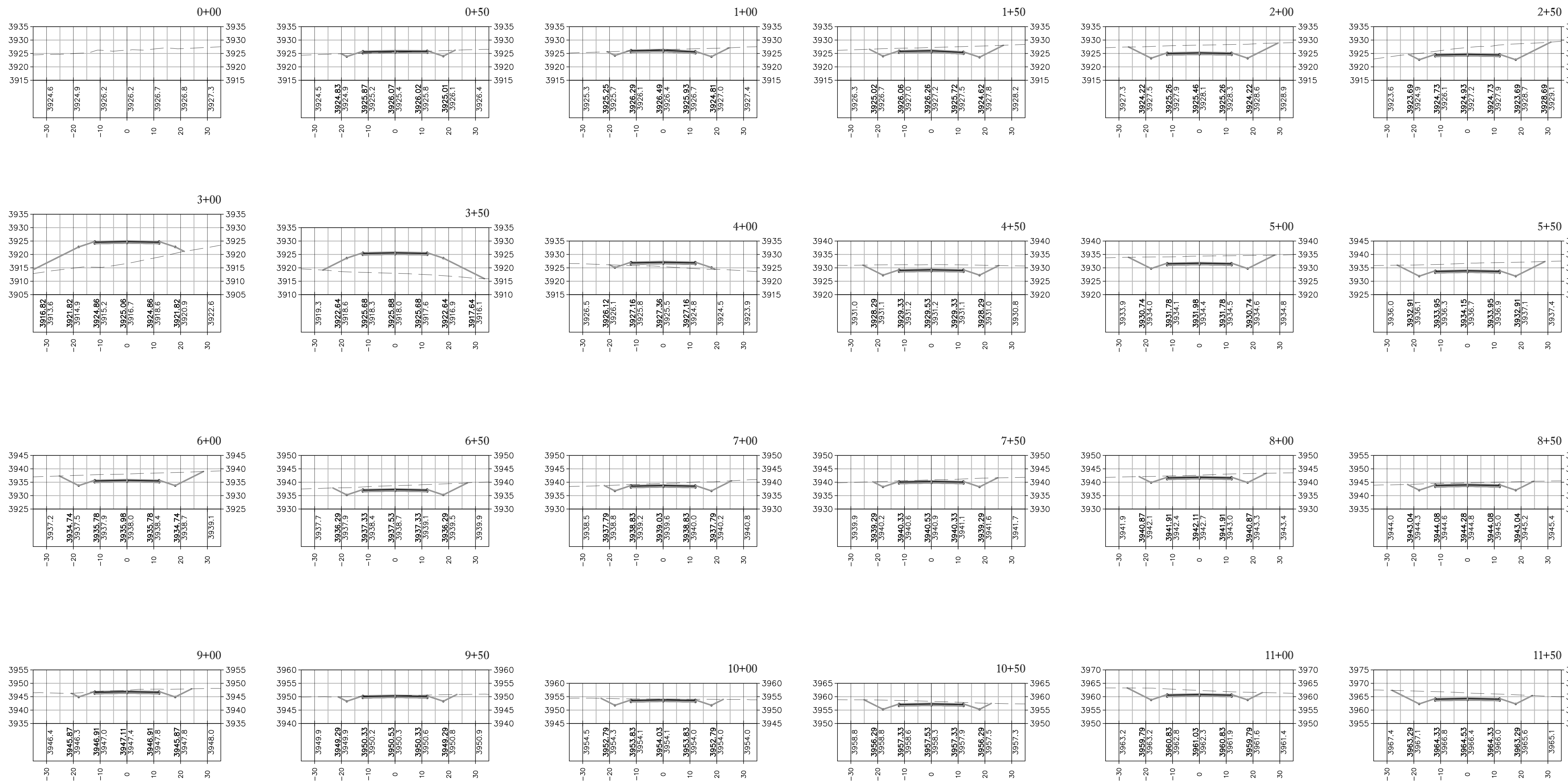

NO.	REVISIONS	DRAWN BY	DATE

DRAFT

SCALE (FEET) 0 20 40 60

PROJECT ENGINEER: MAF | DRAWN BY: JDS

DESIGNED BY: JDS | REVIEWED BY: MAF

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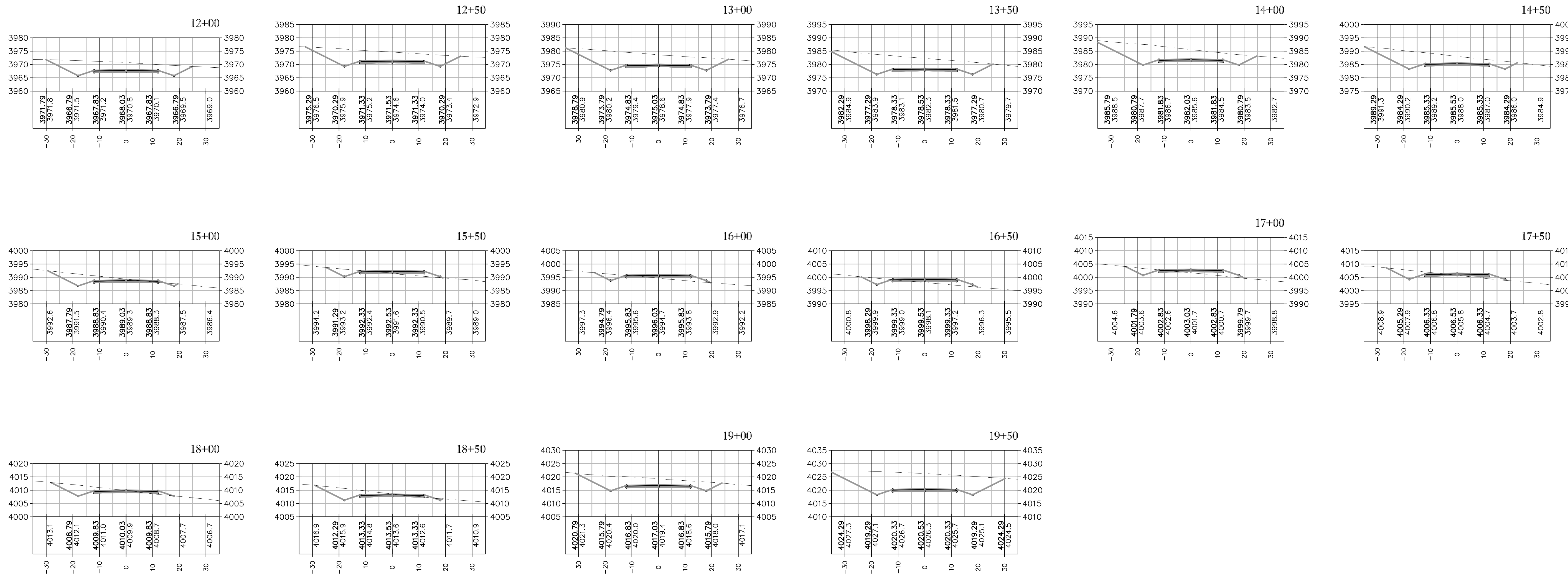
PROJECT #: 19-072
DATE: 02/12/2020

SHEET C2-1

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



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NO.	REVISIONS	DRAWN BY	DATE

DRAFT

0 20 40 60
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
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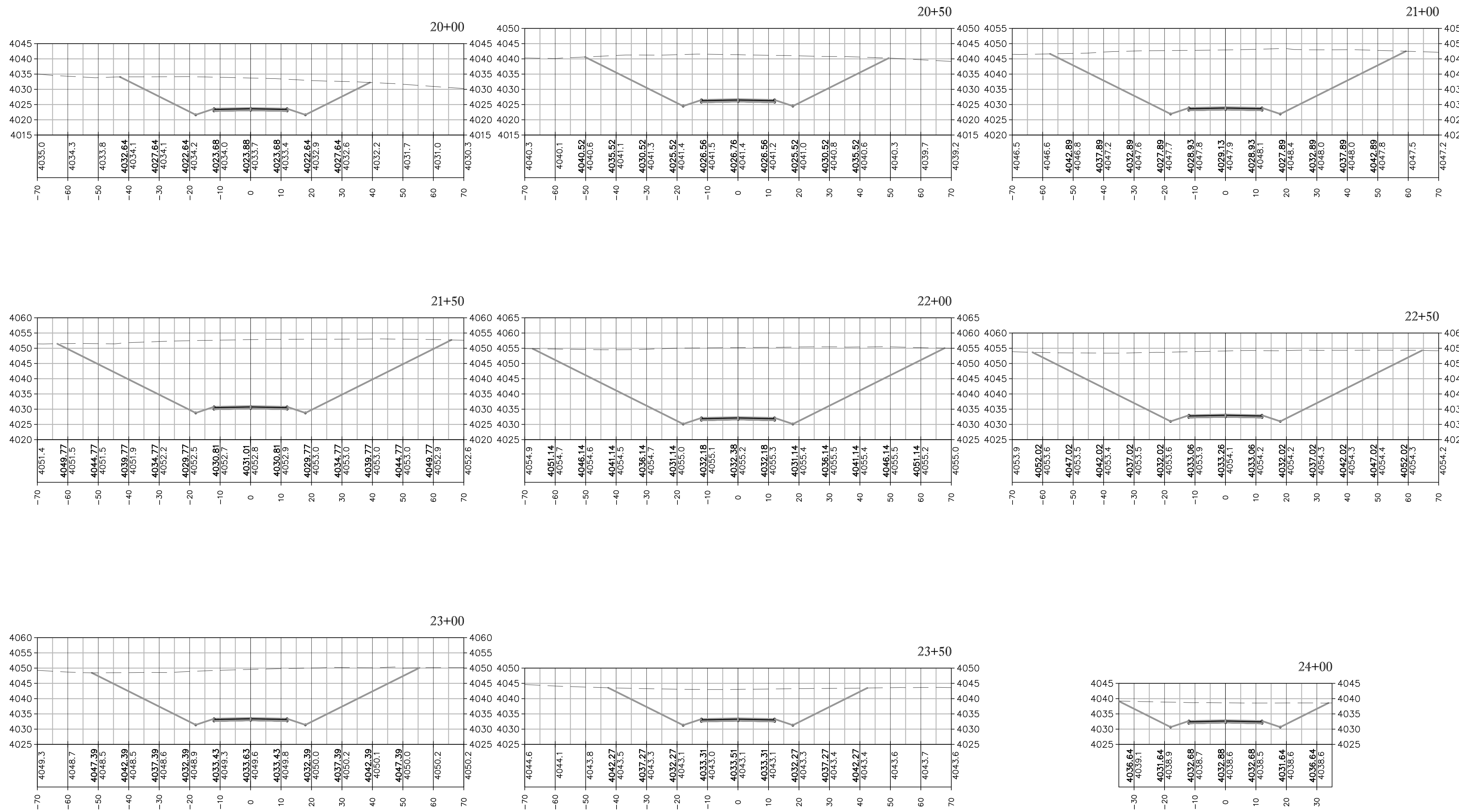
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C2-2

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

SCALE (FEET) 0 20 40 60

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

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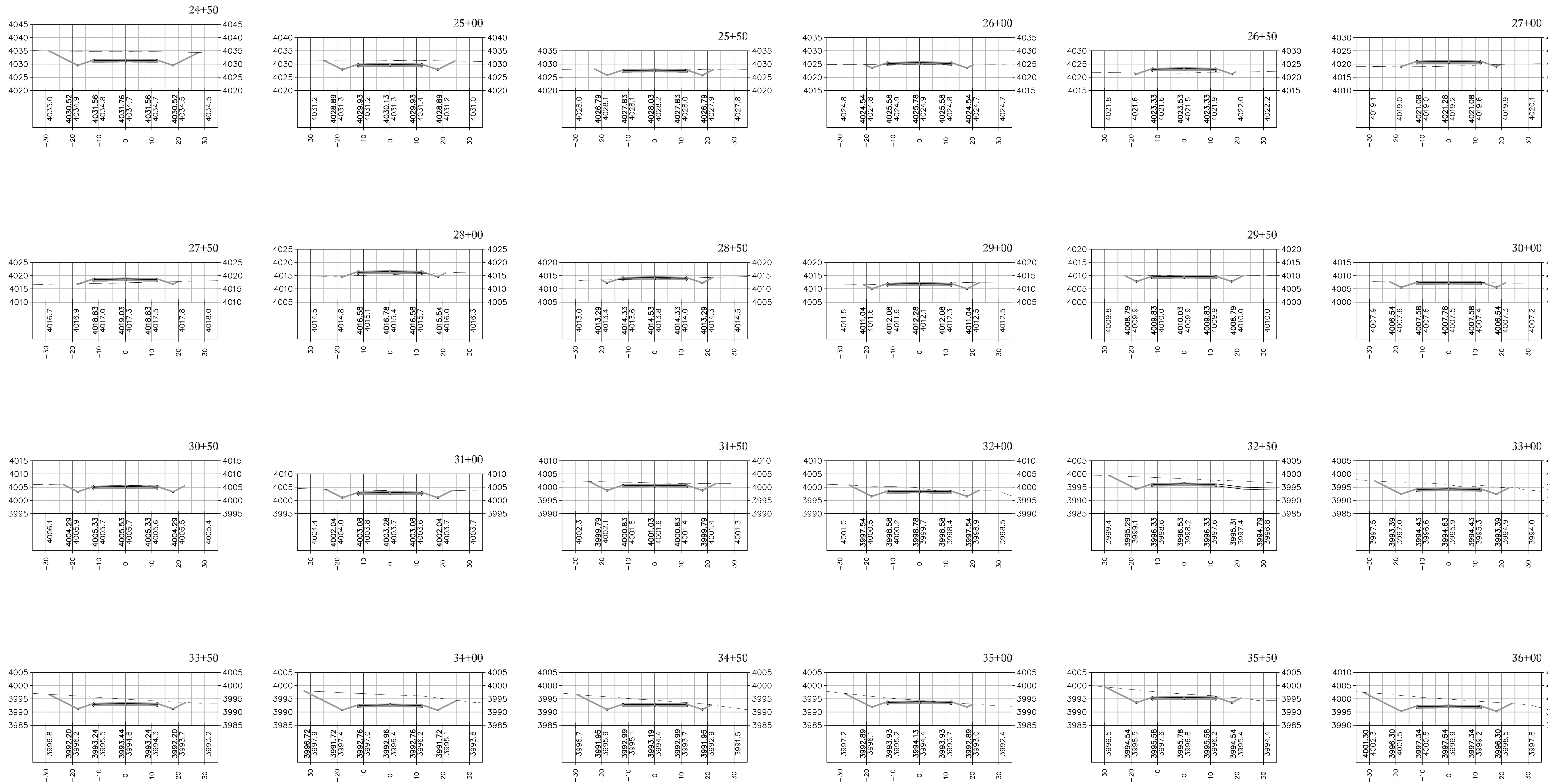
PROJECT #: 19-072
DATE: 02/12/2020

SHEET C2-3

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

DEQ Page 285

0 20 40 60
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

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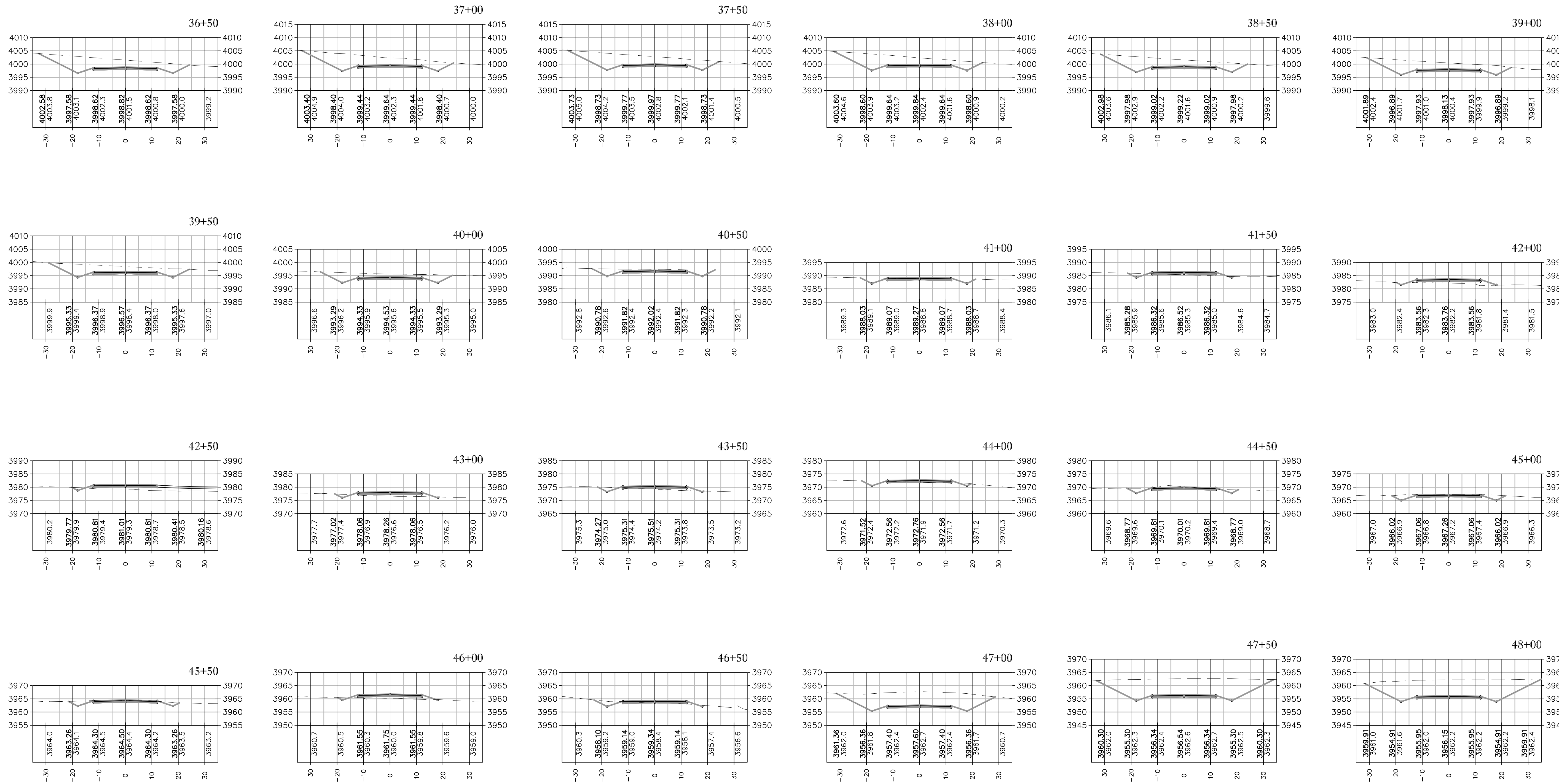
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C2-4

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

DEQ Page 286

0 20 40 60

SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS

DESIGNED BY: JDS | REVIEWED BY: MAF

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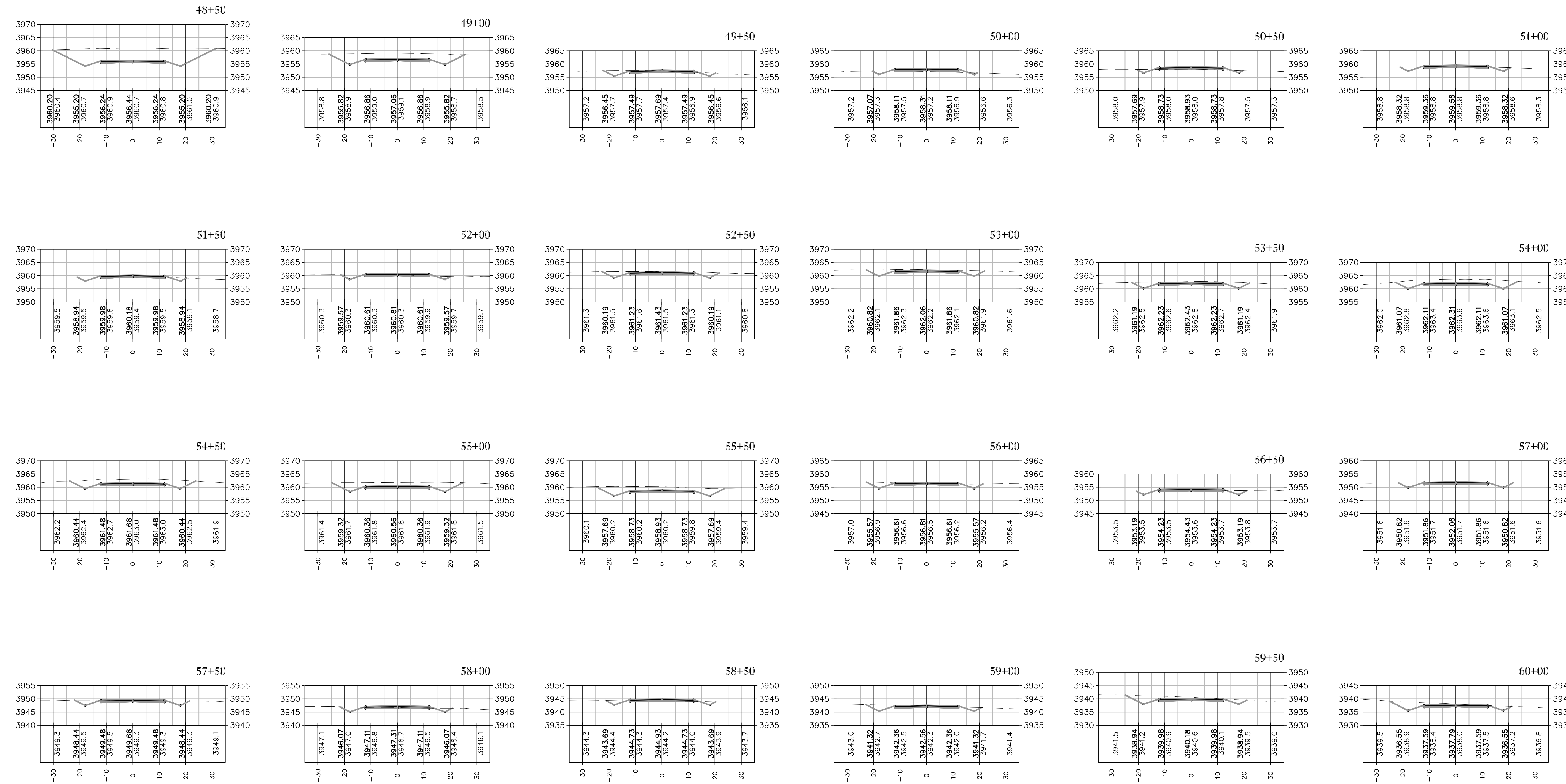
PROJECT #: 19-072

DATE: 02/12/2020

SHEET C2-5

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

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0 20 40 60
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

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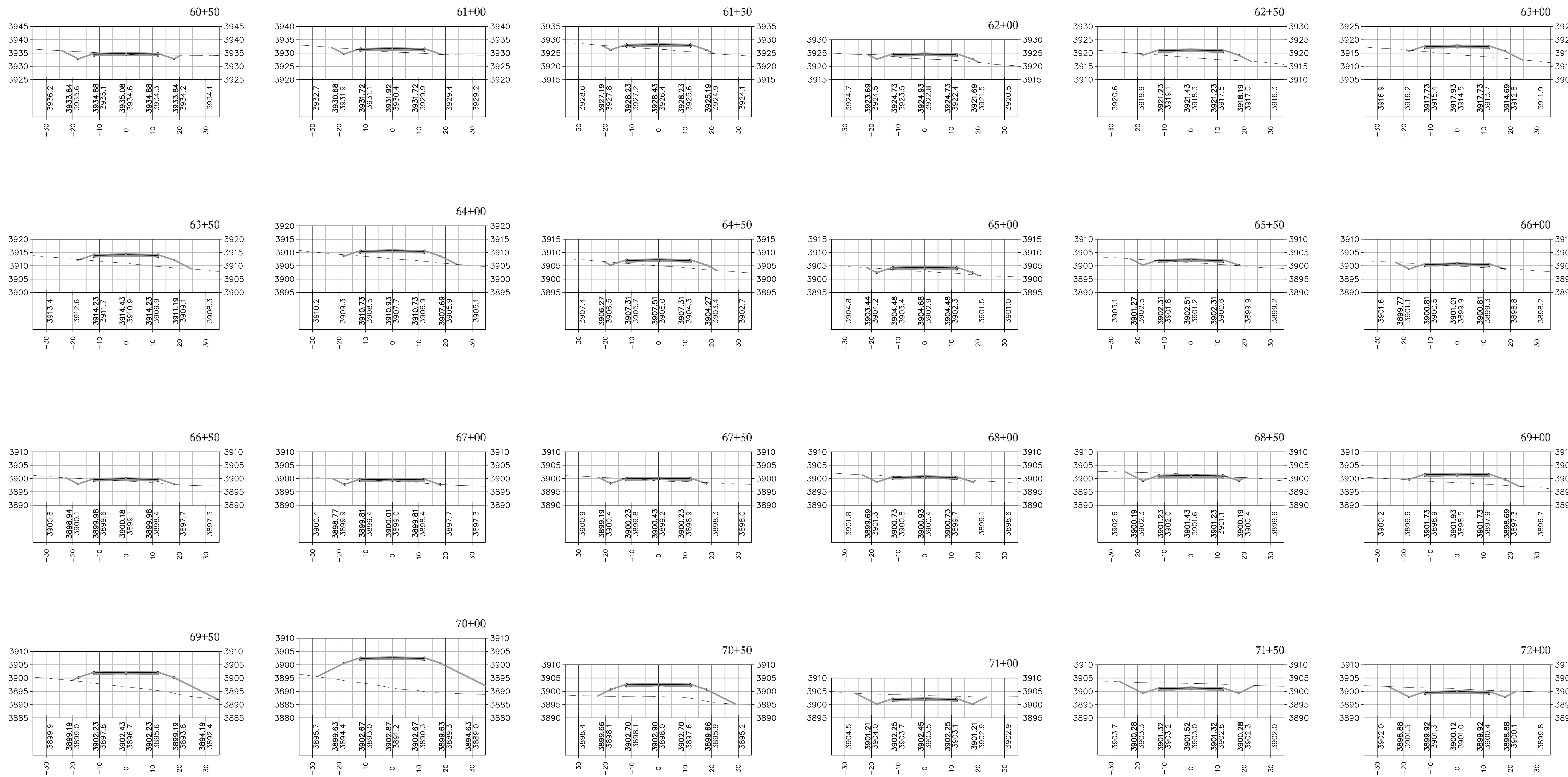
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C2-6

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

SCALE (FEET) 0 20 40 60

PROJECT ENGINEER: MAF
DRAWN BY: JDS
DESIGNED BY: JDS
REVIEWED BY: MAF

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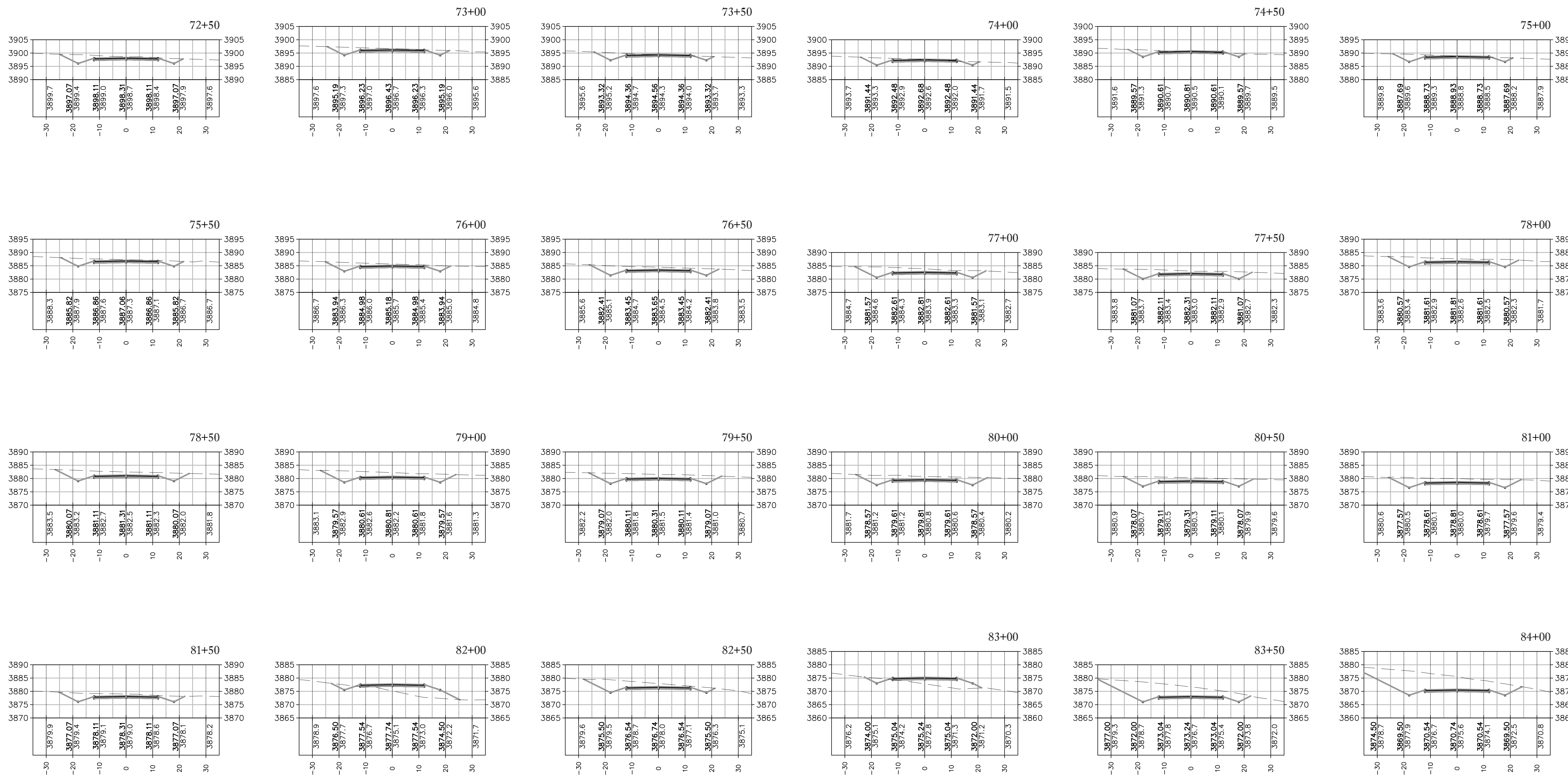
PROJECT #: 19-072
DATE: 02/12/2020

SHEET C2-7

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

DEQ Page 289

0 20 40 60

SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS

DESIGNED BY: JDS | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
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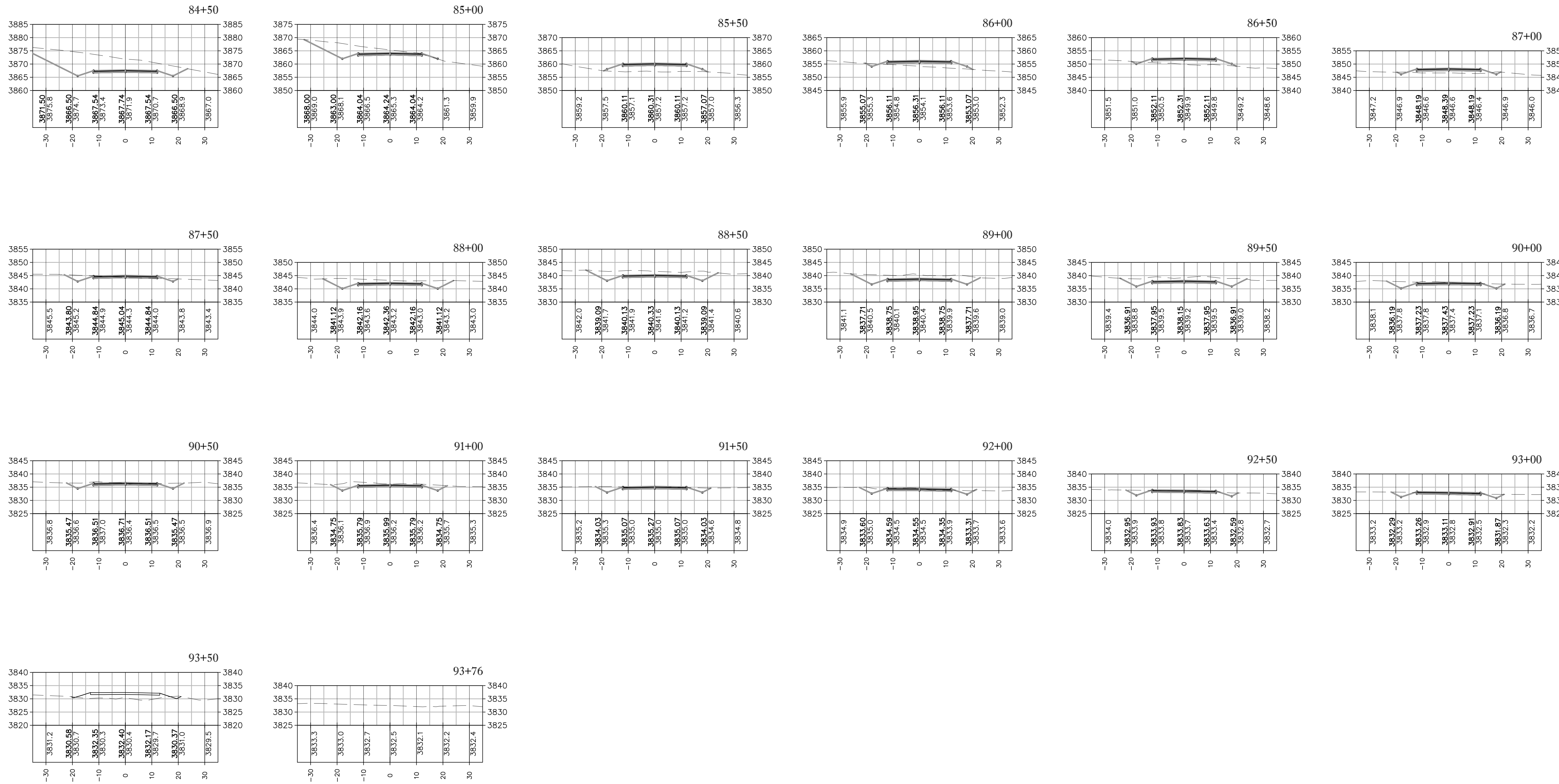
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C2-8

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

DEQ Page 290

0 20 40 60
SCALE (FEET)

PROJECT ENGINEER: MAF	DRAWN BY: JDS
DESIGNED BY: JDS	REVIEWED BY: MAF

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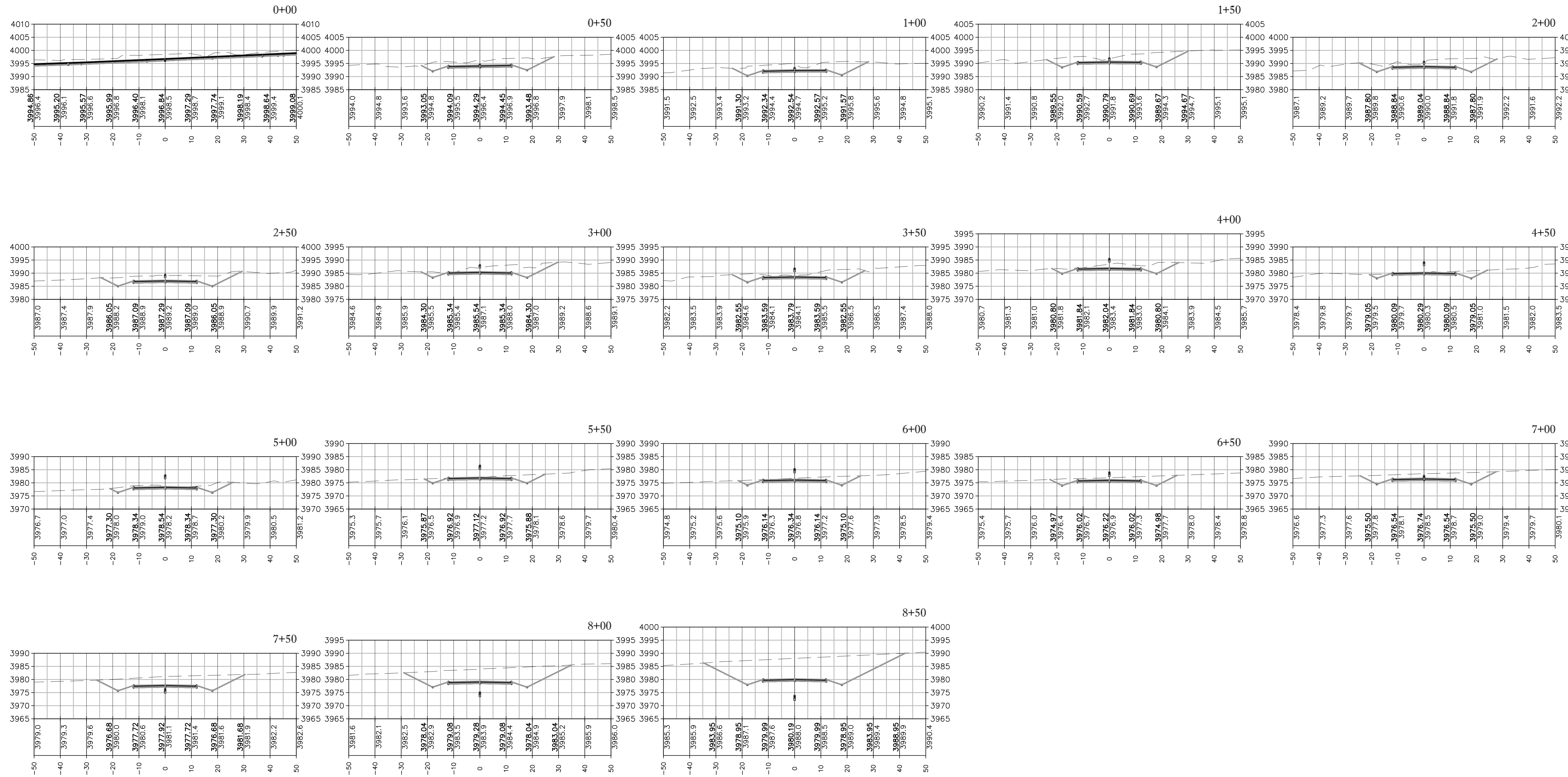
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C2-9

HORSE CREEK HILLS SUB
STRAWBERRY ROAN X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

DEQ Page 291

0 20 40 60

SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS

DESIGNED BY: JDS | REVIEWED BY: MAF

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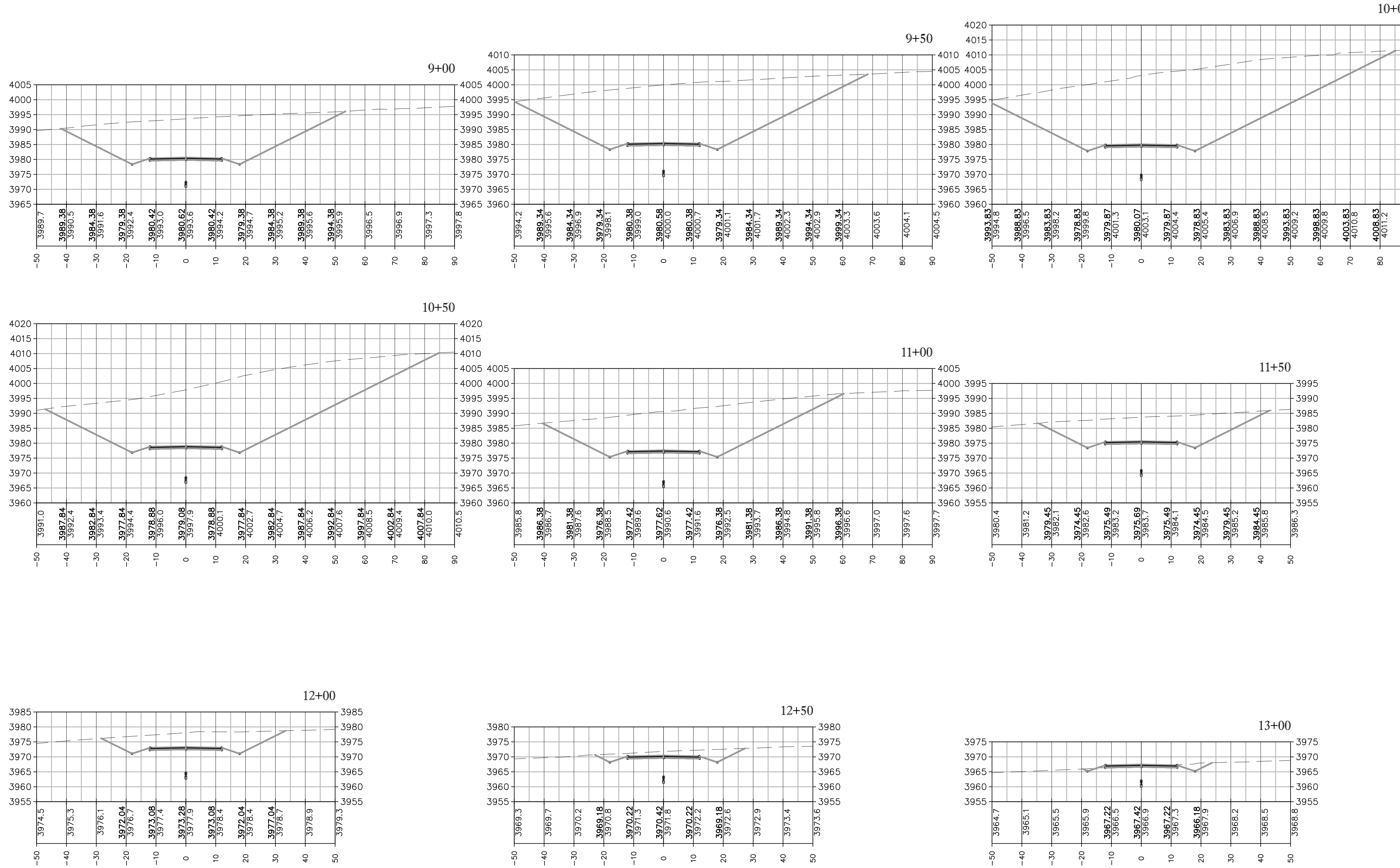
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C2-10

HORSE CREEK HILLS SUB
BUCKSKIN TRAIL X-SECs



NO.	REVISIONS	DRAWN BY	DATE

DRAFT

0 20 40 60

SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS

DESIGNED BY: JDS | REVIEWED BY: MAF

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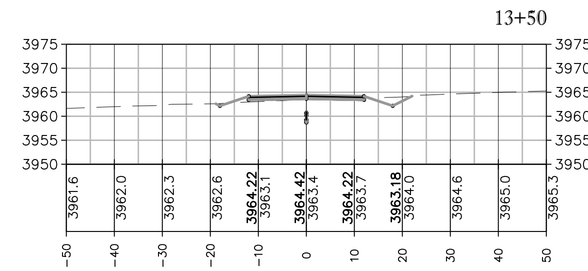
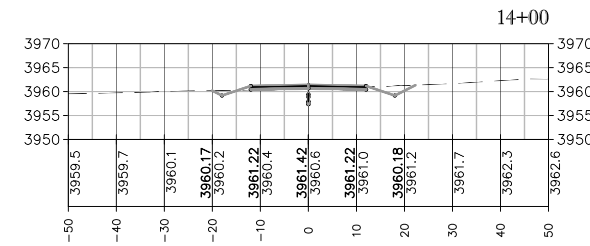
PROJECT #: 19-072

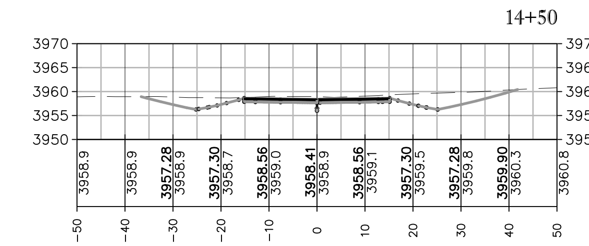
DATE: 02/12/2020

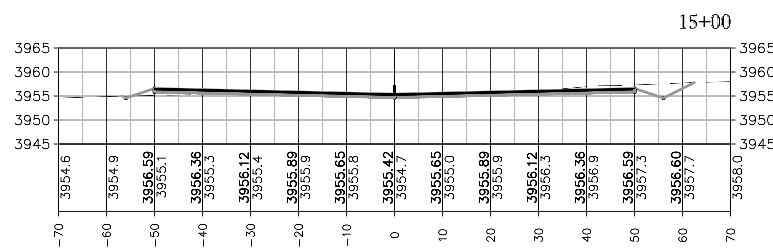
SHEET C2-11

HORSE CREEK HILLS SUB
BUCKSKIN TRAIL X-SECs









NO.	REVISIONS	DRAWN BY	DATE

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DEQ Page 293

0 20 40 60
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
BUCKSKIN TRAIL CROSS-SECTIONS
SEC. 31, T9N, R2E, PMM, BROADWATER COUNTY, MONTANA

32 DISCOVERY DRIVE
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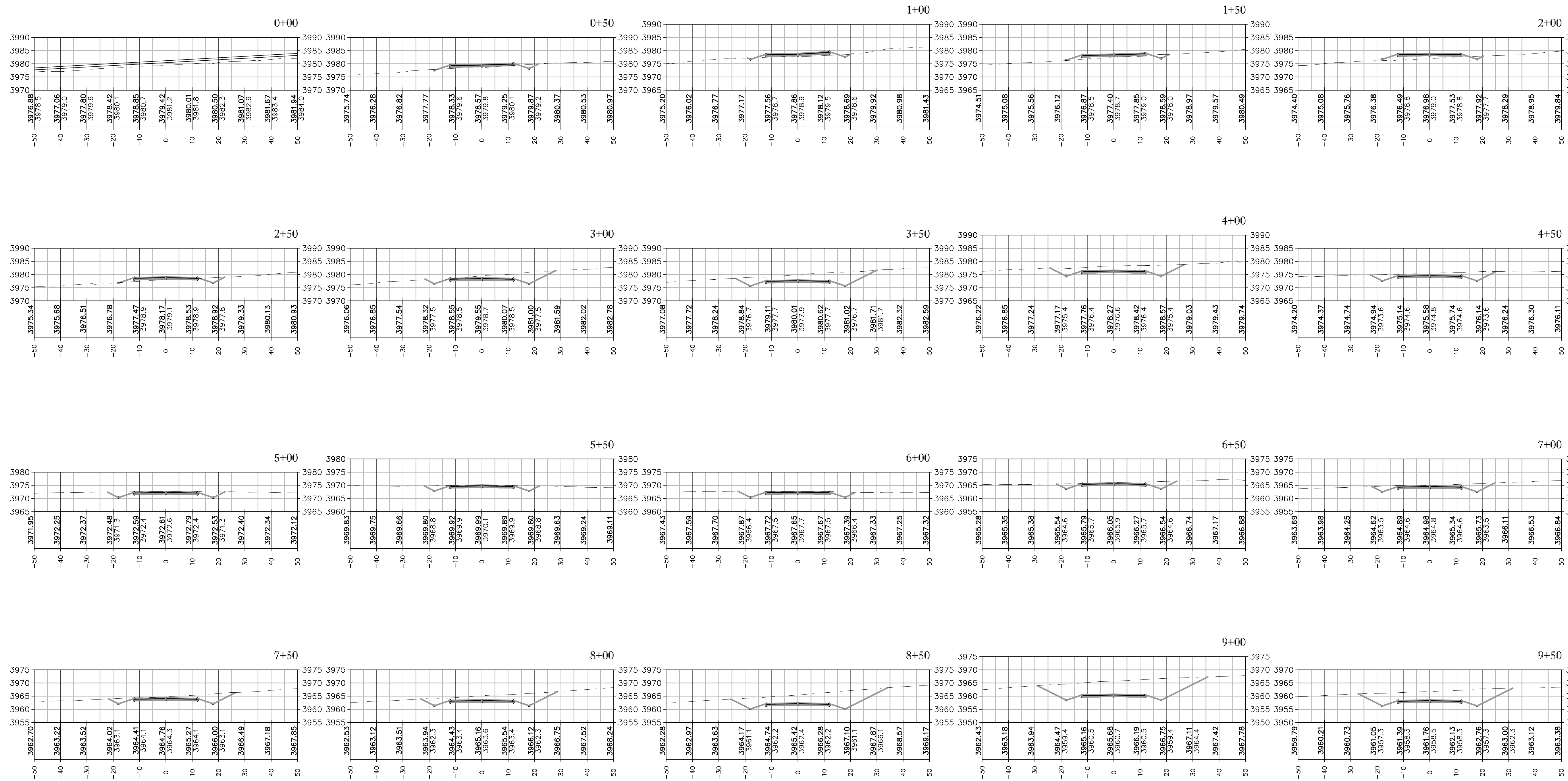
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C2-12

HORSE CREEK HILLS SUB
BUCKSKIN TRAIL X-SECs



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PROJECT ENGINEER: MAF | DRAWN BY: JDS
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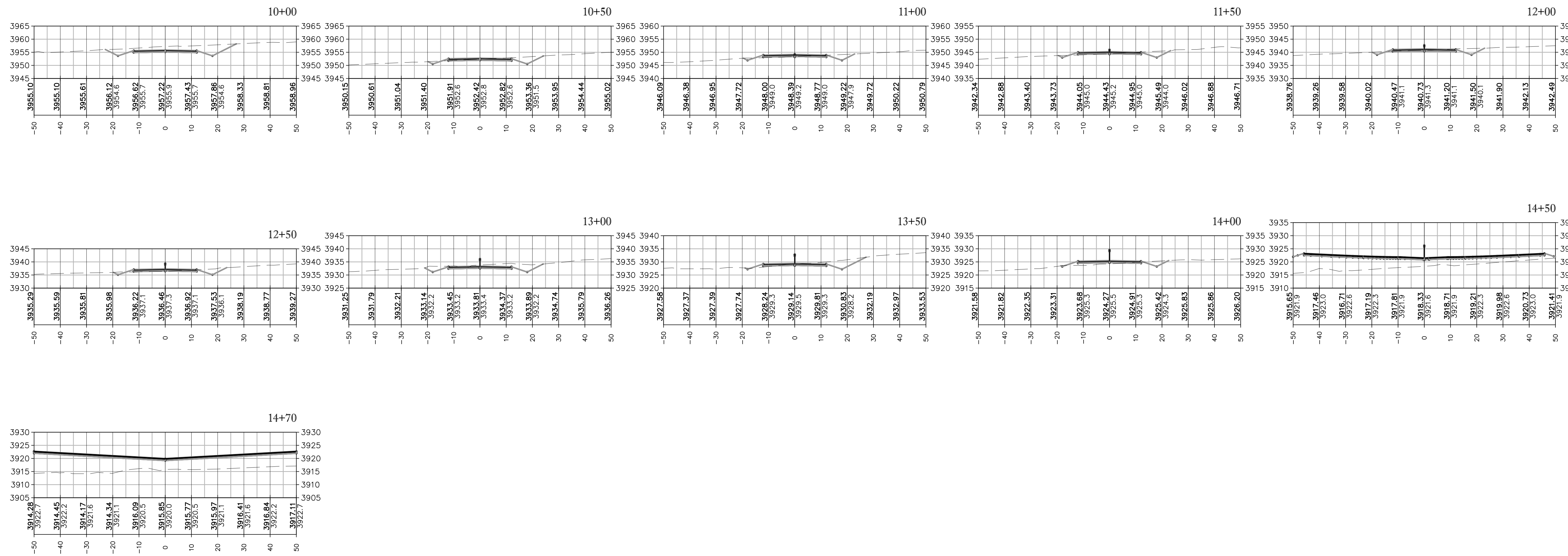
DATE: 02/12/2020

SHEET C2-13

HORSE CREEK HILLS SUB
APPALOOSA TRAIL X-SECs



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SHEET
C2-14

HORSE CREEK HILLS SUB
APPALOOSA TRAIL X-SECs

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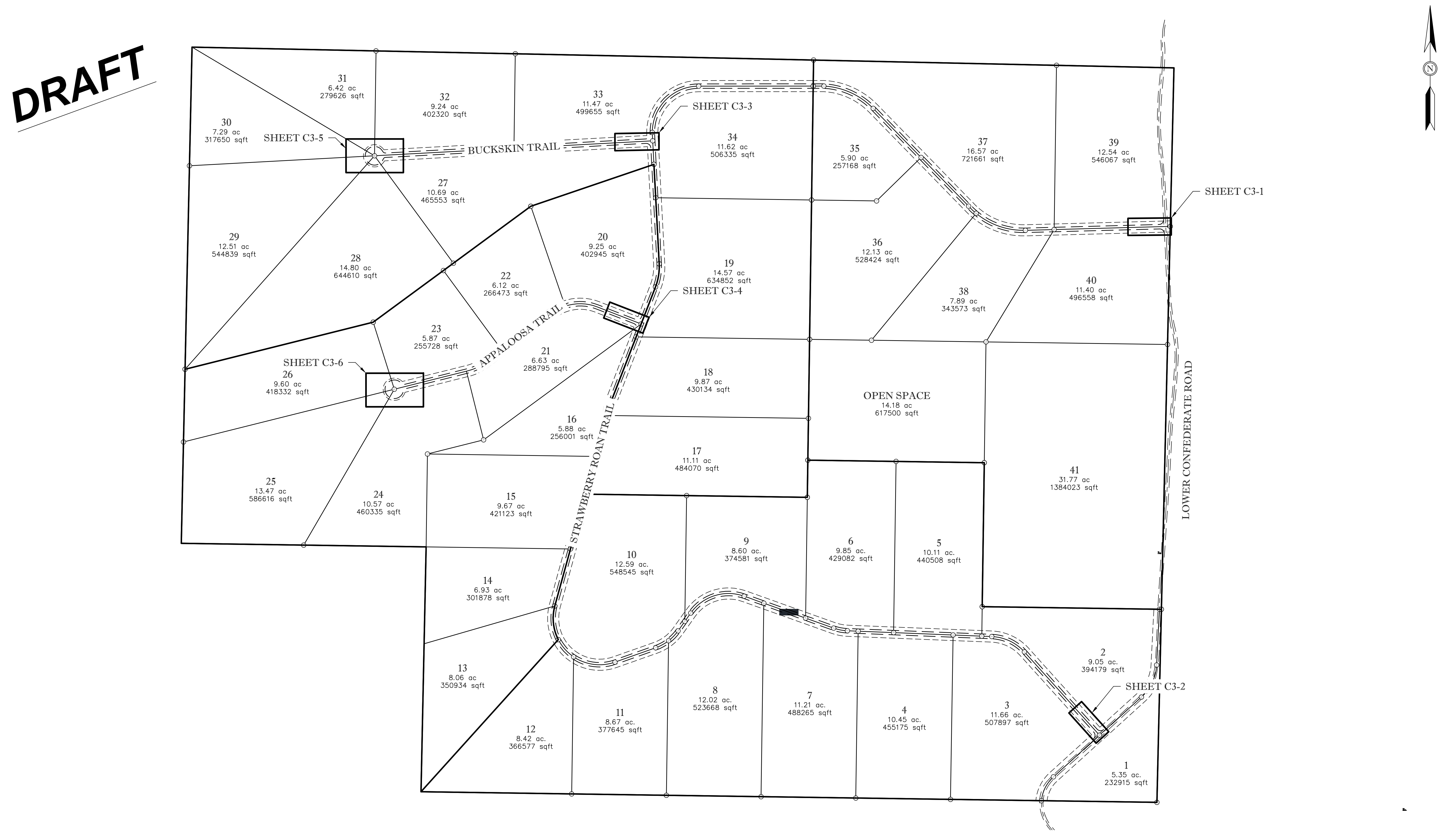

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0 5 10 15
SCALE (FEET)

PROJECT ENGINEER: MAF
DRAWN BY: JDS
DESIGNED BY: JDS
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
INTERSECTION INDEX SHEET
SEC. 31, T9N, R2E, PMM, BROADWATER COUNTY, MONTANA

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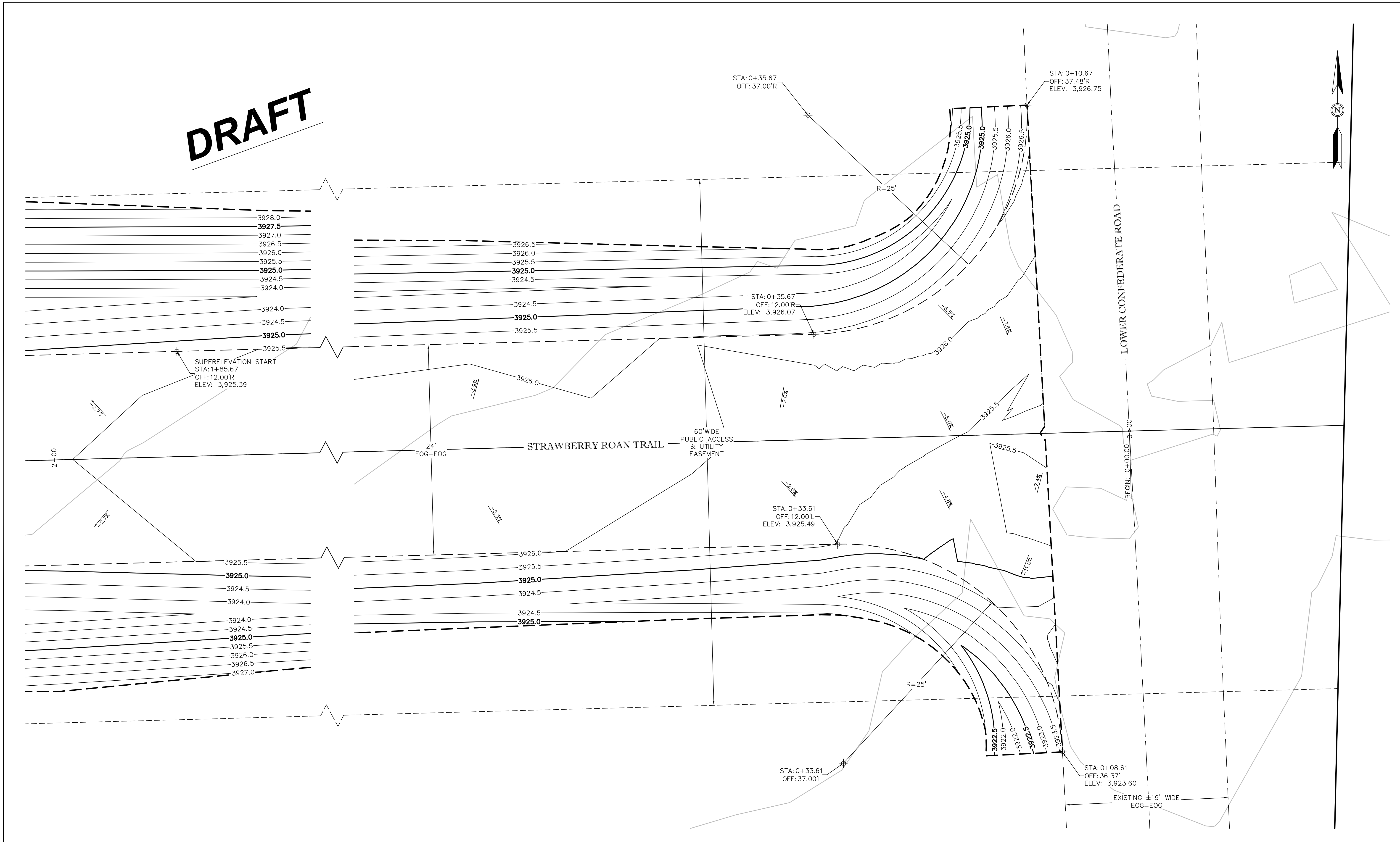
PROJECT #: 19-072
DATE: 02/12/2020
SHEET
C3-0

HORSE CREEK HILLS SUB
INTERSECTION INDEX SHEET



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0 5 10 15
SCALE (FEET)

PROJECT ENGINEER: MAF
DRAWN BY: JDS
DESIGNED BY: JDS
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STRAWBERRY ROAN TRL & LOWER CONFEDERATE
SEC. 31, T9N, R2E, PMM, BROADWATER COUNTY, MONTANA

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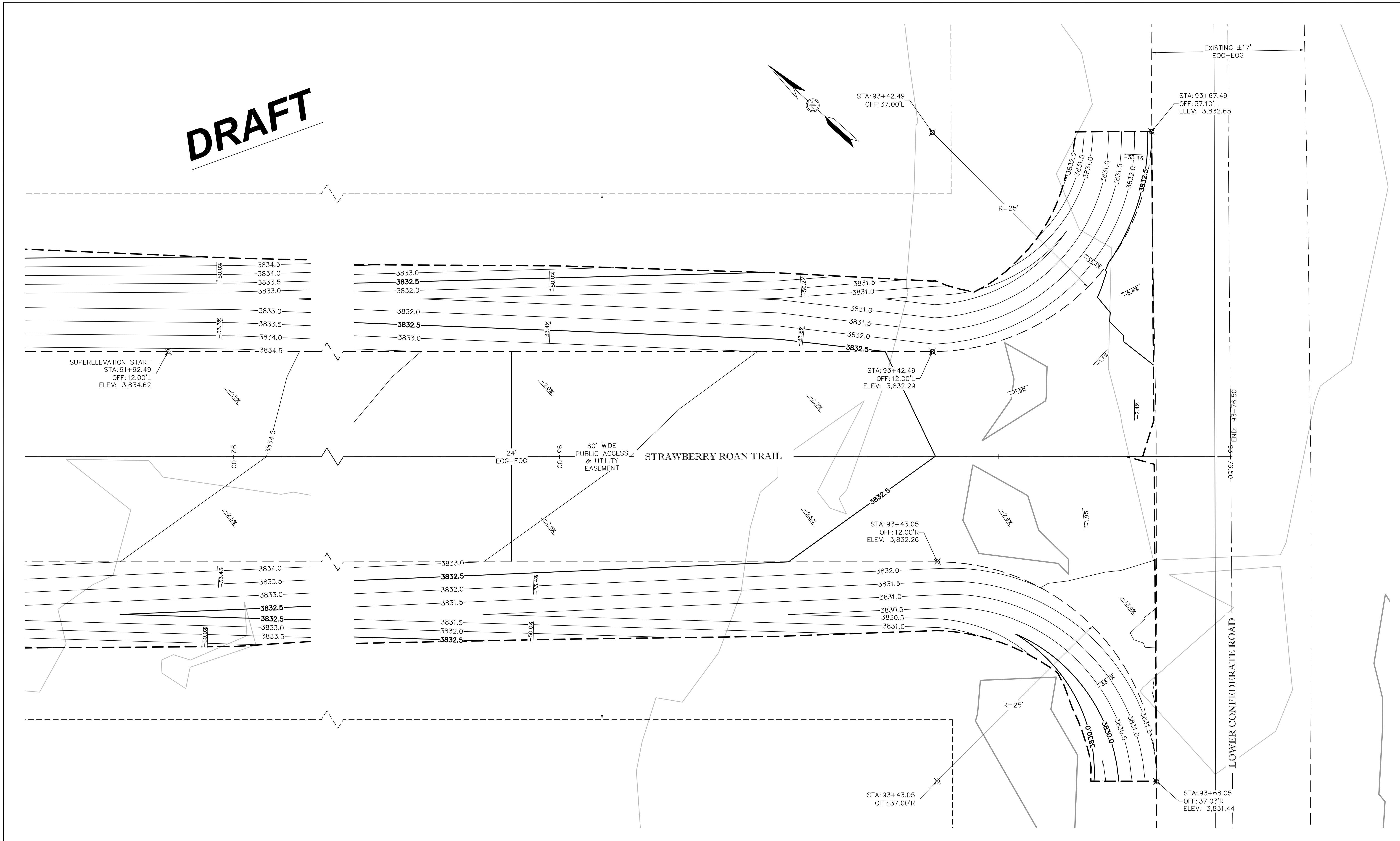
PROJECT #: 19-072
DATE: 02/12/2020
SHEET
C3-1
HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL



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SCALE (FEET)

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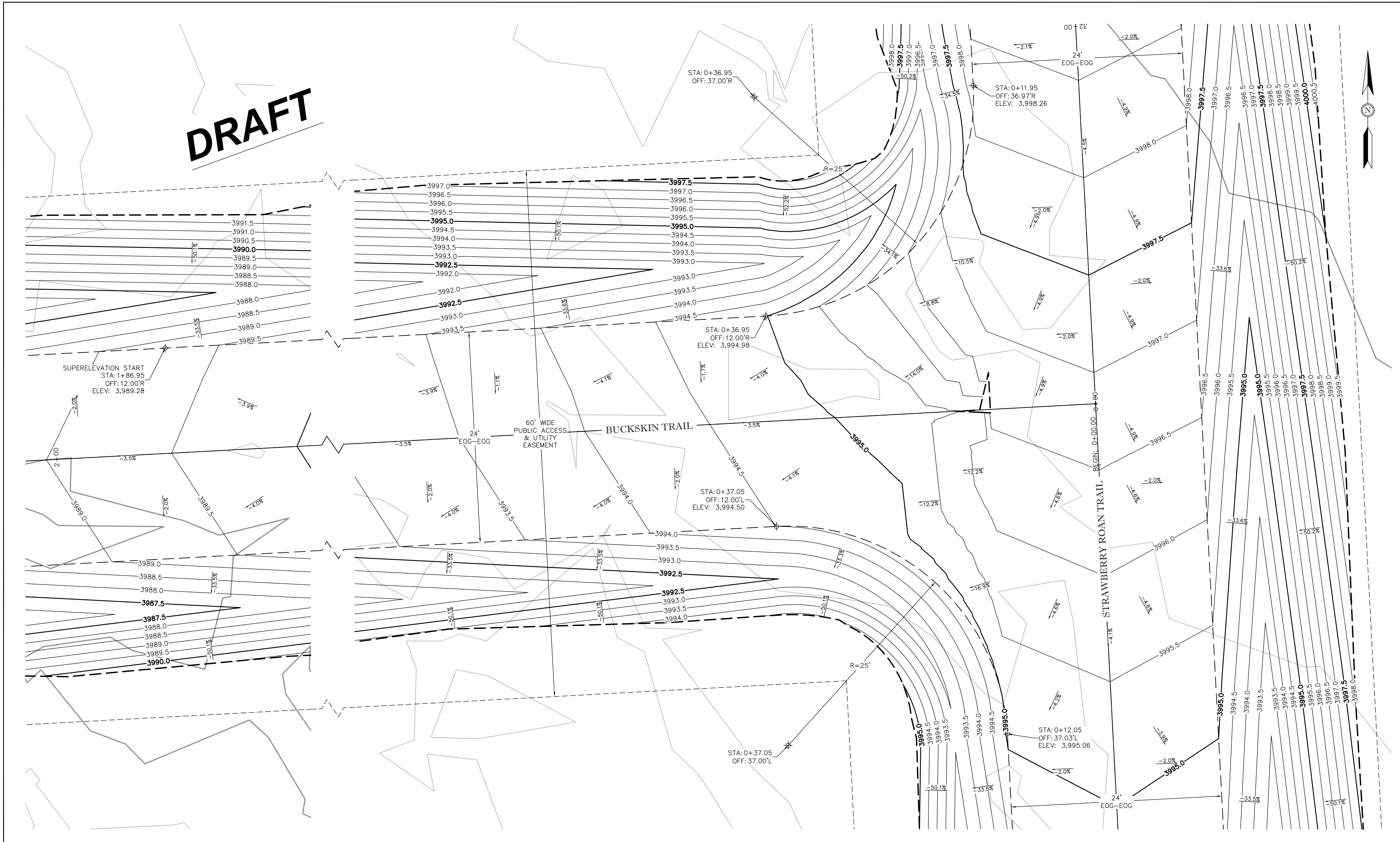
DATE: 02/12/2020

SHEET
C3-2

HORSE CREEK HILLS SUB
STRAWBERRY ROAN TRL



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0 5 10 15
SCALE (FEET)

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DESIGNED BY: JDS
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
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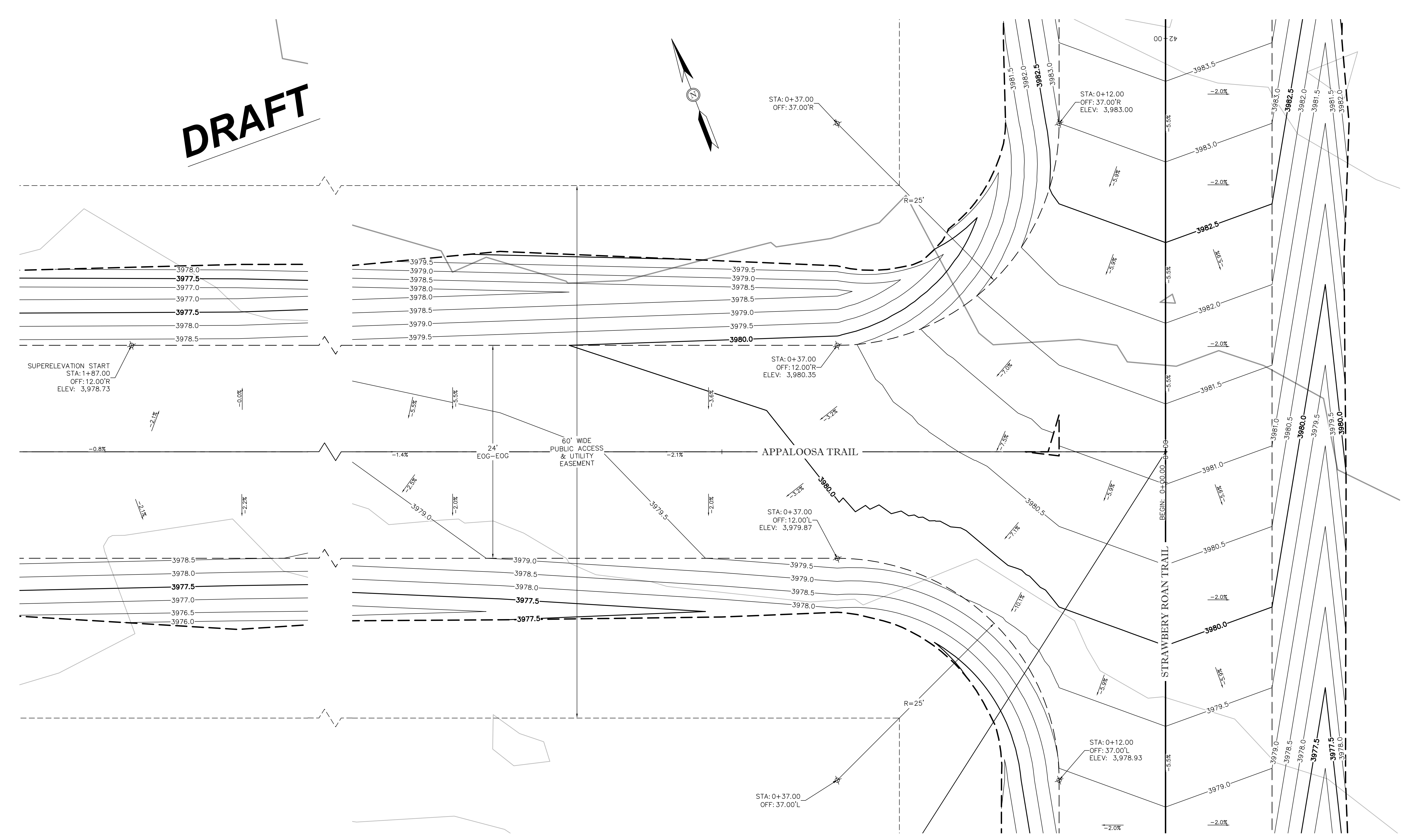
PROJECT #: 19-072
DATE: 02/12/2020
SHEET
C3-3
HORSE CREEK HILLS SUB
STRAWBERRY & BUCKSIN



NO.	REVISIONS	DRAWN BY	DATE
	DEQ Page 300		

0 5 10 15
SCALE (FEET)

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REVIEWED BY: MAF

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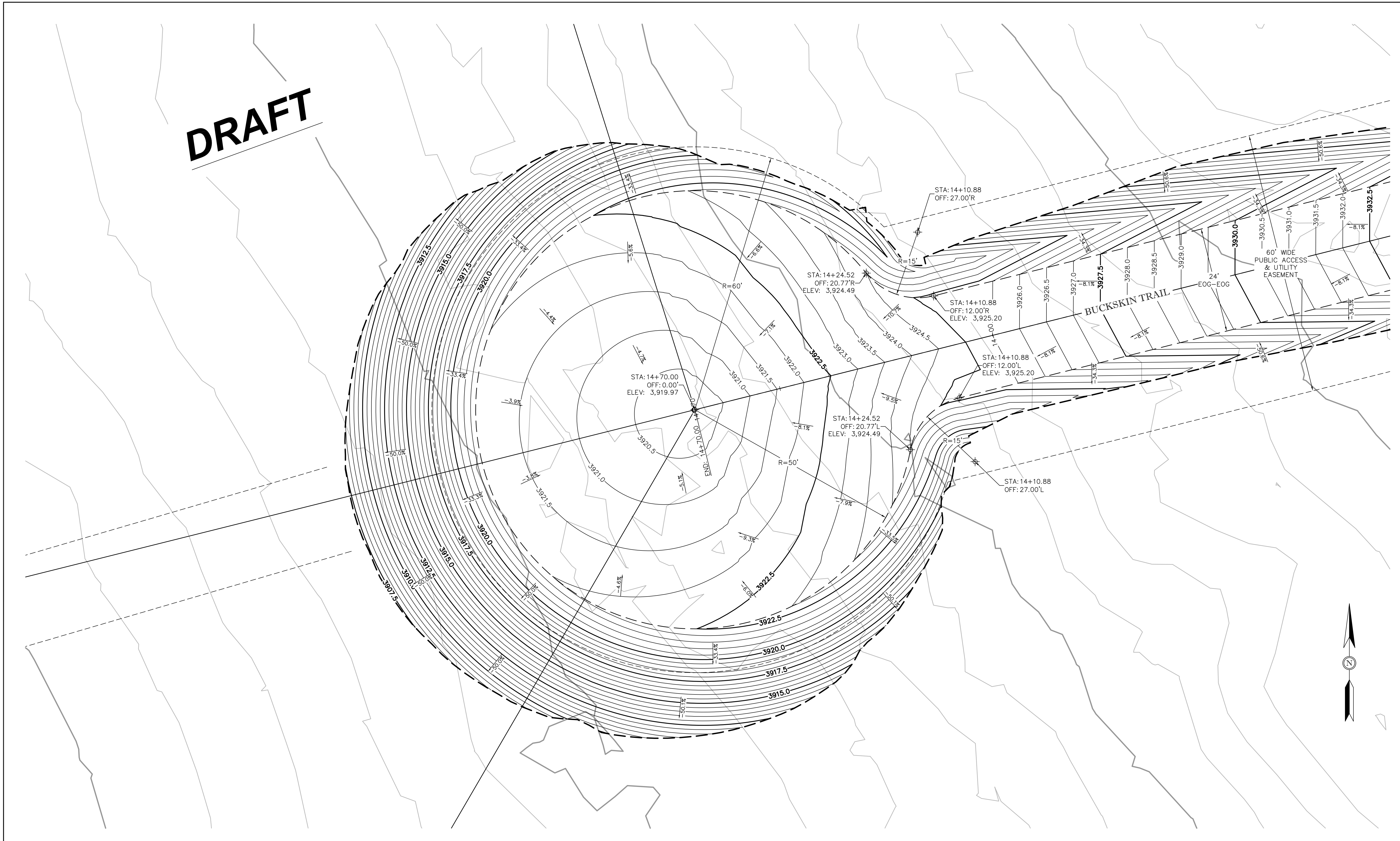
PROJECT #: 19-072
DATE: 02/12/2020

SHEET
C3-4

HORSE CREEK HILLS SUB
STRAWBERRY & APPALOOSA



NO.	REVISIONS	DRAWN BY	DATE
	DEQ Page 301		

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: JDS
DESIGNED BY: JDS | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
BUCKSKIN TRAIL CUL-DE-SAC
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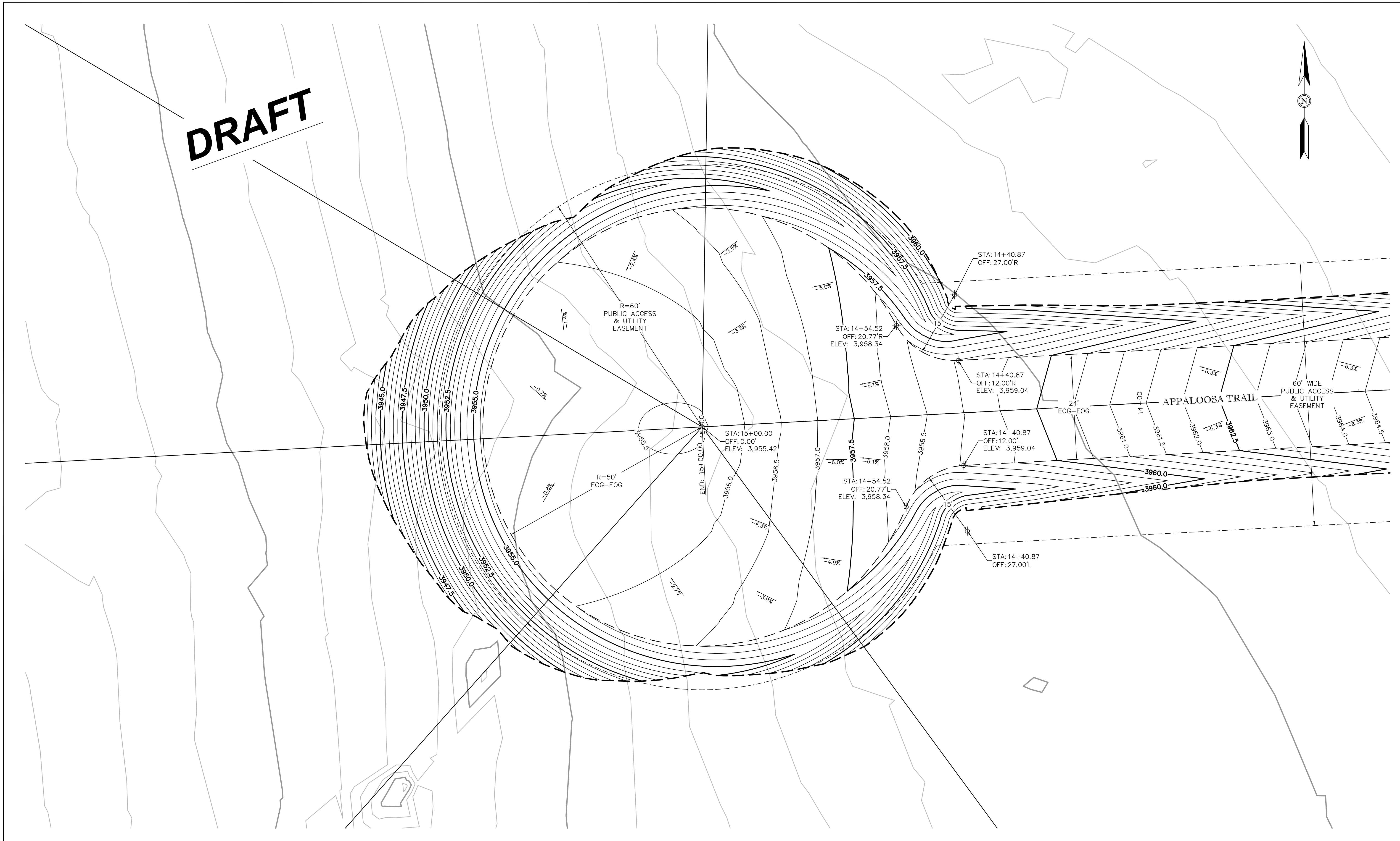
DATE: 02/12/2020

SHEET
C3-5

HORSE CREEK HILLS SUB
BUCKSKIN CUL-DE-SAC



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NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 10 20 30

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HORSE CREEK HILLS SUBDIVISION
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PROJECT #: 19-072
DATE: 02/12/2020
SHEET C3-6
HORSE CREEK HILLS SUB
APPALOOSA CUL-DE-SAC

HORSE CREEK HILLS SUBDIVISION

WASTEWATER AND STORMWATER PLANS

LOCATION: N ½, N ½ of the SE ¼, & NE ¼ of the SW ¼, SEC 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MONTANA

LATITUDE: 46°29'45.6" LONGITUDE: -111°31'13"

DEVELOPER: 71 RANCH LP

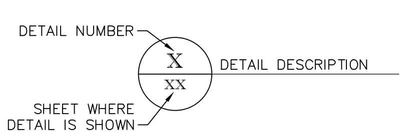
MARCH, 2020

SET NO. _______

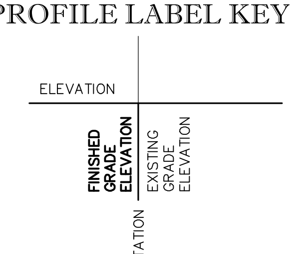
PROJECT MANAGER: MARK FASTING, PE
DESIGN ENGINEER: HUNTER MORRICAL, EI
PROJECT SURVEYOR: GREG FINCK, PLS

SHEET INDEX

PLAN SHEET DETAIL CALLOUTS

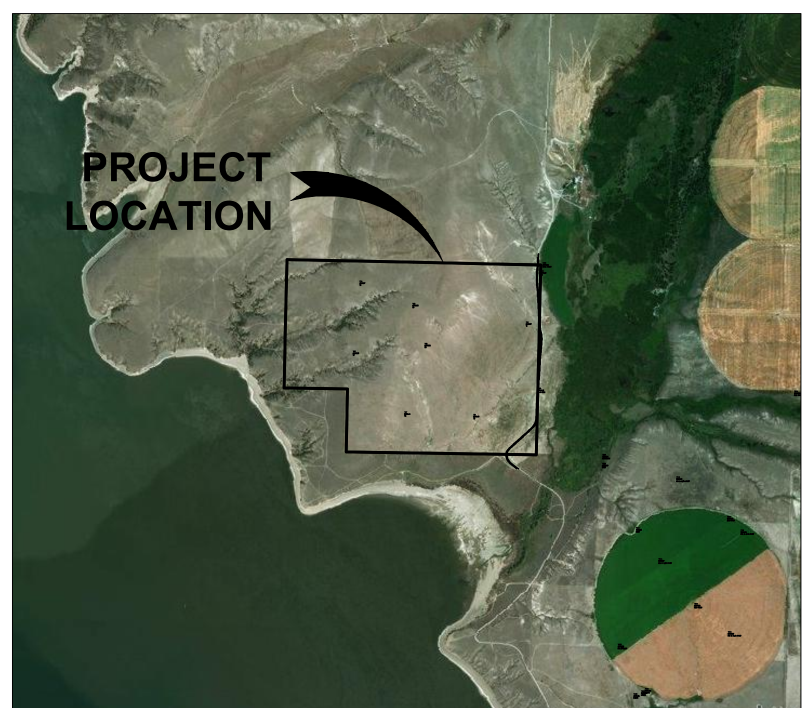


PROPOSED ROADWAY PROFILE LABEL KEY



CIVIL ABBREVIATIONS:

AESI	ALLIED ENGINEERING SERVICES, INC.	MAX	MAXIMUM
AC	ACRE	MH	MANHOLE
AVE	AVENUE	MIN	MINIMUM
BLDG	BUILDING	MJ	MECHANICAL JOINT
BM	BENCHMARK	MP	MID POINT
BOG	BACK OF GRATE (GUTTER)	MPWSS	MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS
CL	CENTERLINE	N	NORTH
CMP	CORRUGATED METAL PIPE	PC	POINT OF CURVATURE
CO	CLEAN OUT	PE	PLAIN END
CONC	CONCRETE	PE	POLYETHYLENE
COB	CITY OF BELGRADE	PI	POINT OF INTERSECTION
CY	CUBIC YARD	PL	PROPERTY LINE
DI	DUCTILE IRON	PSI	POUNDS PER SQUARE INCH
DIA	DIAMETER	PT	POINT OF TANGENCY
DWG	DRAWING	PVC	POLYVINYL CHLORIDE
E	EAST	R	RADIUS
EA	EACH	RP	RADIUS POINT
EG	EXISTING GRADE	RCP	REINFORCED CONCRETE PIPE
ELEV	ELEVATION	ROW	RIGHT-OF-WAY
EOG	EDGE OF GRAVEL	RT	RIGHT
EOP	EDGE OF PAVEMENT	S	SOUTH
EX	EXISTING	SCH	SCHEDULE
FETS	FLARED END TERMINAL SECTION	SD	STORM DRAIN
FG	FINISHED GRADE	SECT	SECTION
FHYD	FIRE HYDRANT	SG	SUBGRADE
FL	FLANGE	S	SANITARY SEWER MAIN
FL	FLOWLINE	SS	SANITARY SEWER SERVICE
FM	SEWER FORCE MAIN	ST	STREET
FT	FEET	STA	STATION
GPM	GALLONS PER MINUTE	STD	STANDARD
GV	GATE VALVE	SY	SQUARE YARD
HDPE	HIGH DENSITY POLYETHYLENE	TBM	TEMPORARY BENCH MARK
HORZ	HORIZONTAL	TBC	TOP BACK OF CURB
HP	HIGH POINT	TDH	TOTAL DYNAMIC HEAD
HWY	HIGHWAY	TYP	TYPICAL
IE	INVERT ELEVATION	UG	UNDERGROUND
IN	INCH	VERT	VERTICAL
INV	INVERT	W	WATER MAIN
LF	LINEAR FEET	W	WEST
LP	LOW POINT	W/	WITH
LT	LEFT	W/O	WITHOUT
		WS	WATER SERVICE

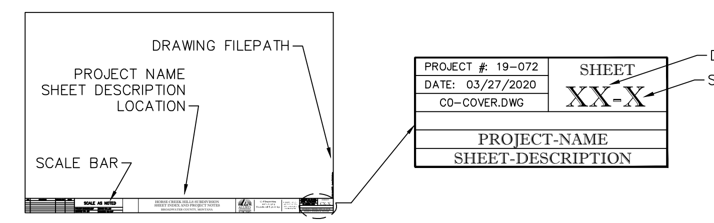


AERIAL MAP

LEGEND

PROPERTY LINE	PROPOSED LOT LINE
FOUND MONUMENT	PROPOSED RIGHT-OF-WAY LINE
CONTROL POINT	PROPOSED MAJOR CONTOUR (5' INTERVAL)
EX. MAJOR CONTOUR (5' INTERVAL)	PROPOSED MINOR CONTOUR (1' INTERVAL)
EX. MINOR CONTOUR (1' INTERVAL)	PROPOSED ROAD CENTERLINE
EX. EDGE OF ROAD	PROPOSED CURB AND GUTTER
EX. DRAINAGE CULVERT	PROPOSED SIDEWALK
EX. FENCE	PROPOSED WATER MAIN
EX. TREE ROW	PROPOSED WATER SERVICE
EX. PINE TREE	PROPOSED GATE VALVE
EX. WATER MAIN	PROPOSED FIRE HYDRANT
EX. GATE VALVE	PROPOSED SEWER MAIN
EX. FIRE HYDRANT	PROPOSED SEWER FORCE MAIN
EX. WELL	PROPOSED SEWER SERVICE
EX. SEWER MAIN	PROPOSED SEWER MANHOLE
EX. SEWER MANHOLE	PROPOSED STORM DRAIN LINE
EX. OVERHEAD POWER LINE	PROPOSED STORM DRAIN CURB INLET
EX. OVERHEAD POWER POLE	PROPOSED DRAINAGE CULVERT
EX. ELECTRIC METER	PROPOSED DRAINAGE DIRECTION
EX. UNDERGROUND FIBER OPTICS LINE	PROPOSED DRAINAGE ARROW
EX. TELEPHONE/FIBER OPTICS PEDESTAL	PROPOSED SIGN POST

AESI STANDARD BORDER FORMAT



GENERAL NOTES AND SPECIFICATIONS:

1. THE CONTRACTOR MUST ADHERE TO THE PROJECT PLANS AND SPECIFICATIONS. THE CONSTRUCTION COMPANY MUST BE A LICENSED CONTRACTOR WITH THE STATE OF MONTANA AND BE COVERED BY LIABILITY INSURANCE. A TWO-YEAR WRITTEN WARRANTY FROM THE PROJECT CONTRACTOR TO GALLATIN COUNTY IS REQUIRED FOR ALL ONSITE AND OFFSITE ROAD IMPROVEMENTS
2. THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES BY CALLING THE NATIONAL 811 "CALL BEFORE YOU DIG" TELEPHONE NUMBER PRIOR TO CONSTRUCTION ACTIVITIES.
3. ALL ROAD AND STORM DRAINAGE IMPROVEMENTS SHALL BE CONSTRUCTED PER THE ALIGNMENT AND GRADE AS SHOWN ON THE PLANS.
4. CONTRACTOR SHALL FIELD VERIFY LOCATION AND DEPTH OF ALL EXISTING UTILITIES AND STRUCTURES WHERE NEW FACILITIES CROSS OR CONNECT. CONTRACTOR SHALL BE RESPONSIBLE FOR EXPOSING POTENTIAL UTILITY CONFLICTS FAR ENOUGH AHEAD OF CONSTRUCTION TO MAKE NECESSARY GRADE MODIFICATIONS WITHOUT DELAYING THE WORK. ALL UTILITY CROSSINGS SHALL BE POTHOLED OR VACUUMED AS NECESSARY PRIOR TO EXCAVATING OR BORING TO ALLOW THE CONTRACTOR TO PREVENT GRADE OR ALIGNMENT CONFLICTS.
5. AT LEAST 10 BUSINESS DAYS BEFORE BEGINNING ANY EXCAVATION, THE CONTRACTOR SHALL NOTIFY THE OWNER AND ENGINEER OF UNDERGROUND FACILITIES AND COORDINATE THE WORK WITH THE OWNERS OF SUCH UNDERGROUND FACILITIES. THE INFORMATION SHOWN OR INDICATED IN THE CONTRACT DOCUMENTS WITH RESPECT TO EXISTING UNDERGROUND FACILITIES IS BASED ON INFORMATION AND DATA OBTAINED FROM THE OWNERS OF THE FACILITIES WITHOUT FIELD EXPLORATION, AND AS SUCH, OWNER AND ENGINEER ARE NOT RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SUCH INFORMATION OR DATA.
6. NO TRENCHES IN ROADS OR DRIVEWAYS SHALL BE LEFT IN AN OPEN CONDITION OVERNIGHT. ALL SUCH TRENCHES SHALL BE BACKFILLED, COMPACTED AND CLOSED BEFORE THE END OF EACH WORK DAY AND NORMAL TRAFFIC FLOWS RESTORED.
7. IF THE ENGINEER IS CONTRACTED FOR CONSTRUCTION STAKING, ENGINEER SHALL BE CONTACTED PRIOR TO STAKING. PROVIDE ADVANCED NOTICE SUFFICIENT TO ACCOMMODATE CONSTRUCTION, 7 WORKING DAYS IS MINIMUM, AND MAY VARY DEPENDING UPON AVAILABILITY.
8. LIGHTING, ELECTRICAL, NATURAL GAS, COMMUNICATIONS, LANDSCAPING, ETC. ARE TO BE DESIGNED BY OTHERS.
9. FINAL QUANTITIES MAY BE HIGHER OR LOWER THAN THOSE ESTIMATED, PENDING FIELD FINDINGS, SITE CONDITIONS, ETC.
10. STRIP THE EMBANKMENT FOUNDATION AREA, BORROW AREAS AND ALL AREAS TO RECEIVE FILL TO A MINIMUM DEPTH OF 6 INCHES AND AS REQUIRED TO REMOVE ALL ORGANIC SOILS, VEGETATIVE MATTER, ROOTS, AND OTHER PERISHABLE, LOOSE OR OBJECTIONABLE MATERIAL INCLUDING FROZEN SOIL THAT MIGHT INTERFERE WITH COMPACTION OF EMBANKMENT LIFT OR THE BONDING OF EMBANKMENT TO FOUNDATION. OBJECTIONABLE MATERIAL WILL BE AS DETERMINED BY THE ENGINEER. PERFORM STRIPPING OPERATIONS IN A MANNER TO CONSERVE ALL TOPSOIL THAT CONTAINS ORGANICS.
11. TRANSPORT STRIPPED MATERIALS TO STOCKPILE AREAS OUTSIDE OF WATERWAYS AND WETLANDS, SUBJECT TO APPROVAL. COORDINATE WITH OWNER TO IDENTIFY STOCKPILE AREAS. LOCATE PILES SO AS NOT TO AFFECT THE OPERATION OF THE EXISTING OPERATIONS, OR INTERFERE WITH THE WORK.
12. TAKE PRECAUTIONS TO PRESERVE, IN A SOUND CONDITION, THE MATERIAL BELOW AND BEYOND THE LINES OF ALL EXCAVATIONS.
13. PERFORM OPERATIONS SO THAT THE EXCAVATIONS WILL YIELD AS MUCH SUITABLE MATERIAL FOR CONSTRUCTION PURPOSES AS PRACTICABLE.
14. REUSE, AS MUCH AS IS PRACTICABLE, ALL SUITABLE MATERIALS FROM REQUIRED EXCAVATION IN THE PERMANENT CONSTRUCTION. SEPARATE UNSUITABLE MATERIALS AND REMOVE THEM FROM THE WORK AREA AS SOON AS PRACTICABLE.
15. SPREAD OUT AND ALLOW MATERIALS TO DRY THAT ARE TOO WET FOR IMMEDIATE COMPACTION UNTIL THE WATER CONTENT IS REDUCED SUFFICIENTLY FOR PLACEMENT IN THE EMBANKMENT. AERATING AND DRYING IS INCIDENTAL TO THE WORK.
16. WATER-CONDITION MATERIALS THAT ARE TOO DRY FOR IMMEDIATE COMPACTION. MOISTURE CONDITIONING IS INCIDENTAL TO THE WORK.
17. LEVEL AND TRIM WASTE PILES TO REASONABLY REGULAR LINES, AND SLOPE TO DRAIN.
18. REMOVE SOFT, WET, OBJECTIONABLE, OR OTHERWISE UNSUITABLE MATERIALS AS DETERMINED BY THE ENGINEER.
19. DE-WATER AS NECESSARY TO PREVENT THE ACCUMULATION AGAINST OR THE INTERMINGLING OF WATER WITH THE FILL.
20. PERFORM EXCAVATION AND PLACEMENT OPERATIONS SUCH THAT THE EMBANKMENT MATERIALS ARE MIXED AND BLENDED TO PROVIDE THE MOST HOMOGENEOUS SECTION AND BEST DEGREE OF COMPACTION AND STABILITY PRACTICAL. ALL FILL SHOULD BE PLACED IN HORIZONTAL LIFTS AND COMPACTED TO AT LEAST 95% OF ASTM D-698. PROVIDE PRIMARY WATER CONDITIONING, MIXING AND BLENDING IN STOCKPILES AS NEEDED. DISTRIBUTE THE FILL IN A LIFT SUCH THAT IT IS FREE FROM LENSES, POCKETS, STREAKS, OR LAYERS DIFFERING MATERIALLY IN TEXTURE OR GRADATION FROM THE SURROUNDING FILL.
21. CONTROL AND CONDUCT ALL TRANSPORTING, STOCKPILING, EXCAVATION, PRODUCTION, AND PLACEMENT OPERATIONS TO MINIMIZE CONTAMINATION, SEGREGATION, AND PARTICLE BREAKDOWN.
22. CARRY OUT COVERAGES OF COMPACTION EQUIPMENT SO THAT THE COMPACTIVE EFFORT IS DISTRIBUTED UNIFORMLY AND IN A SYSTEMATIC MANNER OVER THE ENTIRE LIFT.
23. ALL CONSTRUCTION ASSUMES A STABLE COMPACTED SUBGRADE IS ACHIEVED PRIOR TO PLACEMENT OF NEW FACILITIES.
24. COORDINATE WITH UTILITY COMPANIES REGARDING ALL UTILITY CROSSINGS AND ANY POTENTIAL UTILITY CONFLICTS.
25. CONTRACTOR SHALL COORDINATE DRY UTILITY CONDUIT LOCATIONS, DEPTHS, MATERIAL, QUANTITY, ETC. WITH APPLICABLE UTILITY SERVICE PROVIDERS PRIOR TO CONSTRUCTION.
26. IF APPLICABLE, CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT ALL STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS ARE MET.
27. PROJECT SITE DEVELOPMENT MAY REQUIRE ADDITIONAL STORM WATER FACILITY IMPROVEMENTS (SWALES, PONDS, ROADSIDE DITCH BLOCKS, ETC.), THAT ARE NOT SHOWN ON THESE PLANS.

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HORSE CREEK HILLS SUBDIVISION - ROAD DESIGN
BROADWATER COUNTY, MONTANA

NO.	REVISIONS	DATE

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HORSE CREEK HILLS SUBDIVISION
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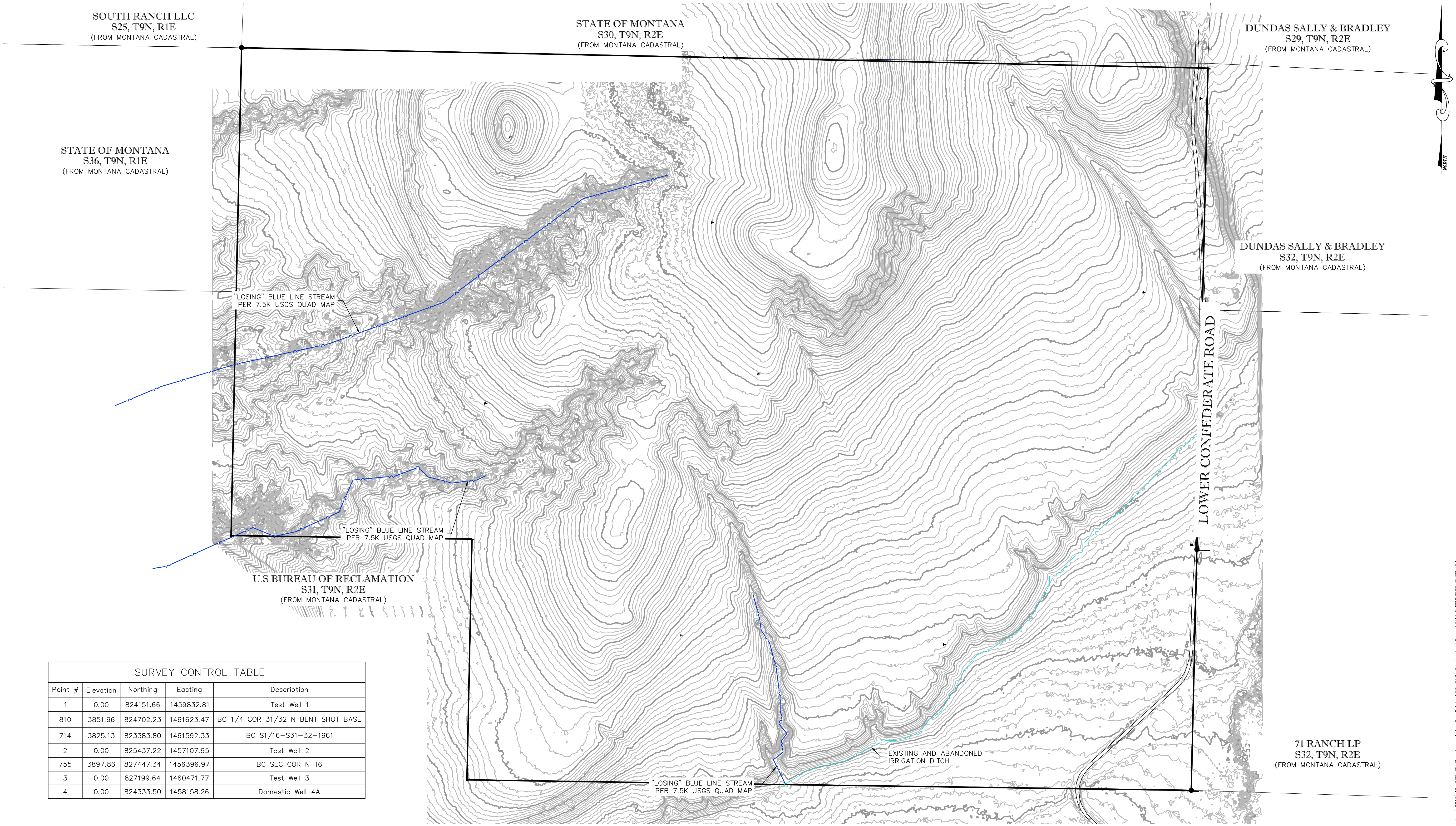

SURVEY CONTROL TABLE

Point #	Elevation	Northing	Easting	Description
1	0.00	824151.66	1459832.81	Test Well 1
810	3851.96	824702.23	1461623.47	BC 1/4 COR 31/32 N BENT SHOT BASE
714	3825.13	823383.80	1461592.33	BC S1/16–S31–32–1961
2	0.00	825437.22	1457107.95	Test Well 2
755	3897.86	827447.34	1456396.97	BC SEC COR N T6
3	0.00	827199.64	1460471.77	Test Well 3
4	0.00	824333.50	1458158.26	Domestic Well 4A

NO.	REVISIONS	DRAWN BY	DATE

0 250 500 750
SCALE (FEET)

PROJECT ENGINEER: MAF
DRAWN BY: HTM
DESIGNED BY: MAF, HTM
REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISIONS
EXISTING CONDITIONS & SURVEY CONTROL
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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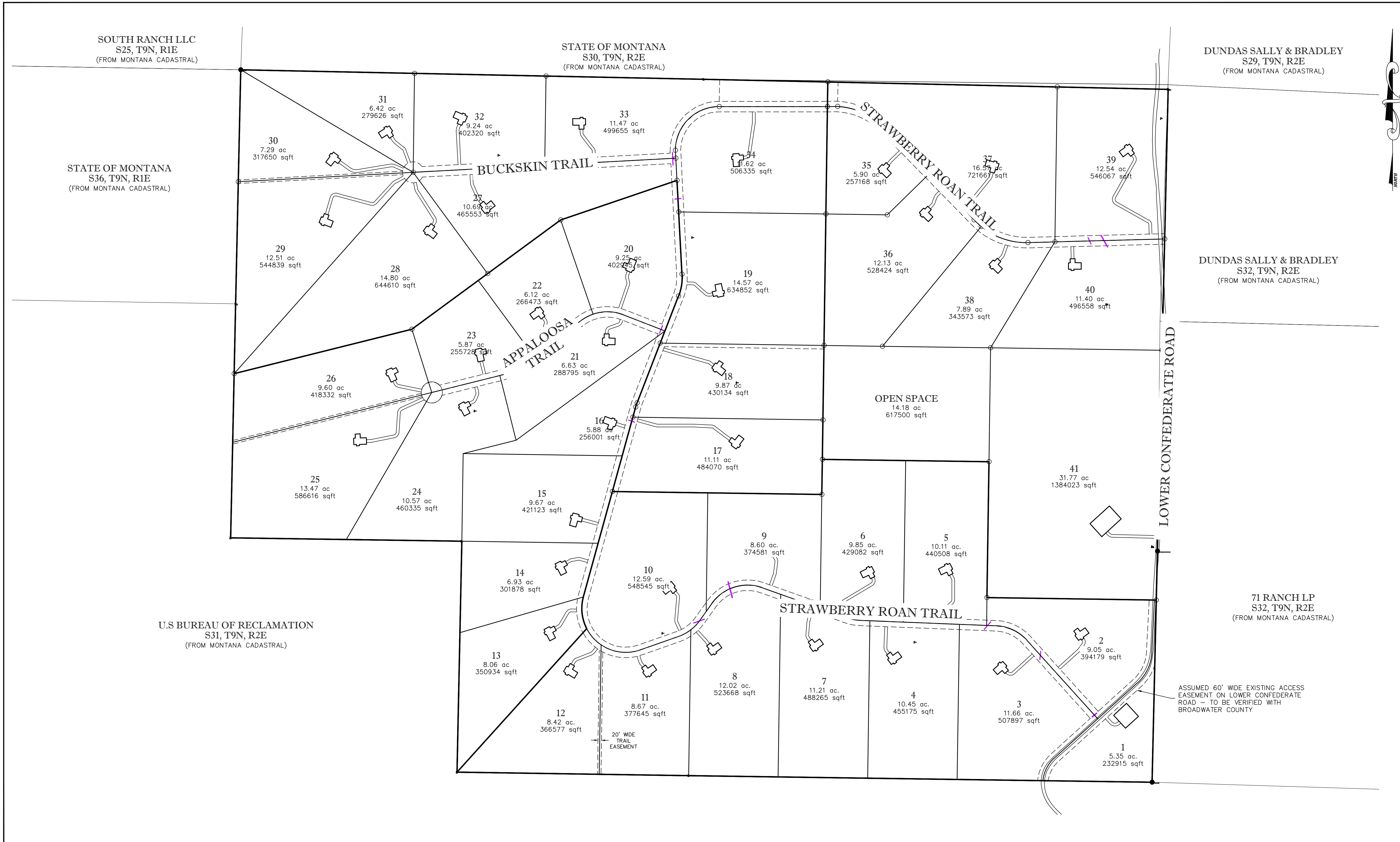
PROJECT #: 19-072
DATE: 3/27/2020

SHEET
WW0.1

HORSE CREEK HILLS
EXISTING CONDITIONS



NO.	REVISIONS	DRAWN BY	DATE

0 250 500 750
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISIONS
PROPOSED IMPROVEMENTS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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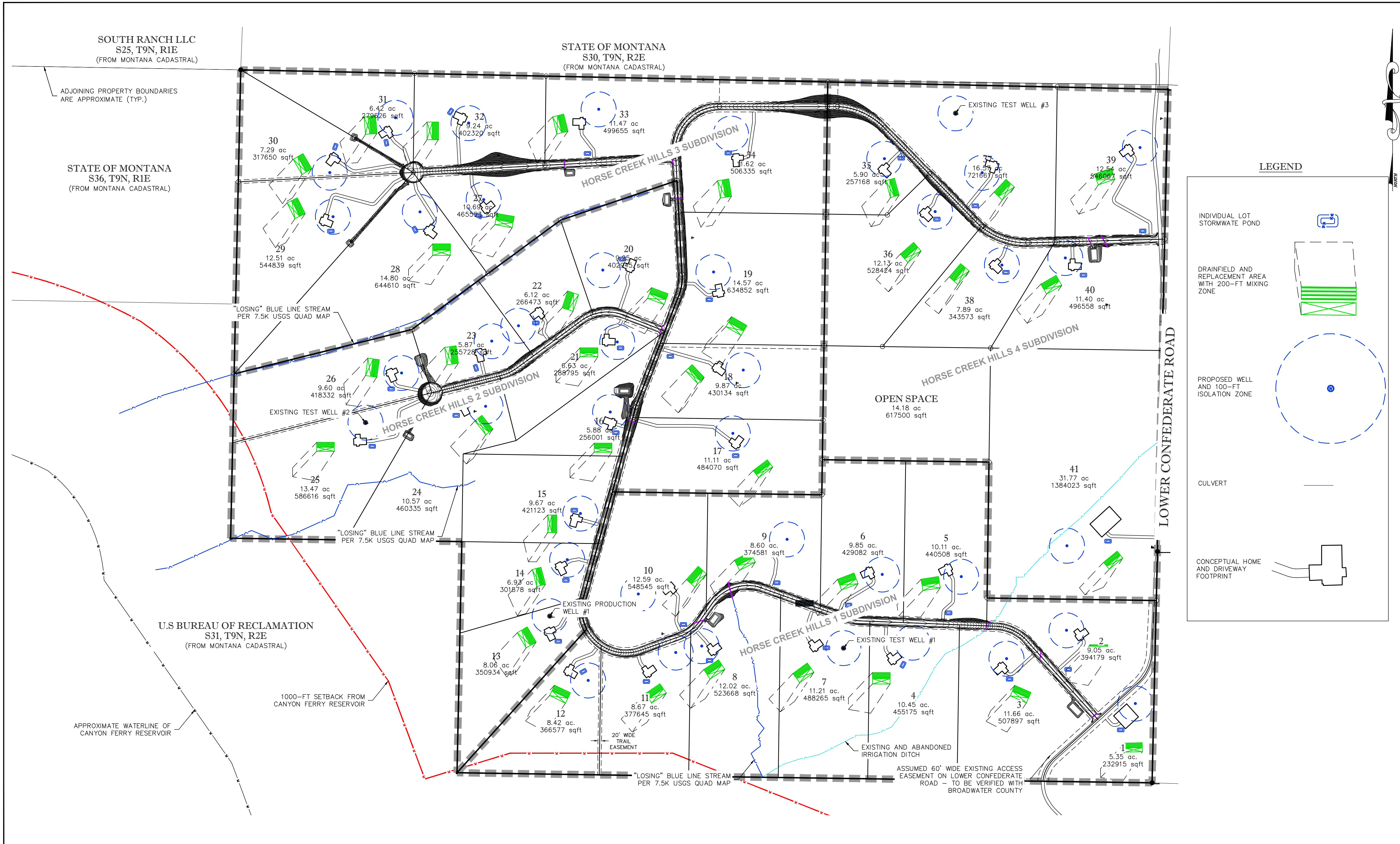
PROJECT #: 19-072
DATE: 3/27/2020
SHEET WW0.2

HORSE CREEK HILLS
SUBDIVISION OVERVIEW



NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 306

0 250 500 750
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - WWTS
WWTS PLAN OVERVIEW
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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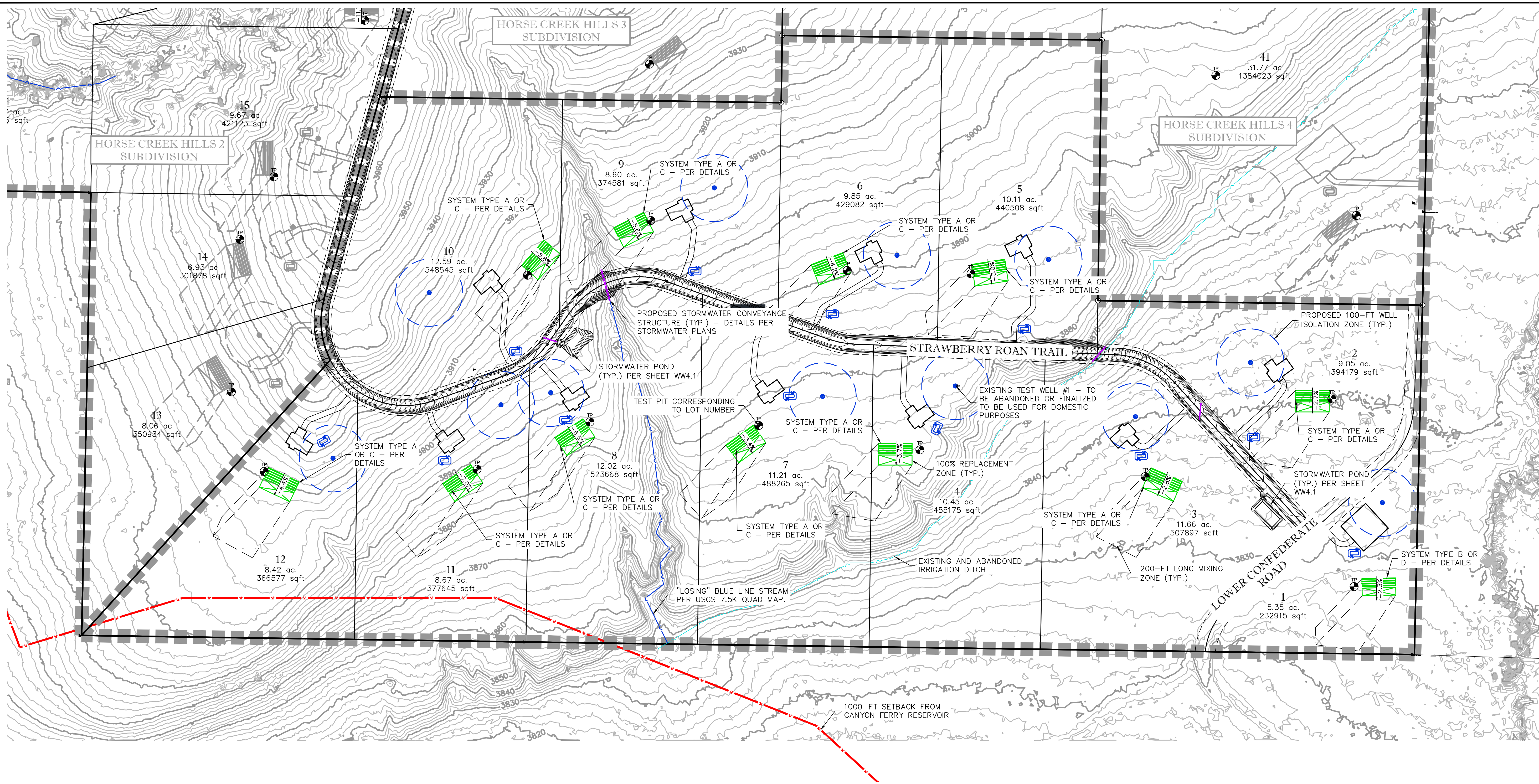
PROJECT #: 19-072
DATE: 3/20/2020

SHEET
WW1.0

HORSE CREEK HILLS
WWTS OVERVIEW



NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #1-12 ARE PROJECT #1 OF THE HORSE CREEK HILLS SUBDIVISION.
3. LOT #1 IS A PROPOSED COMMERCIAL LOT. DRAINFIELD WAS SIZED FOR A 24 EMPLOYEE MAXIMUM FACILITY WITH EACH EMPLOYEE UTILIZING 13 GPD OF WATER.
4. LOTS #2-12 ARE PROPOSED RESIDENTIAL LOTS. EACH DRAINFIELD WAS DESIGNED TO BE GRAVITY FED AND SERVE UP TO A 5-BEDROOM HOME.
5. LOTS #1-4 TO BE EVALUATED PER THE NON-DEGRADATION ANALYSIS. LOTS #5-12 ARE EXEMPT FROM NON-DEGRADATION ANALYSIS PER THE CATEGORY #1 EXEMPTION OF THE NON-DEGRADATION ANALYSIS – APPENDIX P.
6. SEE SHEETS WW2.1, WW2.2, & WW2.4 FOR SYSTEM SIZING DETAILS.
7. SEE STORMWATER SHEETS WW3X SERIES FOR STORMWATER DETAILS.
8. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT
9. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

- INDIVIDUAL LOT STORMWATE POND
- DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE
- DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE
- PROPOSED WELL AND 100-FT ISOLATION ZONE
- SEPTIC TEST PIT (TP)
- CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 1 SUBDIVISION
WASTEWATER TREATMENT SYSTEM PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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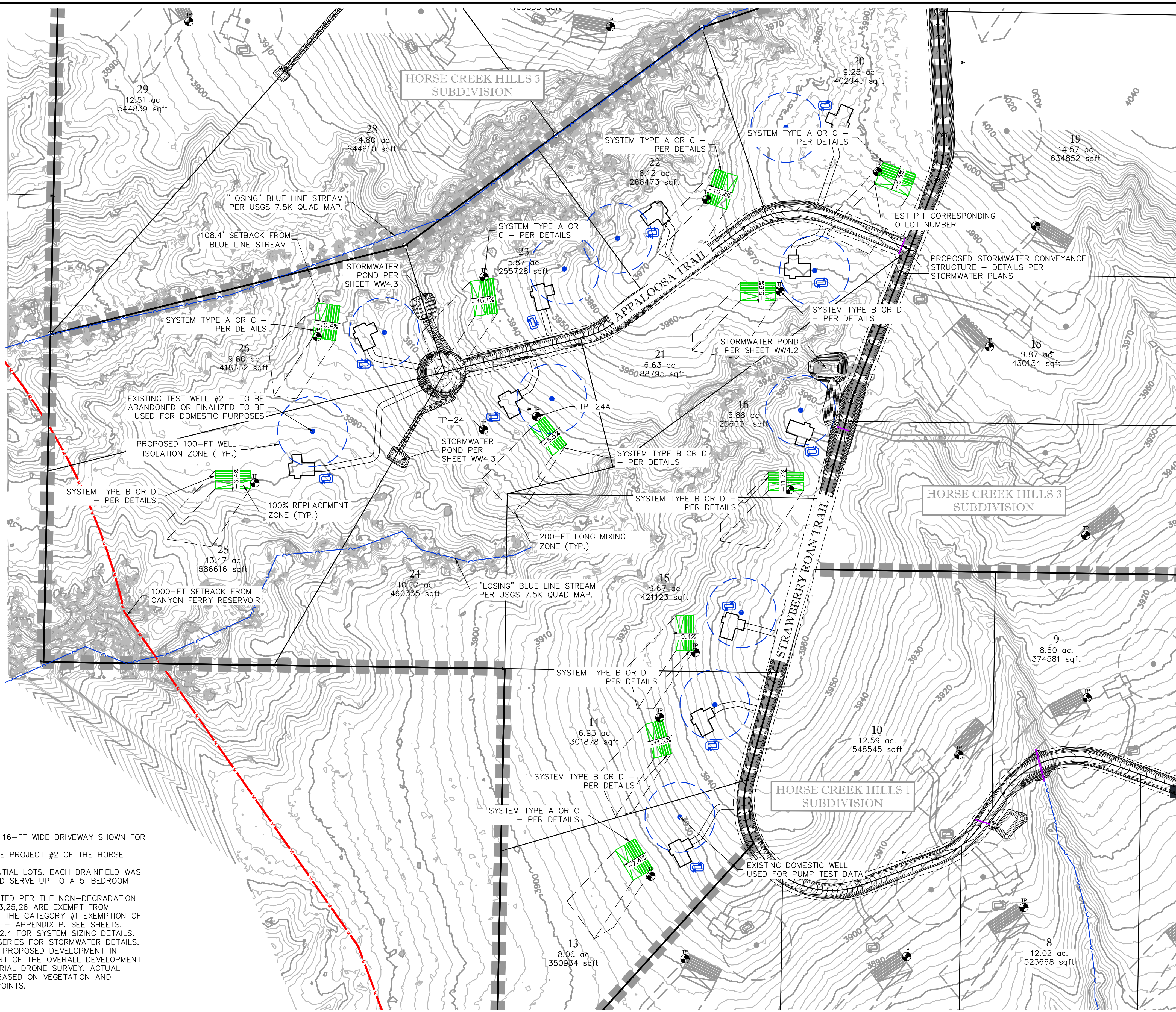
PROJECT #: 19-072
DATE: 3/27/2020
WWTS PROJECT 1

SHEET WW1.1

HORSE CREEK HILLS
WWTS PLAN



NOTES:
1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #13-16 & LOTS #20-26 ARE PROJECT #2 OF THE HORSE CREEK HILLS SUBDIVISION.
3. ALL LOTS ARE PROPOSED RESIDENTIAL LOTS. EACH DRAINFIELD WAS DESIGNED TO BE GRAVITY FED AND SERVE UP TO A 5-BEDROOM HOME.
4. LOTS #15,16 & 24 TO BE EVALUATED PER THE NON-DEGRADATION ANALYSIS. LOTS #13,14,20,21,22,23,25,26 ARE EXEMPT FROM NON-DEGRADATION ANALYSIS PER THE CATEGORY #1 EXEMPTION OF THE NON-DEGRADATION ANALYSIS – APPENDIX P. SEE SHEETS.
5. SEE SHEETS WW2.1, WW2.2, & WW2.4 FOR SYSTEM SIZING DETAILS.
6. SEE STORMWATER SHEETS WW3X SERIES FOR STORMWATER DETAILS.
7. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT
8. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

- INDIVIDUAL LOT STORMWATE POND
- DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE
- DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE
- PROPOSED WELL AND 100-FT ISOLATION ZONE
- SEPTIC TEST PIT (TP)
- CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF — DRAWN BY: HTM
DESIGNED BY: MAF, HTM — REVIEWED BY: MAF

HORSE CREEK HILLS 2 SUBDIVISION
WASTEWATER TREATMENT SYSTEM PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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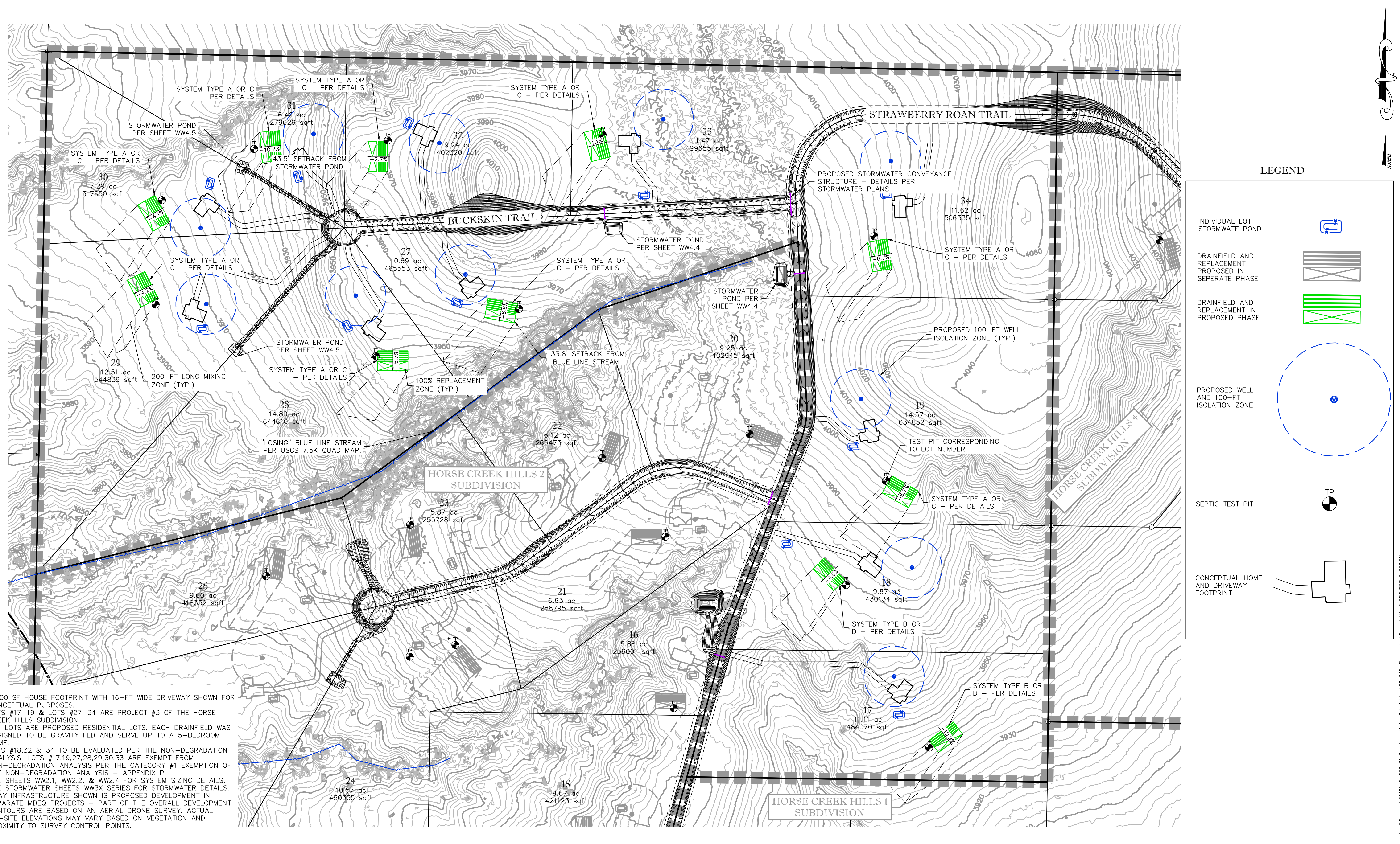
PROJECT #: 19-072
DATE: 3/20/2020
WWTS PROJECT 2

SHEET WW1.2

HORSE CREEK HILLS WWTS PLAN



NOTES:
1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #17-19 & LOTS #27-34 ARE PROJECT #3 OF THE HORSE CREEK HILLS SUBDIVISION.
3. ALL LOTS ARE PROPOSED RESIDENTIAL LOTS. EACH DRAINFIELD WAS DESIGNED TO BE GRAVITY FED AND SERVE UP TO A 5-BEDROOM HOME.
4. LOTS #18,32 & 34 TO BE EVALUATED PER THE NON-DEGRADATION ANALYSIS. LOTS #17,19,27,28,29,30,33 ARE EXEMPT FROM NON-DEGRADATION ANALYSIS PER THE CATEGORY #1 EXEMPTION OF THE NON-DEGRADATION ANALYSIS – APPENDIX P.
5. SEE SHEETS WW2.1, WW2.2, & WW2.4 FOR SYSTEM SIZING DETAILS.
6. SEE STORMWATER SHEETS WW3X SERIES FOR STORMWATER DETAILS.
7. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT
8. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 3 SUBDIVISION
WASTEWATER TREATMENT SYSTEM PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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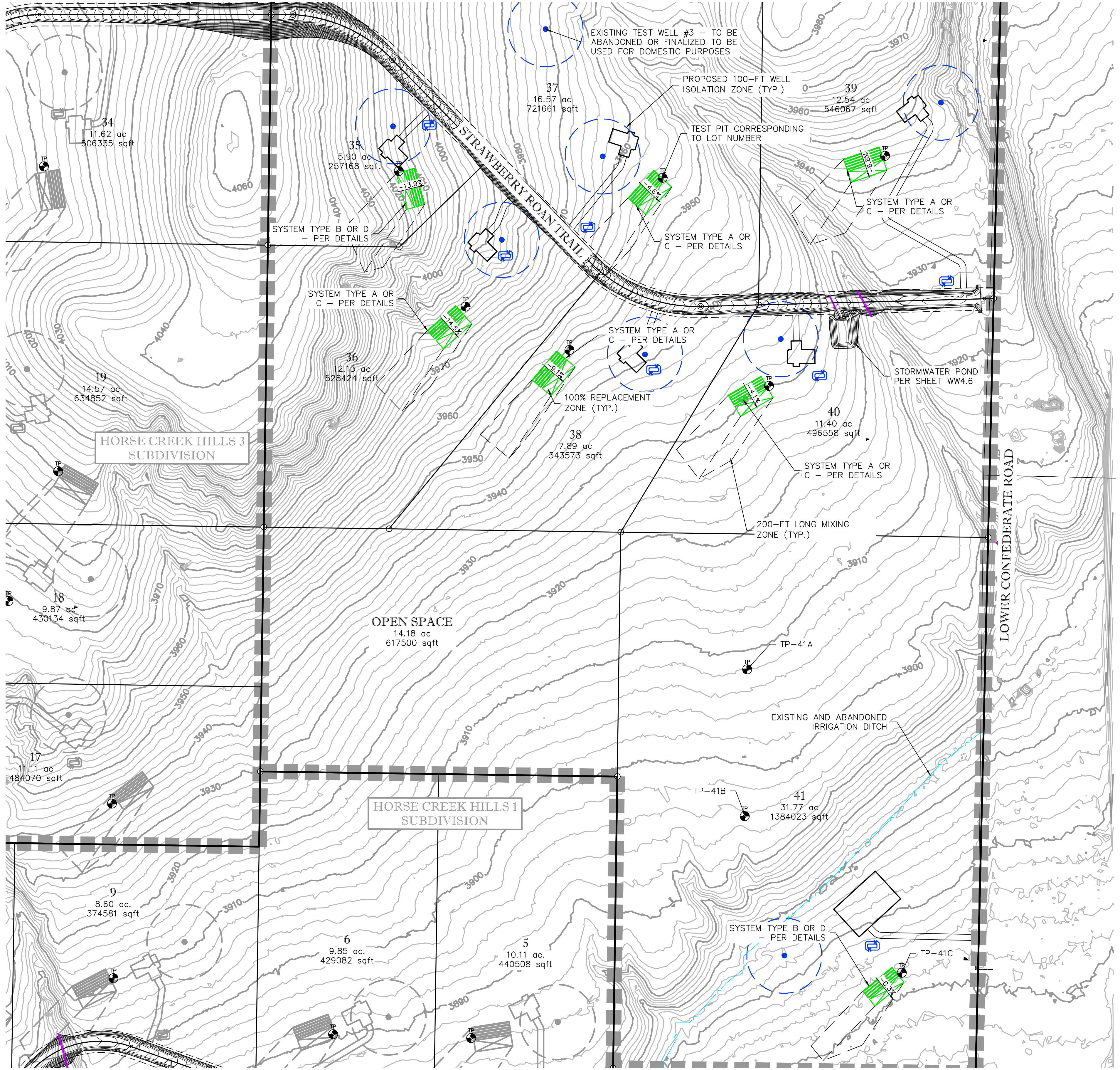
PROJECT #: 19-072
DATE: 3/27/2020
WWTS PROJECT 3

SHEET WW1.3

HORSE CREEK HILLS
WWTS PLANS



LEGEND

- INDIVIDUAL LOT STORMWATE POND
- DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE
- DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE
- PROPOSED WELL AND 100-FT ISOLATION ZONE
- SEPTIC TEST PIT (TP)
- CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #35-41 ARE PROJECT #4 OF THE HORSE CREEK HILLS SUBDIVISION.
3. LOT #41 IS A PROPOSED COMMERCIAL LOT. DRAINFIELD WAS SIZED FOR A 24 EMPLOYEE MAXIMUM FACILITY WITH EACH EMPLOYEE UTILIZING 13 GPD OF WATER.
4. LOTS #35-40 ARE PROPOSED RESIDENTIAL LOTS. EACH DRAINFIELD WAS DESIGNED TO BE GRAVITY FED AND SERVE UP TO A 5-BEDROOM HOME.
5. LOTS #35 & 41 TO BE EVALUATED PER THE NON-DEGRADATION ANALYSIS. LOTS #36,37,38,39,40 ARE EXEMPT FROM NON-DEGRADATION ANALYSIS PER THE CATEGORY #1 EXEMPTION OF THE NON-DEGRADATION ANALYSIS – APPENDIX P.
6. SEE SHEETS WW2.1, WW2.2, & WW2.4 FOR SYSTEM SIZING DETAILS.
7. SEE STORMWATER SHEETS WW3X SERIES FOR STORMWATER DETAILS.
8. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT
9. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 4 SUBDIVISION
WASTEWATER TREATMENT SYSTEM PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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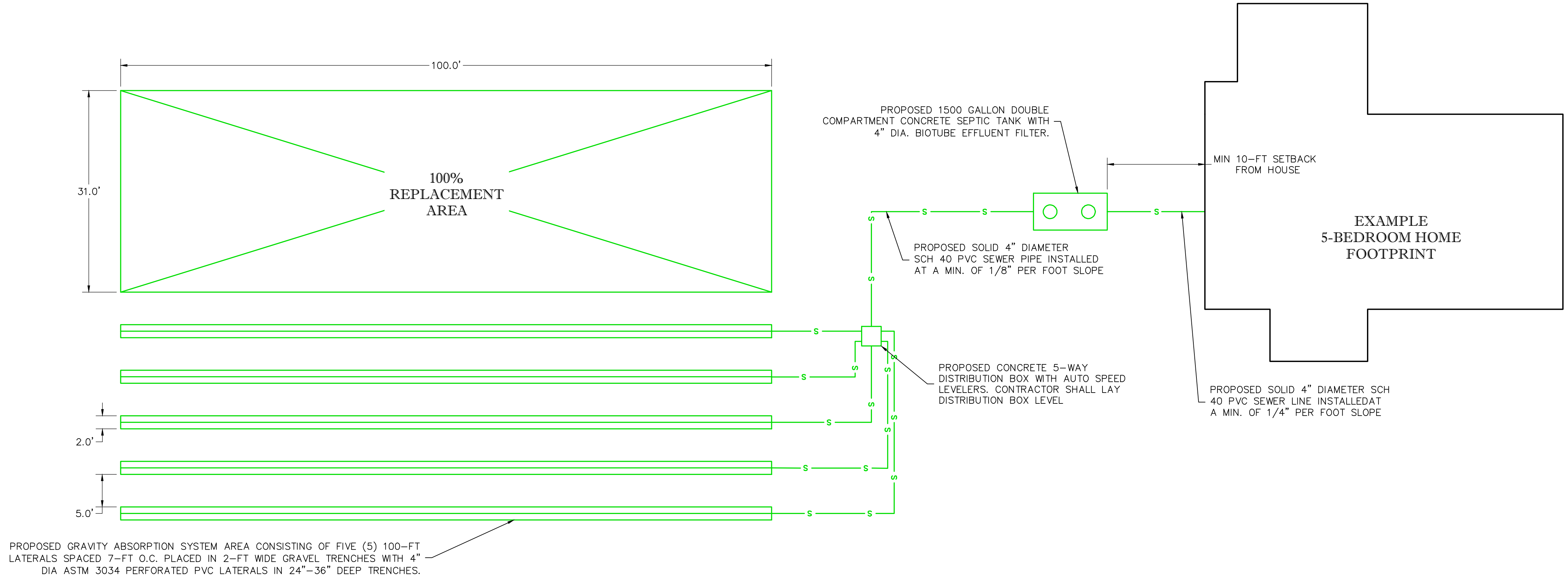
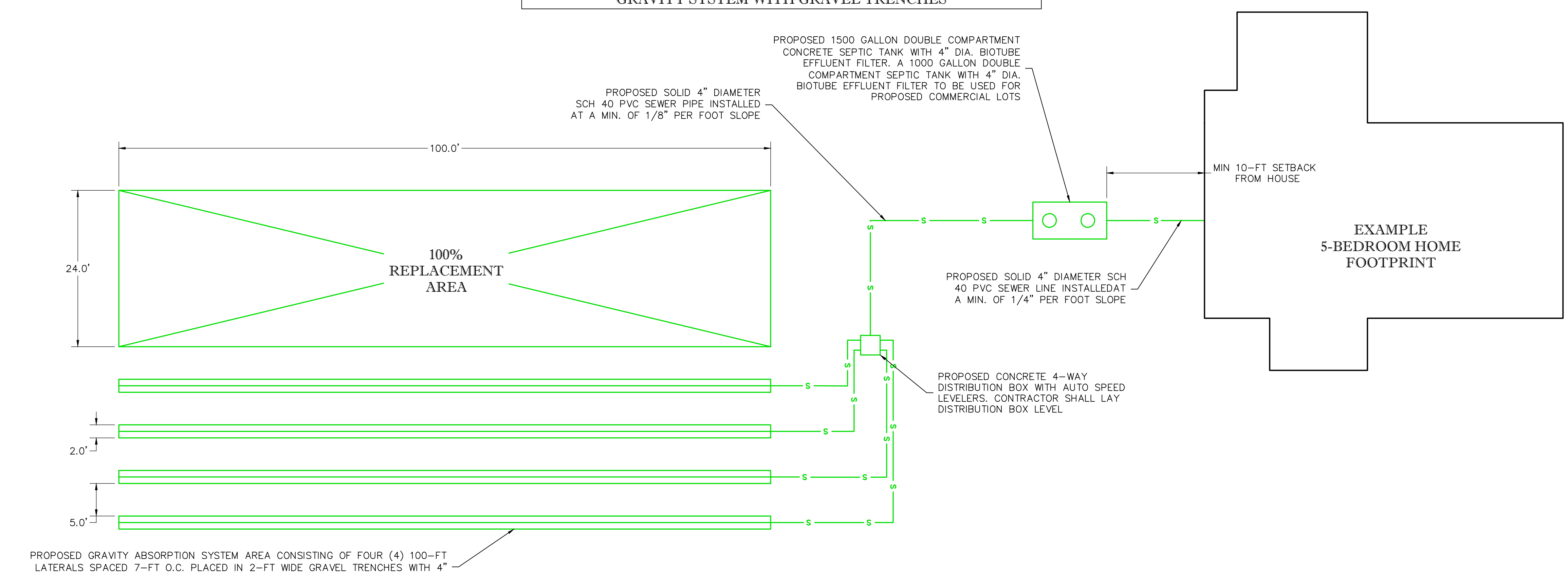
PROJECT #: 19-072
DATE: 3/27/2020
WWTS PROJECT 4

SHEET WW1.4

HORSE CREEK HILLS
WWTS PLANS



DETAIL 1 - WASTEWATER TREATMENT SYSTEM TYPE A - STANDARD GRAVITY SYSTEM WITH GRAVEL TRENCHES



DETAIL 2 - WASTEWATER TREATMENT SYSTEM TYPE B - STANDARD GRAVITY SYSTEM WITH GRAVEL TRENCHES

C:\aesi_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\Sewer\WW2.1 DETAILS.dwg

NO.	REVISIONS	DRAWN BY	DATE

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: MAF	DRAWN BY: HTM
DESIGNED BY: MAF, HTM	REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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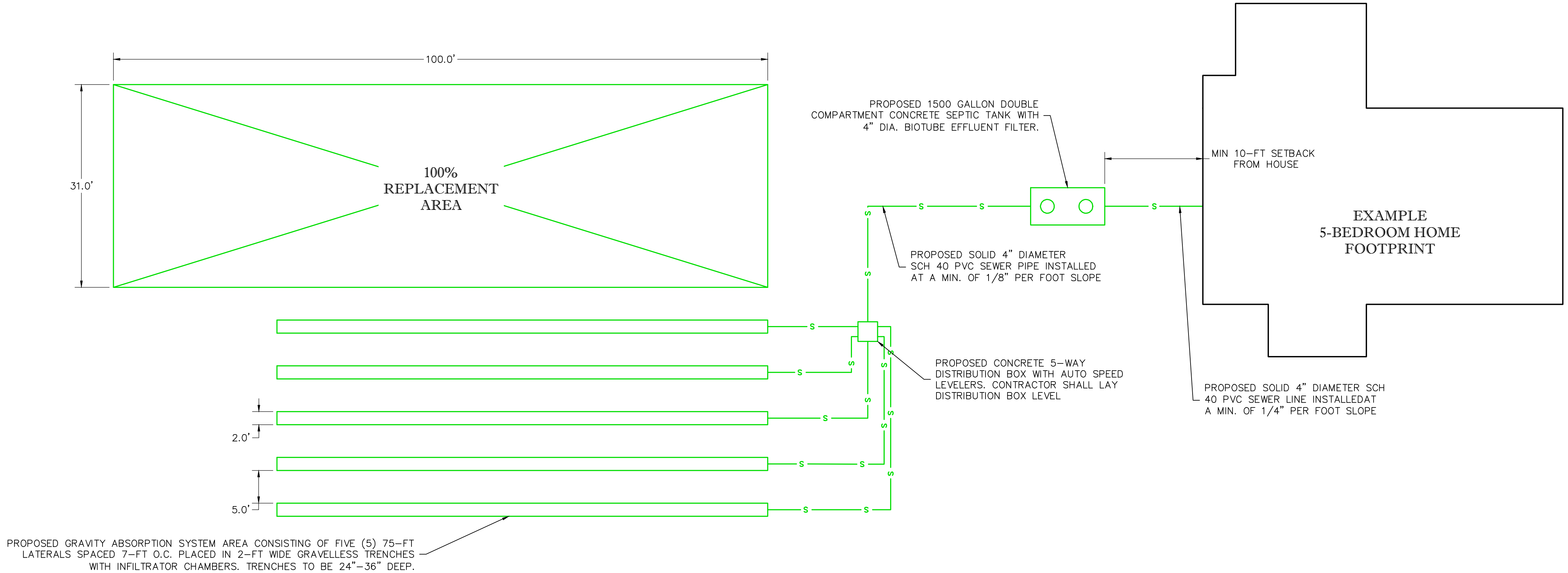
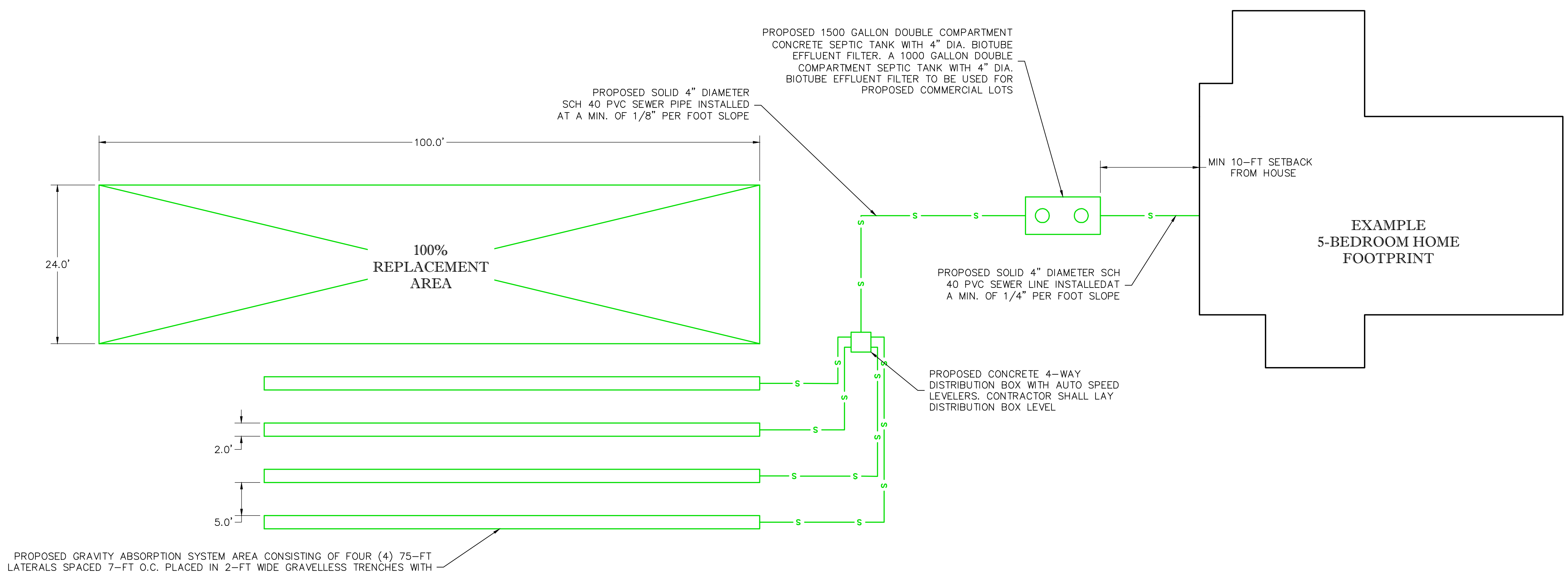
PROJECT #: 19-072
DATE: 3/27/2020
WWTS DETAILS

SHEET
WW2.1

HORSE CREEK HILLS
WWTS DETAILS



DETAIL 1 - WASTEWATER TREATMENT SYSTEM TYPE C - STANDARD GRAVITY SYSTEM WITH GRAVELLESS INFILTRATOR CHAMBERS



DETAIL 2 - WASTEWATER TREATMENT SYSTEM TYPE D - STANDARD GRAVITY SYSTEM WITH GRAVELLES INFILTRATOR CHAMBERS

NO.	REVISIONS	DRAWN BY	DATE

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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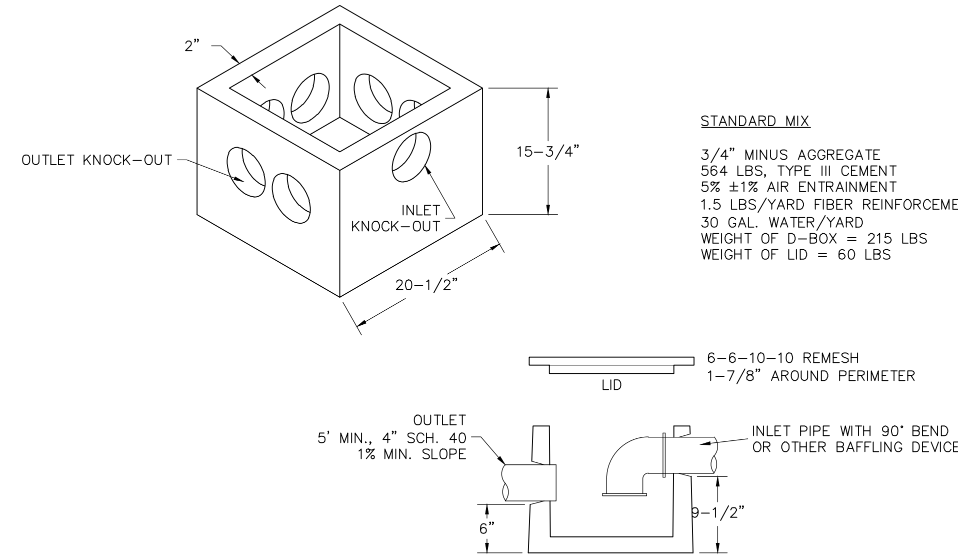
PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS

SHEET
WW2.2

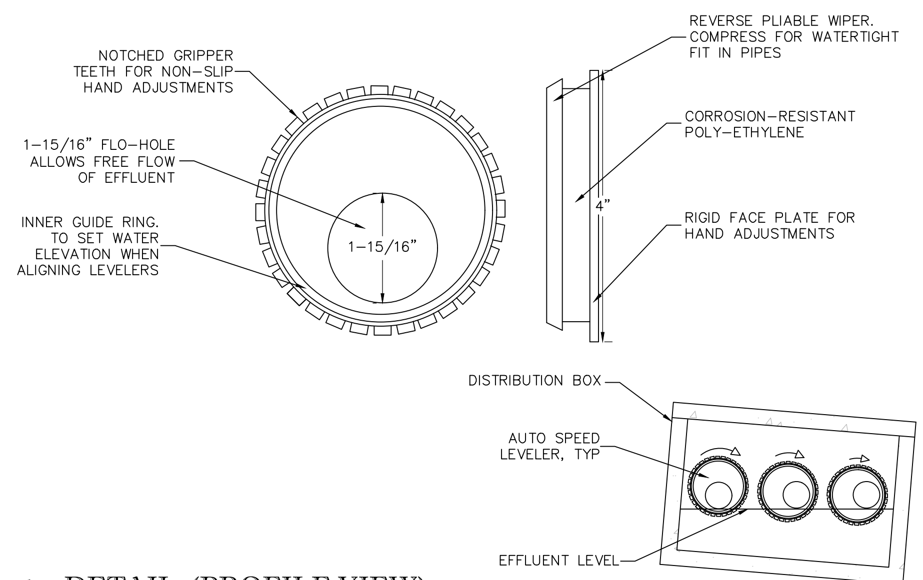
HORSE CREEK HILLS
WWTS PLANS



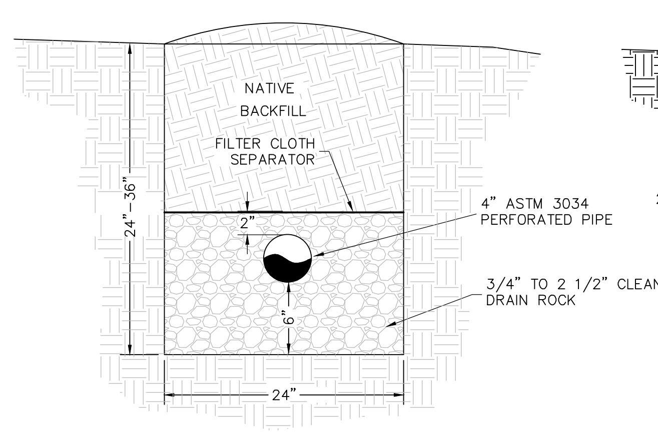
STANDARD MIX

3/4" MINUS AGGREGATE
564 LBS. TYPE III CEMENT
5% ±1% AIR ENTRAINMENT
1.5 LBS/YARD FIBER REINFORCEMENT
30 GAL. WATER/YARD
WEIGHT OF D-BOX = 215 LBS
WEIGHT OF LID = 60 LBS

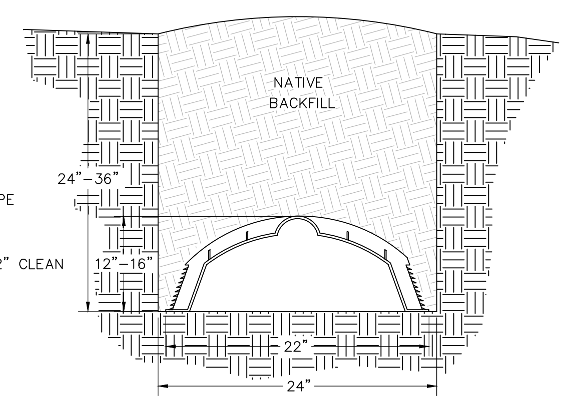
1 WW2.3 DETAIL
DISTRIBUTION BOX
NOT TO SCALE



2 WW2.3 DETAIL (PROFILE VIEW)
AUTO SPEED LEVELER
NOT TO SCALE

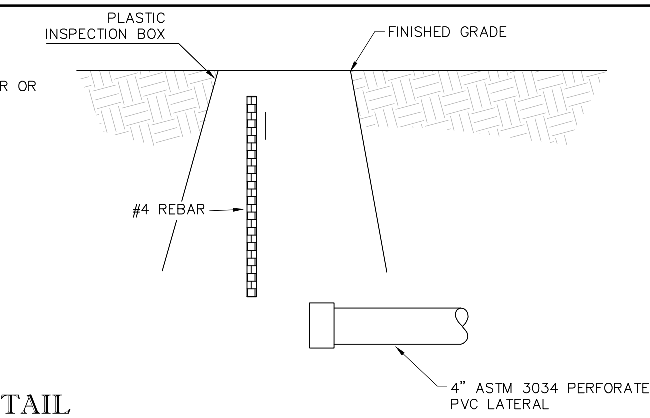


3 WW2.3 SECTION
24" STANDARD TRENCH
NOT TO SCALE

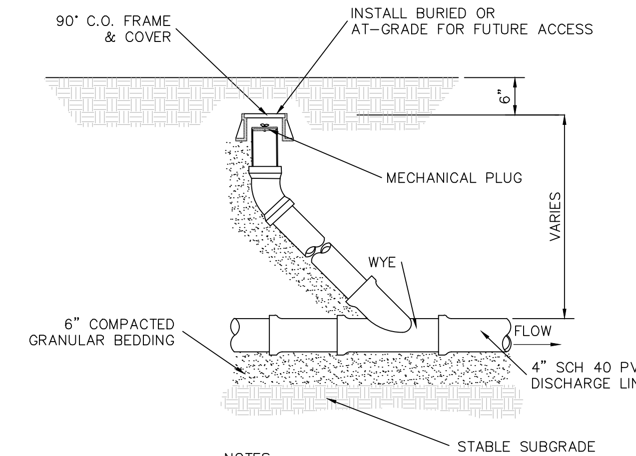


4 WW2.3 SECTION (ALTERNATE)
24" GRAVELLESS TRENCH
NOT TO SCALE

ALTERNATE:
USE C.O. FRAME AND COVER OR BURY INSPECTION BOX FOR PROTECTION FROM WILDLIFE DISTURBANCE.



5 WW2.3 DETAIL
DRAINFIELD INSPECTION BOX
NOT TO SCALE



NOTES:

1. USE INLAND FOUNDRY MODEL 240 FRAME & COVER IN ALL TRAFFIC AREAS.
2. COVER AND FRAME SHALL BE GRAY CAST IRON ASTM A-48, CLASS 30.
3. COVER AND FRAME TO BE MACHINED TO A TRUE BEARING ALL AROUND.

6 WW2.3 DETAIL
4" CLEANOUT
NOT TO SCALE

GENERAL NOTES:

1. WORK SHALL BE PERFORMED IN ACCORDANCE WITH CIRCULAR DEQ 4, AND BROADWATER COUNTY REGULATIONS.
2. CONTRACTOR SHALL BE LICENSED AND QUALIFIED TO INSTALL WASTEWATER TREATMENT SYSTEMS IN BROADWATER COUNTY, MONTANA.
3. NO WELLS OR SURFACE WATER EXIST WITHIN 100 FEET OF PRIMARY DRAINFIELD OR 100% REPLACEMENT AREA.
4. NO WELLS OR SURFACE WATER EXIST WITHIN 50 FEET OF WASTEWATER TREATMENT SYSTEM'S SEALED COMPONENTS.
5. SURFACE DRAINAGE IS ADEQUATE.
6. SLOPE ACROSS DRAINFIELD WAS DETERMINED TO BE LESS THAN 15.0%
7. REBAR SHALL BE PLACED AT THE ENDS OF DRAINFIELD LATERALS PER DETAIL 5 ON SHEET WW2.3.

NOTES TO INSTALLER:

1. CONTRACTOR TO VERIFY LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION ACTIVITIES.
2. CONTRACTOR TO VERIFY SEWER STUB LOCATIONS AND ALL EXISTING WASTEWATER TREATMENT COMPONENTS PRIOR TO INSTALLATION OF WASTEWATER TREATMENT SYSTEM.
3. CONTRACTOR TO FIELD VERIFY ALL APPLICABLE SETBACKS PRIOR TO INSTALLATION OF WASTEWATER TREATMENT SYSTEM. IF ANY DISCREPANCIES ARE DETERMINED BY CONTRACTOR, ENGINEER SHALL BE NOTIFIED IMMEDIATELY IN WRITING.
4. ALL LATERALS ARE TO BE LAID LEVEL.
5. 10 FEET (MIN.) SEPARATION BETWEEN WATER AND SEWER LINES SHALL BE MAINTAINED.
6. BALLAST ALL TANKS AND SEAL ALL TANK RISERS IN HIGH GROUNDWATER.
7. ANY DESIGN CHANGES WITH RESPECT TO ORIENTATION, LAYOUT, MATERIALS, ETC. MUST BE APPROVED BY ENGINEER.

C:\aesi_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\Sewer\WW2.1 DETAILS.dwg

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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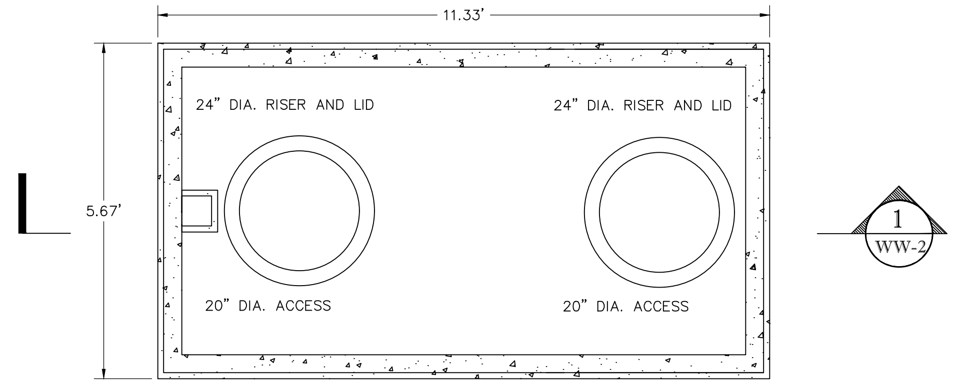
PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS

SHEET
WW2.3

HORSE CREEK HILLS
WWTS PLANS



*INSTALL SAFETY GRATES AT ALL SEPTIC TANK/DOSING TANK OPENINGS. CUT TO FIT AROUND EFFLUENT FILTER HANDLE AND PUMP DISCHARGE PIPING (IF NECESSARY).

ALTERNATE
*OWNER MAY INSTALL FIBERGLASS RISERS AND LIDS IN LIEU OF CONCRETE. RISERS AND LIDS (TYPICAL ALL TANKS)

*PRIOR TO PLACEMENT OF TANKS CONTACT ENGINEER IF TANK DEPTHS ARE ANTICIPATED TO EXCEED 4' BURY DEPTH.

MDEQ4 5.1.2.1.:

LIQUID CONNECTION BETWEEN COMPARTMENTS SHALL CONSIST OF A SINGLE OPENING COMPLETELY ACROSS THE COMPARTMENT WALL OR TWO OR MORE OPENINGS EQUALLY SPACED ACROSS THE WALL. THE TOTAL AREA OF THE OPENINGS SHALL BE AT LEAST THREE TIMES THE AREA OF THE INLET PIPE.

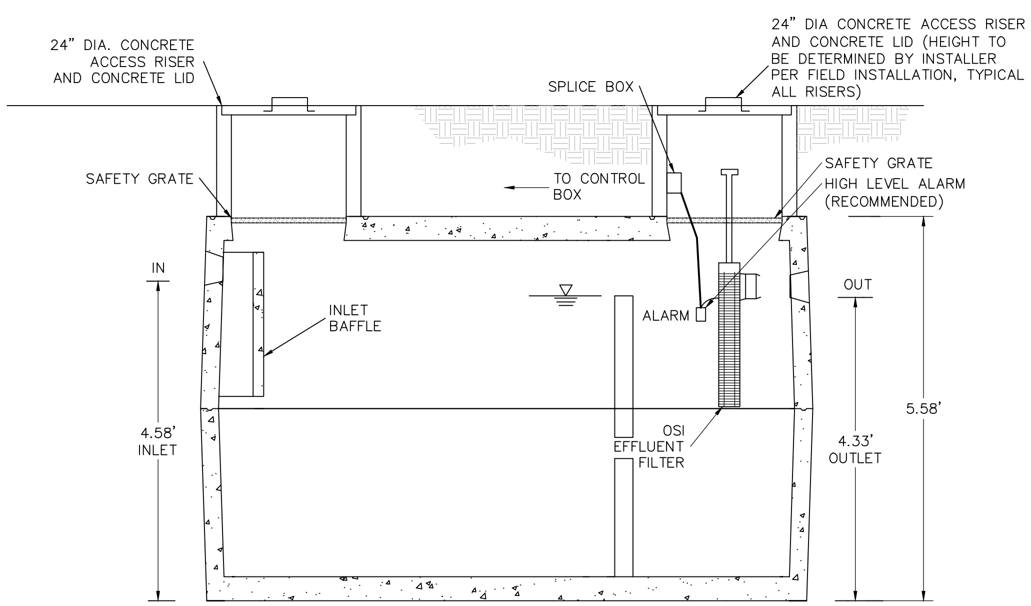
ALL SEPTIC AND DOSING TANKS MUST BE TESTED IN ACCORDANCE WITH MDEQ4 CHAPTER 5 FOR WATERTIGHTNESS.

WATER TESTING MUST BE CONDUCTED BY SEALING THE OUTLETS, FILLING THE SEPTIC TANK TO ITS OPERATIONAL LEVEL, AND ALLOWING THE TANK TO STAND FOR AT LEAST 24 HOURS. IF THERE IS A MEASURABLE LOSS (2 INCHES OR MORE), REFILL THE TANK AND LET STAND FOR ANOTHER 24 HOURS. IF THERE IS AGAIN A MEASURABLE LOSS, THE TANK MUST BE REJECTED.

OR

VACUUM TESTING MUST BE CONDUCTED BY SEALING ALL INLETS, OUTLETS, AND ACCESSES, THEN INTRODUCING A VACUUM OF 4 INCHES OF MERCURY, IF THE VACUUM DROPS IN THE FIRST 5 MINUTES IT MUST BE BROUGHT BACK TO 4 INCHES OF MERCURY. IF THE SEPTIC TANK FAILS TO HOLD THE VACUUM AT 5 INCHES OF MERCURY FOR 5 MINUTES, THE TANK MUST BE REJECTED.

1 / WW3.3 DETAIL (PLAN VIEW) - RESIDENTIAL HOME
1,500 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)
NOT TO SCALE



SECTION VIEW

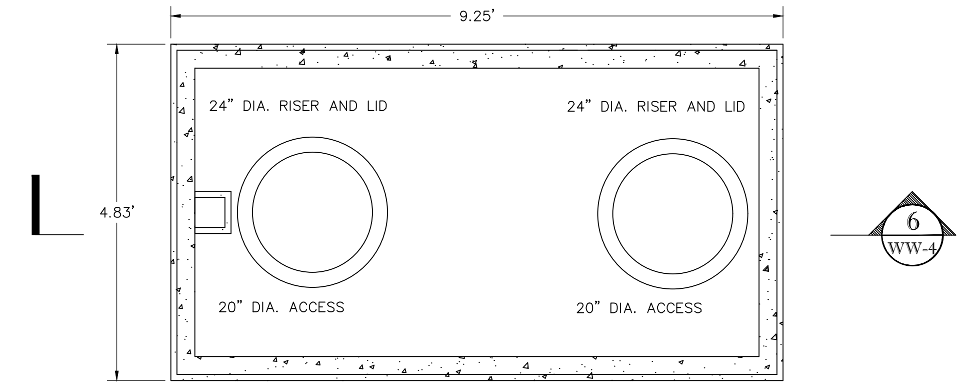
NOTES:

- ALL SEPTIC TANK DIMENSIONS HAVE BEEN SUPPLIED BY ANDERSON PRECAST & SUPPLY, INC (BOZEMAN, MT). CONTRACTOR MAY ELECT TO USE ALTERNATIVE SUPPLIER, IN WHICH CASE CONTRACTOR SHALL SUBMIT STANDARD SEPTIC TANK DETAILS PER SUPPLIERS PROPOSED CONSTRUCTION PRIOR TO INSTALLATION.
- WE RECOMMEND THE USE OF A HIGH LEVEL ALARM.

TANK NOTES:

1. CONCRETE IS 5,000 PSI AT 28 DAYS
2. INLET AND OUTLET HAVE PLASTIC SEAL WHICH ACCEPTS SCH40 OR SEWER AND DRAIN PIPE.
3. NORMALLY SET IN ONE PIECE
4. SIDE INLET (KNOCK-OUTS) PROVIDED.
5. EACH SEGMENT IS POURED MONOLITHICALLY.
6. ALL HANDLES ARE 1/4" SMOOTH STEEL.
7. WEIGHT OF TANK IS 16,000 LBS.
8. REINFORCING = #3 REBAR GRADE 40.
9. ACTUAL CAPACITY = ±1,500 GALLONS
10. MAXIMUM EARTH COVER IS 4 FEET.
11. TANK JOINT IS SEALED WITH 3/4" DIA. CONSEAL.

2 / WW3.3 DETAIL (PROFILE VIEW) - RESIDENTIAL HOME
1,500 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)
NOT TO SCALE



*INSTALL SAFETY GRATES AT ALL SEPTIC TANK/DOSING TANK OPENINGS. CUT TO FIT AROUND EFFLUENT FILTER HANDLE AND PUMP DISCHARGE PIPING (IF NECESSARY).

ALTERNATE
*OWNER MAY INSTALL FIBERGLASS RISERS AND LIDS IN LIEU OF CONCRETE. RISERS AND LIDS (TYPICAL ALL TANKS)

*PRIOR TO PLACEMENT OF TANKS CONTACT ENGINEER IF TANK DEPTHS ARE ANTICIPATED TO EXCEED 4' BURY DEPTH.

MDEQ4 5.1.2.1.:

LIQUID CONNECTION BETWEEN COMPARTMENTS SHALL CONSIST OF A SINGLE OPENING COMPLETELY ACROSS THE COMPARTMENT WALL OR TWO OR MORE OPENINGS EQUALLY SPACED ACROSS THE WALL. THE TOTAL AREA OF THE OPENINGS SHALL BE AT LEAST THREE TIMES THE AREA OF THE INLET PIPE.

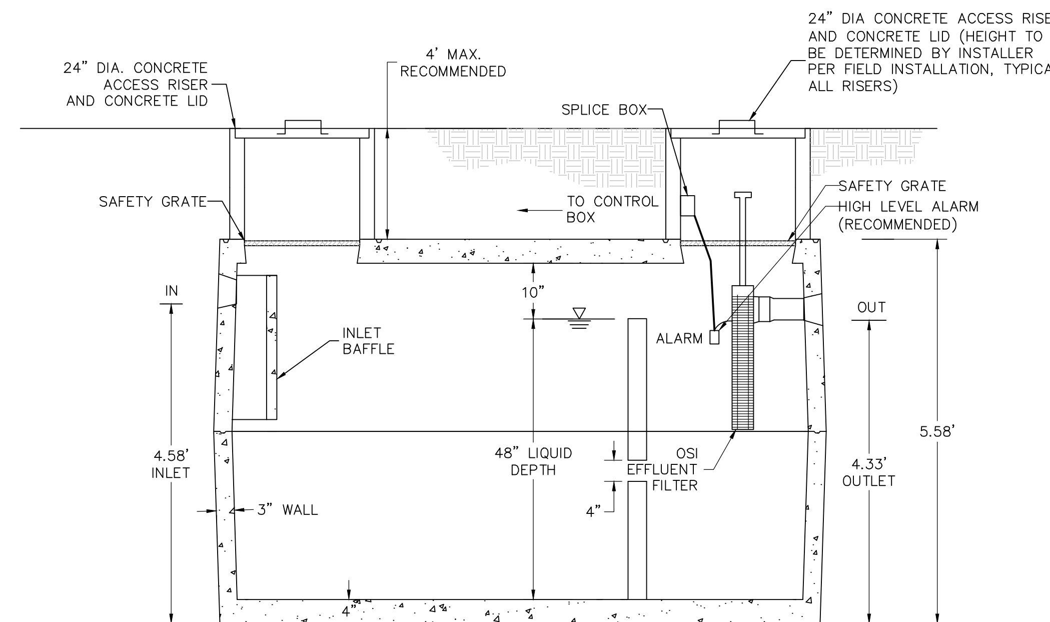
ALL SEPTIC AND DOSING TANKS MUST BE TESTED IN ACCORDANCE WITH MDEQ4 CHAPTER 5 FOR WATERTIGHTNESS.

WATER TESTING MUST BE CONDUCTED BY SEALING THE OUTLETS, FILLING THE SEPTIC TANK TO ITS OPERATIONAL LEVEL, AND ALLOWING THE TANK TO STAND FOR AT LEAST 24 HOURS. IF THERE IS A MEASURABLE LOSS (2 INCHES OR MORE), REFILL THE TANK AND LET STAND FOR ANOTHER 24 HOURS. IF THERE IS AGAIN A MEASURABLE LOSS, THE TANK MUST BE REJECTED.

OR

VACUUM TESTING MUST BE CONDUCTED BY SEALING ALL INLETS, OUTLETS, AND ACCESSES, THEN INTRODUCING A VACUUM OF 4 INCHES OF MERCURY, IF THE VACUUM DROPS IN THE FIRST 5 MINUTES IT MUST BE BROUGHT BACK TO 4 INCHES OF MERCURY. IF THE SEPTIC TANK FAILS TO HOLD THE VACUUM AT 5 INCHES OF MERCURY FOR 5 MINUTES, THE TANK MUST BE REJECTED.

3 / WW2.4 DETAIL (PLAN VIEW) - COMMERCIAL SHOP
1,000 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)
NOT TO SCALE



SECTION VIEW

NOTES:

- ALL SEPTIC TANK DIMENSIONS HAVE BEEN SUPPLIED BY ANDERSON PRECAST & SUPPLY, INC (BOZEMAN, MT). CONTRACTOR MAY ELECT TO USE ALTERNATIVE SUPPLIER, IN WHICH CASE CONTRACTOR SHALL SUBMIT STANDARD SEPTIC TANK DETAILS PER SUPPLIERS PROPOSED CONSTRUCTION PRIOR TO INSTALLATION.
- WE RECOMMEND THE USE OF A HIGH LEVEL ALARM.
- SHALL BE DOUBLE COMPARTMENT

TANK NOTES:

1. CONCRETE IS 5,000 PSI AT 28 DAYS
2. INLET AND OUTLET HAVE PLASTIC SEAL WHICH ACCEPTS SCH40 OR SEWER AND DRAIN PIPE.
3. NORMALLY SET IN ONE PIECE
4. SIDE INLET (KNOCK-OUTS) PROVIDED.
5. EACH SEGMENT IS POURED MONOLITHICALLY.
6. ALL HANDLES ARE 1/4" SMOOTH STEEL.
7. WEIGHT OF TANK IS 10,500 LBS.
8. REINFORCING = #3 REBAR GRADE 40.
9. ACTUAL CAPACITY = ±1,000 GALLONS
10. MAXIMUM EARTH COVER IS 4 FEET.
11. TANK JOINT IS SEALED WITH 3/4" DIA. CONSEAL.

4 / WW2.4 DETAIL (PROFILE VIEW) - COMMERCIAL SHOP
1,000 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)
NOT TO SCALE

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 314

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
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PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS

SHEET WW2.4

HORSE CREEK HILLS
WWTS PLANS

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SUMMARY OF PROPOSED WASTEWATER TREATMENT TYPE
CORRESPONDING TO EACH LOT

Lot Numer	# of Bedrooms	GPD of Wastewater	Texture	Application Rate (gpd/ft^2)	Corresponding Percolation Rate (min/inch)	Min. Drainfield Area (sf)	Length of Lateral (LF)	Min. Drainfield Dimensions (ft)	Infiltrator Size Reduction	Min. Drainfield Area (sf)	Length of Lateral (LF)	Min. Drainfield Dimensions (ft)	Type of System to be Utilized
1	24 Employees	312	SiL	0.4	16 - <31	780	390	23 X 100 (Type B)	0.75	585	292.5	23 x 75 (Type D)	B or D
2	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
3	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
4	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
5	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
6	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
7	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
8	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
9	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
10	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
11	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
12	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
13	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
14	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
15	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
16	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
17	5	400	L	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
18	5	400	L	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
19	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
20	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
21	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
22	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
23	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
24	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
25	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
26	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
27	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
28	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
29	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
30	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
31	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
32	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
33	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
34	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
35	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
36	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
37	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
38	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
39	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
40	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
41	24 Employees	312	SiL	0.4	16 - <31	780	390	23 X 100 (Type B)	0.75	585	292.5	23 x 75 (Type D)	B or D

1 WW2.5 DETAIL
SUMMARY OF DRAINFIELD DIMENSIONS
NOT TO SCALE

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF
DRAWN BY: HTM
DESIGNED BY: MAF, HTM
REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM SUMMARY
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS
SHEET
WW2.5
HORSE CREEK HILLS
WWTS PLANS

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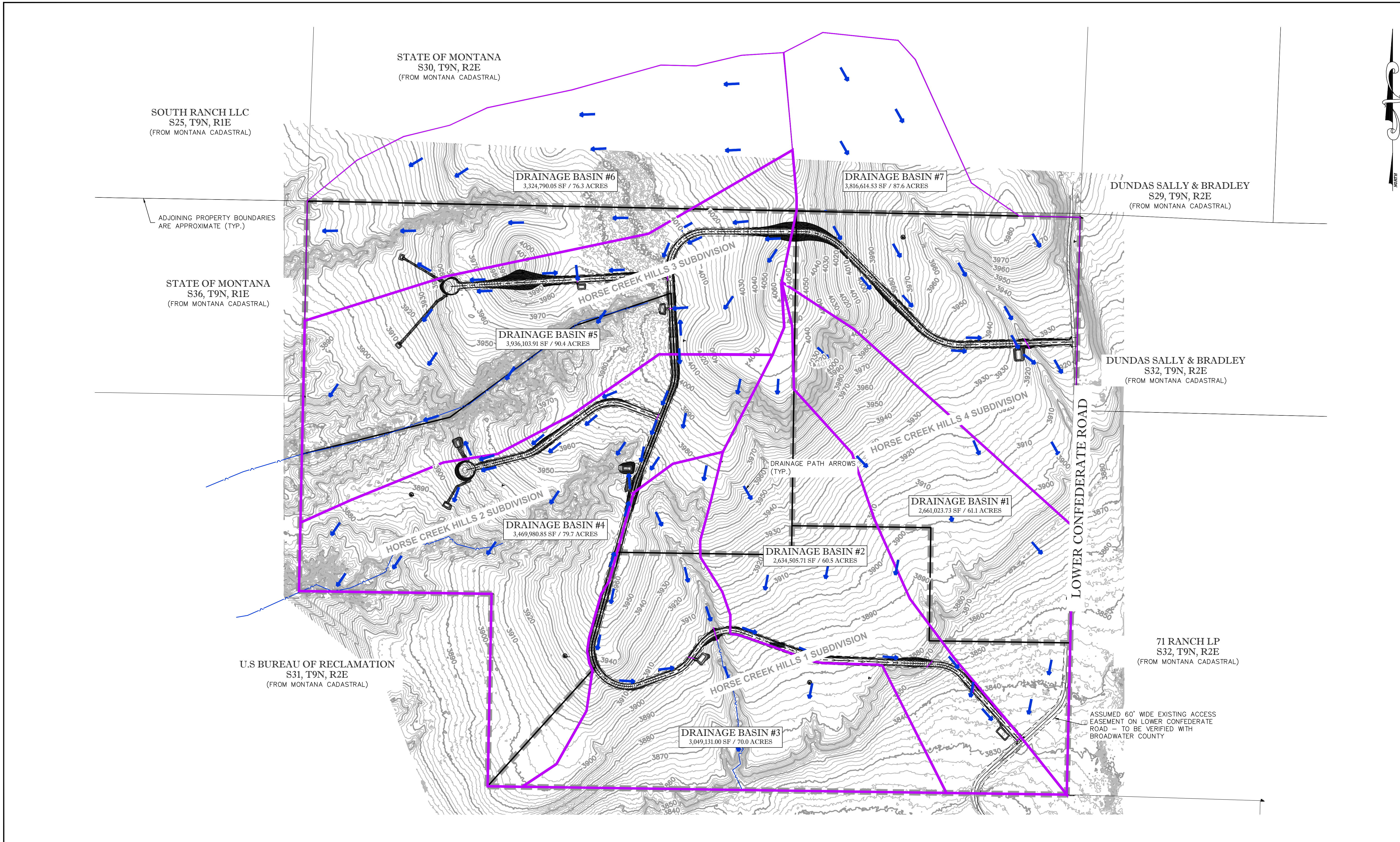

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 316

0 300 600 900
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - STORMWATER
STORM DRAINAGE PLAN OVERVIEW
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW3.0

HORSE CREEK HILLS
STORMWATER OVERVIEW

STRAWBERRY ROAN TRAIL

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L189	0+00.00	826,482.1902; 1,461,639.8195	N/A	755.72	S88° 27' 40.34"W	N/A	7+55.72	826,461.8963; 1,460,884.3754
C1	7+55.72	826,461.8963; 1,460,884.3754	400.00	342.99	N66° 58' 24.92"W	N/A	10+98.71	826,591.9879; 1460578.2912
L190	10+98.71	826,591.9879; 1,460,578.2912	N/A	735.22	N44° 19' 15.89"W	N/A	18+33.93	827,117.9894; 1,460,064.6099
C2	18+33.93	827,117.9894; 1,460,064.6099	400.00	298.01	N65° 39' 52.42"W	N/A	21+31.94	827,237.9727; 1459799.3139
L191	21+31.94	827,237.9727; 1,459,799.3139	N/A	674.27	S89° 58' 32.43"W	N/A	28+06.21	827,237.6864; 1,459,125.0454
C3	28+06.21	827,237.6864; 1,459,125.0454	250.00	391.59	S45° 06' 11.21"W	N/A	31+97.80	826,988.6924; 1458875.1535
L192	31+97.80	826,988.6924; 1,458,875.1535	N/A	708.07	S3° 00' 48.58"E	N/A	39+05.86	826,281.6037; 1,458,912.3774
C4	39+05.86	826,281.6037; 1,458,912.3774	300.00	127.11	S9° 03' 11.56"W	N/A	40+32.97	826,157.0147; 1458892.5259
L193	40+32.97	826,157.0147; 1,458,892.5259	N/A	653.61	S21° 11' 28.51"W	N/A	46+86.58	825,547.6048; 1,458,656.2583
C5	46+86.58	825,547.6048; 1,458,656.2583	250.00	25.34	S18° 17' 13.31"W	N/A	47+11.93	825,523.5509; 1458648.3093
L194	47+11.93	825,523.5509; 1,458,648.3093	N/A	1,123.31	S15° 22' 58.11"W	N/A	58+35.23	824,440.4879; 1,458,350.3337
C6	58+35.23	824,440.4879; 1,458,350.3337	250.00	544.51	S47° 00' 47.37"E	N/A	63+79.74	824,138.3787; 1458674.4553
L195	63+79.74	824,138.3787; 1,458,674.4553	N/A	232.07	N70° 35' 27.16"E	N/A	66+11.81	824,215.4972; 1,458,893.3338
C7	66+11.81	824,215.4972; 1,458,893.3338	250.00	153.67	N52° 58' 54.92"E	N/A	67+65.47	824,306.5655; 1459014.1063
L196	67+65.47	824,306.5655; 1,459,014.1063	N/A	117.56	N35° 22' 22.69"E	N/A	68+83.03	824,402.4253; 1,459,082.1623
C8	68+83.03	824,402.4253; 1,459,082.1623	250.00	323.94	N72° 29' 36.32"E	N/A	72+06.97	824,493.1952; 1459369.9324
L197	72+06.97	824,493.1952; 1,459,369.9324	N/A	511.62	S70° 23' 10.05"E	N/A	77+18.59	824,321.4557; 1,459,851.8638
C9	77+18.59	824,321.4557; 1,459,851.8638	250.00	75.58	S79° 02' 48.73"E	N/A	77+94.17	824,307.1498; 1459925.7840
L198	77+94.17	824,307.1498; 1,459,925.7840	N/A	777.91	S87° 42' 27.42"E	N/A	85+72.08	824,276.0342; 1,460,703.0703
C10	85+72.08	824,276.0342; 1,460,703.0703	250.00	199.23	S64° 52' 38.91"E	N/A	87+71.31	824,193.6704; 1460878.7185
L199	87+71.31	824,193.6704; 1,460,878.7185	N/A	605.19	S42° 03' 14.75"E	N/A	93+76.50	823,744.3085; 1,461,284.0946

APPALOOSA TRAIL

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L200	0+00.00	825,957.8812; 1,458,815.3220	N/A	254.84	N68° 48' 31.49"W	N/A	2+54.84	826,050.0031; 1,458,577.7099
L203	0+00.00	825,957.8812; 1,458,815.3220	N/A	254.84	N68° 48' 31.49"W	N/A	2+54.84	826,050.0031; 1,458,577.7099
C11	2+54.84	826,050.0031; 1,458,577.7099	250.00	250.90	S82° 26' 26.76"W	N/A	5+05.74	826,018.3653; 1458339.3019
C13	2+54.84	826,050.0031; 1,458,577.7099	250.00	250.90	S82° 26' 26.76"W	N/A	5+05.74	826,018.3653; 1458339.3019
L201	5+05.74	826,018.3653; 1,458,339.3019	N/A	458.59	S53° 41' 25.01"W	N/A	9+64.33	825,746.8117; 1,457,969.7578
L204	5+05.74	826,018.3653; 1,458,339.3019	N/A	458.59	S53° 41' 25.01"W	N/A	9+64.33	825,746.8117; 1,457,969.7578
C12	9+64.33	825,746.8117; 1,457,969.7578	250.00	97.18	S64° 49' 34.78"W	N/A	10+61.51	825,705.7345; 1457882.3601
C14	9+64.33	825,746.8117; 1,457,969.7578	250.00	97.18	S64° 49' 34.78"W	N/A	10+61.51	825,705.7345; 1457882.3601
L202	10+61.51	825,705.7345; 1,457,882.3601	N/A	408.49	S75° 57' 44.56"W	N/A	14+70.00	825,606.6509; 1,457,486.0664
L205	10+61.51	825,705.7345; 1,457,882.3601	N/A	408.49	S75° 57' 44.56"W	N/A	14+70.00	825,606.6509; 1,457,486.0664

APT POND 1 SWALE NORTH

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L207	0+00.00	825,638.2166; 1,457,536.3127	N/A	2.86	N82° 46' 27.03"W	N/A	0+02.86	825,638.5769; 1,457,533.4707
L208	0+02.86	825,638.5769; 1,457,533.4707	N/A	3.09	N59° 05' 34.29"W	N/A	0+05.95	825,640.1618; 1,457,530.8234
L209	0+05.95	825,640.1618; 1,457,530.8234	N/A	12.89	N43° 59' 30.64"W	N/A	0+18.84	825,649.4369; 1,457,521.8690
L210	0+18.84	825,649.4369; 1,457,521.8690	N/A	3.41	N43° 59' 30.64"W	N/A	0+22.25	825,651.8888; 1,457,519.5019
L211	0+22.25	825,651.8888; 1,457,519.5019	N/A	0.44	N90° 00' 00.00"W	N/A	0+22.69	825,651.8888; 1,457,519.0603
L212	0+22.69	825,651.8888; 1,457,519.0603	N/A	19.42	N57° 58' 04.11"W	N/A	0+42.12	825,662.1907; 1,457,502.5944
L213	0+42.12	825,662.1907; 1,457,502.5944	N/A	106.03	N35° 14' 27.11"W	N/A	1+48.15	825,748.7927; 1,457,441.4109
L214	1+48.15	825,748.7927; 1,457,441.4109	N/A	86.24	N17° 26' 26.64"W	N/A	2+34.39	825,831.0663; 1,457,415.5637

APT POND 2 SWALE SOUTH

SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L215	0+00.00	825,608.4328; 1,457,567.4019	N/A	12.52	S70° 26' 48.72"W	N/A	0+12.52	825,604.2412; 1,457,555.6000
L216	0+12.52	825,604.2412; 1,457,555.6000	N/A	28.25	S27° 40' 18.04"W	N/A	0+40.77	825,579.2224; 1,457,542.4806
L217	0+40.77	825,579.2224; 1,457,542.4806	N/A	19.89	S28° 26' 49.91"W	N/A	0+60.66	825,561.7344; 1,457,533.0062
L218	0+60.66	825,561.7344; 1,457,533.0062	N/A	16.83	S40° 09' 35.39"W	N/A	0+77.50	825,548.8707; 1,457,522.1510
L219	0+77.50	825,548.8707; 1,457,522.1510	N/A	19.21	S39° 58' 28.96"W	N/A	0+96.70	825,534.1519; 1,457,509.8116
L220	0+96.70	825,534.1519; 1,457,509.8116	N/A	54.21	S64° 59' 00.52"W	N/A	1+50.92	825,511.2259; 1,457,460.6836
L221	1+50.92	825,511.2259; 1,457,460.6836	N/A	44.40	S66° 03' 31.98"W	N/A	1+95.32	825,493.2081; 1,457,420.1029
L222	1+95.32	825,493.2081; 1,457,420.1029	N/A	175.28	S30° 10' 36.13"W	N/A	3+70.60	825,341.6834; 1,457,331.9958

C:\paxl_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\H & H\WW2.0 STORM PROJECT OVERVIEW.dwg

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 317

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - STORMWATER ALIGNMENT COORDINATE TABLES

SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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Diverse Projects

PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW3.01

HORSE CREEK HILLS
COORDINATE TABLES

BUCKSKIN TRAIL								
SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L206	0+00.00	826,943.5358; 1,458,877.5307	N/A	1,500.00	S86° 54' 54.60"W	N/A	15+00.00	826,862.8140; 1,457,379.7043

BST POND 1 SWALE NORTH								
SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L223	0+00.00	826,916.6624; 1,457,395.0411	N/A	8.39	N78° 12' 17.64"W	N/A	0+08.39	826,918.3775; 1,457,386.8280
L224	0+08.39	826,918.3775; 1,457,386.8280	N/A	11.53	N90° 00' 00.00"W	N/A	0+19.92	826,918.3775; 1,457,375.2971
L225	0+19.92	826,918.3775; 1,457,375.2971	N/A	21.41	S73° 52' 32.96"W	N/A	0+41.33	826,912.4322; 1,457,354.7319
L226	0+41.33	826,912.4322; 1,457,354.7319	N/A	25.82	S70° 28' 32.42"W	N/A	0+67.14	826,903.8045; 1,457,330.4009
L227	0+67.14	826,903.8045; 1,457,330.4009	N/A	16.40	S83° 03' 39.63"W	N/A	0+83.54	826,901.8231; 1,457,314.1204
L228	0+83.54	826,901.8231; 1,457,314.1204	N/A	84.22	N59° 15' 21.41"W	N/A	1+67.77	826,944.8775; 1,457,241.7354
L229	1+67.77	826,944.8775; 1,457,241.7354	N/A	207.23	N59° 15' 21.41"W	N/A	3+74.99	827,050.8137; 1,457,063.6305
L230	3+74.99	827,050.8137; 1,457,063.6305	N/A	51.57	N59° 15' 21.41"W	N/A	4+26.57	827,077.1785; 1,457,019.3048

BST POND 2 SWALE SOUTH								
SEGMENT ID #	START STATION	START NORTHING & EASTING	RADIUS [FT]	LENGTH [FT]	LINE/CHORD DIRECTION	A Value	END STATION	END NORTHING & EASTING
L231	0+00.00	826,810.9266; 1,457,400.7388	N/A	7.82	S70° 49' 15.53"W	N/A	0+07.82	826,808.3590; 1,457,393.3570
L232	0+07.82	826,808.3590; 1,457,393.3570	N/A	9.05	S82° 41' 22.27"W	N/A	0+16.87	826,807.2071; 1,457,384.3780
L233	0+16.87	826,807.2071; 1,457,384.3780	N/A	40.98	S77° 54' 37.00"W	N/A	0+57.85	826,798.6231; 1,457,344.3023
L234	0+57.85	826,798.6231; 1,457,344.3023	N/A	65.90	S55° 49' 18.34"W	N/A	1+23.75	826,761.6045; 1,457,289.7866
L235	1+23.75	826,761.6045; 1,457,289.7866	N/A	444.76	S41° 37' 08.04"W	N/A	5+68.51	826,429.1084; 1,456,994.3865

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - STORMWATER ALIGNMENT COORDINATE TABLES

SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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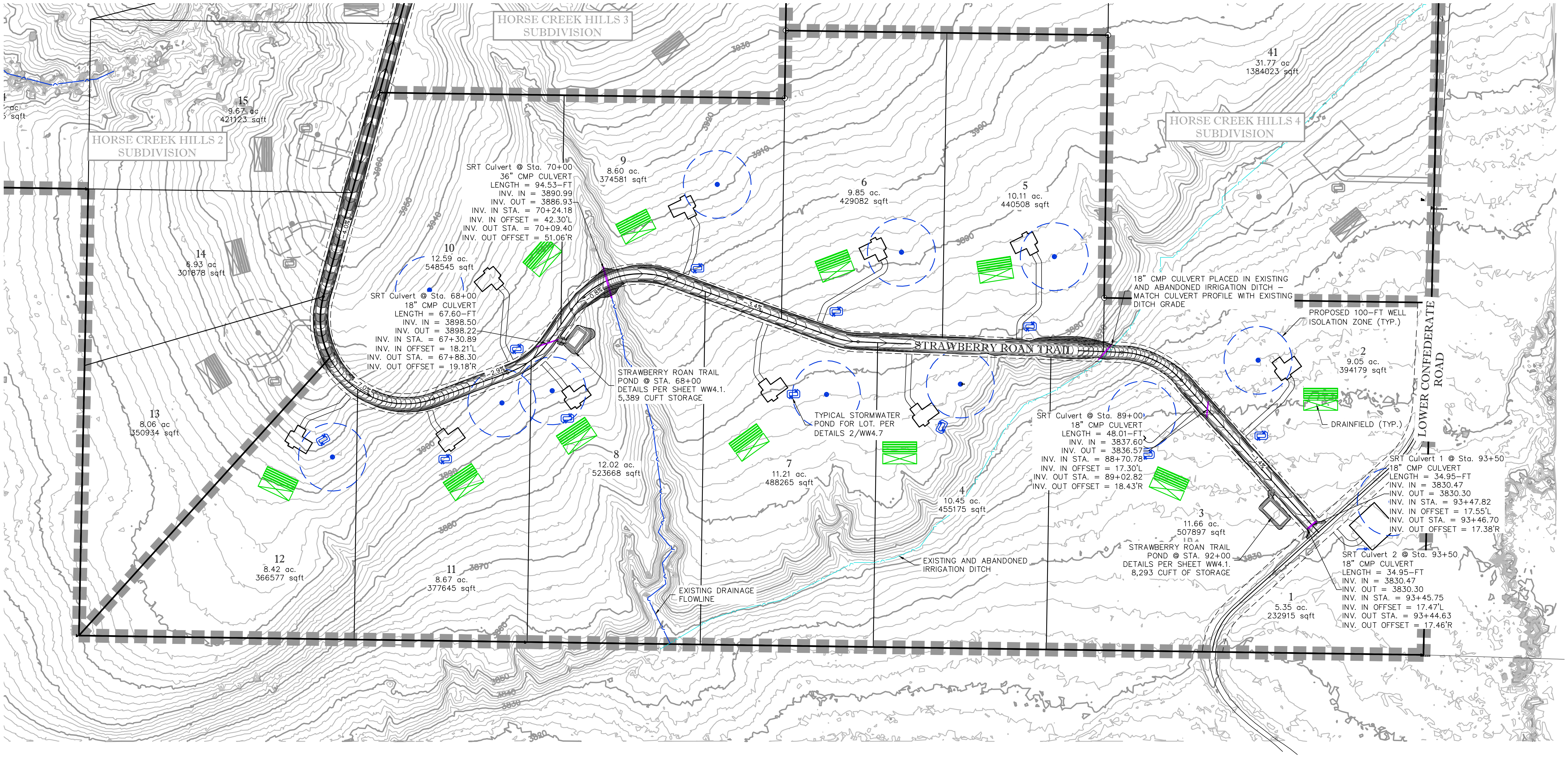
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW3.02

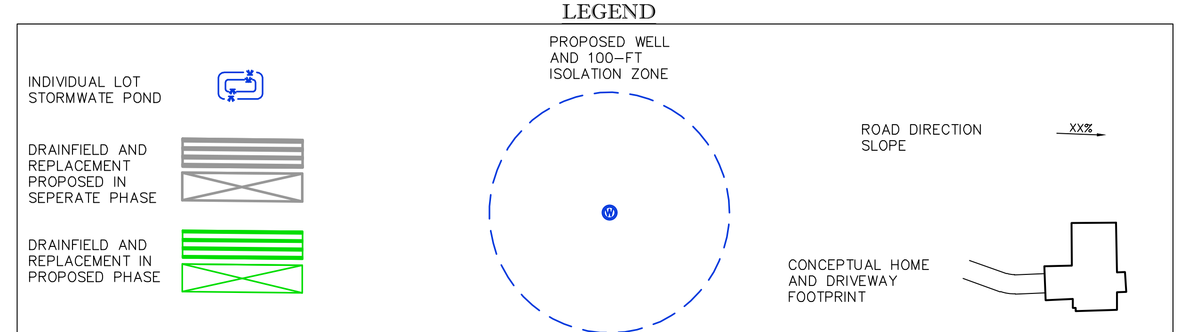
HORSE CREEK HILLS
COORDINATE TABLES



NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16–FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #1–12 ARE PROJECT #1 OF THE HORSE CREEK HILLS SUBDIVISION.
3. LOT #1 IS A PROPOSED COMMERCIAL LOT – RE-SIZING OF RETENTION POND FOR COMMERCIAL LOTS WILL BE REQUIRED IF IMPERVIOUS AREA WILL EXCEED 13,100 SF.
4. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE-SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
5. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2–YEAR, 24–HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10–YEAR, 24–HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100–YEAR, 24–HOUR STORM – PER CIRCULAR DEQ–8 STANDARDS.
6. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 1 SUBDIVISION SHALL BE 18" MIN. CMP CULVERTS.
7. SEE WASTEWATER SHEETS WW2X SERIES FOR WWTS DETAILS.
8. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT
9. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON–SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND



NO.	REVISIONS	DRAWN BY	DATE

0 150 300 450
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 1 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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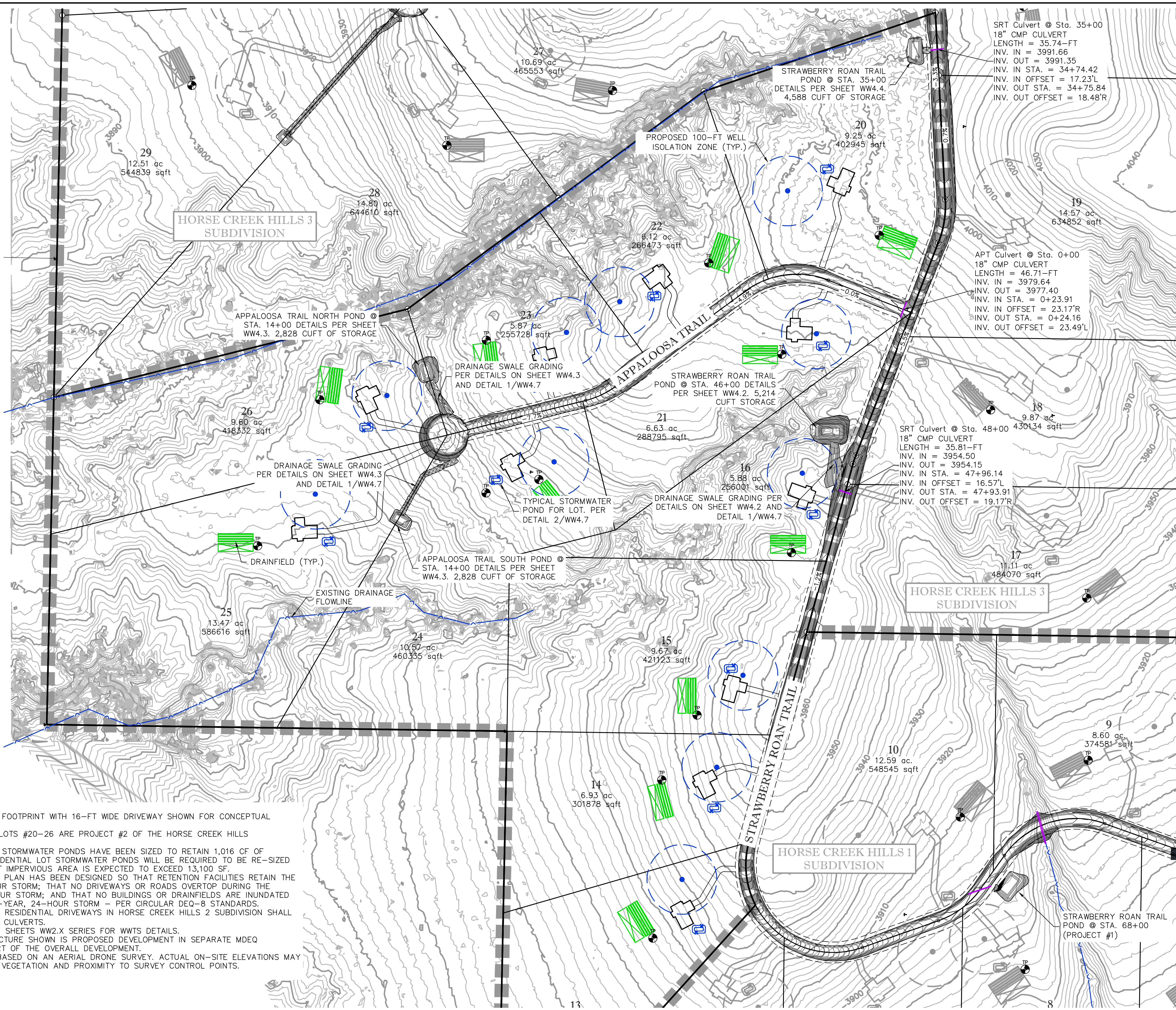
PROJECT #: 19–072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW3.1

HORSE CREEK HILLS
STORMWATER PLANS



NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #13-16 & LOTS #20-26 ARE PROJECT #2 OF THE HORSE CREEK HILLS SUBDIVISION.
3. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE-SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
4. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2-YEAR, 24-HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10-YEAR, 24-HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100-YEAR, 24-HOUR STORM - PER CIRCULAR DEQ-8 STANDARDS.
5. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 2 SUBDIVISION SHALL BE 15" MIN. CMP CULVERTS.
6. SEE WASTEWATER SHEETS WW2.X SERIES FOR WWTS DETAILS.
7. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS - PART OF THE OVERALL DEVELOPMENT.
8. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

- INDIVIDUAL LOT STORMWATE POND
- DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE
- DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE
- PROPOSED WELL AND 100-FT ISOLATION ZONE
- ROAD DIRECTION SLOPE
- CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 2 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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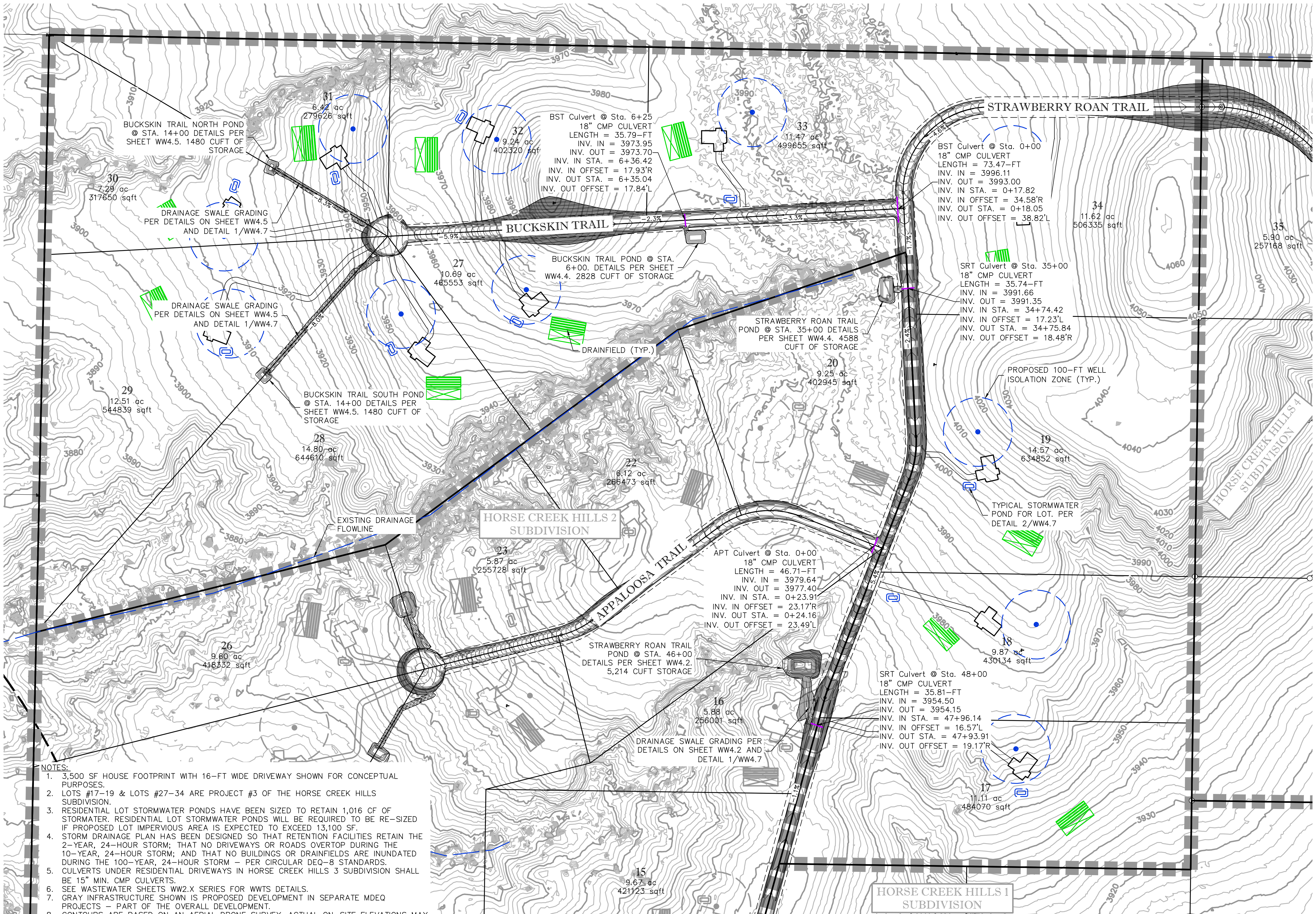
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW3.2

HORSE CREEK HILLS STORMWATER PLANS



NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #17-19 & LOTS #27-34 ARE PROJECT #3 OF THE HORSE CREEK HILLS SUBDIVISION.
3. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE-SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
4. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2-YEAR, 24-HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10-YEAR, 24-HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100-YEAR, 24-HOUR STORM - PER CIRCULAR DEQ-8 STANDARDS.
5. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 3 SUBDIVISION SHALL BE 15" MIN. CMP CULVERTS.
6. SEE WASTEWATER SHEETS WW2.X SERIES FOR WWTS DETAILS.
7. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS - PART OF THE OVERALL DEVELOPMENT.
8. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

- INDIVIDUAL LOT STORMWATE POND
- DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE
- DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE
- PROPOSED WELL AND 100-FT ISOLATION ZONE
- ROAD DIRECTION SLOPE (XX%)
- CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 3 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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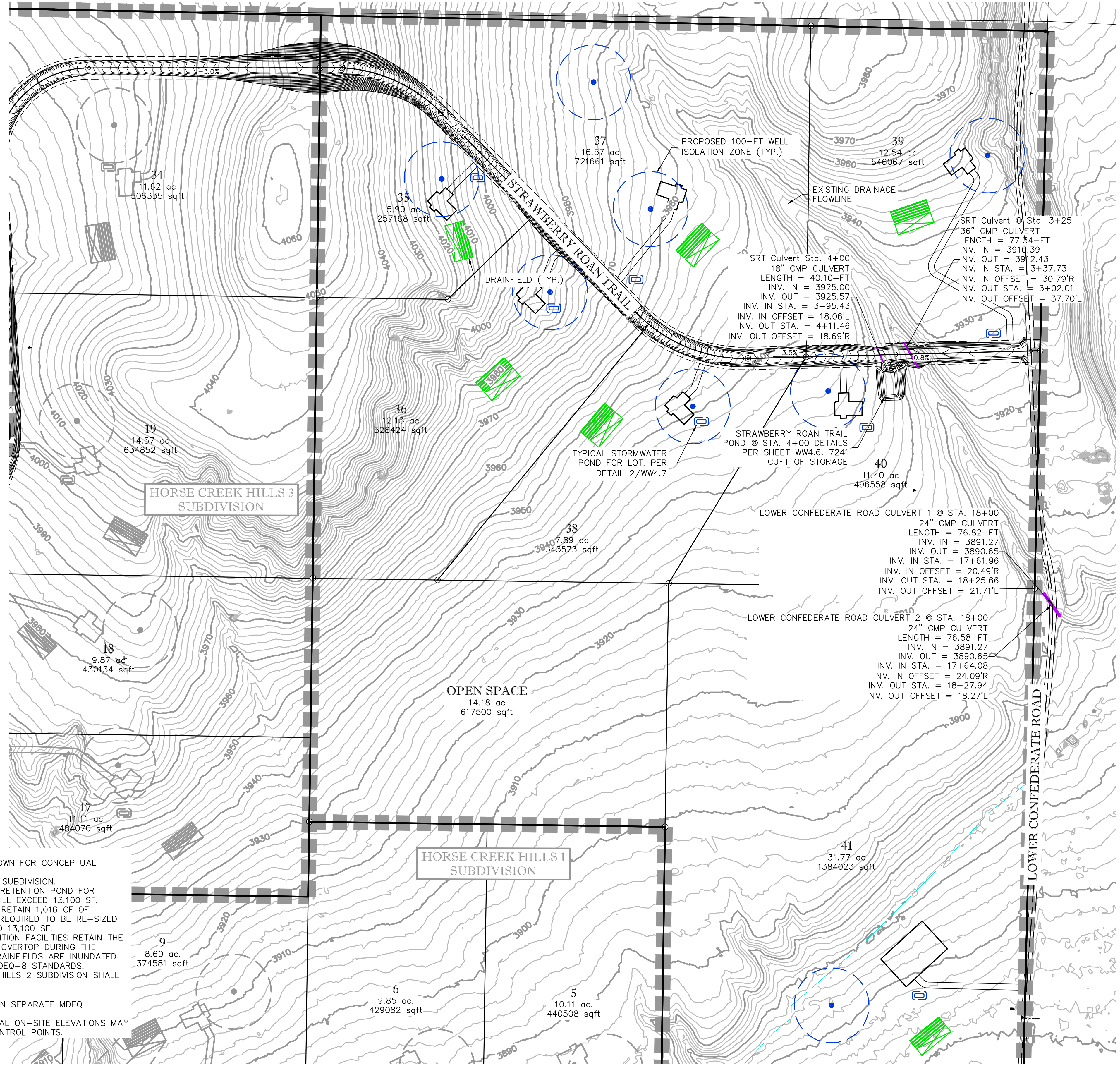
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW3.3

HORSE CREEK HILLS STORMWATER PLANS

C:\aesi_w\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\H & H\WW3.3 PROJECT 3 DESIGN.dwg



LEGEND

INDIVIDUAL LOT STORMWATE POND

DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE

DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE

PROPOSED WELL AND 100-FT ISOLATION ZONE

ROAD DIRECTION SLOPE

XX%

CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NOTES:

1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #35-41 ARE PROJECT #4 OF THE HORSE CREEK HILLS SUBDIVISION.
3. LOT #41 IS A PROPOSED COMMERCIAL LOT - RE-SIZING OF RETENTION POND FOR COMMERCIAL LOTS WILL BE REQUIRED IF IMPERVIOUS AREA WILL EXCEED 13,100 SF.
4. RESIDENTIAL LOT STORMWATER PONDS HAVE BEEN SIZED TO RETAIN 1,016 CF OF STORMATER. RESIDENTIAL LOT STORMWATER PONDS WILL BE REQUIRED TO BE RE-SIZED IF PROPOSED LOT IMPERVIOUS AREA IS EXPECTED TO EXCEED 13,100 SF.
5. STORM DRAINAGE PLAN HAS BEEN DESIGNED SO THAT RETENTION FACILITIES RETAIN THE 2-YEAR, 24-HOUR STORM; THAT NO DRIVEWAYS OR ROADS OVERTOP DURING THE 10-YEAR, 24-HOUR STORM; AND THAT NO BUILDINGS OR DRAINFIELDS ARE INUNDATED DURING THE 100-YEAR, 24-HOUR STORM - PER CIRCULAR DEQ-8 STANDARDS.
6. CULVERTS UNDER RESIDENTIAL DRIVEWAYS IN HORSE CREEK HILLS 2 SUBDIVISION SHALL BE 15" MIN. CMP CULVERTS.
7. SEE WASTEWATER SHEETS WW2.X SERIES FOR WWTS DETAILS.
8. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS - PART OF THE OVERALL DEVELOPMENT.
9. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

NO.	REVISIONS	DRAWN BY	DATE

DEQ Page 322

0 150 300 450
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 4 SUBDIVISION
STORMWATER MANAGEMENT PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW3.4

HORSE CREEK HILLS
STORMWATER PLANS

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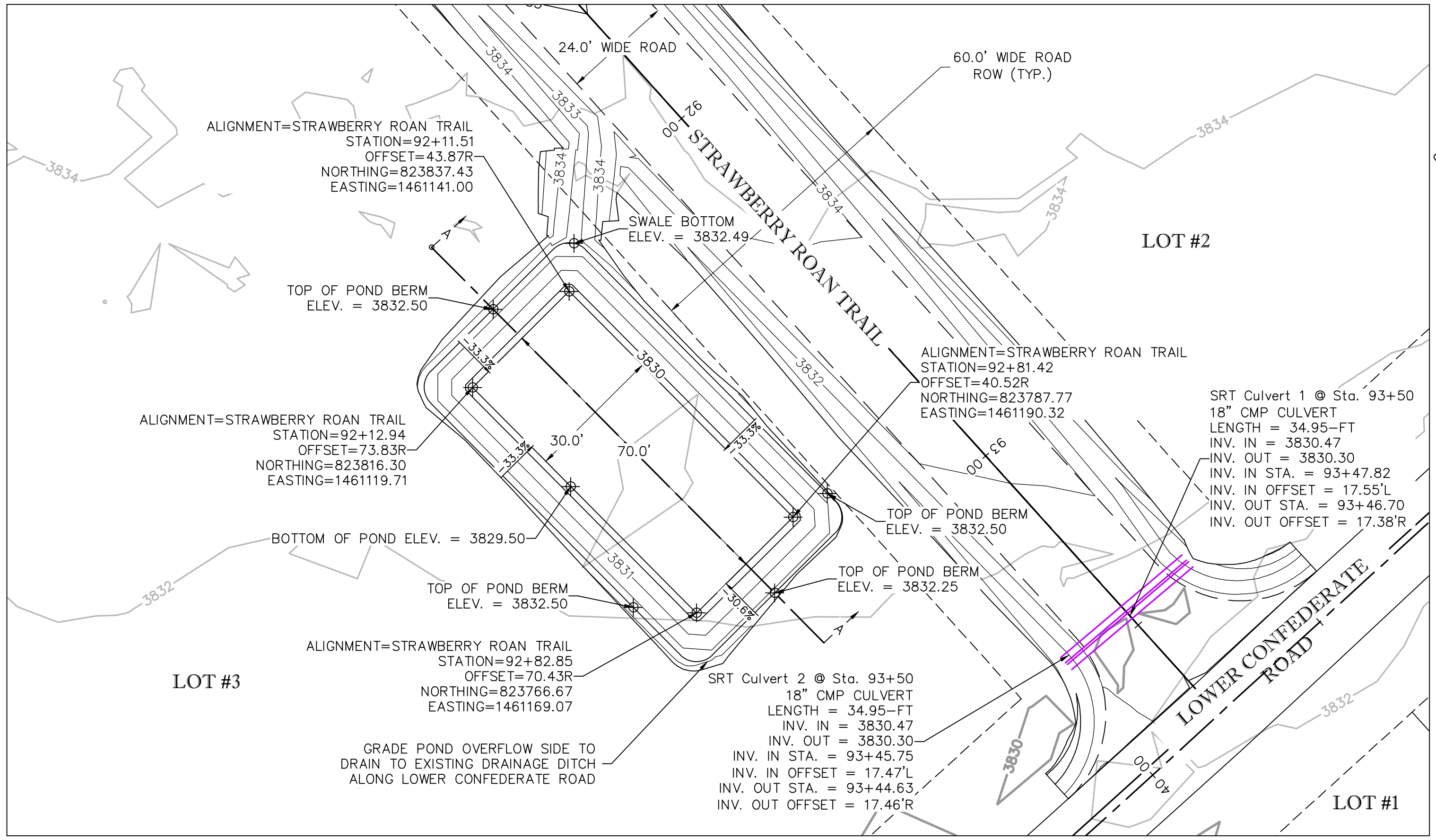
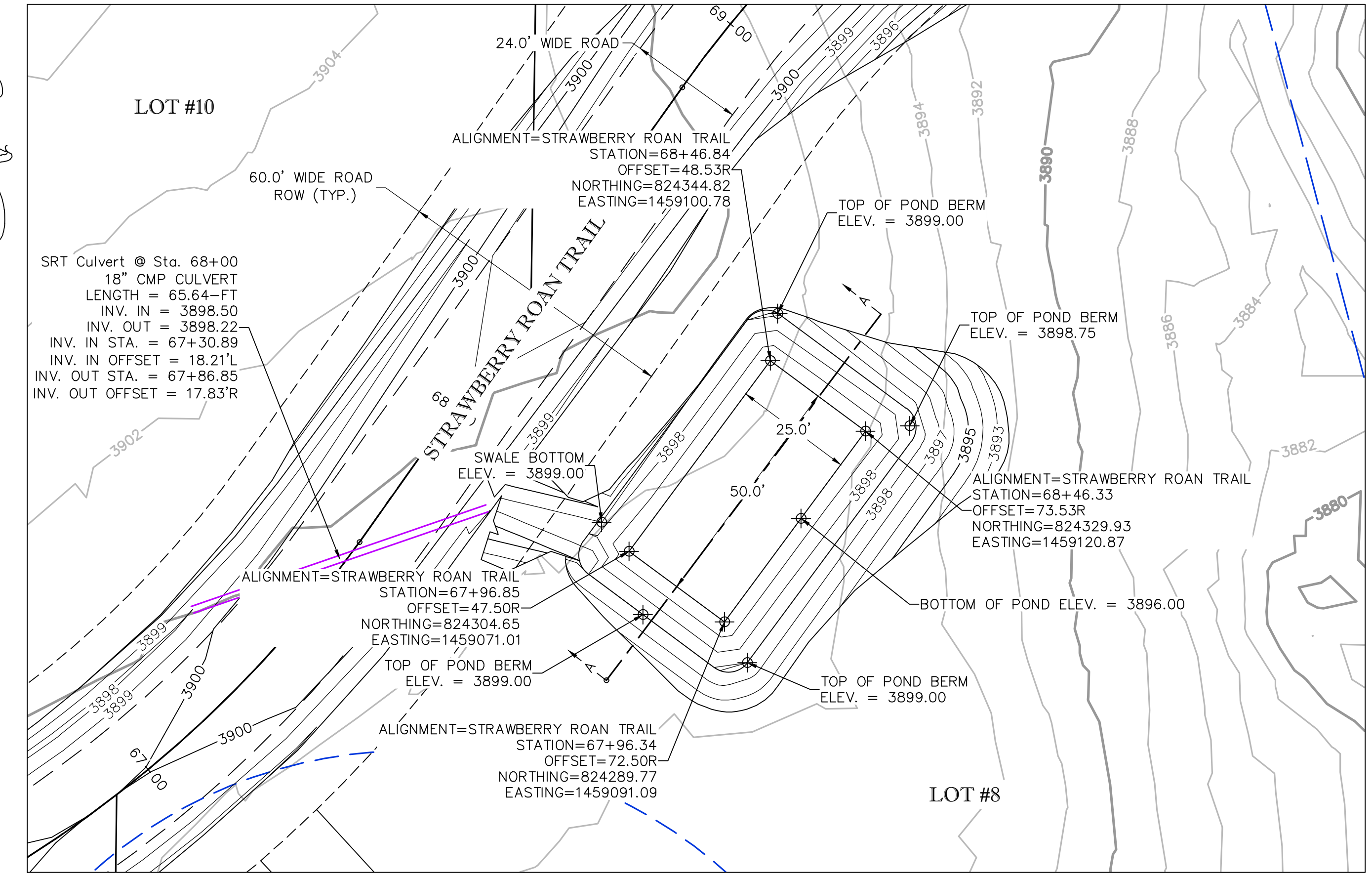
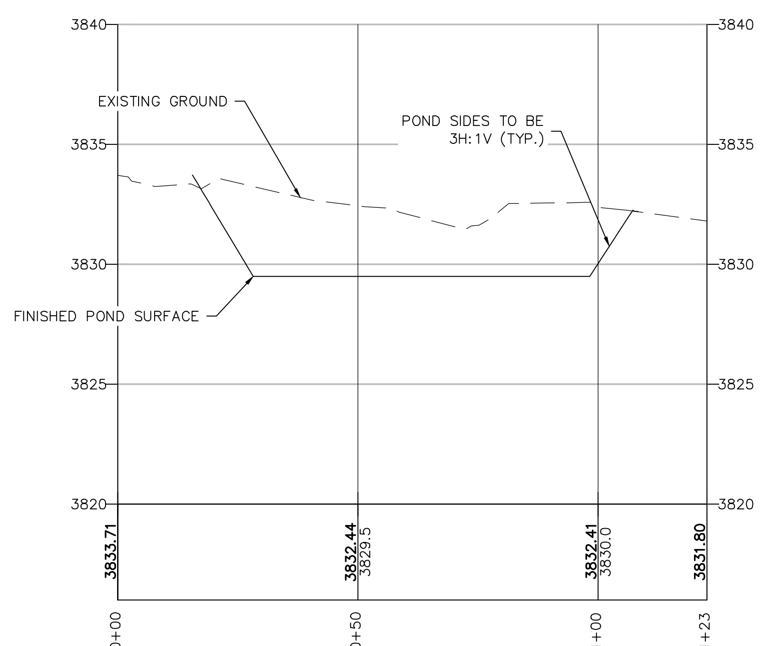


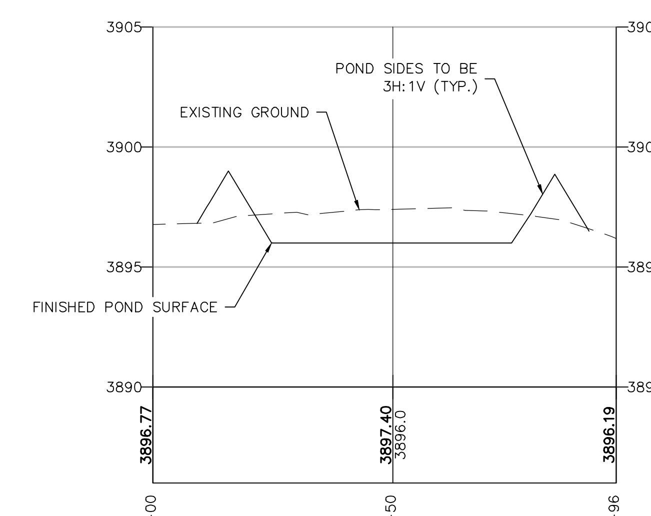
PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 92+00



PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 68+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 92+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 68+00

NO.	REVISIONS	DRAWN BY	DATE
	DEQ Page 323		

HORIZONTAL SCALE FEET: 0, 20, 40
VERTICAL SCALE FEET: 0, 4, 8

PROJECT ENGINEER: MAF
DRAWN BY: HTM
DESIGNED BY: MAF, HTM
REVIEWED BY: MAF

HORSE CREEK HILLS 1 SUBDIVISION
POND GRADING DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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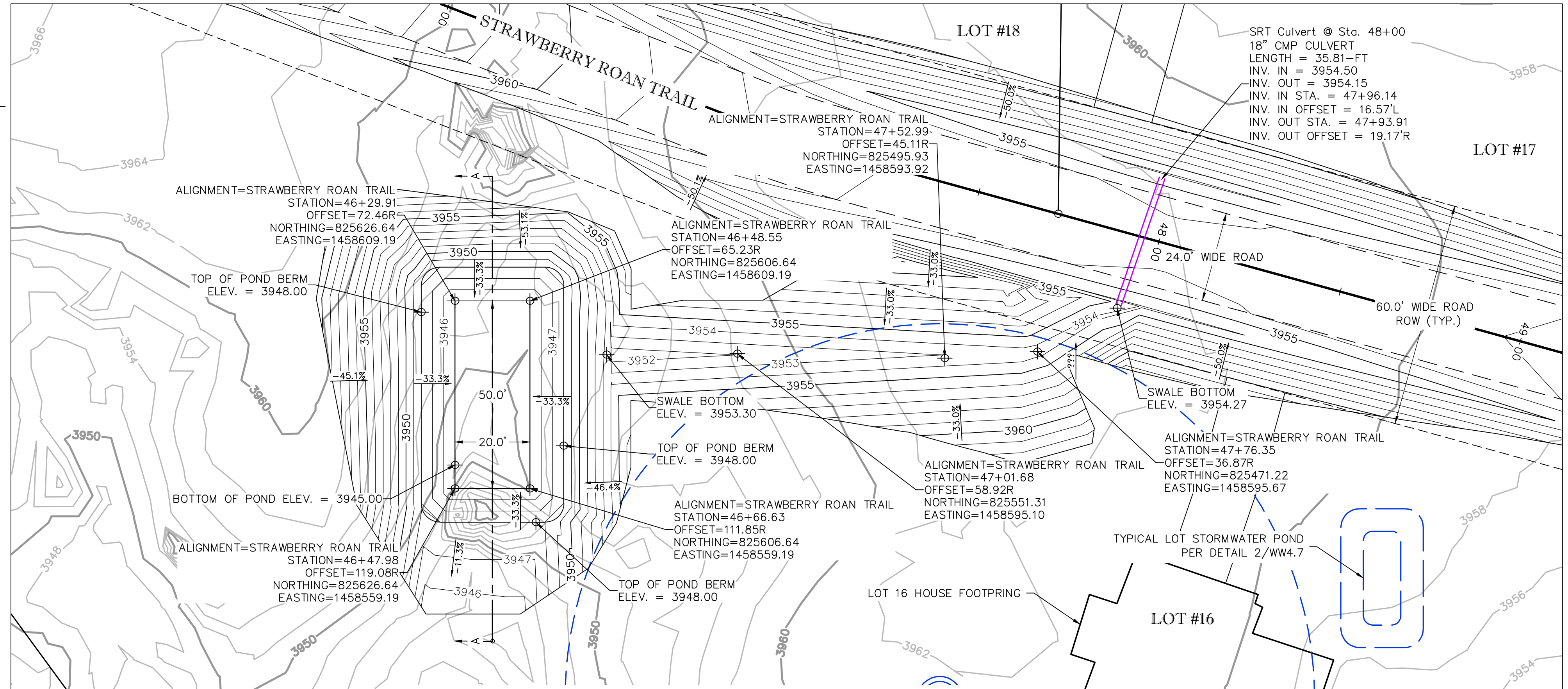
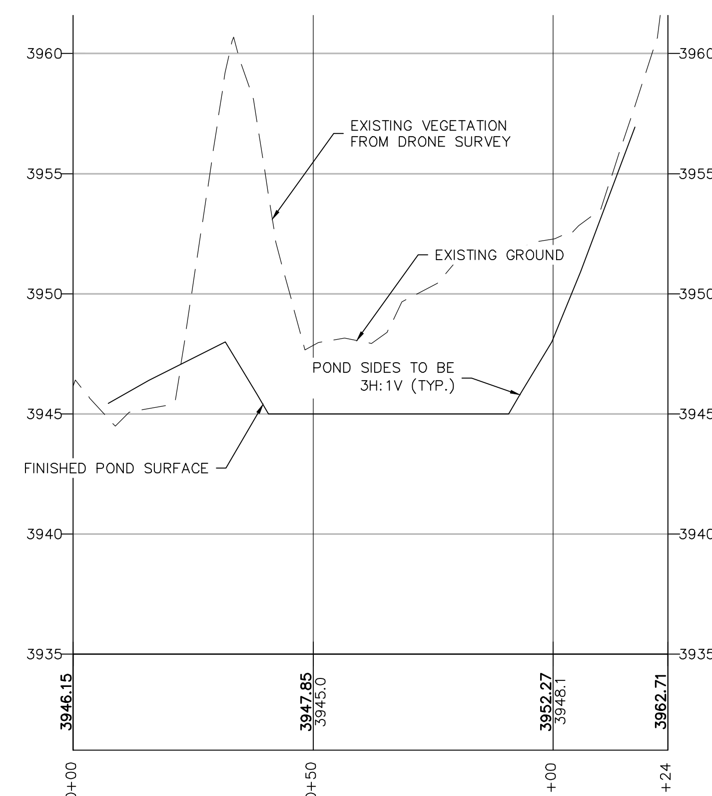
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW4.1

HORSE CREEK HILLS
DRAINAGE DETAILS



PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 46+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 46+00

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 20 40

VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM

DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 2 SUBDIVISION
POND GRADING DETAILS
SECTION 31, TOWNSHIP 9 NORTH, RANGE 2 EAST, P.M.M.

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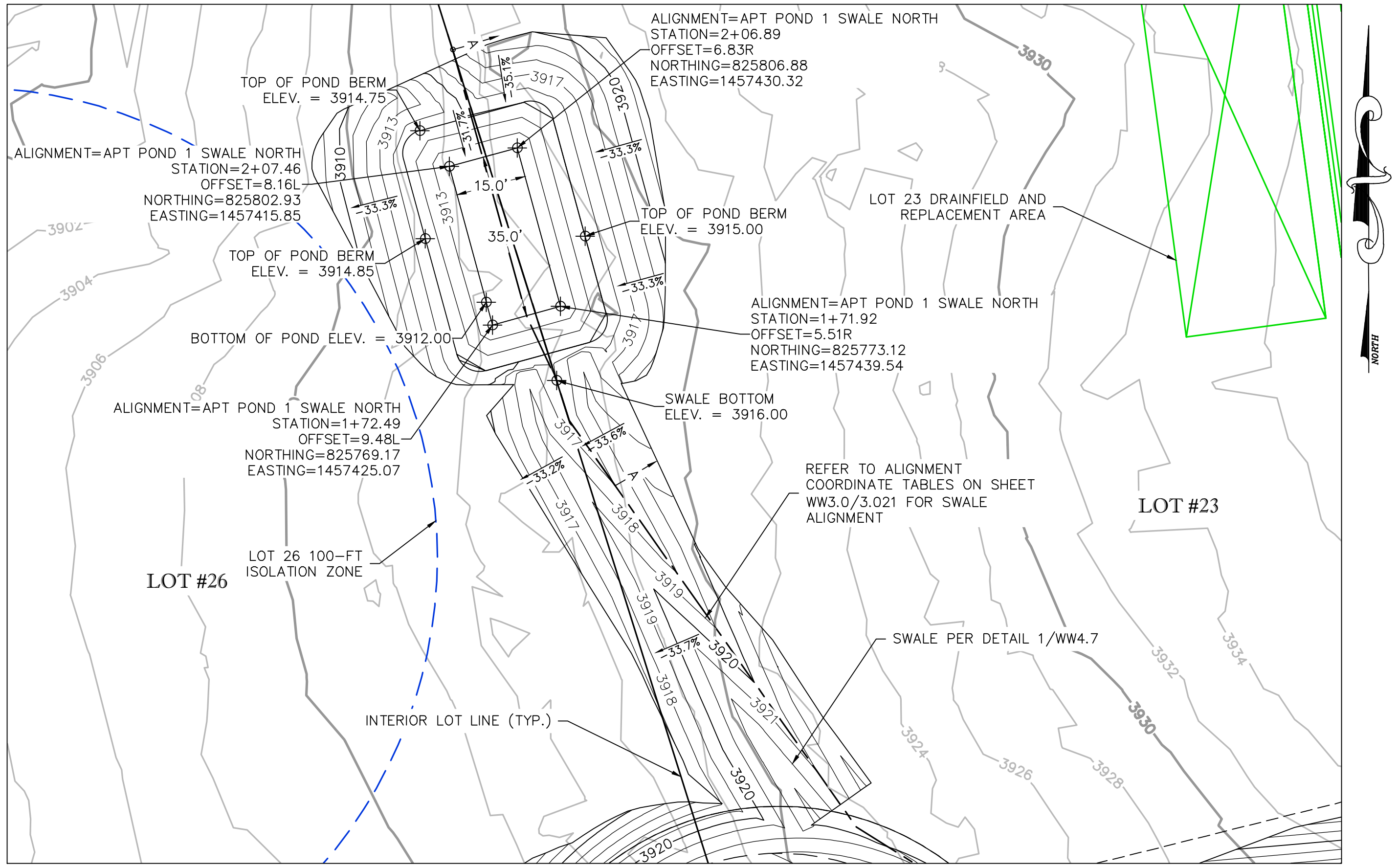
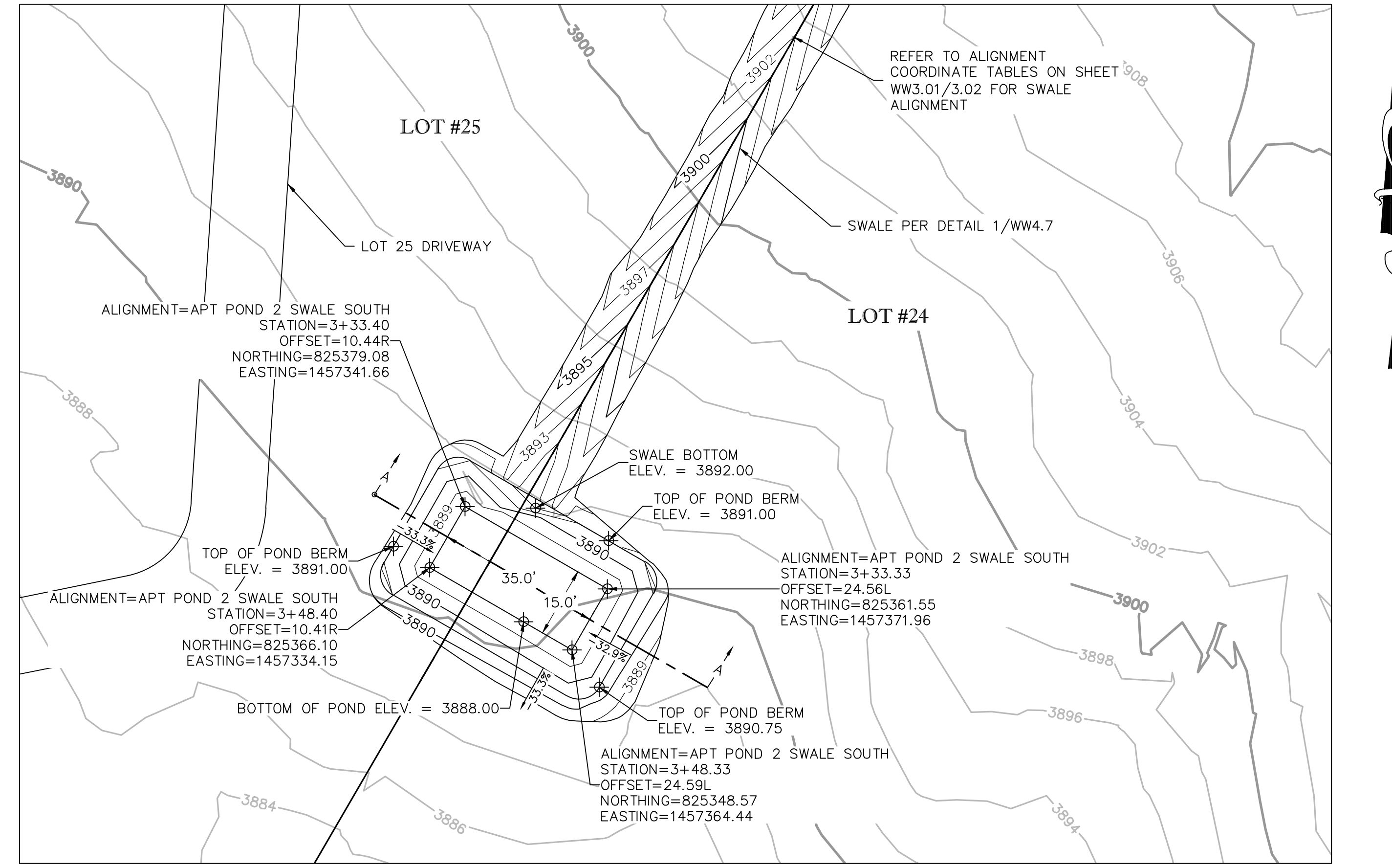
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW4.2

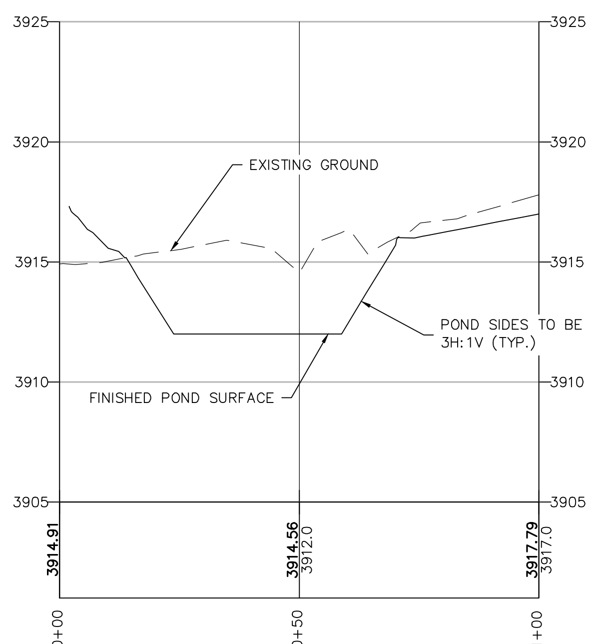
HORSE CREEK HILLS
DRAINAGE DETAILS



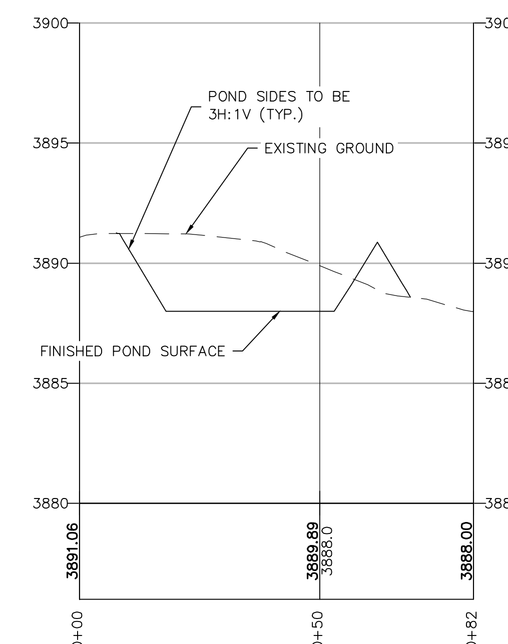
PLAN VIEW - APPALOOSA TRAIL POND NORTH



PLAN VIEW - APPALOOSA TRAIL POND SOUTH



SECTION A-A - APPALOOSA TRAIL POND NORTH



SECTION A-A - APPALOOSA TRAIL POND SOUTH

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 20 40 — VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF — DRAWN BY: HTM
DESIGNED BY: MAF, HTM — REVIEWED BY: MAF

HORSE CREEK HILLS 2 SUBDIVISION
POND GRADING DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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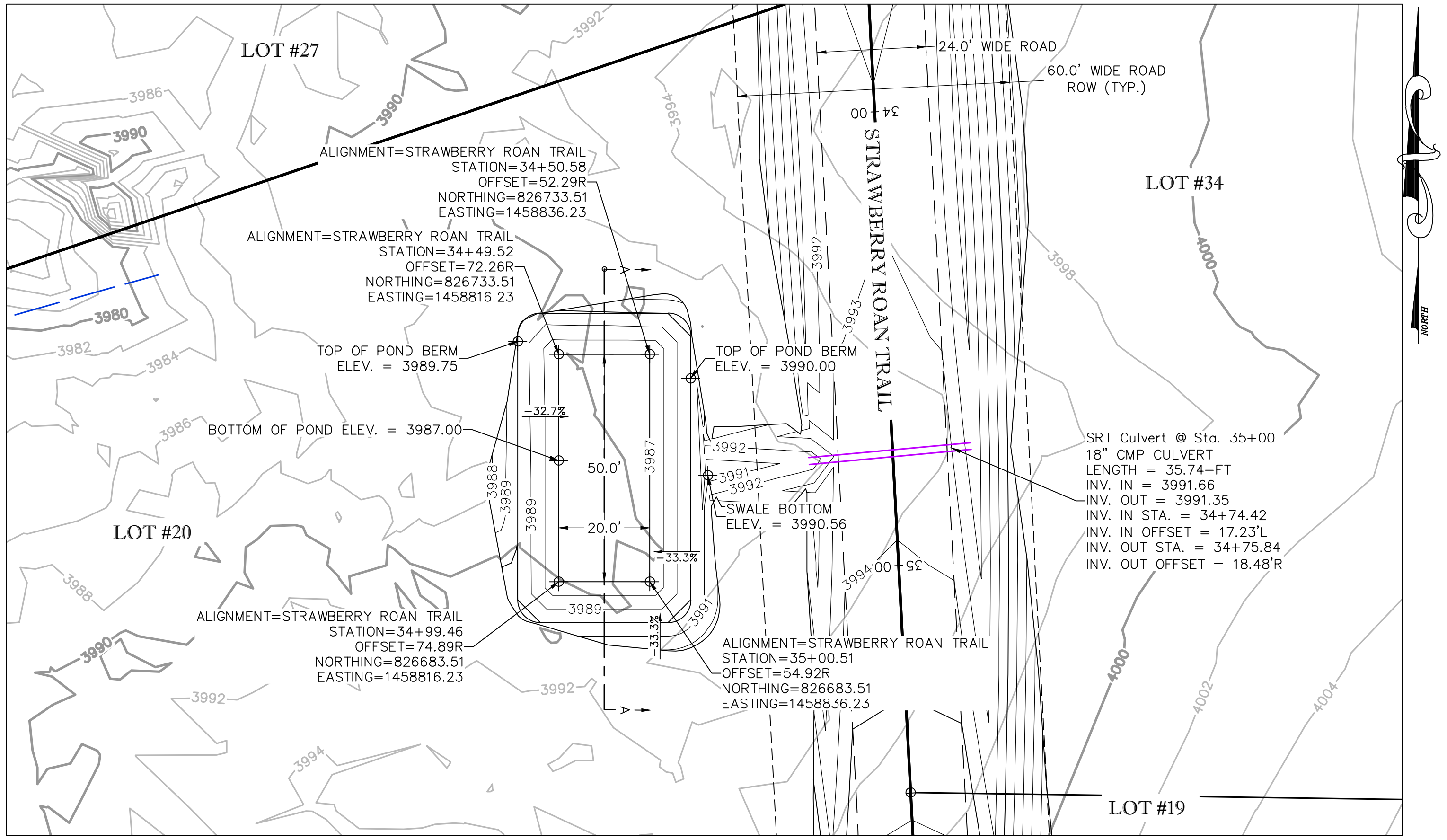
ALLIED ENGINEERING SERVICES, INC.

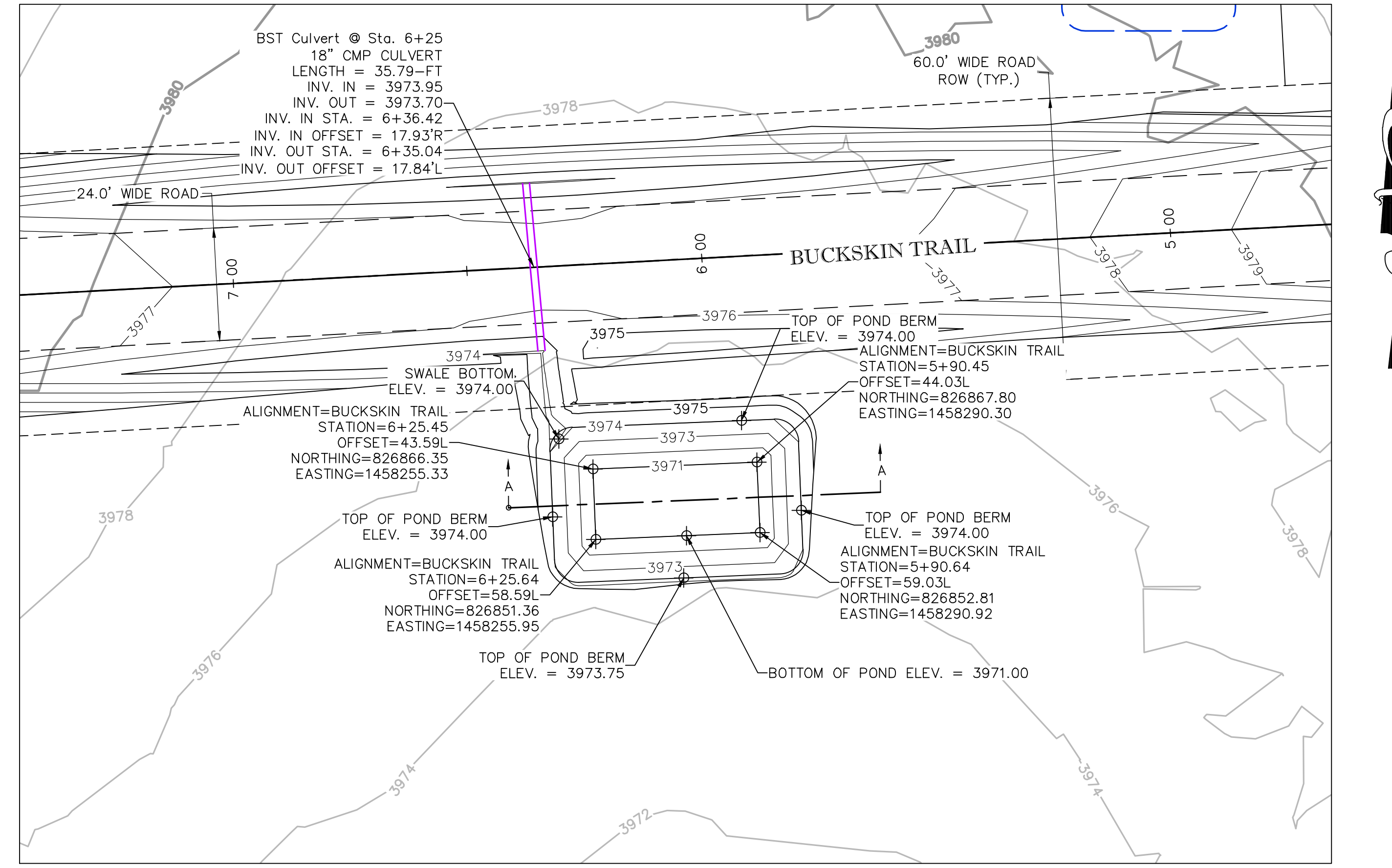
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET WW4.3

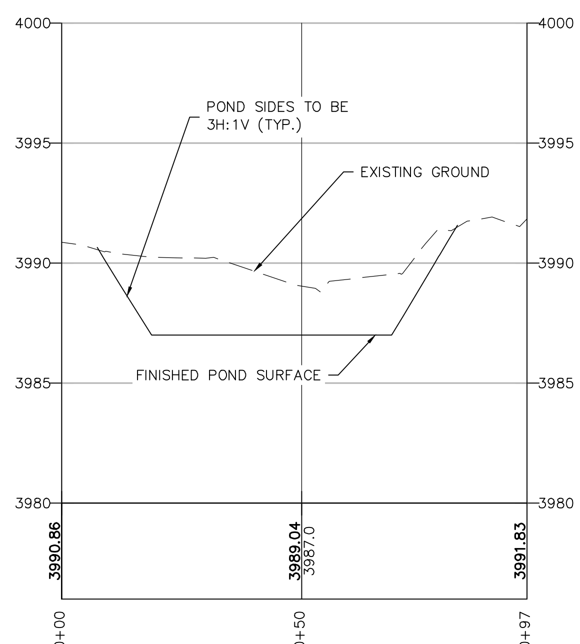
HORSE CREEK HILLS
DRAINAGE DETAILS



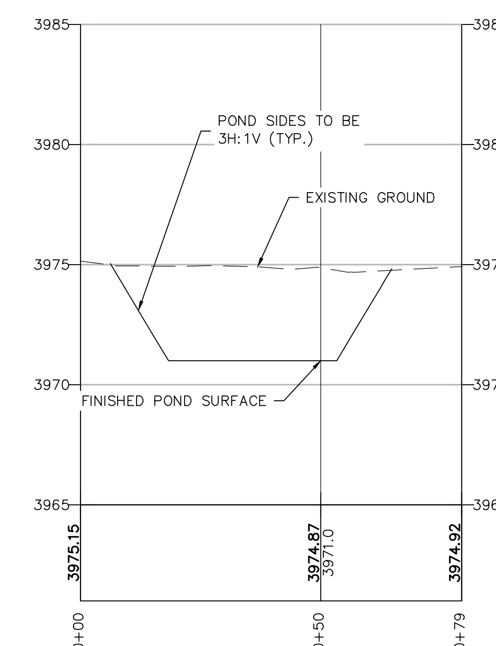
PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 35+00



PLAN VIEW - BUCKSKIN TRAIL POND @ STA. 6+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 35+00



SECTION A-A - BUCKSKIN TRAIL POND @ STA. 6+00

C:\pw_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\H & H\WW4.1 PROJECT DETAILS.dwg

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 20 40
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 2 & 3 SUBDIVISION
POND GRADING DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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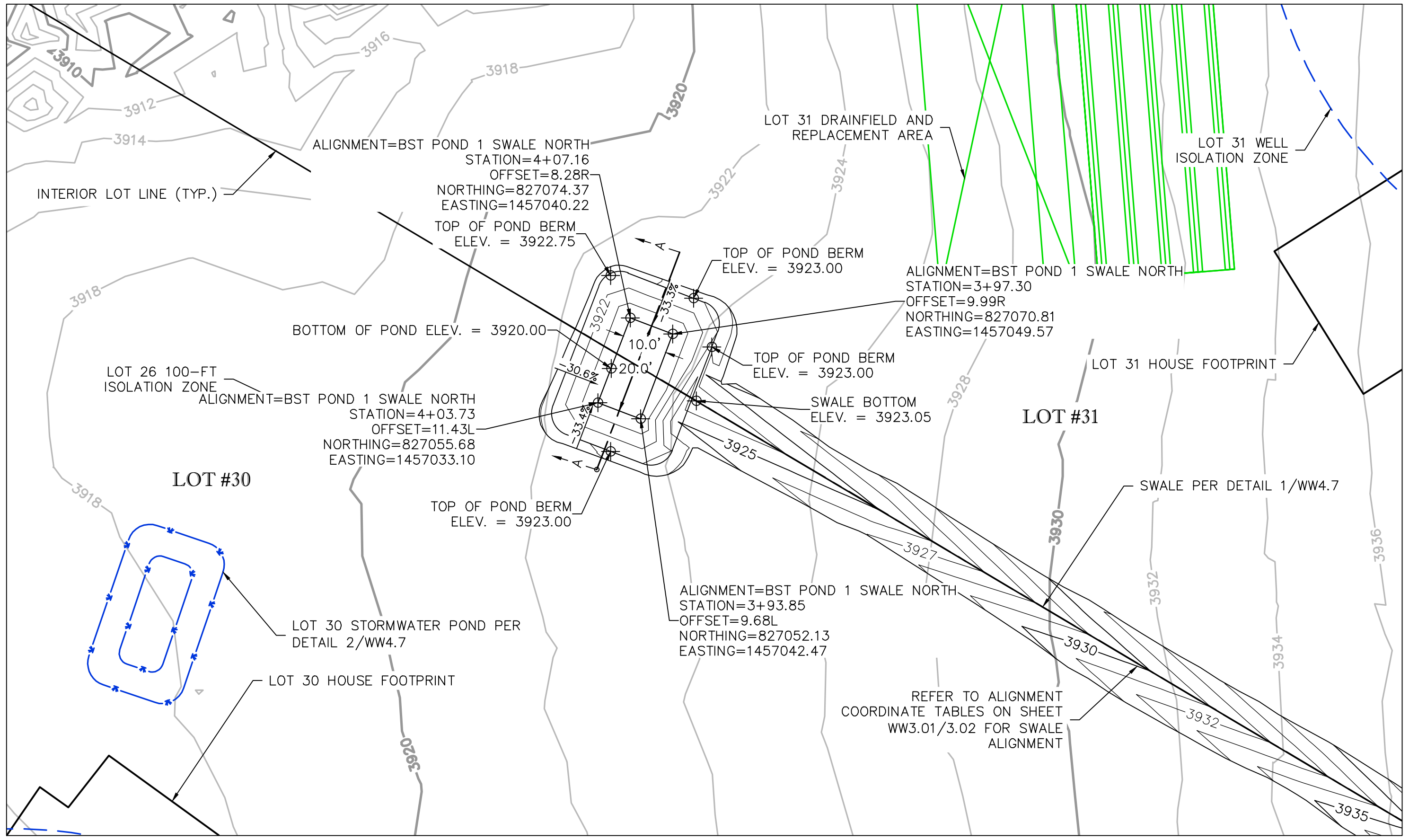
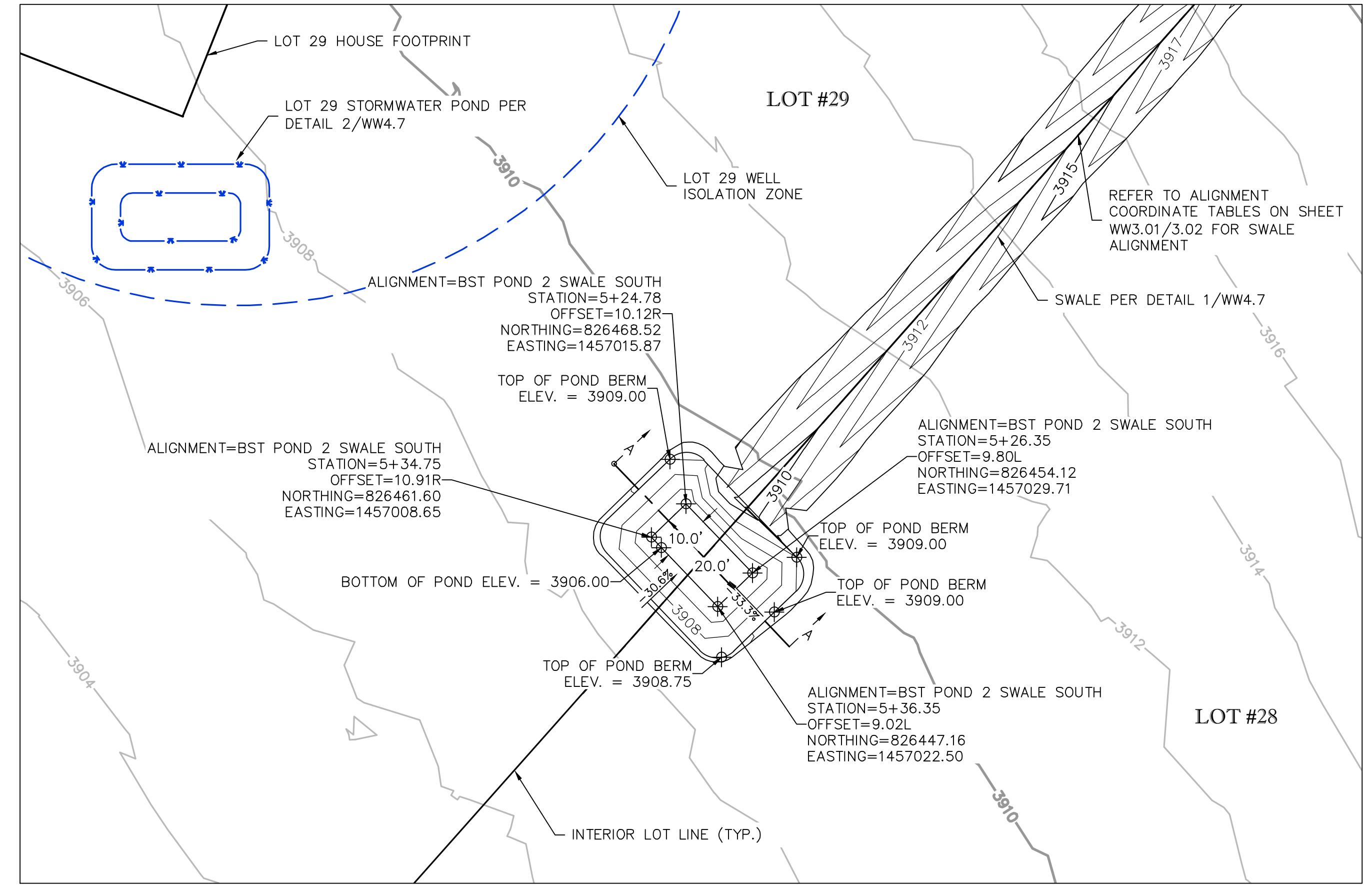
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW4.4

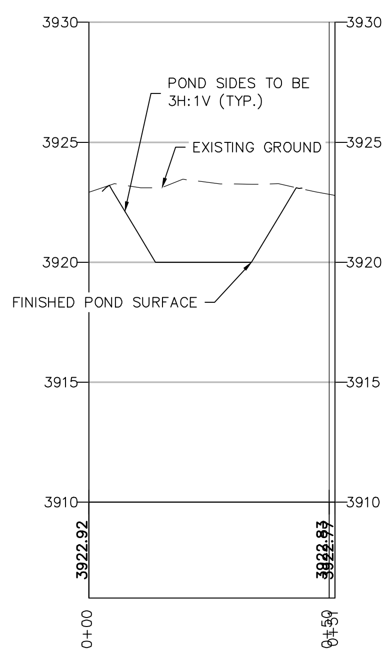
HORSE CREEK HILLS
DRAINAGE DETAILS



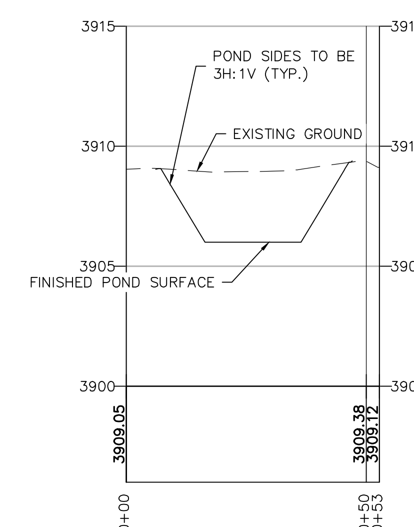
PLAN VIEW - BUCKSKIN TRAIL POND NORTH



PLAN VIEW - BUCKSKIN TRAIL POND SOUTH



SECTION A-A - BUCKSKIN TRAIL POND NORTH



SECTION A-A - BUCKSKIN TRAIL POND SOUTH

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET: 0 20 40
VERTICAL SCALE FEET: 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 3 SUBDIVISION
POND GRADING DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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DATE: 3/20/2020
STORM DRAINAGE
SHEET WW4.5
HORSE CREEK HILLS DRAINAGE DETAILS

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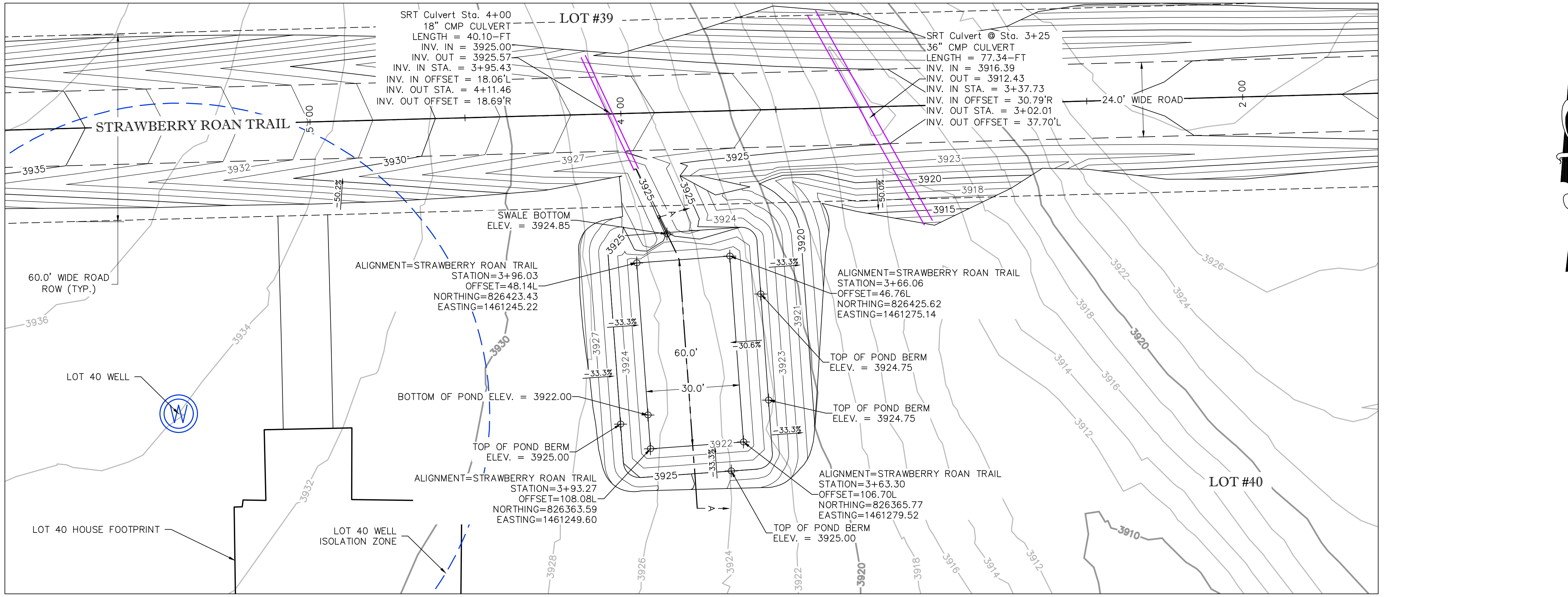
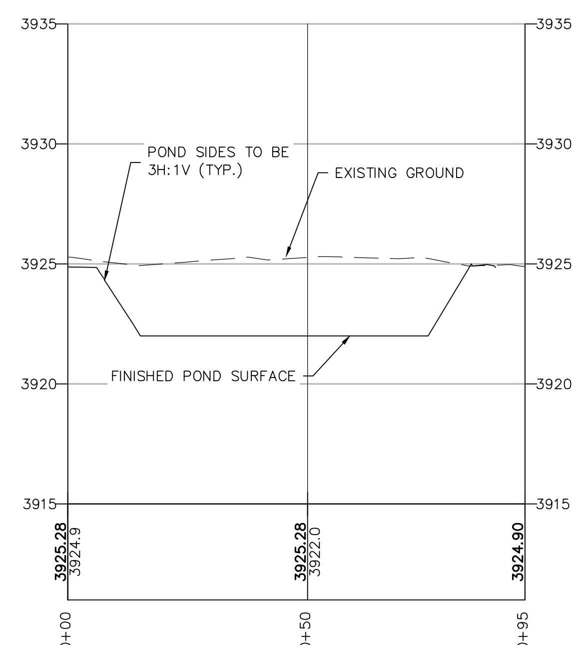


PLAN VIEW - STRAWBERRY ROAN TRAIL POND @ STA. 4+00



SECTION A-A - STRAWBERRY ROAN TRAIL POND @ STA. 4+00

NO.	REVISIONS	DRAWN BY	DATE

HORIZONTAL SCALE FEET 0 20 40
VERTICAL SCALE FEET 0 4 8

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 4 SUBDIVISION
POND GRADING DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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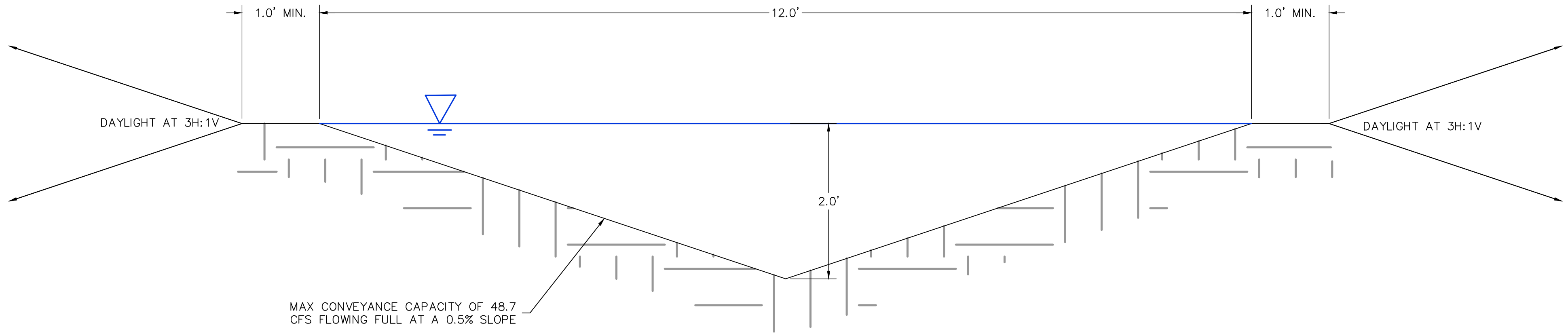
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

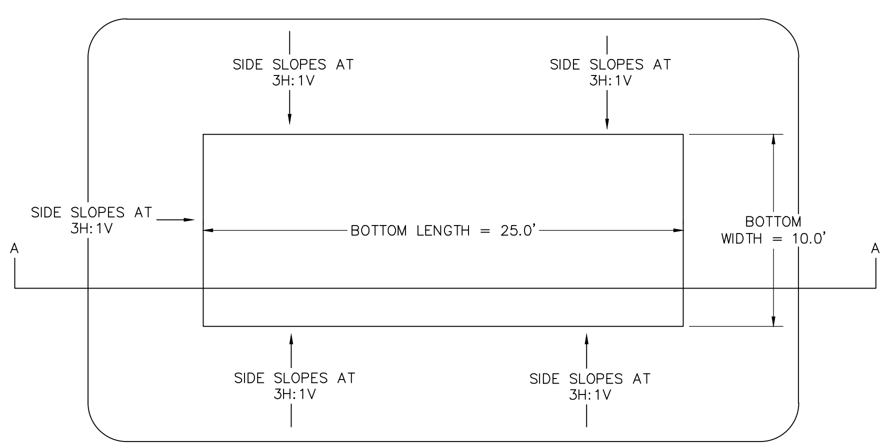
SHEET
WW4.6

HORSE CREEK HILLS
DRAINAGE DETAILS

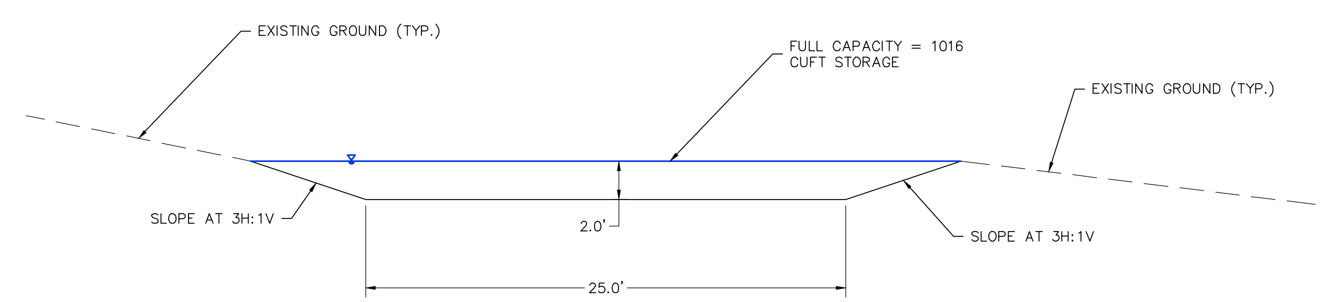


1 DETAIL
WW4.7 TYPICAL DRAINAGE SWALE

0 1 2 3
SCALE (FEET)



PLAN VIEW



PROFILE VIEW – SECTION A–A

2A DETAIL
WW4.7 TYPICAL RETENTION POND FOR LOTS

0 5 10 15
SCALE (FEET)

2B DETAIL
WW4.7 TYPICAL RETENTION POND FOR LOTS

0 5 10 15
SCALE (FEET)

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NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STORM DRAINAGE DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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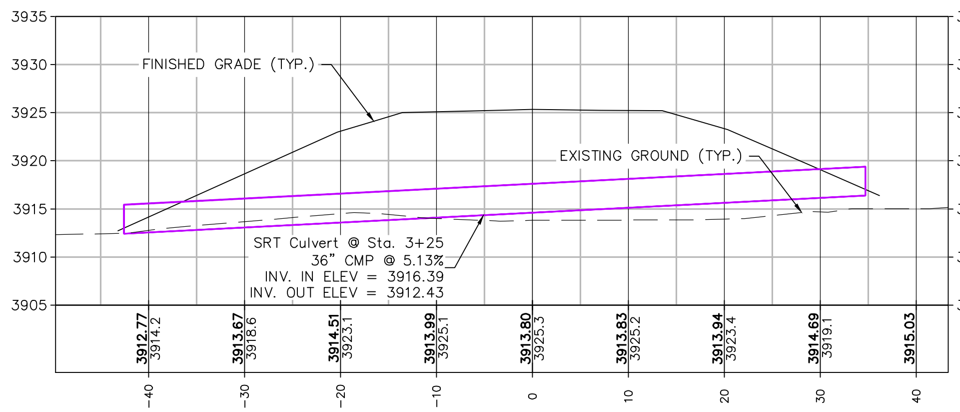
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

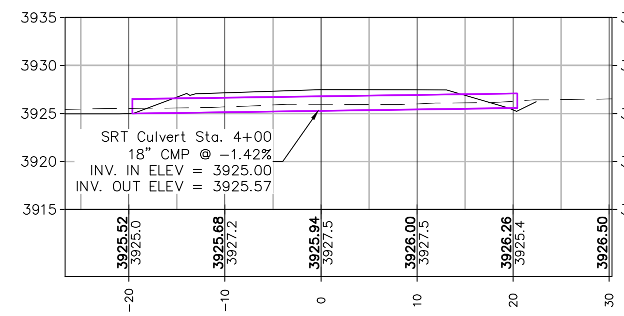
SHEET
WW4.7

HORSE CREEK HILLS
DRAINAGE DETAILS

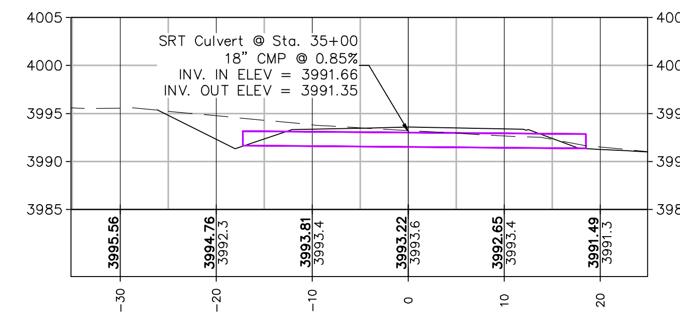
SRT CULVERT @ STA. 3+25



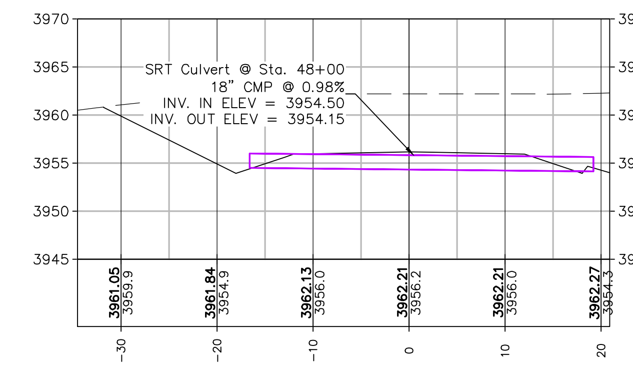
SRT CULVERT @ STA. 4+03



SRT CULVERT @ STA. 35+00



SRT CULVERT @ STA. 48+00



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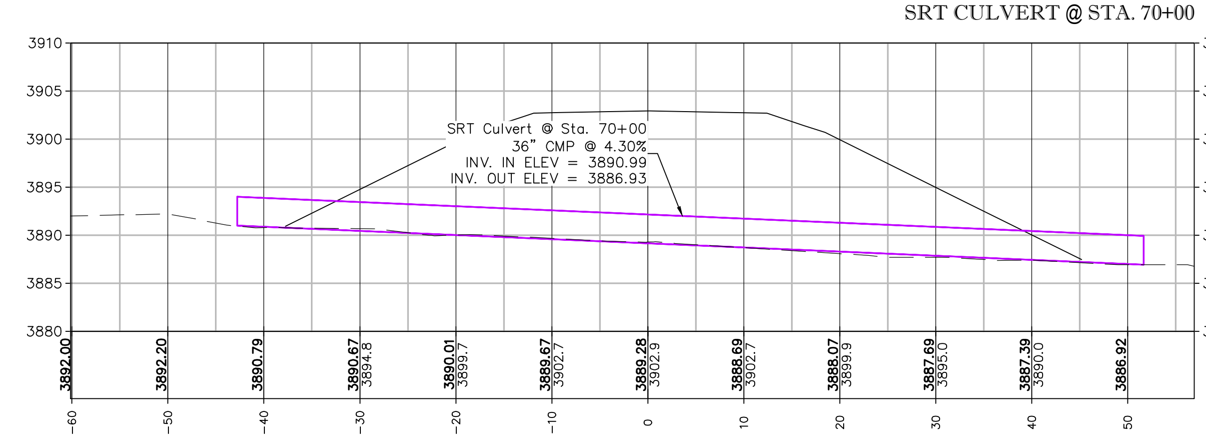
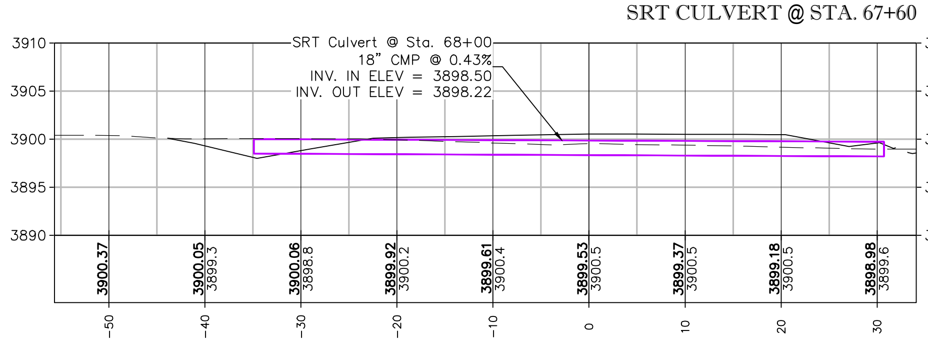


SRT CULVERT @ STA. 67+60



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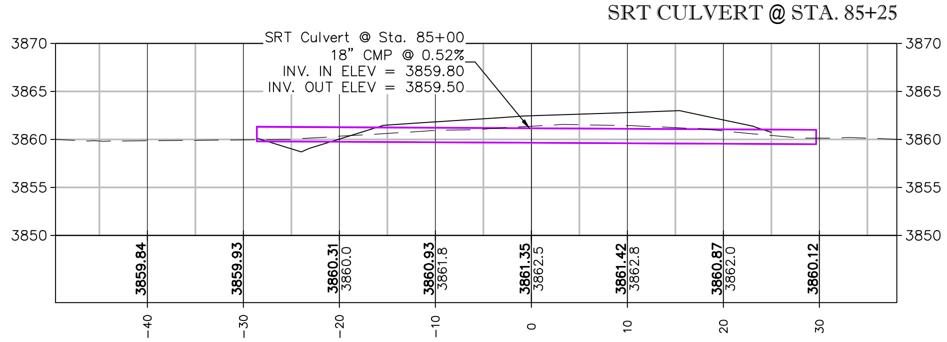
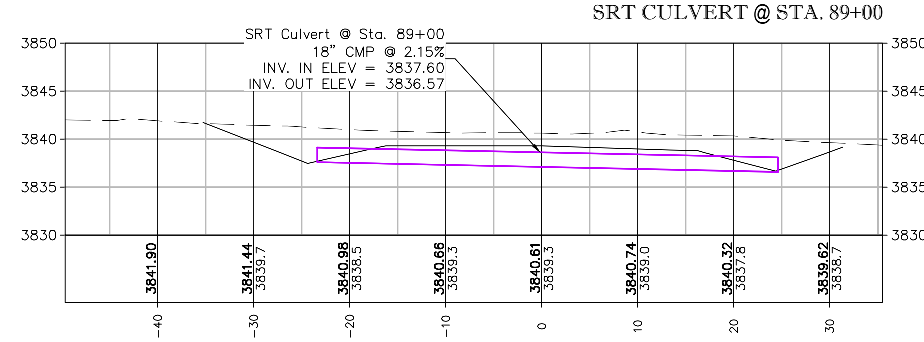
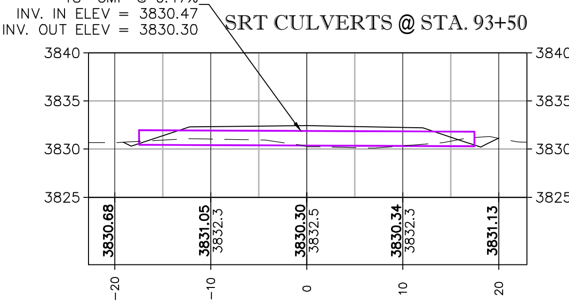


SRT CULVERT @ STA. 89+00



SRT CULVERTS @ STA. 93+50



NO.	REVISIONS	DRAWN BY	DATE

0 150 300 450
SCALE (FEET)

PROJECT ENGINEER: MAF	DRAWN BY: HTM
DESIGNED BY: MAF, HTM	REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STORMWATER - CULVERT PROFILES
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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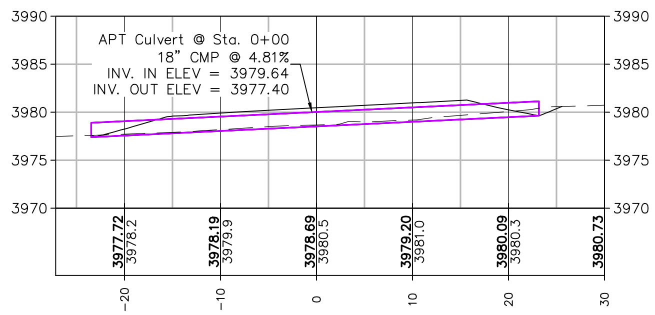
PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW4.8

HORSE CREEK HILLS
CULVERT PROFILES

APT CULVERT @ STA. 25+00



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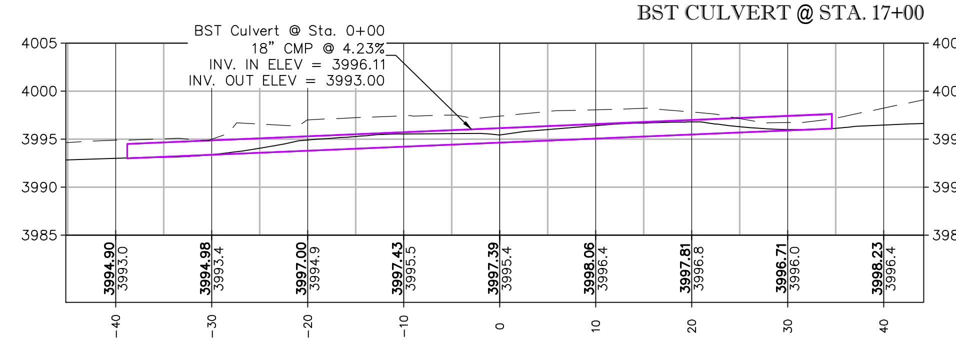
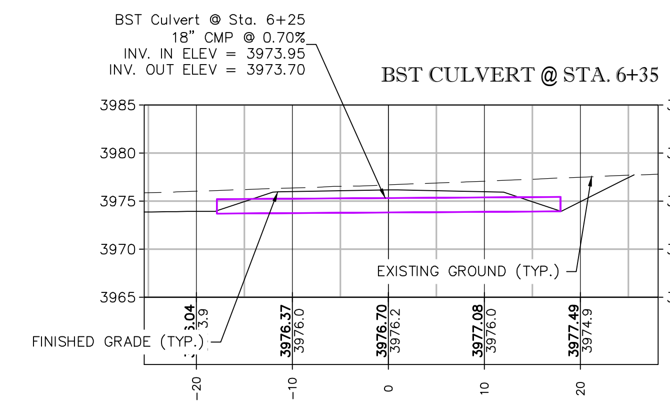
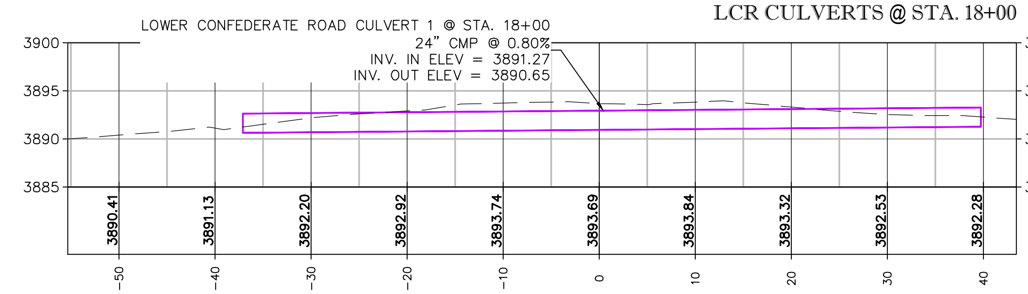


BST CULVERT @ STA. 6+35



LCR CULVERTS @ STA. 18+00



NO.	REVISIONS	DRAWN BY	DATE
	DEQ Page 331		

0 150 300 450

SCALE (FEET)

PROJECT ENGINEER: MAF	DRAWN BY: HTM
DESIGNED BY: MAF, HTM	REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION
STORMWATER - CULVERT PROFILES
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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PROJECT #: 19-072
DATE: 3/20/2020
STORM DRAINAGE

SHEET
WW4.9

HORSE CREEK HILLS
CULVERT PROFILES

C:\pesl_w\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\H & H\WW4.8 CULVERT CROSS SECTIONS.dwg

Appendix H

Wastewater System

- Drainfield Sizing Calculations
- Biotube Effluent Filter Sizing
- Lot Layout (4 Copies)
- Details (4 Copies)

Summary of Drainfield Sizing Calculations

SUMMARY OF PROPOSED WASTEWATER TREATMENT TYPE
CORRESPONDING TO EACH LOT

Lot Numer	# of Bedrooms	GPD of Wastewater	Texture	Application Rate (gpd/ft^2)	Corresponding Percolation Rate (min/inch)	Min. Drainfield Area (sf)	Length of Lateral (LF)	Min. Drainfield Dimensions (ft)	Infiltrator Size Reduction	Min. Drainfield Area (sf)	Length of Lateral (LF)	Min. Drainfield Dimensions (ft)	Type of System to be Utilized
1	24 Employees	312	SiL	0.4	16 - <31	780	390	23 X 100 (Type B)	0.75	585	292.5	23 x 75 (Type D)	B or D
2	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
3	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
4	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
5	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
6	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
7	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
8	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
9	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
10	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
11	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
12	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
13	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
14	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
15	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
16	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
17	5	400	L	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
18	5	400	L	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
19	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
20	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
21	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
22	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
23	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
24	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
25	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
26	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
27	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
28	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
29	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
30	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
31	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
32	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
33	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
34	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
35	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
36	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
37	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
38	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
39	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
40	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
41	24 Employees	312	SiL	0.4	16 - <31	780	390	23 X 100 (Type B)	0.75	585	292.5	23 x 75 (Type D)	B or D

1 WW2.5 DETAIL
SUMMARY OF DRAINFIELD DIMENSIONS
NOT TO SCALE

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF
DRAWN BY: HTM
DESIGNED BY: MAF, HTM
REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM SUMMARY
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS
SHEET
WW2.5
HORSE CREEK HILLS
WWTS PLANS

Design Aid

Biotube® Effluent Filter Sizing

Orenco Systems® Incorporated
1-800-348-9843

Orenco has developed guidelines for calculating the correct sizing of and cleaning frequencies for effluent filters, based on decades of experience as well as monitoring data from thousands of effluent filter installations.*

While these guidelines may not be accurate for every wastewater system, they will be relevant to most situations. (See "Filter Facts," AFL-FT-2, for more information.)

Guidelines were based on the following criteria:

Watertightness

A completely watertight septic tank must be used. If either infiltration or exfiltration is present, there is no way to accurately determine filter sizing.

Hydraulic Retention Time

Residential flows — A septic tank capacity of at least 1000 gallons is used for systems handling flows from a single-family residence of three bedrooms or less. A septic tank capacity of at least 1500 gallons is used for 3-bedroom homes with garbage disposals and for systems handling flows from a single-family residence with more than three bedrooms, up to flows of 600 gpd.

Larger flows — Adequate septic tankage will anaerobically digest organic material, remove settleable and floatable solids, help modulate flow, and consistently discharge effluent that meets "primary treatment" standards.

A septic tank capacity of at least three times the daily design flow is used for systems handling flows greater than those of a single-family home.

After conducting extensive research on septic tankage, Orenco has found that smaller tankage will result in suboptimal effluent quality and more frequent septage pumping. For Orenco's tank sizing recommendations for various applications, see "Primary Tank Sizing," NDA-TNK-1 and "Septic Tank Sizes for Large Flows," NTP-TNK-TRB-2.

Waste Strength

Residential strength wastewater that has been through primary treatment is used. This is equivalent to what Crites and Tchobanoglous describe as "expected effluent wastewater characteristics from a residential septic tank without ... effluent filter" (*Small and Decentralized Wastewater Management Systems*, Table 4-16, p. 183). Here are the parameters:

BOD = 180 mg/L

TSS = 80 mg/L

Oil & Grease = 25 mg/L

Sizing Equations

$A_F = C_f\ (Q)\ (MTBC)$

where:

A_F = Filter area required (ft^2)

C_f = Filter coefficient $\left(\frac{ft^2}{gpd \bullet yr}\right)$

Q = Daily flow in gallons (gpd)

MTBC = Mean time between filter cleaning (years)

The filter coefficient, C_f, is equal to 0.0044 when actual or true daily flow rates are used. A value of 0.002 is applicable if design flow is used. The design flow is defined as a peak flow that allows for a safety margin and is typically about twice the actual flow. All values are based on a filter surface area with approximately 30% or more open or "flow" area.

Actual Flow Equation:

$A_F = 0.0044\ (Q)\ (MTBC)$
(for calculations based on "actual flows")

Design Flow Equation:

$A_F = 0.002\ (Q)\ (MTBC)$
(for calculations based on "design flow" as defined above)

If a kitchen garbage disposal is used, more frequent filter maintenance may be required, due to the additional solids loading. Kitchen garbage disposals contribute an additional 36% (approximately) to the level of solids loading. Increasing the filter area by 36% gives better approximations for sizing and cleaning frequencies when garbage disposals are used.

Sizing filters for systems larger than single family dwellings is more complicated. For systems larger than single family dwellings, utilizing proper tankage and not exceeding residential strength wastewater, filter sizing using the given equations is valid. Systems having less than three times the daily design flow in storage require more conservative filter sizing to prevent the need for frequent cleaning.

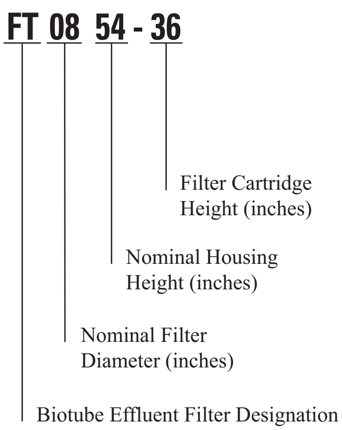
**Orenco's effluent filter performance data is so extensive that Dr. George Tchobanoglous, co-author of Small and Decentralized Wastewater Management Systems, used that data to help develop his findings on effluent filters.*

Biotube® Effluent Filter Sizing

Wastewater from restaurants, industrial plants, and other higher waste strength sources needs more detailed analysis of the wastewater characteristics for proper tank and filter sizing and configurations. Multiple filters may be required. Please call to discuss these applications.

Model Nomenclature

Example:



Modulating Orifices and Peak Flows

Effluent filters must also be able to handle situations in which the majority of the daily flow will enter the septic tank over a relatively short period of time. Modulating plates with orifices are often used to limit the flow rate through a tank during peak flow to prevent the flushing out of solids. However, modulating plates and orifices should be used only when the tank has sufficient surge capacity. Simple high liquid level alarms can be added to any Orenco effluent filter.

Filter Surface Area vs. Flow Area

When comparing filters, be sure to note how filter area is being reported. It's important to compare both the Total Filter Surface Area and the Total Flow Area, because *Flow Area is as important as Filter Surface Area*. The surface area of a filter is important, because that's where solids are caught. But the flow area (the area of the "holes" in the filter) is equally important, because that's what prevents the filter from premature clogging.

Selecting A Biotube® Effluent Filter

Filter and Flow Area Chart

Series	Filter Area (ft^2)	Flow Area (ft^2)
FT15-36	50.5	15.2
FT12-36	30.0	9.0
FT08-36	14.6	4.4
FT04-36	5.1	1.5

Design Example:

A 12-unit condominium has a "design flow" of 3600 gallons per day (12 units at 300 gallons per day per unit). If a minimum 3-year cleaning frequency is desired, how much filter area is necessary? Which Biotube Effluent Filter should be selected?

Answer: In this case, the equation for design flow is applicable.

Therefore, $A_F = (0.002)(3600)(3) = 21.6\ ft^2$

Referring to the Filter and Flow Area Chart, an FT1200 Series filter, with a filter area of 30.0 ft^2, is required to satisfy the minimum design criteria.

Using the 30 ft^2 filter area, the design flow equation can be solved for MTBC, giving a cleaning frequency of 4.2 years.

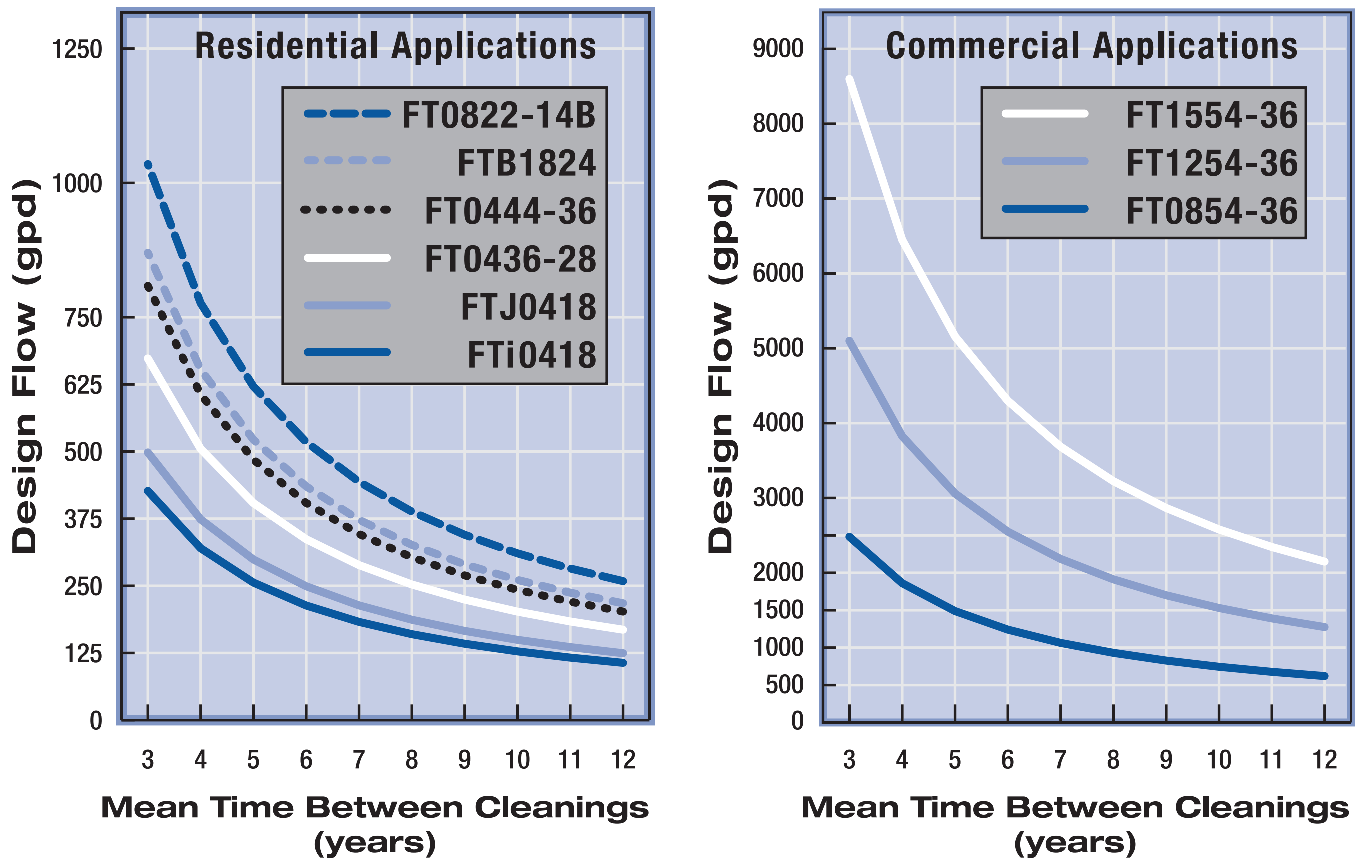
MTBC = 30.0/(3600)(0.002) = 4.2 years.

If the units will include garbage grinders, the filter area is increased by 36% to account for additional solids loading.

Therefore, $A_F = (1.36)(21.6) = 29.4\ ft^2$
And MTBC = 30.0/(3600)(0.002)(1.36) = 3.1 years.

FIGURE 4. **SIZING BIOTUBE EFFLUENT FILTERS**

These charts show the relationship between Biotube filter size (diameter), design flow, and mean time between cleanings. The larger the filter and the smaller the flow, the longer you can go between cleanings. For example, a typical three-year cleaning frequency would require an 8-in. filter for up to 2,500 gpd, a 12-in. filter for up to 5,000 gpd, and a 15-in. filter for up to 8,500 gpd. Assumes a properly sized watertight tank and residential strength waste. See Orenco document *NDA-FT-FT-1* for more information.



HORSE CREEK HILLS SUBDIVISION

WASTEWATER AND STORMWATER PLANS

LOCATION: N ½, N ½ of the SE ¼, & NE ¼ of the SW ¼, SEC 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MONTANA

LATITUDE: 46°29'45.6" LONGITUDE: -111°31'13"

DEVELOPER: 71 RANCH LP

MARCH, 2020

SET NO. _______

PROJECT MANAGER: MARK FASTING, PE
DESIGN ENGINEER: HUNTER MORRICAL, EI
PROJECT SURVEYOR: GREG FINCK, PLS

SHEET INDEX

SHEET NO.	
GENERAL SHEETS	
WW0.0	PLAN SET COVER PAGE
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WW0.2	PROPOSED IMPROVEMENTS
WASTEWATER DESIGN SHEETS	
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WW1.2	HORSE CREEK HILLS 2 SUBDIVISION WASTEWATER TREATMENT SYSTEM PLAN
WW1.3	HORSE CREEK HILLS 3 SUBDIVISION WASTEWATER TREATMENT SYSTEM PLAN
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WW2.3	WASTEWATER TREATMENT SYSTEM DETAILS
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WW3.1	HORSE CREEK HILLS 1 SUBDIVISION STORMWATER MANAGEMENT PLAN
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WW4.1	HORSE CREEK HILLS 1 SUBDIVISION POND GRADING DETAILS
WW4.2	HORSE CREEK HILLS 2 SUBDIVISION POND GRADING DETAILS
WW4.3	HORSE CREEK HILLS 2 SUBDIVISION POND GRADING DETAILS
WW4.4	HORSE CREEK HILLS 2&3 SUBDIVISION POND GRADING DETAILS
WW4.5	HORSE CREEK HILLS 3 SUBDIVISION POND GRADING DETAILS
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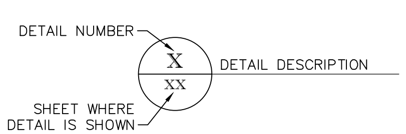
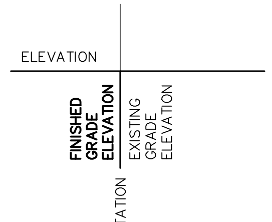
WW4.7	HORSE CREEK HILLS SUBDIVISION GENERAL STORM DETAILS
WW4.8	HORSE CREEK HILLS SUBDIVISION STORM CULVERT CROSS SECTIONS
WW4.9	HORSE CREEK HILLS SUBDIVISION STORM CULVERT CROSS SECTIONS

PLAN SHEET DETAIL CALLOUTS

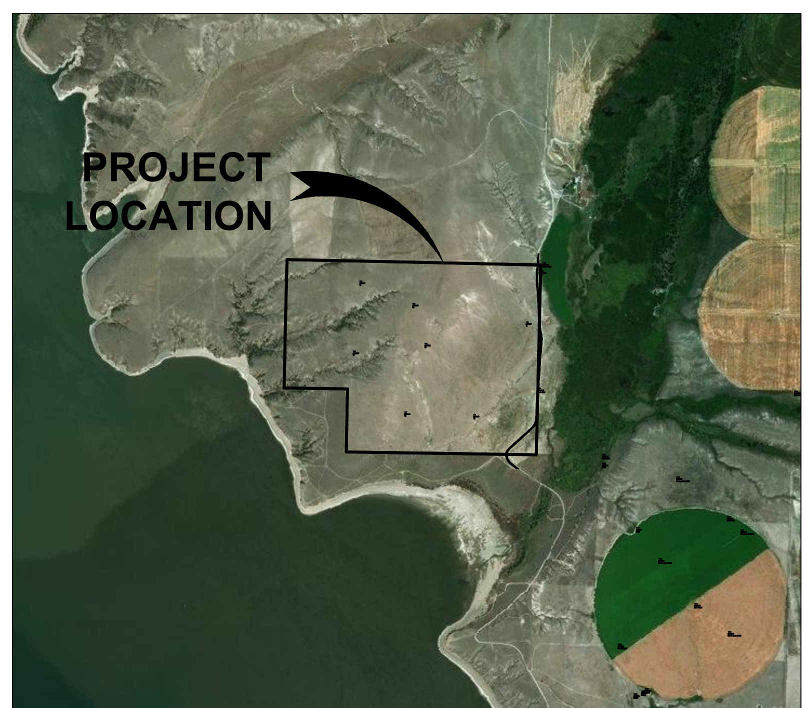


PROPOSED ROADWAY PROFILE LABEL KEY



CIVIL ABBREVIATIONS:

AESI	ALLIED ENGINEERING SERVICES, INC.
AC	ACRE
AVE	AVENUE
BLDG	BUILDING
BM	BENCHMARK
BOG	BACK OF GRATE (GUTTER)
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CONC	CONCRETE
COB	CITY OF BELGRADE
CY	CUBIC YARD
DI	DUCTILE IRON
DIA	DIAMETER
DWG	DRAWING
E	EAST
EA	EACH
EG	EXISTING GRADE
ELEV	ELEVATION
EOG	EDGE OF GRAVEL
EOP	EDGE OF PAVEMENT
EX	EXISTING
FETS	FLARED END TERMINAL SECTION
FG	FINISHED GRADE
FHYD	FIRE HYDRANT
FL	FLANGE
FL	FLOWLINE
FM	SEWER FORCE MAIN
FT	FEET
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
HORZ	HORIZONTAL
HP	HIGH POINT
HWY	HIGHWAY
IE	INVERT ELEVATION
IN	INCH
INV	INVERT
LF	LINEAR FEET
LP	LOW POINT
LT	LEFT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
MP	MID POINT
MPWSS	MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS
N	NORTH
PC	POINT OF CURVATURE
PE	PLAIN END
PE	POLYETHYLENE
PI	POINT OF INTERSECTION
PL	PROPERTY LINE
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
R	RADIUS
RP	RADIUS POINT
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT-OF-WAY
RT	RIGHT
S	SOUTH
SCH	SCHEDULE
SD	STORM DRAIN
SECT	SECTION
SG	SUBGRADE
S	SANITARY SEWER MAIN
SS	SANITARY SEWER SERVICE
ST	STREET
STA	STATION
STD	STANDARD
SY	SQUARE YARD
TBM	TEMPORARY BENCH MARK
TBC	TOP BACK OF CURB
TDH	TOTAL DYNAMIC HEAD
TYP	TYPICAL
UG	UNDERGROUND
VERT	VERTICAL
W	WATER MAIN
W	WEST
W/	WITH
W/O	WITHOUT
WS	WATER SERVICE



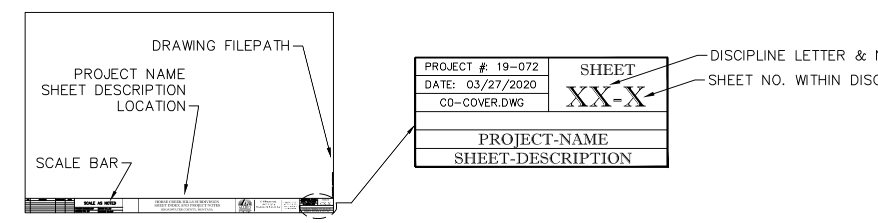
AERIAL MAP

0 2,000 4,000 6,000
SCALE (FEET)

LEGEND

PROPERTY LINE	PROPOSED LOT LINE
FOUND MONUMENT	PROPOSED RIGHT-OF-WAY LINE
CONTROL POINT	PROPOSED MAJOR CONTOUR (5' INTERVAL)
EX. MAJOR CONTOUR (5' INTERVAL)	PROPOSED MINOR CONTOUR (1' INTERVAL)
EX. MINOR CONTOUR (1' INTERVAL)	PROPOSED ROAD CENTERLINE
EX. EDGE OF ROAD	PROPOSED CURB AND GUTTER
EX. DRAINAGE CULVERT	PROPOSED SIDEWALK
EX. FENCE	PROPOSED WATER MAIN
EX. TREE ROW	PROPOSED WATER SERVICE
EX. PINE TREE	PROPOSED GATE VALVE
EX. WATER MAIN	PROPOSED FIRE HYDRANT
EX. GATE VALVE	PROPOSED SEWER MAIN
EX. FIRE HYDRANT	PROPOSED SEWER FORCE MAIN
EX. WELL	PROPOSED SEWER SERVICE
EX. SEWER MAIN	PROPOSED SEWER MANHOLE
EX. SEWER MANHOLE	PROPOSED STORM DRAIN LINE
EX. OVERHEAD POWER LINE	PROPOSED STORM DRAIN CURB INLET
EX. OVERHEAD POWER POLE	PROPOSED DRAINAGE CULVERT
EX. ELECTRIC METER	PROPOSED DRAINAGE DIRECTION
EX. UNDERGROUND FIBER OPTICS LINE	PROPOSED DRAINAGE ARROW
EX. TELEPHONE/FIBER OPTICS PEDESTAL	PROPOSED SIGN POST

AESI STANDARD BORDER FORMAT



GENERAL NOTES AND SPECIFICATIONS:

1. THE CONTRACTOR MUST ADHERE TO THE PROJECT PLANS AND SPECIFICATIONS. THE CONSTRUCTION COMPANY MUST BE A LICENSED CONTRACTOR WITH THE STATE OF MONTANA AND BE COVERED BY LIABILITY INSURANCE. A TWO-YEAR WRITTEN WARRANTY FROM THE PROJECT CONTRACTOR TO GALLATIN COUNTY IS REQUIRED FOR ALL ONSITE AND OFFSITE ROAD IMPROVEMENTS
2. THE CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES BY CALLING THE NATIONAL 811 "CALL BEFORE YOU DIG" TELEPHONE NUMBER PRIOR TO CONSTRUCTION ACTIVITIES.
3. ALL ROAD AND STORM DRAINAGE IMPROVEMENTS SHALL BE CONSTRUCTED PER THE ALIGNMENT AND GRADE AS SHOWN ON THE PLANS.
4. CONTRACTOR SHALL FIELD VERIFY LOCATION AND DEPTH OF ALL EXISTING UTILITIES AND STRUCTURES WHERE NEW FACILITIES CROSS OR CONNECT. CONTRACTOR SHALL BE RESPONSIBLE FOR EXPOSING POTENTIAL UTILITY CONFLICTS FAR ENOUGH AHEAD OF CONSTRUCTION TO MAKE NECESSARY GRADE MODIFICATIONS WITHOUT DELAYING THE WORK. ALL UTILITY CROSSINGS SHALL BE POTHOLED OR VACUUMED AS NECESSARY PRIOR TO EXCAVATING OR BORING TO ALLOW THE CONTRACTOR TO PREVENT GRADE OR ALIGNMENT CONFLICTS.
5. AT LEAST 10 BUSINESS DAYS BEFORE BEGINNING ANY EXCAVATION, THE CONTRACTOR SHALL NOTIFY THE OWNER AND ENGINEER OF UNDERGROUND FACILITIES AND COORDINATE THE WORK WITH THE OWNERS OF SUCH UNDERGROUND FACILITIES. THE INFORMATION SHOWN OR INDICATED IN THE CONTRACT DOCUMENTS WITH RESPECT TO EXISTING UNDERGROUND FACILITIES IS BASED ON INFORMATION AND DATA OBTAINED FROM THE OWNERS OF THE FACILITIES WITHOUT FIELD EXPLORATION, AND AS SUCH, OWNER AND ENGINEER ARE NOT RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SUCH INFORMATION OR DATA.
6. NO TRENCHES IN ROADS OR DRIVEWAYS SHALL BE LEFT IN AN OPEN CONDITION OVERNIGHT. ALL SUCH TRENCHES SHALL BE BACKFILLED, COMPACTED AND CLOSED BEFORE THE END OF EACH WORK DAY AND NORMAL TRAFFIC FLOWS RESTORED.
7. IF THE ENGINEER IS CONTRACTED FOR CONSTRUCTION STAKING, ENGINEER SHALL BE CONTACTED PRIOR TO STAKING. PROVIDE ADVANCED NOTICE SUFFICIENT TO ACCOMMODATE CONSTRUCTION, 7 WORKING DAYS IS MINIMUM, AND MAY VARY DEPENDING UPON AVAILABILITY.
8. LIGHTING, ELECTRICAL, NATURAL GAS, COMMUNICATIONS, LANDSCAPING, ETC. ARE TO BE DESIGNED BY OTHERS.
9. FINAL QUANTITIES MAY BE HIGHER OR LOWER THAN THOSE ESTIMATED, PENDING FIELD FINDINGS, SITE CONDITIONS, ETC.
10. STRIP THE EMBANKMENT FOUNDATION AREA, BORROW AREAS AND ALL AREAS TO RECEIVE FILL TO A MINIMUM DEPTH OF 6 INCHES AND AS REQUIRED TO REMOVE ALL ORGANIC SOILS, VEGETATIVE MATTER, ROOTS, AND OTHER PERISHABLE, LOOSE OR OBJECTIONABLE MATERIAL INCLUDING FROZEN SOIL THAT MIGHT INTERFERE WITH COMPACTION OF EMBANKMENT LIFT OR THE BONDING OF EMBANKMENT TO FOUNDATION. OBJECTIONABLE MATERIAL WILL BE AS DETERMINED BY THE ENGINEER. PERFORM STRIPPING OPERATIONS IN A MANNER TO CONSERVE ALL TOPSOIL THAT CONTAINS ORGANICS.
11. TRANSPORT STRIPPED MATERIALS TO STOCKPILE AREAS OUTSIDE OF WATERWAYS AND WETLANDS, SUBJECT TO APPROVAL. COORDINATE WITH OWNER TO IDENTIFY STOCKPILE AREAS. LOCATE PILES SO AS NOT TO AFFECT THE OPERATION OF THE EXISTING OPERATIONS, OR INTERFERE WITH THE WORK.
12. TAKE PRECAUTIONS TO PRESERVE, IN A SOUND CONDITION, THE MATERIAL BELOW AND BEYOND THE LINES OF ALL EXCAVATIONS.
13. PERFORM OPERATIONS SO THAT THE EXCAVATIONS WILL YIELD AS MUCH SUITABLE MATERIAL FOR CONSTRUCTION PURPOSES AS PRACTICABLE.
14. REUSE, AS MUCH AS IS PRACTICABLE, ALL SUITABLE MATERIALS FROM REQUIRED EXCAVATION IN THE PERMANENT CONSTRUCTION. SEPARATE UNSUITABLE MATERIALS AND REMOVE THEM FROM THE WORK AREA AS SOON AS PRACTICABLE.
15. SPREAD OUT AND ALLOW MATERIALS TO DRY THAT ARE TOO WET FOR IMMEDIATE COMPACTION UNTIL THE WATER CONTENT IS REDUCED SUFFICIENTLY FOR PLACEMENT IN THE EMBANKMENT. AERATING AND DRYING IS INCIDENTAL TO THE WORK.
16. WATER-CONDITION MATERIALS THAT ARE TOO DRY FOR IMMEDIATE COMPACTION. MOISTURE CONDITIONING IS INCIDENTAL TO THE WORK.
17. LEVEL AND TRIM WASTE PILES TO REASONABLY REGULAR LINES, AND SLOPE TO DRAIN.
18. REMOVE SOFT, WET, OBJECTIONABLE, OR OTHERWISE UNSUITABLE MATERIALS AS DETERMINED BY THE ENGINEER.
19. DE-WATER AS NECESSARY TO PREVENT THE ACCUMULATION AGAINST OR THE INTERMINGLING OF WATER WITH THE FILL.
20. PERFORM EXCAVATION AND PLACEMENT OPERATIONS SUCH THAT THE EMBANKMENT MATERIALS ARE MIXED AND BLENDED TO PROVIDE THE MOST HOMOGENEOUS SECTION AND BEST DEGREE OF COMPACTION AND STABILITY PRACTICAL. ALL FILL SHOULD BE PLACED IN HORIZONTAL LIFTS AND COMPACTED TO AT LEAST 95% OF ASTM D-698. PROVIDE PRIMARY WATER CONDITIONING, MIXING AND BLENDING IN STOCKPILES AS NEEDED. DISTRIBUTE THE FILL IN A LIFT SUCH THAT IT IS FREE FROM LENSES, POCKETS, STREAKS, OR LAYERS DIFFERING MATERIALLY IN TEXTURE OR GRADATION FROM THE SURROUNDING FILL.
21. CONTROL AND CONDUCT ALL TRANSPORTING, STOCKPILING, EXCAVATION, PRODUCTION, AND PLACEMENT OPERATIONS TO MINIMIZE CONTAMINATION, SEGREGATION, AND PARTICLE BREAKDOWN.
22. CARRY OUT COVERAGES OF COMPACTION EQUIPMENT SO THAT THE COMPACTIVE EFFORT IS DISTRIBUTED UNIFORMLY AND IN A SYSTEMATIC MANNER OVER THE ENTIRE LIFT.
23. ALL CONSTRUCTION ASSUMES A STABLE COMPACTED SUBGRADE IS ACHIEVED PRIOR TO PLACEMENT OF NEW FACILITIES.
24. COORDINATE WITH UTILITY COMPANIES REGARDING ALL UTILITY CROSSINGS AND ANY POTENTIAL UTILITY CONFLICTS.
25. CONTRACTOR SHALL COORDINATE DRY UTILITY CONDUIT LOCATIONS, DEPTHS, MATERIAL, QUANTITY, ETC. WITH APPLICABLE UTILITY SERVICE PROVIDERS PRIOR TO CONSTRUCTION.
26. IF APPLICABLE, CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THAT ALL STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS ARE MET.
27. PROJECT SITE DEVELOPMENT MAY REQUIRE ADDITIONAL STORM WATER FACILITY IMPROVEMENTS (SWALES, PONDS, ROADSIDE DITCH BLOCKS, ETC.), THAT ARE NOT SHOWN ON THESE PLANS.

299 PRAIRIE DRIVE,
PO BOX 1251
STANLEY, ND 58784
PHONE (701) 628-0221

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770

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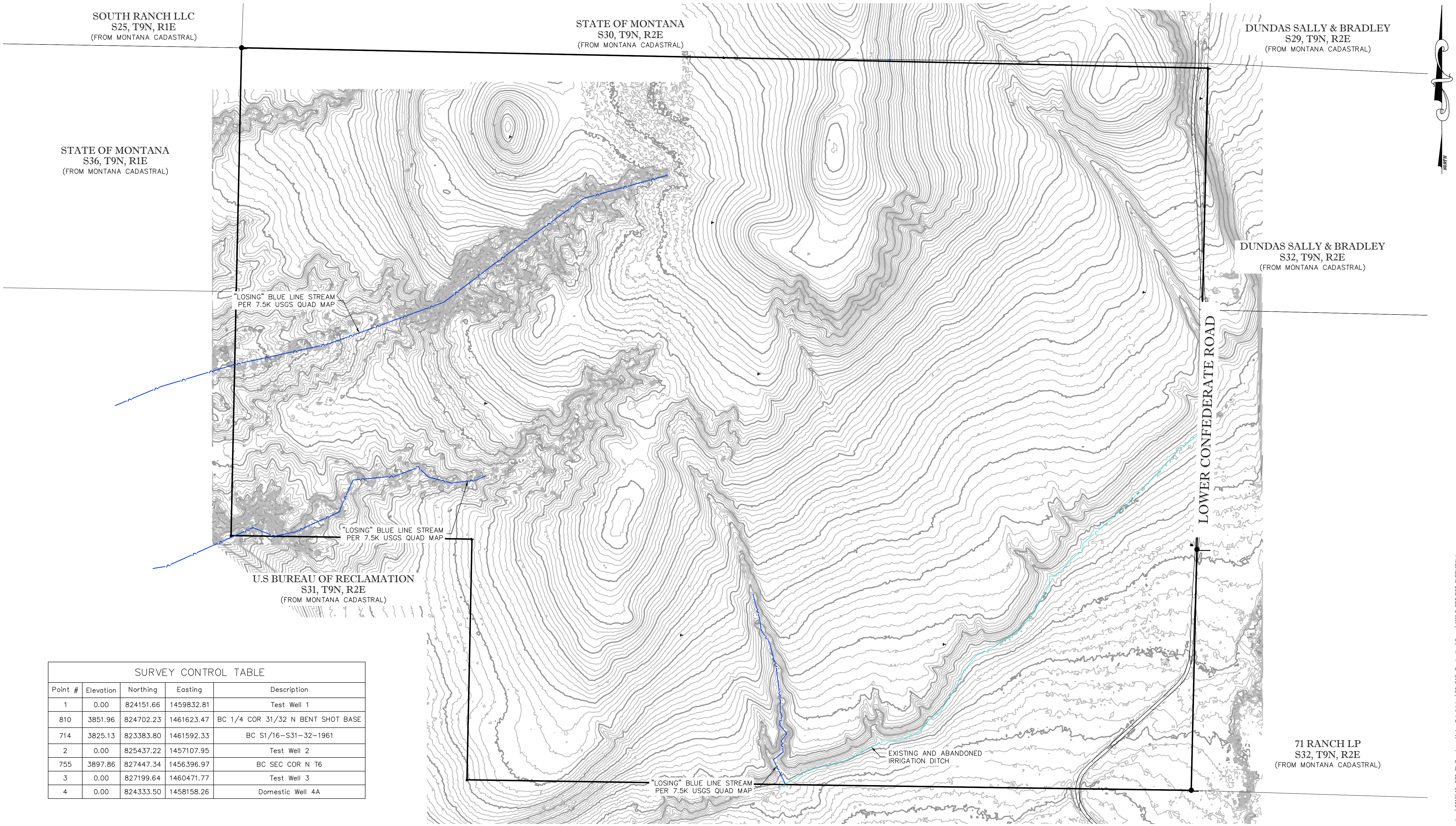
HORSE CREEK HILLS SUBDIVISION - ROAD DESIGN
BROADWATER COUNTY, MONTANA

NO.	REVISIONS	DATE

C:\aesi_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\Sewer\WW1.0 PROJECT OVERVIEW.dwg

HORSE CREEK HILLS SUBDIVISION
WW0.0 COVER SHEET



SURVEY CONTROL TABLE

Point #	Elevation	Northing	Easting	Description
1	0.00	824151.66	1459832.81	Test Well 1
810	3851.96	824702.23	1461623.47	BC 1/4 COR 31/32 N BENT SHOT BASE
714	3825.13	823383.80	1461592.33	BC S1/16–S31–32–1961
2	0.00	825437.22	1457107.95	Test Well 2
755	3897.86	827447.34	1456396.97	BC SEC COR N T6
3	0.00	827199.64	1460471.77	Test Well 3
4	0.00	824333.50	1458158.26	Domestic Well 4A

NO.	REVISIONS	DRAWN BY	DATE

0 250 500 750
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISIONS
EXISTING CONDITIONS & SURVEY CONTROL
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
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PHONE (406) 582-0221
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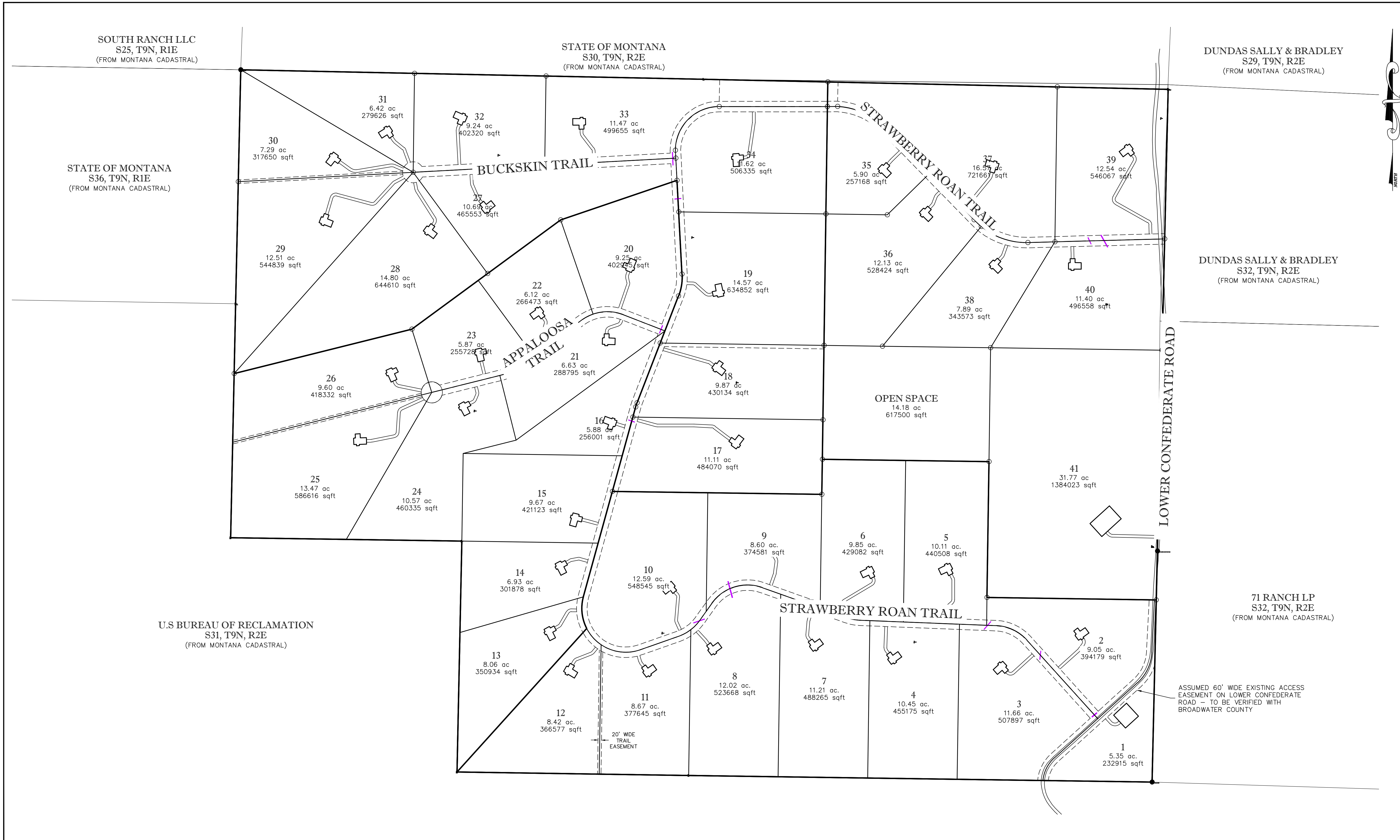
PROJECT #: 19–072
DATE: 3/27/2020
SHEET
WW0.1
HORSE CREEK HILLS
EXISTING CONDITIONS



NO.	REVISIONS	DRAWN BY	DATE

0 250 500 750
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISIONS
PROPOSED IMPROVEMENTS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
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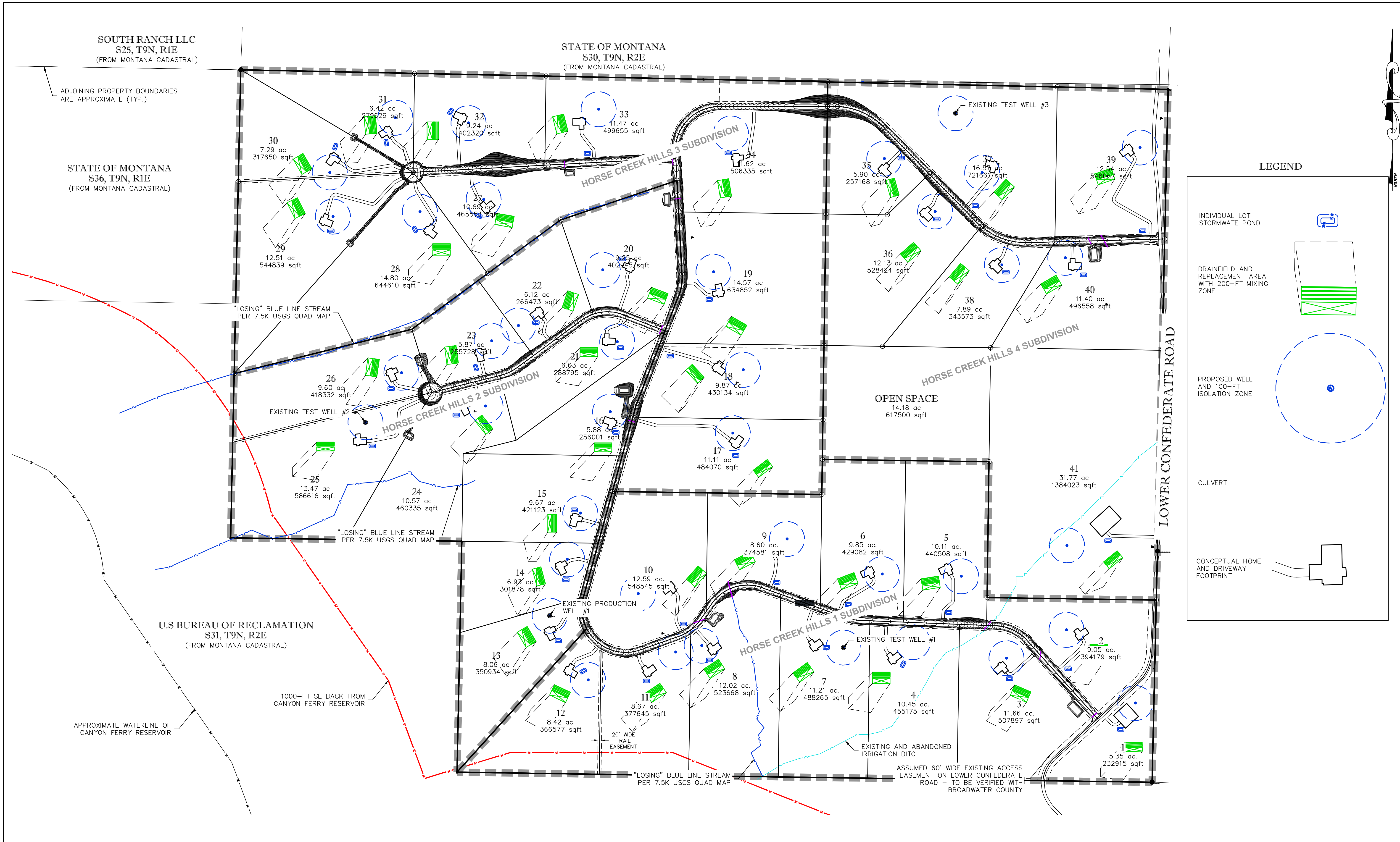
PROJECT #: 19-072
DATE: 3/27/2020
SHEET WW0.2
HORSE CREEK HILLS
SUBDIVISION OVERVIEW



NO.	REVISIONS	DRAWN BY	DATE

0 250 500 750
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS SUBDIVISION - WWTS
WWTS PLAN OVERVIEW
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
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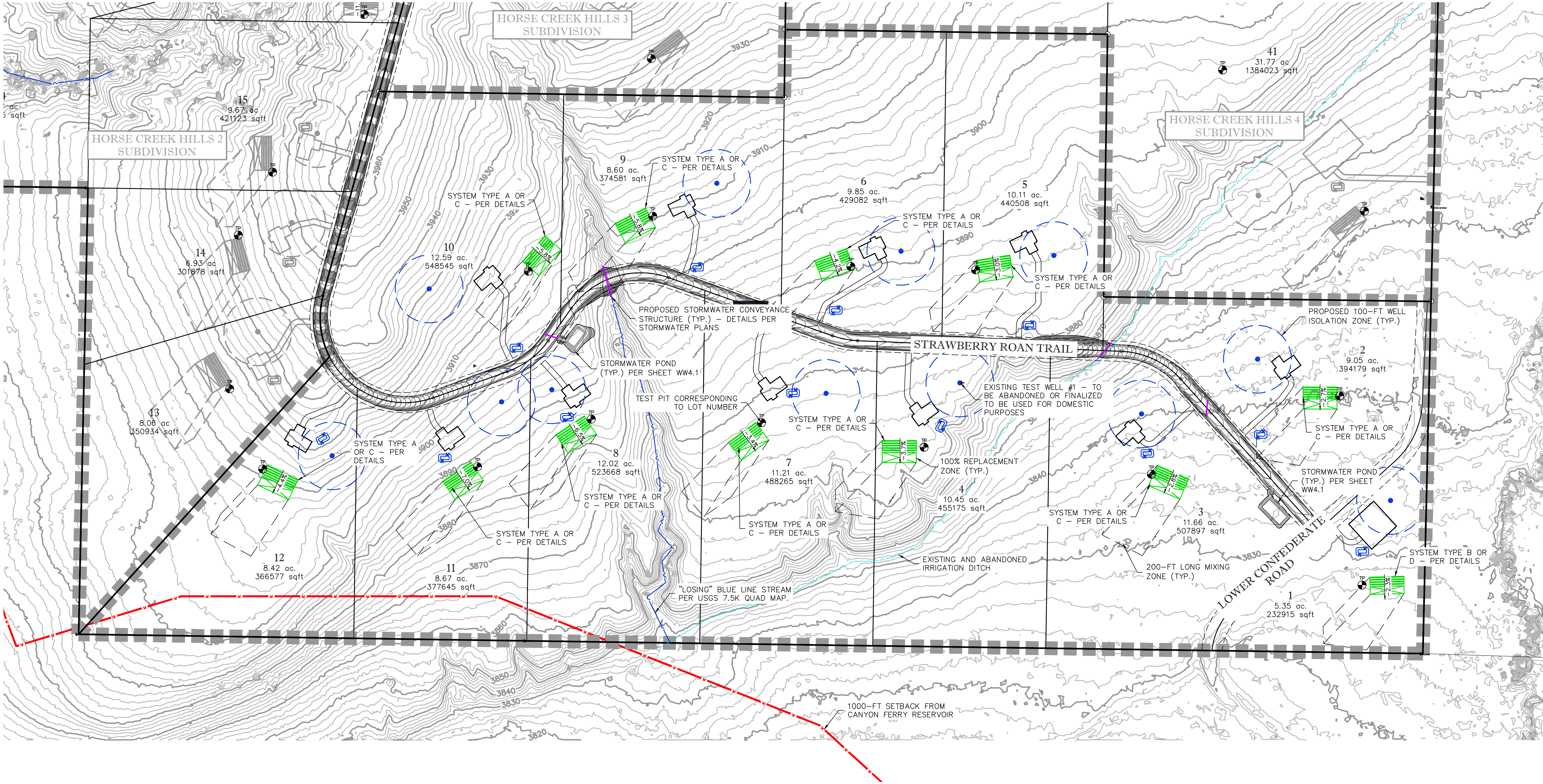
ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19-072
DATE: 3/20/2020
SHEET WW1.0
HORSE CREEK HILLS
WWTS OVERVIEW



NOTES:
1. 3,500 SF HOUSE FOOTPRINT WITH 16-FT WIDE DRIVEWAY SHOWN FOR CONCEPTUAL PURPOSES.
2. LOTS #1-12 ARE PROJECT #1 OF THE HORSE CREEK HILLS SUBDIVISION.
3. LOT #1 IS A PROPOSED COMMERCIAL LOT. DRAINFIELD WAS SIZED FOR A 24 EMPLOYEE MAXIMUM FACILITY WITH EACH EMPLOYEE UTILIZING 13 GPD OF WATER.
4. LOTS #2-12 ARE PROPOSED RESIDENTIAL LOTS. EACH DRAINFIELD WAS DESIGNED TO BE GRAVITY FED AND SERVE UP TO A 5-BEDROOM HOME.
5. LOTS #1-4 TO BE EVALUATED PER THE NON-DEGRADATION ANALYSIS. LOTS #5-12 ARE EXEMPT FROM NON-DEGRADATION ANALYSIS PER THE CATEGORY #1 EXEMPTION OF THE NON-DEGRADATION ANALYSIS – APPENDIX P.
6. SEE SHEETS WW2.1, WW2.2, & WW2.4 FOR SYSTEM SIZING DETAILS.
7. SEE STORMWATER SHEETS WW3X SERIES FOR STORMWATER DETAILS.
8. GRAY INFRASTRUCTURE SHOWN IS PROPOSED DEVELOPMENT IN SEPARATE MDEQ PROJECTS – PART OF THE OVERALL DEVELOPMENT
9. CONTOURS ARE BASED ON AN AERIAL DRONE SURVEY. ACTUAL ON-SITE ELEVATIONS MAY VARY BASED ON VEGETATION AND PROXIMITY TO SURVEY CONTROL POINTS.

LEGEND

INDIVIDUAL LOT STORMWATE POND

DRAINFIELD AND REPLACEMENT PROPOSED IN SEPERATE PHASE

DRAINFIELD AND REPLACEMENT IN PROPOSED PHASE

PROPOSED WELL AND 100-FT ISOLATION ZONE

SEPTIC TEST PIT (TP)

CONCEPTUAL HOME AND DRIVEWAY FOOTPRINT

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET): 0 150 300 450

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS 1 SUBDIVISION
WASTEWATER TREATMENT SYSTEM PLAN
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
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Civil Engineering
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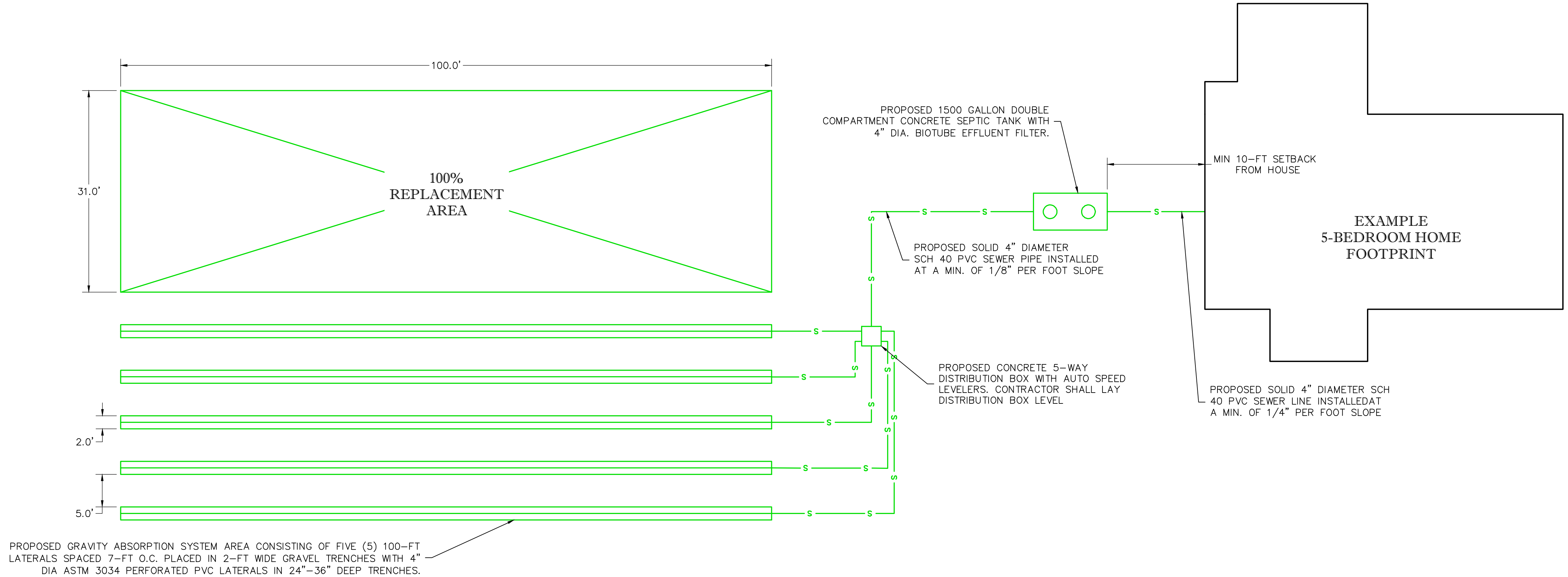
Land Surveying

ALLIED ENGINEERING SERVICES, INC.

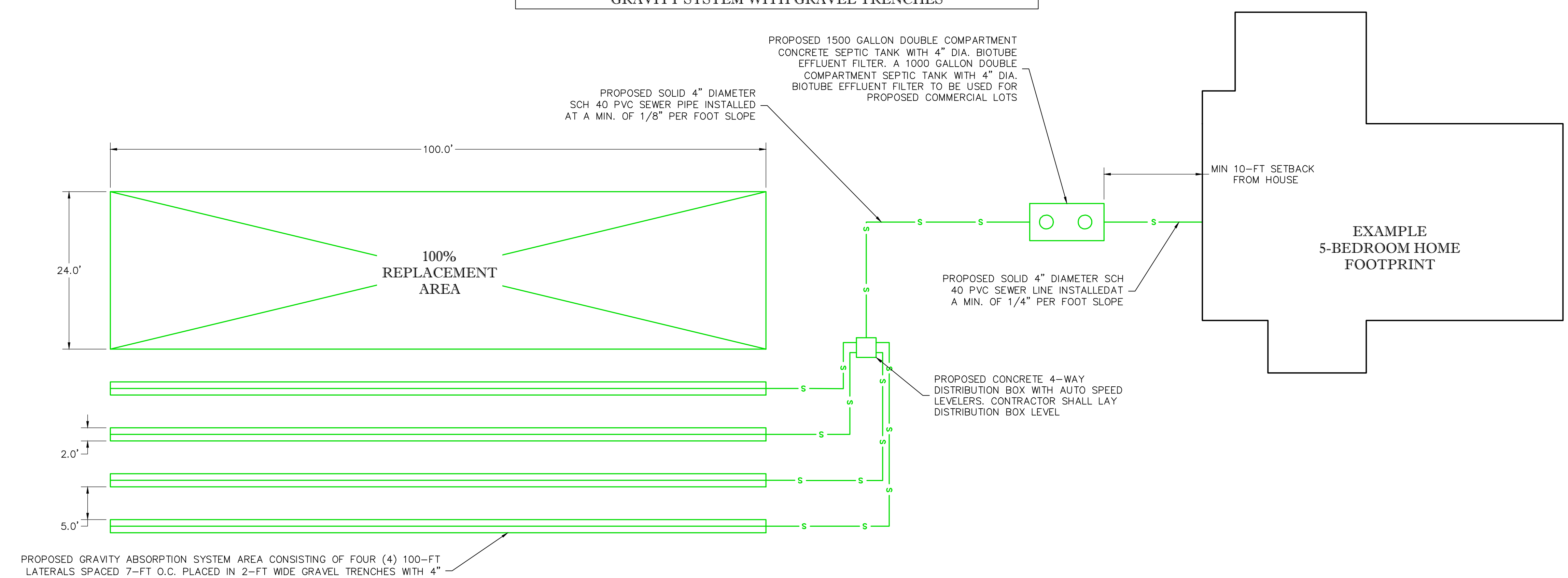
PROJECT #: 19-072
DATE: 3/27/2020
WWTS PROJECT 1

SHEET WW1.1

HORSE CREEK HILLS
WWTS PLAN



DETAIL 1 - WASTEWATER TREATMENT SYSTEM TYPE A - STANDARD GRAVITY SYSTEM WITH GRAVEL TRENCHES



DETAIL 2 - WASTEWATER TREATMENT SYSTEM TYPE B - STANDARD GRAVITY SYSTEM WITH GRAVEL TRENCHES

NO.	REVISIONS	DRAWN BY	DATE

SCALE (FEET) 0 10 20 30

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
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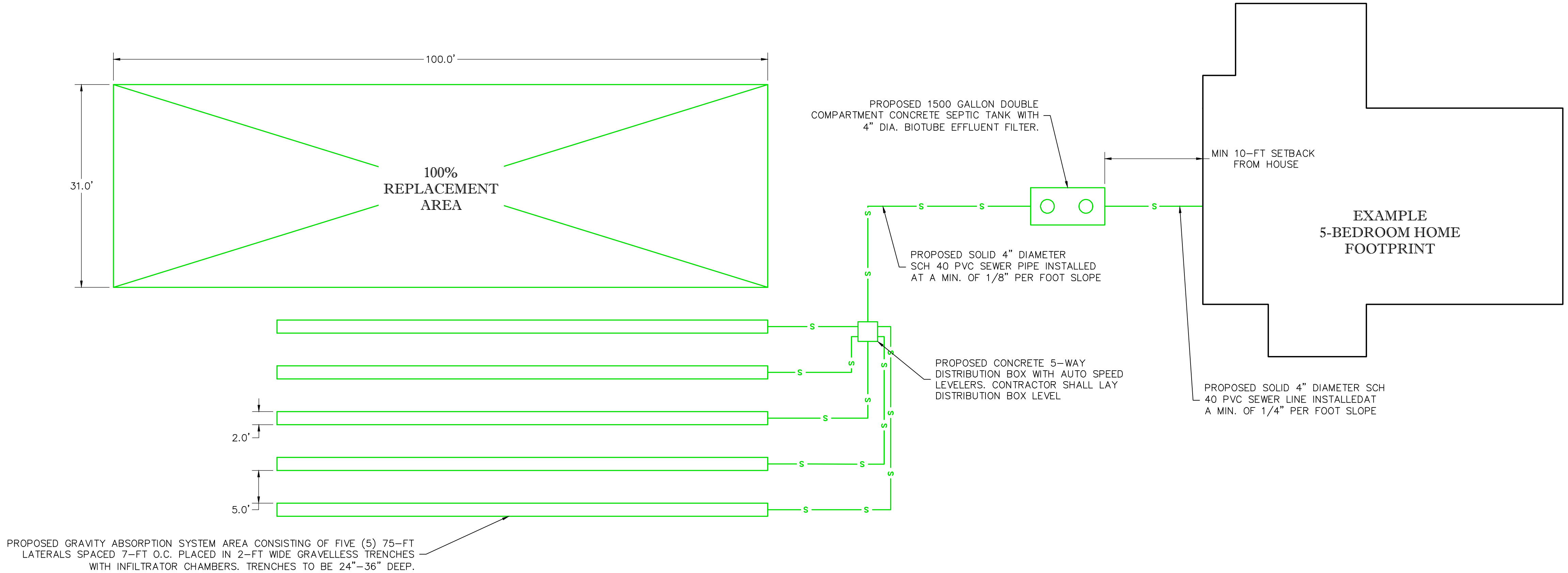
PROJECT #: 19-072
DATE: 3/27/2020
WWTS DETAILS

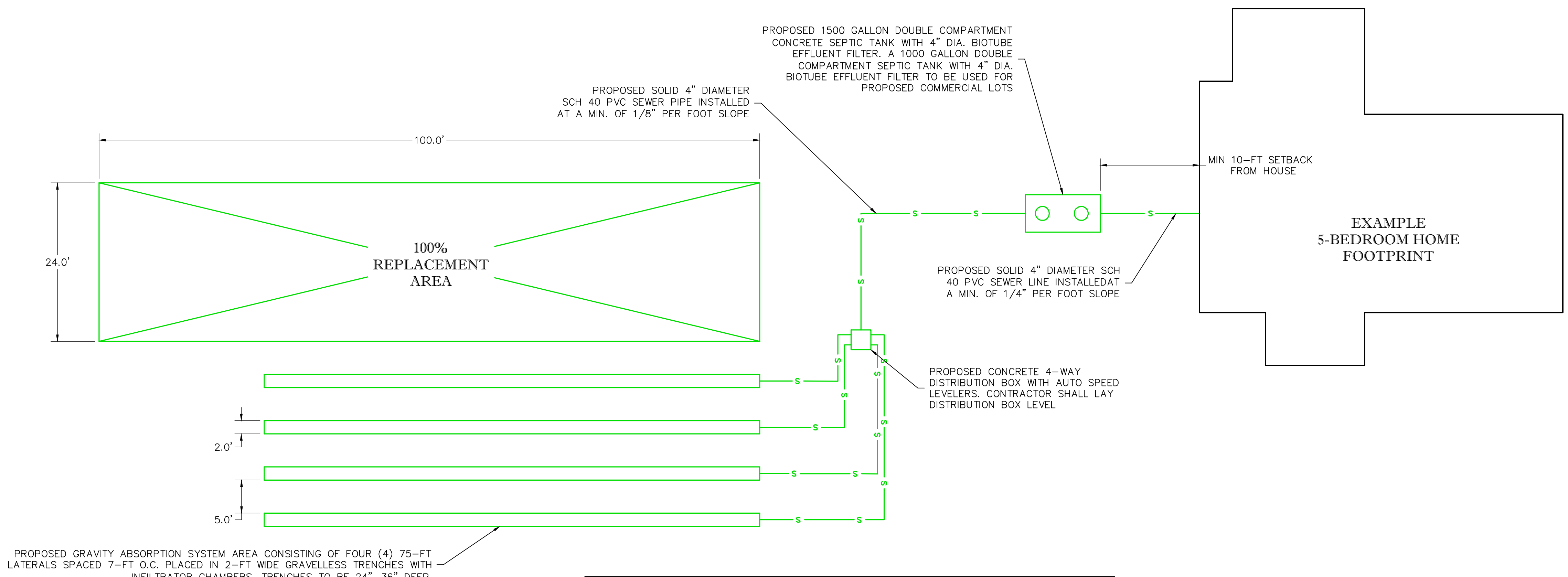
SHEET WW2.1

HORSE CREEK HILLS WWTS DETAILS

C:\cest_w\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\Sewer\WW2.1 DETAILS.dwg



DETAIL 1 - WASTEWATER TREATMENT SYSTEM TYPE C - STANDARD GRAVITY SYSTEM WITH GRAVELLESS INFILTRATOR CHAMBERS



DETAIL 2 - WASTEWATER TREATMENT SYSTEM TYPE D - STANDARD GRAVITY SYSTEM WITH GRAVELLES INFILTRATOR CHAMBERS

NO.	REVISIONS	DRAWN BY	DATE

0 10 20 30
SCALE (FEET)

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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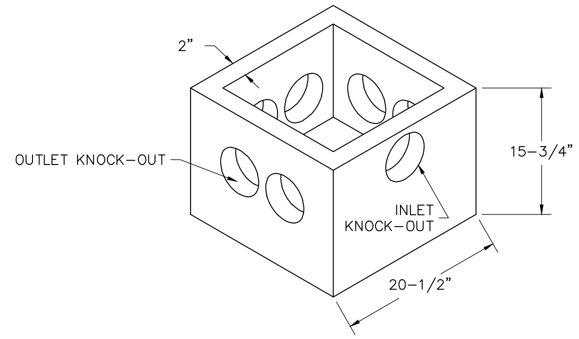
PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS

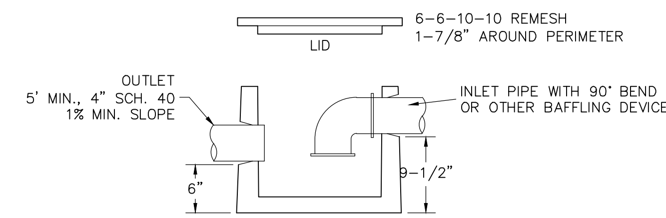
SHEET
WW2.2

HORSE CREEK HILLS
WWTS PLANS

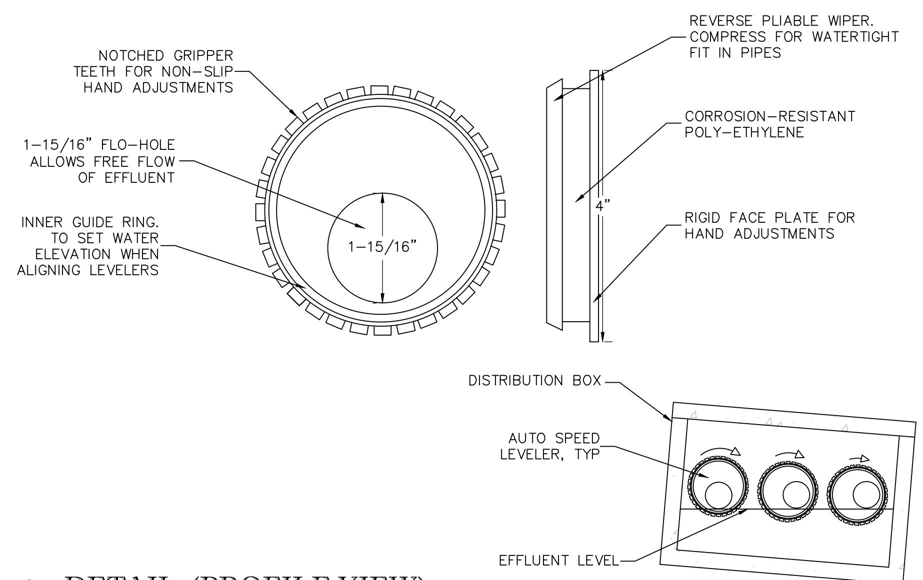


STANDARD MIX

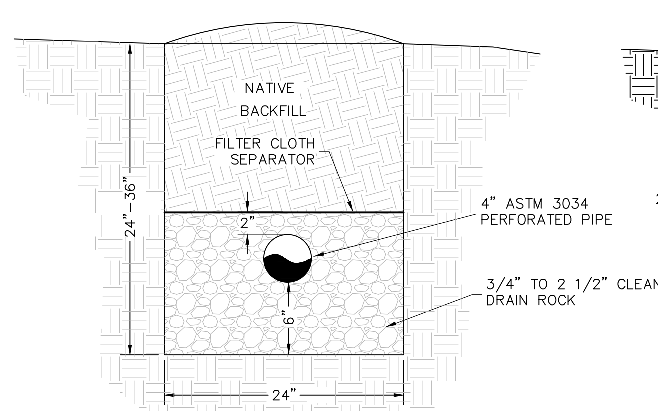
3/4" MINUS AGGREGATE
564 LBS. TYPE III CEMENT
5% ±1% AIR ENTRAINMENT
1.5 LBS/YARD FIBER REINFORCEMENT
30 GAL. WATER/YARD
WEIGHT OF D-BOX = 215 LBS
WEIGHT OF LID = 60 LBS



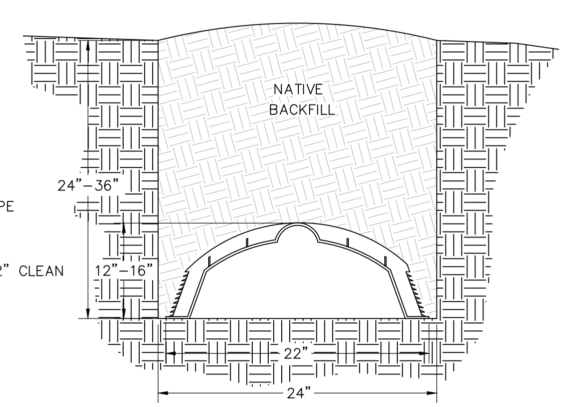
1 WW2.3 DETAIL
DISTRIBUTION BOX
NOT TO SCALE



2 WW2.3 DETAIL (PROFILE VIEW)
AUTO SPEED LEVELER
NOT TO SCALE

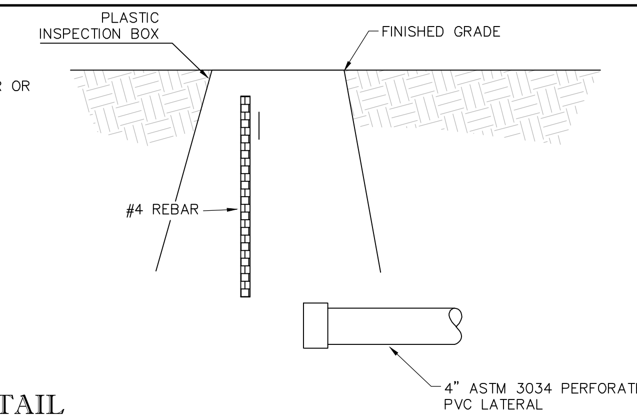


3 WW2.3 SECTION
24" STANDARD TRENCH
NOT TO SCALE

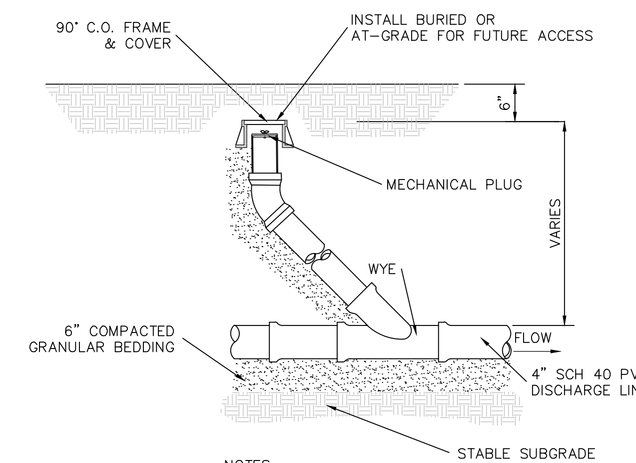


4 WW2.3 SECTION (ALTERNATE)
24" GRAVELLESS TRENCH
NOT TO SCALE

ALTERNATE:
USE C.O. FRAME AND COVER OR BURY INSPECTION BOX FOR PROTECTION FROM WILDLIFE DISTURBANCE.



5 WW2.3 DETAIL
DRAINFIELD INSPECTION BOX
NOT TO SCALE



NOTES:

1. USE INLAND FOUNDRY MODEL 240 FRAME & COVER IN ALL TRAFFIC AREAS.
2. COVER AND FRAME SHALL BE GRAY CAST IRON ASTM A-48, CLASS 30.
3. COVER AND FRAME TO BE MACHINED TO A TRUE BEARING ALL AROUND.

6 WW2.3 DETAIL
4" CLEANOUT
NOT TO SCALE

GENERAL NOTES:

1. WORK SHALL BE PERFORMED IN ACCORDANCE WITH CIRCULAR DEQ 4, AND BROADWATER COUNTY REGULATIONS.
2. CONTRACTOR SHALL BE LICENSED AND QUALIFIED TO INSTALL WASTEWATER TREATMENT SYSTEMS IN BROADWATER COUNTY, MONTANA.
3. NO WELLS OR SURFACE WATER EXIST WITHIN 100 FEET OF PRIMARY DRAINFIELD OR 100% REPLACEMENT AREA.
4. NO WELLS OR SURFACE WATER EXIST WITHIN 50 FEET OF WASTEWATER TREATMENT SYSTEM'S SEALED COMPONENTS.
5. SURFACE DRAINAGE IS ADEQUATE.
6. SLOPE ACROSS DRAINFIELD WAS DETERMINED TO BE LESS THAN 15.0%
7. REBAR SHALL BE PLACED AT THE ENDS OF DRAINFIELD LATERALS PER DETAIL 5 ON SHEET WW2.3.

NOTES TO INSTALLER:

1. CONTRACTOR TO VERIFY LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION ACTIVITIES.
2. CONTRACTOR TO VERIFY SEWER STUB LOCATIONS AND ALL EXISTING WASTEWATER TREATMENT COMPONENTS PRIOR TO INSTALLATION OF WASTEWATER TREATMENT SYSTEM.
3. CONTRACTOR TO FIELD VERIFY ALL APPLICABLE SETBACKS PRIOR TO INSTALLATION OF WASTEWATER TREATMENT SYSTEM. IF ANY DISCREPANCIES ARE DETERMINED BY CONTRACTOR, ENGINEER SHALL BE NOTIFIED IMMEDIATELY IN WRITING.
4. ALL LATERALS ARE TO BE LAID LEVEL.
5. 10 FEET (MIN.) SEPARATION BETWEEN WATER AND SEWER LINES SHALL BE MAINTAINED.
6. BALLAST ALL TANKS AND SEAL ALL TANK RISERS IN HIGH GROUNDWATER.
7. ANY DESIGN CHANGES WITH RESPECT TO ORIENTATION, LAYOUT, MATERIALS, ETC. MUST BE APPROVED BY ENGINEER.

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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PROJECT #: 19-072
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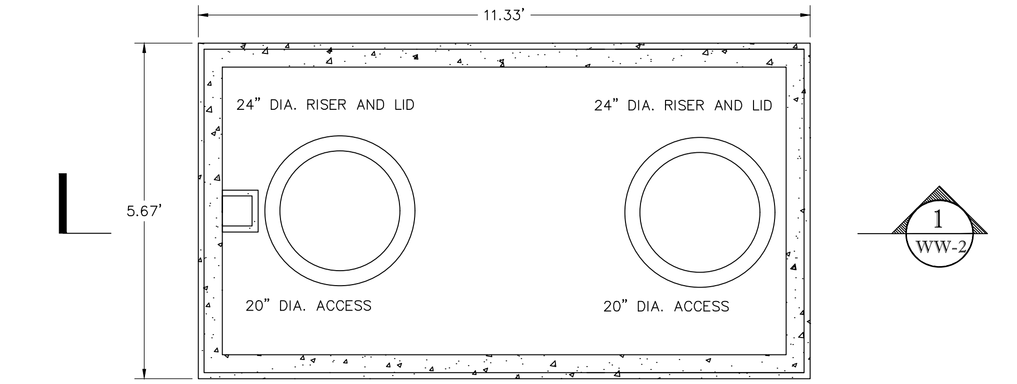
WWTS DETAILS
SHEET WW2.3
HORSE CREEK HILLS
WWTS PLANS



*INSTALL SAFETY GRATES AT ALL SEPTIC TANK/DOSING TANK OPENINGS. CUT TO FIT AROUND EFFLUENT FILTER HANDLE AND PUMP DISCHARGE PIPING (IF NECESSARY).

ALTERNATE
*OWNER MAY INSTALL FIBERGLASS RISERS AND LIDS IN LIEU OF CONCRETE. RISERS AND LIDS (TYPICAL ALL TANKS)

*PRIOR TO PLACEMENT OF TANKS CONTACT ENGINEER IF TANK DEPTHS ARE ANTICIPATED TO EXCEED 4' BURY DEPTH.

MDEQ4 5.1.2.1.:

LIQUID CONNECTION BETWEEN COMPARTMENTS SHALL CONSIST OF A SINGLE OPENING COMPLETELY ACROSS THE COMPARTMENT WALL OR TWO OR MORE OPENINGS EQUALLY SPACED ACROSS THE WALL. THE TOTAL AREA OF THE OPENINGS SHALL BE AT LEAST THREE TIMES THE AREA OF THE INLET PIPE.

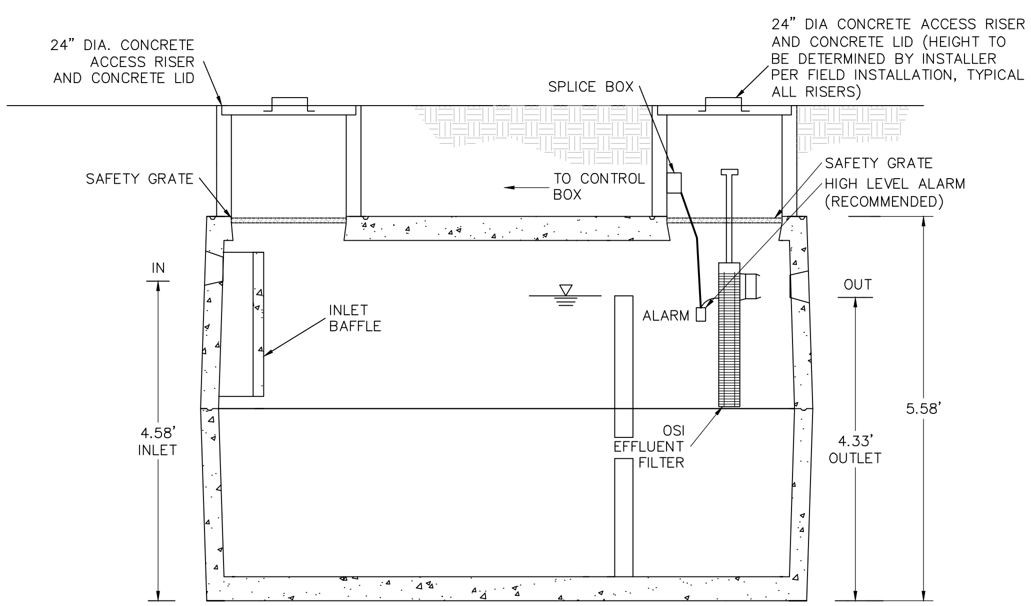
ALL SEPTIC AND DOSING TANKS MUST BE TESTED IN ACCORDANCE WITH MDEQ4 CHAPTER 5 FOR WATERTIGHTNESS.

WATER TESTING MUST BE CONDUCTED BY SEALING THE OUTLETS, FILLING THE SEPTIC TANK TO ITS OPERATIONAL LEVEL, AND ALLOWING THE TANK TO STAND FOR AT LEAST 24 HOURS. IF THERE IS A MEASURABLE LOSS (2 INCHES OR MORE), REFILL THE TANK AND LET STAND FOR ANOTHER 24 HOURS. IF THERE IS AGAIN A MEASURABLE LOSS, THE TANK MUST BE REJECTED.

OR

VACUUM TESTING MUST BE CONDUCTED BY SEALING ALL INLETS, OUTLETS, AND ACCESSES, THEN INTRODUCING A VACUUM OF 4 INCHES OF MERCURY, IF THE VACUUM DROPS IN THE FIRST 5 MINUTES IT MUST BE BROUGHT BACK TO 4 INCHES OF MERCURY. IF THE SEPTIC TANK FAILS TO HOLD THE VACUUM AT 5 INCHES OF MERCURY FOR 5 MINUTES, THE TANK MUST BE REJECTED.

1 / WW3.3 DETAIL (PLAN VIEW) - RESIDENTIAL HOME
1,500 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)
NOT TO SCALE



SECTION VIEW

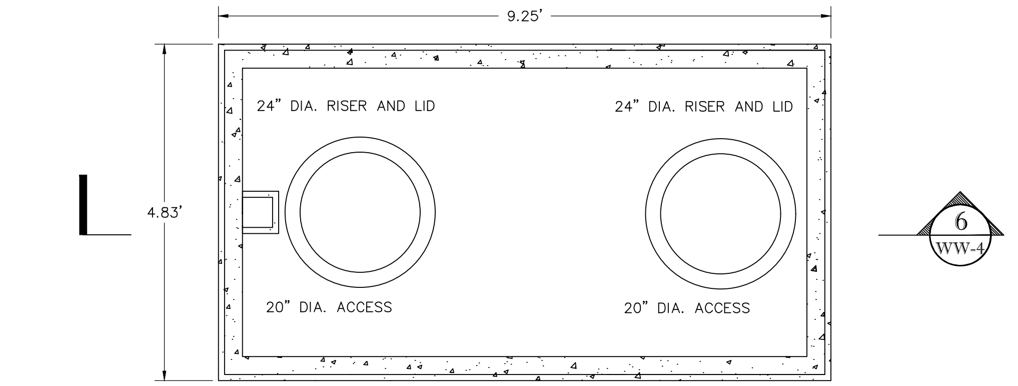
NOTES:

- ALL SEPTIC TANK DIMENSIONS HAVE BEEN SUPPLIED BY ANDERSON PRECAST & SUPPLY, INC (BOZEMAN, MT). CONTRACTOR MAY ELECT TO USE ALTERNATIVE SUPPLIER, IN WHICH CASE CONTRACTOR SHALL SUBMIT STANDARD SEPTIC TANK DETAILS PER SUPPLIERS PROPOSED CONSTRUCTION PRIOR TO INSTALLATION.
- WE RECOMMEND THE USE OF A HIGH LEVEL ALARM.

TANK NOTES:

1. CONCRETE IS 5,000 PSI AT 28 DAYS
2. INLET AND OUTLET HAVE PLASTIC SEAL WHICH ACCEPTS SCH40 OR SEWER AND DRAIN PIPE.
3. NORMALLY SET IN ONE PIECE
4. SIDE INLET (KNOCK-OUTS) PROVIDED.
5. EACH SEGMENT IS POURED MONOLITHICALLY.
6. ALL HANDLES ARE 1/4" SMOOTH STEEL.
7. WEIGHT OF TANK IS 16,000 LBS.
8. REINFORCING = #3 REBAR GRADE 40.
9. ACTUAL CAPACITY = ±1,500 GALLONS
10. MAXIMUM EARTH COVER IS 4 FEET.
11. TANK JOINT IS SEALED WITH 3/4" DIA. CONSEAL.

2 / WW3.3 DETAIL (PROFILE VIEW) - RESIDENTIAL HOME
1,500 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)
NOT TO SCALE



*INSTALL SAFETY GRATES AT ALL SEPTIC TANK/DOSING TANK OPENINGS. CUT TO FIT AROUND EFFLUENT FILTER HANDLE AND PUMP DISCHARGE PIPING (IF NECESSARY).

ALTERNATE
*OWNER MAY INSTALL FIBERGLASS RISERS AND LIDS IN LIEU OF CONCRETE. RISERS AND LIDS (TYPICAL ALL TANKS)

*PRIOR TO PLACEMENT OF TANKS CONTACT ENGINEER IF TANK DEPTHS ARE ANTICIPATED TO EXCEED 4' BURY DEPTH.

MDEQ4 5.1.2.1.:

LIQUID CONNECTION BETWEEN COMPARTMENTS SHALL CONSIST OF A SINGLE OPENING COMPLETELY ACROSS THE COMPARTMENT WALL OR TWO OR MORE OPENINGS EQUALLY SPACED ACROSS THE WALL. THE TOTAL AREA OF THE OPENINGS SHALL BE AT LEAST THREE TIMES THE AREA OF THE INLET PIPE.

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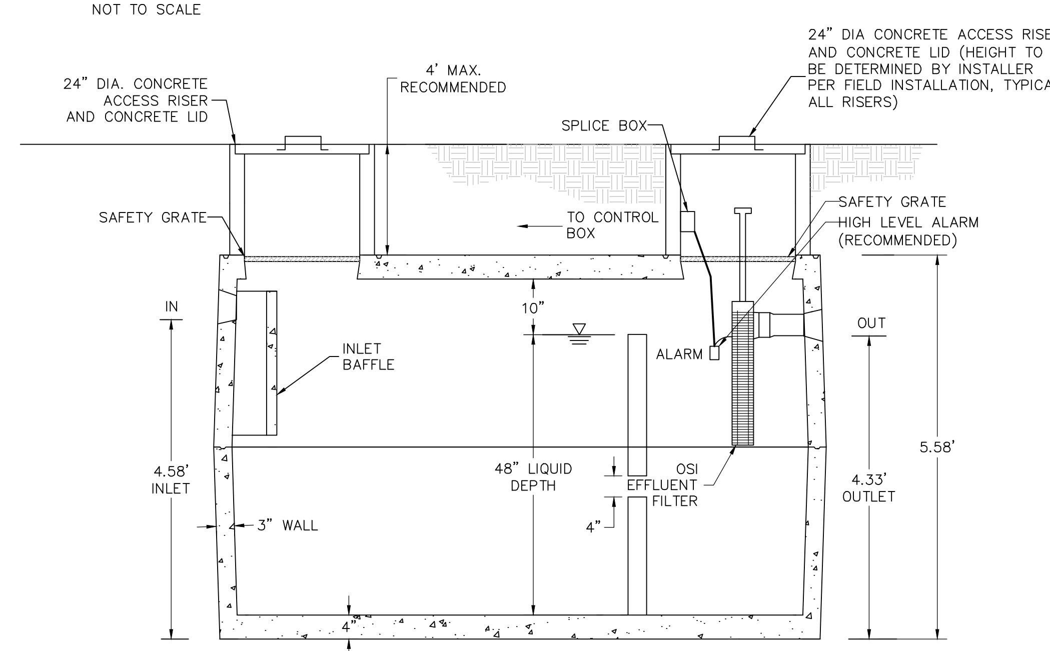
OR

VACUUM TESTING MUST BE CONDUCTED BY SEALING ALL INLETS, OUTLETS, AND ACCESSES, THEN INTRODUCING A VACUUM OF 4 INCHES OF MERCURY, IF THE VACUUM DROPS IN THE FIRST 5 MINUTES IT MUST BE BROUGHT BACK TO 4 INCHES OF MERCURY. IF THE SEPTIC TANK FAILS TO HOLD THE VACUUM AT 5 INCHES OF MERCURY FOR 5 MINUTES, THE TANK MUST BE REJECTED.

3 / WW2.4 DETAIL (PLAN VIEW) - COMMERCIAL SHOP
1,000 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)

NOT TO SCALE



SECTION VIEW

NOTES:

- ALL SEPTIC TANK DIMENSIONS HAVE BEEN SUPPLIED BY ANDERSON PRECAST & SUPPLY, INC (BOZEMAN, MT). CONTRACTOR MAY ELECT TO USE ALTERNATIVE SUPPLIER, IN WHICH CASE CONTRACTOR SHALL SUBMIT STANDARD SEPTIC TANK DETAILS PER SUPPLIERS PROPOSED CONSTRUCTION PRIOR TO INSTALLATION.
- WE RECOMMEND THE USE OF A HIGH LEVEL ALARM.
- SHALL BE DOUBLE COMPARTMENT

TANK NOTES:

1. CONCRETE IS 5,000 PSI AT 28 DAYS
2. INLET AND OUTLET HAVE PLASTIC SEAL WHICH ACCEPTS SCH40 OR SEWER AND DRAIN PIPE.
3. NORMALLY SET IN ONE PIECE
4. SIDE INLET (KNOCK-OUTS) PROVIDED.
5. EACH SEGMENT IS POURED MONOLITHICALLY.
6. ALL HANDLES ARE 1/4" SMOOTH STEEL.
7. WEIGHT OF TANK IS 10,500 LBS.
8. REINFORCING = #3 REBAR GRADE 40.
9. ACTUAL CAPACITY = ±1,000 GALLONS
10. MAXIMUM EARTH COVER IS 4 FEET.
11. TANK JOINT IS SEALED WITH 3/4" DIA. CONSEAL.

4 / WW2.4 DETAIL (PROFILE VIEW) - COMMERCIAL SHOP
1,000 GALLON DOUBLE COMPARTMENT SEPTIC TANK (NOT TRAFFIC RATED)

NOT TO SCALE

C:\oesl_wf\Designs\2019\19-072 71 Ranch - Major Subdivision\29 CAD-Production\Sewer\WW2.1 DETAILS.dwg

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM DETAILS
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS

SHEET
WW2.4

HORSE CREEK HILLS
WWTS PLANS

SUMMARY OF PROPOSED WASTEWATER TREATMENT TYPE
CORRESPONDING TO EACH LOT

Lot Numer	# of Bedrooms	GPD of Wastewater	Texture	Application Rate (gpd/ft^2)	Corresponding Percolation Rate (min/inch)	Min. Drainfield Area (sf)	Length of Lateral (LF)	Min. Drainfield Dimensions (ft)	Infiltrator Size Reduction	Min. Drainfield Area (sf)	Length of Lateral (LF)	Min. Drainfield Dimensions (ft)	Type of System to be Utilized
1	24 Employees	312	SiL	0.4	16 - <31	780	390	23 X 100 (Type B)	0.75	585	292.5	23 x 75 (Type D)	B or D
2	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
3	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
4	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
5	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
6	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
7	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
8	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
9	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
10	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
11	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
12	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
13	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
14	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
15	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
16	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
17	5	400	L	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
18	5	400	L	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
19	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
20	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
21	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
22	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
23	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
24	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
25	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
26	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
27	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
28	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
29	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
30	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
31	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
32	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
33	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
34	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
35	5	400	SL	0.5	10 - <16	800	400	23 X 100 (Type B)	0.75	600	300	23 x 75 (Type D)	B or D
36	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
37	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
38	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
39	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
40	5	400	SiL	0.4	16 - <31	1000	500	30 x 100 (Type A)	0.75	750	375	30 x 75 (Type C)	A or C
41	24 Employees	312	SiL	0.4	16 - <31	780	390	23 X 100 (Type B)	0.75	585	292.5	23 x 75 (Type D)	B or D

1 WW2.5 DETAIL
SUMMARY OF DRAINFIELD DIMENSIONS
NOT TO SCALE

NO.	REVISIONS	DRAWN BY	DATE

PROJECT ENGINEER: MAF | DRAWN BY: HTM
DESIGNED BY: MAF, HTM | REVIEWED BY: MAF

HORSE CREEK HILLS WWTS DETAILS
WASTEWATER TREATMENT SYSTEM SUMMARY
SEC. 31, T9N, R2E, P.M.M., BROADWATER COUNTY, MT

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ALLIED ENGINEERING SERVICES, INC.

PROJECT #: 19-072
DATE: 3/20/2020
WWTS DETAILS

SHEET
WW2.5

HORSE CREEK HILLS
WWTS PLANS

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