

# Joint Application for Proposed Work in Montana's Streams, Wetlands, Floodplains, and Other Waterbodies

## CD/Agency Use Only

Application Number:  Date Received:

Stream or Waterbody:

Date Accepted:  Initials:  Date Forwarded to FWP:

**This section is for all Department of Transportation and SPA 124 Permits (government projects)**

Project Name:

Control Number:  Contract Letting Date:

MEPA/NEPA Compliance: ☐ Yes ☐ No If yes, #C5 of this application does not apply.

## Applicant Use

**This is a standardized application to apply for one or all local, state, or federal permits listed below. Check the box(s) for each permit being applied for.**

- Refer to the instructions to determine which permits apply to your project and submit an application to each applicable agency.
- Incomplete applications will result in a delay of application processing.
- The applicant is responsible for obtaining all necessary permits and landowner permission before beginning work.
- Other laws may apply.

|                                     | Permit                                                      | Agency                                                                                         | Required Application Sections: | Fee                                  |
|-------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------|--------------------------------------|
| <input type="checkbox"/>            | NSLPA 310 Permit                                            | Local Conservation District                                                                    | A-E and G                      | No fee                               |
| <input checked="" type="checkbox"/> | SPA 124 Permit                                              | Department of Fish, Wildlife & Parks (FWP)                                                     | A-E and G                      | No fee                               |
| <input checked="" type="checkbox"/> | 318 Authorization<br>401 Certification                      | Department of Environmental Quality (DEQ)                                                      | A-E and G                      | \$250 (318);<br>\$400-\$20,000 (401) |
| <input type="checkbox"/>            | Navigable Rivers<br>Land Use License,<br>Lease, or Easement | Department of Natural Resources<br>and Conservation (DNRC), Trust<br>Lands Management Division | A-E and G                      | \$50, plus<br>additional fee         |
| <input checked="" type="checkbox"/> | Section 404 Permit,<br>Section 10 Permit                    | U.S. Army Corps of Engineers<br>(USACE)                                                        | A-G and F1-10                  | Varied (\$0-\$100)                   |
| <input checked="" type="checkbox"/> | Floodplain Permit                                           | Local Floodplain Administrator                                                                 | A-G                            | Varied (\$25-\$500+)                 |

# Joint Application for Proposed Work in Montana's Streams, Wetlands, Floodplains, and Other Waterbodies

## A. APPLICANT INFORMATION

APPLICANT (*party responsible for project*) City of Missoula Public Works and Mobility Stormwater Department

Has the landowner consented to the project? ☒ Yes ☐ No

Mailing Address: 1345 W. Broadway City, State: Missoula, MT Zip: 59802

Physical Address: City, State: Zip:

Daytime Phone: 406-552-6379 Email: campbelltl@ci.missoula.mt.us

LANDOWNER NAME (*if different from applicant*) City of Missoula

Mailing Address: City, State: Zip:

Physical Address: City, State: Zip:

Daytime Phone: Email:

CONTRACTOR/COMPANY NAME (*if applicable*)

Mailing Address: City, State: Zip:

Physical Address: City, State: Zip:

Daytime Phone: (406) 531-8657 Email: hbrighton77@gmail.com

## B. PROJECT SITE INFORMATION

### Refer to section B1 of the instructions

1. NAME OF STREAM OR WATERBODY at project location: Pattee Creek

Project Address/Location: PATTEE CANYON Nearest Town: Missoula

County: Missoula Geocode: 04-2200-34-3-17-12-0000

Township: T13N Range: R19W Section: S34 ¼ Section:

Latitude: 46.837 Longitude: -113.991

Driving directions or other instructions needed for finding the site:

### Refer to section B2 of the instructions

2. Is the proposed activity within **SAGE GROUSE** areas designated as general, connected, or core habitat?

☐ Yes ☒ No Attach consultation letter if required.

### Refer to section B3 of the instructions

3. Is this a **STATE NAVIGABLE WATERWAY**? The state owns the beds of certain navigable waterways.

☐ Yes ☒ No If yes, send a copy of this application to the appropriate DNRC land office.

### Refer to section B4 of the instructions

4. **WHAT IS THE CURRENT CONDITION** of the proposed project site? What vegetation is present? Describe the existing bank condition, bank slope, height, nearby structures, and wetlands.

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The project site (Site) spans about 1 acre of open space managed by the City of Missoula (City) with a 200 linear foot reach of Pattee Creek flowing from east to northwest at the northern end. A low intensity residential area surrounds the Site, with Pattee Canyon Road running along the northeastern boundary. Pattee creek has been modified by urban development both upstream and downstream of the Site, where it enters the City's stormwater system. The creek segment is a low-gradient stream flowing through a seasonally flooded riparian shrubland and woodland. Streambanks are well vegetated with a diverse assemblage of native trees and shrubs including *Prunus virginiana* (chokecherry), *Crataegus douglasii* (Douglas hawthorn), *Populus balsamifera* ssp. *trichocarpa* (black cottonwood), *Populus tremuloides* (aspen), *Pseudotsuga menziesii* (Douglas fir), and *Pinus ponderosa* (ponderosa pine). Flooding in this system has influenced channel morphology through sediment deposition and streambank scour. A robust plant community composed of *Carex* sp. (sedges), *Juncus* sp. (rush) and grasses have established in these areas surviving high energy floods and colonizing quickly in sandbars. Pattee Creek flows approximately 7 river miles from Pattee Canyon, west toward the Bitterroot River. The topography of the Site can be described as gently sloping containing grades between 5 and 40 percent. A review of the Federal Emergency Management Administration (FEMA) National Flood Hazard Layer shows the Site is partially within Pattee Creek designated regulatory floodway (FEMA, 2024). A wetland delineation conducted in September of 2024, identified a small, 100 square foot isolated wetland southwest of Pattee Creek at the outfall of a stormwater drain. Vegetation found in this wetland included *Typha latifolia*, (Cattail) *Plantago major* (Broadleaf plantain), *Polygonum aviculare* (Prostate knotweed), and *Scirpus* sp. (Bullrush).

## C. PROJECT ACTIVITY INFORMATION

**Refer to section C1 of the instructions**

### 1. TYPE OF PROJECT (check all that apply)

- ☐ **Agricultural and Irrigation Projects:** Diversions, Headgates, Flumes, Riparian Fencing, Ditches, etc.
- ☐ **Buildings/Structures:** Accessory Structures, Manufactured Homes, Residential or Commercial Buildings, etc.
- ☒ **Channel/Bank Projects:** Stabilization, Restoration, Alteration, Dredging, Fish Habitat, Vegetation or Tree Removal, or any other work that modifies existing channels or banks.
- ☐ **Crossing/Roads:** Bridge, Culvert, Fords, Road Work, Temporary Access, or any project that crosses over or under a stream or channel.
- ☐ **Mining Projects:** All mining related activities including, Placer Mining, Aggregate Mining, etc.
- ☐ **Recreation Related Projects:** Boat Ramps, Docks, Marinas, etc.
- ☒ **Other Projects:** Cisterns, Debris Removal, Excavation/Pit/Pond, Placement of Fill, Drilling or Directional Boring, Utilities, Wetland Alteration. Any other project type not listed here.

**Refer to section C2 of the instructions**

2. Is this application for an **ANNUAL MAINTENANCE PERMIT**? ☐ Yes ☒ No

If yes, attach an annual plan of operations to this application

**Refer to section C3 of the instructions**

3. Why is this project necessary? State the **PURPOSE OR GOAL** of the proposed project.

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The goal of the project is to improve the quality of stormwater that discharges to Pattee Creek.

## *Refer to section C4 of the Instructions*

4. Provide a brief description of the **PROPOSED PROJECT PLAN** and how it will be accomplished.

The City is pursuing stormwater management and water quality improvements at the project Site located directly south of the intersection of Pattee Canyon Drive and Takima Drive.

Takima Park has four stormwater management system outfalls owned and managed by the City. Pattee Creek, a waterbody containing native westslope cutthroat trout, flows through Takima Park and receives stormwater discharge from each of the four outfalls. The stormwater discharging to the Site is generally untreated and likely contains pollutants. The project is funded by a grant obtained through Environmental Protection Agency's (EPA) Columbia River Basin Restoration Funding Assistance Program. The existing storm drain that conveys water to Outfall SW-DC-10059 will be modified (trimmed) so that stormwater enters the new facility at the south end of Takima Park. The Site is naturally sloped and has space constraints; therefore, the facility will contain three tiered bioretention cells. The downstream-most cell will discharge to a meandering biofiltration swale that will discharge to Pattee Creek.

## *Refer to section C5 of the instructions*

5. What **OTHER ALTERNATIVES** were considered to accomplish the stated purpose of the objective? Why was the proposed alternative selected?

The primary factors considered when identifying and evaluating alternatives for this project included Site constraints and design objectives. Three Best Management Practices (BMP) alternatives were considered including 1) constructed wetlands, 2) a wet detention basin, and 3) bioretention. After presenting, reviewing and discussing stormwater alternatives, the City directed NewFields to proceed with preliminary design of a bioretention facility using the larger site layout option. This alternative was selected because it has the best treatment potential, minimizes risk and uncertainties, and allows for habitat and aesthetic improvements at the Site.

## *Refer to section C6 of the instructions*

6. What are the **NATURAL RESOURCE BENEFITS** or **POTENTIAL IMPACTS**? Please complete the information requested below to the best of your ability:

6a. Explain any temporary or permanent changes in erosion, sedimentation, turbidity, or increases of potential contaminants. What will be done to minimize impacts?

The majority of ground disturbance including earthwork related to the installation of structures, digging, trenching, and grading will occur above Pattee Creek. Streambank disturbances will be minimized and concentrated at the base of each stormwater outfall. The contractor shall actively implement Best Management Practices (BMPs) to prevent erosion and the discharge of sediment and pollutants into wetlands and waters during project activities. BMPs such as straw wattles and silt fencing shall be installed below proposed work to limit the disturbance caused by the activities of mechanized equipment. Staging areas will be located outside of the riparian corridor and concentrated to a minimal area.



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6b. Will the project cause temporary or permanent impacts to fish and/or aquatic habitat? What will be done to protect the fisheries and habitat?

The project will minimize temporary impacts to fish and/or aquatic habitat by implementing BMPs that limit the amount of sedimentation, soil compaction, vegetation disturbance and invasive weed infestations. Additionally, work occurring near the Ordinary High Water Mark will occur after July 1<sup>st</sup> to support westslope cutthroat trout. Permanent changes to aquatic habitat are minimized by salvaging existing rock, performing minor grading and replacing existing rock back on the streambank. All disturbed areas will be revegetated with native species by seeding or planting.

6c. What will be done to minimize temporary or permanent impacts to the floodplain, wetlands, or riparian habitat?

In addition to implementing BMPs the project has a revegetation plan that incorporates lowland, midland and upland native plant species in addition to a native seed application schedule. The landscape plan covers the entire project footprint and any areas that will be disturbed during project construction activities will either be seeded or planted according to the project design.

6d. What efforts will be made to decrease flooding potential upstream and downstream of the project?

The proposed bioretention / infiltration facility has the potential to provide some reduction in flooding downstream of the project as it will capture, detain, and infiltrate a portion of the runoff discharged through the park's primary storm sewer outfall instead of routing it directly to Pattee Creek.

The lone catch basin inlet upstream of the Pattee Canyon Road culvert inlet will be replaced by a structure that has a deep sump in order to reduce the sediment in stormwater discharges to Pattee Creek. Reducing the sediment load here, as well as from the primary outfall, will lessen the amount of sediment that could be deposited throughout the Pattee Creek corridor thus providing some benefit to flooding potential both upstream and downstream of the project.

6e. Explain any potential temporary or permanent changes to the water flow or to the bed and banks of the waterbody. What will be done to minimize those changes?

Minor permanent changes are proposed to the Pattee Creek streambank at the discharge swale outlet north of Pattee Creek and a second location upstream beneath the southeast stormdrain outfall. Changes at the north outlet will involve salvaging existing rock, performing minor regrading, and replacing existing rock back onto the streambank. The second change will occur at the base of the southeast stormdrain outfall where a swale will be graded in. These changes will not alter water flow or the normal functioning of the bed and banks of the waterbody.

6f. How will existing vegetation be protected and its removal minimized? Explain how the site will be revegetated, including weed control plans.

Vegetation disturbance such as driving over or crushing vegetation with vehicles will be minimized to the extent possible and confined to the project footprint. Per project specifications, 3 large diameter cottonwood and 4 small diameter trees will be removed outside of the ordinary highwater mark. No unapproved removal or cutting of vegetation shall occur within waters or riparian areas unless reviewed and released by engineer lead. If unplanned trimming or removal of vegetation does occur, work will immediately stop and engineer lead will be contacted. Any trees damaged during construction that could have reasonably been avoided shall be replaced by the contractor once the City's urban forester has been notified. A site-specific weed control plan to prevent weed invasions during construction follow the City of Missoula's unique requirements found in Appendix 2-A of the Technical

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Specifications and General Planting Notes in the of the design. All areas that will be disturbed as a result of construction activities will be seeded according to the landscape design plan to prevent further weed invasion.

## D. CONSTRUCTION DETAILS

*Refer to section D1 of the instructions*

1. Proposed **CONSTRUCTION DATES:** Start: 7/2/2025 End: 10/3/2025

Is any portion of the work already completed? ☐ Yes ☒ No If yes, please describe previously completed work:

*Refer to section D2 of the instructions*

2. **PROJECT DIMENSIONS.** Describe the length and width of the project.

With regards to work below the Flood Insurance Rate Map's (FIRM) approximate Base Flood Elevation (BFE) of ~3316.5 (see Drawing Sheet 003 and 004), grading work is proposed to construct the proposed bioretention basin and related facilities. The proposed grading work will include excavations, fills using material generated from the onsite excavations, and fills using imported materials for erosion protection, bioretention, and site restoration. The proposed grading work will result in a net excavation across the site that produces approximately 300cy of surplus soil which will be hauled off site and disposed of. An estimated 215cy of material will be imported to the site – these materials are described below in section 3.

With regards to the ordinary high water mark (OHWM), the majority of project activities will occur above the OHWM; however, two locations will require minor grading work below the OHWM: (1) at the discharge swale outlet north of Pattee Creek, and (2) upstream of the Pattee Canyon Road culvert beneath the southeast stormdrain. Work at the discharge swale outlet near the Pattee Canyon Road culvert inlet will include salvaging of existing riprap along the north streambank, minor regrading along the bank to connect the discharge swale to Pattee Creek, and replacement of existing riprap back along the north streambank below the discharge swale. Work near the southeast stormdrain outfall will include connecting a discharge swale to Pattee Creek but riprap erosion protection is not proposed for this location below the OHWM.

*Refer to section D3 of the instructions*

3. **MATERIALS.** Provide the total quantity and source of materials proposed to be used or removed. Note: this may be modified during the permitting process, therefore it is recommended that you do not purchase materials until all permits are issued. List soil/fill type, cubic yards and source, culvert size, rip-rap size, and any other materials to be used or removed on the project.

| Cubic yards/ Linear Feet | Size and Type                                            | Source            |
|--------------------------|----------------------------------------------------------|-------------------|
| 30 CY                    | Graded Drain. Agg. (6" minus stone)                      | TBD By Contractor |
| 50 CY                    | Bioretention Soil Media (sand, fines, & organic mixture) |                   |
| 80 CY                    | Riprap (13" and 18" minus stone)                         |                   |
| 40 CY                    | 2-4' Landscape Boulders                                  |                   |
| 20 CY                    | 1' Landscaping Boulders                                  |                   |

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## Refer to section D4 of the Instructions

4. **EQUIPMENT.** List all equipment that will be used for this project. How will the equipment be used on the bank and/or in the water? Note: all equipment used in the water must be **CLEANED, DRAINED, AND DRY.**

A small excavator will likely be used to perform a minimal amount of work near the streambank including salvaging of existing rock, minor grading to connect stormwater drainages to the stream, and replacement of salvaged rock back along the streambank. To the extent possible, all construction equipment will stay above the Pattee Creek Ordinary High Water Mark and not enter the water.

Will equipment from out of state be used?

☐ Yes ☐ No ☒ Unknown

Will the equipment cross west over the Continental Divide to the project site?

☐ Yes ☐ No ☒ Unknown

Will equipment enter the Flathead Basin?

☐ Yes ☐ No ☒ Unknown

## E. REQUIRED ATTACHMENTS

1. Plans and/or drawings of the proposed project should include:
  - a. Plan/Aerial View
  - b. An elevation or cross-section view
  - c. Dimensions of the project (height, width, depth in linear feet)
  - d. Location of storage stockpile materials and location of fill or excavation sites
  - e. Drainage facilities
  - f. Location of existing/proposed structures, such as buildings, utilities, roads or, bridges
  - g. An arrow indicating north
  - h. Site photos
2. Attach a vicinity map or a sketch, which includes: The water body where the project is located, roads, tributaries, and other landmarks. Plan an "X" on the project location. Provide written directions to the site. This is a plan view (looking at the project from above).
3. If requesting a Maintenance 310 Permit, attach an Annual Plan of Operation.
4. Attach an Aquatic Resource Map, which documents the location and boundary of all waters of the U.S. in the project vicinity and includes wetlands and other special aquatic sites. Show the location of the ordinary high-water mark of streams or waterbodies if requesting a Section 404 or Section 10 Permit. Include the ordinary high-water mark delineation on plans or drawings and/or a separate wetland delineation.

## F. ADDITIONAL INFORMATION FOR US ARMY CORPS OF ENGINEERS (USACE) SECTION 404, SECTION 10, AND FLOODPLAIN PERMITS

### Refer to section F of the instructions

Section F should only be filled out by those needing Section 404, Section 10, and/or Floodplain permits.

Applicants applying for Section 404 and/or Section 10 permits must complete questions F1-10. For questions on Section 404 and/or Section 10 permits, contact the USACE by telephone at 406-441-1375 or by email at [montana.reg@usace.army.mil](mailto:montana.reg@usace.army.mil).

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*Applicants applying for Floodplain permits must complete all of Section F.*

## **Refer to section F1 of the instructions**

1. Does the proposed activity and/or property have permitting history with USACE? If yes, and available, provide the USACE project number(s) associated with the previous permits, including no permit required letters and approved jurisdictional determinations.

The proposed activity and property do not have a permitting history with USACE.

## **Refer to section F2 of the instructions**

2. Identify the specific **Nationwide Permit(s)** that you want to use to authorize the proposed activity.

Nationwide Permit 27 for Stream and Wetland Restoration Activities

## **Refer to section F3 of the instructions**

3. Provide the footprint of impacts and the quantity of materials proposed to be placed in wetlands and/or below the ordinary high-water mark in waters of the United States. Delineations are required of wetland and other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site.

3a. What is the length and width (or square footage/acreage) for each impact occurring within the waters of the United States, including wetlands?

A wetland delineation was conducted on September 16<sup>th</sup> of 2024 and identified the Pattee Creek Ordinary High Water Mark and a small, 100 square foot depression created by and dependent on City stormwater. The wetland appears to drain towards Pattee Creek to the east but does not have an observable nexus.

Given its elevation and reliant position next to the stormwater outfall, this is characterized as an isolated wetland with no connection to Pattee Creek.

No impacts will occur below the OHWM. The 100 square foot isolated wetland will be filled with native soil and graded into a natural swale.

3b. How many cubic yards of fill material will be placed below the ordinary high-water mark, in a wetland, stream, or other waters of the United States?

The project will not require any new fill to be placed below the Ordinary High Water Mark. Approximately 7 cubic yards of native soil generated from excavating the bioretention basins will fill the isolated wetland as it is incorporated into the stormwater swale.

## **Refer to section F4 of the instructions**

4. How will the proposed project avoid or minimize **impacts to waters of the United States**? Attach additional sheets if necessary.

The purpose of this project is to minimize impacts to waters of the United States by treating and slowing stormwater before it enters Pattee Creek. This goal will be achieved through the following methods:

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1. **Bioretention Basins:** Three bioretention basins with rock-lined low-flow channels and boulder-lined sheetpile retaining walls have been designed to retain and absorb water onsite, rather than allowing it to discharge directly into Pattee Creek.
2. **Biofiltration Discharge Swale:** A biofiltration discharge swale will allow water to soak into the ground, preventing direct flow into the creek.
3. **Rock Drainage Chutes and Catch Basins:** Rock drainage chutes and catch basins at storm drain outfalls will reduce erosion by slowing the flow and stabilizing the area around the outfall.
4. **Vegetation:** The bioretention basins and any disturbed areas will be planted and seeded to help slow and filter stormwater before it enters Pattee Creek.

Short-term impacts during construction will be mitigated by following Best Management Practices (BMPs) and ensuring that no equipment crosses or accesses Pattee Creek below the Ordinary High Water Mark (OHWM).

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### Refer to section F5 of the instructions

5. Will the project impact(s) be equal to or greater than 0.10 acre of wetland and/or 0.03 acre of stream or other waters? If yes, describe how the applicant is going to **compensate (mitigation bank, in-lieu fee program, or permittee responsible)** for these unavoidable impacts to waters of the United States.

No

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### Refer to section F6 of the instructions

6. Is the proposed activity within any component of the **National Wild and Scenic Rivers System**, or a river that has been officially designated by Congress as a “**study river?**” ☐ Yes ☒ No

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### Refer to section F7 of the instructions

7. Does this activity require permission from the **USACE because it will alter or temporarily or permanently occupy or use a USACE authorized civil works project?** (Examples include USACE owned levees, Fort Peck Dam, and others). ☐ Yes ☒ No

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### Refer to section F8 of the instructions

8. List the **ENDANGERED AND THREATENED SPECIES** and **CRITICAL HABITAT(S)** that might be present in the project location.

A U.S. Fish and Wildlife Service IPaC investigation revealed that there are no Critical Habitats at the Site however the following species may be potentially impacted:

Canada Lynx, *Lynx canadensis* - Threatened

Grizzly Bear, *Ursus arctos horribilis* - Threatened

North American Wolverine, *Gulo gulo luscus* – Threatened

Additionally, Pattee Creek supports westslope cutthroat trout, a listed species of concern with Montana Fish Wildlife and Parks.

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**Refer to section F9 of the instructions**

9. List any **HISTORIC PROPERTY(S)** that are listed, determined to be eligible or are potentially eligible (over 50 years old) for listing on the National Register of Historic Places.

According to City Parks and Recreation land managers, no historic properties are known to occur within the project footprint.

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**Refer to section F10 of the instructions**

10. List the **NAMES AND ADDRESS OF LANDOWNERS** adjacent to the project site. This includes properties to and across from the project site. Note: Some floodplain communities require certified adjoining landowner lists.

NAME/ADDRESS OF **Adjacent Landowner**: Bobby Grimshaw/ 116 Takima Drive, Missoula, MT 59803

NAME/ADDRESS OF **Adjacent Landowner**: Terry and Patricia Payne/ 501 Pattee Canyon Rd, Missoula, MT 59803

NAME/ADDRESS OF **Adjacent Landowner**:

NAME/ADDRESS OF **Adjacent Landowner**:

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**Refer to section F11 of the instructions**

12. **Floodplain Map Number**: 30063C1480E

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**Refer to section F11 of the instructions**

13. **Does this project comply with local planning or zoning regulations?** ☒ Yes ☐ No

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## G. SIGNATURE REQUIREMENTS

### *Refer to section G of the instructions*

Some agencies require original signatures for an application to be considered complete. After completing the application form, make the required number of copies and sign each copy. Send the copies with original signatures and additional information required directly to each applicable agency.

The statements contained in this application are true and correct. The applicant possesses the authority to undertake the work described herein or is acting as the duly authorized agent of the landowner. The applicant understands that the granting of a permit does not include landowner permission to access land or construct a project. Inspections of the project site after notice by inspection authorities are hereby authorized.

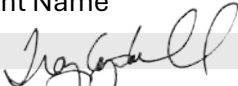
*\*By signing or typing my name on the signature line below, I hereby swear and affirm that I am the applicant for this project and am responsible for all information contained in this application.*

\*APPLICANT (party responsible for project)

LANDOWNER (If different from applicant)

Tracy Campbell, City of Missoula

Print Name

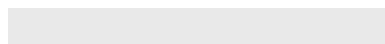


Signature of Applicant

3/21/2025

Date

Print Name



Signature of Landowner

CONTRACTOR (If applicable. Contact agency to determine if contractor signature is required)

Print Name of Primary Contractor



Signature of Contractor



Date

Company/Entity Name (If applicable)



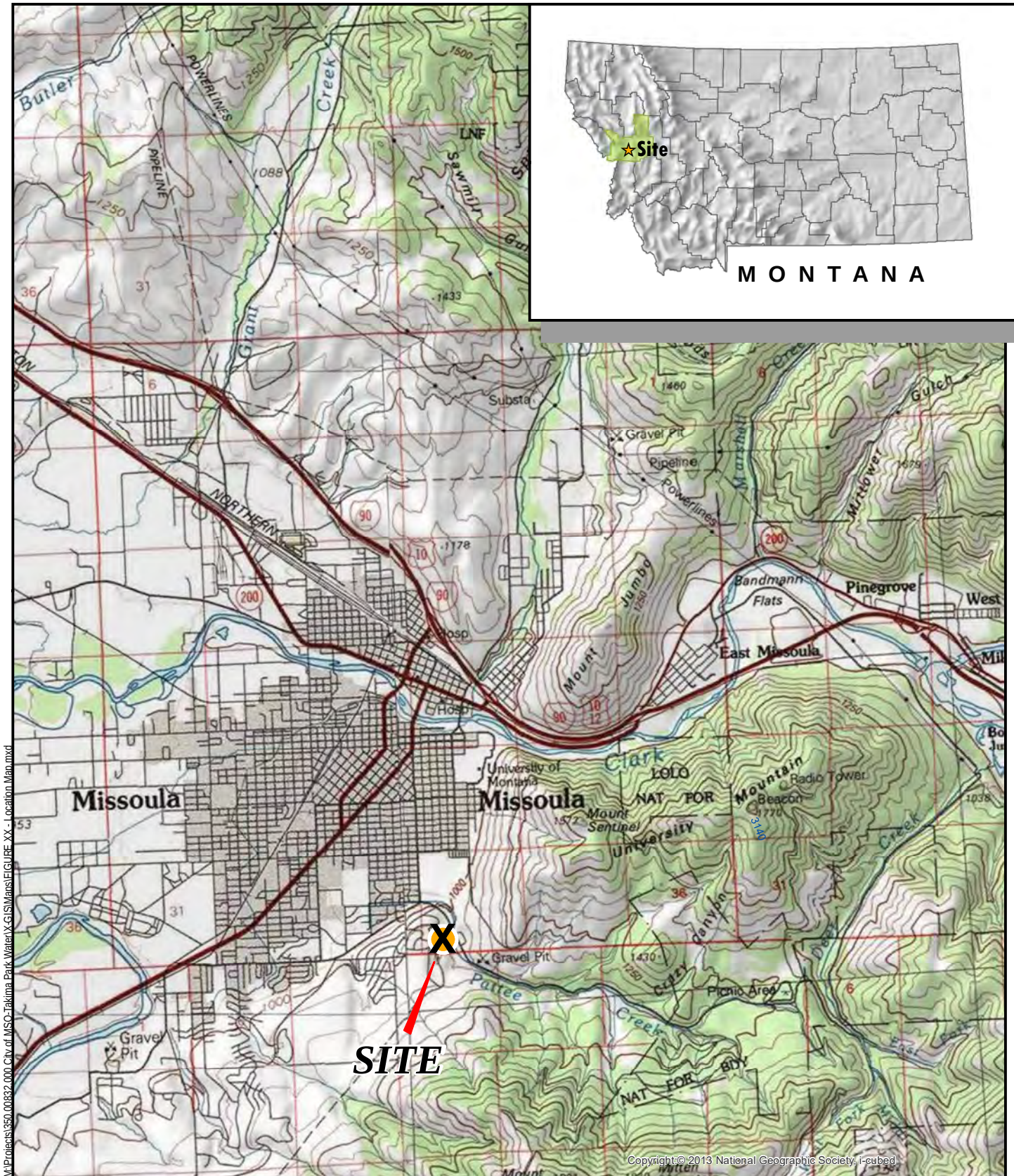
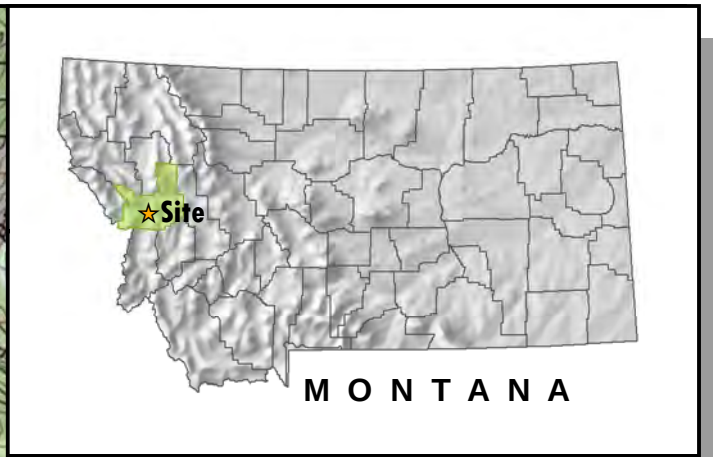


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## LOCATION MAP

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0 Feet 10,000

Vicinity Map  
Takima Park Stormwater Improvement Project  
Missoula County, MT

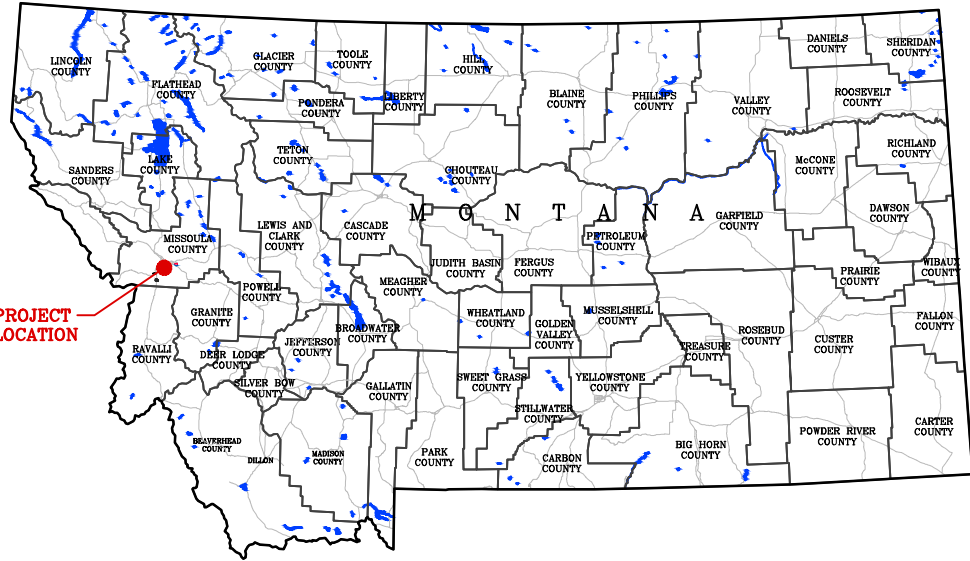


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## DESIGN DRAWINGS

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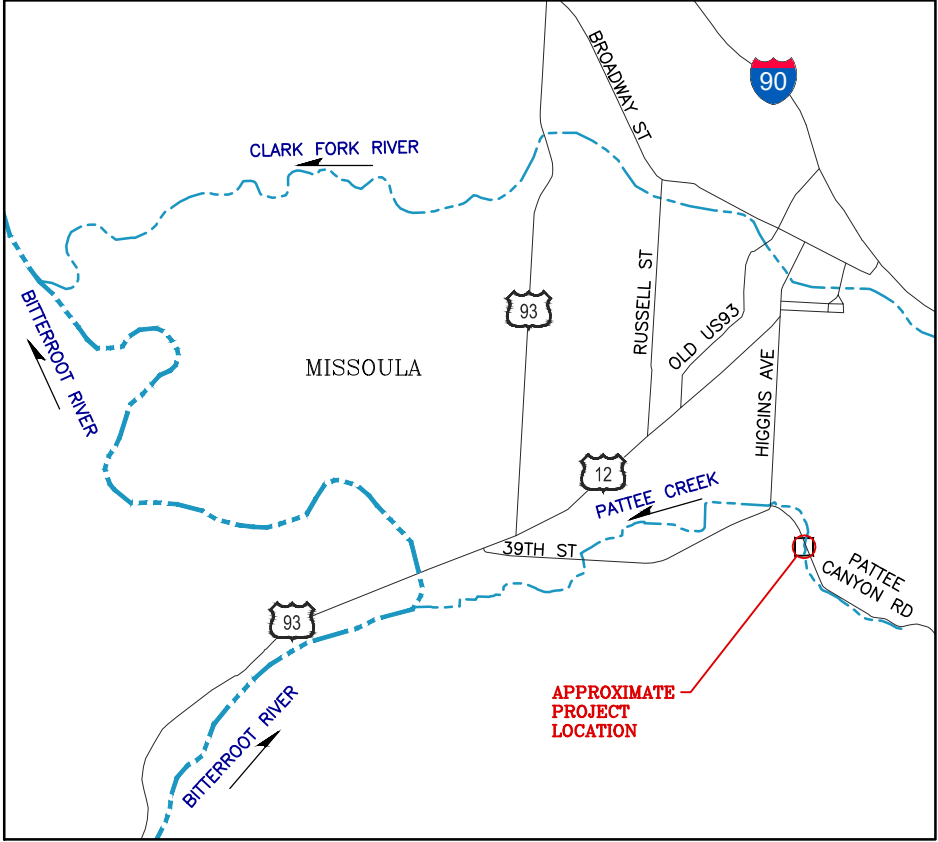




COUNTY MAP

# TAKIMA PARK WATER QUALITY IMPROVEMENTS PROJECT

## 90 PERCENT DESIGN ISSUED FOR REVIEW MARCH 5, 2025



VICINITY MAP

| DRAWING INDEX |                                                |     |
|---------------|------------------------------------------------|-----|
| DWG #         | DRAWING TITLE                                  | REV |
| 001           | COVER SHEET AND INDEX                          | B   |
| 002           | DRAWING LEGEND AND PROJECT NOTES               | B   |
| 003           | EXISTING CONDITIONS & DEMOLITION PLAN          | B   |
| 004           | SITE PLAN                                      | B   |
| 005           | PRETREATMENT VAULT PLAN AND PROFILE            | B   |
| 006           | BIORETENTION BASIN PLAN                        | B   |
| 007           | BIORETENTION BASIN STAKEOUT TABLES             | B   |
| 008           | BIORETENTION BASIN PROFILE                     | B   |
| 009           | DISCHARGE SWALE PLAN AND PROFILE               | B   |
| 010           | MINOR OUTFALL TREATMENT PLANS                  | B   |
| 011           | MINOR OUTFALL TREATMENT PROFILES               | B   |
| 012           | MINOR OUTFALL TREATMENT PROFILES               | B   |
| 013           | BIORETENTION BASIN TYPICAL SECTION             | B   |
| 014           | DISCHARGE SWALE AND ACCES PAD TYPICAL SECTIONS | B   |
| 015           | SHEETPILE AND WEIR DETAILS                     | B   |
| 016           | EROSION PROTECTION DETAILS                     | B   |
| 017           | PRETREATMENT VAULT DETAILS                     | B   |
| 018           | STORMWATER MANHOLE DETAILS                     | B   |
| 019           | ALIGNMENT TABLES                               | B   |
| 020           | STANDARD CONSTRUCTION DETAILS                  | B   |
| 021           | STANDARD CONSTRUCTION DETAILS                  | B   |
| 022           | GENERAL LANDSCAPE NOTES                        | B   |
| 023           | LANDSCAPE PLAN OVERVIEW                        | B   |
| 024           | LANDSCAPE PLAN                                 | B   |
| 025           | PLANTING SPECIES LIST                          | B   |
| 026           | PLANTING PLAN – CELL 1                         | B   |
| 027           | PLANTING PLAN – CELL 2 AND 3                   | B   |
| 028           | PLANTING PLAN – BIOFILTRATION DISCHARGE SWALE  | B   |
| 029           | PLANTING DETAILS                               | B   |

**PREPARED FOR:**



**CITY OF MISSOULA - PUBLIC WORKS AND MOBILITY  
STORMWATER DEPARTMENT  
1345 W. BROADWAY  
MISSOULA, MT 59802**



**700 SW Higgins Ave, Suite 15, Missoula, MT 59803  
Phone: (406) 549-8270      [www.newfields.com](http://www.newfields.com)**



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LEGEND

|  |      |                                      |  |                                     |
|--|------|--------------------------------------|--|-------------------------------------|
|  | 3330 | MAJOR CONTOUR (EXISTING)             |  | SURVEY CONTROL POINT                |
|  | 3328 | MINOR CONTOUR (EXISTING)             |  | GEOTECHNICAL INVESTIGATION TEST PIT |
|  | 3330 | MAJOR CONTOUR (PROPOSED)             |  | SANITARY SEWER MANHOLE (EXISTING)   |
|  | 3329 | MINOR CONTOUR (PROPOSED)             |  | STORMWATER MANHOLE (EXISTING)       |
|  |      | PARCEL BOUNDARY / ROW                |  | STORMWATER DRYWELL (EXISTING)       |
|  |      | FENCE – CHAIN LINK                   |  | STORMWATER CATCH BASIN (EXISTING)   |
|  |      | FENCE – PARK FENCE (TREE)            |  | STORMWATER CURB INLET (EXISTING)    |
|  |      | FENCE – SPLIT BOARD                  |  | CULVERT OVERFLOW INLET (EXISTING)   |
|  |      | EXISTING STORMDRAIN                  |  | GAS VALVE (EXISTING)                |
|  |      | EXISTING SANITARY SEWER              |  | WATER VALVE (EXISTING)              |
|  |      | EXISTING WATER LINE                  |  | HYDRANT (EXISTING)                  |
|  |      | EXISTING GAS LINE                    |  | TREE – CONIFEROUS                   |
|  |      | EXISTING OVERHEAD ELECTRIC           |  | TREE – DECIDUOUS                    |
|  |      | EXISTING STORM DRAIN OUTFALL         |  | SIGN – PARK SIGN                    |
|  |      | EXISTING PATTEE CANYON DRIVE CULVERT |  | SIGN – ROAD SIGN                    |
|  |      | PATTEE CREEK THALWEG                 |  | MAILBOX                             |
|  |      | EDGE OF WATER (AT TIME OF SURVEY)    |  | EARTH (EXISTING)                    |
|  |      | PERMANENT EROSION CONTROL GEOTEXTILE |  | FILL SECTION                        |
|  |      | BRUSHLINE                            |  | CUT SECTION                         |
|  |      |                                      |  | BIORETENTION SOIL MEDIA             |
|  |      |                                      |  | ROCK LINED CHANNEL                  |
|  |      |                                      |  | EROSION PROTECTION/RIPRAP           |

ACRONYMS AND ABBREVIATIONS

|       |                                                |
|-------|------------------------------------------------|
| Ø     | DIAMETER                                       |
| ANSI  | AMERICAN NATIONAL STANDARDS INSTITUTE          |
| CP    | CONTROL POINT                                  |
| CPEP  | CORRUGATED POLYETHYLENE PIPE                   |
| CY    | CUBIC YARD                                     |
| DEMO  | DEMOLISH                                       |
| DEQ   | DEPARTMENT OF ENVIRONMENTAL QUALITY            |
| DIA   | DIAMETER                                       |
| DWG   | DRAWING                                        |
| INV   | INVERT                                         |
| MDT   | MONTANA DEPARTMENT OF TRANSPORTATION           |
| MH    | MANHOLE                                        |
| MPDES | MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM |
| MPWSS | MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS   |
| NTS   | NOT TO SCALE                                   |
| RCP   | REINFORCED CONCRETE PIPE                       |
| ROW   | RIGHT OF WAY                                   |
| SF    | SQUARE FOOT                                    |
| TP    | TEST PIT                                       |
| TP    | TYPICAL                                        |

GENERAL NOTES:

- ALL WORK SHALL CONFORM TO THE MISSOULA CITY PUBLIC WORKS STANDARDS AND SPECIFICATIONS MANUAL; THE MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS, SEVENTH EDITION, AS MODIFIED BY MISSOULA CITY PUBLIC WORKS STANDARDS AND SPECIFICATIONS MANUAL; AND THESE CONTRACT DOCUMENTS.
- SUBMIT A WORK PLAN FOR REVIEW AND APPROVAL BY THE ENGINEER FOR ALL WORK RELATED TO MODIFICATIONS TO THE EXISTING STORMWATER SYSTEM. THE WORK PLAN SHALL ADDRESS SEQUENCING AND STAGING OF REMOVALS AND TEMPORARY STORMWATER MANAGEMENT FOR THE DURATION OF THE PROJECT. CONTRACTOR'S TEMPORARY STORMWATER MANAGEMENT PLAN SHALL INCLUDE MANAGEMENT OF FLOWS FROM THE 10-YEAR STORM (20 CFS) THROUGH THE PARK'S SOUTHWEST STORMDRAIN AS WELL AS ALL STORMWATER RUNOFF PASSING THROUGH THE MINOR OUTFALLS (NORTH OUTFALL, EAST OUTFALL, AND SOUTHEAST OUTFALL).
- NOTIFY THE CITY OF MISSOULA A MINIMUM OF 48 HOURS PRIOR TO BEGINNING WORK.
- USE THESE DRAWINGS TO ASSIST IN HORIZONTAL LOCATION DURING STAKING AND LAYOUT OF PROJECT FACILITIES. CONTACT THE ENGINEER FOR CLARIFICATION IF ANY DISCREPANCY BETWEEN THE GIVEN DATA AND THE INTENT SHOWN ON THE DRAWINGS IS IDENTIFIED.
- APPLY ALL NECESSARY FITTINGS, COUPLINGS, AND APPURTENANCES FOR CONNECTING NEW STORMWATER FACILITIES TO EXISTING FACILITIES. ALL REQUIRED COMPONENTS FOR MAKING THE CONNECTIONS MAY NOT BE SHOWN IN THESE DRAWINGS. VERIFY LINE, GRADE, AND SIZE OF CONNECTIONS TO EXISTING FACILITIES IN ADVANCE OF MAKING THE CONNECTION.
- DESIGN GRADES PRESENTED IN THESE DRAWINGS ARE BASED ON MAPPING INFORMATION AVAILABLE AT THE TIME OF DESIGN. VERIFY EXISTING ELEVATIONS AT TIE IN POINTS PRIOR TO INSTALLATION OF IMPROVEMENTS AND NOTIFY ENGINEER IF DIFFERENT CONDITIONS ARE IDENTIFIED. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING POSITIVE DRAINAGE FOR CONSTRUCTED IMPROVEMENTS.
- PROTECT ALL INFRASTRUCTURE OUTSIDE OF CONSTRUCTION LIMITS. ANY INFRASTRUCTURE DAMAGED DURING CONSTRUCTION SHALL BE REMOVED AND REPLACED BY THE CONTRACTOR AT HIS OWN EXPENSE.
- COORDINATE WITH ADJACENT LANDOWNERS TO SCHEDULE NECESSARY PROJECT RELATED WORK ON DRIVEWAYS, APPROACHES, AND OTHER WORK THAT MAY AFFECT ACCESS TO THEIR PROPERTIES.
- COMPLY WITH ALL CITY OF MISSOULA TRAFFIC CONTROL REGULATIONS.
- REPLACE EXISTING PAVEMENT MARKINGS DAMAGED OR DEMOLISHED AS A RESULT OF THIS PROJECT PER CITY OF MISSOULA STANDARDS. PAVEMENT MARKING REPLACEMENT SHALL BE INCIDENTAL TO THE WORK.
- RESTORE ALL SIDEWALKS, CURB AND GUTTER, AND ROADWAY SURFACES TO EQUAL OR BETTER CONDITION THAN EXISTED PRIOR TO DISTURBANCE.
- MINIMIZE DISTURBANCE TO EXISTING LANDSCAPING OUTSIDE OF GRADING LIMITS AND RESTORE ALL DISTURBED LANDSCAPED AREAS OUTSIDE OF THE PROJECT'S GRADING LIMITS TO EQUAL OR BETTER CONDITION THAN EXISTED PRIOR TO DISTURBANCE.

UTILITY NOTES AND COORDINATION:

- THE CONTRACTOR IS RESPONSIBLE FOR ALL UTILITY LOCATES. CONTACT MONTANA 811 AT LEAST THREE WORKING DAYS PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES TO REQUEST MARKING OF EXISTING UTILITY LOCATIONS AT THE PROJECT SITE.
- UTILITY LOCATIONS SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND NOT ALL EXISTING UTILITIES ARE SHOWN. BURIED UTILITIES SHOWN ARE BASED ON AVAILABLE RECORDS AND UTILITY LOCATOR MARKS AT THE TIME OF DESIGN. VERIFY THE LOCATION, SIZE, AND DEPTH OF ALL UTILITIES THAT MAY BE IMPACTED BY THIS PROJECT AND PROTECT ALL EXISTING UTILITIES DURING CONSTRUCTION. NOTIFY THE ENGINEER OF ANY CONFLICTS OR DISCREPANCIES WITH THE DRAWINGS PRIOR TO CONSTRUCTION. IF APPLICABLE, COORDINATE ALL UTILITY RELOCATIONS WITH THE UTILITY PROVIDERS AT NO COST TO THE CITY OF MISSOULA.
- THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR DAMAGE TO EXISTING FACILITIES AS A RESULT OF FAILURE TO LOCATE OR TO PROVIDE PROPER PROTECTION WHEN LOCATION IS KNOWN.

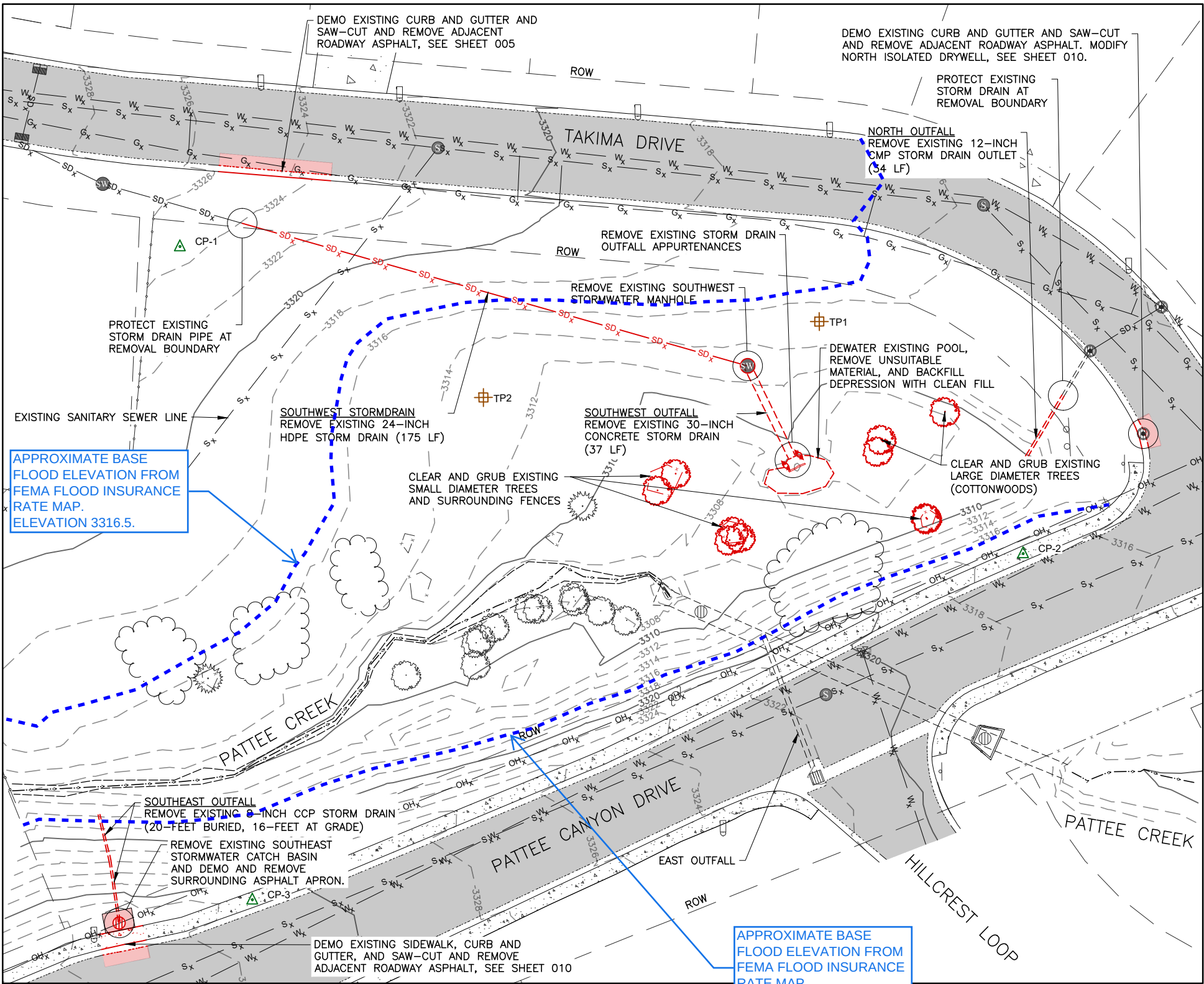
PERMITS AND ENVIRONMENTAL CONSIDERATIONS:

- OBTAIN ALL NECESSARY PERMITS FROM THE CITY OF MISSOULA, STATE OF MONTANA, AND UTILITY COMPANIES PRIOR TO STARTING WORK.
- ADHERE TO ALL REQUIREMENTS OF THE MPDES STORM WATER PERMITTING PROGRAM ADMINISTERED BY THE MONTANA DEQ. AN AUTHORIZATION UNDER THE GENERAL PERMIT FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY IS REQUIRED FOR CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS PROJECT.
- OBTAIN AND ADHERE TO ALL REQUIREMENTS UNDER THE CITY OF MISSOULA'S STORMWATER PERMIT.
- ALL EXCESS MATERIAL (INCLUDING CONSTRUCTION MATERIALS AND HARDWARE, IMPORTED SOIL, NATIVE SOILS, GRAVEL, RIPRAP, EXCAVATED MATERIALS, DEBRIS, ETC.) OR EQUIPMENT SHALL BE STAGED / PARKED, REFUELED, STORED, AND STOCKPILED OUTSIDE OF RIPARIAN AREAS.
- TO THE EXTENT FEASIBLE, ALL CONSTRUCTION EQUIPMENT SHALL STAY ABOVE THE PATTEE CREEK ORDINARY HIGH WATER MARK. CONSTRUCTION EQUIPMENT SHALL AT NO TIME ENTER THE WATER. WHERE IN-STREAM WORK IS NECESSARY, IT SHALL BE CONDUCTED BETWEEN JULY 1 AND NOVEMBER 1.
- CONTROL DUST DURING CONSTRUCTION. STREETS AND DISTURBED AREAS SHALL BE WATERED TO CONTROL DUST WHEN ORDERED BY THE ENGINEER.
- VEGETATION CLEARING SHALL OCCUR OUTSIDE OF THE MIGRATORY NESTING BIRD SEASON (MARCH 15 TO AUGUST 15).

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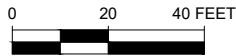
|     |          |                                       |  |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                        |             |                                        |                  |
|-----|----------|---------------------------------------|--|--|------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------|------------------|
|     |          |                                       |  |  |      | APPROVED BY:<br>MSP | DISCLAIMER                                                                                                                                                                                                                                                                                                                                                                             |             | CLIENT                                 | CITY OF MISSOULA |
|     |          |                                       |  |  |      | CHECKED BY:<br>MSP  | NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS. | PROJECT     | TAKIMA PARK WATER QUALITY IMPROVEMENTS |                  |
|     |          |                                       |  |  |      | DESIGNED BY:<br>SBA |                                                                                                                                                                                                                                                                                                                                                                                        | TITLE       | DRAWING LEGEND AND PROJECT NOTES       |                  |
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                        | FILENAME    | 35832.000.002D                         |                  |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                        | DRAWING NO. | 002                                    | REVISION         |
| REV | DATE     | DESCRIPTION                           |  |  | TECH | ENG                 | NEWFIELDS                                                                                                                                                                                                                                                                                                                                                                              |             |                                        | B                |





SURVEY NOTES:

- THIS PROJECT, INCLUDING THE EXISTING AND PROPOSED CONDITIONS SHOWN IN THESE DRAWINGS, ARE BASED ON THE FOLLOWING COORDINATE SYSTEM, DATUMS, AND UNITS.  
  
COORDINATE SYSTEM: MONTANA STATE PLANE, STATEWIDE ZONE (2500)  
HORIZONTAL DATUM: NAD83 (2011)  
VERTICAL DATUM: NAVD88  
UNITS: INTERNATIONAL FEET
- EXISTING CONDITIONS SHOWN IN THE PLAN INCLUDING CONTOURS, UTILITIES, ROADWAYS, AND OTHER TOPOGRAPHIC DATA ARE BASED ON AN ONSITE SURVEY COMPLETED BY DJ&A DURING THE WEEK OF SEPTEMBER 2, 2024.
- PARCEL LINEWORK WAS DOWNLOADED FROM CITY OF MISSOULA GIS ON APRIL 4, 2024.
- THE STORM AND SANITARY SCHEDULE PROVIDED ON THE PLAN IS PROVIDED AS A REFERENCE CONTAINING INFRASTRUCTURE MOST CLOSELY RELATED TO AND IMPACTED BY THE PROJECT.



|     |          |                                       |  |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                     |                                                    |                            |
|-----|----------|---------------------------------------|--|--|------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|----------------------------|
|     |          |                                       |  |  |      | APPROVED BY:<br>MSP | DISCLAIMER<br><br>NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS. |   CLIENT CITY OF MISSOULA |                                                    |                            |
|     |          |                                       |  |  |      | CHECKED BY:<br>MSP  |                                                                                                                                                                                                                                                                                                                                                                                                          | PROJECT<br><br>TAKIMA PARK WATER QUALITY IMPROVEMENTS                                                                                                                                               |                                                    |                            |
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                                          | DESIGNED BY:<br>SBA                                                                                                                                                                                 | TITLE<br><br>EXISTING CONDITIONS & DEMOLITION PLAN | FILENAME<br>35832.000.003M |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                                          | DRAWN BY:<br>NEWFIELDS                                                                                                                                                                              |                                                    | DRAWING NO.<br>003         |
| REV | DATE     | DESCRIPTION                           |  |  | TECH | ENG                 |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                     |                                                    |                            |

TAKIMA PARK EXISTING STORM AND SANITARY SEWER PIPE SCHEDULE

| PIPE NAME                    | SIZE (INCHES) | TYPE  | LENGTH (LF) | U/S INVERT | D/S INVERT | REMOVAL BOUNDARY |           |
|------------------------------|---------------|-------|-------------|------------|------------|------------------|-----------|
|                              |               |       |             |            |            | NORTHING         | EASTING   |
| SANITARY SEWER               | 8             | CONC. | 160         | 3313.67    | 3312.49    | N/A              | N/A       |
| SOUTHWEST STORMDRAIN         | 24            | HDPE  | 225         | 3321.05    | 3307.63    | 975310.01        | 845568.68 |
| SOUTHWEST OUTFALL            | 30            | CONC. | 37          | 3307.39    | 3306.87    | ALL              | ALL       |
| NORTH OUTFALL                | 12            | CMP   | 51          | 3309.38    | 3307.13    | 975584.7         | 845628.47 |
| EAST OUTFALL                 | 18            | CPP   | 51          | 3317.84    | 3315.44    | N/A              | N/A       |
| SOUTHEAST OUTFALL (BURIED)   | 8             | CPP   | 21          | 3330.28    | 3322.83    | ALL              | ALL       |
| SOUTHEAST OUTFALL (AT GRADE) | 8             | CPP   | 16          | 3322.83    | 3314.57    | ALL              | ALL       |
| PATTEE CANYON CULVERT        | 60            | CONC. | 149         | 3303.51    | 3300.83    | N/A              | N/A       |

TAKIMA PARK EXISTING SEWER STRUCTURE SCHEDULE

| STRUCTURE NAME         | DIAM (FEET) | TYPE     | TYPE        | RIM ELEV. | BOTTOM ELEV. | NORTHING  | EASTING   |
|------------------------|-------------|----------|-------------|-----------|--------------|-----------|-----------|
| SW STORMWATER MANHOLE  | 5           | CONC.    | SW MANHOLE  | 3312.71   | ~ 3307       | 975479.03 | 845617.75 |
| NORTH ISOLATED DRYWELL | 4           | CONC.    | DRYWELL     | 3314.15   | 3309.57      | 975611.45 | 845641.47 |
| SOUTHEAST CATCH BASIN  | 5           | CONCRETE | CATCH BASIN | 3332.55   | ~3329        | 975267.00 | 845802.87 |

TAKIMA PARK TEST PITS

| NAME | TEST DATE | NORTHING  | EASTING   | SURFACE ELEV. | DEPTH (FEET) | BOTTOM ELEV. | GW OBS? | INFILTRATION (MIN/IN) |
|------|-----------|-----------|-----------|---------------|--------------|--------------|---------|-----------------------|
| TP1  | 9/25/2024 | 975503.20 | 845603.08 | 3315.41       | ~10          | ~3305        | NO      | 8.6                   |
| TP2  | 9/25/2024 | 975390.43 | 845627.67 | 3313.11       | ~10          | ~3303        | NO      | 6                     |

TAKIMA PARK SURVEY CONTROL

| SURVEY CONTROL         | DIAM (FEET) | NORTHING  | EASTING   | ELEVATION | DESCRIPTION                   |
|------------------------|-------------|-----------|-----------|-----------|-------------------------------|
| SURVEY CONTROL POINT 1 | CP-1        | 975289.07 | 845576.37 | 3324.58   | SET 1/2-INCH REBAR W/ RED CAP |
| SURVEY CONTROL POINT 2 | CP-2        | 975570.67 | 845681.29 | 3317.13   | SET MAG NAIL IN CONCRETE      |
| SURVEY CONTROL POINT 3 | CP-3        | 975311.68 | 845795.26 | 3331.36   | SET MAG NAIL IN CONCRETE      |

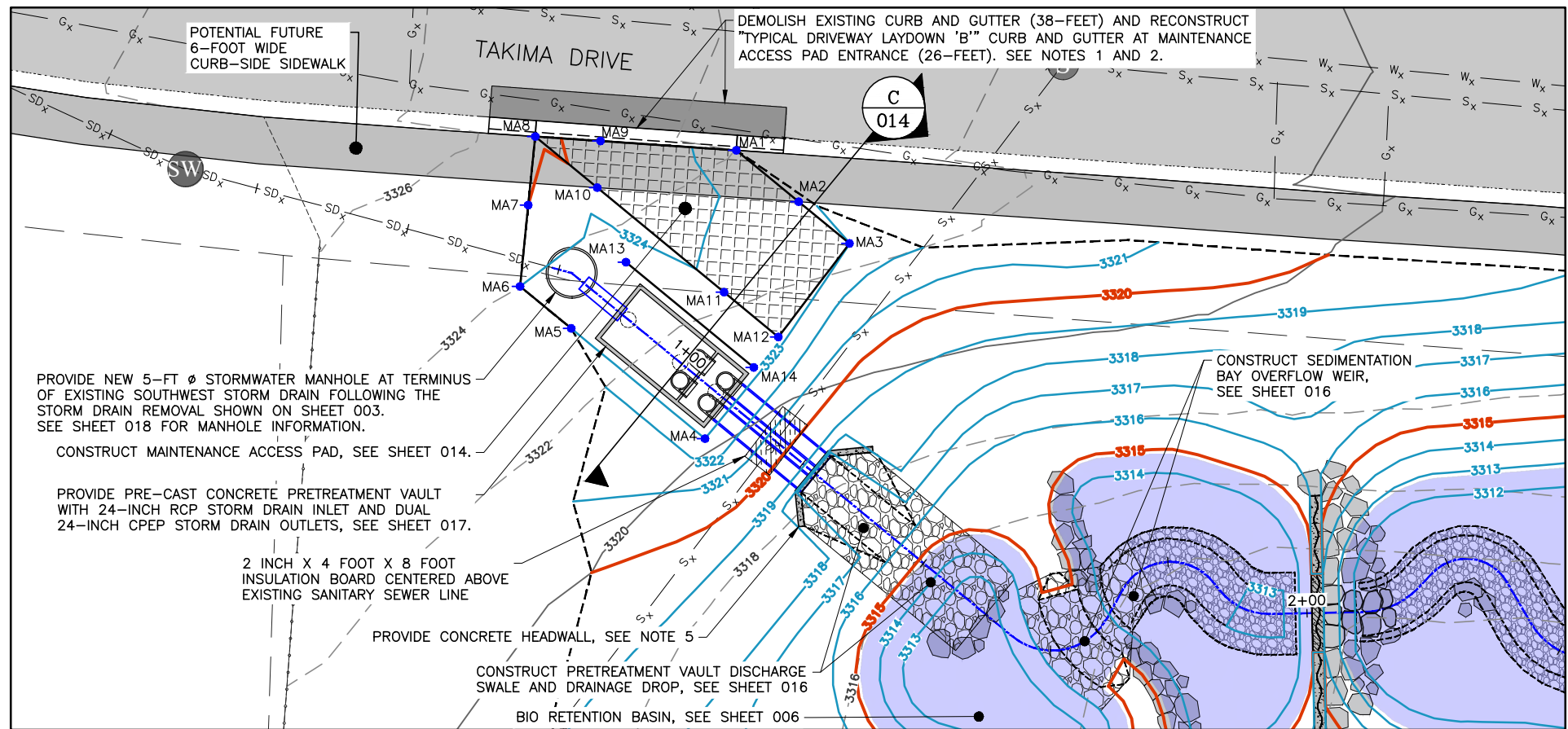
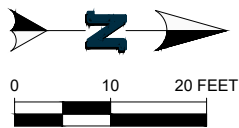
NOTES:

- DISPOSE OF ALL REMOVAL ITEMS, INCLUDING BUT NOT LIMITED TO EXISTING STORM DRAIN PIPES, STRUCTURES, UNSATISFACTORY OR EXCESS SOILS, FENCES, CLEARED AND GRUBBED TREES, CONCRETE, DEBRIS, AND OTHER RELATED ITEMS AT AN OFFSITE LOCATION IN ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE, AND FEDERAL RULES AND REGULATIONS.
- SAW CUT AND PROTECT STORM DRAIN LINES THAT WILL BE PARTIALLY REMOVED TO PROVIDE A CLEAN FACE FOR RE-CONNECTING TO THE NEW STORM DRAIN SYSTEM. PROTECT EXPOSED PIPE AND KEEP OUTLET FREE AND CLEAR OF DEBRIS, SOILS, AND OTHER POTENTIAL OBSTRUCTIONS THAT COULD INHIBIT STORMWATER FLOWS.
- ALL EXISTING SITE ELEMENTS AND FACILITIES MAY NOT BE SHOWN ON THESE DRAWINGS. CONTACTOR IS RESPONSIBLE TO VISIT THE SITE AND FAMILIARIZE THEMSELVES WITH EXISTING FACILITIES AND PLANS FOR ALL REQUIRED DEMOLITION.
- IMMEDIATELY REPORT ANY DAMAGE TO SURFACE IMPROVEMENTS, BURIED SYSTEMS, OR OTHER INFRASTRUCTURE "NOT IDENTIFIED FOR REMOVAL" TO ENGINEER. THE ENGINEER WILL DETERMINE REPAIR SCHEDULE AT CONTRACTORS EXPENSE.
- REMOVE TREES AND ROOT BALLS AS SHOWN ON THIS DRAWING. PROTECT ALL OTHER TREES IN PLACE. TREES DAMAGED DURING CONSTRUCTION THAT COULD HAVE REASONABLY BEEN AVOIDED SHALL BE REPLACED BY THE CONTRACTOR. NOTIFY THE CITY'S URBAN FORESTER BEFORE WORK TREE REMOVAL WORK BEGINS.
- THE NORTH STORM DRAIN OUTFALL OUTLET IS BURIED WITH ONLY THE CROWN OF THE OUTLET EXPOSED. THE REPORTED NORTH OUTFALL DOWNSTREAM INVERT IS BASED ON AN ASSUMED 12-INCH CMP CULVERT.
- THE SOUTHEAST CATCH BASIN APPEARS TO BE FULL OF SEDIMENT AND THE REPORTED BOTTOM ELEVATION IS ESTIMATED.
- THE NORTH DRYWELL APPEARS TO BE FULL OF SEDIMENT AND THE REPORTED BOTTOM ELEVATION IS LIKELY 2 - 3 FT HIGHER THAN THE ACTUAL STRUCTURE INVERT.

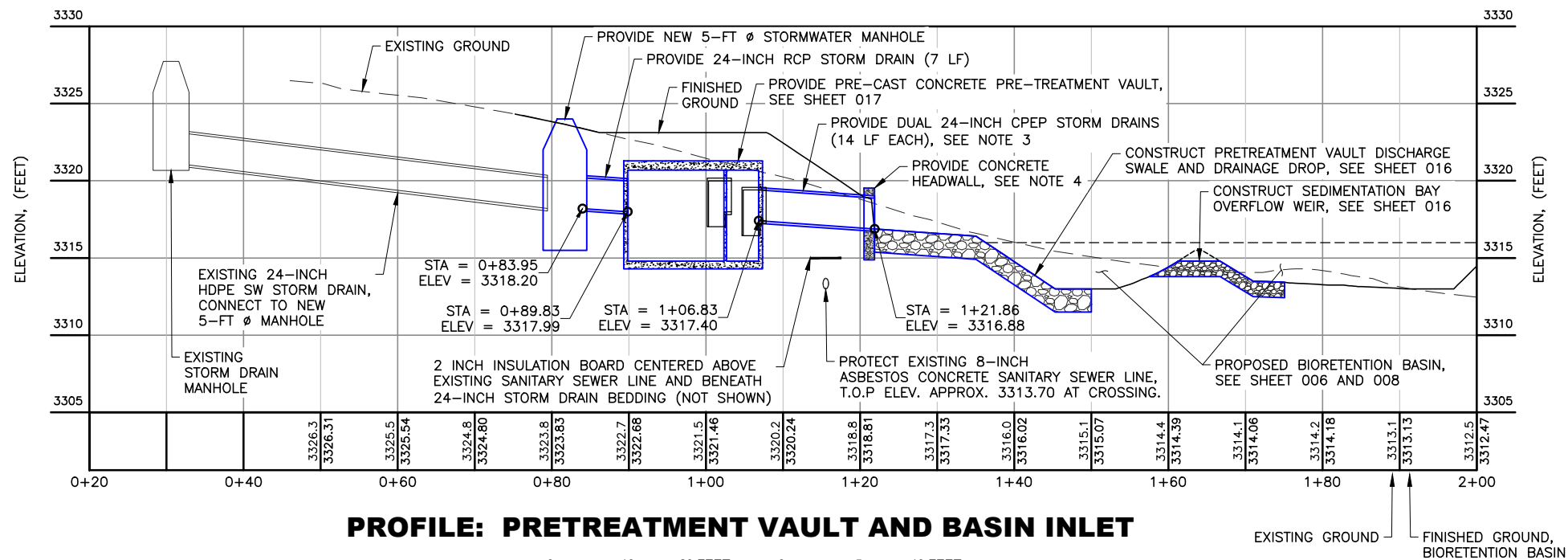








PLAN: PRETREATMENT VAULT AND BASIN INLET



PROFILE: PRETREATMENT VAULT AND BASIN INLET



NOTES:

1. DEMO EXISTING CURB AND GUTTER AND RECONSTRUCT "TYPICAL DRIVEWAY LAYDOWN 'B'" CURB AND GUTTER. TRANSITION TO EXISTING CURB AND GUTTER (TYPICAL L TYPE) BEYOND MAINTENANCE ACCESS PAD ENTRANCE, BOTH SIDES (MAX 10% SLOPE). SEE CITY OF MISSOULA STANDARD DRAWINGS STD-740 AND STD-741.
2. SAWCUT AND REMOVE ROADWAY ASPHALT 4- FEET BEYOND CURB AND GUTTER DEMOLITION LIMITS AND RECONSTRUCT ROADWAY ASPHALT SECTION IN KIND. SEE CITY OF MISSOULA STANDARD DRAWING STD-744 FOR ASPHALT CUTTING, REMOVAL, AND REPLACEMENT REQUIREMENTS. WHERE DISTURBED, RECONSTRUCT ROADWAY STRUCTURAL SECTION IN KIND AND IN ACCORDANCE WITH SPECIFICATION SECTION 02230.
3. THE PRETREATMENT VAULT, AS SHOWN ON SHEET 017, INCLUDES DUAL 24-INCH, 90-DEGREE CPEP ELBOW FITTINGS CAST INTO BOTH THE INTERNAL WALL AND THE DOWNSTREAM WALL. CONNECT THE SPIGOT END OF THE DUAL CPEP STORM DRAIN OUTLET PIPES TO THE BELLED END OF THE PRETREATMENT VAULT'S DOWNSTREAM WALL ELBOW FITTINGS.
4. CONNECT EXISTING RCP STORMDRAIN TO PROPOSED MANHOLE AND PRETREATMENT VAULT IN ACCORDANCE WITH CITY OF MISSOULA STANDARD DETAILS AND REQUIREMENTS. SEE ALSO SHEET 017, 018, AND 020.
5. PROVIDE CONCRETE HEADWALL WITH 45-DEGREE WINGWALLS AT OUTLET END OF THE DUAL CPEP STORM DRAINS CONNECTED TO THE DOWNSTREAM WALL OF THE PRETREATMENT VAULT. SEE MDT DETAILED DRAWING 613-12 FOR GENERAL INFORMATION.

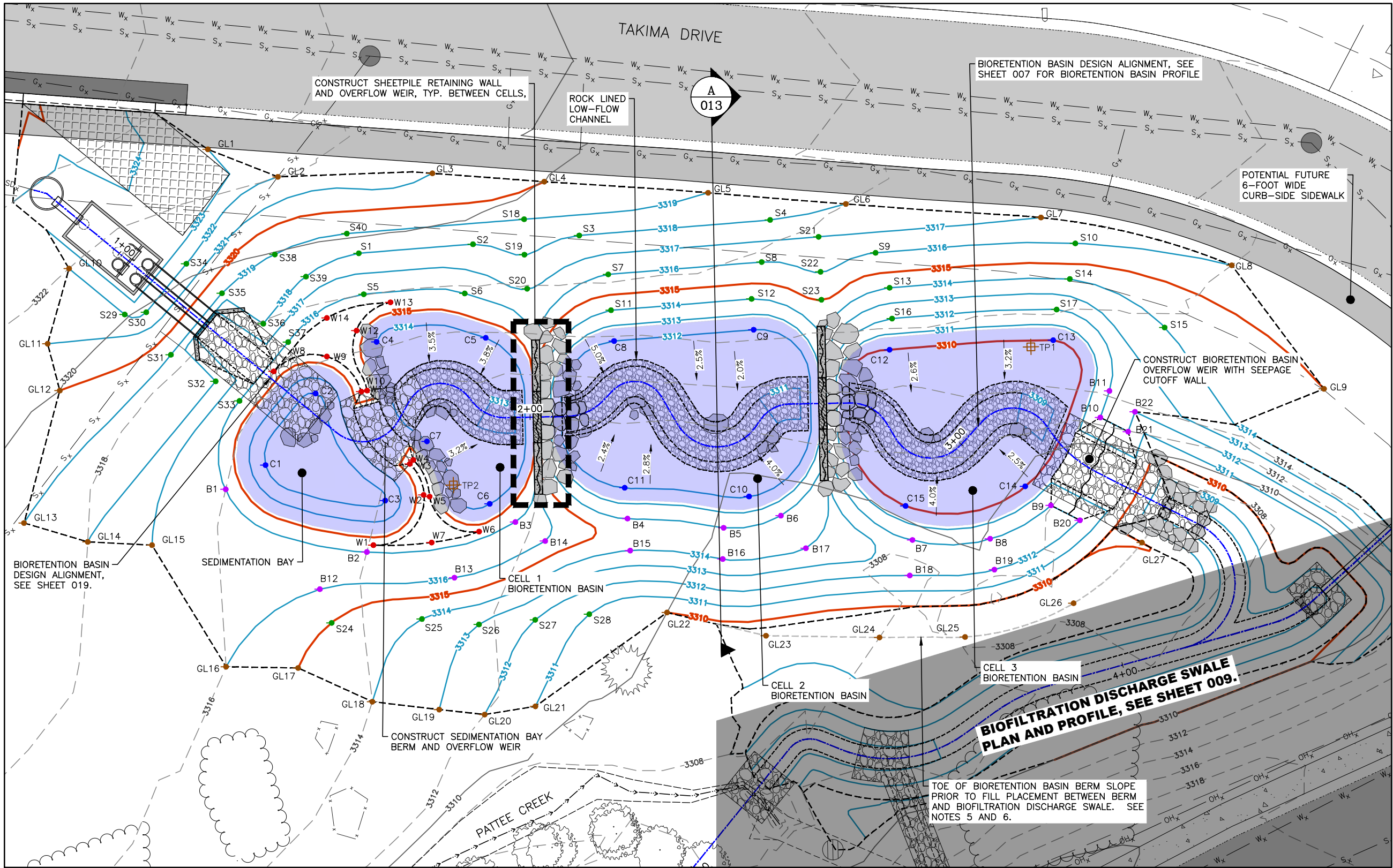
MAINTENANCE ACCESS PAD STAKEOUT POINTS

| POINT NUMBER | NORTHING   | EASTING    | ELEVATION |
|--------------|------------|------------|-----------|
| MA1          | 975333.852 | 845554.134 | 3323.66   |
| MA2          | 975341.691 | 845560.871 | 3323.47   |
| MA3          | 975348.075 | 845566.347 | 3323.00   |
| MA4          | 975329.111 | 845590.935 | 3323.00   |
| MA5          | 975312.295 | 845576.498 | 3323.00   |
| MA6          | 975305.874 | 845570.986 | 3324.00   |
| MA7          | 975307.129 | 845560.594 | 3325.00   |
| MA8          | 975308.200 | 845551.856 | 3325.20   |
| MA9          | 975316.517 | 845552.595 | 3324.70   |
| MA10         | 975315.987 | 845558.559 | 3324.82   |
| MA11         | 975331.921 | 845572.246 | 3323.77   |
| MA12         | 975338.747 | 845578.109 | 3323.32   |
| MA13         | 975319.460 | 845568.152 | 3323.25   |
| MA14         | 975335.518 | 845581.938 | 3323.25   |

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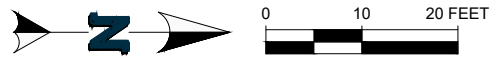
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|--------------------------------------------------|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------|--|----------------------------------------|--|
| APPROVED BY: MSP                                 |  | DISCLAIMER                                                                                                                                                                                                                                                                                                                                                                             |  | NewFields   |  | CLIENT CITY OF MISSOULA                |  |
| CHECKED BY: MSP                                  |  | NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS. |  | PROJECT     |  | TAKIMA PARK WATER QUALITY IMPROVEMENTS |  |
| DESIGNED BY: SBA                                 |  | DRAWN BY: NEWFIELDS                                                                                                                                                                                                                                                                                                                                                                    |  | TITLE       |  | PRETREATMENT VAULT PLAN AND PROFILE    |  |
| B 3/5/25 90 PERCENT DESIGN - ISSUED FOR REVIEW   |  | SBA MSP                                                                                                                                                                                                                                                                                                                                                                                |  | FILENAME    |  | 35832.000.005P                         |  |
| A 11/22/24 60 PERCENT DESIGN - ISSUED FOR REVIEW |  | SBA MSP                                                                                                                                                                                                                                                                                                                                                                                |  | DRAWING NO. |  | 005                                    |  |
| REV DATE DESCRIPTION                             |  | TECH ENG                                                                                                                                                                                                                                                                                                                                                                               |  | REVISION    |  | B                                      |  |





- NOTES:
- SEE SHEET 007 FOR BIORETENTION BASIN STAKEOUT TABLES.
  - SEE SHEET 005 FOR MAINTENANCE ACCESS PAD STAKEOUT TABLE.
  - SEE SHEET 009 FOR BIOFILTRATION DISCHARGE SWALE STAKEOUT TABLE.
  - SEE SHEETS 022 - 029 FOR LANDSCAPE PLANS.
  - STRIP AND STOCKPILE TOPSOIL WITHIN THE GRADING LIMITS PRIOR TO EXCAVATION, FILL, AND OTHER CONSTRUCTION ACTIVITIES EXCEPT FOR BENEATH THE BIORETENTION BASIN BERM.
- GRADING LIMITS FOR THE BIORETENTION BASIN ARE BOUND BY THE "GL#" POINTS SHOWN IN THE PLAN.
- THE BASIN BERM FOOTPRINT, WHERE EXISTING VEGETATION SHOULD BE LEFT IN PLACE AS SHOWN IN THE BERM TYPICAL SECTION ON SHEET 013, IS BOUND BY THE FOLLOWING POINTS:
- C3
  - C6
  - C11
  - C10
  - C15
  - C14
  - S24
  - S25
  - S26
  - S27
  - S28
  - GL22
  - GL23
  - GL24
  - GL25
  - GL26
  - GL27
- STAKEOUT POINTS GL23 - GL27 REPRESENT THE TOE OF THE BERM SLOPE WHERE IT TIES INTO THE EXISTING GROUND. THESE POINTS ARE NOT FINISHED GRADE POINTS AS THEY WILL BE BURIED BY FILL PLACED AGAINST AND BETWEEN THE BASIN BERM SLOPE AND THE BIOFILTRATION DISCHARGE SWALE AS DEPICTED ON SHEETS 009 AND 014.

PLAN: BIORETENTION BASIN



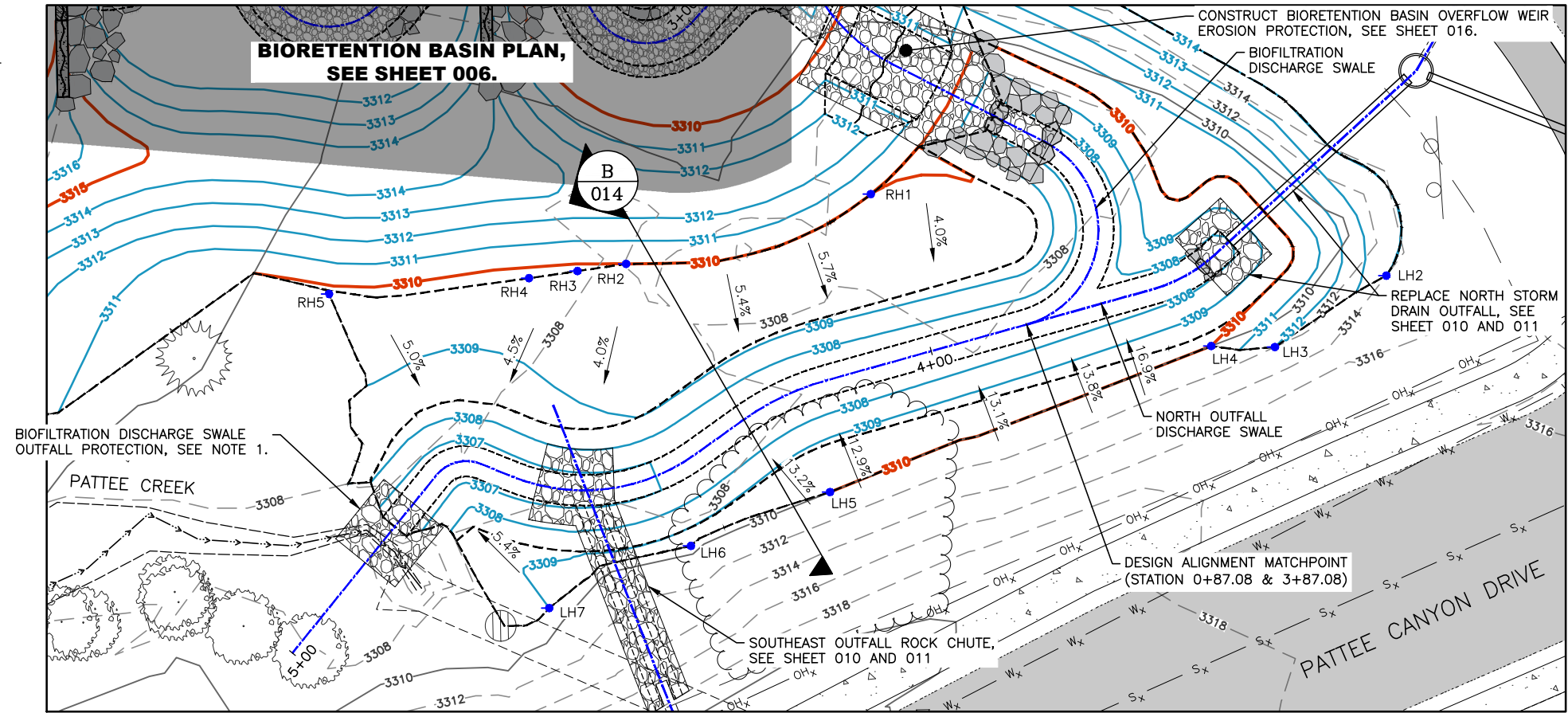
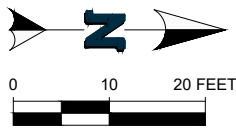
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| ##                                   | ##       | ##                                    | ## | ## | ##   | DESIGNED BY:<br>SBA |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                        |   |
| B                                    | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW |    |    | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                        |   |
| A                                    | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |    |    | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                        |   |
| REV                                  | DATE     | DESCRIPTION                           |    |    | TECH | ENG                 | DRAWN BY:<br>NEWFIELDS                                                                                                                                                                                                                                                                                                                                                                                   | PROJECT<br><br>TAKIMA PARK WATER QUALITY IMPROVEMENTS                                                                                                                                                  |   |
| TITLE<br><br>BIORETENTION BASIN PLAN |          |                                       |    |    |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                          | 35832.000.006M                                                                                                                                                                                         |   |
|                                      |          |                                       |    |    |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                          | 006                                                                                                                                                                                                    | B |







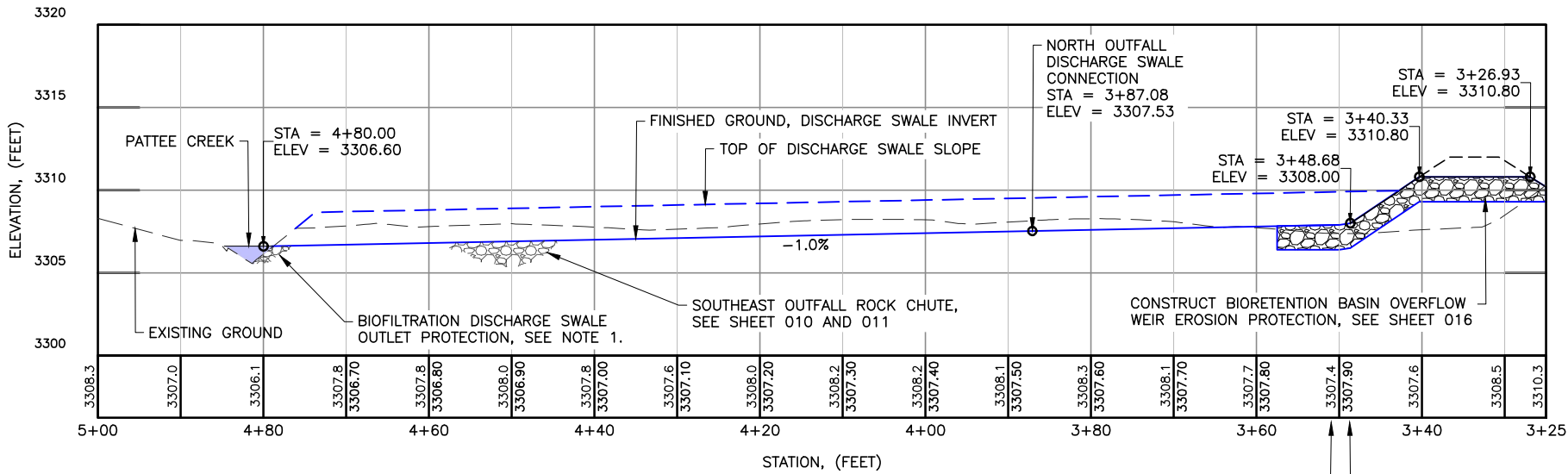


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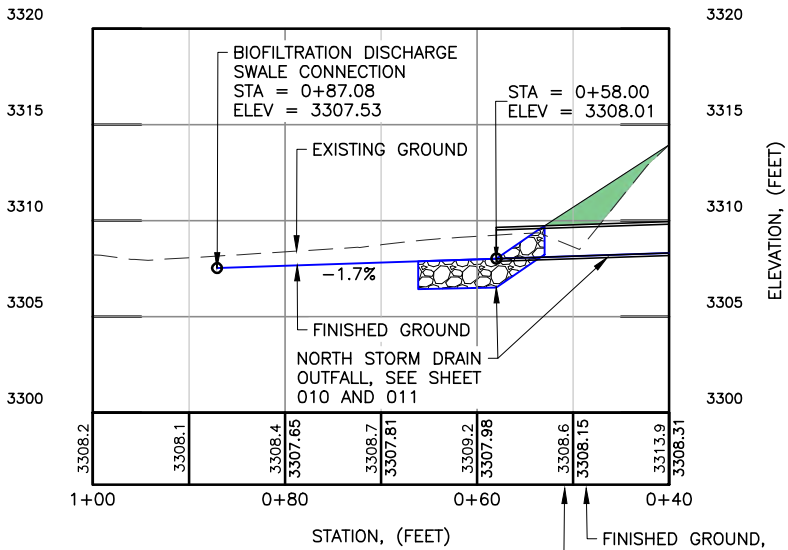
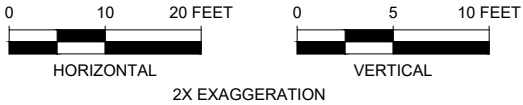
- BIOFILTRATION DISCHARGE SWALE OUTLET PROTECTION TO PATTEE CREEK TO BE CONSTRUCTED WITH EXISTING RIPRAP FROM NORTH BANK OF PATTEE CREEK. REMOVE EXISTING RIPRAP TO FACILITATE BIOFILTRATION SWALE GRADING AND RESET RIPRAP ALONG NORTH BANK OF PATTEE CREEK BENEATH BIOFILTRATION SWALE OUTLET.
- CONDUCT ALL IN-STREAM WORK, INCLUDING INSTALLATION OF BIOFILTRATION SWALE OUTFALL PROTECTION, BETWEEN JULY 1 AND NOVEMBER 1.
- TIE-IN POINT LH1 NOT SHOWN.
- REFER TO THE LANDSCAPE PLANS (SHEETS 022 - 029) FOR SEEDING AND PLANTING REQUIREMENTS.

| DISCHARGE SWALE TIE IN POINTS |            |            |           |
|-------------------------------|------------|------------|-----------|
| POINT NUMBER                  | NORTHING   | EASTING    | ELEVATION |
| LH1                           | 975542.477 | 845618.985 | 3314.00   |
| LH2                           | 975579.482 | 845656.612 | 3314.00   |
| LH3                           | 975564.736 | 845665.657 | 3312.00   |
| LH4                           | 975556.412 | 845665.368 | 3310.00   |
| LH5                           | 975506.200 | 845683.449 | 3310.00   |
| LH6                           | 975487.862 | 845690.131 | 3309.50   |
| LH7                           | 975469.165 | 845697.877 | 3309.00   |
| RH1                           | 975512.305 | 845644.602 | 3310.00   |
| RH2                           | 975480.115 | 845653.091 | 3310.00   |
| RH3                           | 975473.732 | 845653.899 | 3309.75   |
| RH4                           | 975467.389 | 845654.703 | 3309.50   |
| RH5                           | 975441.204 | 845656.236 | 3309.50   |

PLAN: BIOFILTRATION DISCHARGE SWALE



PROFILE: BIOFILTRATION DISCHARGE SWALE



PROFILE: NORTH OUTFALL DISCHARGE SWALE

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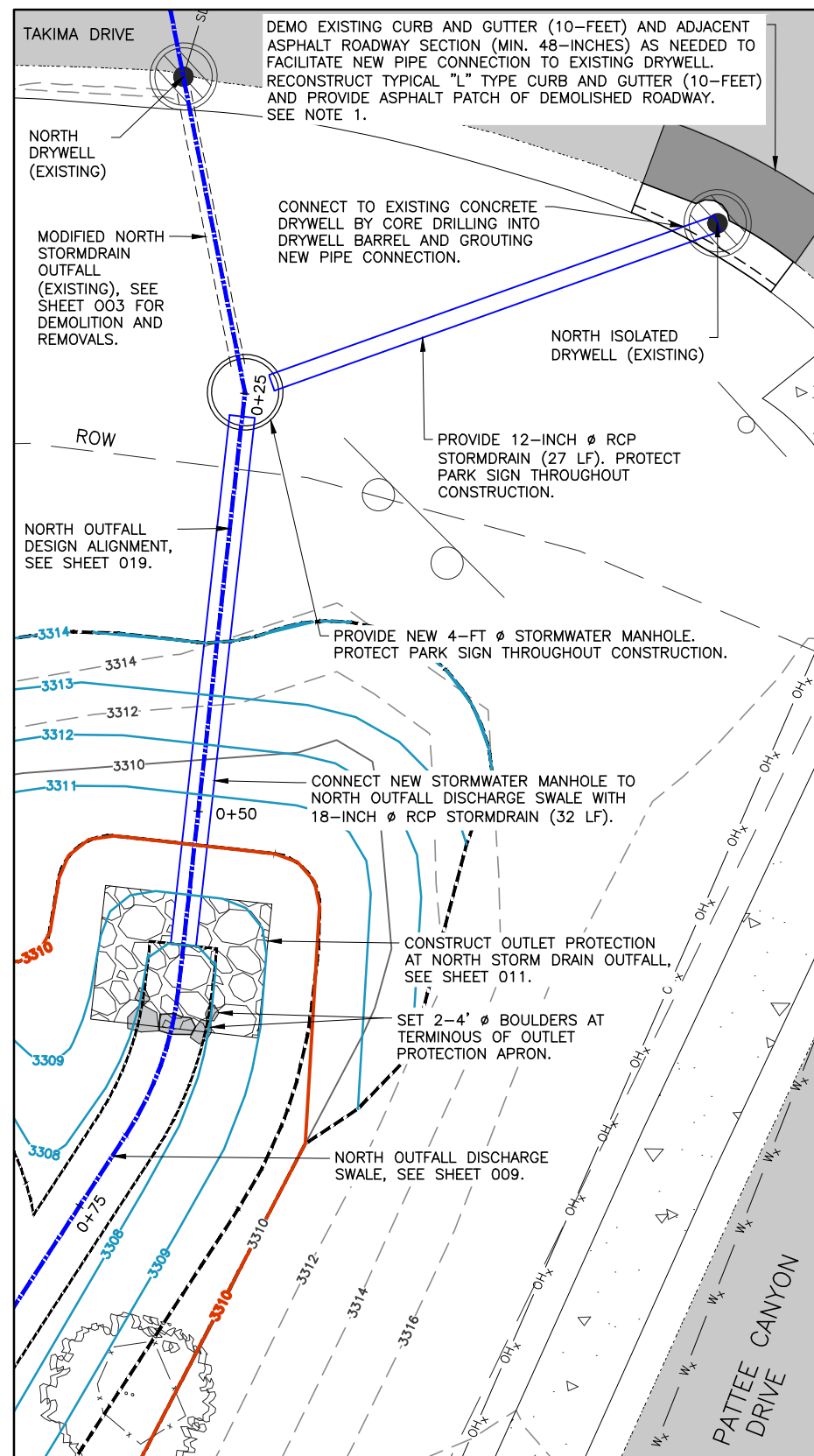
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| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP |    |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP |    |
| REV | DATE     | DESCRIPTION                           | TECH | ENG |    |

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| CHECKED BY:  | MSP |
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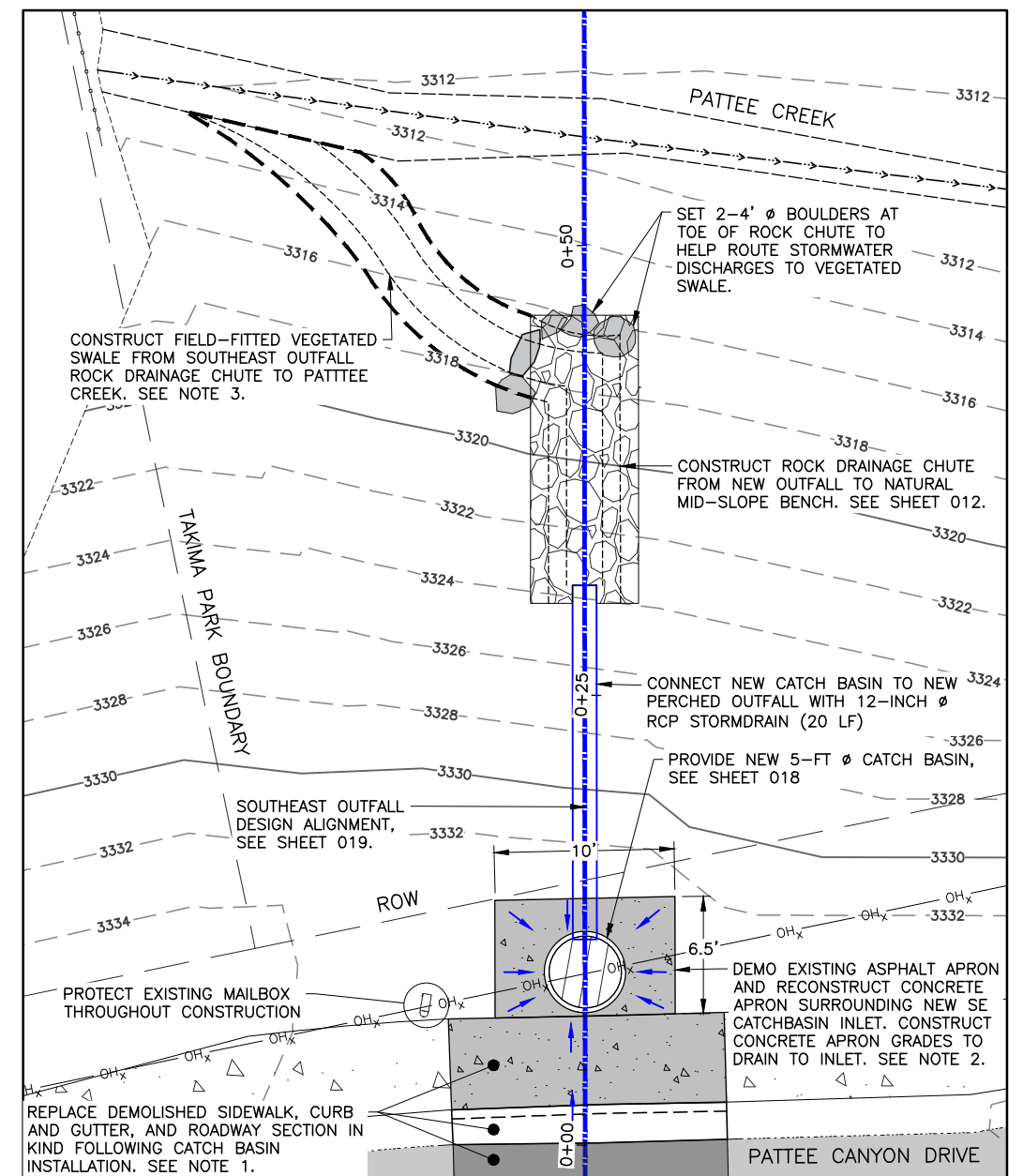
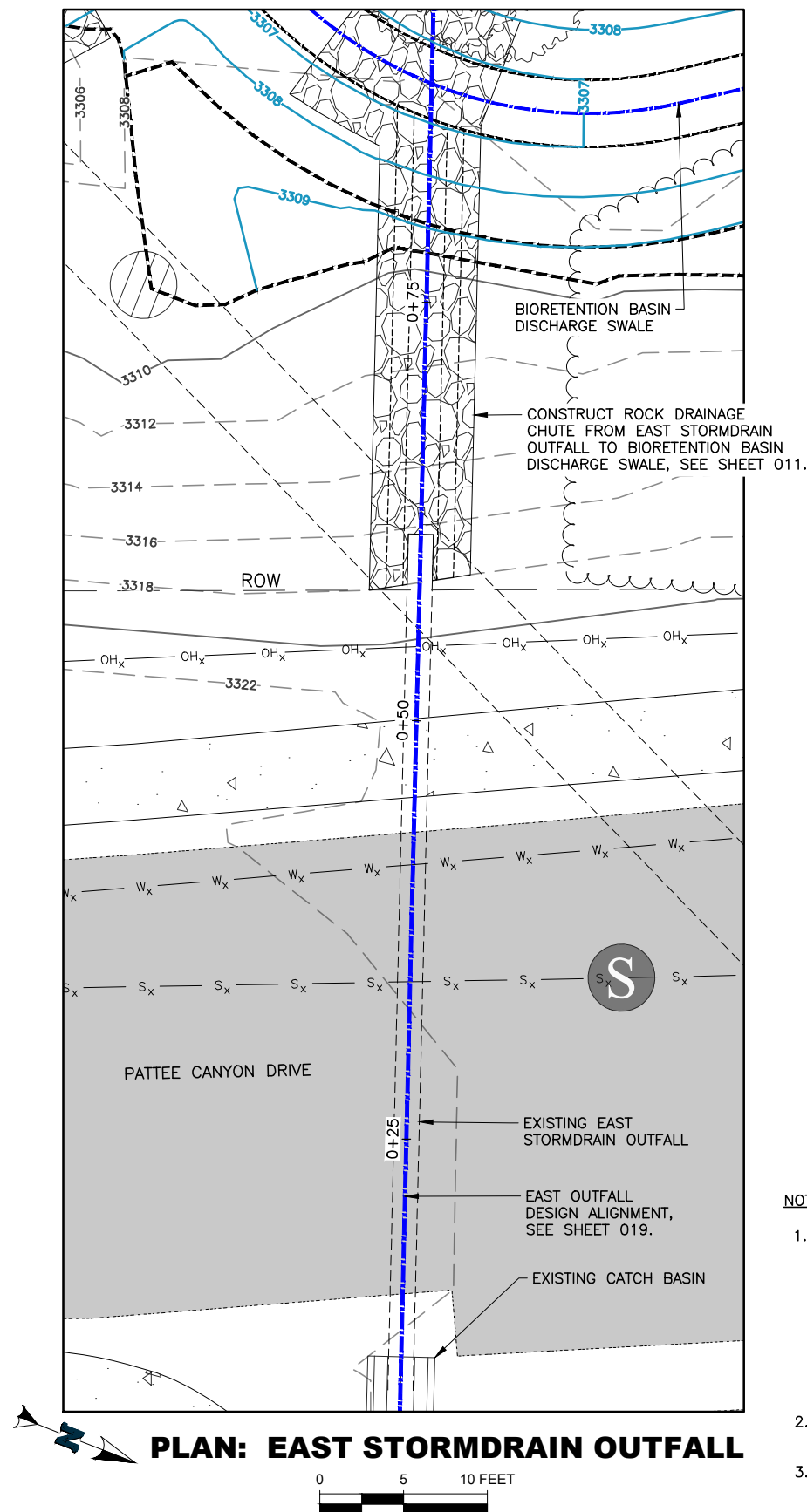
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| <b>NewFields</b>                                  |  | CLIENT<br>CITY OF MISSOULA |               |
| PROJECT<br>TAKIMA PARK WATER QUALITY IMPROVEMENTS |  | FILENAME<br>35832.000.009P |               |
| TITLE<br>DISCHARGE SWALE PLAN AND PROFILE         |  | DRAWING NO.<br>009         | REVISION<br>B |





NOTES:

1. SEE CITY OF MISSOULA STANDARD DRAWING STD-740 FOR TYPICAL "L" TYPE CURB AND GUTTER SECTION. SEE CITY OF MISSOULA STANDARD DRAWING STD-744 FOR ASPHALT CUTTING, REMOVAL, AND REPLACEMENT REQUIREMENTS. WHERE DISTURBED, RECONSTRUCT ROADWAY STRUCTURAL SECTION IN KIND AND IN ACCORDANCE WITH SPECIFICATION SECTION 02230.



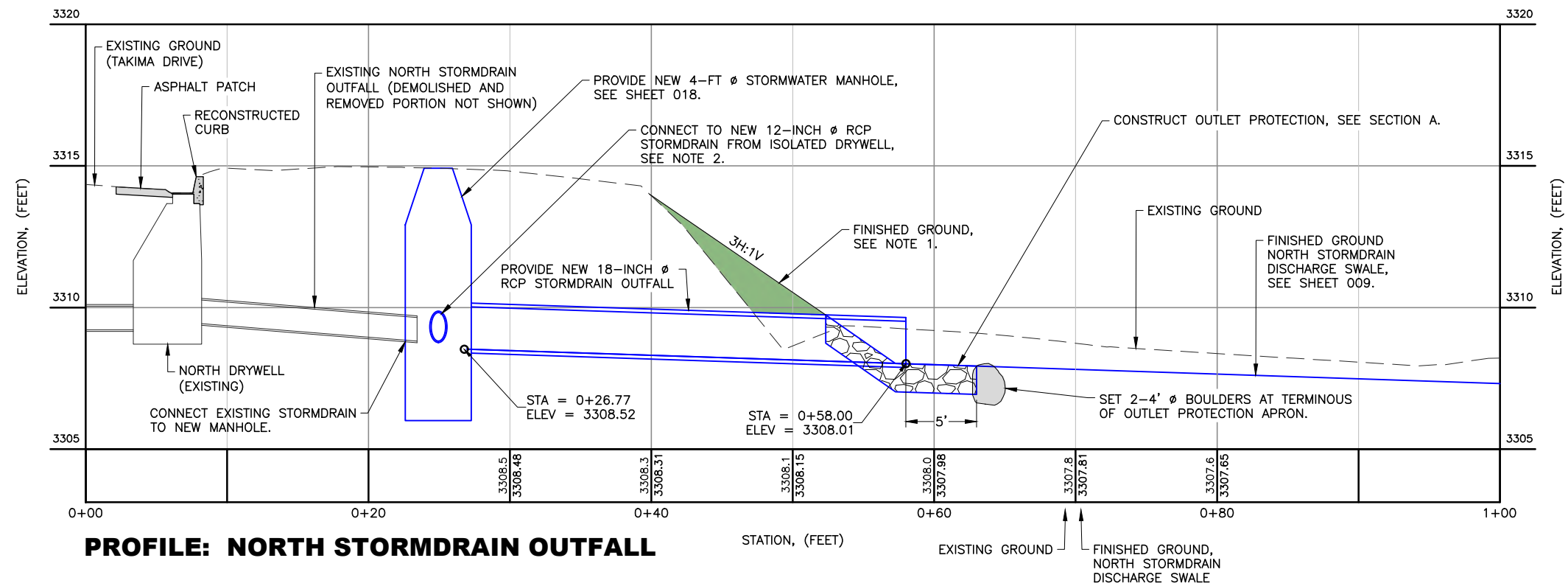
NOTES:

1. SEE CITY OF MISSOULA STANDARD DRAWING STD-740 FOR "L" TYPE CURB AND GUTTER SECTION. SEE CITY OF MISSOULA STD-741 FOR DRIVEWAY LAYDOWN "B" AND CURB RAMP LAYDOWN "C" TYPE CURB AND GUTTERS. SEE CITY OF MISSOULA STANDARD DRAWING STD-744 FOR ASPHALT CUTTING, REMOVAL, AND REPLACEMENT REQUIREMENTS. WHERE DISTURBED, RECONSTRUCT ROADWAY STRUCTURAL SECTION IN KIND AND IN ACCORDANCE WITH SPECIFICATION SECTION 02230. SEE CITY OF MISSOULA STANDARD DRAWING STD-752 FOR TYPICAL SIDEWALK SECTION. CONSTRUCT CURB AND GUTTER AND SIDEWALK GRADES TO ROUTE STORMWATER FLOWS FROM CURB AND GUTTER FLOWLINE, ACROSS SIDEWALK, TO CATCH BASIN INLET.
2. REFER TO CITY OF MISSOULA STANDARD DRAWING STD-752 FOR APRON CONCRETE THICKNESS AND SUBGRADE REQUIREMENTS.
3. FIELD FIT VEGETATED SWALE FROM SOUTHEAST STORMDRAIN OUTFALL ROCK CHUTE TO PATTEE CREEK ALONG EXISTING MID-SLOPE BENCH. SEE SHEET 012 FOR TYPICAL SECTION. COORDINATE PLACEMENT OF VEGETATED SWALE WITH ENGINEER PRIOR TO CONSTRUCTION.

**DRAFT**

|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |
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| ##  | ##       | ##                                    | ##   | ##  | ##        | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |
| ##  | ##       | ##                                    | ##   | ##  | ##        | DESIGNED BY: |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |
| B   | 3/6/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP | SBA       | SBA          | TITLE                                                                                                                                                                                                                                                                                                                                                                                                    | MINOR OUTFALL TREATMENT PLANS                                                                                                                                                                                     |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP | SBA       | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |
| REV | DATE     | DESCRIPTION                           | TECH | ENG | NEWFIELDS | DRAWN BY:    |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                   |
|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          | MINOR OUTFALL TREATMENT PLANS                                                                                                                                                                                     |
|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          | FILENAME<br>35832.000.010M                                                                                                                                                                                        |
|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          | DRAWING NO.<br>010                                                                                                                                                                                                |
|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          | REVISION<br>B                                                                                                                                                                                                     |

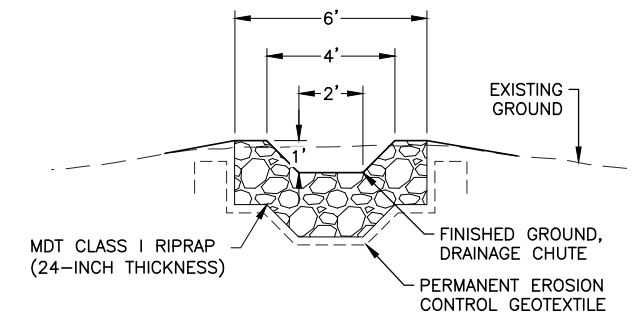
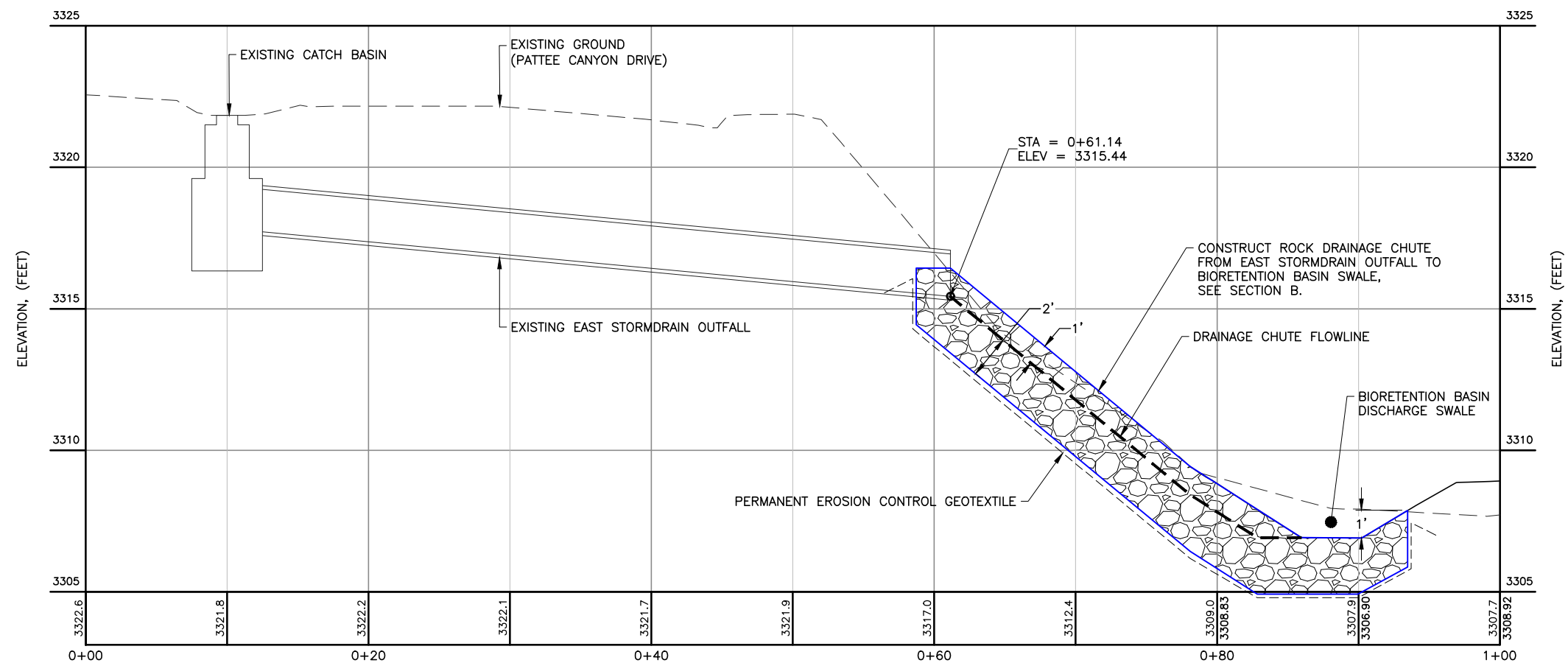
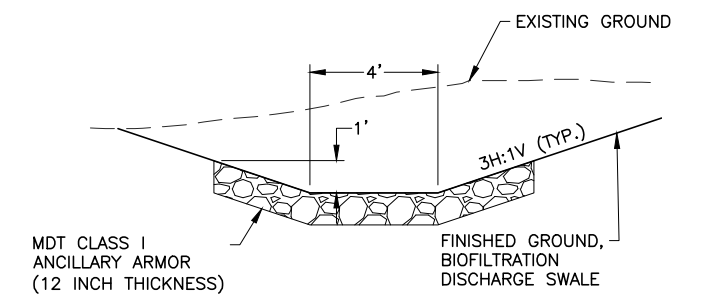




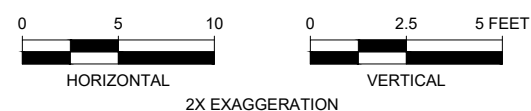
1. USE EXCESS SOILS GENERATED FROM BIORETENTION BASIN OR BIOFILTRATION SWALE EXCAVATION TO REBUILD THE SLOPE ABOVE AND ADJACENT TO THE NORTH STORM DRAIN OUTFALL. PROVIDE MAXIMUM 3H:1V SLOPE. SEE SHEET 009 FOR ADDITIONAL INFORMATION.
2. INLET AND OUTLET ELEVATIONS OF NEW STORMDRAIN CONNECTING OFFLINE DRYWELL TO NEW STORMWATER MANHOLE (NOT SHOWN IN PROFILE) AS FOLLOWS.

INLET INVERT ELEVATION: 3310.00 (MIN. 3309.45)  
OUTLET INVERT ELEVATION: 3308.85

3. ANCHOR PERMANENT EROSION CONTROL GEOTEXTILE AT EDGES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.



**DRAFT**



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| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW |    |    | SBA MSP  | DESIGNED BY<br>SB     |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |    |    | SBA MSP  |                       |
| REV | DATE     | DESCRIPTION                           |    |    | TECH ENG | DRAWN BY:<br>NEWFIELD |

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CITY OF MISSOULA

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TAKIMA PARK WATER QUALITY IMPROVEMENTS

|      |       |
|------|-------|
| WORK |       |
| DATE | TITLE |

### MINOR OUTFALL TREATMENT PROFILES

FILENAME

35832.000.011P

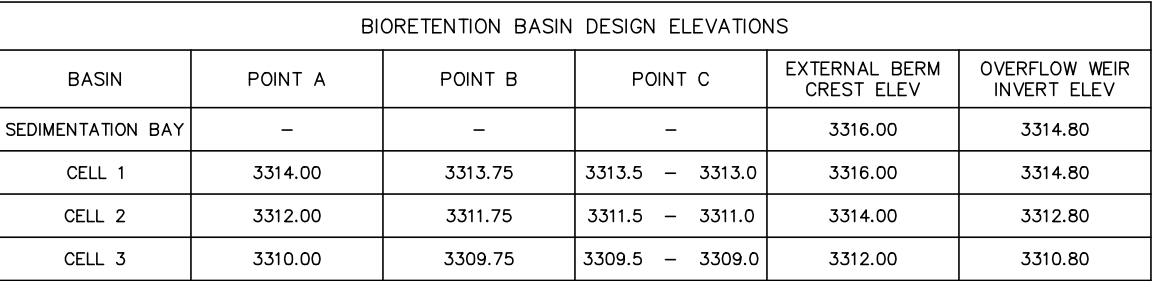
DRAWING NO.

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B





NOTES:

1. THE LOW FLOW CHANNEL INVERT ELEVATION IS REPRESENTED BY POINT C IN THE BIORETENTION BASIN TYPICAL SECTION AND TABLE. LOW FLOW INVERT ELEVATION VARIES AS CHANNEL PASSES THROUGH EACH CELL. SEE SHEET 008 FOR THE BIORETENTION BASIN LOW FLOW CHANNEL PROFILE.
2. THE SEDIMENTATION BAY OVERFLOW WEIR IS AN EARTHEN BERM BROAD-CRESTED WEIR SHOWN IN THE PLAN ON SHEET 006 AND IN THE PROFILE ON SHEET 008. THE CELL 3 OVERFLOW WEIR IS ALSO AN EARTHEN BERM BROAD-BROADCRESTED WEIR SHOWN IN PLAN AND PROFILE ON SHEET 009. THE CELL 1 AND CELL 2 OVERFLOW WEIR'S ARE SHARP-CRESTED WEIRS (SHEETPILE WITH TOP CAP) SHOWN ON SHEET 015.
3. CONSTRUCT BASIN AND BERM IN ACCORDANCE WITH THE FOLLOWING SUBGRADE PREPARATION AND CONSTRUCTION REQUIREMENTS.

BIORETENTION BASIN – CUT SECTION:

CONSTRUCT PORTIONS OF THE BIORETENTION BASIN WITHIN CUT SECTIONS BY STRIPPING AND STOCKPILING TOPSOIL, EXCAVATING (WITHOUT COMPACTION), AND PLACING TOPSOIL TO THE FINISHED LINES AND GRADES.

BIORETENTION BASIN – FILL SECTION:

CONSTRUCT PORTIONS OF THE BIORETENTION BASIN WITHIN FILL SECTIONS, NOT INCLUDING THE EXTERNAL BERM, BY STRIPPING AND STOCKPILING TOPSOIL, PLACING AND TRACK-WALKING SUITABLE MATERIAL GENERATED FROM BASIN EXCAVATION INTO THE FILL SECTIONS IN 8-INCH LOOSE LIFTS, AND PLACING TOPSOIL TO THE FINISHED LINES AND GRADES.

BIORETENTION BASIN EXTERNAL BERM:

CONSTRUCT THE EXTERNAL BERM BY CLEARING AND GRUBBING ALL VEGETATION WITHIN IT'S FOOTPRINT THAT HAS A 1/2-INCH DIAMETER OR GREATER TRUNK (LEAVE GRASSES AND TOPSOIL IN PLACE), COMPACTING THE EXISTING VEGETATED SURFACE WITHIN THE BERM FOOTPRINT WITH A SHEEPSFOOT ROLLER, PLACING SUITABLE MATERIAL GENERATED FROM BASIN EXCAVATION IN 8-INCH THICK LOOSE LIFTS, COMPACTING EACH LIFT TO A STANDARD RELATIVE COMPACTION (ASTM D698) OF AT LEAST 98 PERCENT, AND PLACING TOPSOIL TO THE FINISHED LINES AND GRADES. SEE SHEETS 006 AND 007 FOR STAKEOUT POINTS DEFINING THE BIORETENTION BASIN EXTERNAL BERM FOOTPRINT.

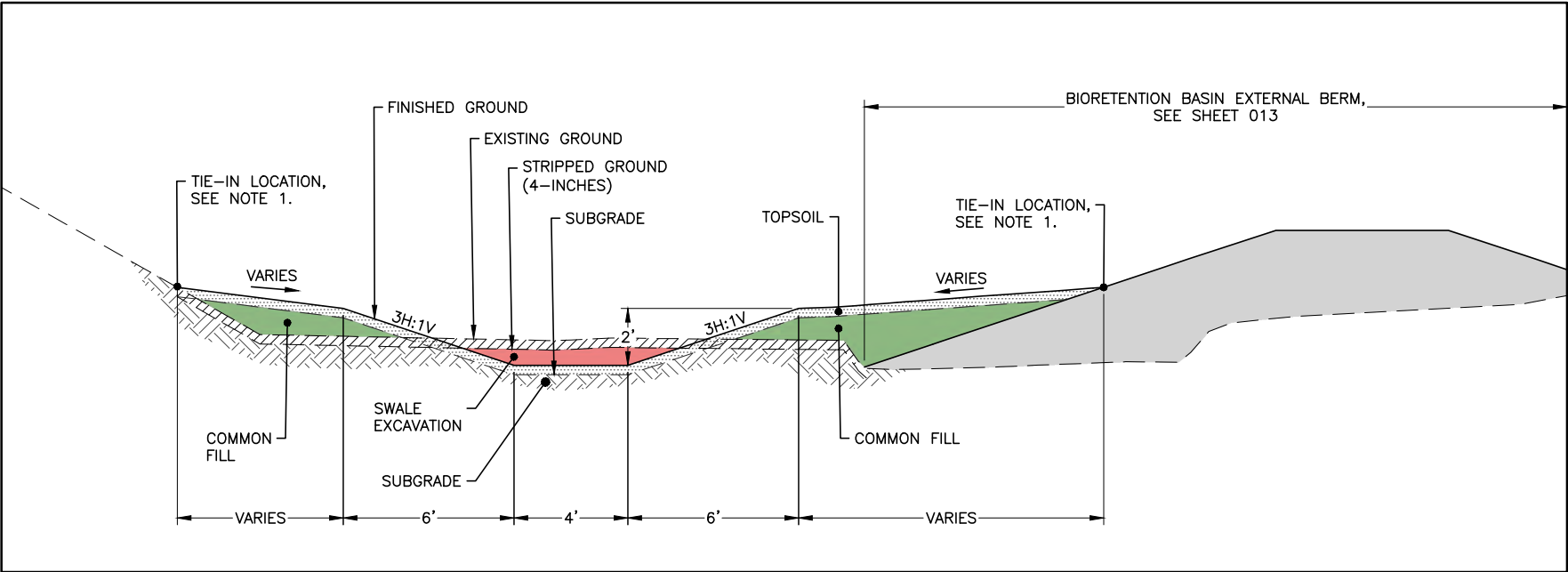
4. SEE LANDSCAPE PLANS (SHEETS 022 - 029) FOR SEEDING AND PLANTING REQUIREMENTS.

**DRAFT**

|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                       |                                        |  |
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| ##  | ##       | ##                                    | ##   | ##  | ##        | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                                         | PROJECT                                                                                                                                               | TAKIMA PARK WATER QUALITY IMPROVEMENTS |  |
| ##  | ##       | ##                                    | ##   | ##  | ##        | CHECKED BY:  |                                                                                                                                                                                                                                                                                                                                                                                                                         | TITLE                                                                                                                                                 | BIORETENTION BASIN TYPICAL SECTION     |  |
| ##  | ##       | ##                                    | ##   | ##  | ##        | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                                         | FILENAME                                                                                                                                              | 35632.000.013D                         |  |
| ##  | ##       | ##                                    | ##   | ##  | ##        | DESIGNED BY: |                                                                                                                                                                                                                                                                                                                                                                                                                         | DRAWING NO.                                                                                                                                           | 013                                    |  |
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP | SBA       | MSP          | REVISION                                                                                                                                                                                                                                                                                                                                                                                                                | B                                                                                                                                                     |                                        |  |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP | SBA       | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                       |                                        |  |
| REV | DATE     | DESCRIPTION                           | TECH | ENG | NEWFIELDS |              |                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                       |                                        |  |

BIOFILTRATION DISCHARGE SWALE NOTES:

1. SEE SHEET 009 FOR BIOFILTRATION DISCHARGE SWALE PLAN, PROFILE, AND TIE-IN LOCATION AND ELEVATION INFORMATION.
2. COMMON FILL USED TO ACHIEVE THE GRADES SHOWN IN THE PLANS SHOULD BE ONSITE SOILS GENERATED FROM SWALE EXCAVATION OR OTHER EXCAVATIONS ASSOCIATED WITH CONSTRUCTION OF THE BIORETENTION BASIN AND IT'S ASSOCIATED FACILITIES FOLLOWING STRIPPING AND STOCKPILING OF TOPSOIL.
3. TOPSOIL AND SEED BIOFILTRATION DISCHARGE SWALE IN ACCORDANCE WITH THE LANDSCAPE PLANS ON SHEETS 022 - 029.

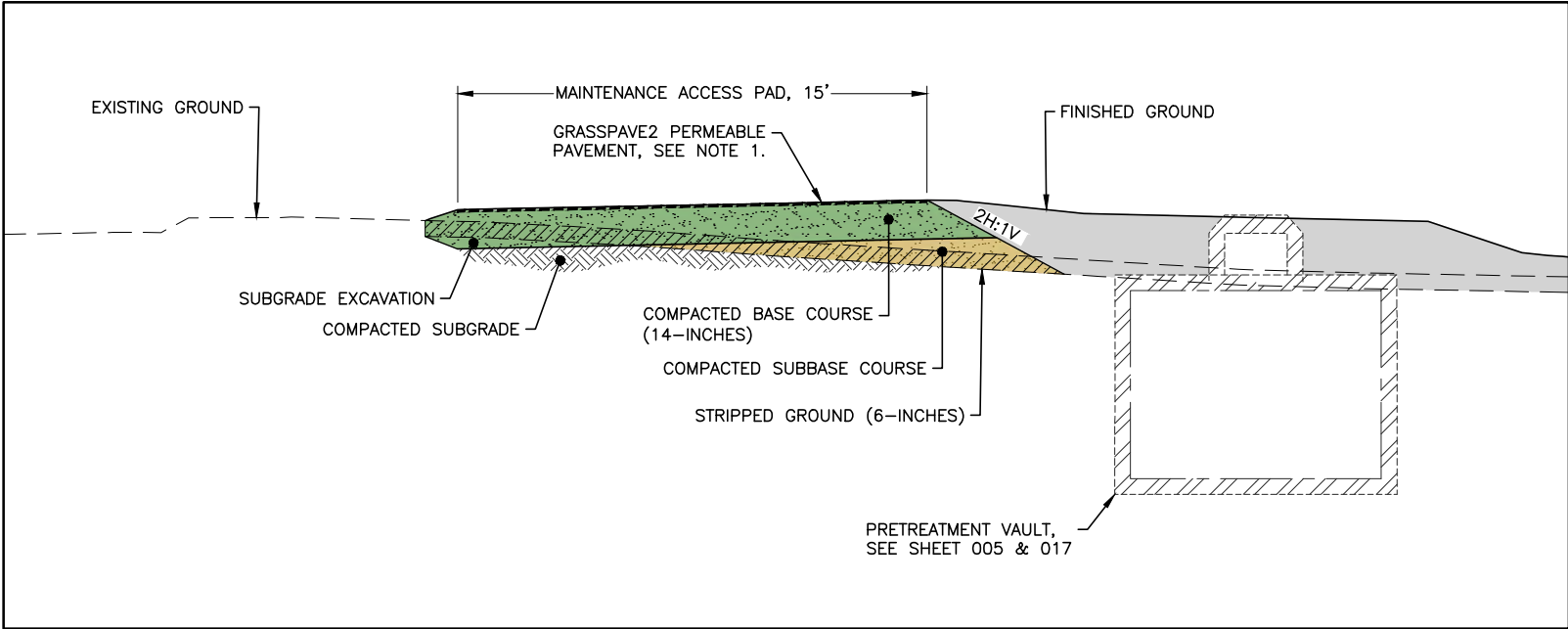


**B** BIOFILTRATION DISCHARGE SWALE TYPICAL SECTION  
009



MAINTENANCE ACCESS PAD NOTES:

1. INSTALL GRASSPAVE2 PERMEABLE PAVEMENT IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS. GENERAL INSTALLATION PROCEDURE INCLUDES:
  - STRIP TOPSOIL
  - WHERE NEEDED TO ACHIEVE THE REQUIRED BASE COURSE THICKNESS (IN CUT SECTIONS), COMPLETE SUBGRADE EXCAVATION TO EXPOSE BOTTOM OF BASE COURSE LEVEL
  - COMPACT STRIPPED OR EXCAVATED SUBGRADE
  - WHERE NEEDED TO ACHIEVE THE PROPER BASE COURSE GRADE (IN FILL SECTIONS), PLACE AND COMPACT SUBBASE COURSE MATERIAL TO THE BOTTOM OF BASE COURSE LEVEL
  - PLACE AND COMPACT BASE COURSE MATERIAL (ENTIRE MAINTENANCE ACCESS PAD)
  - SPREAD MANUFACTURER'S GROWTH SUPPLEMENT ACROSS ENTIRE MAINTENANCE ACCESS PAD AREA (HYDROGROW MIX)
  - PLACE GRASSPAVE2 GRID ACROSS MAINTENANCE ACCESS PAD IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND BACKFILL WITH CONCRETE SAND
  - PLACE SOD ABOVE GRASSPAVE2 RINGS OR ADD 0.25 INCHES OF TOPSOIL ABOVE GRASSPAVE2 RINGS AND HYDROSEED IN ACCORDANCE WITH LANDSCAPE PLANS ON SHEETS 022 - 029.



**C** MAINTENANCE ACCESS PAD TYPICAL SECTION  
005

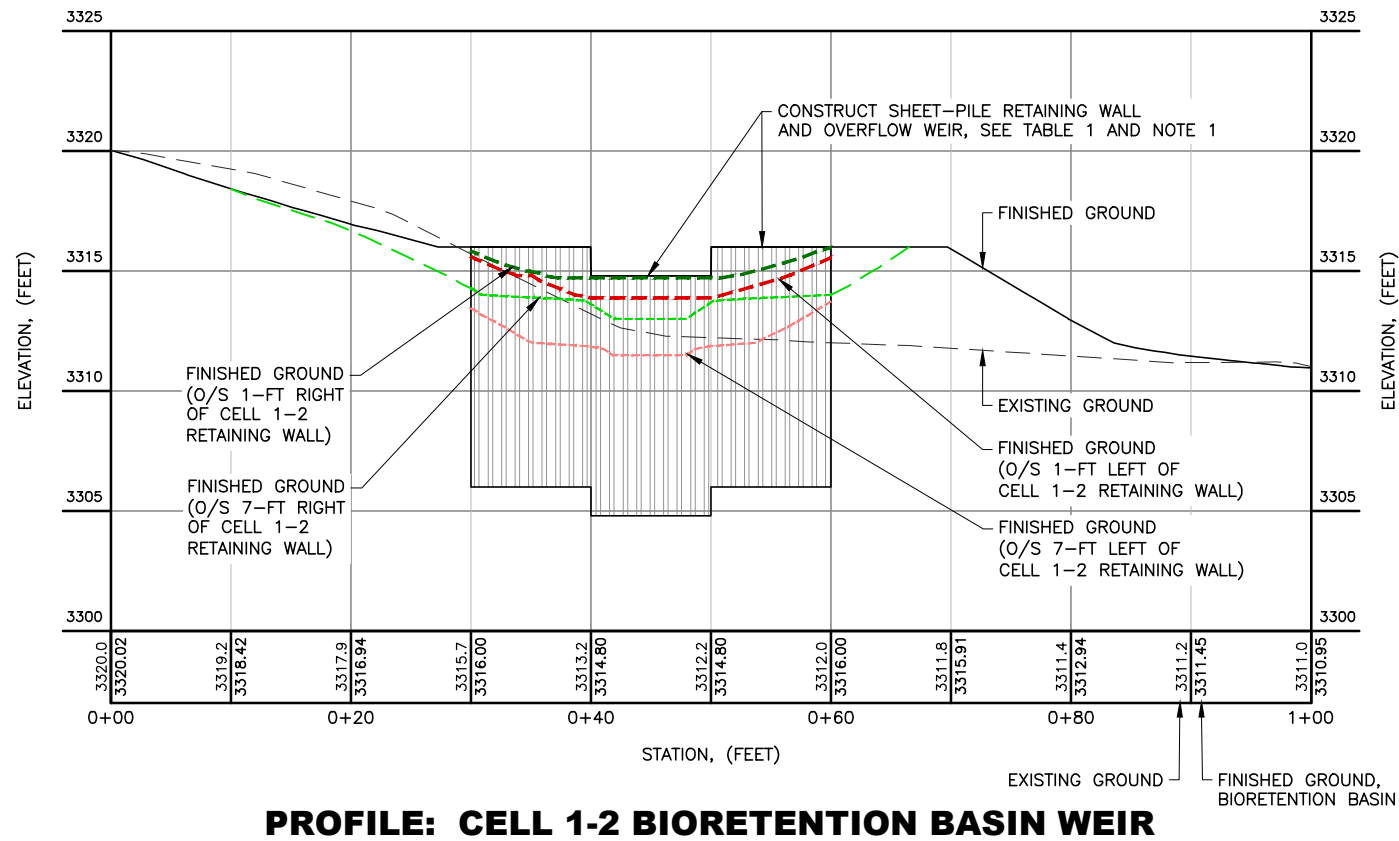


**DRAFT**

|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                     |
|-----|----------|---------------------------------------|------|-----|-----------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| ##  | ##       | ##                                    | ##   | ##  | ##        | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                     |
| ##  | ##       | ##                                    | ##   | ##  | ##        | CHECKED BY:  |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                     |
| ##  | ##       | ##                                    | ##   | ##  | ##        | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                     |
| ##  | ##       | ##                                    | ##   | ##  | ##        | DESIGNED BY: |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                     |
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP | SBA       |              |                                                                                                                                                                                                                                                                                                                                                                                                          | PROJECT TAKIMA PARK WATER QUALITY IMPROVEMENTS                                                                                                                                                      |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          | TITLE DISCHARGE SWALE AND ACCESS PAD TYPICAL SECTIONS                                                                                                                                               |
| REV | DATE     | DESCRIPTION                           | TECH | ENG | NEWFIELDS |              |                                                                                                                                                                                                                                                                                                                                                                                                          | FILENAME 35832.000.014D                                                                                                                                                                             |
|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          | DRAWING NO. 014                                                                                                                                                                                     |
|     |          |                                       |      |     |           |              |                                                                                                                                                                                                                                                                                                                                                                                                          | REVISION B                                                                                                                                                                                          |

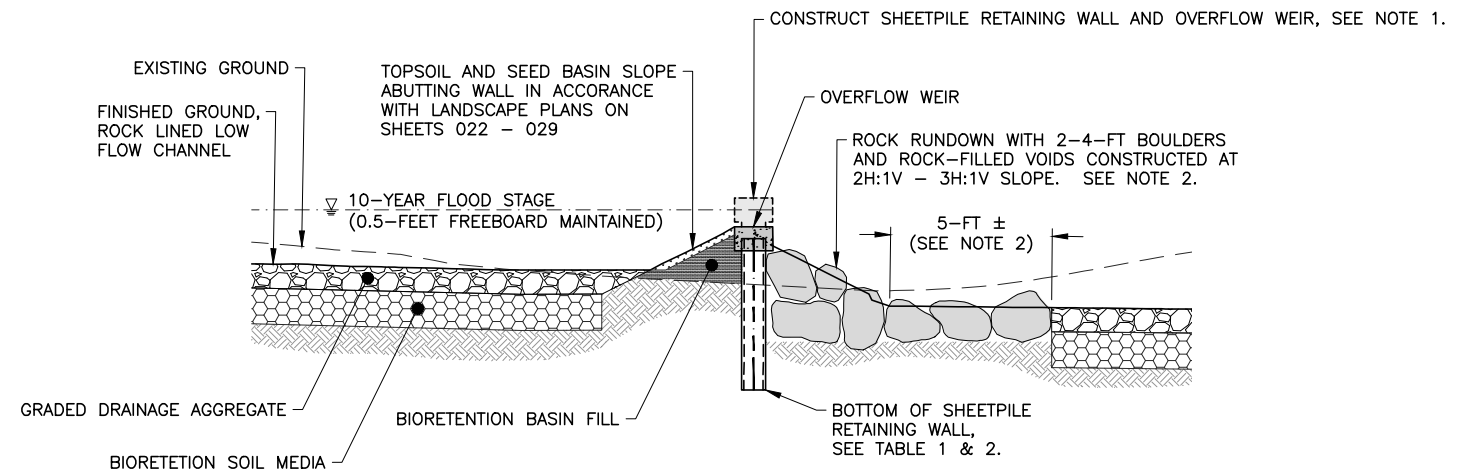


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| TABLE 1: CELL 1-2 WEIR DESIGN |                       |                          |
|-------------------------------|-----------------------|--------------------------|
| STATION                       | TOP OF WALL ELEVATION | BOTTOM OF WALL ELEVATION |
| 0+30                          | 3316.00               | 3306.00                  |
| 0+40                          | 3316.00               | 3306.00                  |
| 0+40                          | 3314.80               | 3304.80                  |
| 0+50                          | 3314.80               | 3304.80                  |
| 0+50                          | 3316.00               | 3306.00                  |
| 0+60                          | 3316.00               | 3306.00                  |

| TABLE 2: CELL 2-3 WEIR DESIGN |                       |                          |
|-------------------------------|-----------------------|--------------------------|
| STATION                       | TOP OF WALL ELEVATION | BOTTOM OF WALL ELEVATION |
| 0+30                          | 3314.00               | 3304.00                  |
| 0+40                          | 3314.00               | 3304.00                  |
| 0+40                          | 3312.80               | 3302.80                  |
| 0+50                          | 3312.80               | 3302.80                  |
| 0+50                          | 3314.00               | 3304.00                  |
| 0+60                          | 3314.00               | 3304.00                  |



**NOTES:**

- SHEETPILE RETAINING WALL AND OVERFLOW WEIR PRODUCT INFORMATION PROVIDED BELOW.
  - SHEETPILE TYPE: CMI VINYL SHEET PILE SG625 (OR APPROVED EQUAL)
  - TOP CAP: CMI ALUMIGUARD AW-1075 (OR APPROVED EQUAL)INSTALL VINYL SHEETPILE AND TOP CAP IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS. INSTALLATION CAN BE COMPLETED USING A SMALL EXCAVATOR AND A VIBRATORY PLATE COMPACTOR. GENERAL INSTALLATION PROCEDURE INCLUDES:
  - EXCAVATE SHALLOW 1 - 2-FT DEEP TRENCH ALONG RETAINING WALL DESIGN ALIGNMENT (WIDTH AS NEEDED TO ALLOW VIBRATORY PLATE COMPACTION ON EITHER SIDE OF SHEET PILE FOLLOWING INSTALLATION)
  - PLACE VINYL SHEET (2.5-FT WIDTH) ALONG DESIGN ALIGNMENT
  - DRIVE VINYL SHEET TO THE DESIGN ELEVATION PROVIDED IN TABLE 1 AND 2 IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS. SHEET DRIVING METHODS MAY INCLUDE USING AN EXCAVATOR-MOUNTED VIBRATORY HAMMER OR AIR PNEUMATIC HAMMER. VERIFY INSTALLATION METHOD WITH MANUFACTURER PRIOR TO CONSTRUCTION.
  - SET ADJACENT SHEET IN PLACE, CONNECT TO INSTALLED SHEET USING INTERLOCKING CHANNEL, AND CONTINUE INSTALLATION.
- CONSTRUCT ROCK RUNDOWN DOWNSTREAM OF RETAINING WALL AND OVERFLOW WEIR USING 2-4-FT BOULDERS. EXTEND BOULDERING APPROXIMATELY 5- FEET BEYOND TOE OF BASIN SLOPE AND SET FINAL BOULDERS TO PROVIDE 6-INCH DEEP STILLING BASIN. FILL VOIDS IN PRIMARY BOULDERS WITH RIPRAP.
- STATIONS REPRESENTED IN TABLE 1 AND 2 ARE IN REFERENCE TO THE CELL 1/2 AND CELL 2/3 RETAINING WALL AND OVERFLOW WEIR DESIGN ALIGNMENTS. REFER TO SHEET 019 FOR ALIGNMENT INFORMATION.

**DRAFT**

**PROFILE: CELL 2-3 BIORETENTION BASIN WEIR**

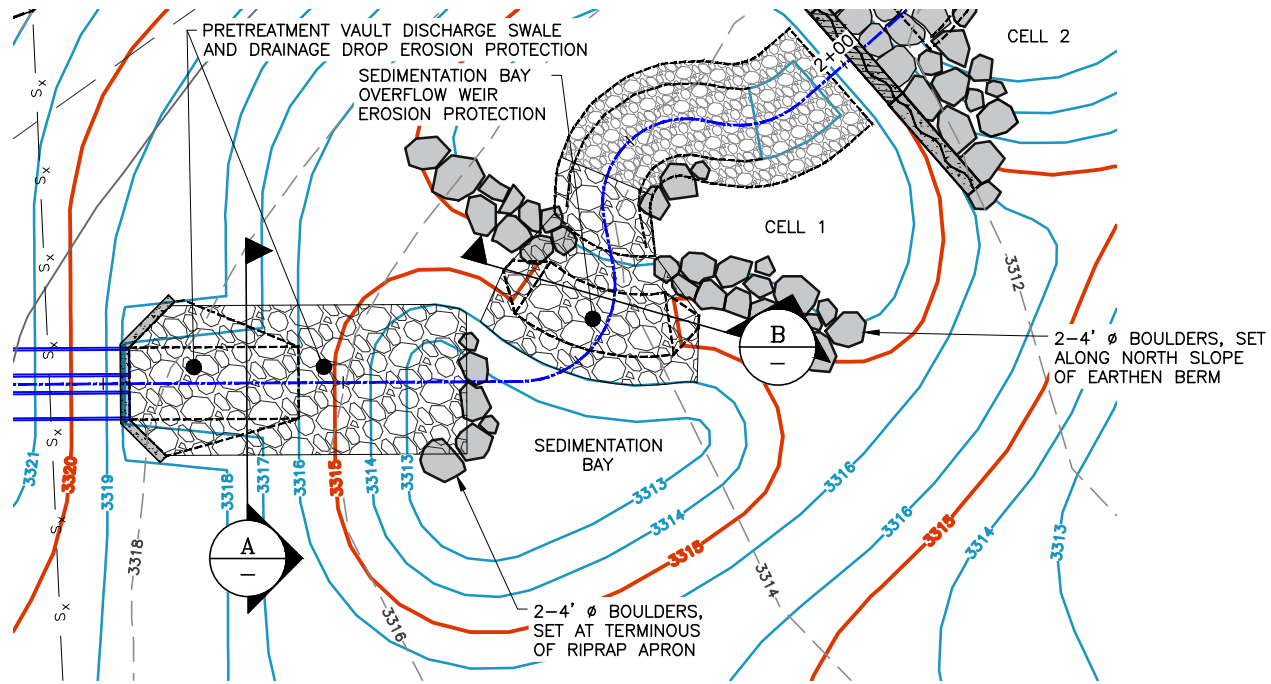


| REV | DATE     | DESCRIPTION                           | TECH | ENG |
|-----|----------|---------------------------------------|------|-----|
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP |

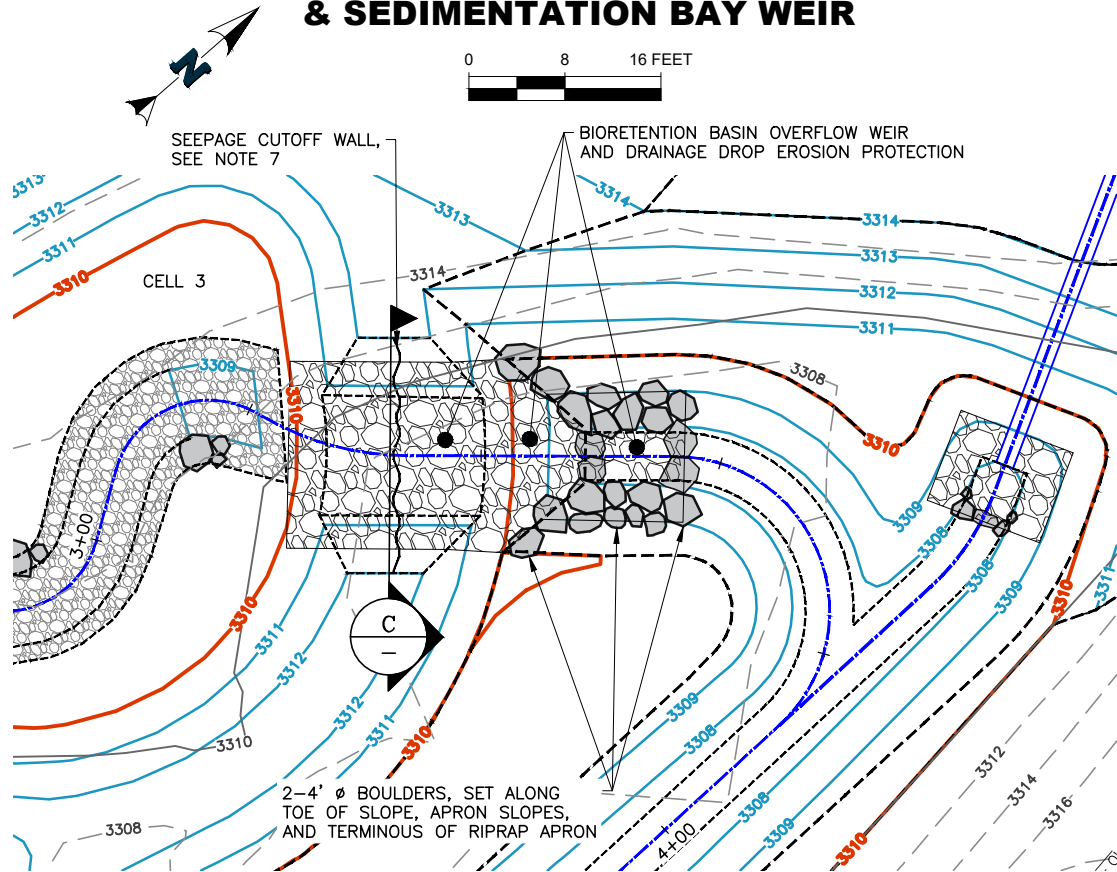
| APPROVED BY: | DISCLAIMER                                                                                                                                                                                                                                                                                                                                                                             |
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| MSP          | NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS. |
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| MSP          |                                                                                                                                                                                                                                                                                                                                                                                        |
| DESIGNED BY: |                                                                                                                                                                                                                                                                                                                                                                                        |
| SBA          |                                                                                                                                                                                                                                                                                                                                                                                        |
| DRAWN BY:    |                                                                                                                                                                                                                                                                                                                                                                                        |
| NEWFIELDS    |                                                                                                                                                                                                                                                                                                                                                                                        |

| PROJECT                                |  | CLIENT           |          |
|----------------------------------------|--|------------------|----------|
| TAKIMA PARK WATER QUALITY IMPROVEMENTS |  | CITY OF MISSOULA |          |
| TITLE                                  |  | FILENAME         |          |
| SHEETPILE AND WEIR DETAILS             |  | 35832.000.015P   |          |
|                                        |  | DRAWING NO.      | REVISION |
|                                        |  | 015              | B        |

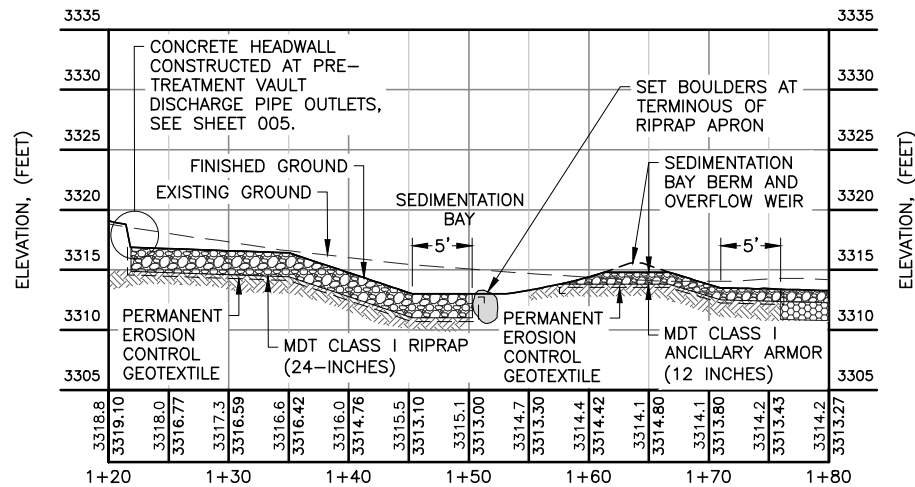
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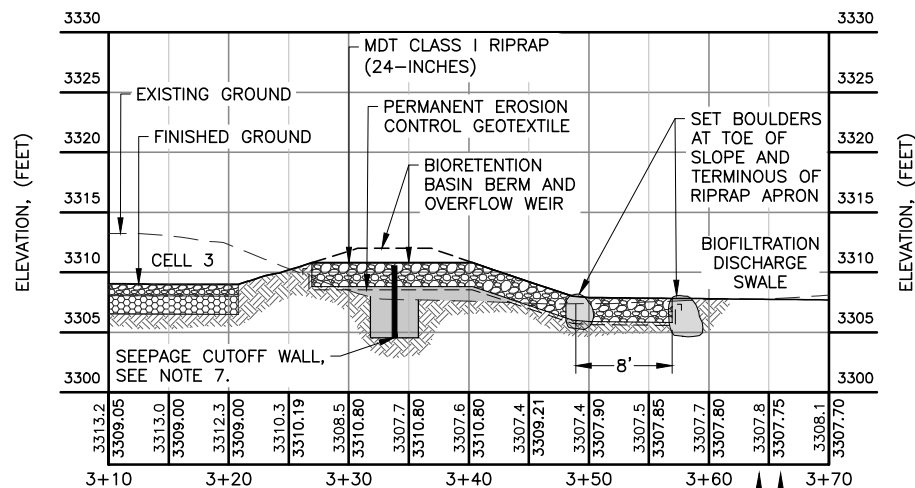
**PLAN: PRETREATMENT VAULT DISCHARGE SWALE & SEDIMENTATION BAY WEIR**



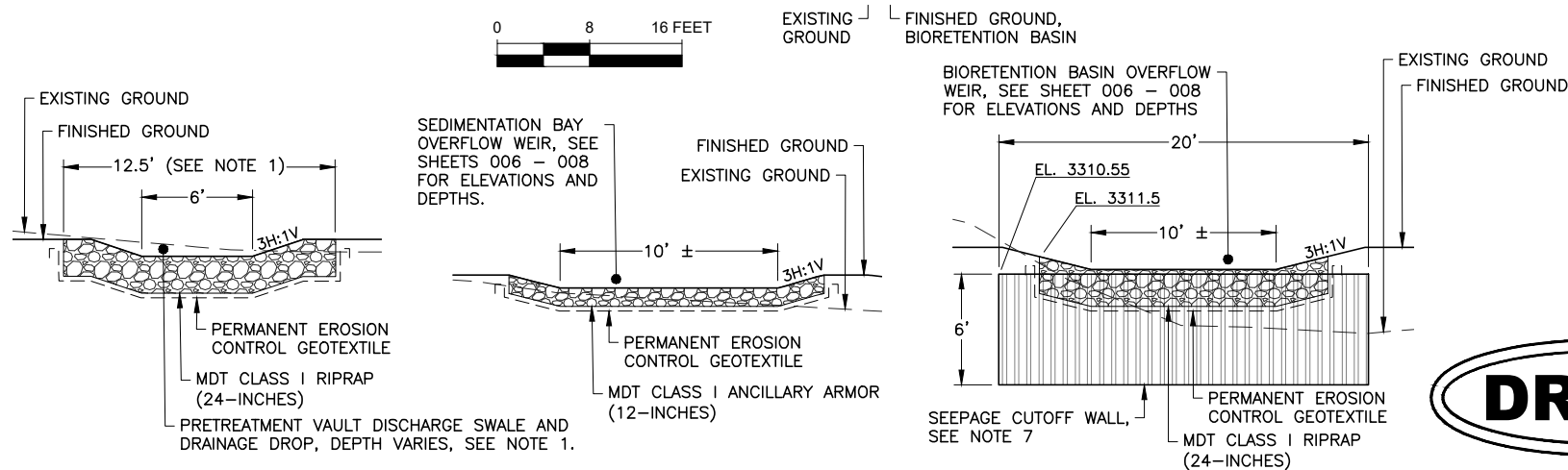
**PLAN: BIORETENTION BASIN OVERFLOW WEIR**



**PROFILE: P-V DISCHARGE SWALE & SEDIMENTATION BAY WEIR**



**PROFILE: BIORETENTION BASIN OVERFLOW WEIR**



**A** PV DISCHARGE SWALE & DRAINAGE DROP

**B** SEDIMENTATION BAY - CELL 1 OVERFLOW WEIR

**C** BIORETENTION BASIN OVERFLOW WEIR

**NOTES: PRETREATMENT VAULT DISCHARGE SWALE AND DRAINAGE DROP**

1. DISCHARGE SWALE DEPTH VARIES AS SWALE APPROACHES SLOPE OF SEDIMENTATION BAY. EXTEND RIPRAP EROSION PROTECTION BEYOND SHOULDER OF SWALE TO MATCH OVERALL WIDTH OF CONCRETE HEADWALL AT PRETREATMENT VAULT DISCHARGE PIPE OUTLETS.
2. CONFINE RIPRAP APRON USING 2 - 4' DIAMETER BOULDERS AS SHOWN IN THE PLAN AND PROFILE.
3. ANCHOR PERMANENT EROSION CONTROL GEOTEXTILE AT EDGES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.

**NOTES: SEDIMENTATION BAY OVERFLOW WEIR**

4. SET BOULDERS ALONG NORTH SLOPE OF SEDIMENTATION BAY EARTHEN BERM AS SHOWN IN THE PLAN.
5. TRANSITION FROM SEDIMENTATION BAY OVERFLOW WEIR EROSION PROTECTION TO ROCK-LINED DITCH AT TERMINUS OF RIPRAP APRON.
6. ANCHOR PERMANENT EROSION CONTROL GEOTEXTILE AT EDGES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.

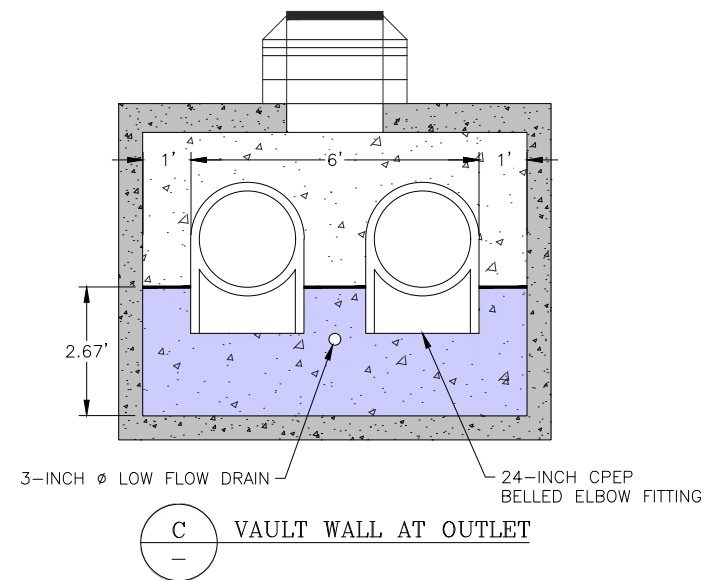
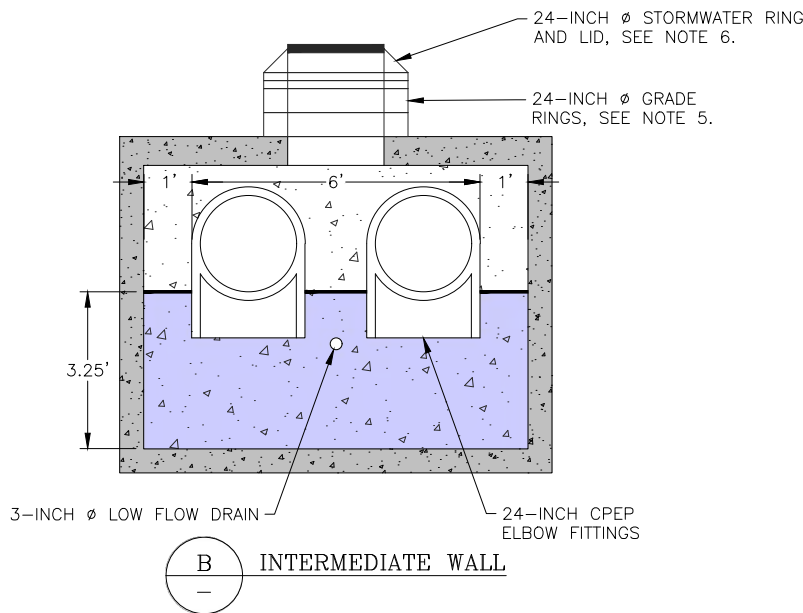
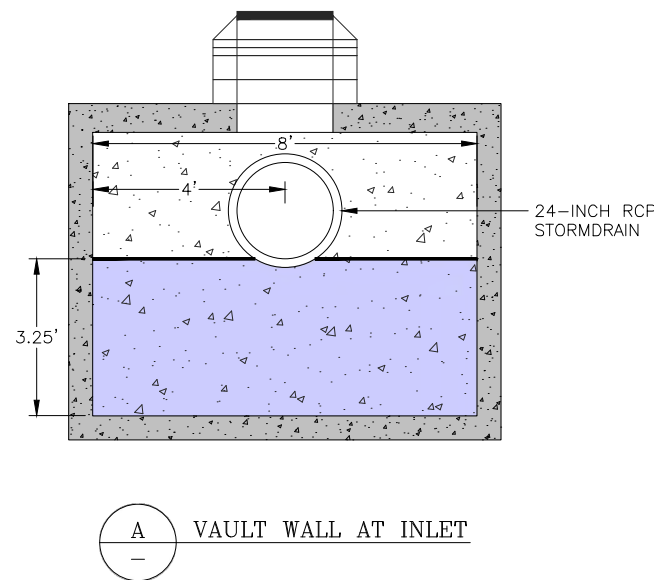
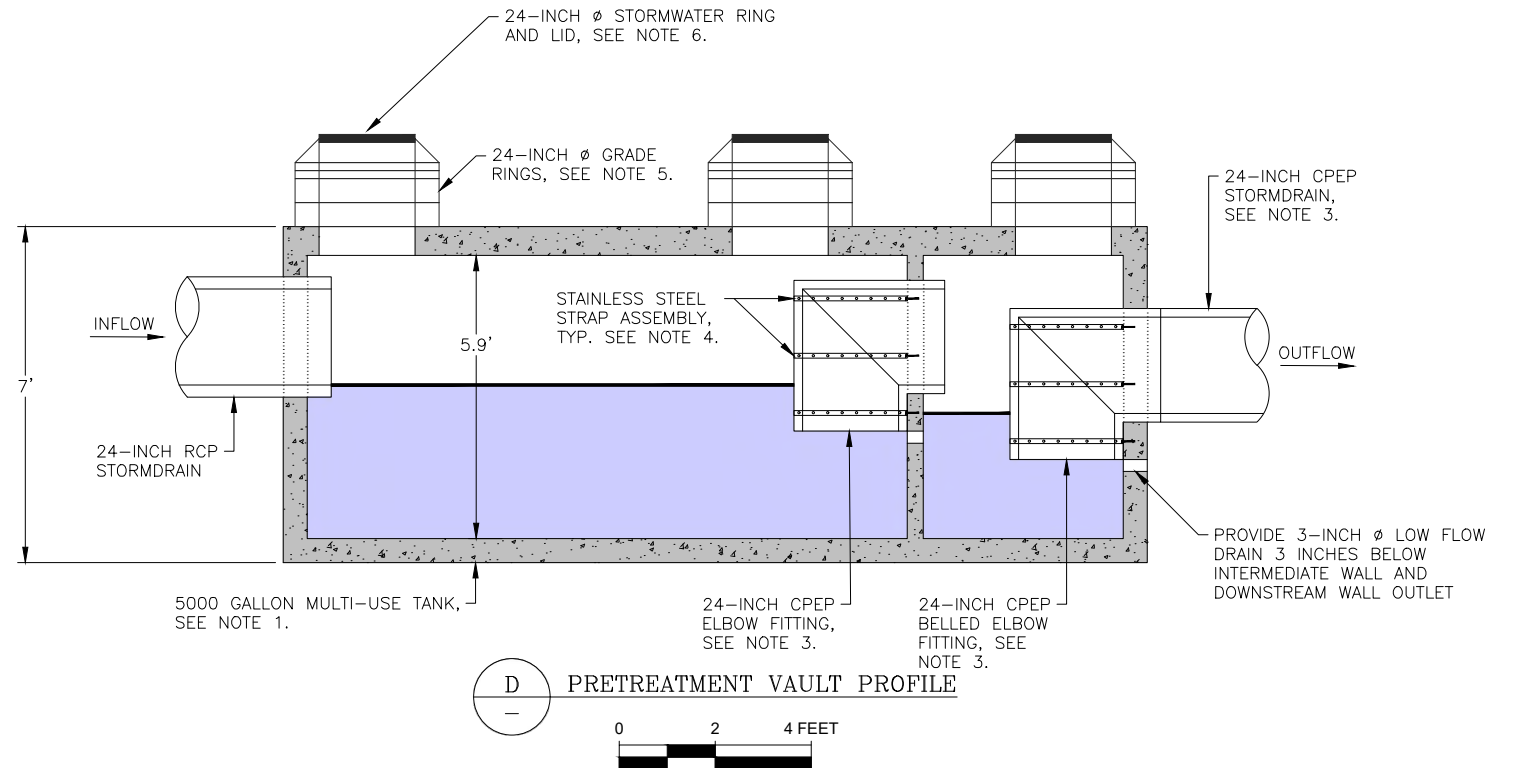
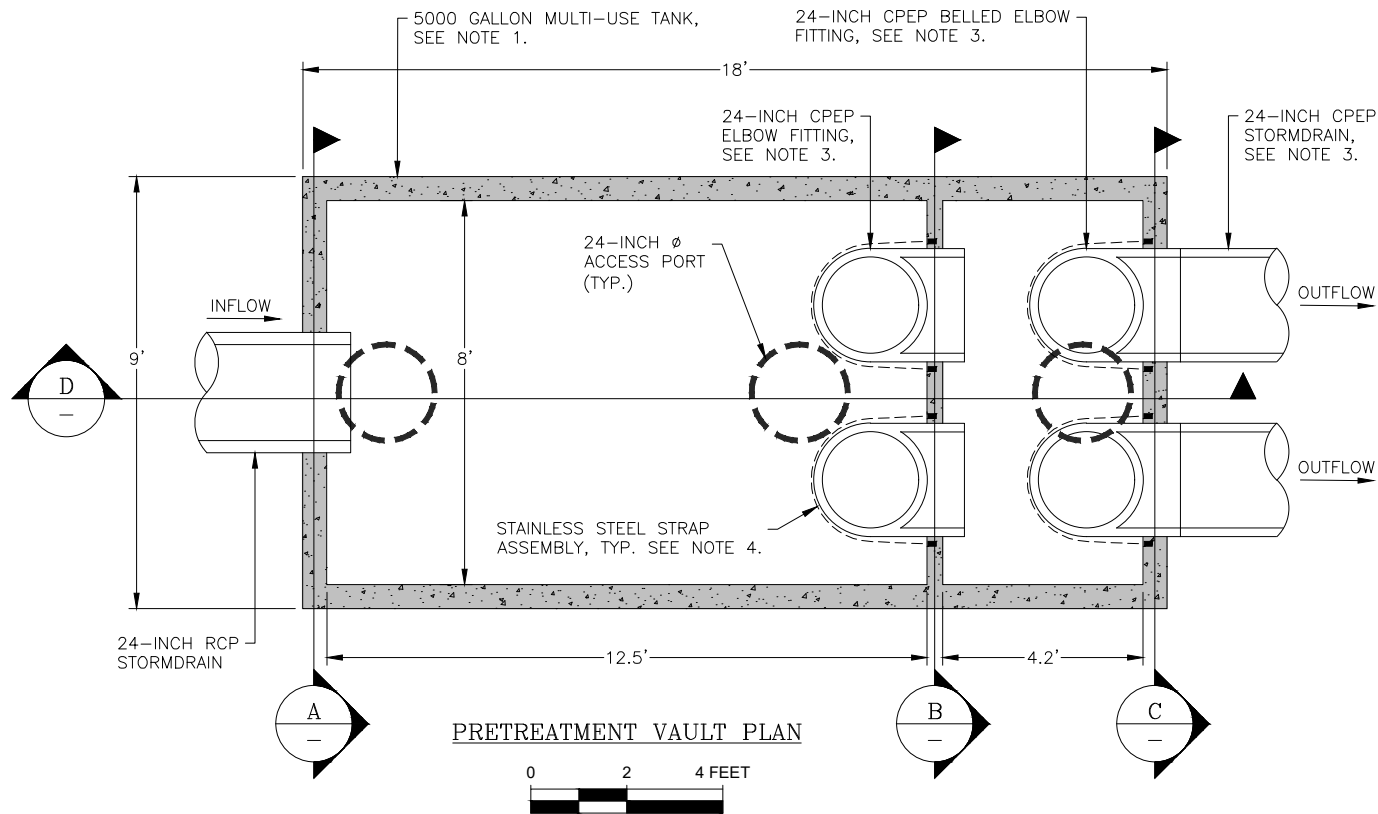
**NOTES: BIORETENTION BASIN OVERFLOW WEIR AND DRAINAGE DROP**

7. SEEPAGE CUTOFF WALL SHALL BE CMI SHOREGUARD SG-425 RIGID VINYL SHEETPILE OR APPROVED EQUAL.
8. PRIOR TO CONSTRUCTION OF OVERFLOW WEIR, EXCAVATE SEEPAGE CUTOFF TRENCH (5-FOOT MINIMUM WIDTH) ALONG CENTERLINE OF BIORETENTION BASIN EXTERNAL BERM, SET SEEPAGE CUTOFF WALL ALONG CENTERLINE OF TRENCH, AND BACKFILL AND COMPACT AROUND SEEPAGE CUTOFF TRENCH IN ACCORDANCE WITH THE EXTERNAL BERM CONSTRUCTION REQUIREMENTS PROVIDED ON SHEET 013.
9. CONFINE RIPRAP EROSION PROTECTION USING BOULDERS SET ALONG TOE OF BIORETENTION BASIN OVERFLOW WEIR, AT TERMINUS OF RIPRAP APRON, AND ALONG BIOFILTRATION SWALE SLOPES ABOVE RIPRAP APRON.
10. ANCHOR PERMANENT EROSION CONTROL GEOTEXTILE AT EDGES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.

**DRAFT**

|     |          |                                       |    |    |      |              |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                       |                            |                                        |
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| ##  | ##       | ##                                    | ## | ## | ##   | CHECKED BY:  |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                       |                            |                                        |
| ##  | ##       | ##                                    | ## | ## | ##   | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                       |                            |                                        |
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW |    |    | SBA  | MSP          |                                                                                                                                                                                                                                                                                                                                                                                                          | DESIGNED BY:                                                                          | PROJECT                    | TAKIMA PARK WATER QUALITY IMPROVEMENTS |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |    |    | SBA  | MSP          | SBA                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                       |                            |                                        |
| REV | DATE     | DESCRIPTION                           |    |    | TECH | ENG          | DRAWN BY:                                                                                                                                                                                                                                                                                                                                                                                                | TITLE                                                                                 |                            |                                        |
|     |          |                                       |    |    |      |              | NEWFIELDS                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                       | FILENAME<br>35832.000.016D |                                        |
|     |          |                                       |    |    |      |              |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                       | DRAWING NO.                | REVISION                               |
|     |          |                                       |    |    |      |              |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                       | 016                        | B                                      |

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NOTES:

1. PRETREATMENT VAULT SHALL BE THE "5000 GALLON MULTI-USE HS20-44 RATED" PRECAST CONCRETE TANK MANUFACTURED BY BRIDGER PRECAST, OR APPROVED EQUAL. COORDINATE WITH BRIDGER PRECAST TO PROVIDE THE PRETREATMENT VAULT SHOWN ABOVE. INSTALL VAULT IN ACCORDANCE WITH ALL MANUFACTURERS RECOMMENDATIONS INCLUDING BUT NOT LIMITED TO SUGRADE PREPARATION, BACKFILL AND COMPACTION, PIPE CONNECTIONS, AND SETTING THE INTERMEDIATE WALL / INTERNAL BAFLE WALL.
2. CAST ROUGH OPENINGS INTO VAULT LARGE ENOUGH TO PROVIDE 2-INCHES OF SPACE BEYOND OUTSIDE DIAMETER OF PIPE OR FITTING. GROUT VOID SPACE AT PIPE CONNECTIONS IN ACCORDANCE WITH VAULT MANUFACTURERS RECOMMENDATIONS.
3. INTERMEDIATE WALL 24-INCH CPEP ELBOW FITTINGS SHALL BE PRINSCO "GOLDFLO 2-PIECE 90-DEGREE ELBOW" OR APPROVED EQUAL. OUTLET WALL 24-INCH CPEP ELBOW FITTINGS SHALL BE PRINSCO "GOLDFLOW 2-PIECE 90-DEGREE ELBOW - BELLED." REMOVE BELL FROM DOWN-FACING PORTION OF THE OUTLET WALL FITTINGS. CONNECT BELL END OF OUTLET WALL CPEP FITTING TO SPIGOT END OF 24-INCH DUAL WALL CPEP OUTLET PIPE. USE 24-INCH CPEP OUTLET PIPE FROM SAME MANUFACTURER AS ELBOW FITTING WITH SPIGOT COMPATIBLE TO BELL END OF ELBOW FITTING.
4. SECURE 24-INCH CPEP FITTINGS TO CONCRETE WALL WITH 3 EACH STAINLESS STEEL STRAP ASSEMBLIES PER FITTING CONSISTING OF 0.75-INCH HANGING STRAP (304 STAINLESS STEEL) AND 0.25 INCH x 2.5 INCH STAINLESS STEEL CONCRETE ANCHORS.
5. USE CONCRETE GRADE RINGS SET IN MASTIC ABOVE ACCESS PORTS TO RAISE STORMWATER RING AND LID TO FINISHED GRADE ABOVE VAULT. TOTAL RING HEIGHT (TOP OF TANK TO TOP OF CONCRETE GRADE RING) ESTIMATED TO BE 16-INCHES, CONTRACTOR TO VERIFY.
6. PROVIDE STORMWATER RING AND SOLID LID ABOVE EACH ACCESS PORT AND CORRESPONDING GRADE RINGS MEETING THE REQUIREMENTS OF CITY OF MISSOULA STANDARD DETAILS STD-604A AND STD-604B.
7. SET PRETREATMENT VAULT ON 12-INCHES OF 0.75-INCH MINUS ROAD BASE MATERIAL COMPACTED TO MINIMUM 95% STANDARD PROCTOR. BACKFILL THE TANK WITH MAXIMUM 8-INCH LOOSE LIFTS COMPACTED TO 95% STANDARD PROCTOR.

| REV | DATE     | DESCRIPTION                           | TECH | ENG |
|-----|----------|---------------------------------------|------|-----|
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW | SBA  | MSP |

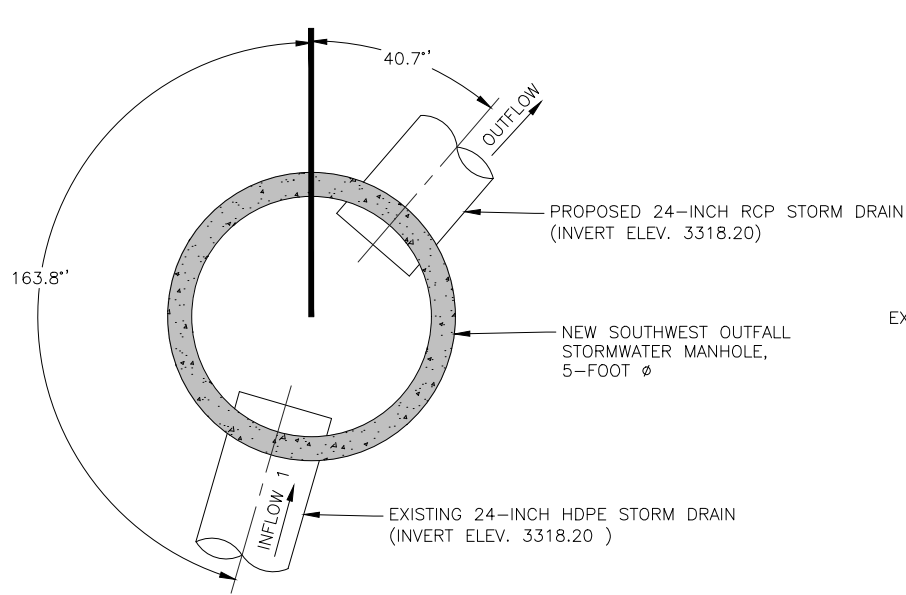
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| APPROVED BY: | MSP |
| CHECKED BY:  | MSP |
| DESIGNED BY: | SBA |
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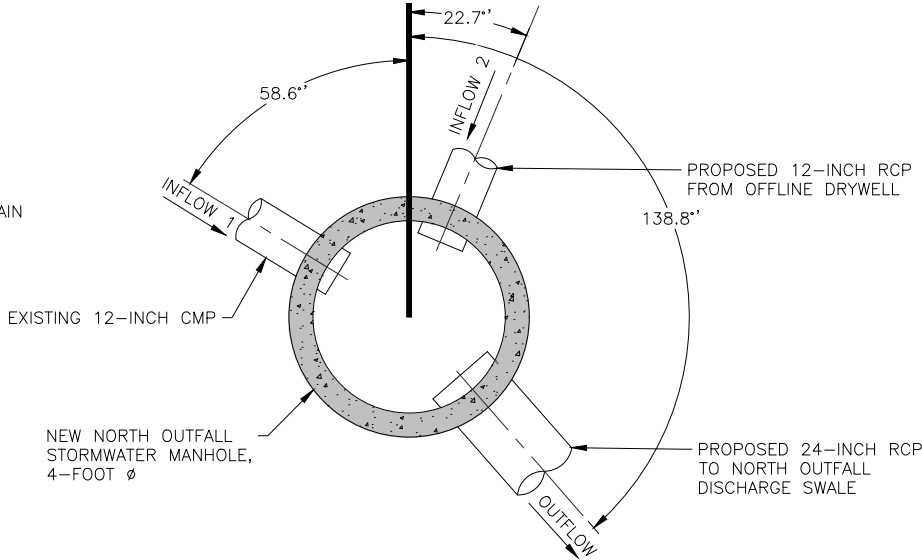
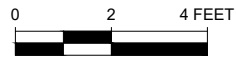
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| <b>NewFields</b> <small>CLIENT</small> CITY OF MISSOULA   |                            |
| PROJECT<br>TAKIMA PARK WATER QUALITY IMPROVEMENTS PROJECT |                            |
| TITLE<br>PRETREATMENT VAULT DETAILS                       | FILENAME<br>35832.000.017D |
| DRAWING NO.<br>017                                        | REVISION<br>B              |

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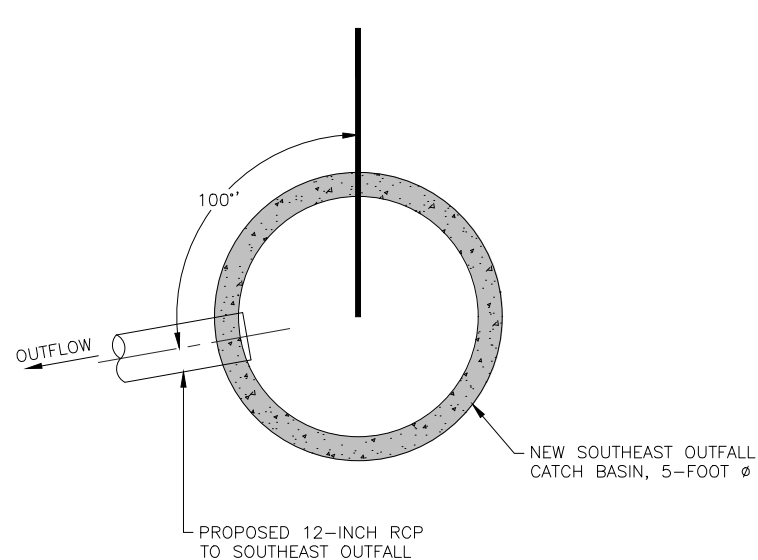
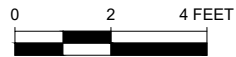




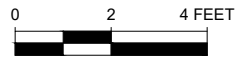
DETAIL: SOUTHWEST OUTFALL  
STORMWATER MANHOLE



DETAIL: NORTH OUTFALL  
STORMWATER MANHOLE



DETAIL: SOUTHEAST OUTFALL  
STORMWATER CATCH BASIN



| STRUCTURE NAME                           | NORTHING   | EASTING    | INTERNAL DIAMETER (ft) | LID / GRATE RIM ELEV. | BARREL INVERT ELEV. | INFLOW 1 INVERT ELEV. | INFLOW 2 INVERT ELEV. | OUTFLOW INVERT ELEV. | STRUCTURE TYPE (1) | RING TYPE (1) | COVER TYPE (1) |
|------------------------------------------|------------|------------|------------------------|-----------------------|---------------------|-----------------------|-----------------------|----------------------|--------------------|---------------|----------------|
| SOUTHWEST OUTFALL STORMWATER MANHOLE     | 975312.488 | 845569.397 | 5                      | 3324.00               | 3316.00             | 3318.20               | —                     | 3318.20              | STD-612-1          | STD-604A      | STD-604B       |
| NORTH OUTFALL STORMWATER MANHOLE         | 975583.910 | 845629.945 | 4                      | 3315.00               | 3306.50             | 3308.85               | 3308.85               | 3308.52              | STD-612-1          | STD-604A      | STD-604B       |
| SOUTHEAST OUTFALL STORMWATER CATCH BASIN | 975267.002 | 845802.867 | 5                      | 3332.55               | 3324.05             | —                     | —                     | 3327.00              | STD-614            | STD-604A      | STD-604C       |

NOTES:

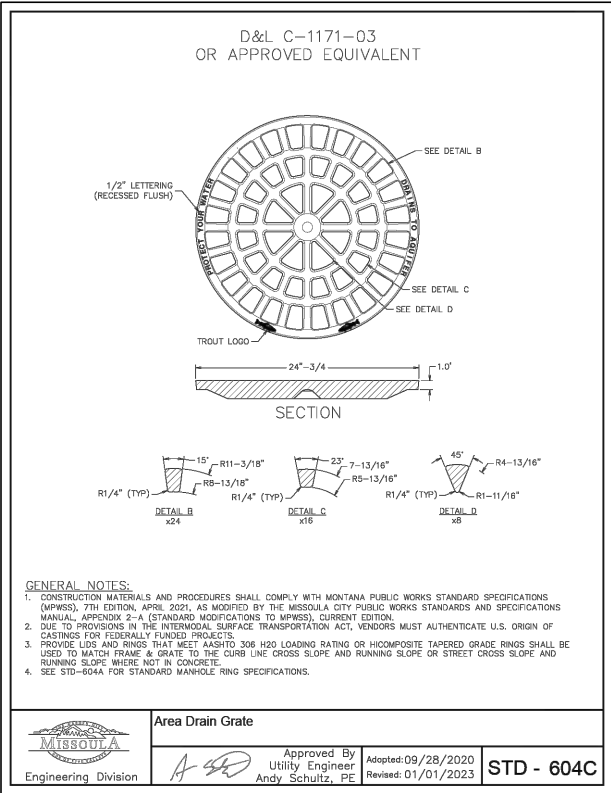
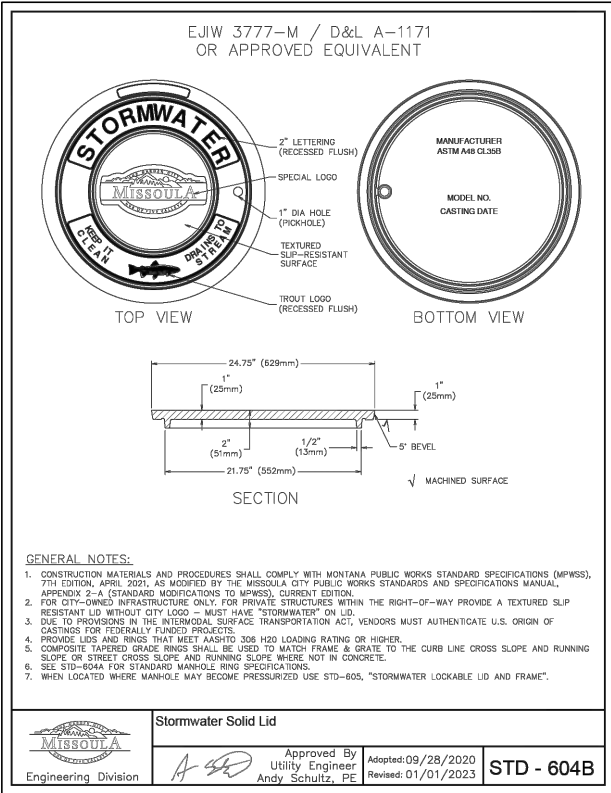
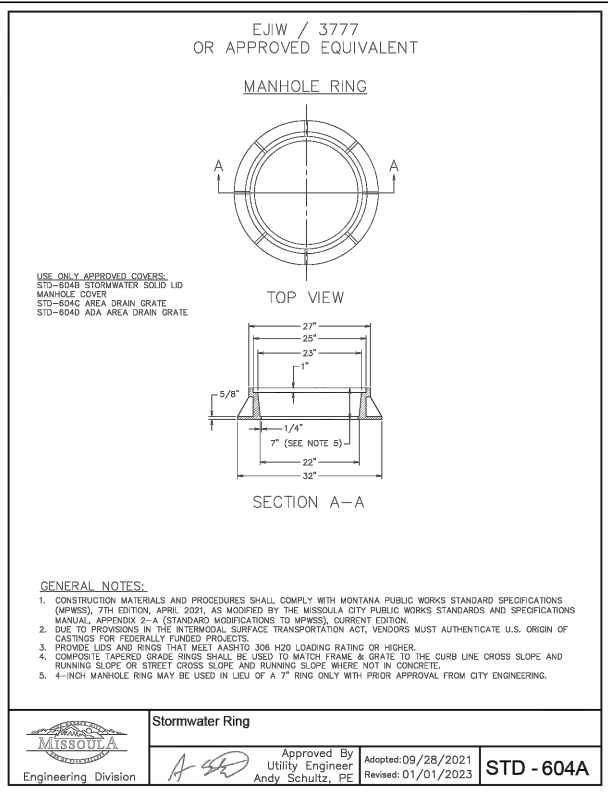
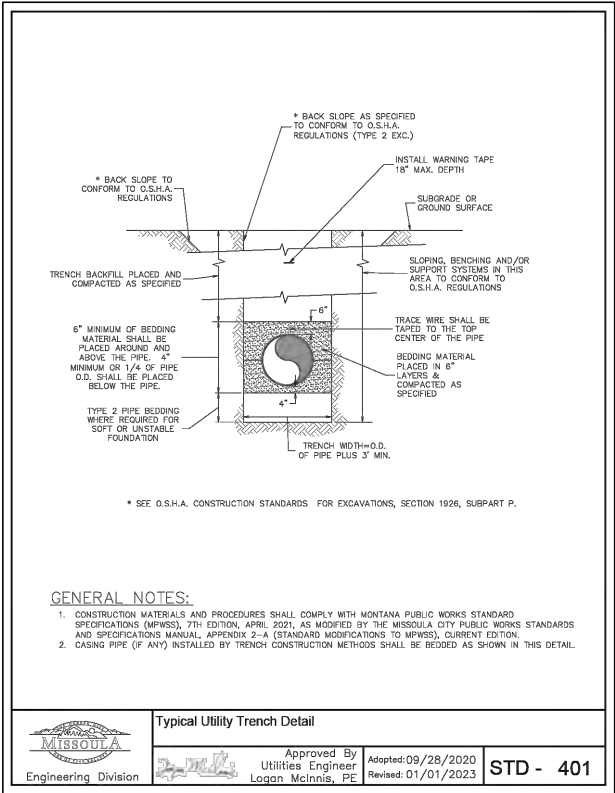
- STRUCTURE TYPE, RING TYPE, AND COVER TYPE REFERENCES ARE TO CITY OF MISSOULA STANDARD DETAILS. PROVIDE MANHOLE, CATCH BASIN, RING, AND COVER MEETING ALL REQUIREMENTS OF THE REFERENCED STANDARD DETAILS.
- CONNECT PROPOSED MANHOLES AND CATCH BASINS TO EXISTING AND/OR PROPOSED STORM DRAINS IN ACCORDANCE WITH CITY OF MISSOULA STANDARD DETAILS AND REQUIREMENTS.

**DRAFT**

|     |          |                                       |  |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                           |               |
|-----|----------|---------------------------------------|--|--|------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
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|     |          |                                       |  |  |      | CHECKED BY:<br>MSP  |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                           |               |
|     |          |                                       |  |  |      | DESIGNED BY:<br>SBA |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                           |               |
| B   | 3/5/25   | 90 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                           |               |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | SBA  | MSP                 |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                           |               |
| REV | DATE     | DESCRIPTION                           |  |  | TECH | ENG                 | DRAWN BY:<br>SBA                                                                                                                                                                                                                                                                                                                                                                                         | PROJECT<br>TAKIMA PARK WATER QUALITY IMPROVEMENTS PROJECT                                                                                                                                                                 |               |
|     |          |                                       |  |  |      |                     | TITLE<br>STORMWATER MANHOLE DETAILS                                                                                                                                                                                                                                                                                                                                                                      | FILENAME<br>35832.000.018D                                                                                                                                                                                                |               |
|     |          |                                       |  |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                          | DRAWING NO.<br>018                                                                                                                                                                                                        | REVISION<br>B |







**NOTES:**

- CONSTRUCT PROJECT COMPONENTS RELATED TO CITY OF MISSOULA INFRASTRUCTURE IN ACCORDANCE WITH ALL APPLICABLE CITY OF MISSOULA STANDARD DETAILS.

- STANDARD DETAILS APPLICABLE TO THE PROJECT INCLUDE BUT ARE NOT LIMITED TO THE CITY OF MISSOULA STANDARD DETAILS SHOWN ON SHEET 020 AND 021 AND THE MONTANA DEPARTMENT OF TRANSPORTATION STANDARD DETAILS SHOWN ON SHEET 021.

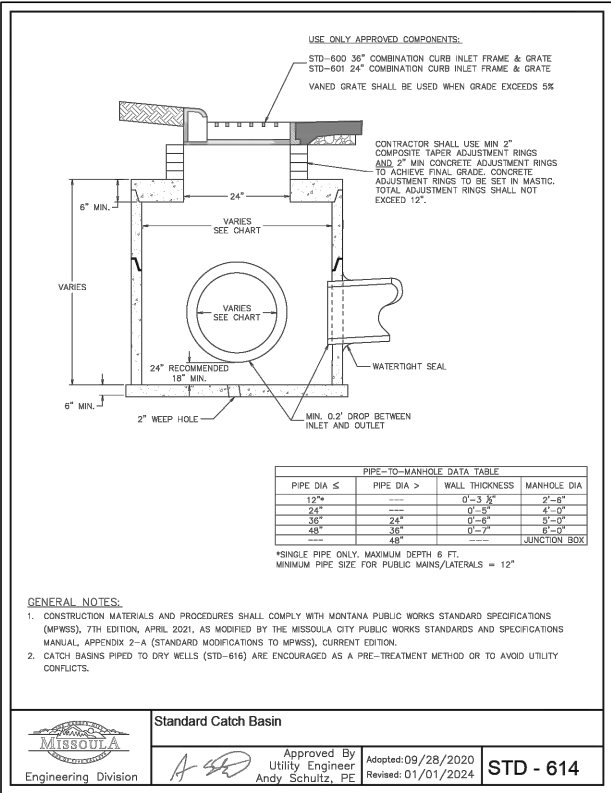
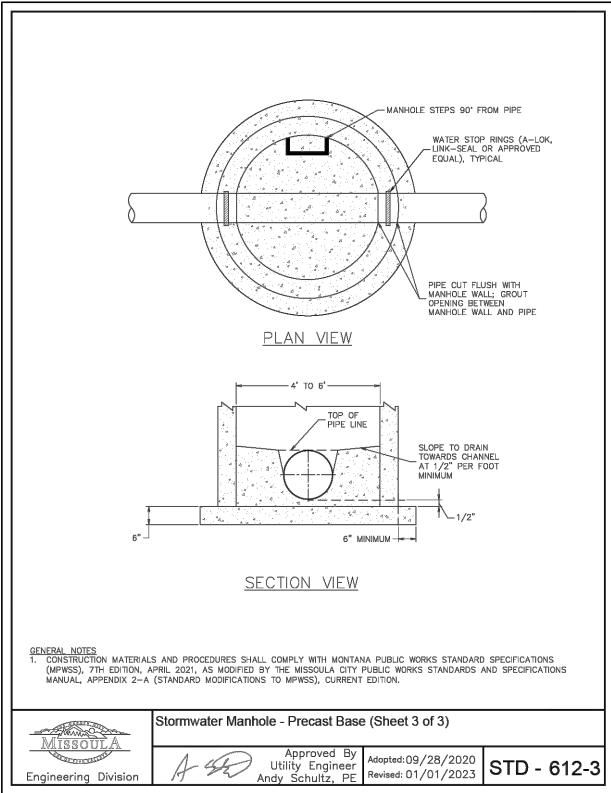
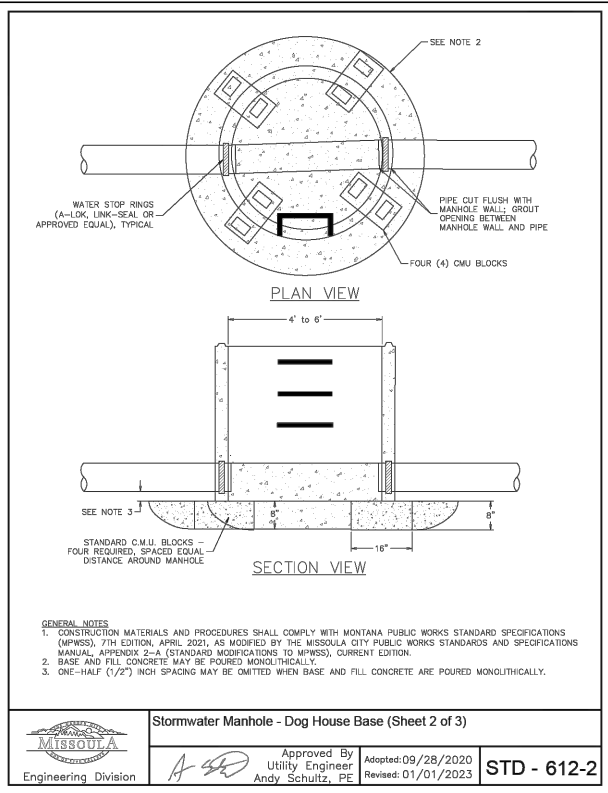
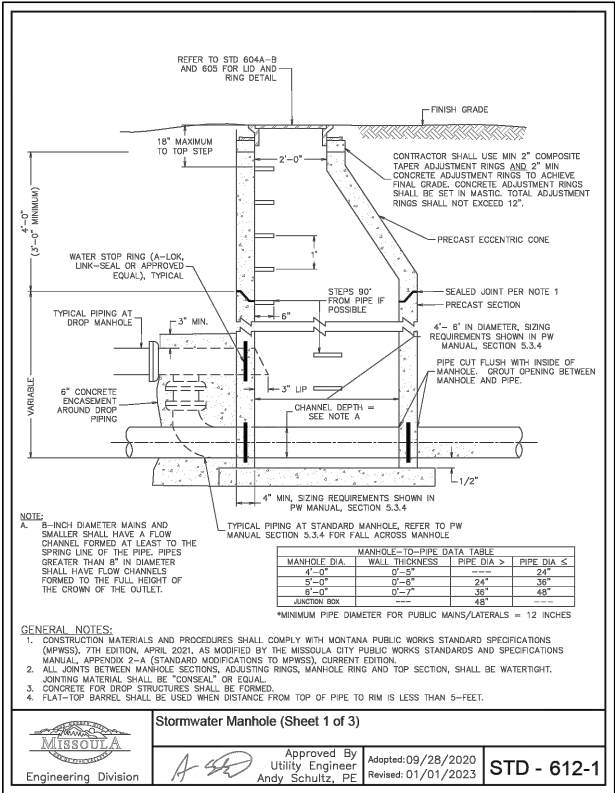
- STANDARD DETAILS SHOWN ON SHEET 020 AND 021 INCLUDE:

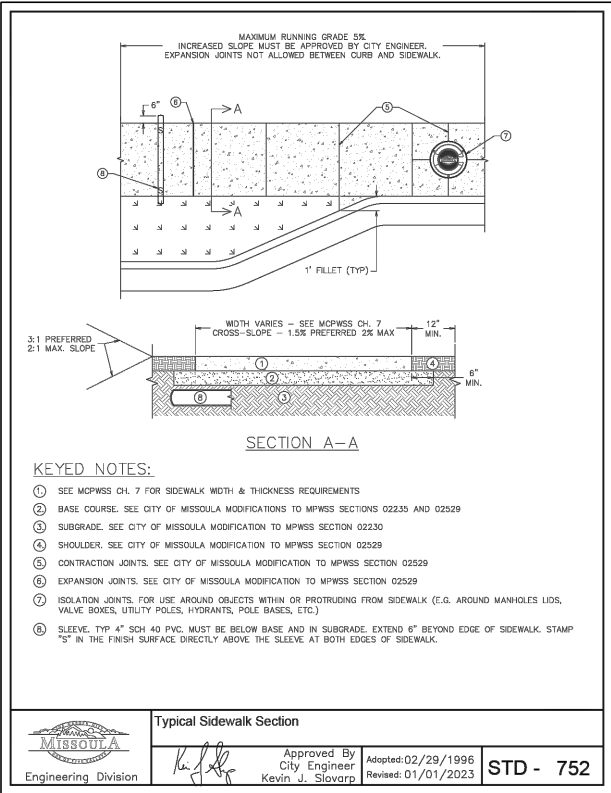
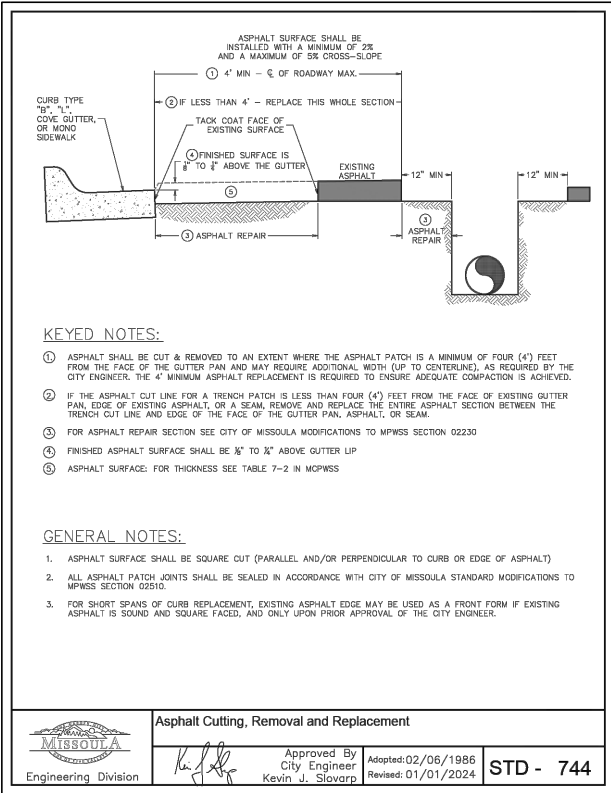
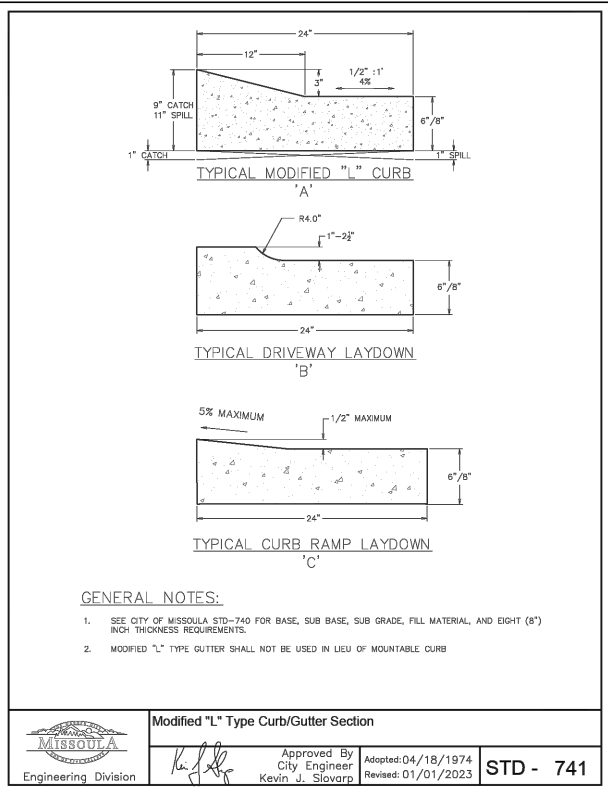
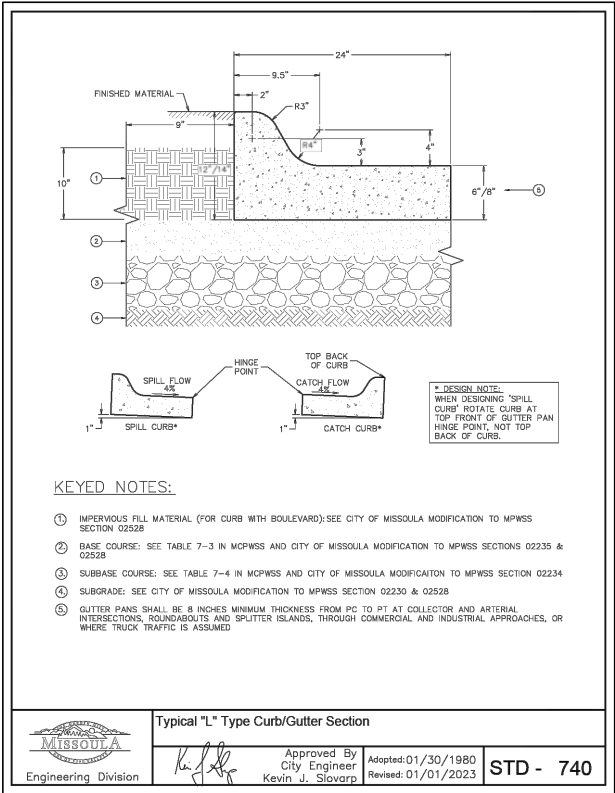
**CITY OF MISSOULA**

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- STD-604A
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- STD-604C
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- STD-612-2
- STD-612-3
- STD-614
- STD-740
- STD-741
- STD-744
- STD-752

**MONTANA DOT**

- MDD-613-12





**NOTES:**

- CONSTRUCT PROJECT COMPONENTS RELATED TO CITY OF MISSOULA INFRASTRUCTURE IN ACCORDANCE WITH ALL APPLICABLE CITY OF MISSOULA STANDARD DETAILS.

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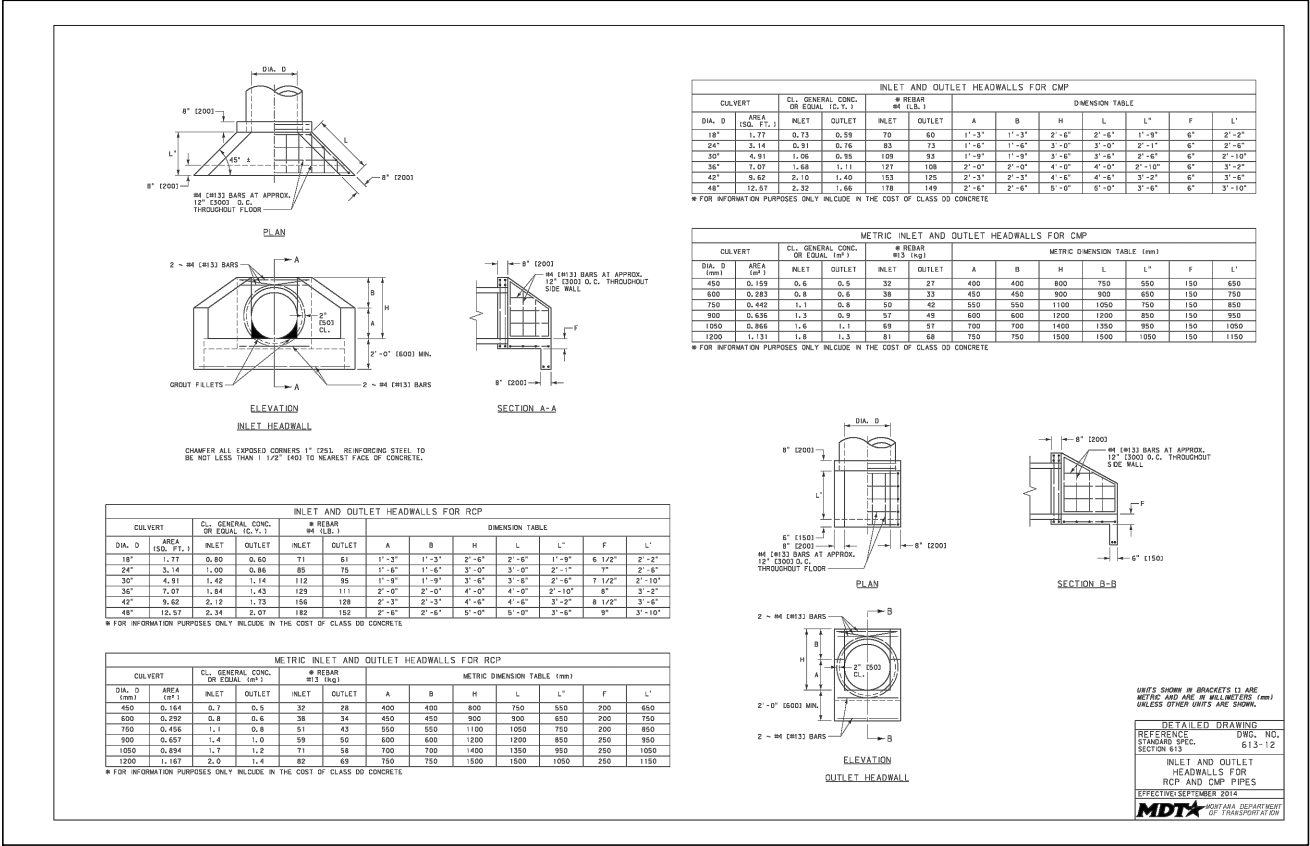
- STANDARD DETAILS SHOWN ON SHEET 020 AND 021 INCLUDE:

**CITY OF MISSOULA**

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**MONTANA DOT**

- MDD-613-12



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|     |        |                                       |  |  |      |                  |                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                       |                            |
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|     |        |                                       |  |  |      | CHECKED BY: MSP  |                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                       |                            |
|     |        |                                       |  |  |      | DESIGNED BY: SBA |                                                                                                                                                                                                                                                                                                                                                                                                      | PROJECT<br>TAKIMA PARK WATER QUALITY IMPROVEMENTS PROJECT                             |                            |
| B   | 3/5/25 | 90 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | SBA  | MSP              |                                                                                                                                                                                                                                                                                                                                                                                                      | TITLE<br>STANDARD CONSTRUCTION DETAILS                                                | FILENAME<br>35832.000.021D |
| REV | DATE   | DESCRIPTION                           |  |  | TECH | ENG              | DRAWN BY: SBA                                                                                                                                                                                                                                                                                                                                                                                        | DRAWING NO.<br>021                                                                    | REVISION<br>B              |



# GENERAL PLANTING NOTES

## A.1 GENERAL LANDSCAPE CONSTRUCTION NOTES

1. All planting work, including soil preparation, shall be done by a licensed contractor in a professional manner.
2. Prepare and install the planting areas including, but not limited to:
  - a. Removing all existing exposed and/or buried concrete, gravel, asphalt pavement, rocks (over 1" in size), weeds, including all underground propagules, and debris within the planting area.
  - b. Excavation of existing site soil to the depth called for on the plans and stockpile for use on the basin berms. Dispose of excess fill off the site.
  - c. Thoroughly ripping and scarifying existing site soil in the excavated area to a depth of 18". Use smaller equipment or hand tools in tight areas where damage could occur to walks, curbing, pavement or walls.
  - d. Removal, importation and placement of good quality friable soil free from weeds, contaminants and other noxious materials to a depth called for on the plans and in the specifications.
  - e. Importation, placement and cultivation of organic soil amendment into the imported soil as called for on the plans and in the specifications.
  - f. Application of a pre-emergent weed control in the planting area.
  - g. Planting, staking and fertilizing of plant materials.
  - h. Supplying and placing of mulch within planted areas.
  - i. Maintenance and clean-up of project area during the installation work and the two (2) year maintenance period.
  - j. Guarantee all plant materials for two (2) years after the final acceptance by the City of Missoula

## B.1 FINISH GRADING AND PLANT INSTALLATION

- Complete finish grading and plant installation per the following:
1. Finish grading shall consist of finely finished surfaces by raking smoothly and evenly, removing all extraneous City Council Adopted December 18, 2017, Missoula Parks and Recreation Design Manual 80 matter to facilitate natural runoff. Finish grades shall slope to drain, without water pockets or irregularities greater than ½" in depth. Finish grades shall meet all existing controls and shall be one inch below tops of sidewalks or curbs. Grades shall be of uniform slope and not to exceed 3:1 in landscape areas and 6:1 in turf areas.
  2. The Planting Plan is drawn to scale. Planting should be located in the relative locations shown on the plans, with adjustments for existing conditions allowed. Spacing on shrubs and ground covers shall be as called for on the Planting Plan. Final planting locations shall be approved by the owner's representative.
  3. Plant trees, shrubs and ground covers only during periods which are normal for such work as determined by the season, weather and accepted practice. The Contractor may elect to conduct planting operations under unseasonable conditions. However, if plants fail after planting, the Contractor is responsible for replacing failed plants at no cost to the city. In such cases, the required two (2) year maintenance period will begin once seasonable conditions return.
  4. All plant materials are to be inspected and approved by the owner's representative prior to installation. Contact the owner's representative forty-eight (48) hours prior to any planting work. Work days are defined as Monday to Friday from 7:00 AM to 4:30 PM.

## B.2 LANDSCAPE MATERIALS

Provide landscape materials in accordance with the following:

1. Topsoil shall be a natural, fertile, friable loam or clay loam possessing characteristics of productive soils in naturally well drained areas and shall be free from subsoil, construction contaminants, noxious weeds or any other material harmful to plant growth. Submit sample and soils analysis report prior to delivery to site. The soil be in the pH range of 6.0 to 7.8, with a SAR of 0 – 3, and an Ece of 0 – 2.
2. Amendments and commercial fertilizers shall be incorporated at the rates called for in the project specifications or on the project plans. The amendments shall be thoroughly incorporated into the top 6" of soil.
3. Planting backfill shall consist of existing site soil, less any rocks or debris over 1" in diameter.
4. Water shall be suitable for irrigation and free of contaminants harmful to plant growth.
5. Supports for trees shall be two 3-inch diameter treated lodgepole pine stakes. See Detail PR-101 for spacing information.
6. Plant materials provided shall be the quantity, genus, species, variety, size, and condition as shown on the Planting Plan and plant list. Plants are to be healthy nursery stock meeting the current ANSI Z60.1 Standard, and as specified on the plant legend. Trees shall be well branched, with central leaders intact, and free from disease, insect, injury or weeds. Roots on potted groundcovers, grasses or shrubs shall not be pot-bound, and be free from circling and girdling roots. Trees shall be free of circling and girdling roots, and be free of adventitious roots in excess of ½".
7. Provide clean, dry mulch materials per planting details, consisting of ¾" to 1 ¼" fir bark, or approved equal, free from foreign and harmful materials. Submit mulch sample prior to delivery to the site.
8. Pre-emergent weed control shall be an application of Surflan, or approved oryzalin equal, applied at manufacture's recommended rate and application method.

## B.3 LANDSCAPE INSTALLATION

Install landscaping in accordance with the following:

1. Remove all existing soil, concrete, asphalt, road base or other debris to a depth of 30" in median planter areas and replace with imported topsoil as shown in Detail PR-127. Remove surface concrete, asphalt, base and other debris in areas other than median island planters.
2. The Contractor shall remove existing soil, concrete, asphalt, road base or other debris in landscape planters to a depth of 18" below finish grade as shown in Detail PR-126. Excavated material shall be replaced with imported topsoil defined on the plans or in the specifications.
3. Rip compacted native soil to a depth of 18" below existing grade level as shown in Detail PR-126. Where native soil is not compacted, rip to a depth of 12" below existing grade before placing imported topsoil on site.
4. Place the initial topsoil in a 6" lift. Scarify the first lift into the native soil to eliminate soil texture barriers. Add the remaining soil.
5. Evenly spread organic and fertilizer amendments to the depth called for by the landscape architect. Thoroughly mix applied amendments into the top 6" of soil.
6. Mixed soil shall be raked and otherwise sufficiently worked so that the soil level is one inch below the top of the curb or sidewalk, or as shown on the plans.
7. Planting holes shall be 3 times the rootball diameter. Place trees and shrubs plumb and faced to give best appearance or relationship to adjacent plants and structures. Backfill planting holes as per the city details
8. Slow-release plant tabs, if called for, shall be placed within the lower two-thirds of the root ball.
9. Form basins around trees and shrubs as indicated on the planting details. Stake trees if called for on the plans.
10. The planting area shall be restored to finish grades after planting. Fill any low areas after settling.
11. After each planting area is finished, apply the pre-emergent weed control as specified using the manufacturer's recommended application rate and method.
12. All areas of work shall be kept in a neat and orderly condition at all times. Where public access is available to the site, provide public protection measures as necessary. Cleanup of the area will be required prior to final acceptance for operations and maintenance by the City of Missoula.

## B.4 TEMPORARY IRRIGATION REQUIREMENTS

1. Provide watering bags for all newly planted trees.
2. Install one 20-gallon capacity bag per tree. Fill completely twice weekly during growing season (April-October) and once weekly during dormant season.
3. Hand water all shrubs with 2 gallons minimum at same frequency as trees.
4. Maintain temporary irrigation for two (2) years from date of Substantial Completion.
5. Document all watering events and submit monthly logs to Owner.
6. Replace damaged bags immediately. Adjust watering frequency as directed by Landscape Architect.
7. Remove all temporary irrigation components upon written approval at end of establishment period.

## C.1 MAINTENANCE

Provide maintenance activities in accordance with the following:

City Council Adopted December 18, 2017, Missoula Parks and Recreation Design Manual 82

1. Maintenance shall be the responsibility of the Contractor during construction maintenance period and during the two (2) year maintenance period. Two (2) year maintenance activities include, but at not limited to:
  - Weed and pest control
  - Pruning and mowing appropriate for NATIVE landscapes
  - Plant replacement
2. The two (2) year maintenance period shall commence upon the 100% completion of the project and acceptance by the owner's representative.
3. All plant material must be in a healthy growing condition and all areas weed free before acceptance for two (2) year maintenance period.
4. Maintain walks, drives and pavement free of hazardous materials and conditions resulting from the irrigation and planting work.
5. The general requirements of the two (2) year maintenance period are intended to keep all planting areas mowed, weed free, and to repair any damage to site improvements; replace any dead trees and shrubs with comparable healthy plant specimens; and, keep the project area neat and orderly.
6. All plant material must be in a healthy growing condition and all areas weed free before final acceptance of maintenance and operations by the City of Missoula.

## D.1 GUARANTEE

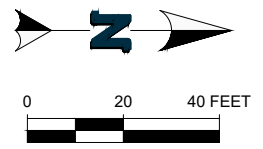
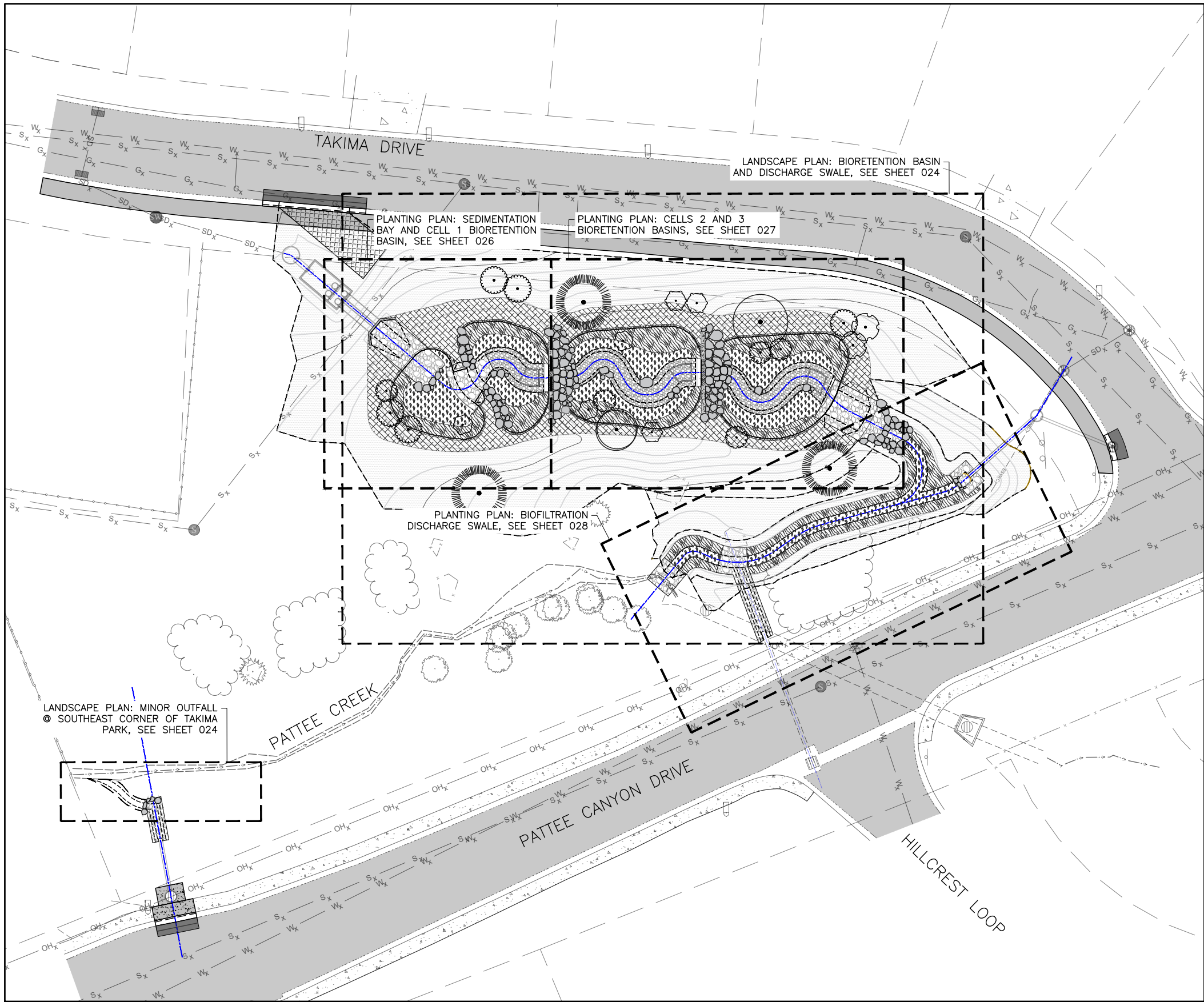
Provide a guarantee for materials and workmanship, including the following:

1. The guarantee period shall commence upon the final project acceptance for operations and maintenance by the City of Missoula.
2. Guarantee that all soil preparation, weed control and planting were performed in accordance with these specifications and acceptable practices and that all plant materials were planted in a healthy, growing condition. Trees, shrubs, grasses and ground covers shall be guaranteed for two (2) years following final acceptance. The guarantee period shall be at no additional cost to the City of Missoula.

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|     |          |                                       |  |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                             |          |                                        |                     |   |
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|     |          |                                       |  |  |      | APPROVED BY:<br>TWH | DISCLAIMER<br><br>NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS. |   | CLIENT   | CITY OF MISSOULA                       |                     |   |
|     |          |                                       |  |  |      | CHECKED BY:<br>TWH  |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                             | PROJECT  | TAKIMA PARK WATER QUALITY IMPROVEMENTS |                     |   |
| B   | 03/05/25 | 90 PERCENT DESIGN – ISSUED FOR REVIEW |  |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                                          | DESIGNED BY:<br>BJS                                                                                                                                                         | TITLE    | GENERAL LANDSCAPE NOTES – TAKIMA PARK  |                     |   |
| A   | 11/22/24 | 60 PERCENT DESIGN – ISSUED FOR REVIEW |  |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                                          | DRAWN BY:<br>DJ&A                                                                                                                                                           | FILENAME |                                        | 7476_Landscape Plan |   |
| REV | DATE     | DESCRIPTION                           |  |  | TECH | ENG                 | DRAWING NO.                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                             | 022      |                                        | REVISION            | B |





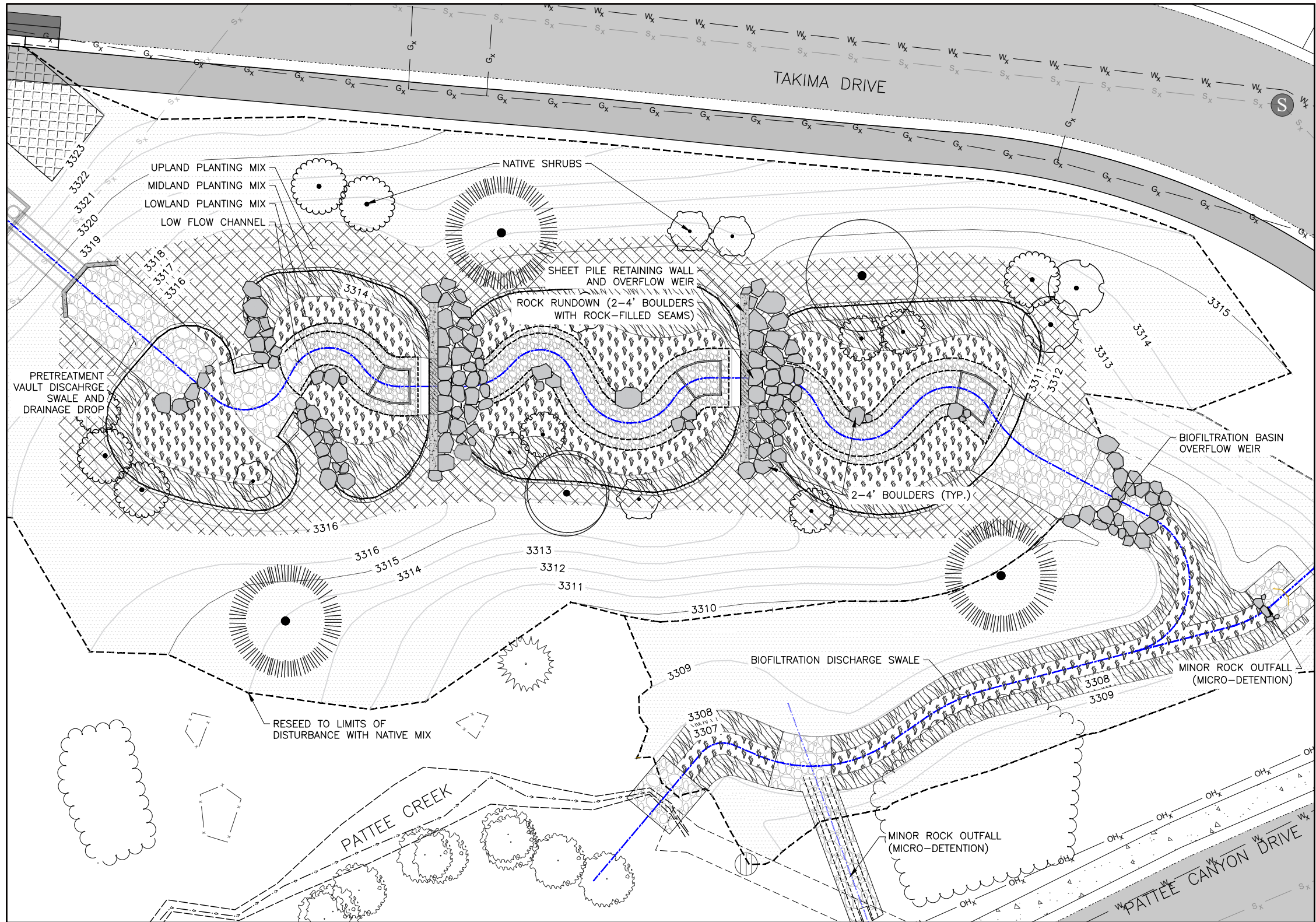
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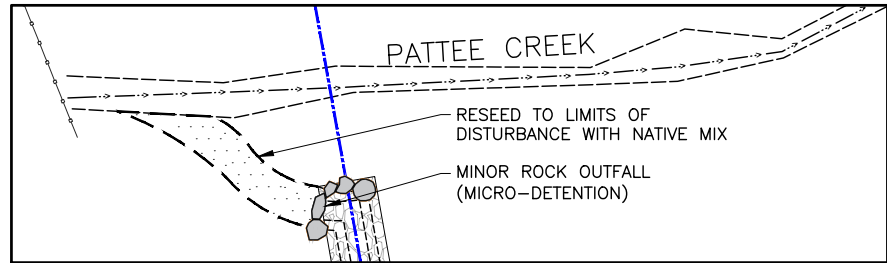
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LANDSCAPE PLAN: BIORETENTION BASINS AND DISCHARGE SWALE



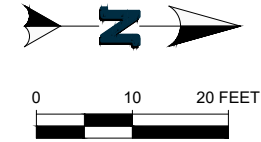
MINOR OUTFALL @ SOUTHEAST CORNER OF TAKIMA PARK

LANDSCAPE AREA SCHEDULE

|  |                                                                                                 |           |
|--|-------------------------------------------------------------------------------------------------|-----------|
|  | LOWLAND PLANTS<br>SPECIES ADAPTED TO STANDING<br>AND FLUCTUATING WATER LEVELS.                  | 1,977 SF  |
|  | MIDLAND PLANTS<br>SPECIES TOLERANT OF<br>FLUCTUATING WATER LEVELS.                              | 2,659 SF  |
|  | UPLAND PLANTS<br>SPECIES TOLERANT OF DROUGHT.                                                   | 3,088 SF  |
|  | NATIVE SEED MIX<br>LOCAL ECOTYPE SEED FOR THE<br>MIDLAND, UPLAND, AND TO<br>DISTURBANCE LIMITS. | 19,787 SF |

NOTES:

1. SEE SHEET 025 FOR FULL PLANTING SCHEDULE
2. SEE SHEETS 026-028 FOR PLANTING PLANS
2. SEE SHEET 029 FOR PLANTING DETAILS



**DRAFT**

|     |          |                                       |  |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                             |                                                   |                                 |               |
|-----|----------|---------------------------------------|--|--|------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|---------------------------------|---------------|
|     |          |                                       |  |  |      | APPROVED BY:<br>TWH | DISCLAIMER<br><br>NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS. |   | CLIENT<br>CITY OF MISSOULA                        |                                 |               |
|     |          |                                       |  |  |      | CHECKED BY:<br>TWH  |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                             | PROJECT<br>TAKIMA PARK WATER QUALITY IMPROVEMENTS |                                 |               |
| B   | 03/05/25 | 90 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                                          | DESIGNED BY:<br>BJS                                                                                                                                                         | TITLE<br><br>LANDSCAPE PLAN - TAKIMA PARK         | FILENAME<br>7476_Landscape_Plan |               |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |  |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                                          | DRAWN BY:<br>DJ&A                                                                                                                                                           |                                                   | DRAWING NO.<br>024              | REVISION<br>B |
| REV | DATE     | DESCRIPTION                           |  |  | TECH | ENG                 |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                             |                                                   |                                 |               |

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| BLOOM SCHEDULE                                  |  |              |            |             |              |            |             |            |          |           |              |            |
|-------------------------------------------------|--|--------------|------------|-------------|--------------|------------|-------------|------------|----------|-----------|--------------|------------|
| BOTANICAL / COMMON NAME                         |  | EARLY SPRING | MID SPRING | LATE SPRING | EARLY SUMMER | MID SUMMER | LATE SUMMER | EARLY FALL | MID FALL | LATE FALL | EARLY WINTER | MID WINTER |
| TREES                                           |  |              |            |             |              |            |             |            |          |           |              |            |
| POPULUS TRICHOCARPA / BLACK COTTONWOOD          |  |              |            |             |              |            |             |            |          |           |              |            |
| PRUNUS VIRGINIANA / CHOKECHERRY                 |  |              |            |             |              |            |             |            |          |           |              |            |
| SHRUBS                                          |  |              |            |             |              |            |             |            |          |           |              |            |
| ACHILLEA MILLEFOLIUM / COMMON YARROW            |  |              |            |             |              |            |             |            |          |           |              |            |
| AGASTACHE URTICIFOLIA / NETTLELEAF GIANT HYSSOP |  |              |            |             |              |            |             |            |          |           |              |            |
| AMELANCHIER ALNIFOLIA / SERVICEBERRY            |  |              |            |             |              |            |             |            |          |           |              |            |
| ANEMONE MULTIFIDA / PACIFIC ANEMONE             |  |              |            |             |              |            |             |            |          |           |              |            |
| ARTEMISIA FRIGIDA / FRINGED WORMWOOD            |  |              |            |             |              |            |             |            |          |           |              |            |
| ASCLEPIAS SPECIOSA / SHOWY MILKWEED             |  |              |            |             |              |            |             |            |          |           |              |            |
| CAREX NEBRASCENSIS / NEBRASKA SEDGE             |  |              |            |             |              |            |             |            |          |           |              |            |
| CAREX PELLITA / WOOLLY SEDGE                    |  |              |            |             |              |            |             |            |          |           |              |            |
| CAREX UTRICULATA / BEAKED SEDGE                 |  |              |            |             |              |            |             |            |          |           |              |            |
| CORNUS SERICEA / RED TWIG DOGWOOD               |  |              |            |             |              |            |             |            |          |           |              |            |
| DESCHAMPسيا CESPITOSA / TUFTED HAIR GRASS       |  |              |            |             |              |            |             |            |          |           |              |            |
| ELEOCHARIS PALUSTRIS / GREAT SPIKE RUSH         |  |              |            |             |              |            |             |            |          |           |              |            |
| ERIGERON PUMILUS / SHAGGY DAISY                 |  |              |            |             |              |            |             |            |          |           |              |            |
| ERIGERON SPECIOSUS / SHOWY FLEABANE             |  |              |            |             |              |            |             |            |          |           |              |            |
| ERIOPHYLLUM LANATUM / WOOLLY SUNFLOWER          |  |              |            |             |              |            |             |            |          |           |              |            |
| FESTUCA CAMPESTRIS / ROUGH FESCUE               |  |              |            |             |              |            |             |            |          |           |              |            |
| FESTUCA IDAHOENSIS / IDAHO FESCUE               |  |              |            |             |              |            |             |            |          |           |              |            |
| GAILLARDIA ARISTATA / BLANKET FLOWER            |  |              |            |             |              |            |             |            |          |           |              |            |
| GERANIUM VISCOSISSIMUM / STICKY GERANIUM        |  |              |            |             |              |            |             |            |          |           |              |            |
| GEUM TRIFLORUM / PRAIRIE SMOKE                  |  |              |            |             |              |            |             |            |          |           |              |            |
| IRIS MISSOURIENSIS / WESTERN BLUE IRIS          |  |              |            |             |              |            |             |            |          |           |              |            |
| JUNCUS BALTICUS / BALTIC RUSH                   |  |              |            |             |              |            |             |            |          |           |              |            |
| KOELERIA MACRANTHA / PRAIRIE JUNEGRASS          |  |              |            |             |              |            |             |            |          |           |              |            |
| MONARDA FISTULOSA / BERGAMOT                    |  |              |            |             |              |            |             |            |          |           |              |            |
| PACKERA CANA / WOOLLY GROUNDSEL                 |  |              |            |             |              |            |             |            |          |           |              |            |
| PANICUM VIRGATUM / SWITCH GRASS                 |  |              |            |             |              |            |             |            |          |           |              |            |
| PENSTEMON ERIANTHERUS / CRESTED BEARDTONGUE     |  |              |            |             |              |            |             |            |          |           |              |            |
| PSEUDOROEGRNERIA SPICATA / BLUEBUNCH WHEATGRASS |  |              |            |             |              |            |             |            |          |           |              |            |
| ROSA WOODSII / WOODS' ROSE                      |  |              |            |             |              |            |             |            |          |           |              |            |
| SHEPHERDIA ARGENTEA / SILVER BUFFALOBERRY       |  |              |            |             |              |            |             |            |          |           |              |            |
| SOLIDAGO MISSOURIENSIS / MISSOURI GOLDENROD     |  |              |            |             |              |            |             |            |          |           |              |            |
| STIPA VIRIDULA / GREEN NEEDLE GRASS             |  |              |            |             |              |            |             |            |          |           |              |            |
| SYMPHORICARPOS ALBUS / COMMON WHITE SNOWBERRY   |  |              |            |             |              |            |             |            |          |           |              |            |
| SYMPHYOTRICHUM LAEVE / SMOOTH ASTER             |  |              |            |             |              |            |             |            |          |           |              |            |
| GROUND COVERS                                   |  |              |            |             |              |            |             |            |          |           |              |            |
| AGROPYRON SMITHII / WESTERN WHEATGRASS          |  |              |            |             |              |            |             |            |          |           |              |            |
| FESTUCA IDAHOENSIS / IDAHO FESCUE               |  |              |            |             |              |            |             |            |          |           |              |            |
| KOELERIA MACRANTHA / PRAIRIE JUNEGRASS          |  |              |            |             |              |            |             |            |          |           |              |            |
| POA SECUNDA / BLUEGRASS                         |  |              |            |             |              |            |             |            |          |           |              |            |
| PSEUDOROEGRNERIA SPICATA / BLUEBUNCH WHEATGRASS |  |              |            |             |              |            |             |            |          |           |              |            |

| PLANTING SCHEDULE                                                                     |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------|---------------------------------------------------------------------------------|
| LOWLAND ZONE PLANTINGS                                                                |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|    | LOWLAND PLANTS 1<br>WATER REQUIREMENTS: WET<br>CAREX UTRICULATA / BEAKED SEDGE<br>ELEOCHARIS PALUSTRIS / GREAT SPIKE RUSH                                                                                                               | 743 SF<br>QTY<br>65<br>65               | SIZE<br>PLUG, CONETAINER<br>PLUG, CONETAINER                     | SPACING<br>50% @ 24" o.c.<br>50% @ 24" o.c.                                     |
|    | LOWLAND PLANTS 2<br>WATER REQUIREMENTS: MEDIUM TO WET<br>CAREX PELLITA / WOOLLY SEDGE<br>IRIS MISSOURIENSIS / WESTERN BLUE IRIS<br>JUNCUS BALTICUS / BALTIC RUSH                                                                        | 747 SF<br>QTY<br>64<br>64<br>64         | SIZE<br>PLUG, CONETAINER<br>PLUG, CONETAINER<br>PLUG, CONETAINER | SPACING<br>33.3% @ 24" o.c.<br>33.3% @ 24" o.c.<br>33.4% @ 24" o.c.             |
|    | LOWLAND PLANTS 3<br>WATER REQUIREMENTS: DRY TO MEDIUM<br>ASCLEPIAS SPECIOSA / SHOWY MILKWEED<br>STIPA VIRIDULA / GREEN NEEDLE GRASS                                                                                                     | 459 SF<br>QTY<br>59<br>55               | SIZE<br>PLUG, CONETAINER<br>PLUG, CONETAINER                     | SPACING<br>52% @ 24" o.c.<br>48% @ 24" o.c.                                     |
| MIDLAND ZONE PLANTINGS                                                                |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|    | MIDLAND PLANTS 1<br>WATER REQUIREMENTS: MEDIUM TO MOIST<br>ANEMONE MULTIFIDA / PACIFIC ANEMONE<br>CAREX NEBRASCENSIS / NEBRASKA SEDGE<br>MONARDA FISTULOSA / BERGAMOT                                                                   | 790 SF<br>QTY<br>17<br>17<br>54         | SIZE<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT                | SPACING<br>20% @ 36" o.c.<br>20% @ 36" o.c.<br>60% @ 36" o.c.                   |
|    | MIDLAND PLANTS 2<br>WATER REQUIREMENTS: DRY TO MEDIUM<br>AGASTACHE URTICIFOLIA / NETTLELEAF GIANT HYSSOP<br>DESCHAMPسيا CESPITOSA / TUFTED HAIR GRASS<br>ERIOPHYLLUM LANATUM / WOOLLY SUNFLOWER<br>FESTUCA IDAHOENSIS / IDAHO FESCUE    | 894 SF<br>QTY<br>23<br>23<br>27<br>19   | SIZE<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT | SPACING<br>25% @ 36" o.c.<br>25% @ 36" o.c.<br>30% @ 36" o.c.<br>20% @ 36" o.c. |
|                                                                                       |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|                                                                                       |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|                                                                                       |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|   | MIDLAND PLANTS 3<br>WATER REQUIREMENTS: DRY TO MEDIUM<br>ACHILLEA MILLEFOLIUM / COMMON YARROW<br>FESTUCA CAMPESTRIS / ROUGH FESCUE<br>GERANIUM VISCOSISSIMUM / STICKY GERANIUM<br>SYMPHYOTRICHUM LAEVE / SMOOTH ASTER                   | 915 SF<br>QTY<br>15<br>47<br>25<br>15   | SIZE<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT | SPACING<br>15% @ 36" o.c.<br>45% @ 36" o.c.<br>25% @ 36" o.c.<br>15% @ 36" o.c. |
| UPLAND ZONE PLANTINGS                                                                 |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|  | UPLAND PLANTS 1<br>WATER REQUIREMENTS: DROUGT TOLERANT<br>ARTEMISIA FRIGIDA / FRINGED WORMWOOD<br>ERIGERON SPECIOSUS / SHOWY FLEABANE<br>PSEUDOROEGRNERIA SPICATA / BLUEBUNCH WHEATGRASS<br>SOLIDAGO MISSOURIENSIS / MISSOURI GOLDENROD | 958 SF<br>QTY<br>17<br>9<br>25<br>9     | SIZE<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT | SPACING<br>30% @ 48" o.c.<br>15% @ 48" o.c.<br>40% @ 48" o.c.<br>15% @ 48" o.c. |
|  | UPLAND PLANTS 2<br>WATER REQUIREMENTS: DROUGT TOLERANT<br>ERIGERON PUMILUS / SHAGGY DAISY<br>FESTUCA IDAHOENSIS / IDAHO FESCUE<br>PACKERA CANA / WOOLLY GROUNDSEL<br>PENSTEMON ERIANTHERUS / CRESTED BEARDTONGUE                        | 1,160 SF<br>QTY<br>13<br>32<br>22<br>13 | SIZE<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT | SPACING<br>15% @ 48" o.c.<br>40% @ 48" o.c.<br>30% @ 48" o.c.<br>15% @ 48" o.c. |
|                                                                                       |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|                                                                                       |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|                                                                                       |                                                                                                                                                                                                                                         |                                         |                                                                  |                                                                                 |
|  | UPLAND PLANTS 3<br>WATER REQUIREMENTS: DROUGT TOLERANT<br>GAILLARDIA ARISTATA / BLANKET FLOWER<br>GEUM TRIFLORUM / PRAIRIE SMOKE<br>KOELERIA MACRANTHA / PRAIRIE JUNEGRASS<br>PANICUM VIRGATUM / SWITCH GRASS                           | 866 SF<br>QTY<br>15<br>7<br>22<br>7     | SIZE<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT<br>1 GAL., POT | SPACING<br>30% @ 48" o.c.<br>15% @ 48" o.c.<br>40% @ 48" o.c.<br>15% @ 48" o.c. |

| TREES & SHRUBS                                                                      |                                                       |         |           |              |     |
|-------------------------------------------------------------------------------------|-------------------------------------------------------|---------|-----------|--------------|-----|
| SYMBOL                                                                              | BOTANICAL / COMMON NAME                               | SIZE    | CONTAINER | MINIMUM SIZE | QTY |
| TREES                                                                               |                                                       |         |           |              |     |
|  | PINUS PONDEROSA<br>PONDEROSA PINE                     | 2" CAL. | B&B       | 6' MIN HT    | 3   |
|  | POPULUS TRICHOCARPA<br>BLACK COTTONWOOD               | 2" CAL. | B&B       | 6' MIN HT    | 1   |
|  | PRUNUS VIRGINIANA<br>CHOKECHERRY                      | 5 GAL.  | POT       |              | 1   |
| SYMBOL                                                                              | BOTANICAL / COMMON NAME                               | SIZE    | CONTAINER |              | QTY |
| SHRUBS                                                                              |                                                       |         |           |              |     |
|  | AMELANCHIER ALNIFOLIA<br>SERVICEBERRY                 | #5      | CONT      |              | 5   |
|  | CERCOCARPUS LEDIFOLIUS<br>CURL-LEAF MOUNTAIN MAHOGANY | #5      | CONT      |              | 2   |
|  | CORNUS SERICEA<br>RED TWIG DOGWOOD                    | #5      | CONT      |              | 3   |
|  | ROSA WOODSII<br>WOODS' ROSE                           | #5      | CONT      |              | 3   |
|  | SHEPHERDIA ARGENTEA<br>SILVER BUFFALOBERRY            | #5      | CONT      |              | 2   |
|  | SYMPHORICARPOS ALBUS<br>COMMON WHITE SNOWBERRY        | #5      | CONT      |              | 3   |

| NATIVE SEED                                                                         |                                                                                                 |           |  |  |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------|--|--|
|  | NATIVE SEED MIX<br>LOCAL ECOTYPE SEED FOR THE<br>MIDLAND, UPLAND, AND TO<br>DISTURBANCE LIMITS. | 19,787 SF |  |  |

| NATIVE SEED SCHEDULE     |          |           |         |  |
|--------------------------|----------|-----------|---------|--|
| TOTAL AREA — 19,460 SF   | % OF MIX | #PLS/ACRE | VARIETY |  |
| AGROPYRON SMITHII        | 50       | 20        |         |  |
| FESTUCA IDAHOENSIS       | 25       | 10        |         |  |
| KOELERIA MACRANTHA       | 15       | 6         |         |  |
| POA SECUNDA              | 5        | 2         |         |  |
| PSEUDOROEGRNERIA SPICATA | 5        | 2         | GOLDAR  |  |

|                                                                                                                                                                                                                                                                                       |  |  |  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| SEEDING NOTES:                                                                                                                                                                                                                                                                        |  |  |  |  |
| 1. CONTRACTOR TO USE LOCALLY SOURCED ECOTYPE FOR NATIVE SEED MIXES.                                                                                                                                                                                                                   |  |  |  |  |
| 2. SEED APPLICATION RATE OF 40LBS PLS / ACRE. RATE BASED ON BROADCAST SEEDING WITH HYDROMULCH.                                                                                                                                                                                        |  |  |  |  |
| 3. SEED TO BE DELIVERED TO THE PROJECT SITE IN UNOPENED PACKAGING WITH SEED TAGS FIRMLY AFFIXED TO THE OUTSIDE OF THE PACKAGE. SEED TAGS TO BE PROVIDED TO THE OWNER PRIOR TO COMMENCEMENT OF SEEDING OPERATIONS SHOWING SOURCE OR ORIGIN AND THE COMPLIANCE WITH SPECIFIED SEED MIX. |  |  |  |  |
| 4. SEEDING LIMITS SHOWN ON PLANS ARE APPROXIMATE. ALL AREAS DISTURBED BY CONSTRUCTION OPERATIONS SHALL BE PREPARED, SEEDED, AND HYDROMULCHED BY THE CONTRACTOR.                                                                                                                       |  |  |  |  |
| 5. REFER TO GENERAL PLANTING NOTES FOR CONTRACTOR RESPONSIBILITES REGARDING WEED CONTROL.                                                                                                                                                                                             |  |  |  |  |

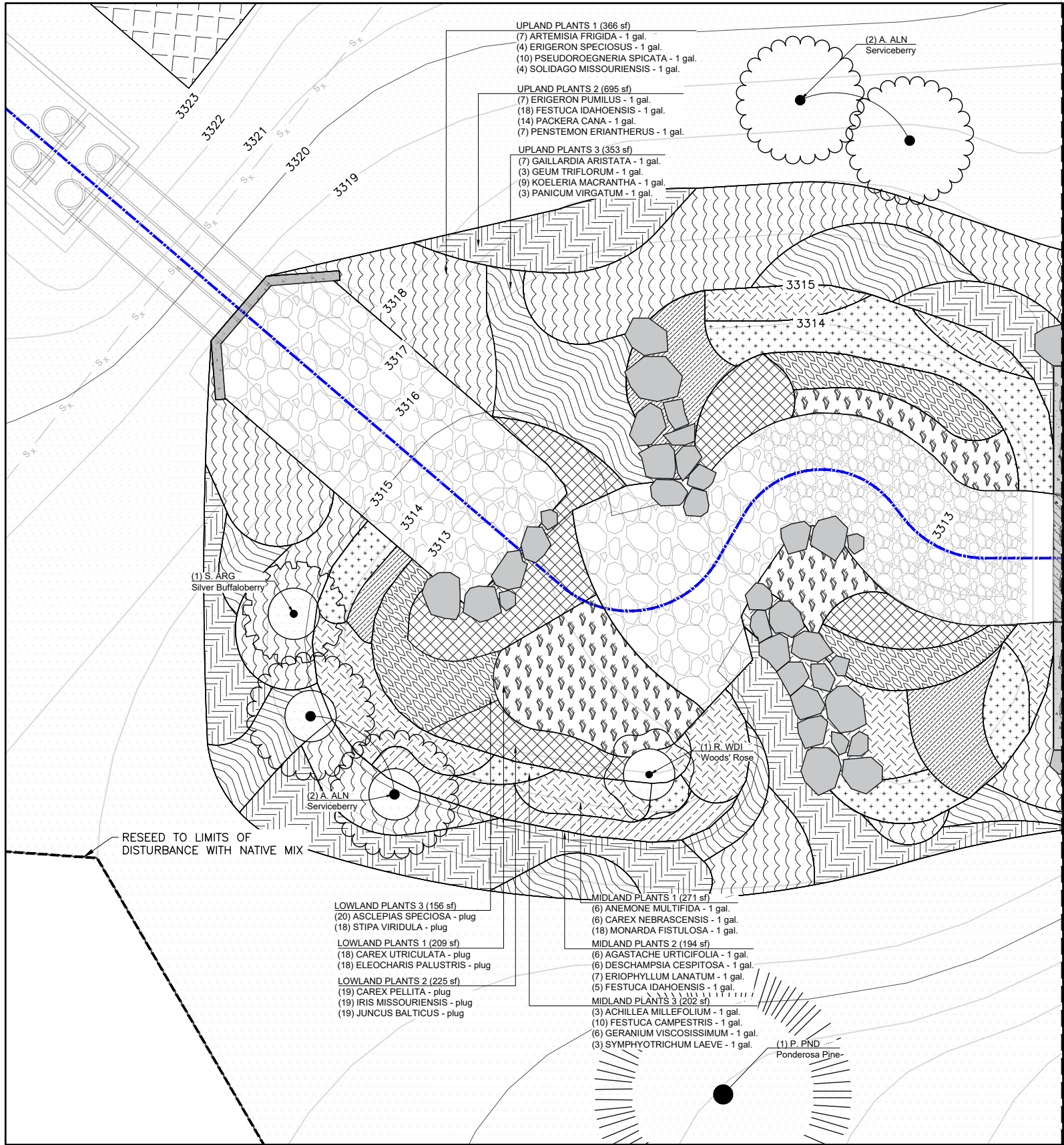
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|     |          |                                       |  |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                                                                     |
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|     |          |                                       |  |  |      | DESIGNED BY:<br>BJS |                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                                                                     |
|     |          |                                       |  |  |      | DRAWN BY:<br>DJ&A   |                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                                                                     |
| B   | 03/05/25 | 90 PERCENT DESIGN — ISSUED FOR REVIEW |  |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                        |  | PROJECT<br>TAKIMA PARK WATER QUALITY IMPROVEMENTS                                                                                   |
| A   | 11/22/24 | 60 PERCENT DESIGN — ISSUED FOR REVIEW |  |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                                                                     |
| REV | DATE     | DESCRIPTION                           |  |  | TECH | ENG                 |                                                                                                                                                                                                                                                                                                                                                                                        |  |                                                                                                                                     |

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| TITLE                               |  | FILENAME            |          |
| PLANTING SPECIES LIST — TAKIMA PARK |  | 7476_Landscape_Plan |          |
|                                     |  | DRAWING NO.         | REVISION |
|                                     |  | 025                 | B        |



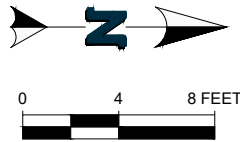
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PLANTING PLAN - SEDIMENTATION BAY AND CELL 1 BIORETENTION BASIN

NOTES:

1. STAKE ALL TREES AND SHRUBS BASED ON THESE DRAWINGS. EXACT LOCATIONS OF PLANT MATERIALS TO BE APPROVED BY THE LANDSCAPE ARCHITECT AND PROJECT MANAGER IN THE FIELD PRIOR TO INSTALLATION. LANDSCAPE ARCHITECT RESERVES THE RIGHT TO ADJUST EXACT LOCATIONS IN THE FIELD.



| REV | DATE     | DESCRIPTION                           | TECH | ENG |
|-----|----------|---------------------------------------|------|-----|
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| CHECKED BY:  | TWH  |
| DESIGNED BY: | BJS  |
| DRAWN BY:    | DJ&A |

| DISCLAIMER                                                                                                                                                                                                                                                                                                                                                                             |  |
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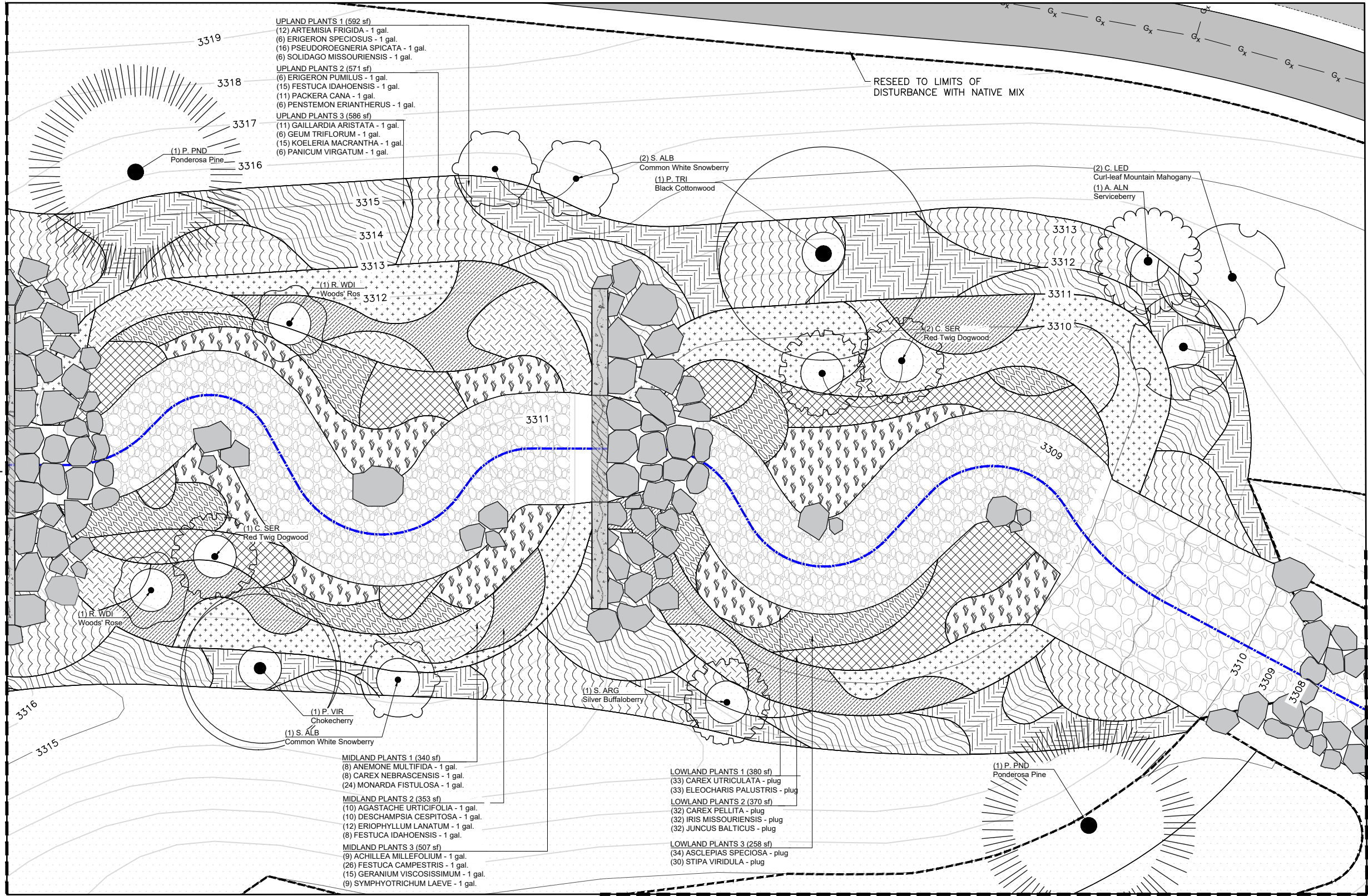
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|  CLIENT |  | CITY OF MISSOULA                       |          |
| PROJECT                                                                                      |  | TAKIMA PARK WATER QUALITY IMPROVEMENTS |          |
| TITLE                                                                                        |  | FILENAME                               |          |
| LANDSCAPE PLAN – TAKIMA PARK                                                                 |  | 7476_Landscape Plan                    |          |
|                                                                                              |  | DRAWING NO.                            | REVISION |
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MATCHLINE | SEE SHEET 026



MATCHLINE | SEE SHEET 028

PLANTING PLAN - CELLS 1 AND 2 BIORETENTION BASINS

**DRAFT**

NOTES:

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| REV | DATE     | DESCRIPTION                           | TECH | ENG |
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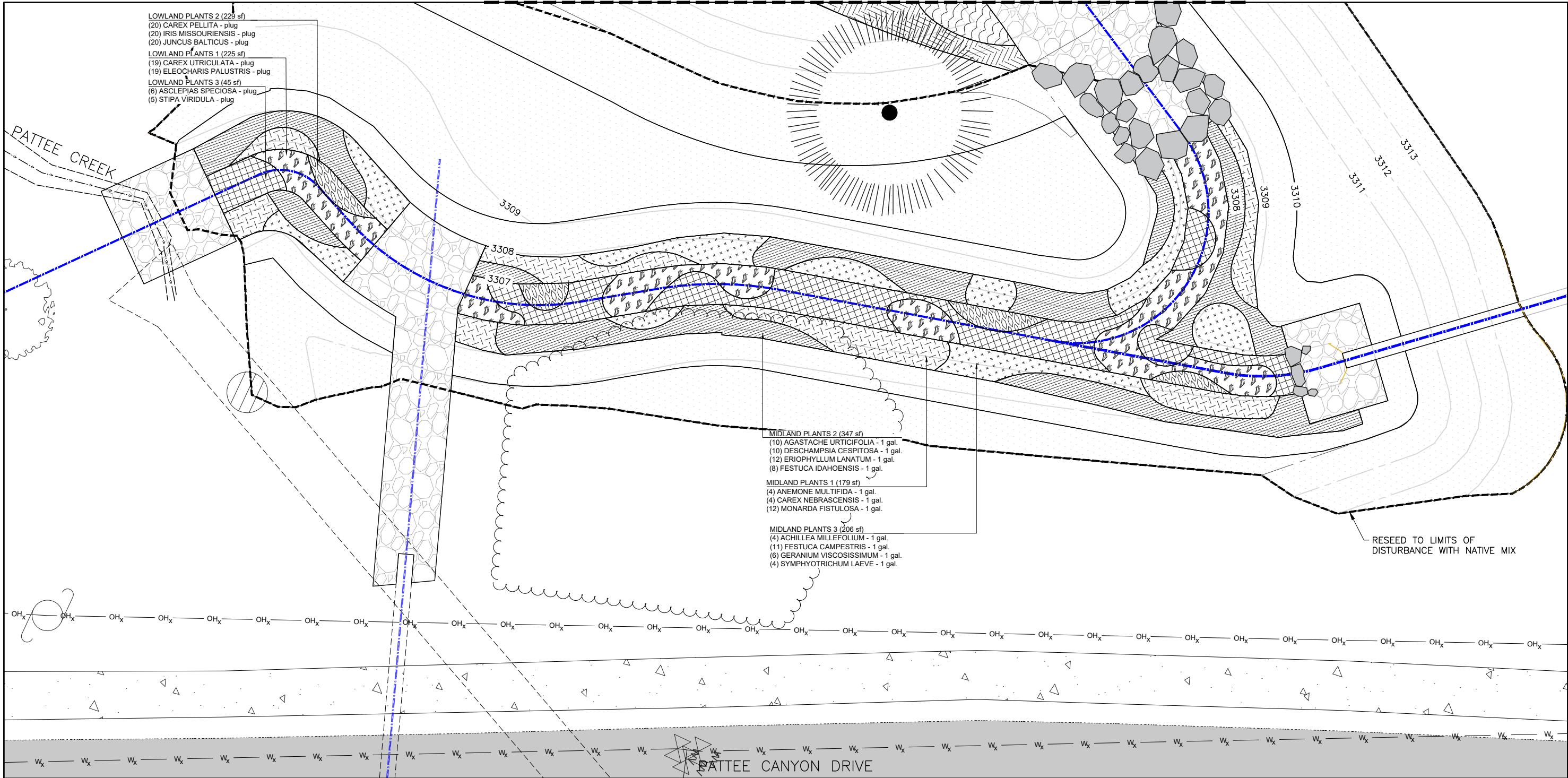
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| PROJECT                                |  | CLIENT              |          |
| TAKIMA PARK WATER QUALITY IMPROVEMENTS |  | CITY OF MISSOULA    |          |
| TITLE                                  |  | FILENAME            |          |
| LANDSCAPE PLAN - TAKIMA PARK           |  | 7476_Landscape Plan |          |
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MATCHLINE | SEE SHEET 027



PLANTING PLAN - BIOFILTRATION DISCHARGE SWALE

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|                                       |          |                                       |  |      |     |                     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                        |               |
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|                                       |          |                                       |  |      |     | DESIGNED BY:<br>BJS |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                        |               |
| B                                     | 03/05/25 | 90 PERCENT DESIGN – ISSUED FOR REVIEW |  | BJS  | TWH |                     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                        |               |
| A                                     | 11/22/24 | 60 PERCENT DESIGN – ISSUED FOR REVIEW |  | BJS  | TWH |                     |                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                        |               |
| REV                                   | DATE     | DESCRIPTION                           |  | TECH | ENG | DRAWN BY:<br>DJ&A   |                                                                                                                                                                                                                                                                                                                                                                                                          | PROJECT<br>TAKIMA PARK WATER QUALITY IMPROVEMENTS                                                                                                                                                      |               |
| TITLE<br>LANDSCAPE PLAN – TAKIMA PARK |          |                                       |  |      |     |                     |                                                                                                                                                                                                                                                                                                                                                                                                          | FILENAME<br>7476_Landscape Plan                                                                                                                                                                        |               |
|                                       |          |                                       |  |      |     |                     |                                                                                                                                                                                                                                                                                                                                                                                                          | DRAWING NO.<br>028                                                                                                                                                                                     | REVISION<br>B |

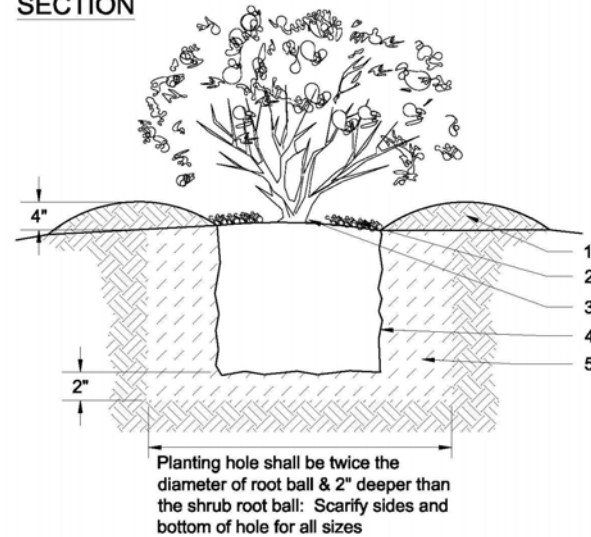
Diagram illustrating the process of transplanting a tree into a new location, showing the tree, root ball, and surrounding soil structure.

Instructions and Labels:

- REMOVE ALL TABS & LABELS
- REMOVE TRUNK WRAP
- POLYLOCK TREE TIES
- 8' TREE STAKES DRIVE 2' INTO SOIL
- GRAFT UNION: TYP. 4" - 6" ABOVE ROOT FLARE
- ROOT FLARE: LEVEL WITH OR UP TO 1" ABOVE FINISH GRADE
- TEMPORARY RAISED RING OF SOIL 6" MIN. HEIGHT
- REMOVE ALL TWINE, WIRE AND BURLAP FROM TOP, SIDES AND BOTTOM OF ROOTBALL PRIOR TO BACKFILLING
- SET ROOT BALL ON UNDISTURBED NATIVE SOIL TO PREVENT SETTLING
- DIG HOLE 2-3 TIMES THE WIDTH OF ROOT BALL ROUGHEN SIDES TO DISTURB GLAZING
- 36" MIN. DIA. MULCH RING

## BALL & BURLAP TREE PLANTING NOTES

- ## SECTION



1. Temporary watering basin; 4" high and twice the diameter of the root ball
2. Top dress Mulch as per specifications
3. Set Root Crown of plant 1" above soil finish grade to allow for settlement  
Remove excess potting mix to expose root crown
4. Scarify the outside of root ball & remove all circling roots
5. Backfill planting hole 2/3 full with existing soil, settle with water, continue to fill with soil, water again. Water thoroughly after installation to eliminate air pockets

LANDSCAPE CONTAINER SHRUB PLANTING DETAIL

The diagram illustrates the layout of a 10' x 10' x 10' experimental plot. It shows a series of plants arranged in a row, with a central path or gap between them. The plants are labeled 1 through 5. A distance of 8' is indicated between the first two plants. A scale bar at the bottom indicates 10'.

1. Use triangular equidistant spacing between plantings. See planting plan for spacing details.
2. Ground Cover plant location
3. 2" - 4" of top dress mulch as per specifications
4. Set Root Crown of plant 1" above soil finish grade to allow for settlement  
Remove excess potting mix to expose root crown
5. Backfill planting hole 2/3 full with existing soil, settle with water, continue to fill with soil, water again. Water thoroughly after installation to eliminate air pockets.

### GROUND COVER PLANTING & SPACING DETAIL

|     |          |                                       |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                             |                                        |                                |                     |
|-----|----------|---------------------------------------|--|------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------|---------------------|
|     |          |                                       |  |      | APPROVED BY:<br>TWH | <p>DISCLAIMER</p> <p>NEWFIELDS PRODUCED THE INFORMATION PRESENTED ON THIS DRAWING THROUGH THE USE OF AVAILABLE TECHNICAL INFORMATION AND EXPERIENCE. RECEIVING THIS DRAWING DOES NOT GUARANTEE ANY RIGHTS TO EITHER SUCH TECHNICAL INFORMATION OR EXPERIENCE. ANY MODIFICATION OR ADAPTATION OF THE DATA OR DRAWING SHALL BE AT USER'S RISK AND WITHOUT ANY LIABILITY OR LEGAL RESPONSIBILITY TO NEWFIELDS.</p> |   | CLIENT                                 | CITY OF MISSOULA               |                     |
|     |          |                                       |  |      | CHECKED BY:<br>TWH  |                                                                                                                                                                                                                                                                                                                                                                                                                 | PROJECT                                                                                                                                                                     | TAKIMA PARK WATER QUALITY IMPROVEMENTS |                                |                     |
| B   | 03/05/25 | 90 PERCENT DESIGN - ISSUED FOR REVIEW |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                                                 | DESIGNED BY:<br>BJS                                                                                                                                                         | TITLE                                  | PLANTING DETAILS - TAKIMA PARK |                     |
| A   | 11/22/24 | 60 PERCENT DESIGN - ISSUED FOR REVIEW |  | BJS  | TWH                 |                                                                                                                                                                                                                                                                                                                                                                                                                 | DRAWN BY:<br>DJ&A                                                                                                                                                           |                                        | FILENAME                       | 7476_Landscape Plan |
| REV | DATE     | DESCRIPTION                           |  | TECH | ENG                 |                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                             |                                        | DRAWING NO.                    | REVISION            |
|     |          |                                       |  |      |                     |                                                                                                                                                                                                                                                                                                                                                                                                                 | 029                                                                                                                                                                         | B                                      |                                |                     |





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## AQUATIC RESOURCES MAPS

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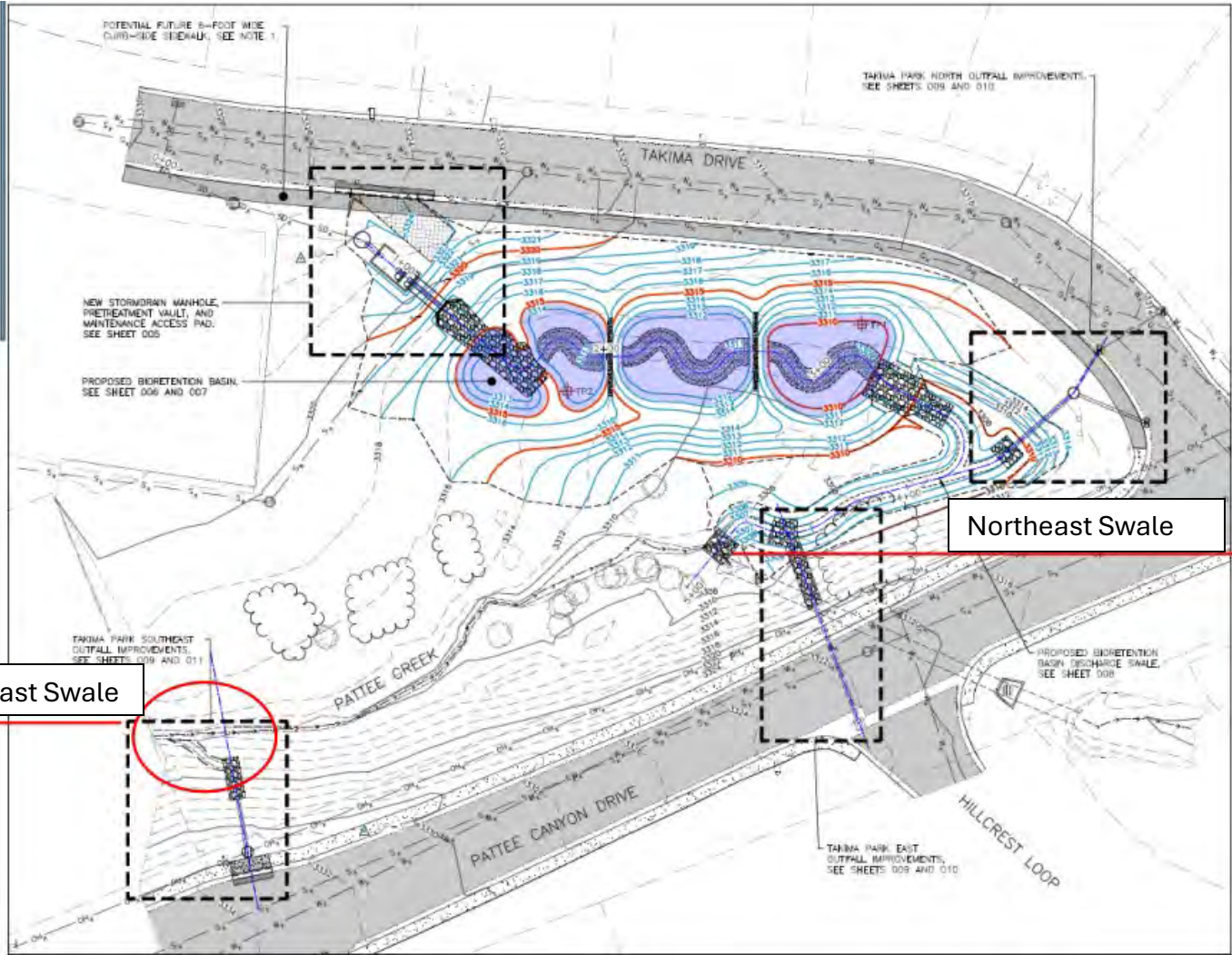
- Data Collection Points
- OHWM
- Contour (1ft)
- Wetland A
- Regulatory Floodway
- Wetland Delineation Boundary

Wetland A - 100 (Sq. Ft.)  
 Pattee Creek - 250 (Ln. Ft.)

**Aquatic Resource Map  
 Takima Park Wetland Delineation  
 Missoula County, MT**



Takima Park Stormwater Improvement Design Planview







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## PHOTOS

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Northeast swale outfall



Current Riprap will be removed then placed back after grading the Biofiltration discharge swale to protect culvert. No riprap will be placed in the stream channel.



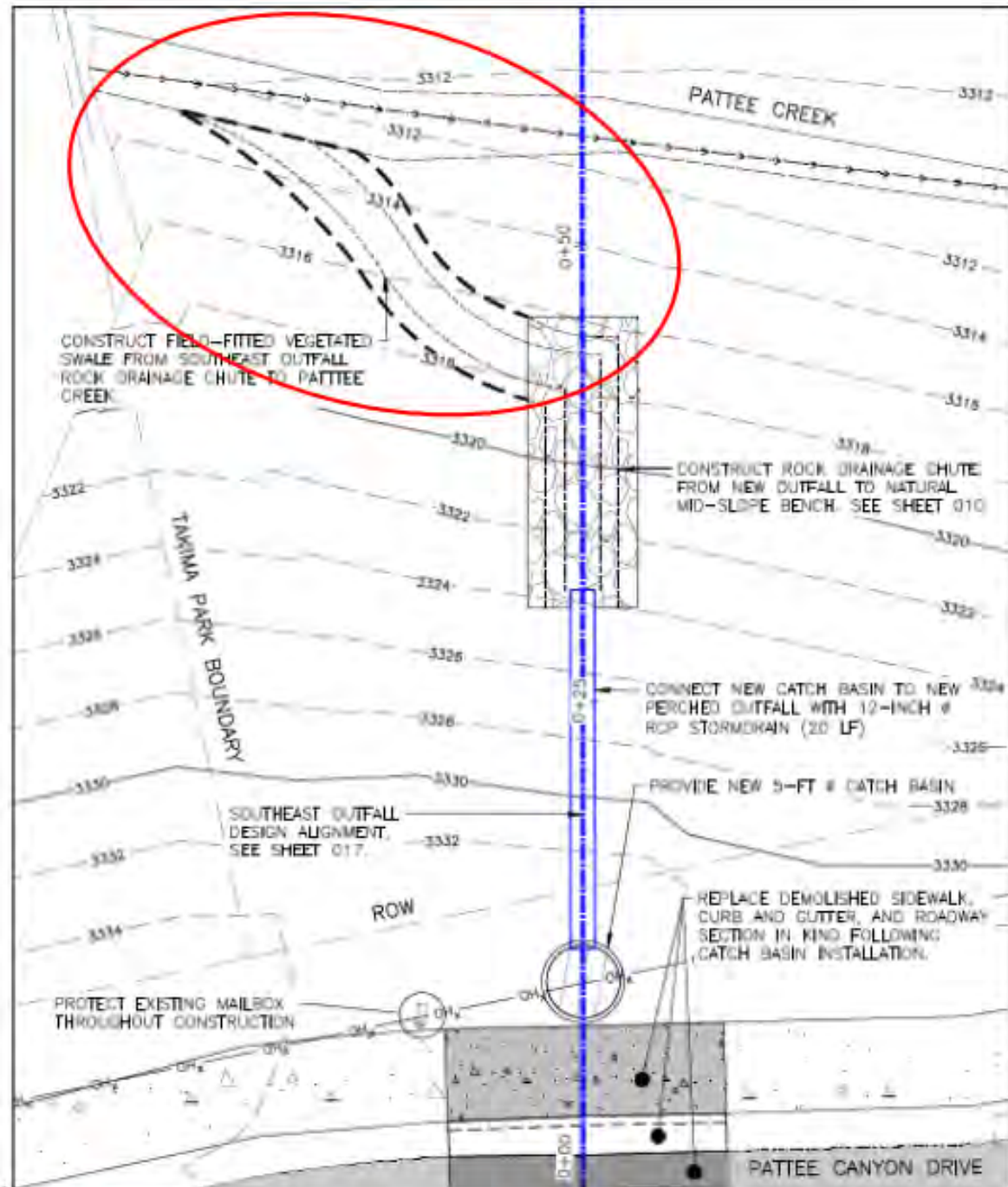
Southeast stormdrain outfall



Toe of rock  
drainage chute.

Approximate field fit  
vegetated swale





**PLAN: SOUTHEAST STORMDRAIN OUTFALL**



## Pattee Creek Instream Vegetation



Section of Pattee Creek that includes large woody debris, cottonwoods and chokecherry throughout streambanks with sedges, rushes and grasses at lower elevations.



## Takima Park Riparian Vegetation





## Takima Park Wetland Vegetation



100 square foot isolated wetland at the base of a stormwater outfall. Contains cattails, bullrush and broadleaf plantain. Surrounded by rangeland grasses at higher elevations.



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# FLOODPLAIN ANALYSIS REPORT

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## TECHNICAL MEMORANDUM

**To:** City of Missoula Floodplain Administrator  
c/o Alex Bramlette, Senior Planner  
Missoula, MT

**From:** Matthew Peterson, PE; NewFields

**Reviewed By:** Brian Wellington, PhD; NewFields

**Project:** Takima Park Water Quality Improvements

**Subject:** Floodway No-Rise Analysis for the Takima Park Water Quality Improvements Project near Pattee Creek

**Date:** 17 March 2025



## INTRODUCTION

The City of Missoula (City) is pursuing stormwater management and water quality improvements at Takima Park (Site) in Missoula, Montana. The Site is located directly south of the Pattee Canyon Drive – Takima Drive intersection and has four stormwater management system outfalls owned and managed by the City (**Figure 1**). Pattee Creek flows through Takima Park and receives stormwater discharge from each of the four outfalls. The stormwater discharging to the Site is untreated and likely contains pollutants.

The objective of the Takima Park Water Quality Improvements Project (Project) is to construct bioretention basins and associated stormwater management facilities at the Site to improve the quality of stormwater that discharges to Pattee Creek. The existing storm drain that conveys water to the Site's primary outfall will be modified (trimmed) so that stormwater enters the new facility at the south end of Takima Park. The Site is naturally sloped and has space constraints, so the new facility will contain three tiered bioretention cells. The downstream-most cell will discharge to a meandering biofiltration swale that will discharge to Pattee Creek. A rendering of the proposed Site modifications is provided in **Figure A-1 (Attachment A)**.

A portion of the Site is designated as a Regulatory Floodway by the Federal Emergency Management Agency (FEMA). The floodway and floodplain are associated with Pattee Creek (**Figure 2**), and the proposed Project will modify the existing ground within a portion of the Regulatory Floodway. Based on discussion with the City's Development Services staff, a floodway no-rise analysis is required for proposed work in the Regulatory Floodway. The no-rise analysis must show the Project will not cause any increase to the Base Flood Elevation of the Regulatory Floodway.<sup>1</sup>

This technical memorandum presents the methodology and results of the no-rise analysis for the proposed Project.

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<sup>1</sup> The Base Flood Elevation is the water surface elevation of a flood having a 1-percent chance of being equaled or exceeded in any given year (i.e., a 100-year flood).



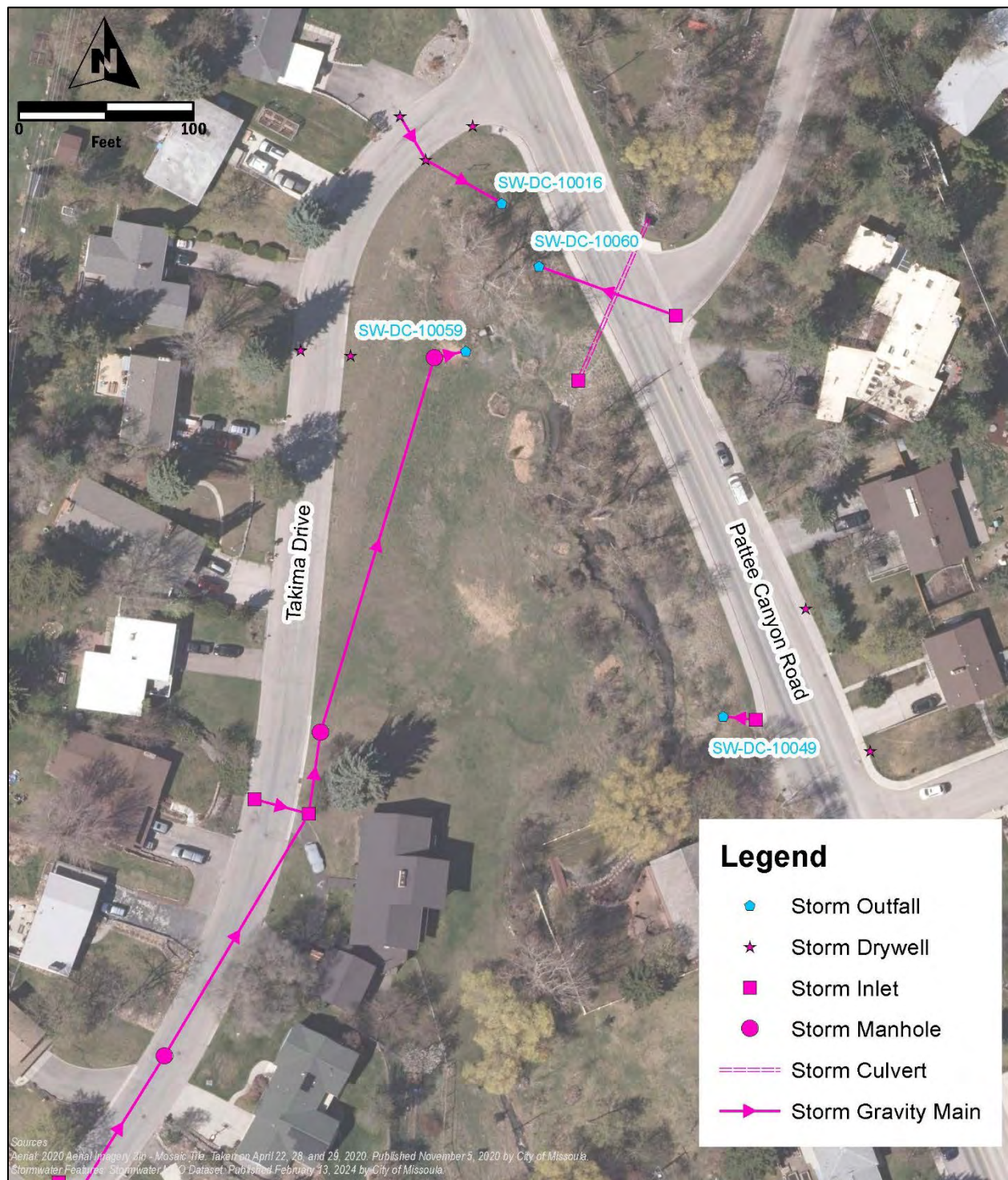


Figure 1. Existing Site Layout



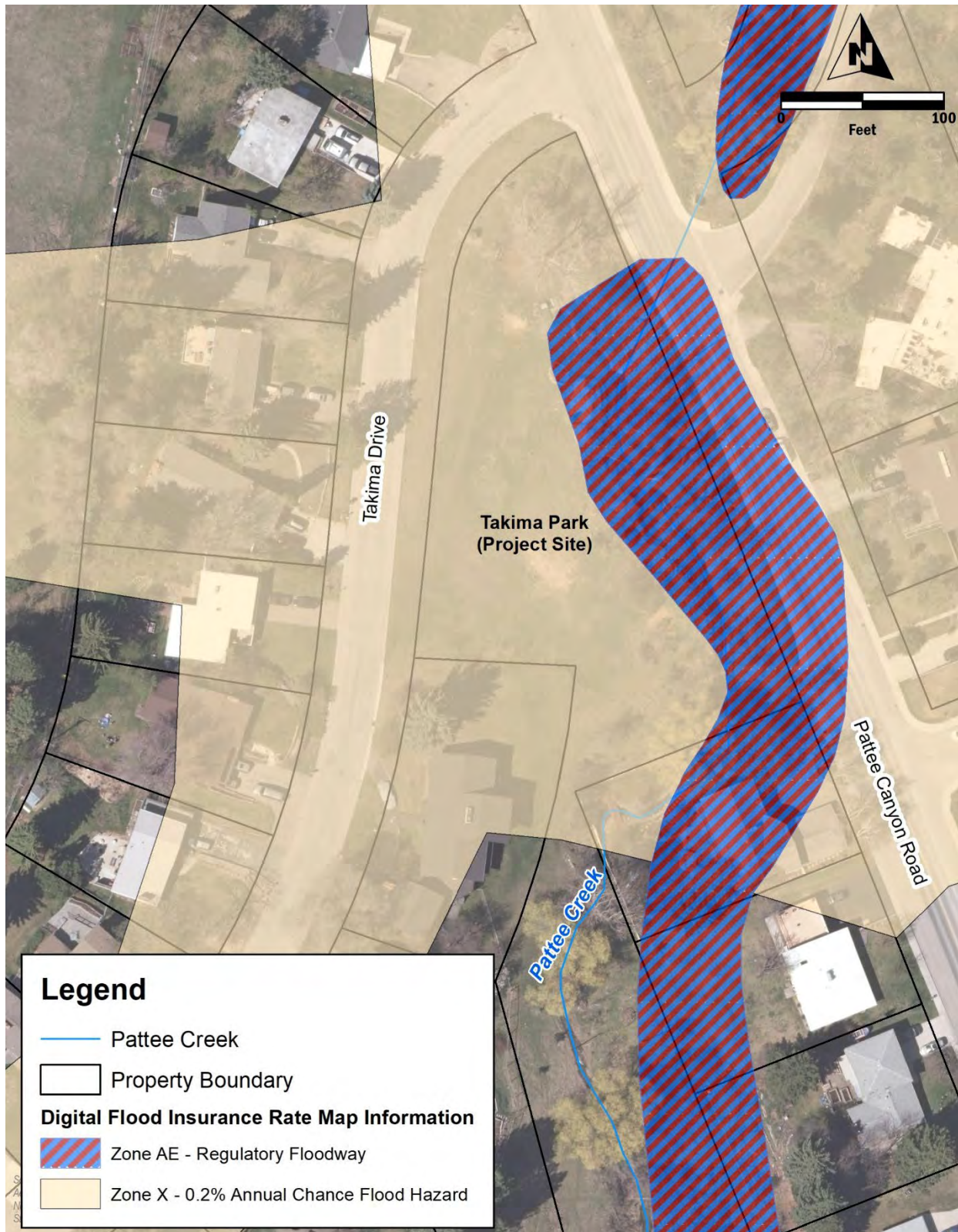


Figure 2. FEMA Flood Insurance Rate Map Information



## HYDROLOGIC AND HYDRAULICS ANALYSIS METHODOLOGY AND RESULTS

This section presents NewFields hydrologic and hydraulic analyses in support of the no-rise analysis.

### Hydrologic Analysis and Results

The Pattee Creek 1-percent annual chance peak discharge (i.e., 100-year flood flow) through the Site is defined in the Missoula County Flood Insurance Study (FIS) as 195 cubic feet per second (CFS) (FEMA, 2023). NewFields conducted a secondary hydrologic analysis using U.S. Geological Survey (USGS) regional regression equations for comparison because the study referenced in the FIS was conducted in 1977. Use of regional regression equations is generally appropriate for ungaged streams, such as Pattee Creek, when a 1-percent annual chance peak discharge is not published in the FIS (FEMA, 2019).

The regional regression equation for Montana's West Hydrologic Region, presented in USGS's *Scientific Investigation Report 2015-5019-F* (Sando, Sando, McCarthy, & Dutton, 2016), predicts a 100-year peak flow rate of 169 cfs at the Project Site.<sup>2</sup> The more conservative value of 195 cfs presented in the FIS was used for the hydraulics analysis.

### Existing Conditions Hydraulics Analysis

The hydraulics analysis simulated the Pattee Creek 100-year flood discharge (195 CFS) through the Site to predict the 100-year flood profile and inundation area for the pre-Project (existing) conditions. NewFields developed a two-dimensional (2D) hydraulic model using the U.S. Army Corps of Engineers HEC-RAS software program. A 2D model was selected for use because the terrain modifications associated with the Project include complex grading in the Pattee Creek overbank immediately upstream of the existing Pattee Canyon Rd culvert. A 2D model can better evaluate hydraulic impacts associated with complex terrain in a channel overbank.

The HEC-RAS model geometry was developed using a single 2D flow area that simulates flow entering the study area approximately 1,350 feet upstream of Pattee Canyon Rd. The 2D flow area has an average cell size of approximately 390 square feet and extends 415 feet downstream of Pattee Canyon Rd. The model terrain was developed from a publicly available LiDAR bare-earth digital elevation model (DEM) developed by Quantum Spatial in 2019.

The culvert that conveys Pattee Creek flows through Pattee Canyon Rd is a complex structure. The inlet is a 60-inch diameter reinforced concrete pipe (RCP) with a flared end section and trash grate. A circular 60-inch diameter grated manhole-type structure is located approximately 15 feet downstream of the RCP flared end section (upstream of Pattee Canyon Rd). NewFields anticipates this is an overflow inlet designed to convey flood flows into the culvert if the flared end section trash grate gets clogged. A nearly identical 60-inch diameter grated manhole-type structure is located downstream of Pattee Canyon Rd, approximately 30 feet upstream of the culvert outlet. The culvert outlet is a 36-inch diameter RCP with a flared wood headwall. A survey diagram with photos is provided as **Figure A-2 (Attachment A)**.

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<sup>2</sup> Pattee Creek basin characteristics were determined using the USGS StreamStats program. The StreamStats report is provided in **Attachment B**.





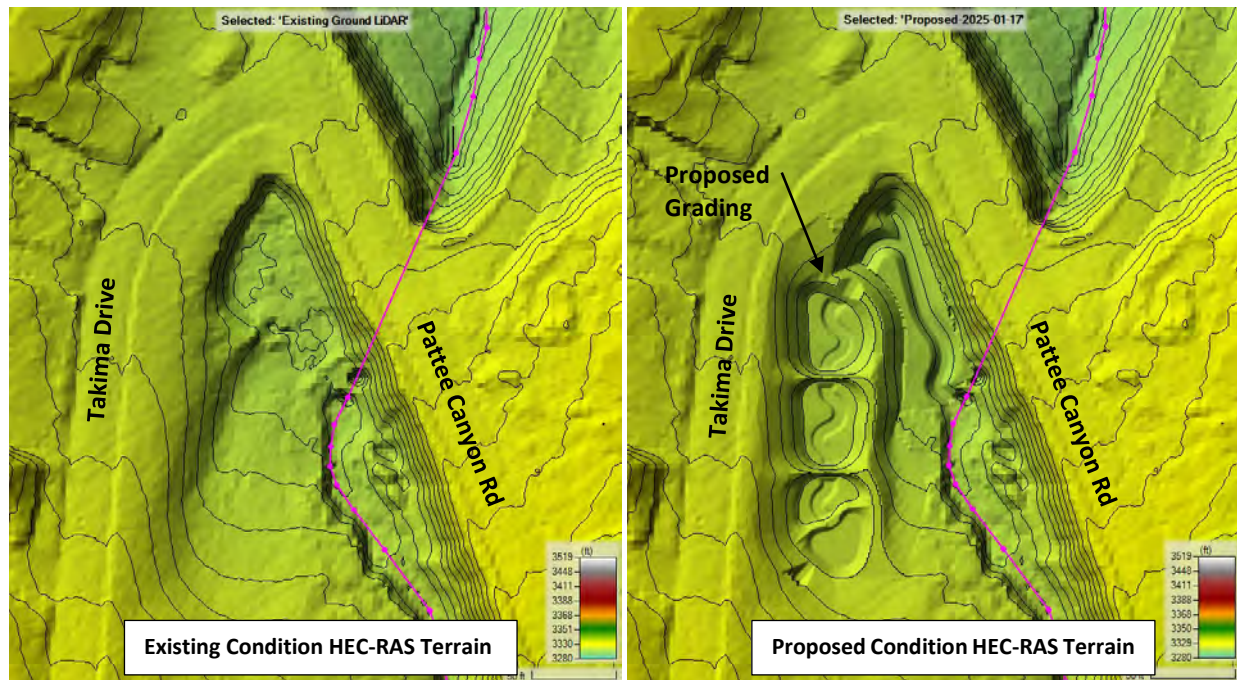
HEC-RAS does not have the ability to model the Pattee Creek Rd culvert using a standard culvert geometry. The 36-inch diameter outlet will greatly reduce the capacity of the structure; however, the capacity will not be reduced to that of a standard 36-inch diameter pipe because of the grated manhole on the downstream side of Pattee Canyon Rd. The rim elevation of this 60-inch diameter manhole is 3310.52 feet (ft), over 4 ft below the Pattee Creek Rd and Takima Drive crest elevation of approximately 3315; therefore, the downstream manhole will be activated before upstream flood flows overtop the road and the culvert will operate with a capacity that's greater than a standard 36-inch diameter RCP. Based on this information, the culvert has an undefined conveyance capacity of less than a standard 60-inch RCP and more than a standard 36-inch RCP. NewFields therefore developed four existing conditions geometries with varying culvert sizes: 36-inches, 42-inches, 48-inches, and 54-inches for comparison and consideration.

The model was run as an unsteady flow analysis using an inflow hydrograph with a constant flow of 195 cfs to simulate the Pattee Creek 100-year flood event. Supplementary HEC-RAS model setup information is provided in **Attachment C**.

### **Proposed Conditions Hydraulics Analysis**

The proposed Project will involve terrain modifications along the Pattee Creek left overbank upstream of Pattee Canyon Rd to construct the three tiered bioretention cells and the biofiltration swale that will discharge to Pattee Creek. These features were merged with the existing condition LiDAR DEM to create the proposed condition HEC-RAS 2D terrain.

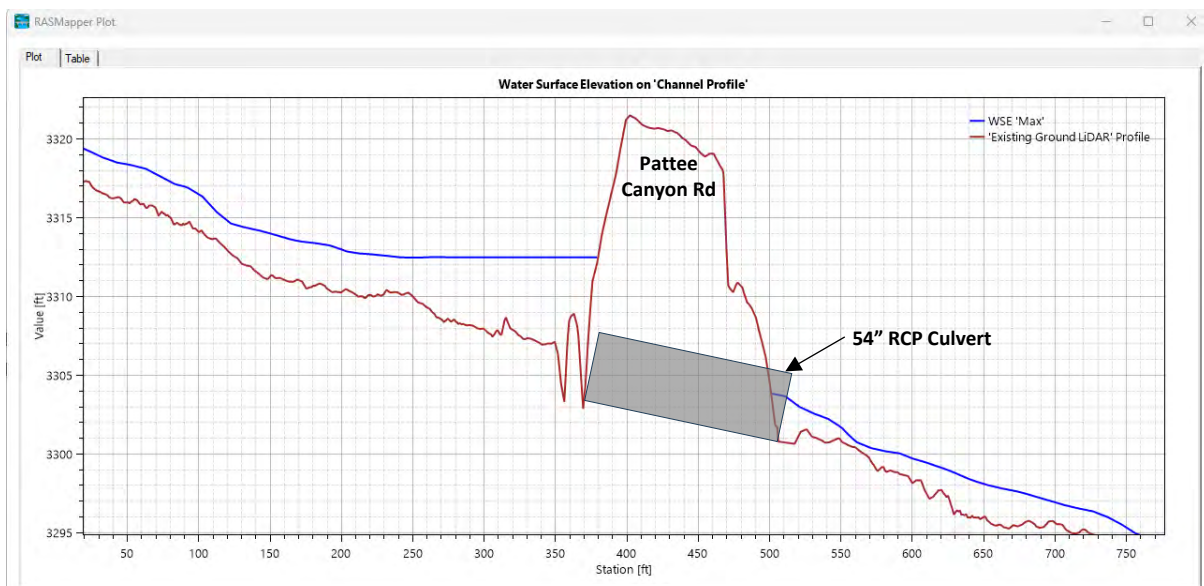
Screenshots of the HEC-RAS terrain comparisons for existing to proposed conditions are provided in **Figure 3**. The four existing condition geometries (four culvert size scenarios) were copied and the proposed condition terrain was applied to each of them. As with the existing condition analyses, the model was run as an unsteady flow analysis using an inflow hydrograph with a constant flow of 195 cfs to simulate the Pattee Creek 100-year flood event.



**Figure 3. HEC-RAS Model Terrain Comparison**

### HYDRAULICS ANALYSIS RESULTS

The Pattee Canyon Rd culvert has far less capacity than the Pattee Creek channel and floodplain upstream of Pattee Canyon Rd. This is evident because the existing condition HEC-RAS model predicts backed-up flow for 140 feet upstream of Pattee Creek Road for even the largest culvert that was modeled (54-inch diameter; **Figure 4**).



**Figure 4. Pattee Creek Existing Condition HEC-RAS Model Results for 54-Inch Diameter Culvert**



The objective of the no-rise analysis is to evaluate whether the Project will cause a rise to the Pattee Creek 100-year water surface elevations. This is a comparative analysis and does not require verification or establishment of regulatory Base Flood Elevations. Basic hydraulic principles would suggest that terrain modifications in the overbank upstream of a culvert that limits flow through the system will not impact the conveyance capacity of the system and therefore should not impact the predicted water surface elevations compared to existing conditions. The model results confirm this and show no-rise in water surface elevations along the Pattee Creek alignment for each of the four culvert's evaluated. Tabulated results are provided in **Attachment D**. Additionally, predicted flood inundation extents are nearly identical for each existing vs. proposed scenario (**Figures A-3 to A-7**).

## CONCLUSION

Four culvert scenarios were evaluated for the existing versus proposed hydraulic model no-rise analysis because the existing culvert is a complex structure and HEC-RAS cannot accurately simulate it using standard culvert geometries. The culvert's conveyance capacity is greater than the 36-inch RCP outlet and less than the 60-inch RCP inlet. Modeling four scenarios with culvert sizes between 36- and 60-inches accounts for the uncertainty associated with the complex culvert structure. In all scenarios, the Pattee Canyon Rd culvert limits conveyance through the system, and as expected the results show no-rise in water surface elevations along the Pattee Creek alignment for existing versus proposed conditions.

Based on this no-rise analysis, the Project will not cause an increase of more than 0.00 feet to the Base Flood Elevation of the Pattee Creek Regulatory Floodway.

Please contact me at [mpeterson@newfields.com](mailto:mpeterson@newfields.com) if you have any questions.

Sincerely,  
NewFields

Matthew Peterson, PE  
Civil Engineer





## REFERENCES

- FEMA. (2019). *Guidance for Flood Risk Analysis and Mapping: General Hydrologic Considerations*.
- FEMA. (2023). *Flood Insurance Rate Study for Missoula County, Montana*.
- Quantum Spatial. (2019). *Clark Fork Bitterroot, Montana: Q1 LiDAR Technical Data Report*. Corvallis, OR.
- Sando, R., Sando, S., McCarthy, P., & Dutton, D. (2016). *Scientific Investigations Report 2015–5019–F: Methods for Estimating Peak-Flow Frequencies at Ungaged Sites in Montana Based on Data through Water Year 2011*. U.S. Geological Survey.
- U. S. Army Corps of Engineers - Hydrologic Engineering Center. (2024). *HEC-RAS 6.6*. Davis, CA.

## **ATTACHMENT A – SUPPLEMENTARY FIGURES**



TAKIMA PARK STORMWATER TREATMENT

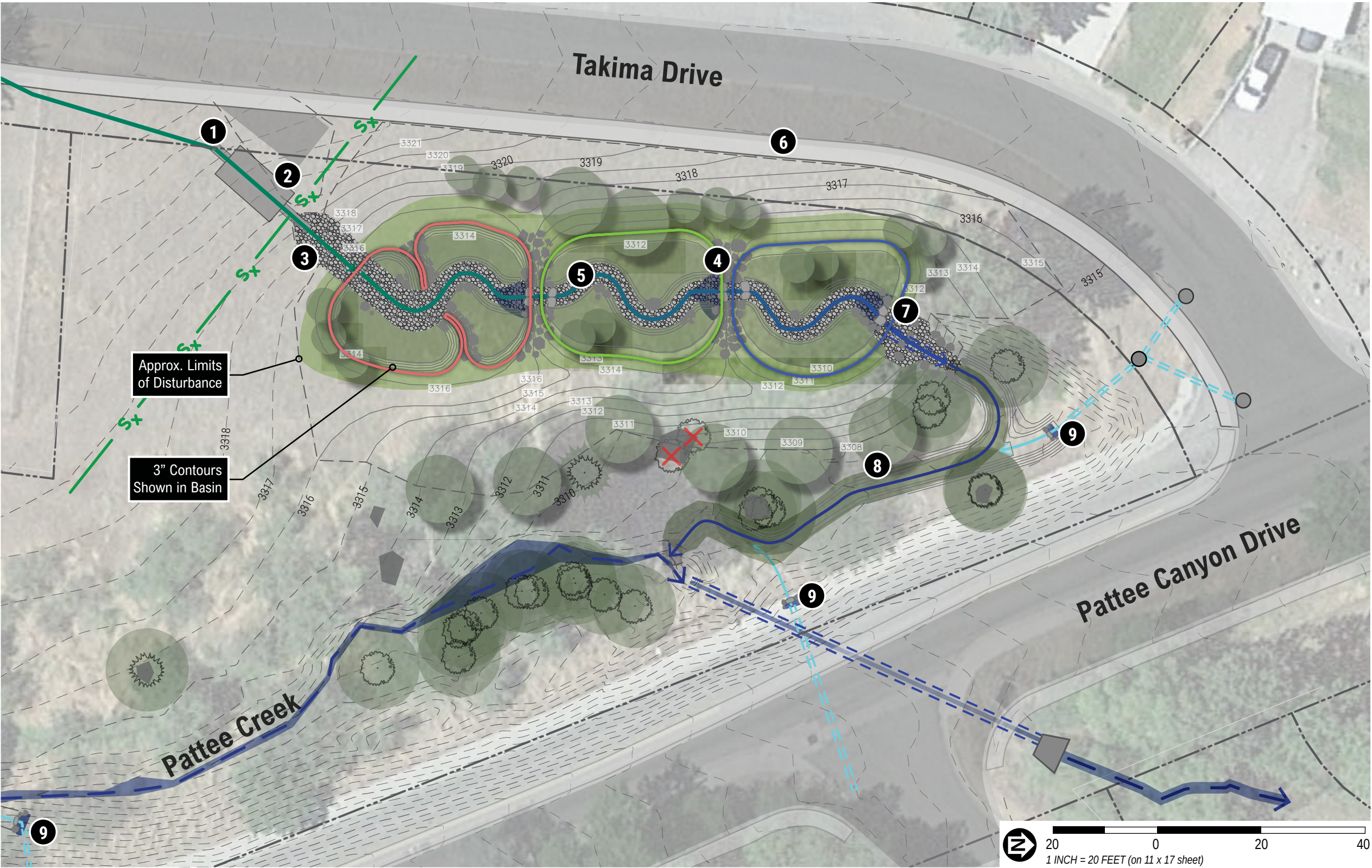
# BIORETENTION BASIN - SITE PLAN

**SITE PLAN LEGEND**

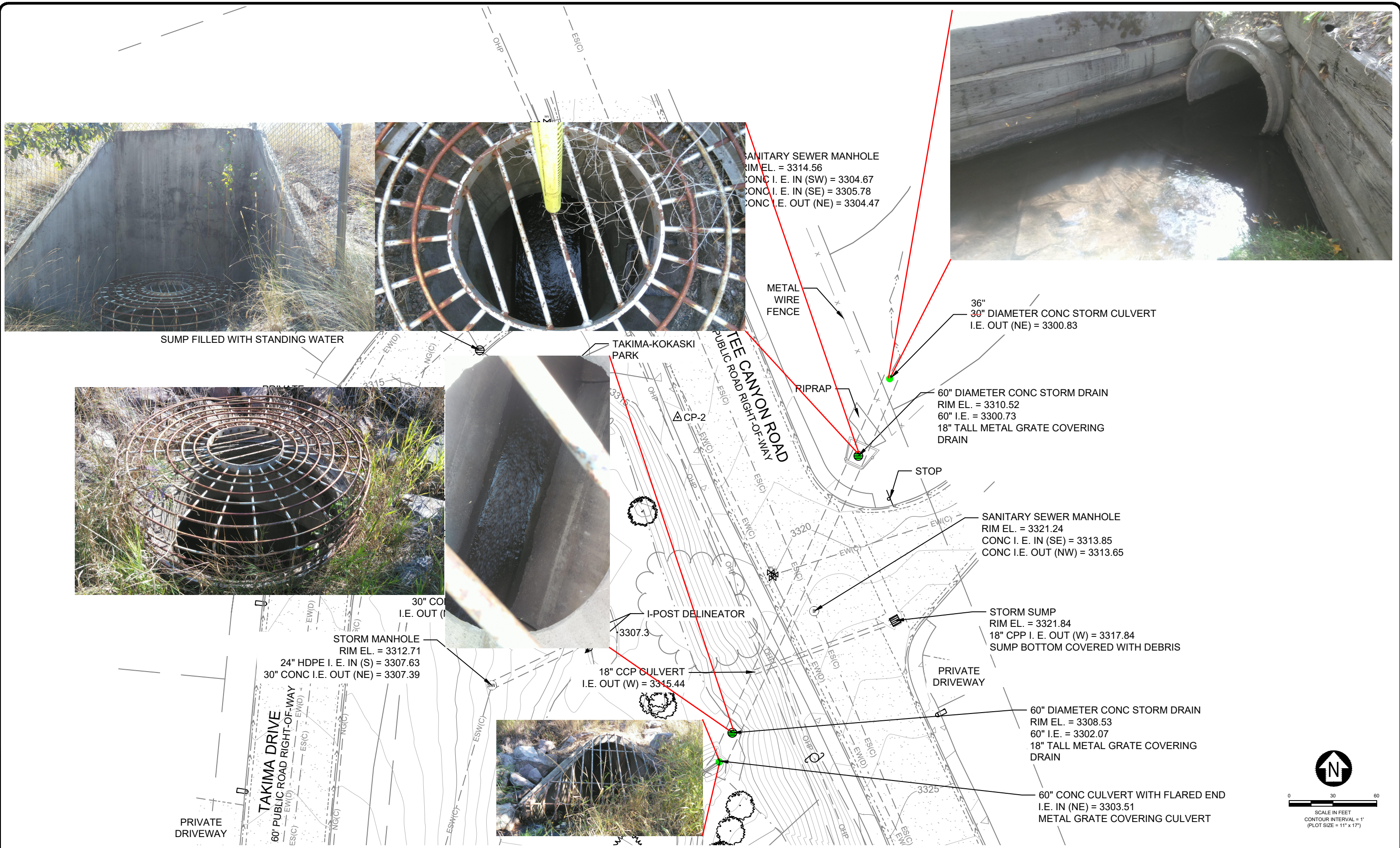
- 1 Tie-into Existing Stormwater Line
- 2 Pretreatment Cell and Outflow
- 3 Rockery - Water Energy Dissipation
- 4 Rock Weir - 3' Drop
- 5 Meandering Low-flow Water Channel
- 6 Future Curbside Sidewalk - 6' Wide
- 7 Outfall - Water Overflows to Swale
- 8 Biofiltration Discharge Swale from "Zone 3" to Pattee Creek
- 9 Minor Outfall - Microdetention
- Native Plantings - Consists of Upland, Riparian, & Emergent Vegetation
- Boulders / Rip-Rap
- Existing Sanitary Sewer Line
- Existing Contours
- Proposed Contours
- Flow of Stormwater to be Treated
- Minor Storm Drain Outfalls
- Water Pooling Areas - Standing Water
- Trees to be Removed

**BIORETENTION ZONES**

- Zone 1 - Partial Water Infiltration
- Zone 2 - Partial Water Infiltration
- Zone 3 - Occassional Standing Water

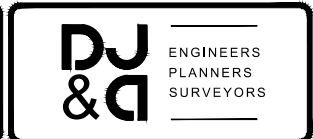






| REVISION | DATE | DESCRIPTION |
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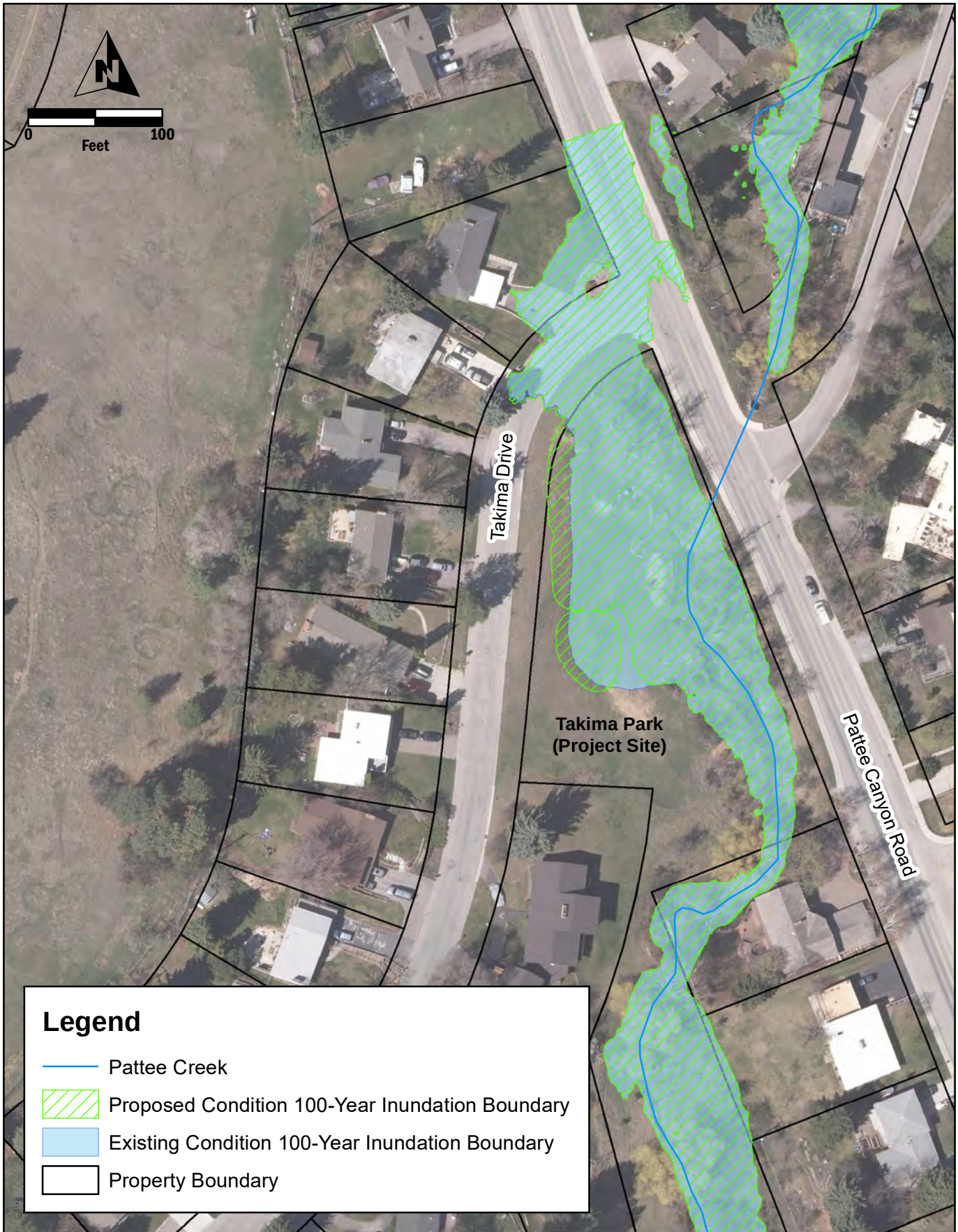
|          |     |           |           |
|----------|-----|-----------|-----------|
| DESIGNER | -   | PROJ. NO. | 7476      |
| DRAWN    | CKM | DATE      | 09/2024   |
| CHECKED  | HBT | SURVEYED  | DJ&A P.C. |



TAKIMA PARK  
MISSOULA, MT  
NEWFIELDS LLC

FIGURE A-2  
TOPOGRAPHIC MAP





36" Culvert Scenario HEC-RAS Model Results  
Takima Park Water Quality Improvements Project  
Missoula County, Montana  
**FIGURE A-3**





42" Culvert Scenario HEC-RAS Model Results  
 Takima Park Water Quality Improvements Project  
 Missoula County, Montana  
**FIGURE A-4**





48" Culvert Scenario HEC-RAS Model Results  
 Takima Park Water Quality Improvements Project  
 Missoula County, Montana  
**FIGURE A-5**





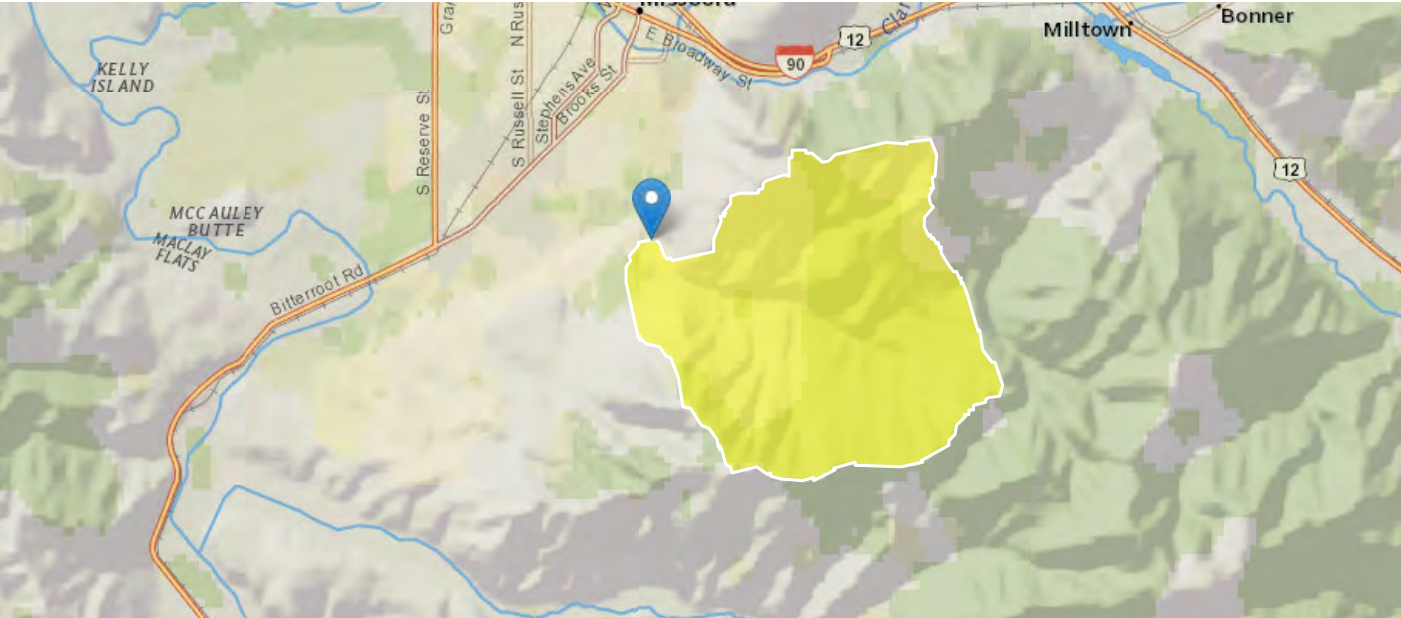
54" Culvert Scenario HEC-RAS Model Results  
 Takima Park Water Quality Improvements Project  
 Missoula County, Montana  
**FIGURE A-6**



## **ATTACHMENT B – HYDROLOGIC ANALYSIS SUPPORTING DOCUMENTATION**

# Pattee Creek StreamStats Report

Region ID: MT  
Workspace ID: MT20240722180447418000  
Clicked Point (Latitude, Longitude): 46.83722, -113.99124  
Time: 2024-07-22 12:05:32 -0600



Location: Intersection of Pattee Canyon Rd & Takima Drive

Collapse All

➤ Basin Characteristics

| Parameter Code | Parameter Description                                                                | Value | Unit         |
|----------------|--------------------------------------------------------------------------------------|-------|--------------|
| CHANWD_RS      | Channel width determined from remotely sensed data sources, including aerial imagery | 0     | feet         |
| CONTDA         | Area that contributes flow to a point on a stream                                    | 9.5   | square miles |
| FOREST         | Percentage of area covered by forest                                                 | 69.8  | percent      |
| PRECIP         | Mean Annual Precipitation                                                            | 22.34 | inches       |
| WACTCH         | Width of active channel                                                              | 0     | feet         |
| WBANKFULL      | Width of channel at bankfull                                                         | 0     | feet         |



➤ Peak-Flow Statistics

Peak-Flow Statistics Parameters [W Region BasinC 2015 5019F]

| Parameter Code | Parameter Name             | Value | Units        | Min Limit | Max Limit |
|----------------|----------------------------|-------|--------------|-----------|-----------|
| CONTDA         | Contributing Drainage Area | 9.5   | square miles | 0.6       | 2470      |
| PRECIP         | Mean Annual Precipitation  | 22.34 | inches       | 14.6      | 62.1      |
| FOREST         | Percent Forest             | 69.8  | percent      | 20.4      | 99.1      |

Peak-Flow Statistics Parameters [W Region Active Channel SIR 2020 5142]

| Parameter Code | Parameter Name          | Value | Units | Min Limit | Max Limit |
|----------------|-------------------------|-------|-------|-----------|-----------|
| WACTCH         | Width Of Active Channel | 0     | feet  | 3         | 213       |

Peak-Flow Statistics Parameters [W Region Bankfull SIR 2020 5142]

| Parameter Code | Parameter Name            | Value | Units | Min Limit | Max Limit |
|----------------|---------------------------|-------|-------|-----------|-----------|
| WBANKFULL      | Width Of Bankfull Channel | 0     | feet  | 5         | 246       |

Peak-Flow Statistics Parameters [W Region Aerial Photo SIR 2020 5142]

| Parameter Code | Parameter Name                | Value | Units | Min Limit | Max Limit |
|----------------|-------------------------------|-------|-------|-----------|-----------|
| CHANWD_RS      | Channel_Width_remotely_sensed | 0     | feet  | 2.3       | 203.8     |

Peak-Flow Statistics Flow Report [W Region BasinC 2015 5019F]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

| Statistic              | Value | Unit   | PIL  | PIU  | ASEp |
|------------------------|-------|--------|------|------|------|
| 66.7-percent AEP flood | 21.5  | ft^3/s | 8.64 | 53.5 | 59.4 |
| 50-percent AEP flood   | 29.9  | ft^3/s | 12.4 | 71.9 | 56.5 |
| 42.9-percent AEP flood | 34.3  | ft^3/s | 14.4 | 81.8 | 55.7 |
| 20-percent AEP flood   | 56.4  | ft^3/s | 24.5 | 130  | 53.4 |
| 10-percent AEP flood   | 81.2  | ft^3/s | 35.5 | 186  | 52.8 |
| 4-percent AEP flood    | 112   | ft^3/s | 48.8 | 257  | 53.2 |
| 2-percent AEP flood    | 139   | ft^3/s | 59.4 | 325  | 54.2 |
| 1-percent AEP flood    | 169   | ft^3/s | 70.8 | 403  | 56   |
| 0.5-percent AEP flood  | 202   | ft^3/s | 82.4 | 495  | 58   |
| 0.2-percent AEP flood  | 244   | ft^3/s | 95.2 | 625  | 61.4 |

Peak-Flow Statistics Disclaimers [W Region Active Channel SIR 2020 5142]

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

Peak-Flow Statistics Flow Report [W Region Active Channel SIR 2020 5142]

| Statistic                                | Value | Unit   |
|------------------------------------------|-------|--------|
| Active chan width 66.7 percent AEP flood | 0     | ft^3/s |

| Statistic                                  | Value | Unit   |
|--------------------------------------------|-------|--------|
| Active Channel Width 50-percent AEP flood  | 0     | ft^3/s |
| Active chan width 42.9 percent AEP flood   | 0     | ft^3/s |
| Active Channel Width 20-percent AEP flood  | 0     | ft^3/s |
| Active Channel Width 10-percent AEP flood  | 0     | ft^3/s |
| Active Channel Width 4-percent AEP flood   | 0     | ft^3/s |
| Active Channel Width 2-percent AEP flood   | 0     | ft^3/s |
| Active Channel Width 1-percent AEP flood   | 0     | ft^3/s |
| Active Channel Width 0.5-percent AEP flood | 0     | ft^3/s |
| Active Channel Width 0.2-percent AEP flood | 0     | ft^3/s |

Peak-Flow Statistics Disclaimers [W Region Bankfull SIR 2020 5142]

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

Peak-Flow Statistics Flow Report [W Region Bankfull SIR 2020 5142]

| Statistic                             | Value | Unit   |
|---------------------------------------|-------|--------|
| Bankfull width 66.7 percent AEP flood | 0     | ft^3/s |
| Bankfull Width 50-percent AEP flood   | 0     | ft^3/s |
| Bankfull width 42.9 percent AEP flood | 0     | ft^3/s |
| Bankfull Width 20-percent AEP flood   | 0     | ft^3/s |
| Bankfull Width 10-percent AEP flood   | 0     | ft^3/s |
| Bankfull Width 4-percent AEP flood    | 0     | ft^3/s |
| Bankfull Width 2-percent AEP flood    | 0     | ft^3/s |
| Bankfull Width 1-percent AEP flood    | 0     | ft^3/s |
| Bankfull Width 0.5-percent AEP flood  | 0     | ft^3/s |
| Bankfull Width 0.2-percent AEP flood  | 0     | ft^3/s |

Peak-Flow Statistics Disclaimers [W Region Aerial Photo SIR 2020 5142]

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

Peak-Flow Statistics Flow Report [W Region Aerial Photo SIR 2020 5142]

| Statistic                                | Value | Unit   |
|------------------------------------------|-------|--------|
| Rem sens chan width 66.7 percent AEP fld | 0     | ft^3/s |
| Rem_sens_chan_width_50_percent_AEP_flood | 0     | ft^3/s |
| Rem sens chan width 42.9 percent AEP fld | 0     | ft^3/s |
| Rem_sens_chan_width_20_percent_AEP_flood | 0     | ft^3/s |
| Rem_sens_chan_width_10_percent_AEP_flood | 0     | ft^3/s |
| Rem_sens_chan_width_4_percent_AEP_flood  | 0     | ft^3/s |
| Rem_sens_chan_width_2_percent_AEP_flood  | 0     | ft^3/s |
| Rem_sens_chan_width_1_percent_AEP_flood  | 0     | ft^3/s |
| Rem_sens_chan_width_0_5_pct_AEP_flood    | 0     | ft^3/s |



| Statistic                             | Value | Unit   |
|---------------------------------------|-------|--------|
| Rem_sens_chan_width_0_2_pct_AEP_flood | 0     | ft^3/s |

### Peak-Flow Statistics Flow Report [Area-Averaged]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct (other -- see report)

| Statistic                                  | Value | Unit   | PIL  | PIU  | ASEp |
|--------------------------------------------|-------|--------|------|------|------|
| 66.7-percent AEP flood                     | 21.5  | ft^3/s | 8.64 | 53.5 | 59.4 |
| 50-percent AEP flood                       | 29.9  | ft^3/s | 12.4 | 71.9 | 56.5 |
| 42.9-percent AEP flood                     | 34.3  | ft^3/s | 14.4 | 81.8 | 55.7 |
| 20-percent AEP flood                       | 56.4  | ft^3/s | 24.5 | 130  | 53.4 |
| 10-percent AEP flood                       | 81.2  | ft^3/s | 35.5 | 186  | 52.8 |
| 4-percent AEP flood                        | 112   | ft^3/s | 48.8 | 257  | 53.2 |
| 2-percent AEP flood                        | 139   | ft^3/s | 59.4 | 325  | 54.2 |
| 1-percent AEP flood                        | 169   | ft^3/s | 70.8 | 403  | 56   |
| 0.5-percent AEP flood                      | 202   | ft^3/s | 82.4 | 495  | 58   |
| 0.2-percent AEP flood                      | 244   | ft^3/s | 95.2 | 625  | 61.4 |
| Active chan width 66.7 percent AEP flood   | 0     | ft^3/s |      |      |      |
| Active Channel Width 50-percent AEP flood  | 0     | ft^3/s |      |      |      |
| Active chan width 42.9 percent AEP flood   | 0     | ft^3/s |      |      |      |
| Active Channel Width 20-percent AEP flood  | 0     | ft^3/s |      |      |      |
| Active Channel Width 10-percent AEP flood  | 0     | ft^3/s |      |      |      |
| Active Channel Width 4-percent AEP flood   | 0     | ft^3/s |      |      |      |
| Active Channel Width 2-percent AEP flood   | 0     | ft^3/s |      |      |      |
| Active Channel Width 1-percent AEP flood   | 0     | ft^3/s |      |      |      |
| Active Channel Width 0.5-percent AEP flood | 0     | ft^3/s |      |      |      |
| Active Channel Width 0.2-percent AEP flood | 0     | ft^3/s |      |      |      |
| Bankfull width 66.7 percent AEP flood      | 0     | ft^3/s |      |      |      |
| Bankfull Width 50-percent AEP flood        | 0     | ft^3/s |      |      |      |
| Bankfull width 42.9 percent AEP flood      | 0     | ft^3/s |      |      |      |
| Bankfull Width 20-percent AEP flood        | 0     | ft^3/s |      |      |      |
| Bankfull Width 10-percent AEP flood        | 0     | ft^3/s |      |      |      |
| Bankfull Width 4-percent AEP flood         | 0     | ft^3/s |      |      |      |
| Bankfull Width 2-percent AEP flood         | 0     | ft^3/s |      |      |      |
| Bankfull Width 1-percent AEP flood         | 0     | ft^3/s |      |      |      |
| Bankfull Width 0.5-percent AEP flood       | 0     | ft^3/s |      |      |      |
| Bankfull Width 0.2-percent AEP flood       | 0     | ft^3/s |      |      |      |
| Rem sens chan width 66.7 percent AEP fld   | 0     | ft^3/s |      |      |      |
| Rem_sens_chan_width_50_percent_AEP_flood   | 0     | ft^3/s |      |      |      |
| Rem sens chan width 42.9 percent AEP fld   | 0     | ft^3/s |      |      |      |
| Rem_sens_chan_width_20_percent_AEP_flood   | 0     | ft^3/s |      |      |      |
| Rem_sens_chan_width_10_percent_AEP_flood   | 0     | ft^3/s |      |      |      |

| Statistic                               | Value | Unit   | PIL | PIU | ASEp |
|-----------------------------------------|-------|--------|-----|-----|------|
| Rem_sens_chan_width_4_percent_AEP_flood | 0     | ft^3/s |     |     |      |
| Rem_sens_chan_width_2_percent_AEP_flood | 0     | ft^3/s |     |     |      |
| Rem_sens_chan_width_1_percent_AEP_flood | 0     | ft^3/s |     |     |      |
| Rem_sens_chan_width_0_5_pct_AEP_flood   | 0     | ft^3/s |     |     |      |
| Rem_sens_chan_width_0_2_pct_AEP_flood   | 0     | 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>)

Chase, K.J., Sando, R., Armstrong, D.W., and McCarthy, P., 2021, Regional regression equations based on channel-width characteristics to estimate peak-flow frequencies at ungaged sites in Montana using peak-flow frequency data through water year 2011 (ver. 1.1, September 2021): U.S. Geological Survey Scientific Investigations Report 2020–5142, 49 p. (<https://doi.org/10.3133/sir20205142>)

➤ Channel-width Methods Weighting

No method weighting results returned.

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Application Version: 4.21.0  
StreamStats Services Version: 1.2.22  
NSS Services Version: 2.2.1



## **ATTACHMENT C – HYDRALICS ANALYSIS SUPPLEMENTARY INFORMATION**

## HYDRAULICS ANALYSIS SUPPLEMENTARY INFORMATION

**PROJECT:** Floodway Encroachment Analysis for the Takima Park Water Quality Improvements Project near Pattee Creek

**Date:** 17 March 2025

### OBJECTIVE

This analysis compares modeled existing and proposed water surface elevations for the Pattee Creek 100-year flood through Takima Park (Site) in support of the City of Missoula's Takima Park Water Quality Improvements Project (Project).

### METHODOLOGY

A two-dimensional (2D) HEC-RAS model was developed to simulate the Pattee Creek 100-year flood (a flow of 195 cfs) through the Project Site and to compare the 100-year flood profile for existing and proposed conditions.

### MODEL GEOMETRY

A 2D flow area was developed as the basis for the model geometry. Model geometry information is provided in **Table 1**.

**Table 1. HEC-RAS Model Geometry Information**

| Model Element              | Description                                                                                                                                                                                                                                                               | Source/Reference                                     |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| Terrain                    | Hydro-flattened (bare-earth) DEM. <ul style="list-style-type: none"> <li>Vertical accuracy: <math>\leq 15\text{cm}</math> RMSEz</li> <li>3.0 foot pixel resolution</li> <li>Vertical reference: NAVD 88</li> </ul>                                                        | Quantum Spatial, 2019<br>Montana State Library, 2024 |
| 2D Flow Area: Cell Size    | Cell size varies throughout the terrain. <ul style="list-style-type: none"> <li>Average cell size: <math>387\text{ ft}^2</math></li> <li>Pattee Creek Channel: <math>10' \times 10'</math></li> <li>Floodplain and Overbank Areas: <math>30' \times 30'</math></li> </ul> |                                                      |
| 2D Flow Area: Definition   | Added breaklines to define feature boundaries such as channel banks, roads, and proposed Project features.                                                                                                                                                                |                                                      |
| 2D Flow Area: Mannin's 'n' | Developed for full 2D Area using 2021 National Land Cover Database and 2D Area Manning's n regions. See <b>Table 2</b> .                                                                                                                                                  |                                                      |
| Hydraulic Structures       | Culverts: <ul style="list-style-type: none"> <li>Culvert under Pattee Canyon Road. Culvert geometry and modeling approach is described in the main body of this technical memorandum.</li> </ul>                                                                          |                                                      |

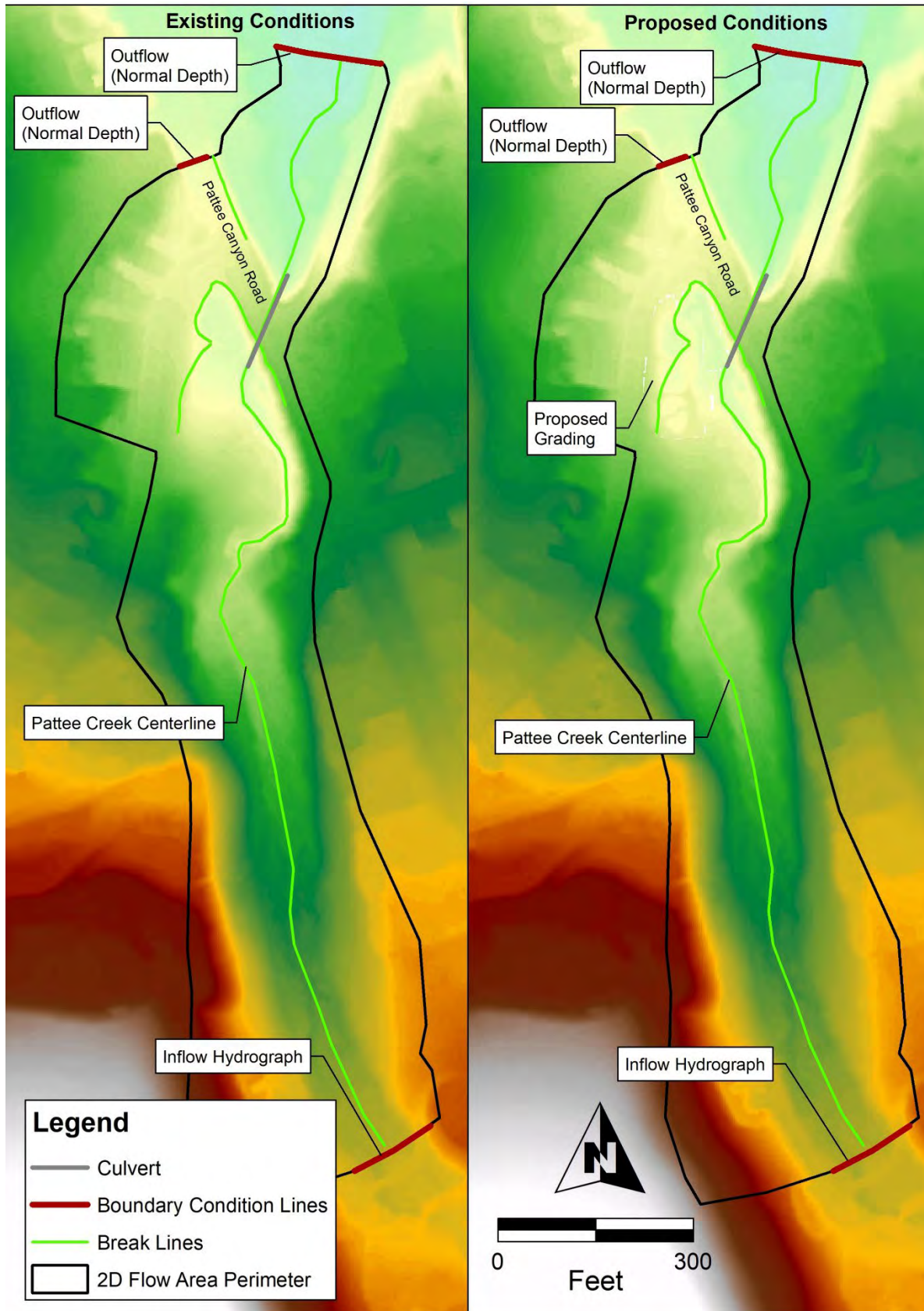




| Model Element       | Description                                                                                                            | Source/Reference |
|---------------------|------------------------------------------------------------------------------------------------------------------------|------------------|
| Boundary Conditions | Boundary conditions at model inflow and outflow locations. See <b>Figure 1</b> and Error! Reference source not found.. |                  |

**Table 2. Manning's n Values**

|                           | Description                 | Manning's n | Comments/source         |
|---------------------------|-----------------------------|-------------|-------------------------|
| Manning's n by Land Cover | Developed, open space       | 0.04        | HEC-RAS 2D Users Manual |
|                           | Developed, low intensity    | 0.07        |                         |
|                           | Developed, medium intensity | 0.1         |                         |
|                           | Grassland/herbaceous        | 0.03        |                         |
|                           | Shrub/scrub                 | 0.08        |                         |
|                           | Developed, high intensity   | 0.15        |                         |
| Calibration Regions       | Pattee Creek                | 0.045       | Stream Corridor         |
|                           | Takima Park - Grass         | 0.03        | Grass in Overbank       |



**Figure 1. HEC-RAS Model Geometry**



## MODEL FLOW DATA

Flow data was developed to simulate the Pattee Creek 100-year flow. The inflow hydrograph is a constant flow of 195 cfs. Boundary conditions were placed at inflow and outflow locations. Boundary condition locations are shown in **Figure 1** and additional information is provided in **Table 3**.

**Table 3. Unsteady Flow Data Boundary Conditions**

| Name                      | Boundary Condition | Discussion                                                                                                                |
|---------------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------|
| Upstream Inlet Hydrograph | Flow Hydrograph    | 2D flow area inflow hydrograph. Set at a constant flow of 195 cfs to allow the model to simulate a steady flow condition. |
| Pattee Canyon Rd          | Normal Depth       | Outflow of 2D flow area along Pattee Canyon Road for cases where flow overtops Pattee Canyon Road.                        |
| Downstream Outlet BC      | Normal Depth       | Outflow of 2D flow area along Pattee Creek downstream from the Project Site.                                              |

## MODEL RUN PARAMETERS

An unsteady flow simulation file was developed to run the 2D flow model. Key model run parameters are presented in **Table 4**.

**Table 4. Model Run Parameters**

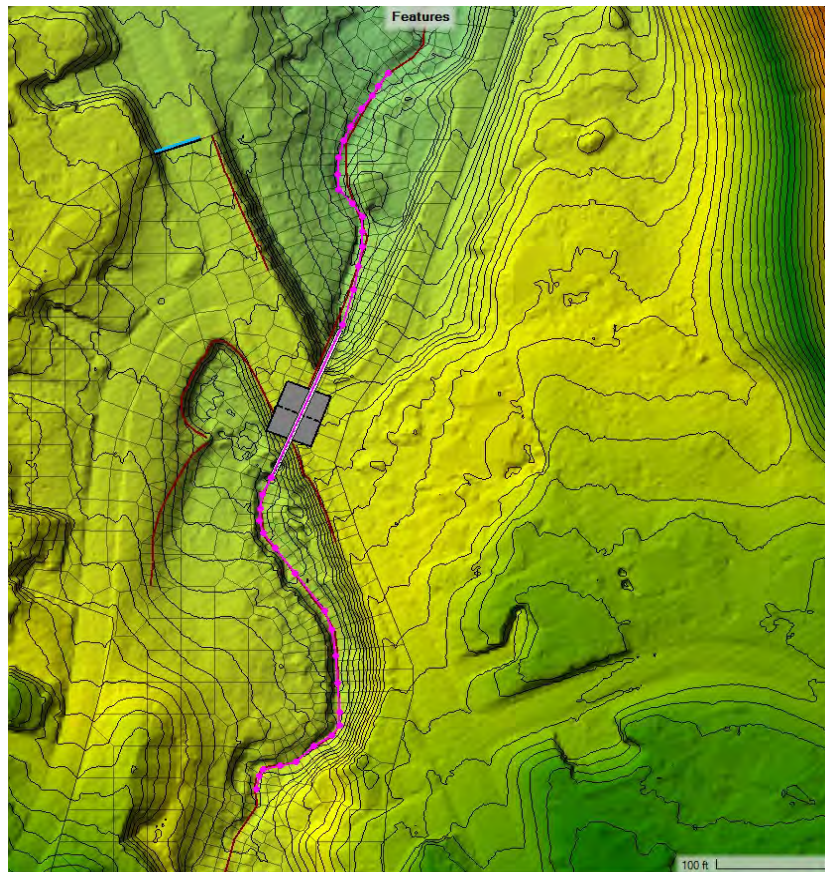
| Parameter            | Setting                           | Discussion                                                           |
|----------------------|-----------------------------------|----------------------------------------------------------------------|
| Run Time             | 6 hours                           | Allow initially inflows to move all the way through the 2D flow area |
| Computation Interval | Adjust based on courant condition | Initially set at 2 seconds                                           |
| Equation Set         | SWE-ELM                           | Generally more accurate than the Diffusion Wave equations            |

## REFERENCES

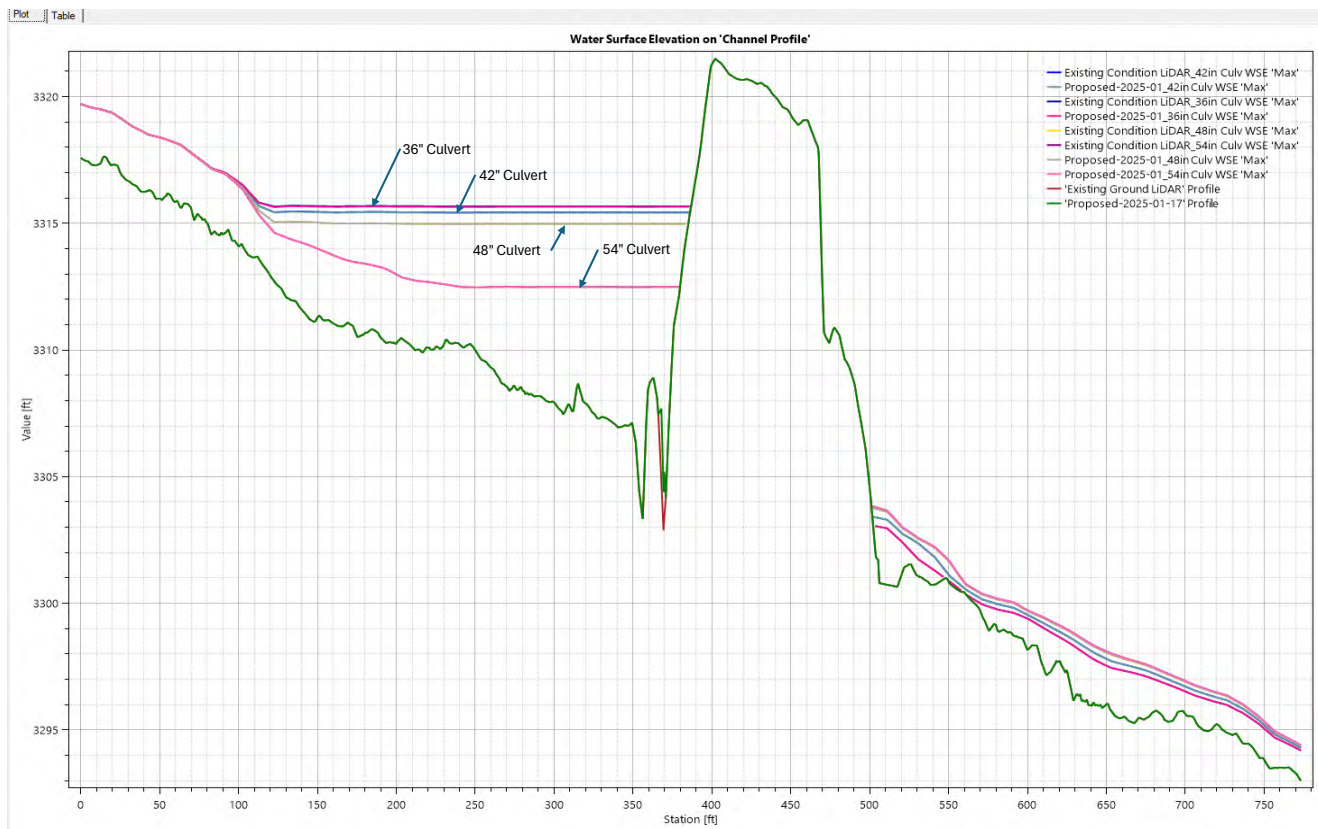
- Montana State Library. (2024). *Montana Lidar Inventory*.
- Quantum Spatial. (2019). *Clark Fork Bitterroot, Montana: Q1 LiDAR Technical Data Report*. Corvallis, OR.
- U. S. Army Corps of Engineers - Hydrologic Engineering Center. (2024). *HEC-RAS 6.6*. Davis, CA.



## **ATTACHMENT D – HYDRAULICS ANALYSIS RESULTS COMPARISON**



Profile Line Location in RasMapper



Maximum 100-Year WSE along Profile Line Titled Channel Profile in HEC-RAS 2D Model

| Station | 36" Culvert Scenario |                   |                 | 42" Culvert Scenario |                   |                 | 54" Culvert Scenario |                   |                 | 60" Culvert Scenario |                   |                 |
|---------|----------------------|-------------------|-----------------|----------------------|-------------------|-----------------|----------------------|-------------------|-----------------|----------------------|-------------------|-----------------|
|         | Existing WSE (ft)    | Proposed WSE (ft) | Difference (ft) | Existing WSE (ft)    | Proposed WSE (ft) | Difference (ft) | Existing WSE (ft)    | Proposed WSE (ft) | Difference (ft) | Existing WSE (ft)    | Proposed WSE (ft) | Difference (ft) |
| 0       | 3319.711             | 3319.711          | 0.00            | 3319.711             | 3319.711          | 0.00            | 3319.711             | 3319.711          | 0.00            | 3319.711             | 3319.711          | 0.00            |
| 0.734   | 3319.695             | 3319.695          | 0.00            | 3319.695             | 3319.695          | 0.00            | 3319.695             | 3319.695          | 0.00            | 3319.695             | 3319.695          | 0.00            |
| 1.242   | 3319.685             | 3319.685          | 0.00            | 3319.684             | 3319.684          | 0.00            | 3319.684             | 3319.684          | 0.00            | 3319.684             | 3319.684          | 0.00            |
| 1.6     | 3319.677             | 3319.677          | 0.00            | 3319.677             | 3319.677          | 0.00            | 3319.677             | 3319.677          | 0.00            | 3319.677             | 3319.677          | 0.00            |
| 3.656   | 3319.632             | 3319.632          | 0.00            | 3319.632             | 3319.632          | 0.00            | 3319.632             | 3319.632          | 0.00            | 3319.632             | 3319.632          | 0.00            |
| 4.194   | 3319.62              | 3319.62           | 0.00            | 3319.62              | 3319.62           | 0.00            | 3319.62              | 3319.62           | 0.00            | 3319.62              | 3319.62           | 0.00            |
| 4.287   | 3319.618             | 3319.618          | 0.00            | 3319.618             | 3319.618          | 0.00            | 3319.618             | 3319.618          | 0.00            | 3319.618             | 3319.618          | 0.00            |
| 4.42    | 3319.615             | 3319.615          | 0.00            | 3319.615             | 3319.615          | 0.00            | 3319.615             | 3319.615          | 0.00            | 3319.615             | 3319.615          | 0.00            |
| 5.283   | 3319.596             | 3319.596          | 0.00            | 3319.596             | 3319.596          | 0.00            | 3319.596             | 3319.596          | 0.00            | 3319.596             | 3319.596          | 0.00            |
| 6.788   | 3319.574             | 3319.574          | 0.00            | 3319.574             | 3319.574          | 0.00            | 3319.574             | 3319.574          | 0.00            | 3319.574             | 3319.574          | 0.00            |
| 7.332   | 3319.566             | 3319.566          | 0.00            | 3319.566             | 3319.566          | 0.00            | 3319.566             | 3319.566          | 0.00            | 3319.566             | 3319.566          | 0.00            |
| 8.106   | 3319.556             | 3319.556          | 0.00            | 3319.555             | 3319.555          | 0.00            | 3319.555             | 3319.555          | 0.00            | 3319.555             | 3319.555          | 0.00            |
| 9.382   | 3319.54              | 3319.54           | 0.00            | 3319.539             | 3319.539          | 0.00            | 3319.539             | 3319.539          | 0.00            | 3319.539             | 3319.539          | 0.00            |
| 10.377  | 3319.528             | 3319.528          | 0.00            | 3319.528             | 3319.528          | 0.00            | 3319.528             | 3319.528          | 0.00            | 3319.527             | 3319.527          | 0.00            |
| 11.793  | 3319.512             | 3319.512          | 0.00            | 3319.512             | 3319.512          | 0.00            | 3319.512             | 3319.512          | 0.00            | 3319.512             | 3319.512          | 0.00            |
| 11.976  | 3319.51              | 3319.51           | 0.00            | 3319.51              | 3319.51           | 0.00            | 3319.51              | 3319.51           | 0.00            | 3319.51              | 3319.51           | 0.00            |
| 12.642  | 3319.503             | 3319.503          | 0.00            | 3319.503             | 3319.503          | 0.00            | 3319.503             | 3319.503          | 0.00            | 3319.503             | 3319.503          | 0.00            |
| 13.581  | 3319.486             | 3319.486          | 0.00            | 3319.486             | 3319.486          | 0.00            | 3319.486             | 3319.486          | 0.00            | 3319.486             | 3319.486          | 0.00            |
| 14.243  | 3319.474             | 3319.474          | 0.00            | 3319.474             | 3319.474          | 0.00            | 3319.474             | 3319.474          | 0.00            | 3319.474             | 3319.474          | 0.00            |
| 14.4    | 3319.471             | 3319.471          | 0.00            | 3319.471             | 3319.471          | 0.00            | 3319.471             | 3319.471          | 0.00            | 3319.471             | 3319.471          | 0.00            |
| 15.188  | 3319.454             | 3319.454          | 0.00            | 3319.454             | 3319.454          | 0.00            | 3319.454             | 3319.454          | 0.00            | 3319.453             | 3319.453          | 0.00            |
| 16.397  | 3319.43              | 3319.43           | 0.00            | 3319.43              | 3319.43           | 0.00            | 3319.43              | 3319.43           | 0.00            | 3319.429             | 3319.429          | 0.00            |
| 17.243  | 3319.415             | 3319.415          | 0.00            | 3319.415             | 3319.415          | 0.00            | 3319.415             | 3319.415          | 0.00            | 3319.415             | 3319.415          | 0.00            |
| 18.551  | 3319.395             | 3319.395          | 0.00            | 3319.395             | 3319.395          | 0.00            | 3319.395             | 3319.395          | 0.00            | 3319.395             | 3319.395          | 0.00            |
| 19.252  | 3319.386             | 3319.386          | 0.00            | 3319.386             | 3319.386          | 0.00            | 3319.386             | 3319.386          | 0.00            | 3319.385             | 3319.385          | 0.00            |
| 19.942  | 3319.362             | 3319.362          | 0.00            | 3319.362             | 3319.362          | 0.00            | 3319.362             | 3319.362          | 0.00            | 3319.362             | 3319.362          | 0.00            |
| 20.921  | 3319.327             | 3319.327          | 0.00            | 3319.327             | 3319.327          | 0.00            | 3319.327             | 3319.327          | 0.00            | 3319.326             | 3319.326          | 0.00            |
| 22.435  | 3319.266             | 3319.266          | 0.00            | 3319.266             | 3319.266          | 0.00            | 3319.266             | 3319.266          | 0.00            | 3319.266             | 3319.266          | 0.00            |
| 23.035  | 3319.24              | 3319.24           | 0.00            | 3319.24              | 3319.24           | 0.00            | 3319.24              | 3319.24           | 0.00            | 3319.239             | 3319.239          | 0.00            |
| 23.394  | 3319.223             | 3319.223          | 0.00            | 3319.223             | 3319.223          | 0.00            | 3319.223             | 3319.223          | 0.00            | 3319.223             | 3319.223          | 0.00            |
| 23.425  | 3319.222             | 3319.222          | 0.00            | 3319.222             | 3319.222          | 0.00            | 3319.222             | 3319.222          | 0.00            | 3319.221             | 3319.221          | 0.00            |
| 24.834  | 3319.164             | 3319.164          | 0.00            | 3319.164             | 3319.164          | 0.00            | 3319.164             | 3319.164          | 0.00            | 3319.164             | 3319.164          | 0.00            |
| 25.868  | 3319.121             | 3319.121          | 0.00            | 3319.121             | 3319.121          | 0.00            | 3319.121             | 3319.121          | 0.00            | 3319.121             | 3319.121          | 0.00            |
| 26.127  | 3319.11              | 3319.11           | 0.00            | 3319.11              | 3319.11           | 0.00            | 3319.11              | 3319.11           | 0.00            | 3319.11              | 3319.11           | 0.00            |
| 26.558  | 3319.092             | 3319.092          | 0.00            | 3319.092             | 3319.092          | 0.00            | 3319.092             | 3319.092          | 0.00            | 3319.092             | 3319.092          | 0.00            |
| 28.342  | 3319.017             | 3319.017          | 0.00            | 3319.016             | 3319.016          | 0.00            | 3319.016             | 3319.016          | 0.00            | 3319.016             | 3319.016          | 0.00            |
| 30.681  | 3318.915             | 3318.915          | 0.00            | 3318.915             | 3318.915          | 0.00            | 3318.915             | 3318.915          | 0.00            | 3318.915             | 3318.915          | 0.00            |
| 30.816  | 3318.909             | 3318.909          | 0.00            | 3318.909             | 3318.909          | 0.00            | 3318.909             | 3318.909          | 0.00            | 3318.909             | 3318.909          | 0.00            |
| 32.312  | 3318.843             | 3318.843          | 0.00            | 3318.843             | 3318.843          | 0.00            | 3318.843             | 3318.843          | 0.00            | 3318.842             | 3318.842          | 0.00            |
| 32.688  | 3318.826             | 3318.826          | 0.00            | 3318.826             | 3318.826          | 0.00            | 3318.826             | 3318.826          | 0.00            | 3318.825             | 3318.825          | 0.00            |
| 33.29   | 3318.809             | 3318.809          | 0.00            | 3318.809             | 3318.809          | 0.00            | 3318.809             | 3318.809          | 0.00            | 3318.808             | 3318.808          | 0.00            |
| 34.804  | 3318.763             | 3318.763          | 0.00            | 3318.763             | 3318.763          | 0.00            | 3318.763             | 3318.763          | 0.00            | 3318.762             | 3318.762          | 0.00            |
| 34.881  | 3318.761             | 3318.761          | 0.00            | 3318.761             | 3318.761          | 0.00            | 3318.761             | 3318.761          | 0.00            | 3318.76              | 3318.76           | 0.00            |
| 35.402  | 3318.745             | 3318.745          | 0.00            | 3318.745             | 3318.745          | 0.00            | 3318.745             | 3318.745          | 0.00            | 3318.744             | 3318.744          | 0.00            |
| 35.774  | 3318.733             | 3318.733          | 0.00            | 3318.733             | 3318.733          | 0.00            | 3318.733             | 3318.733          | 0.00            | 3318.732             | 3318.732          | 0.00            |
| 37.386  | 3318.683             | 3318.683          | 0.00            | 3318.682             | 3318.682          | 0.00            | 3318.682             | 3318.682          | 0.00            | 3318.681             | 3318.681          | 0.00            |
| 38.275  | 3318.654             | 3318.654          | 0.00            | 3318.654             | 3318.654          | 0.00            | 3318.654             | 3318.654          | 0.00            | 3318.653             | 3318.653          | 0.00            |
| 38.48   | 3318.648             | 3318.648          | 0.00            | 3318.647             | 3318.647          | 0.00            | 3318.647             | 3318.647          | 0.00            | 3318.646             | 3318.646          | 0.00            |
| 38.809  | 3318.637             | 3318.637          | 0.00            | 3318.636             | 3318.636          | 0.00            | 3318.636             | 3318.636          | 0.00            | 3318.635             | 3318.635          | 0.00            |
| 40.777  | 3318.572             | 3318.572          | 0.00            | 3318.571             | 3318.571          | 0.00            | 3318.571             | 3318.571          | 0.00            | 3318.57              | 3318.57           | 0.00            |
| 41.559  | 3318.545             | 3318.545          | 0.00            | 3318.545             | 3318.545          | 0.00            | 3318.545             | 3318.545          | 0.00            | 3318.544             | 3318.544          | 0.00            |
| 42.681  | 3318.507             | 3318.507          | 0.00            | 3318.506             | 3318.506          | 0.00            | 3318.506             | 3318.506          | 0.00            | 3318.505             | 3318.505          | 0.00            |
| 42.811  | 3318.505             | 3318.505          | 0.00            | 3318.504             | 3318.504          | 0.00            | 3318.504             | 3318.504          | 0.00            | 3318.503             | 3318.503          | 0.00            |
| 43.278  | 3318.498             | 3318.498          | 0.00            | 3318.498             | 3318.498          | 0.00            | 3318.498             | 3318.498          | 0.00            | 3318.496             | 3318.496          | 0.00            |
| 44.638  | 3318.478             | 3318.478          | 0.00            | 3318.477             | 3318.477          | 0.00            | 3318.477             | 3318.477          | 0.00            | 3318.476             | 3318.476          | 0.00            |
| 45.78   | 3318.461             | 3318.46           | 0.00            | 3318.46              | 3318.46           | 0.00            | 3318.46              | 3318.46           | 0.00            | 3318.458             | 3318.458          | 0.00            |
| 46.814  | 3318.445             | 3318.445          | 0.00            | 3318.444             | 3318.444          | 0.00            | 3318.444             | 3318.444          | 0.00            | 3318.442             | 3318.442          | 0.00            |
| 47.717  | 3318.431             | 3318.431          | 0.00            | 3318.43              | 3318.43           | 0.00            | 3318.43              | 3318.43           | 0.00            | 3318.429             | 3318.429          | 0.00            |
| 48.281  | 3318.422             | 3318.422          | 0.00            | 3318.421             | 3318.421          | 0.00            | 3318.421             | 3318.421          | 0.00            | 3318.42              | 3318.42           | 0.00            |
| 49.331  | 3318.406             | 3318.406          | 0.00            | 3318.405             | 3318.405          | 0.00            | 3318.405             | 3318.405          | 0.00            | 3318.403             | 3318.403          | 0.00            |
| 50.563  | 3318.383             | 3318.383          | 0.00            | 3318.382             | 3318.382          | 0.00            | 3318.382             | 3318.382          | 0.00            | 3318.38              | 3318.38           | 0.00            |
| 51.284  | 3318.37              | 3318.37           | 0.00            | 3318.369             | 3318.369          | 0.00            | 3318.369             | 3318.369          | 0.00            | 3318.367             | 3318.367          | 0.00            |
| 52.686  | 3318.345             | 3318.345          | 0.00            | 3318.344             | 3318.344          | 0.00            | 3318.344             | 3318.344          | 0.00            | 3318.342             | 3318.342          | 0.00            |
| 53.09   | 3318.338             | 3318.337          | 0.00            | 3318.336             | 3318.336          | 0.00            | 3318.336             | 3318.336          | 0.00            | 3318.335             | 3318.335          | 0.00            |
| 54.188  | 3318.313             | 3318.313          | 0.00            | 3318.312             | 3318.312          | 0.00            | 3318.312             | 3318.312          | 0.00            | 3318.31              | 3318.31           | 0.00            |
| 54.808  | 3318.299             | 3318.299          | 0.00            | 3318.298             | 3318.298          | 0.00            | 3318.298             | 3318.298          | 0.00            | 3318.296             | 3318.296          | 0.00            |
| 55.387  | 3318.286             | 3318.286          | 0.00            | 3318.285             | 3318.285          | 0.00            | 3318.285             | 3318.285          | 0.00            | 3318.283             | 3318.283          | 0.00            |
| 56.931  | 3318.252             | 3318.251          | 0.00            | 3318.25              | 3318.25           | 0.00            | 3318.25              | 3318.25           | 0.00            | 3318.247             | 3318.247          | 0.00            |
| 58.585  | 3318.214             | 3318.212          | 0.00            | 3318.212             | 3318.212          | 0.00            | 3318.212             | 3318.212          | 0.00            | 3318.209             | 3318.209          | 0.00            |
| 59.491  | 3318.193             | 3318.193          | 0.00            | 3318.191             | 3318.191          | 0.00            | 3318.191             | 3318.191          | 0.00            | 3318.188             | 3318.188          | 0.00            |
| 61.176  | 3318.154             | 3318.154          | 0.00            | 3318.152             | 3318.152          | 0.00            | 3318.152             | 3318.152          | 0.00            | 3318.149             | 3318.149          | 0.00            |
| 62.981  | 3318.112             | 3318.112          | 0.00            | 3318.111             | 3318.11           | 0.00            | 3318.11              | 3318.11           | 0.00            | 3318.106             | 3318.106          | 0.00            |
| 63.119  | 3318.109             | 3318.108          | 0.00            | 3318.107             | 3318.107          | 0.00            | 3318.107             | 3318.107          | 0.00            | 3318.103             | 3318.103          | 0.00            |
| 63.298  | 3318.1               | 3318.1            | 0.00            | 3318.098             | 3318.098          | 0.00            | 3318.098             | 3318.098          | 0.00            | 3318.095             | 3318.095          | 0.00            |
| 63.595  | 3318.085             | 3318.085          | 0.00            | 3318.084             | 3318.084          | 0.00            | 3318.084             | 3318.084          | 0.00            | 3318.08              | 3318.08           | 0.00            |
| 65.421  | 3317.998             | 3317.998          | 0.00            | 3317.996             | 3317.996          | 0.00            | 3317.996             | 3317.996          | 0.00            | 3317.991             | 3317.991          | 0.00            |
| 65.668  | 3317.986             | 3317.986          | 0.00            | 3317.984             | 3317.984          | 0.00            | 3317.984             | 3317.984          | 0.00            | 3317.979             | 3317.979          | 0.00            |
| 67.378  | 3317.905             | 3317.905          | 0.00            | 3317.902             | 3317.902          | 0.00            | 3317.9               |                   |                 |                      |                   |                 |



| Station | 36" Culvert Scenario |                      |                    | 42" Culvert Scenario |                      |                    | 54" Culvert Scenario |                      |                    | 60" Culvert Scenario |                      |                    |
|---------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
|         | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) |
| 69.666  | 3317.797             | 3317.797             | 0.00               | 3317.794             | 3317.794             | 0.00               | 3317.794             | 3317.794             | 0.00               | 3317.788             | 3317.788             | 0.00               |
| 71.553  | 3317.71              | 3317.71              | 0.00               | 3317.707             | 3317.707             | 0.00               | 3317.707             | 3317.707             | 0.00               | 3317.699             | 3317.699             | 0.00               |
| 71.668  | 3317.705             | 3317.704             | 0.00               | 3317.701             | 3317.701             | 0.00               | 3317.701             | 3317.701             | 0.00               | 3317.694             | 3317.694             | 0.00               |
| 71.773  | 3317.7               | 3317.7               | 0.00               | 3317.696             | 3317.696             | 0.00               | 3317.696             | 3317.696             | 0.00               | 3317.689             | 3317.689             | 0.00               |
| 71.793  | 3317.699             | 3317.699             | 0.00               | 3317.695             | 3317.695             | 0.00               | 3317.695             | 3317.695             | 0.00               | 3317.688             | 3317.688             | 0.00               |
| 71.823  | 3317.698             | 3317.697             | 0.00               | 3317.694             | 3317.694             | 0.00               | 3317.694             | 3317.694             | 0.00               | 3317.687             | 3317.687             | 0.00               |
| 73.17   | 3317.636             | 3317.635             | 0.00               | 3317.632             | 3317.632             | 0.00               | 3317.632             | 3317.632             | 0.00               | 3317.624             | 3317.624             | 0.00               |
| 73.953  | 3317.599             | 3317.598             | 0.00               | 3317.595             | 3317.595             | 0.00               | 3317.595             | 3317.595             | 0.00               | 3317.586             | 3317.586             | 0.00               |
| 75.398  | 3317.531             | 3317.531             | 0.00               | 3317.526             | 3317.526             | 0.00               | 3317.526             | 3317.526             | 0.00               | 3317.516             | 3317.516             | 0.00               |
| 76.113  | 3317.498             | 3317.497             | 0.00               | 3317.492             | 3317.492             | 0.00               | 3317.492             | 3317.492             | 0.00               | 3317.481             | 3317.481             | 0.00               |
| 77.165  | 3317.448             | 3317.448             | 0.00               | 3317.442             | 3317.442             | 0.00               | 3317.442             | 3317.442             | 0.00               | 3317.43              | 3317.43              | 0.00               |
| 78.273  | 3317.396             | 3317.396             | 0.00               | 3317.39              | 3317.39              | 0.00               | 3317.39              | 3317.39              | 0.00               | 3317.377             | 3317.377             | 0.00               |
| 79.024  | 3317.361             | 3317.36              | 0.00               | 3317.354             | 3317.354             | 0.00               | 3317.354             | 3317.354             | 0.00               | 3317.34              | 3317.34              | 0.00               |
| 80.432  | 3317.295             | 3317.294             | 0.00               | 3317.288             | 3317.287             | 0.00               | 3317.288             | 3317.287             | 0.00               | 3317.272             | 3317.272             | 0.00               |
| 82.508  | 3317.198             | 3317.197             | 0.00               | 3317.189             | 3317.189             | 0.00               | 3317.189             | 3317.189             | 0.00               | 3317.171             | 3317.171             | 0.00               |
| 82.592  | 3317.194             | 3317.193             | 0.00               | 3317.185             | 3317.185             | 0.00               | 3317.185             | 3317.185             | 0.00               | 3317.168             | 3317.168             | 0.00               |
| 82.649  | 3317.191             | 3317.19              | 0.00               | 3317.182             | 3317.182             | 0.00               | 3317.182             | 3317.182             | 0.00               | 3317.165             | 3317.165             | 0.00               |
| 82.947  | 3317.177             | 3317.176             | 0.00               | 3317.169             | 3317.168             | 0.00               | 3317.169             | 3317.168             | 0.00               | 3317.15              | 3317.15              | 0.00               |
| 83.046  | 3317.172             | 3317.171             | 0.00               | 3317.164             | 3317.163             | 0.00               | 3317.164             | 3317.163             | 0.00               | 3317.146             | 3317.146             | 0.00               |
| 84.752  | 3317.136             | 3317.135             | 0.00               | 3317.125             | 3317.125             | 0.00               | 3317.125             | 3317.125             | 0.00               | 3317.103             | 3317.103             | 0.00               |
| 86.275  | 3317.105             | 3317.104             | 0.00               | 3317.093             | 3317.092             | 0.00               | 3317.093             | 3317.092             | 0.00               | 3317.067             | 3317.067             | 0.00               |
| 86.912  | 3317.093             | 3317.091             | 0.00               | 3317.08              | 3317.079             | 0.00               | 3317.08              | 3317.079             | 0.00               | 3317.052             | 3317.052             | 0.00               |
| 87.851  | 3317.075             | 3317.074             | 0.00               | 3317.061             | 3317.061             | 0.00               | 3317.061             | 3317.061             | 0.00               | 3317.031             | 3317.031             | 0.00               |
| 89.072  | 3317.054             | 3317.052             | 0.00               | 3317.038             | 3317.037             | 0.00               | 3317.038             | 3317.037             | 0.00               | 3317.005             | 3317.005             | 0.00               |
| 89.876  | 3317.04              | 3317.038             | 0.00               | 3317.024             | 3317.023             | 0.00               | 3317.024             | 3317.023             | 0.00               | 3316.988             | 3316.988             | 0.00               |
| 92.174  | 3316.969             | 3316.967             | 0.00               | 3316.951             | 3316.95              | 0.00               | 3316.951             | 3316.95              | 0.00               | 3316.912             | 3316.912             | 0.00               |
| 92.726  | 3316.95              | 3316.948             | 0.00               | 3316.931             | 3316.93              | 0.00               | 3316.931             | 3316.93              | 0.00               | 3316.891             | 3316.891             | 0.00               |
| 93.373  | 3316.92              | 3316.918             | 0.00               | 3316.899             | 3316.898             | 0.00               | 3316.899             | 3316.898             | 0.00               | 3316.854             | 3316.854             | 0.00               |
| 95.875  | 3316.812             | 3316.809             | 0.00               | 3316.782             | 3316.78              | 0.00               | 3316.782             | 3316.78              | 0.00               | 3316.714             | 3316.714             | 0.00               |
| 97.671  | 3316.738             | 3316.733             | 0.00               | 3316.7               | 3316.699             | 0.00               | 3316.7               | 3316.699             | 0.00               | 3316.617             | 3316.617             | 0.00               |
| 98.061  | 3316.722             | 3316.718             | 0.00               | 3316.683             | 3316.681             | 0.00               | 3316.683             | 3316.681             | 0.00               | 3316.597             | 3316.597             | 0.00               |
| 98.271  | 3316.713             | 3316.709             | 0.00               | 3316.674             | 3316.672             | 0.00               | 3316.674             | 3316.672             | 0.00               | 3316.586             | 3316.586             | 0.00               |
| 99.575  | 3316.652             | 3316.647             | -0.01              | 3316.608             | 3316.606             | 0.00               | 3316.608             | 3316.606             | 0.00               | 3316.51              | 3316.51              | 0.00               |
| 99.82   | 3316.641             | 3316.636             | -0.01              | 3316.596             | 3316.594             | 0.00               | 3316.596             | 3316.594             | 0.00               | 3316.497             | 3316.497             | 0.00               |
| 100.158 | 3316.625             | 3316.62              | -0.01              | 3316.58              | 3316.578             | 0.00               | 3316.58              | 3316.578             | 0.00               | 3316.478             | 3316.478             | 0.00               |
| 101.9   | 3316.55              | 3316.544             | -0.01              | 3316.499             | 3316.497             | 0.00               | 3316.499             | 3316.497             | 0.00               | 3316.385             | 3316.385             | 0.00               |
| 101.996 | 3316.545             | 3316.54              | -0.01              | 3316.494             | 3316.492             | 0.00               | 3316.494             | 3316.492             | 0.00               | 3316.379             | 3316.379             | 0.00               |
| 102.716 | 3316.508             | 3316.502             | -0.01              | 3316.454             | 3316.451             | 0.00               | 3316.454             | 3316.451             | 0.00               | 3316.334             | 3316.334             | 0.00               |
| 103.016 | 3316.487             | 3316.481             | -0.01              | 3316.431             | 3316.429             | 0.00               | 3316.431             | 3316.429             | 0.00               | 3316.304             | 3316.304             | 0.00               |
| 104.036 | 3316.417             | 3316.41              | -0.01              | 3316.354             | 3316.35              | 0.00               | 3316.354             | 3316.35              | 0.00               | 3316.203             | 3316.203             | 0.00               |
| 106.016 | 3316.282             | 3316.273             | -0.01              | 3316.202             | 3316.198             | 0.00               | 3316.202             | 3316.198             | 0.00               | 3316.009             | 3316.009             | 0.00               |
| 107.036 | 3316.212             | 3316.202             | -0.01              | 3316.124             | 3316.12              | 0.00               | 3316.124             | 3316.12              | 0.00               | 3315.908             | 3315.908             | 0.00               |
| 107.996 | 3316.147             | 3316.136             | -0.01              | 3316.051             | 3316.046             | -0.01              | 3316.051             | 3316.046             | -0.01              | 3315.814             | 3315.814             | 0.00               |
| 109.016 | 3316.077             | 3316.065             | -0.01              | 3315.973             | 3315.968             | -0.01              | 3315.973             | 3315.968             | -0.01              | 3315.713             | 3315.713             | 0.00               |
| 110.036 | 3316.007             | 3315.994             | -0.01              | 3315.895             | 3315.889             | -0.01              | 3315.895             | 3315.889             | -0.01              | 3315.613             | 3315.613             | 0.00               |
| 110.996 | 3315.941             | 3315.928             | -0.01              | 3315.822             | 3315.815             | -0.01              | 3315.822             | 3315.815             | -0.01              | 3315.519             | 3315.519             | 0.00               |
| 112.016 | 3315.871             | 3315.857             | -0.01              | 3315.743             | 3315.737             | -0.01              | 3315.743             | 3315.737             | -0.01              | 3315.418             | 3315.418             | 0.00               |
| 112.685 | 3315.825             | 3315.811             | -0.01              | 3315.692             | 3315.686             | -0.01              | 3315.692             | 3315.686             | -0.01              | 3315.352             | 3315.352             | 0.00               |
| 113.036 | 3315.82              | 3315.805             | -0.02              | 3315.683             | 3315.676             | -0.01              | 3315.683             | 3315.676             | -0.01              | 3315.327             | 3315.327             | 0.00               |
| 113.814 | 3315.807             | 3315.791             | -0.02              | 3315.664             | 3315.656             | -0.01              | 3315.664             | 3315.656             | -0.01              | 3315.27              | 3315.27              | 0.00               |
| 115.017 | 3315.787             | 3315.771             | -0.02              | 3315.633             | 3315.625             | -0.01              | 3315.633             | 3315.625             | -0.01              | 3315.183             | 3315.183             | 0.00               |
| 117.131 | 3315.752             | 3315.735             | -0.02              | 3315.579             | 3315.569             | -0.01              | 3315.579             | 3315.569             | -0.01              | 3315.03              | 3315.03              | 0.00               |
| 118.019 | 3315.738             | 3315.719             | -0.02              | 3315.556             | 3315.546             | -0.01              | 3315.556             | 3315.546             | -0.01              | 3314.966             | 3314.966             | 0.00               |
| 118.839 | 3315.725             | 3315.705             | -0.02              | 3315.535             | 3315.525             | -0.01              | 3315.535             | 3315.525             | -0.01              | 3314.906             | 3314.906             | 0.00               |
| 121.021 | 3315.689             | 3315.668             | -0.02              | 3315.48              | 3315.468             | -0.01              | 3315.48              | 3315.468             | -0.01              | 3314.748             | 3314.748             | 0.00               |
| 121.726 | 3315.677             | 3315.656             | -0.02              | 3315.461             | 3315.449             | -0.01              | 3315.461             | 3315.449             | -0.01              | 3314.697             | 3314.697             | 0.00               |
| 122.634 | 3315.662             | 3315.64              | -0.02              | 3315.438             | 3315.426             | -0.01              | 3315.438             | 3315.426             | -0.01              | 3314.63              | 3314.63              | 0.00               |
| 123.386 | 3315.665             | 3315.643             | -0.02              | 3315.441             | 3315.428             | -0.01              | 3315.441             | 3315.428             | -0.01              | 3314.612             | 3314.612             | 0.00               |
| 124.613 | 3315.669             | 3315.647             | -0.02              | 3315.445             | 3315.432             | -0.01              | 3315.445             | 3315.432             | -0.01              | 3314.581             | 3314.581             | 0.00               |
| 126.513 | 3315.676             | 3315.654             | -0.02              | 3315.451             | 3315.439             | -0.01              | 3315.451             | 3315.439             | -0.01              | 3314.533             | 3314.533             | 0.00               |
| 127.026 | 3315.678             | 3315.656             | -0.02              | 3315.453             | 3315.44              | -0.01              | 3315.453             | 3315.44              | -0.01              | 3314.521             | 3314.521             | 0.00               |
| 127.5   | 3315.679             | 3315.658             | -0.02              | 3315.455             | 3315.442             | -0.01              | 3315.455             | 3315.442             | -0.01              | 3314.509             | 3314.509             | 0.00               |
| 129.641 | 3315.687             | 3315.665             | -0.02              | 3315.462             | 3315.45              | -0.01              | 3315.462             | 3315.45              | -0.01              | 3314.455             | 3314.455             | 0.00               |
| 130.029 | 3315.688             | 3315.666             | -0.02              | 3315.463             | 3315.451             | -0.01              | 3315.463             | 3315.451             | -0.01              | 3314.446             | 3314.446             | 0.00               |
| 130.386 | 3315.69              | 3315.668             | -0.02              | 3315.465             | 3315.452             | -0.01              | 3315.465             | 3315.452             | -0.01              | 3314.437             | 3314.437             | 0.00               |
| 130.74  | 3315.691             | 3315.669             | -0.02              | 3315.466             | 3315.453             | -0.01              | 3315.466             | 3315.453             | -0.01              | 3314.428             | 3314.428             | 0.00               |
| 132.6   | 3315.698             | 3315.676             | -0.02              | 3315.473             | 3315.461             | -0.01              | 3315.473             | 3315.461             | -0.01              | 3314.384             | 3314.384             | 0.00               |
| 132.768 | 3315.698             | 3315.676             | -0.02              | 3315.473             | 3315.46              | -0.01              | 3315.473             | 3315.46              | -0.01              | 3314.381             | 3314.381             | 0.00               |
| 133.031 | 3315.697             | 3315.676             | -0.02              | 3315.473             | 3315.46              | -0.01              | 3315.473             | 3315.46              | -0.01              | 3314.376             | 3314.376             | 0.00               |
| 133.273 | 3315.697             | 3315.676             | -0.02              | 3315.473             | 3315.46              | -0.01              | 3315.473             | 3315.46              | -0.01              | 3314.371             | 3314.371             | 0.00               |
| 135.896 | 3315.696             | 3315.674             | -0.02              | 3315.471             | 3315.458             | -0.01              | 3315.471             | 3315.458             | -0.01              | 3314.318             | 3314.318             | 0.00               |
| 136.033 | 3315.695             | 3315.674             | -0.02              | 3315.471             | 3315.458             | -0.01              | 3315.471             | 3315.458             | -0.01              | 3314.315             | 3314.315             | 0.00               |
| 136.16  | 3315.695             | 3315.674             | -0.02              | 3315.471             | 3315.458             | -0.01              | 3315.471             | 3315.458             | -0.01              | 3314.313             | 3314.313             | 0.00               |
| 139.036 | 3315.693             | 3315.672             | -0.02              | 3315.468             | 3315.456             | -0.01              | 3315.468             | 3315.456             | -0.01              | 3314.255             | 3314.255             | 0.00               |
| 139.047 | 3315.693             | 3315.672             | -0.02              | 3315.468             | 3315.456             | -0.01              | 3315.468             | 3315.456             | -0.01              | 3314.255             | 3314.255             | 0.00               |
| 139.335 | 3315.693             | 3315.672             | -0.02              | 3315.468             | 3315.455             | -0.01              | 3315.468             | 3315.455             | -0.01              | 3314.249             | 3314.249             | 0.00               |
| 140.911 | 3315.692             | 3315.671             | -0.02              | 3315.467             | 3315.454             | -0.01              | 3315.467             | 3315.454             | -0.01              | 3314.218             | 3314.218             | 0.00               |
| 142.039 | 3315.691             | 3315.67              | -0.02              | 3315.466             | 3315.453             | -0.01              | 3315.466             | 3315.453             | -0.01              | 3314.197             | 331                  |                    |

| Station | 36" Culvert Scenario |                      |                    | 42" Culvert Scenario |                      |                    | 54" Culvert Scenario |                      |                    | 60" Culvert Scenario |                      |                    |
|---------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
|         | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) |
| 148.051 | 3315.685             | 3315.663             | -0.02              | 3315.456             | 3315.443             | -0.01              | 3315.456             | 3315.443             | -0.01              | 3314.053             | 3314.053             | 0.00               |
| 148.594 | 3315.684             | 3315.662             | -0.02              | 3315.455             | 3315.442             | -0.01              | 3315.455             | 3315.442             | -0.01              | 3314.04              | 3314.04              | 0.00               |
| 150.401 | 3315.682             | 3315.66              | -0.02              | 3315.451             | 3315.438             | -0.01              | 3315.451             | 3315.438             | -0.01              | 3313.994             | 3313.994             | 0.00               |
| 151.057 | 3315.681             | 3315.659             | -0.02              | 3315.45              | 3315.437             | -0.01              | 3315.45              | 3315.437             | -0.01              | 3313.978             | 3313.978             | 0.00               |
| 151.801 | 3315.68              | 3315.658             | -0.02              | 3315.448             | 3315.435             | -0.01              | 3315.448             | 3315.435             | -0.01              | 3313.959             | 3313.959             | 0.00               |
| 152.536 | 3315.679             | 3315.657             | -0.02              | 3315.446             | 3315.433             | -0.01              | 3315.446             | 3315.433             | -0.01              | 3313.94              | 3313.94              | 0.00               |
| 153.23  | 3315.678             | 3315.657             | -0.02              | 3315.446             | 3315.432             | -0.01              | 3315.446             | 3315.432             | -0.01              | 3313.921             | 3313.921             | 0.00               |
| 154.063 | 3315.679             | 3315.656             | -0.02              | 3315.445             | 3315.431             | -0.01              | 3315.445             | 3315.431             | -0.01              | 3313.899             | 3313.899             | 0.00               |
| 156.059 | 3315.676             | 3315.654             | -0.02              | 3315.442             | 3315.429             | -0.01              | 3315.442             | 3315.429             | -0.01              | 3313.846             | 3313.846             | 0.00               |
| 157.069 | 3315.675             | 3315.654             | -0.02              | 3315.441             | 3315.428             | -0.01              | 3315.441             | 3315.428             | -0.01              | 3313.82              | 3313.82              | 0.00               |
| 158.213 | 3315.675             | 3315.653             | -0.02              | 3315.44              | 3315.426             | -0.01              | 3315.44              | 3315.426             | -0.01              | 3313.79              | 3313.79              | 0.00               |
| 158.888 | 3315.674             | 3315.652             | -0.02              | 3315.439             | 3315.426             | -0.01              | 3315.439             | 3315.426             | -0.01              | 3313.772             | 3313.772             | 0.00               |
| 160.075 | 3315.673             | 3315.651             | -0.02              | 3315.438             | 3315.424             | -0.01              | 3315.438             | 3315.424             | -0.01              | 3313.741             | 3313.741             | 0.00               |
| 161.419 | 3315.672             | 3315.65              | -0.02              | 3315.436             | 3315.423             | -0.01              | 3315.436             | 3315.423             | -0.01              | 3313.707             | 3313.707             | 0.00               |
| 161.717 | 3315.672             | 3315.65              | -0.02              | 3315.436             | 3315.422             | -0.01              | 3315.436             | 3315.422             | -0.01              | 3313.699             | 3313.699             | 0.00               |
| 162.51  | 3315.671             | 3315.65              | -0.02              | 3315.435             | 3315.421             | -0.01              | 3315.435             | 3315.421             | -0.01              | 3313.679             | 3313.679             | 0.00               |
| 163.08  | 3315.672             | 3315.65              | -0.02              | 3315.436             | 3315.422             | -0.01              | 3315.436             | 3315.422             | -0.01              | 3313.665             | 3313.665             | 0.00               |
| 164.546 | 3315.673             | 3315.652             | -0.02              | 3315.437             | 3315.423             | -0.01              | 3315.437             | 3315.423             | -0.01              | 3313.631             | 3313.631             | 0.00               |
| 164.626 | 3315.673             | 3315.652             | -0.02              | 3315.437             | 3315.423             | -0.01              | 3315.437             | 3315.423             | -0.01              | 3313.629             | 3313.629             | 0.00               |
| 166.086 | 3315.675             | 3315.653             | -0.02              | 3315.438             | 3315.425             | -0.01              | 3315.438             | 3315.425             | -0.01              | 3313.595             | 3313.594             | 0.00               |
| 166.955 | 3315.676             | 3315.654             | -0.02              | 3315.439             | 3315.426             | -0.01              | 3315.439             | 3315.426             | -0.01              | 3313.574             | 3313.574             | 0.00               |
| 167.346 | 3315.676             | 3315.654             | -0.02              | 3315.44              | 3315.426             | -0.01              | 3315.44              | 3315.426             | -0.01              | 3313.567             | 3313.567             | 0.00               |
| 167.934 | 3315.677             | 3315.655             | -0.02              | 3315.44              | 3315.427             | -0.01              | 3315.44              | 3315.427             | -0.01              | 3313.558             | 3313.558             | 0.00               |
| 169.112 | 3315.678             | 3315.656             | -0.02              | 3315.441             | 3315.427             | -0.01              | 3315.441             | 3315.427             | -0.01              | 3313.539             | 3313.538             | 0.00               |
| 169.98  | 3315.678             | 3315.656             | -0.02              | 3315.442             | 3315.428             | -0.01              | 3315.442             | 3315.428             | -0.01              | 3313.524             | 3313.524             | 0.00               |
| 171.513 | 3315.679             | 3315.658             | -0.02              | 3315.443             | 3315.429             | -0.01              | 3315.443             | 3315.429             | -0.01              | 3313.499             | 3313.499             | 0.00               |
| 172.147 | 3315.68              | 3315.658             | -0.02              | 3315.443             | 3315.429             | -0.01              | 3315.443             | 3315.429             | -0.01              | 3313.489             | 3313.489             | 0.00               |
| 172.472 | 3315.68              | 3315.658             | -0.02              | 3315.443             | 3315.43              | -0.01              | 3315.443             | 3315.43              | -0.01              | 3313.483             | 3313.483             | 0.00               |
| 172.613 | 3315.68              | 3315.658             | -0.02              | 3315.443             | 3315.43              | -0.01              | 3315.443             | 3315.43              | -0.01              | 3313.482             | 3313.482             | 0.00               |
| 175.182 | 3315.682             | 3315.66              | -0.02              | 3315.445             | 3315.431             | -0.01              | 3315.445             | 3315.431             | -0.01              | 3313.457             | 3313.457             | 0.00               |
| 175.247 | 3315.682             | 3315.66              | -0.02              | 3315.445             | 3315.431             | -0.01              | 3315.445             | 3315.431             | -0.01              | 3313.456             | 3313.456             | 0.00               |
| 175.679 | 3315.682             | 3315.66              | -0.02              | 3315.445             | 3315.432             | -0.01              | 3315.445             | 3315.432             | -0.01              | 3313.452             | 3313.452             | 0.00               |
| 177.881 | 3315.684             | 3315.661             | -0.02              | 3315.447             | 3315.433             | -0.01              | 3315.447             | 3315.433             | -0.01              | 3313.43              | 3313.429             | 0.00               |
| 178.672 | 3315.684             | 3315.662             | -0.02              | 3315.447             | 3315.433             | -0.01              | 3315.447             | 3315.433             | -0.01              | 3313.421             | 3313.421             | 0.00               |
| 180.515 | 3315.685             | 3315.663             | -0.02              | 3315.448             | 3315.435             | -0.01              | 3315.448             | 3315.435             | -0.01              | 3313.402             | 3313.402             | 0.00               |
| 181.251 | 3315.686             | 3315.663             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.394             | 3313.394             | 0.00               |
| 182.254 | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.436             | -0.01              | 3315.449             | 3315.436             | -0.01              | 3313.383             | 3313.383             | 0.00               |
| 184.285 | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.353             | 3313.353             | 0.00               |
| 185.782 | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.332             | 3313.331             | 0.00               |
| 185.83  | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.331             | 3313.331             | 0.00               |
| 188.416 | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.294             | 3313.293             | 0.00               |
| 189.409 | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.279             | 3313.279             | 0.00               |
| 190.354 | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.266             | 3313.265             | 0.00               |
| 191.05  | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.256             | 3313.255             | 0.00               |
| 191.831 | 3315.686             | 3315.664             | -0.02              | 3315.449             | 3315.435             | -0.01              | 3315.449             | 3315.435             | -0.01              | 3313.244             | 3313.244             | 0.00               |
| 192.151 | 3315.686             | 3315.663             | -0.02              | 3315.448             | 3315.435             | -0.01              | 3315.448             | 3315.435             | -0.01              | 3313.232             | 3313.231             | 0.00               |
| 193.261 | 3315.685             | 3315.663             | -0.02              | 3315.448             | 3315.434             | -0.01              | 3315.448             | 3315.434             | -0.01              | 3313.199             | 3313.199             | 0.00               |
| 193.441 | 3315.685             | 3315.663             | -0.02              | 3315.447             | 3315.434             | -0.01              | 3315.447             | 3315.434             | -0.01              | 3313.194             | 3313.194             | 0.00               |
| 193.531 | 3315.685             | 3315.662             | -0.02              | 3315.447             | 3315.434             | -0.01              | 3315.447             | 3315.434             | -0.01              | 3313.191             | 3313.191             | 0.00               |
| 195.903 | 3315.683             | 3315.661             | -0.02              | 3315.445             | 3315.431             | -0.01              | 3315.445             | 3315.431             | -0.01              | 3313.119             | 3313.119             | 0.00               |
| 196.603 | 3315.682             | 3315.66              | -0.02              | 3315.444             | 3315.431             | -0.01              | 3315.444             | 3315.431             | -0.01              | 3313.097             | 3313.097             | 0.00               |
| 198.004 | 3315.681             | 3315.659             | -0.02              | 3315.443             | 3315.429             | -0.01              | 3315.443             | 3315.429             | -0.01              | 3313.053             | 3313.053             | 0.00               |
| 198.274 | 3315.681             | 3315.659             | -0.02              | 3315.443             | 3315.429             | -0.01              | 3315.443             | 3315.429             | -0.01              | 3313.044             | 3313.044             | 0.00               |
| 199.765 | 3315.68              | 3315.658             | -0.02              | 3315.441             | 3315.428             | -0.01              | 3315.441             | 3315.428             | -0.01              | 3312.995             | 3312.995             | 0.00               |
| 200.646 | 3315.679             | 3315.657             | -0.02              | 3315.44              | 3315.427             | -0.01              | 3315.44              | 3315.427             | -0.01              | 3312.966             | 3312.965             | 0.00               |
| 201.61  | 3315.679             | 3315.656             | -0.02              | 3315.44              | 3315.426             | -0.01              | 3315.44              | 3315.426             | -0.01              | 3312.933             | 3312.933             | 0.00               |
| 202.747 | 3315.679             | 3315.656             | -0.02              | 3315.44              | 3315.426             | -0.01              | 3315.44              | 3315.426             | -0.01              | 3312.894             | 3312.894             | 0.00               |
| 202.928 | 3315.679             | 3315.656             | -0.02              | 3315.44              | 3315.426             | -0.01              | 3315.44              | 3315.426             | -0.01              | 3312.888             | 3312.888             | 0.00               |
| 203.018 | 3315.679             | 3315.656             | -0.02              | 3315.44              | 3315.426             | -0.01              | 3315.44              | 3315.426             | -0.01              | 3312.885             | 3312.885             | 0.00               |
| 203.288 | 3315.679             | 3315.656             | -0.02              | 3315.44              | 3315.426             | -0.01              | 3315.44              | 3315.426             | -0.01              | 3312.876             | 3312.875             | 0.00               |
| 204.622 | 3315.678             | 3315.656             | -0.02              | 3315.439             | 3315.425             | -0.01              | 3315.439             | 3315.425             | -0.01              | 3312.849             | 3312.848             | 0.00               |
| 206.09  | 3315.678             | 3315.656             | -0.02              | 3315.439             | 3315.425             | -0.01              | 3315.439             | 3315.425             | -0.01              | 3312.827             | 3312.827             | 0.00               |
| 207.761 | 3315.678             | 3315.656             | -0.02              | 3315.439             | 3315.425             | -0.01              | 3315.439             | 3315.425             | -0.01              | 3312.803             | 3312.802             | 0.00               |
| 210.988 | 3315.677             | 3315.655             | -0.02              | 3315.438             | 3315.424             | -0.01              | 3315.438             | 3315.424             | -0.01              | 3312.756             | 3312.756             | 0.00               |
| 211.858 | 3315.677             | 3315.655             | -0.02              | 3315.438             | 3315.424             | -0.01              | 3315.438             | 3315.424             | -0.01              | 3312.742             | 3312.742             | 0.00               |
| 211.927 | 3315.677             | 3315.655             | -0.02              | 3315.438             | 3315.424             | -0.01              | 3315.438             | 3315.424             | -0.01              | 3312.742             | 3312.742             | 0.00               |
| 212.358 | 3315.677             | 3315.655             | -0.02              | 3315.438             | 3315.424             | -0.01              | 3315.438             | 3315.424             | -0.01              | 3312.739             | 3312.739             | 0.00               |
| 212.683 | 3315.677             | 3315.655             | -0.02              | 3315.438             | 3315.424             | -0.01              | 3315.438             | 3315.424             | -0.01              | 3312.737             | 3312.736             | 0.00               |
| 214.5   | 3315.677             | 3315.654             | -0.02              | 3315.437             | 3315.424             | -0.01              | 3315.437             | 3315.424             | -0.01              | 3312.724             | 3312.724             | 0.00               |
| 214.998 | 3315.676             | 3315.654             | -0.02              | 3315.437             | 3315.423             | -0.01              | 3315.437             | 3315.423             | -0.01              | 3312.721             | 3312.721             | 0.00               |
| 216.44  | 3315.676             | 3315.654             | -0.02              | 3315.437             | 3315.423             | -0.01              | 3315.437             | 3315.423             | -0.01              | 3312.711             | 3312.711             | 0.00               |
| 216.642 | 3315.676             | 3315.654             | -0.02              | 3315.437             | 3315.423             | -0.01              | 3315.437             | 3315.423             | -0.01              | 3312.71              | 3312.71              | 0.00               |
| 216.91  | 3315.676             | 3315.654             | -0.02              | 3315.437             | 3315.423             | -0.01              | 3315.437             | 3315.423             | -0.01              | 3312.708             | 3312.708             | 0.00               |
| 218.784 | 3315.676             | 3315.653             | -0.02              | 3315.436             | 3315.423             | -0.01              | 3315.436             | 3315.423             | -0.01              | 3312.696             | 3312.696             | 0.00               |
| 220.197 | 3315.675             | 3315.653             | -0.02              | 3315.436             | 3315.422             | -0.01              | 3315.436             | 3315.422             | -0.01              | 3312.687             | 3312.686             | 0.00               |
| 220.926 | 3315.675             | 3315.653             | -0.02              | 3315.436             | 3315.422             | -0.01              | 3315.436             | 3315.422             | -0.01              | 3312.682             | 3312.681             | 0.00               |
| 221.804 | 3315.675             | 3315.653             | -0.02              | 3315.436             | 3315.422             | -0.01              | 3315.436             | 3315.422             | -0.01              | 3312.676             | 3312.675             | 0.00               |
| 221.894 | 3315.675             | 3315.653             | -0.02              | 3315.436             | 3315.422             | -0.01              | 3                    |                      |                    |                      |                      |                    |

| Station | 36" Culvert Scenario |                      |                    | 42" Culvert Scenario |                      |                    | 54" Culvert Scenario |                      |                    | 60" Culvert Scenario |                      |                    |
|---------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
|         | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) |
| 227.353 | 3315.673             | 3315.651             | -0.02              | 3315.433             | 3315.419             | -0.01              | 3315.433             | 3315.419             | -0.01              | 3312.625             | 3312.624             | 0.00               |
| 227.711 | 3315.673             | 3315.65              | -0.02              | 3315.433             | 3315.419             | -0.01              | 3315.433             | 3315.419             | -0.01              | 3312.621             | 3312.621             | 0.00               |
| 229.495 | 3315.672             | 3315.65              | -0.02              | 3315.432             | 3315.419             | -0.01              | 3315.432             | 3315.419             | -0.01              | 3312.605             | 3312.605             | 0.00               |
| 230.261 | 3315.672             | 3315.649             | -0.02              | 3315.432             | 3315.418             | -0.01              | 3315.432             | 3315.418             | -0.01              | 3312.598             | 3312.598             | 0.00               |
| 231.467 | 3315.671             | 3315.649             | -0.02              | 3315.431             | 3315.418             | -0.01              | 3315.431             | 3315.418             | -0.01              | 3312.588             | 3312.587             | 0.00               |
| 231.637 | 3315.671             | 3315.649             | -0.02              | 3315.431             | 3315.418             | -0.01              | 3315.431             | 3315.418             | -0.01              | 3312.586             | 3312.586             | 0.00               |
| 231.679 | 3315.671             | 3315.649             | -0.02              | 3315.431             | 3315.418             | -0.01              | 3315.431             | 3315.418             | -0.01              | 3312.586             | 3312.585             | 0.00               |
| 233.779 | 3315.671             | 3315.649             | -0.02              | 3315.431             | 3315.418             | -0.01              | 3315.431             | 3315.418             | -0.01              | 3312.565             | 3312.565             | 0.00               |
| 235.224 | 3315.671             | 3315.649             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.55              | 3312.55              | 0.00               |
| 235.921 | 3315.671             | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.543             | 3312.543             | 0.00               |
| 236.845 | 3315.671             | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.534             | 3312.533             | 0.00               |
| 238.981 | 3315.67              | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.513             | 3312.512             | 0.00               |
| 240.205 | 3315.67              | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.5               | 3312.5               | 0.00               |
| 241.68  | 3315.67              | 3315.648             | -0.02              | 3315.43              | 3315.417             | -0.01              | 3315.43              | 3315.417             | -0.01              | 3312.485             | 3312.485             | 0.00               |
| 241.829 | 3315.67              | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.485             | 3312.485             | 0.00               |
| 242.347 | 3315.67              | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.484             | 3312.484             | 0.00               |
| 242.738 | 3315.67              | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.484             | 3312.483             | 0.00               |
| 244.49  | 3315.671             | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.481             | 3312.481             | 0.00               |
| 245.523 | 3315.671             | 3315.648             | -0.02              | 3315.431             | 3315.417             | -0.01              | 3315.431             | 3315.417             | -0.01              | 3312.48              | 3312.479             | 0.00               |
| 246.495 | 3315.671             | 3315.648             | -0.02              | 3315.431             | 3315.418             | -0.01              | 3315.431             | 3315.418             | -0.01              | 3312.478             | 3312.478             | 0.00               |
| 246.632 | 3315.671             | 3315.648             | -0.02              | 3315.431             | 3315.418             | -0.01              | 3315.431             | 3315.418             | -0.01              | 3312.478             | 3312.478             | 0.00               |
| 246.813 | 3315.671             | 3315.648             | -0.02              | 3315.431             | 3315.418             | -0.01              | 3315.431             | 3315.418             | -0.01              | 3312.478             | 3312.477             | 0.00               |
| 248.774 | 3315.671             | 3315.649             | -0.02              | 3315.432             | 3315.418             | -0.01              | 3315.432             | 3315.418             | -0.01              | 3312.475             | 3312.474             | 0.00               |
| 251.647 | 3315.671             | 3315.649             | -0.02              | 3315.432             | 3315.418             | -0.01              | 3315.432             | 3315.418             | -0.01              | 3312.471             | 3312.47              | 0.00               |
| 253.058 | 3315.672             | 3315.649             | -0.02              | 3315.432             | 3315.419             | -0.01              | 3315.432             | 3315.419             | -0.01              | 3312.475             | 3312.474             | 0.00               |





| Station | 36" Culvert Scenario |                      |                    | 42" Culvert Scenario |                      |                    | 54" Culvert Scenario |                      |                    | 60" Culvert Scenario |                      |                    |
|---------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
|         | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) |
| 385.666 | 3315.674             | 3315.652             | -0.02              | 3315.435             | 3315.421             | -0.01              | 3315.435             | 3315.421             | -0.01              | NaN                  | NaN                  | #VALUE!            |
| 385.759 | 3315.674             | 3315.652             | -0.02              | 3315.435             | 3315.421             | -0.01              | 3315.435             | 3315.421             | -0.01              | NaN                  | NaN                  | #VALUE!            |
| 503.512 | 3303.053             | 3303.052             | 0.00               | 3303.399             | 3303.398             | 0.00               | 3303.399             | 3303.398             | 0.00               | 3303.804             | 3303.804             | 0.00               |
| 503.778 | 3303.05              | 3303.049             | 0.00               | 3303.396             | 3303.395             | 0.00               | 3303.396             | 3303.395             | 0.00               | 3303.8               | 3303.8               | 0.00               |
| 503.881 | 3303.049             | 3303.047             | 0.00               | 3303.395             | 3303.394             | 0.00               | 3303.395             | 3303.394             | 0.00               | 3303.798             | 3303.798             | 0.00               |
| 504.112 | 3303.046             | 3303.044             | 0.00               | 3303.392             | 3303.391             | 0.00               | 3303.392             | 3303.391             | 0.00               | 3303.793             | 3303.793             | 0.00               |
| 505.279 | 3303.032             | 3303.031             | 0.00               | 3303.377             | 3303.376             | 0.00               | 3303.377             | 3303.376             | 0.00               | 3303.772             | 3303.772             | 0.00               |
| 506.052 | 3303.022             | 3303.021             | 0.00               | 3303.367             | 3303.366             | 0.00               | 3303.367             | 3303.366             | 0.00               | 3303.757             | 3303.757             | 0.00               |
| 506.101 | 3303.022             | 3303.021             | 0.00               | 3303.366             | 3303.365             | 0.00               | 3303.366             | 3303.365             | 0.00               | 3303.756             | 3303.756             | 0.00               |
| 506.609 | 3303.016             | 3303.014             | 0.00               | 3303.36              | 3303.359             | 0.00               | 3303.36              | 3303.359             | 0.00               | 3303.747             | 3303.747             | 0.00               |
| 508.777 | 3302.99              | 3302.989             | 0.00               | 3303.332             | 3303.331             | 0.00               | 3303.332             | 3303.331             | 0.00               | 3303.707             | 3303.707             | 0.00               |
| 510.945 | 3302.963             | 3302.962             | 0.00               | 3303.304             | 3303.303             | 0.00               | 3303.304             | 3303.303             | 0.00               | 3303.667             | 3303.667             | 0.00               |
| 513.074 | 3302.846             | 3302.845             | 0.00               | 3303.188             | 3303.187             | 0.00               | 3303.188             | 3303.187             | 0.00               | 3303.527             | 3303.527             | 0.00               |
| 513.334 | 3302.831             | 3302.83              | 0.00               | 3303.174             | 3303.173             | 0.00               | 3303.174             | 3303.173             | 0.00               | 3303.511             | 3303.511             | 0.00               |
| 513.671 | 3302.813             | 3302.812             | 0.00               | 3303.156             | 3303.155             | 0.00               | 3303.156             | 3303.155             | 0.00               | 3303.489             | 3303.489             | 0.00               |
| 517.47  | 3302.597             | 3302.596             | 0.00               | 3302.94              | 3302.939             | 0.00               | 3302.94              | 3302.939             | 0.00               | 3303.231             | 3303.231             | 0.00               |
| 520.941 | 3302.398             | 3302.397             | 0.00               | 3302.735             | 3302.735             | 0.00               | 3302.735             | 3302.735             | 0.00               | 3302.991             | 3302.991             | 0.00               |
| 521.668 | 3302.348             | 3302.347             | 0.00               | 3302.71              | 3302.71              | 0.00               | 3302.71              | 3302.71              | 0.00               | 3302.963             | 3302.963             | 0.00               |
| 522.565 | 3302.287             | 3302.286             | 0.00               | 3302.679             | 3302.679             | 0.00               | 3302.679             | 3302.679             | 0.00               | 3302.927             | 3302.927             | 0.00               |
| 523.881 | 3302.198             | 3302.197             | 0.00               | 3302.632             | 3302.632             | 0.00               | 3302.632             | 3302.632             | 0.00               | 3302.874             | 3302.874             | 0.00               |
| 524.972 | 3302.125             | 3302.124             | 0.00               | 3302.592             | 3302.592             | 0.00               | 3302.592             | 3302.592             | 0.00               | 3302.829             | 3302.829             | 0.00               |
| 526.158 | 3302.046             | 3302.045             | 0.00               | 3302.548             | 3302.547             | 0.00               | 3302.548             | 3302.547             | 0.00               | 3302.78              | 3302.78              | 0.00               |
| 527.379 | 3301.965             | 3301.964             | 0.00               | 3302.501             | 3302.5               | 0.00               | 3302.501             | 3302.5               | 0.00               | 3302.728             | 3302.728             | 0.00               |
| 528.37  | 3301.9               | 3301.899             | 0.00               | 3302.462             | 3302.461             | 0.00               | 3302.462             | 3302.461             | 0.00               | 3302.685             | 3302.685             | 0.00               |
| 529.291 | 3301.84              | 3301.84              | 0.00               | 3302.425             | 3302.425             | 0.00               | 3302.425             | 3302.425             | 0.00               | 3302.644             | 3302.644             | 0.00               |
| 529.786 | 3301.808             | 3301.808             | 0.00               | 3302.405             | 3302.405             | 0.00               | 3302.405             | 3302.405             | 0.00               | 3302.622             | 3302.622             | 0.00               |
| 530.801 | 3301.743             | 3301.742             | 0.00               | 3302.363             | 3302.363             | 0.00               | 3302.363             | 3302.363             | 0.00               | 3302.576             | 3302.576             | 0.00               |
| 530.978 | 3301.732             | 3301.731             | 0.00               | 3302.356             | 3302.355             | 0.00               | 3302.356             | 3302.355             | 0.00               | 3302.568             | 3302.568             | 0.00               |
| 531.423 | 3301.713             | 3301.712             | 0.00               | 3302.333             | 3302.332             | 0.00               | 3302.333             | 3302.332             | 0.00               | 3302.555             | 3302.555             | 0.00               |
| 532.193 | 3301.679             | 3301.679             | 0.00               | 3302.292             | 3302.292             | 0.00               | 3302.292             | 3302.292             | 0.00               | 3302.531             | 3302.531             | 0.00               |
| 532.425 | 3301.669             | 3301.669             | 0.00               | 3302.28              | 3302.28              | 0.00               | 3302.28              | 3302.28              | 0.00               | 3302.524             | 3302.524             | 0.00               |
| 532.858 | 3301.651             | 3301.65              | 0.00               | 3302.258             | 3302.257             | 0.00               | 3302.258             | 3302.257             | 0.00               | 3302.51              | 3302.51              | 0.00               |
| 534.6   | 3301.576             | 3301.575             | 0.00               | 3302.167             | 3302.166             | 0.00               | 3302.167             | 3302.166             | 0.00               | 3302.454             | 3302.454             | 0.00               |
| 535.559 | 3301.535             | 3301.534             | 0.00               | 3302.117             | 3302.117             | 0.00               | 3302.117             | 3302.117             | 0.00               | 3302.423             | 3302.423             | 0.00               |
| 537.007 | 3301.473             | 3301.472             | 0.00               | 3302.042             | 3302.042             | 0.00               | 3302.042             | 3302.042             | 0.00               | 3302.374             | 3302.374             | 0.00               |
| 537.347 | 3301.458             | 3301.458             | 0.00               | 3302.024             | 3302.024             | 0.00               | 3302.024             | 3302.024             | 0.00               | 3302.362             | 3302.362             | 0.00               |
| 538.693 | 3301.401             | 3301.4               | 0.00               | 3301.955             | 3301.955             | 0.00               | 3301.955             | 3301.955             | 0.00               | 3302.315             | 3302.315             | 0.00               |
| 539.414 | 3301.37              | 3301.369             | 0.00               | 3301.918             | 3301.917             | 0.00               | 3301.918             | 3301.917             | 0.00               | 3302.289             | 3302.289             | 0.00               |
| 541.095 | 3301.298             | 3301.297             | 0.00               | 3301.832             | 3301.831             | 0.00               | 3301.832             | 3301.831             | 0.00               | 3302.228             | 3302.228             | 0.00               |
| 541.804 | 3301.266             | 3301.265             | 0.00               | 3301.775             | 3301.775             | 0.00               | 3301.775             | 3301.775             | 0.00               | 3302.187             | 3302.187             | 0.00               |
| 541.821 | 3301.265             | 3301.264             | 0.00               | 3301.774             | 3301.773             | 0.00               | 3301.774             | 3301.773             | 0.00               | 3302.186             | 3302.186             | 0.00               |
| 541.836 | 3301.264             | 3301.263             | 0.00               | 3301.773             | 3301.772             | 0.00               | 3301.773             | 3301.772             | 0.00               | 3302.185             | 3302.185             | 0.00               |
| 544.228 | 3301.156             | 3301.155             | 0.00               | 3301.584             | 3301.583             | 0.00               | 3301.584             | 3301.583             | 0.00               | 3302.045             | 3302.045             | 0.00               |
| 544.96  | 3301.123             | 3301.122             | 0.00               | 3301.526             | 3301.526             | 0.00               | 3301.526             | 3301.526             | 0.00               | 3302.003             | 3302.003             | 0.00               |
| 546.324 | 3301.061             | 3301.06              | 0.00               | 3301.42              | 3301.419             | 0.00               | 3301.42              | 3301.419             | 0.00               | 3301.924             | 3301.924             | 0.00               |
| 546.635 | 3301.046             | 3301.046             | 0.00               | 3301.396             | 3301.395             | 0.00               | 3301.396             | 3301.395             | 0.00               | 3301.906             | 3301.906             | 0.00               |
| 550.408 | 3300.876             | 3300.875             | 0.00               | 3301.106             | 3301.106             | 0.00               | 3301.106             | 3301.106             | 0.00               | 3301.665             | 3301.665             | 0.00               |
| 551.152 | 3300.842             | 3300.841             | 0.00               | 3301.051             | 3301.051             | 0.00               | 3301.051             | 3301.051             | 0.00               | 3301.614             | 3301.614             | 0.00               |
| 551.182 | 3300.84              | 3300.839             | 0.00               | 3301.049             | 3301.049             | 0.00               | 3301.049             | 3301.049             | 0.00               | 3301.612             | 3301.612             | 0.00               |
| 551.671 | 3300.816             | 3300.815             | 0.00               | 3301.024             | 3301.023             | 0.00               | 3301.024             | 3301.023             | 0.00               | 3301.563             | 3301.563             | 0.00               |
| 554.114 | 3300.694             | 3300.694             | 0.00               | 3300.898             | 3300.898             | 0.00               | 3300.898             | 3300.898             | 0.00               | 3301.329             | 3301.329             | 0.00               |
| 554.199 | 3300.69              | 3300.69              | 0.00               | 3300.894             | 3300.894             | 0.00               | 3300.894             | 3300.894             | 0.00               | 3301.321             | 3301.321             | 0.00               |
| 554.589 | 3300.671             | 3300.67              | 0.00               | 3300.874             | 3300.874             | 0.00               | 3300.874             | 3300.874             | 0.00               | 3301.286             | 3301.286             | 0.00               |
| 557.246 | 3300.538             | 3300.537             | 0.00               | 3300.737             | 3300.736             | 0.00               | 3300.737             | 3300.736             | 0.00               | 3301.055             | 3301.055             | 0.00               |
| 557.821 | 3300.51              | 3300.509             | 0.00               | 3300.707             | 3300.707             | 0.00               | 3300.707             | 3300.707             | 0.00               | 3301.008             | 3301.008             | 0.00               |
| 561.528 | 3300.327             | 3300.326             | 0.00               | 3300.52              | 3300.519             | 0.00               | 3300.52              | 3300.519             | 0.00               | 3300.738             | 3300.738             | 0.00               |
| 562.018 | 3300.308             | 3300.307             | 0.00               | 3300.501             | 3300.501             | 0.00               | 3300.501             | 3300.501             | 0.00               | 3300.719             | 3300.719             | 0.00               |
| 563.34  | 3300.257             | 3300.256             | 0.00               | 3300.452             | 3300.451             | 0.00               | 3300.452             | 3300.451             | 0.00               | 3300.67              | 3300.67              | 0.00               |
| 564.605 | 3300.209             | 3300.208             | 0.00               | 3300.404             | 3300.404             | 0.00               | 3300.404             | 3300.404             | 0.00               | 3300.623             | 3300.623             | 0.00               |
| 565.235 | 3300.185             | 3300.184             | 0.00               | 3300.381             | 3300.38              | 0.00               | 3300.381             | 3300.38              | 0.00               | 3300.599             | 3300.599             | 0.00               |
| 566.387 | 3300.141             | 3300.141             | 0.00               | 3300.338             | 3300.337             | 0.00               | 3300.338             | 3300.337             | 0.00               | 3300.556             | 3300.556             | 0.00               |
| 567.192 | 3300.111             | 3300.11              | 0.00               | 3300.308             | 3300.308             | 0.00               | 3300.308             | 3300.308             | 0.00               | 3300.526             | 3300.526             | 0.00               |
| 568.941 | 3300.045             | 3300.045             | 0.00               | 3300.243             | 3300.243             | 0.00               | 3300.243             | 3300.243             | 0.00               | 3300.462             | 3300.462             | 0.00               |
| 569.778 | 3300.014             | 3300.013             | 0.00               | 3300.213             | 3300.212             | 0.00               | 3300.213             | 3300.212             | 0.00               | 3300.431             | 3300.431             | 0.00               |
| 570.471 | 3299.989             | 3299.988             | 0.00               | 3300.187             | 3300.187             | 0.00               | 3300.187             | 3300.187             | 0.00               | 3300.405             | 3300.405             | 0.00               |
| 571.31  | 3299.957             | 3299.957             | 0.00               | 3300.156             | 3300.156             | 0.00               | 3300.156             | 3300.156             | 0.00               | 3300.374             | 3300.374             | 0.00               |
| 571.469 | 3299.954             | 3299.953             | 0.00               | 3300.153             | 3300.153             | 0.00               | 3300.153             | 3300.153             | 0.00               | 3300.371             | 3300.371             | 0.00               |
| 572.311 | 3299.937             | 3299.937             | 0.00               | 3300.137             | 3300.137             | 0.00               | 3300.137             | 3300.137             | 0.00               | 3300.355             | 3300.355             | 0.00               |
| 572.499 | 3299.933             | 3299.933             | 0.00               | 3300.134             | 3300.133             | 0.00               | 3300.134             | 3300.133             | 0.00               | 3300.351             | 3300.351             | 0.00               |
| 572.795 | 3299.928             | 3299.927             | 0.00               | 3300.128             | 3300.128             | 0.00               | 3300.128             | 3300.128             | 0.00               | 3300.346             | 3300.346             | 0.00               |
| 574.324 | 3299.897             | 3299.896             | 0.00               | 3300.099             | 3300.099             | 0.00               | 3300.099             | 3300.099             | 0.00               | 3300.317             | 3300.317             | 0.00               |
| 574.824 | 3299.887             | 3299.886             | 0.00               | 3300.09              | 3300.089             | 0.00               | 3300.09              | 3300.089             | 0.00               | 3300.307             | 3300.307             | 0.00               |
| 575.573 | 3299.871             | 3299.871             | 0.00               | 3300.075             | 3300.075             | 0.00               | 3300.075             | 3300.075             | 0.00               | 3300.292             | 3300.292             | 0.00               |
| 576.752 | 3299.847             | 3299.846             | 0.00               | 3300.052             | 3300.052             | 0.00               | 3300.052             | 3300.052             | 0.00               | 3300.269             | 3300.269             | 0.00               |
| 577.337 | 3299.835             | 3299.835             | 0.00               | 3300.041             | 3300.04              | 0.00               | 3300.041             | 3300.04              | 0.00               | 3300.258             | 3300.258             | 0.00               |
| 578.647 | 3299.808             | 3299.807             | 0.00               | 3300.015             | 3300.015             | 0.00               | 3300.015             | 3300.015             | 0.00               | 3300.231             | 3300.231             | 0.00               |
| 579.85  | 3299.783             | 3299.783             | 0.00               | 3299.991             | 3299.991             | 0.00               | 3299.991             | 3299.991             | 0.00               | 3300.208             | 3300.208             | 0.00               |
| 580.71  | 3299.765             | 3299.76              |                    |                      |                      |                    |                      |                      |                    |                      |                      |                    |

| Station | 36" Culvert Scenario |                      |                    | 42" Culvert Scenario |                      |                    | 54" Culvert Scenario |                      |                    | 60" Culvert Scenario |                      |                    |
|---------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
|         | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) |
| 585.239 | 3299.703             | 3299.703             | 0.00               | 3299.909             | 3299.908             | 0.00               | 3299.909             | 3299.908             | 0.00               | 3300.126             | 3300.126             | 0.00               |
| 587.388 | 3299.676             | 3299.675             | 0.00               | 3299.879             | 3299.879             | 0.00               | 3299.879             | 3299.879             | 0.00               | 3300.097             | 3300.097             | 0.00               |
| 587.868 | 3299.67              | 3299.669             | 0.00               | 3299.873             | 3299.872             | 0.00               | 3299.873             | 3299.872             | 0.00               | 3300.09              | 3300.09              | 0.00               |
| 588.624 | 3299.66              | 3299.66              | 0.00               | 3299.862             | 3299.862             | 0.00               | 3299.862             | 3299.862             | 0.00               | 3300.08              | 3300.08              | 0.00               |
| 589.757 | 3299.646             | 3299.645             | 0.00               | 3299.846             | 3299.846             | 0.00               | 3299.846             | 3299.846             | 0.00               | 3300.064             | 3300.064             | 0.00               |
| 589.932 | 3299.643             | 3299.643             | 0.00               | 3299.844             | 3299.844             | 0.00               | 3299.844             | 3299.844             | 0.00               | 3300.062             | 3300.062             | 0.00               |
| 590.914 | 3299.63              | 3299.629             | 0.00               | 3299.829             | 3299.829             | 0.00               | 3299.829             | 3299.829             | 0.00               | 3300.047             | 3300.047             | 0.00               |
| 591.137 | 3299.627             | 3299.626             | 0.00               | 3299.826             | 3299.826             | 0.00               | 3299.826             | 3299.826             | 0.00               | 3300.044             | 3300.044             | 0.00               |
| 591.865 | 3299.61              | 3299.609             | 0.00               | 3299.804             | 3299.804             | 0.00               | 3299.804             | 3299.804             | 0.00               | 3300.018             | 3300.018             | 0.00               |
| 592.981 | 3299.583             | 3299.582             | 0.00               | 3299.777             | 3299.769             | 0.00               | 3299.77              | 3299.769             | 0.00               | 3299.979             | 3299.979             | 0.00               |
| 593.914 | 3299.56              | 3299.559             | 0.00               | 3299.741             | 3299.74              | 0.00               | 3299.741             | 3299.74              | 0.00               | 3299.945             | 3299.945             | 0.00               |
| 594.818 | 3299.537             | 3299.536             | 0.00               | 3299.712             | 3299.712             | 0.00               | 3299.712             | 3299.712             | 0.00               | 3299.913             | 3299.913             | 0.00               |
| 596.915 | 3299.483             | 3299.482             | 0.00               | 3299.646             | 3299.646             | 0.00               | 3299.646             | 3299.646             | 0.00               | 3299.837             | 3299.837             | 0.00               |
| 597.771 | 3299.46              | 3299.46              | 0.00               | 3299.618             | 3299.618             | 0.00               | 3299.618             | 3299.618             | 0.00               | 3299.806             | 3299.806             | 0.00               |
| 599.079 | 3299.425             | 3299.425             | 0.00               | 3299.576             | 3299.575             | 0.00               | 3299.576             | 3299.575             | 0.00               | 3299.759             | 3299.759             | 0.00               |
| 599.915 | 3299.402             | 3299.401             | 0.00               | 3299.548             | 3299.548             | 0.00               | 3299.548             | 3299.548             | 0.00               | 3299.728             | 3299.728             | 0.00               |
| 600.005 | 3299.399             | 3299.399             | 0.00               | 3299.545             | 3299.545             | 0.00               | 3299.545             | 3299.545             | 0.00               | 3299.725             | 3299.725             | 0.00               |
| 600.724 | 3299.375             | 3299.375             | 0.00               | 3299.523             | 3299.522             | 0.00               | 3299.523             | 3299.522             | 0.00               | 3299.705             | 3299.705             | 0.00               |
| 602.128 | 3299.326             | 3299.325             | 0.00               | 3299.479             | 3299.479             | 0.00               | 3299.479             | 3299.479             | 0.00               | 3299.667             | 3299.667             | 0.00               |
| 602.915 | 3299.298             | 3299.297             | 0.00               | 3299.454             | 3299.454             | 0.00               | 3299.454             | 3299.454             | 0.00               | 3299.645             | 3299.645             | 0.00               |
| 603.408 | 3299.28              | 3299.28              | 0.00               | 3299.439             | 3299.438             | 0.00               | 3299.439             | 3299.438             | 0.00               | 3299.632             | 3299.632             | 0.00               |
| 603.674 | 3299.271             | 3299.27              | 0.00               | 3299.43              | 3299.43              | 0.00               | 3299.43              | 3299.43              | 0.00               | 3299.625             | 3299.625             | 0.00               |
| 605.203 | 3299.215             | 3299.214             | 0.00               | 3299.382             | 3299.381             | 0.00               | 3299.382             | 3299.381             | 0.00               | 3299.584             | 3299.584             | 0.00               |
| 605.917 | 3299.188             | 3299.187             | 0.00               | 3299.359             | 3299.359             | 0.00               | 3299.359             | 3299.359             | 0.00               | 3299.565             | 3299.565             | 0.00               |
| 606.588 | 3299.163             | 3299.162             | 0.00               | 3299.338             | 3299.337             | 0.00               | 3299.338             | 3299.337             | 0.00               | 3299.547             | 3299.547             | 0.00               |
| 608.297 | 3299.098             | 3299.097             | 0.00               | 3299.283             | 3299.283             | 0.00               | 3299.283             | 3299.283             | 0.00               | 3299.502             | 3299.502             | 0.00               |
| 608.918 | 3299.075             | 3299.074             | 0.00               | 3299.264             | 3299.263             | 0.00               | 3299.264             | 3299.263             | 0.00               | 3299.486             | 3299.486             | 0.00               |
| 609.461 | 3299.054             | 3299.053             | 0.00               | 3299.246             | 3299.246             | 0.00               | 3299.246             | 3299.246             | 0.00               | 3299.472             | 3299.472             | 0.00               |
| 609.502 | 3299.053             | 3299.052             | 0.00               | 3299.245             | 3299.244             | 0.00               | 3299.245             | 3299.244             | 0.00               | 3299.471             | 3299.471             | 0.00               |
| 611.177 | 3298.992             | 3298.991             | 0.00               | 3299.188             | 3299.188             | 0.00               | 3299.188             | 3299.188             | 0.00               | 3299.419             | 3299.419             | 0.00               |
| 611.391 | 3298.984             | 3298.983             | 0.00               | 3299.18              | 3299.18              | 0.00               | 3299.18              | 3299.18              | 0.00               | 3299.412             | 3299.412             | 0.00               |
| 611.919 | 3298.964             | 3298.963             | 0.00               | 3299.162             | 3299.161             | 0.00               | 3299.162             | 3299.161             | 0.00               | 3299.395             | 3299.395             | 0.00               |
| 614.485 | 3298.869             | 3298.868             | 0.00               | 3299.072             | 3299.072             | 0.00               | 3299.072             | 3299.072             | 0.00               | 3299.313             | 3299.313             | 0.00               |
| 614.921 | 3298.853             | 3298.852             | 0.00               | 3299.057             | 3299.057             | 0.00               | 3299.057             | 3299.057             | 0.00               | 3299.299             | 3299.299             | 0.00               |
| 615.331 | 3298.838             | 3298.837             | 0.00               | 3299.043             | 3299.043             | 0.00               | 3299.043             | 3299.043             | 0.00               | 3299.286             | 3299.286             | 0.00               |
| 617.579 | 3298.756             | 3298.756             | 0.00               | 3298.967             | 3298.967             | 0.00               | 3298.967             | 3298.967             | 0.00               | 3299.217             | 3299.217             | 0.00               |
| 617.922 | 3298.744             | 3298.743             | 0.00               | 3298.956             | 3298.955             | 0.00               | 3298.956             | 3298.955             | 0.00               | 3299.206             | 3299.206             | 0.00               |
| 618.179 | 3298.735             | 3298.734             | 0.00               | 3298.947             | 3298.947             | 0.00               | 3298.947             | 3298.947             | 0.00               | 3299.199             | 3299.199             | 0.00               |
| 618.228 | 3298.733             | 3298.733             | 0.00               | 3298.946             | 3298.945             | 0.00               | 3298.946             | 3298.945             | 0.00               | 3299.197             | 3299.197             | 0.00               |
| 618.743 | 3298.717             | 3298.716             | 0.00               | 3298.93              | 3298.93              | 0.00               | 3298.93              | 3298.93              | 0.00               | 3299.183             | 3299.183             | 0.00               |
| 619.908 | 3298.679             | 3298.679             | 0.00               | 3298.895             | 3298.895             | 0.00               | 3298.895             | 3298.895             | 0.00               | 3299.151             | 3299.151             | 0.00               |
| 620.381 | 3298.662             | 3298.661             | 0.00               | 3298.879             | 3298.878             | 0.00               | 3298.879             | 3298.878             | 0.00               | 3299.135             | 3299.135             | 0.00               |
| 621.533 | 3298.62              | 3298.619             | 0.00               | 3298.839             | 3298.839             | 0.00               | 3298.839             | 3298.839             | 0.00               | 3299.097             | 3299.097             | 0.00               |
| 622.534 | 3298.583             | 3298.582             | 0.00               | 3298.804             | 3298.804             | 0.00               | 3298.804             | 3298.804             | 0.00               | 3299.063             | 3299.063             | 0.00               |
| 623.958 | 3298.53              | 3298.53              | 0.00               | 3298.755             | 3298.755             | 0.00               | 3298.755             | 3298.755             | 0.00               | 3299.016             | 3299.016             | 0.00               |
| 624.687 | 3298.503             | 3298.502             | 0.00               | 3298.73              | 3298.729             | 0.00               | 3298.73              | 3298.729             | 0.00               | 3298.992             | 3298.992             | 0.00               |
| 625.2   | 3298.484             | 3298.483             | 0.00               | 3298.712             | 3298.711             | 0.00               | 3298.712             | 3298.711             | 0.00               | 3298.975             | 3298.975             | 0.00               |
| 625.993 | 3298.455             | 3298.454             | 0.00               | 3298.685             | 3298.684             | 0.00               | 3298.685             | 3298.684             | 0.00               | 3298.948             | 3298.948             | 0.00               |
| 628.144 | 3298.368             | 3298.367             | 0.00               | 3298.603             | 3298.602             | 0.00               | 3298.603             | 3298.602             | 0.00               | 3298.869             | 3298.869             | 0.00               |
| 628.868 | 3298.338             | 3298.337             | 0.00               | 3298.575             | 3298.575             | 0.00               | 3298.575             | 3298.575             | 0.00               | 3298.842             | 3298.842             | 0.00               |
| 628.994 | 3298.333             | 3298.332             | 0.00               | 3298.57              | 3298.57              | 0.00               | 3298.57              | 3298.57              | 0.00               | 3298.837             | 3298.837             | 0.00               |
| 629.173 | 3298.326             | 3298.325             | 0.00               | 3298.564             | 3298.563             | 0.00               | 3298.564             | 3298.563             | 0.00               | 3298.831             | 3298.831             | 0.00               |
| 630.236 | 3298.282             | 3298.281             | 0.00               | 3298.523             | 3298.522             | 0.00               | 3298.523             | 3298.522             | 0.00               | 3298.791             | 3298.791             | 0.00               |
| 631.147 | 3298.243             | 3298.242             | 0.00               | 3298.485             | 3298.484             | 0.00               | 3298.485             | 3298.484             | 0.00               | 3298.754             | 3298.754             | 0.00               |
| 632.535 | 3298.183             | 3298.182             | 0.00               | 3298.428             | 3298.427             | 0.00               | 3298.428             | 3298.427             | 0.00               | 3298.698             | 3298.698             | 0.00               |
| 633.3   | 3298.15              | 3298.149             | 0.00               | 3298.397             | 3298.396             | 0.00               | 3298.397             | 3298.396             | 0.00               | 3298.667             | 3298.667             | 0.00               |
| 633.327 | 3298.149             | 3298.148             | 0.00               | 3298.395             | 3298.395             | 0.00               | 3298.395             | 3298.395             | 0.00               | 3298.666             | 3298.666             | 0.00               |
| 634.216 | 3298.111             | 3298.11              | 0.00               | 3298.36              | 3298.359             | 0.00               | 3298.36              | 3298.359             | 0.00               | 3298.631             | 3298.631             | 0.00               |
| 635.423 | 3298.061             | 3298.06              | 0.00               | 3298.312             | 3298.311             | 0.00               | 3298.312             | 3298.311             | 0.00               | 3298.584             | 3298.584             | 0.00               |
| 636.562 | 3298.013             | 3298.012             | 0.00               | 3298.267             | 3298.266             | 0.00               | 3298.267             | 3298.266             | 0.00               | 3298.54              | 3298.54              | 0.00               |
| 637.545 | 3297.971             | 3297.97              | 0.00               | 3298.228             | 3298.228             | 0.00               | 3298.228             | 3298.228             | 0.00               | 3298.503             | 3298.503             | 0.00               |
| 638.586 | 3297.927             | 3297.926             | 0.00               | 3298.188             | 3298.187             | 0.00               | 3298.188             | 3298.187             | 0.00               | 3298.464             | 3298.464             | 0.00               |
| 639.667 | 3297.882             | 3297.881             | 0.00               | 3298.146             | 3298.145             | 0.00               | 3298.146             | 3298.145             | 0.00               | 3298.424             | 3298.424             | 0.00               |
| 640.688 | 3297.839             | 3297.838             | 0.00               | 3298.106             | 3298.106             | 0.00               | 3298.106             | 3298.106             | 0.00               | 3298.387             | 3298.387             | 0.00               |
| 640.881 | 3297.831             | 3297.83              | 0.00               | 3298.099             | 3298.098             | 0.00               | 3298.099             | 3298.098             | 0.00               | 3298.379             | 3298.379             | 0.00               |
| 641.79  | 3297.799             | 3297.798             | 0.00               | 3298.068             | 3298.067             | 0.00               | 3298.068             | 3298.067             | 0.00               | 3298.35              | 3298.35              | 0.00               |
| 642.956 | 3297.759             | 3297.758             | 0.00               | 3298.029             | 3298.028             | 0.00               | 3298.029             | 3298.028             | 0.00               | 3298.312             | 3298.312             | 0.00               |
| 643.912 | 3297.728             | 3297.727             | 0.00               | 3297.997             | 3297.996             | 0.00               | 3297.997             | 3297.996             | 0.00               | 3298.283             | 3298.283             | 0.00               |
| 644.814 | 3297.698             | 3297.697             | 0.00               | 3297.968             | 3297.967             | 0.00               | 3297.968             | 3297.967             | 0.00               | 3298.256             | 3298.256             | 0.00               |
| 646.034 | 3297.66              | 3297.659             | 0.00               | 3297.93              | 3297.929             | 0.00               | 3297.93              | 3297.929             | 0.00               | 3298.22              | 3298.22              | 0.00               |
| 647.325 | 3297.62              | 3297.619             | 0.00               | 3297.89              | 3297.889             | 0.00               | 3297.89              | 3297.889             | 0.00               | 3298.184             | 3298.184             | 0.00               |
| 648.156 | 3297.595             | 3297.594             | 0.00               | 3297.866             | 3297.865             | 0.00               | 3297.866             | 3297.865             | 0.00               | 3298.161             | 3298.161             | 0.00               |
| 648.94  | 3297.572             | 3297.571             | 0.00               | 3297.843             | 3297.842             | 0.00               | 3297.843             | 3297.842             | 0.00               | 3298.14              | 3298.14              | 0.00               |
| 650.278 | 3297.534             | 3297.533             | 0.00               | 3297.804             | 3297.803             | 0.00               | 3297.804             | 3297.803             | 0.00               | 3298.106             | 3298.106             | 0.00               |
| 650.998 | 3297.514             | 3297.513             | 0.00               | 3297.784             | 3297.783             | 0.00               | 3297.784             | 3297.783             | 0.00               | 3298.088             | 3298.088             | 0.00               |
| 652.112 | 3297.481             | 3297.48              | 0.00               | 3297.749             | 3297.748             | 0.00               | 3297.749             | 3297.748             | 0.00               | 3298.054             | 3298.054             | 0.00               |
| 652.506 | 3297.469             | 3297.468             | 0.00               | 3297.736             | 3297.735             | 0.00               | 3297.736             | 3297.735             | 0.00               | 3298.042             | 3298.042             | 0.00               |
| 652.84  |                      |                      |                    |                      |                      |                    |                      |                      |                    |                      |                      |                    |



| Station | 36" Culvert Scenario |                      |                    | 42" Culvert Scenario |                      |                    | 54" Culvert Scenario |                      |                    | 60" Culvert Scenario |                      |                    |
|---------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
|         | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) |
| 658.432 | 3297.379             | 3297.378             | 0.00               | 3297.631             | 3297.631             | 0.00               | 3297.631             | 3297.631             | 0.00               | 3297.912             | 3297.912             | 0.00               |
| 658.524 | 3297.378             | 3297.377             | 0.00               | 3297.63              | 3297.629             | 0.00               | 3297.63              | 3297.629             | 0.00               | 3297.91              | 3297.91              | 0.00               |
| 658.631 | 3297.377             | 3297.376             | 0.00               | 3297.628             | 3297.627             | 0.00               | 3297.628             | 3297.627             | 0.00               | 3297.908             | 3297.908             | 0.00               |
| 661.226 | 3297.341             | 3297.34              | 0.00               | 3297.586             | 3297.585             | 0.00               | 3297.586             | 3297.585             | 0.00               | 3297.854             | 3297.854             | 0.00               |
| 661.891 | 3297.332             | 3297.331             | 0.00               | 3297.575             | 3297.574             | 0.00               | 3297.575             | 3297.574             | 0.00               | 3297.84              | 3297.84              | 0.00               |
| 664.02  | 3297.303             | 3297.302             | 0.00               | 3297.54              | 3297.54              | 0.00               | 3297.54              | 3297.54              | 0.00               | 3297.795             | 3297.795             | 0.00               |
| 664.091 | 3297.302             | 3297.301             | 0.00               | 3297.539             | 3297.539             | 0.00               | 3297.539             | 3297.539             | 0.00               | 3297.794             | 3297.794             | 0.00               |
| 665.119 | 3297.288             | 3297.287             | 0.00               | 3297.524             | 3297.524             | 0.00               | 3297.524             | 3297.524             | 0.00               | 3297.779             | 3297.779             | 0.00               |
| 667.549 | 3297.248             | 3297.247             | 0.00               | 3297.484             | 3297.484             | 0.00               | 3297.484             | 3297.484             | 0.00               | 3297.736             | 3297.736             | 0.00               |
| 667.959 | 3297.242             | 3297.241             | 0.00               | 3297.477             | 3297.477             | 0.00               | 3297.477             | 3297.477             | 0.00               | 3297.729             | 3297.729             | 0.00               |
| 670.308 | 3297.203             | 3297.203             | 0.00               | 3297.438             | 3297.437             | 0.00               | 3297.438             | 3297.437             | 0.00               | 3297.686             | 3297.686             | 0.00               |
| 670.557 | 3297.2               | 3297.199             | 0.00               | 3297.434             | 3297.433             | 0.00               | 3297.434             | 3297.433             | 0.00               | 3297.681             | 3297.681             | 0.00               |
| 670.773 | 3297.196             | 3297.195             | 0.00               | 3297.43              | 3297.429             | 0.00               | 3297.43              | 3297.429             | 0.00               | 3297.678             | 3297.678             | 0.00               |
| 673.564 | 3297.15              | 3297.149             | 0.00               | 3297.382             | 3297.382             | 0.00               | 3297.382             | 3297.382             | 0.00               | 3297.626             | 3297.626             | 0.00               |
| 673.586 | 3297.15              | 3297.149             | 0.00               | 3297.382             | 3297.381             | 0.00               | 3297.382             | 3297.381             | 0.00               | 3297.625             | 3297.625             | 0.00               |
| 673.905 | 3297.145             | 3297.144             | 0.00               | 3297.376             | 3297.376             | 0.00               | 3297.376             | 3297.376             | 0.00               | 3297.619             | 3297.619             | 0.00               |
| 674.396 | 3297.137             | 3297.136             | 0.00               | 3297.368             | 3297.367             | 0.00               | 3297.368             | 3297.367             | 0.00               | 3297.61              | 3297.61              | 0.00               |
| 676.399 | 3297.092             | 3297.091             | 0.00               | 3297.321             | 3297.32              | 0.00               | 3297.321             | 3297.32              | 0.00               | 3297.561             | 3297.561             | 0.00               |
| 676.571 | 3297.088             | 3297.087             | 0.00               | 3297.316             | 3297.316             | 0.00               | 3297.316             | 3297.316             | 0.00               | 3297.557             | 3297.557             | 0.00               |
| 676.768 | 3297.084             | 3297.083             | 0.00               | 3297.312             | 3297.311             | 0.00               | 3297.312             | 3297.311             | 0.00               | 3297.552             | 3297.552             | 0.00               |
| 679.212 | 3297.03              | 3297.029             | 0.00               | 3297.254             | 3297.254             | 0.00               | 3297.254             | 3297.254             | 0.00               | 3297.492             | 3297.492             | 0.00               |
| 679.578 | 3297.022             | 3297.021             | 0.00               | 3297.246             | 3297.245             | 0.00               | 3297.246             | 3297.245             | 0.00               | 3297.484             | 3297.484             | 0.00               |
| 679.998 | 3297.012             | 3297.011             | 0.00               | 3297.236             | 3297.235             | 0.00               | 3297.236             | 3297.235             | 0.00               | 3297.473             | 3297.473             | 0.00               |
| 680.861 | 3296.993             | 3296.992             | 0.00               | 3297.216             | 3297.215             | 0.00               | 3297.216             | 3297.215             | 0.00               | 3297.452             | 3297.452             | 0.00               |
| 681.858 | 3296.968             | 3296.968             | 0.00               | 3297.189             | 3297.189             | 0.00               | 3297.189             | 3297.189             | 0.00               | 3297.425             | 3297.425             | 0.00               |
| 682.657 | 3296.948             | 3296.948             | 0.00               | 3297.168             | 3297.167             | 0.00               | 3297.168             | 3297.167             | 0.00               | 3297.402             | 3297.402             | 0.00               |
| 684.14  | 3296.911             | 3296.911             | 0.00               | 3297.129             | 3297.128             | 0.00               | 3297.129             | 3297.128             | 0.00               | 3297.361             | 3297.361             | 0.00               |
| 684.872 | 3296.893             | 3296.892             | 0.00               | 3297.109             | 3297.109             | 0.00               | 3297.109             | 3297.109             | 0.00               | 3297.341             | 3297.341             | 0.00               |
| 685.789 | 3296.873             | 3296.872             | 0.00               | 3297.085             | 3297.085             | 0.00               | 3297.085             | 3297.085             | 0.00               | 3297.316             | 3297.316             | 0.00               |
| 686.677 | 3296.853             | 3296.852             | 0.00               | 3297.062             | 3297.062             | 0.00               | 3297.062             | 3297.062             | 0.00               | 3297.292             | 3297.292             | 0.00               |
| 688.615 | 3296.808             | 3296.807             | 0.00               | 3297.012             | 3297.012             | 0.00               | 3297.012             | 3297.012             | 0.00               | 3297.24              | 3297.24              | 0.00               |
| 688.921 | 3296.801             | 3296.8               | 0.00               | 3297.004             | 3297.004             | 0.00               | 3297.004             | 3297.004             | 0.00               | 3297.231             | 3297.231             | 0.00               |
| 689.086 | 3296.797             | 3296.796             | 0.00               | 3297                 | 3296.999             | 0.00               | 3297                 | 3296.999             | 0.00               | 3297.227             | 3297.227             | 0.00               |
| 689.636 | 3296.784             | 3296.783             | 0.00               | 3296.986             | 3296.985             | 0.00               | 3296.986             | 3296.985             | 0.00               | 3297.212             | 3297.212             | 0.00               |
| 692.053 | 3296.726             | 3296.725             | 0.00               | 3296.923             | 3296.923             | 0.00               | 3296.923             | 3296.923             | 0.00               | 3297.149             | 3297.149             | 0.00               |
| 693.089 | 3296.701             | 3296.7               | 0.00               | 3296.897             | 3296.897             | 0.00               | 3296.897             | 3296.897             | 0.00               | 3297.122             | 3297.122             | 0.00               |
| 693.904 | 3296.68              | 3296.68              | 0.00               | 3296.876             | 3296.876             | 0.00               | 3296.876             | 3296.876             | 0.00               | 3297.101             | 3297.101             | 0.00               |
| 695.185 | 3296.648             | 3296.647             | 0.00               | 3296.844             | 3296.843             | 0.00               | 3296.844             | 3296.843             | 0.00               | 3297.068             | 3297.068             | 0.00               |
| 695.76  | 3296.633             | 3296.633             | 0.00               | 3296.829             | 3296.828             | 0.00               | 3296.829             | 3296.828             | 0.00               | 3297.053             | 3297.053             | 0.00               |
| 696.314 | 3296.62              | 3296.619             | 0.00               | 3296.815             | 3296.814             | 0.00               | 3296.815             | 3296.814             | 0.00               | 3297.039             | 3297.039             | 0.00               |
| 697.563 | 3296.589             | 3296.588             | 0.00               | 3296.783             | 3296.783             | 0.00               | 3296.783             | 3296.783             | 0.00               | 3297.006             | 3297.006             | 0.00               |
| 697.821 | 3296.583             | 3296.582             | 0.00               | 3296.777             | 3296.776             | 0.00               | 3296.777             | 3296.776             | 0.00               | 3296.999             | 3296.999             | 0.00               |
| 698.34  | 3296.569             | 3296.568             | 0.00               | 3296.763             | 3296.763             | 0.00               | 3296.763             | 3296.763             | 0.00               | 3296.985             | 3296.985             | 0.00               |
| 698.673 | 3296.56              | 3296.559             | 0.00               | 3296.754             | 3296.754             | 0.00               | 3296.754             | 3296.754             | 0.00               | 3296.976             | 3296.976             | 0.00               |
| 699.43  | 3296.54              | 3296.539             | 0.00               | 3296.734             | 3296.734             | 0.00               | 3296.734             | 3296.734             | 0.00               | 3296.956             | 3296.956             | 0.00               |
| 700.949 | 3296.5               | 3296.499             | 0.00               | 3296.694             | 3296.694             | 0.00               | 3296.694             | 3296.694             | 0.00               | 3296.914             | 3296.914             | 0.00               |
| 703.337 | 3296.436             | 3296.436             | 0.00               | 3296.631             | 3296.631             | 0.00               | 3296.631             | 3296.631             | 0.00               | 3296.849             | 3296.849             | 0.00               |
| 704.895 | 3296.395             | 3296.394             | 0.00               | 3296.59              | 3296.59              | 0.00               | 3296.59              | 3296.59              | 0.00               | 3296.807             | 3296.807             | 0.00               |
| 705.501 | 3296.379             | 3296.378             | 0.00               | 3296.574             | 3296.574             | 0.00               | 3296.574             | 3296.574             | 0.00               | 3296.791             | 3296.791             | 0.00               |
| 706.303 | 3296.358             | 3296.357             | 0.00               | 3296.553             | 3296.553             | 0.00               | 3296.553             | 3296.553             | 0.00               | 3296.769             | 3296.769             | 0.00               |
| 706.879 | 3296.347             | 3296.346             | 0.00               | 3296.542             | 3296.541             | 0.00               | 3296.542             | 3296.541             | 0.00               | 3296.757             | 3296.757             | 0.00               |
| 708.173 | 3296.323             | 3296.322             | 0.00               | 3296.517             | 3296.516             | 0.00               | 3296.517             | 3296.516             | 0.00               | 3296.729             | 3296.729             | 0.00               |
| 709.189 | 3296.303             | 3296.302             | 0.00               | 3296.497             | 3296.496             | 0.00               | 3296.497             | 3296.496             | 0.00               | 3296.708             | 3296.708             | 0.00               |
| 711.45  | 3296.26              | 3296.259             | 0.00               | 3296.452             | 3296.451             | 0.00               | 3296.452             | 3296.451             | 0.00               | 3296.659             | 3296.659             | 0.00               |
| 712.612 | 3296.237             | 3296.236             | 0.00               | 3296.429             | 3296.428             | 0.00               | 3296.429             | 3296.428             | 0.00               | 3296.634             | 3296.634             | 0.00               |
| 713.955 | 3296.21              | 3296.209             | 0.00               | 3296.401             | 3296.4               | 0.00               | 3296.401             | 3296.4               | 0.00               | 3296.605             | 3296.605             | 0.00               |
| 714.871 | 3296.191             | 3296.19              | 0.00               | 3296.382             | 3296.382             | 0.00               | 3296.382             | 3296.382             | 0.00               | 3296.585             | 3296.585             | 0.00               |
| 716.244 | 3296.164             | 3296.163             | 0.00               | 3296.355             | 3296.354             | 0.00               | 3296.355             | 3296.354             | 0.00               | 3296.556             | 3296.556             | 0.00               |
| 716.359 | 3296.161             | 3296.161             | 0.00               | 3296.353             | 3296.352             | 0.00               | 3296.353             | 3296.352             | 0.00               | 3296.553             | 3296.553             | 0.00               |
| 716.714 | 3296.155             | 3296.154             | 0.00               | 3296.346             | 3296.346             | 0.00               | 3296.346             | 3296.346             | 0.00               | 3296.547             | 3296.547             | 0.00               |
| 718.369 | 3296.126             | 3296.125             | 0.00               | 3296.316             | 3296.315             | 0.00               | 3296.316             | 3296.315             | 0.00               | 3296.515             | 3296.515             | 0.00               |
| 718.901 | 3296.117             | 3296.116             | 0.00               | 3296.306             | 3296.306             | 0.00               | 3296.306             | 3296.306             | 0.00               | 3296.505             | 3296.505             | 0.00               |
| 719.786 | 3296.102             | 3296.101             | 0.00               | 3296.291             | 3296.29              | 0.00               | 3296.291             | 3296.29              | 0.00               | 3296.489             | 3296.489             | 0.00               |
| 721.087 | 3296.08              | 3296.079             | 0.00               | 3296.268             | 3296.267             | 0.00               | 3296.268             | 3296.267             | 0.00               | 3296.465             | 3296.465             | 0.00               |
| 721.868 | 3296.067             | 3296.066             | 0.00               | 3296.254             | 3296.254             | 0.00               | 3296.254             | 3296.254             | 0.00               | 3296.451             | 3296.451             | 0.00               |
| 723.274 | 3296.043             | 3296.043             | 0.00               | 3296.23              | 3296.23              | 0.00               | 3296.23              | 3296.23              | 0.00               | 3296.426             | 3296.426             | 0.00               |
| 724.99  | 3296.015             | 3296.015             | 0.00               | 3296.201             | 3296.201             | 0.00               | 3296.201             | 3296.201             | 0.00               | 3296.395             | 3296.395             | 0.00               |
| 725.366 | 3296.01              | 3296.009             | 0.00               | 3296.195             | 3296.194             | 0.00               | 3296.195             | 3296.194             | 0.00               | 3296.389             | 3296.389             | 0.00               |
| 725.46  | 3296.008             | 3296.007             | 0.00               | 3296.193             | 3296.193             | 0.00               | 3296.193             | 3296.193             | 0.00               | 3296.387             | 3296.387             | 0.00               |
| 726.383 | 3295.993             | 3295.993             | 0.00               | 3296.178             | 3296.178             | 0.00               | 3296.178             | 3296.178             | 0.00               | 3296.371             | 3296.371             | 0.00               |
| 729.834 | 3295.881             | 3295.88              | 0.00               | 3296.06              | 3296.06              | 0.00               | 3296.06              | 3296.06              | 0.00               | 3296.247             | 3296.247             | 0.00               |
| 731.448 | 3295.828             | 3295.827             | 0.00               | 3296.005             | 3296.005             | 0.00               | 3296.005             | 3296.005             | 0.00               | 3296.189             | 3296.189             | 0.00               |
| 731.557 | 3295.825             | 3295.824             | 0.00               | 3296.001             | 3296.001             | 0.00               | 3296.001             | 3296.001             | 0.00               | 3296.185             | 3296.185             | 0.00               |
| 732.011 | 3295.811             | 3295.81              | 0.00               | 3295.987             | 3295.986             | 0.00               | 3295.987             | 3295.986             | 0.00               | 3296.17              | 3296.17              | 0.00               |
| 732.417 | 3295.798             | 3295.798             | 0.00               | 3295.974             | 3295.973             | 0.00               | 3295.974             | 3295.973             | 0.00               | 3296.156             | 3296.156             | 0.00               |
| 734.156 | 3295.745             | 3295.745             | 0.00               | 3295.918             | 3295.918             | 0.00               | 3295.918             | 3295.918             | 0.00               | 3296.097             | 3296.097             | 0.00               |
| 735.12  | 3295.716             | 3295.715             | 0.00               | 3295.887             | 3295.887             | 0.00               | 3295.887             | 3295.887             | 0.00               | 3296.064             | 3296.064             | 0.00               |
| 736.147 | 3295.685             | 3295.684             | 0.00               | 3295.854             | 3295.854             | 0.00               | 3295.854             | 3295.8               |                    |                      |                      |                    |

| Station | 36" Culvert Scenario |                      |                    | 42" Culvert Scenario |                      |                    | 54" Culvert Scenario |                      |                    | 60" Culvert Scenario |                      |                    |
|---------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
|         | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) | Existing WSE<br>(ft) | Proposed WSE<br>(ft) | Difference<br>(ft) |
| 741.557 | 3295.459             | 3295.458             | 0.00               | 3295.616             | 3295.615             | 0.00               | 3295.616             | 3295.615             | 0.00               | 3295.775             | 3295.775             | 0.00               |
| 742.737 | 3295.408             | 3295.408             | 0.00               | 3295.562             | 3295.562             | 0.00               | 3295.562             | 3295.562             | 0.00               | 3295.719             | 3295.719             | 0.00               |
| 743.609 | 3295.371             | 3295.37              | 0.00               | 3295.523             | 3295.523             | 0.00               | 3295.523             | 3295.523             | 0.00               | 3295.677             | 3295.677             | 0.00               |
| 746.504 | 3295.247             | 3295.246             | 0.00               | 3295.391             | 3295.391             | 0.00               | 3295.391             | 3295.391             | 0.00               | 3295.537             | 3295.537             | 0.00               |
| 747.045 | 3295.218             | 3295.218             | 0.00               | 3295.362             | 3295.361             | 0.00               | 3295.362             | 3295.361             | 0.00               | 3295.507             | 3295.507             | 0.00               |
| 748.727 | 3295.128             | 3295.127             | 0.00               | 3295.268             | 3295.268             | 0.00               | 3295.268             | 3295.268             | 0.00               | 3295.41              | 3295.41              | 0.00               |
| 749.196 | 3295.103             | 3295.102             | 0.00               | 3295.242             | 3295.242             | 0.00               | 3295.242             | 3295.242             | 0.00               | 3295.383             | 3295.383             | 0.00               |
| 750.9   | 3295.011             | 3295.01              | 0.00               | 3295.147             | 3295.147             | 0.00               | 3295.147             | 3295.147             | 0.00               | 3295.284             | 3295.284             | 0.00               |
| 751.366 | 3294.986             | 3294.985             | 0.00               | 3295.121             | 3295.121             | 0.00               | 3295.121             | 3295.121             | 0.00               | 3295.257             | 3295.257             | 0.00               |
| 753.535 | 3294.868             | 3294.868             | 0.00               | 3294.999             | 3294.999             | 0.00               | 3294.999             | 3294.999             | 0.00               | 3295.131             | 3295.131             | 0.00               |
| 756.474 | 3294.709             | 3294.708             | 0.00               | 3294.835             | 3294.834             | 0.00               | 3294.835             | 3294.834             | 0.00               | 3294.96              | 3294.96              | 0.00               |
| 757.607 | 3294.675             | 3294.675             | 0.00               | 3294.799             | 3294.799             | 0.00               | 3294.799             | 3294.799             | 0.00               | 3294.923             | 3294.923             | 0.00               |
| 758.01  | 3294.663             | 3294.663             | 0.00               | 3294.787             | 3294.786             | 0.00               | 3294.787             | 3294.786             | 0.00               | 3294.91              | 3294.91              | 0.00               |
| 758.047 | 3294.662             | 3294.662             | 0.00               | 3294.786             | 3294.785             | 0.00               | 3294.786             | 3294.785             | 0.00               | 3294.909             | 3294.909             | 0.00               |
| 759.008 | 3294.634             | 3294.633             | 0.00               | 3294.756             | 3294.756             | 0.00               | 3294.756             | 3294.756             | 0.00               | 3294.877             | 3294.877             | 0.00               |
| 760.03  | 3294.604             | 3294.603             | 0.00               | 3294.724             | 3294.724             | 0.00               | 3294.724             | 3294.724             | 0.00               | 3294.844             | 3294.844             | 0.00               |
| 761.702 | 3294.554             | 3294.554             | 0.00               | 3294.672             | 3294.672             | 0.00               | 3294.672             | 3294.672             | 0.00               | 3294.789             | 3294.789             | 0.00               |
| 762.185 | 3294.54              | 3294.539             | 0.00               | 3294.657             | 3294.657             | 0.00               | 3294.657             | 3294.657             | 0.00               | 3294.773             | 3294.773             | 0.00               |
| 764.341 | 3294.476             | 3294.475             | 0.00               | 3294.59              | 3294.59              | 0.00               | 3294.59              | 3294.59              | 0.00               | 3294.702             | 3294.702             | 0.00               |
| 765.356 | 3294.446             | 3294.445             | 0.00               | 3294.558             | 3294.558             | 0.00               | 3294.558             | 3294.558             | 0.00               | 3294.669             | 3294.669             | 0.00               |
| 765.885 | 3294.43              | 3294.43              | 0.00               | 3294.542             | 3294.542             | 0.00               | 3294.542             | 3294.542             | 0.00               | 3294.651             | 3294.651             | 0.00               |
| 766.405 | 3294.414             | 3294.414             | 0.00               | 3294.525             | 3294.525             | 0.00               | 3294.525             | 3294.525             | 0.00               | 3294.634             | 3294.634             | 0.00               |
| 766.496 | 3294.411             | 3294.411             | 0.00               | 3294.522             | 3294.522             | 0.00               | 3294.522             | 3294.522             | 0.00               | 3294.631             | 3294.631             | 0.00               |
| 768.134 | 3294.358             | 3294.358             | 0.00               | 3294.468             | 3294.467             | 0.00               | 3294.468             | 3294.467             | 0.00               | 3294.575             | 3294.575             | 0.00               |
| 768.651 | 3294.341             | 3294.341             | 0.00               | 3294.45              | 3294.45              | 0.00               | 3294.45              | 3294.45              | 0.00               | 3294.558             | 3294.558             | 0.00               |
| 769.011 | 3294.33              | 3294.329             | 0.00               | 3294.439             | 3294.438             | 0.00               | 3294.439             | 3294.438             | 0.00               | 3294.546             | 3294.546             | 0.00               |
| 770.806 | 3294.272             | 3294.272             | 0.00               | 3294.379             | 3294.379             | 0.00               | 3294.379             | 3294.379             | 0.00               | 3294.486             | 3294.486             | 0.00               |
| 771.015 | 3294.266             | 3294.265             | 0.00               | 3294.373             | 3294.372             | 0.00               | 3294.373             | 3294.372             | 0.00               | 3294.479             | 3294.479             | 0.00               |
| 771.632 | 3294.244             | 3294.244             | 0.00               | 3294.352             | 3294.351             | 0.00               | 3294.352             | 3294.351             | 0.00               | 3294.458             | 3294.458             | 0.00               |
| 772.665 | 3294.212             | 3294.212             | 0.00               | 3294.318             | 3294.318             | 0.00               | 3294.318             | 3294.318             | 0.00               | 3294.424             | 3294.424             | 0.00               |
| 773.182 | 3294.196             | 3294.196             | 0.00               | 3294.301             | 3294.301             | 0.00               | 3294.301             | 3294.301             | 0.00               | 3294.407             | 3294.407             | 0.00               |