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October 10, 2023

Kittson-Roseau Joint Ditch Board
407 5th Ave NW
Roseau, MN 56751

Subject: Engineer's Report and Findings of Fact
State Ditches No. 95 and 72
HEI Project No. 6263_0033

Dear Joint Board:

In 2021, a petition was submitted to the Joint Board by the Two Rivers Watershed District in accordance with MN Statutes 103E.227 which allows for the impounding, rerouting, and diverting of drainage system waters. In accordance with Subd. 3 of that statute, Erik Jones, Houston Engineering, Inc. (HEI), was appointed on May 17, 2022, by the Joint Board to investigate the effect of the proposed project on the ditch system and file a report of findings. In accordance with MN Statutes 103E.227, we have completed a review of the Klondike Clean Water Retention Project #11 (KCWRP #11) as currently proposed. The plan has changed fairly significantly since the publication of the Engineer's Report on June 28, 2017. The latest copies of modeling files for the project were provided to HEI on May 30, 2023. Copies of the latest project factsheets are attached in **Appendix A**. Findings and recommendations for the Joint Board regarding impacts to State Ditches 72 and 95 have been summarized in this report.

Project MN Drainage Law Implications

Minnesota Statues 103E.227 pertains to the rerouting of drainage system waters; Subd. 3. discusses the procedure to establish a project. After receiving the petition and bond, if required (no bond is required in this case, since the petition was filed by the Watershed District), the drainage authority must appoint an engineer to investigate the effect of the proposed installation and file a report of findings. In addition, Minnesota Statues 103E.806 pertains to the partial abandonment of drainage system waters, which also requires a report of findings. This letter report serves as the engineer's report of findings. The Joint Board appointed Houston Engineering to complete this investigation at their meeting on May 17, 2022. After filing the engineer's report, the Joint Board must give notice and hold a public hearing as provided in Minnesota Statutes, Section 103E.261. The investigation and findings follow.

Background on State Ditch 72

The main of State Ditch 72 begins along the north section line between Sections 20 and 21 of Soler Township (T162N, R43W), Roseau County. From that beginning point the ditch runs west for 10 miles and then northwesterly approximately 5 more miles joining State Ditch 85 and Kittson County Ditch 11 at that location. There are 14 laterals that generally run north and south that feed runoff into main. The laterals that are affected by the KCWRP #11 are laterals 6, 8, and 12. Lateral 6 begins at 280th ST between Sections 1 of Polonia Township and Section 36 of Juneberry Township and runs north three miles along the west side of Sections 36, 25, and 24 before joining the Main. Lateral 8 begins at 280th ST between Sections 2 of Polonia Township and Section 35 of Juneberry Township and runs north three miles along the west side of Sections 35, 26, and 23 before joining the Main. And finally, Lateral 12 begins at 280th ST between Sections 6 of Polonia Township and Section 31 of Juneberry Township and runs north three miles along the west side of Sections 31, 30, and 19 before joining the Main. While there is some drainage in Laterals 6, 8, and 12 that drain south into SD 95, originally when the ditch was established, there were

no connections between the systems in these areas. 280th Street was a drainage divide between the State Ditch 72 and 95 systems. A map showing the extent of SD 72 as well as its benefit area can be seen in **Appendix B**.

Background on State Ditch 95

SD 95 consists of a main ditch and numerous laterals and branches. In the mid-1940s, Lateral 1 of State Ditch 95 was constructed to divert Badger Creek from its original northerly outlet into the Roseau River to a westerly outlet into the Two Rivers watershed. The new ditch was not constructed with proper capacity, and this combined with the slope of the land and rather large upstream drainage area causes frequent breakouts from the ditch leading to large scale overland flooding. Typical damages that occur both in spring and summer floods are road washouts, culvert and bridge damages, sloughing along side slopes, overland flooding resulting in erosion, sedimentation, and crop damage. A map showing the extent of SD 95 as well as its benefit area can be seen in **Appendix B**.

Klondike Clean Water Retention Project #11 Project Background

The Two Rivers Watershed District (TRWD) is proposing KCWRP #11, a flood retention project located eight miles east and one mile north of Lake Bronson in Kittson and Roseau Counties, Minnesota. The purpose of the project is to reduce flood damages along the State Ditch (SD) 50, 72 and portions of the State Ditch 95 systems, and also to contribute to the regional goal of 20% flow reduction of the 1997 flood's peak on the Red River of the North, which will address the severe and repeated damage that currently occurs to public infrastructure, private property, and agricultural lands in the watershed.

This flood damage reduction project is known as the Klondike Clean Water Retention Project #11 (KCWRP #11). The project concept currently includes construction of 7 miles of inlet ditches, 2 miles of diversion ditch, 3 inlet control structures, a 16-mile-long impoundment dike, 2 outlet structures, 2 emergency spillways, and interior pilot channels for water conveyance. These components are discussed in more detail below. Detailed construction plans and specifications have not been developed but the concepts and typical drawings have been developed.

The impoundment dike will be constructed up to elevation 1019.5 (NAVD 88) primarily using backhoes, scrapers, and bulldozers. Off road trucks and compaction equipment may also be used on site during construction. Interior borrow pits adjacent to the dike will be dug to provide earthen materials for construction. Dike construction will generally include ground preparation by stripping topsoil, backfilling with clay, compaction of the dike, topdressing with topsoil, and seeding with appropriate vegetation. Dikes will typically have a 12-foot top width and a minimum 4:1 side slope. In areas where the dike will double as a road, the top width will be 20'.

An exterior ditch will be constructed around the outside of the impoundment. This ditch will be approximately 3' deep, have an 8' wide bottom width with 4:1 side slopes and varying depth. It will have a minimal slope and will drain to either State Ditch 50 or Lateral 1 State Ditch 95. All dike and ditch construction will be set back 50 feet from property lines to avoid impacts to adjacent property.

Depending upon funding, the project may be constructed in 3 phases. Phase 1 will store up to 16,500 acre-feet of water, phase 2 up to 26,750 acre-feet, and phase 3 up to 35,250 acre-feet. In summary, the project includes multiple features as shown on Figure 1. Project features labeled as Phase 1 and 2 are the currently proposed alternative. Phase 2A is beyond the scope of the current project. The review discussed in this report considers the implementation of Phase 1 and 2 features as shown on Figure 1.

The project is located in the vicinity of State Ditches 72, and 95. All of these systems will be affected in some way by the project. The various project features are highlighted in the following paragraphs.

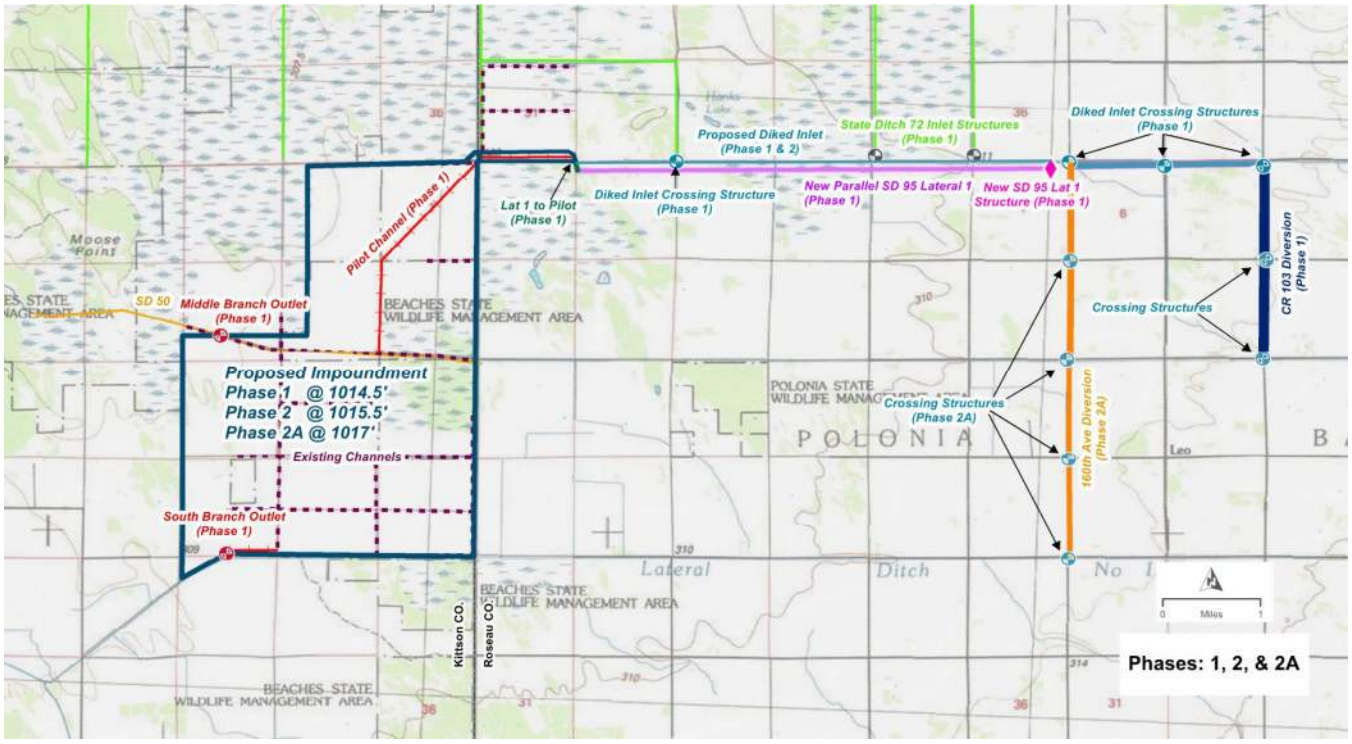

FIGURE 1 - KLONDIKE CLEAN WATER RETENTION PROJECT FEATURES (SOURCE: HDR)

County Road 103 Diversion

A new channel that will divert flows out of SD 95 Lat 1 Br 3 to the north and into the Diked Inlet will be constructed along the east side of County Road 103 (CR 103). The existing ditch is only about 2 feet below natural ground along CR 103, and less than 5 feet below the edge of the road. The bottom width is 3 to 8 feet. There is a berm on the field side of the ditch when it gets near SD 95 Lat 1. Otherwise the land to the east is unprotected from breakout flows from the ditch.

This diversion is planned for Phase 1 and designed for a 50-year capacity. The drainage area for Br 3 Lat 1 SD 95 at this diversion is 14.7 square miles. An additional 2.75 square miles of drainage area that normally reaches SD 95 Lat 1 by going under CR 103 and across private lands before reaching SD 95 Lat 1 will be cut off by this diversion.

The diversion inlet culverts are proposed to be higher than the existing ditch. Therefore, a 2-year, 24- hour runoff event will bypass this diversion through the existing culvert in Br 3 Lat 1 SD 95. Flap gates on the north end (diversion outlet) will prevent flows from leaving SD 95 Lat 1 and also keep flows from entering the Diked Inlet when water levels reach elevations higher than the CR 103 Diversion. This design will keep post-project flooding conditions the same or better than the existing condition.

Lateral 1 State Ditch 95 Upstream Improvements

The Diked Inlet as an extension of the Retention Area extends to 160th Ave (six miles east of the Roseau Kittson county line). From 160th Ave to CR 103 the existing SD 95 Lat 1 has inconsistent bottom widths and grades. This two-mile section of Lat 1 SD 95 will be improved in Phase 1.

In Phase 1, with a consistent 20’ bottom width, 4:1 side slope (field side), and greater than 0.03% grade, the channel will convey the 50-year, 24-hour event from both upstream drainage areas (Lateral 1 and CR 103 diversion). The existing roadside slope is 2.5:1 which appears unstable, due to the slope failures observed during survey. Phase 3 would further expand this channel to a 35’ bottom width, which would have capacity to carry the 100-year, 10-day event from SD 95 Lat 1 (1,400 cfs).

Diked Inlet (on State Ditch 95 Lateral 1)

The Diked Inlet is an extension of the Retention Area. It has a two-stage channel design that utilizes the existing SD 95 Lat 1 for low flows.

The SD 95 Lat 1 in Roseau County has a drainage area that extends east to the former Badger Creek. TRWD owns and operates the Ross #7 project, which controls a little over 18 square miles of the upstream portion of the drainage area. The existing SD 95 Lat 1 has a positive grade going east to west of approximately 1 foot per mile (0.02%). It also passes through a higher ridge in the vicinity of 120th Ave. The natural ground has even less elevation change from east to west. West of 120th Ave, the topography falls and remains very flat between 1011 and 1012 feet.

The topography in the Project area has only 1 foot of elevation difference per mile. Hydraulically, in order for the Diked Inlet to convey flows from upstream during a flood event, the water surface elevation has to rise on the upstream end of the channel and create a positive energy grade going east to west. When this happens naturally with the existing ditch system in place, the water surface rises until it is no longer contained within the banks of SD 95 Lat 1 and it inundates the surrounding lands. By constructing an embankment along the south side of SD 95 Lat 1 with continuous protection from the upstream end of the Project all the way to the retention area, the Diked Inlet can convey these flood events without water breaking out and inundating the lands adjacent to the Project.

The current legal ditch has capacity for less than a 10-year rainfall. The landowners along SD 95 Lat 1 petitioned for improvement of the ditch up to a 10-year capacity, but the petition was denied due to an inadequate outlet. The existing SD 95 Lat 1 can convey flows below natural ground up to a 2-year, 24-hour event as the low flow portion of the Diked Inlet. Events greater than a 2-year, 24-hour will be conveyed above ground in the high flow channel created by 280th St and the Diked Inlet embankment.

280th Street Road Raise & Exterior Drainage

The existing 280th St is located on the north side of SD 95 Lat 1 and on the boundary lines between Soler/Barto and Juneberry/Polonia Townships. Phase 2 of the project includes altering the existing road to create the northern boundary of the Diked Inlet.

280th St is a gravel road from 120th Ave to the east, and a minimum maintenance road from 120th Ave to the west. The road currently acts as a dam during flood events.

Existing pipes through 280th St will be removed and replaced with new culverts, and screw gates will be installed on the south (outlet) end of each culvert. An exterior drainage ditch will provide local drainage along all privately-owned lands and will outlet into Lat 11 or 12 of SD 72.

State Ditch 72, Lateral 6 Structure

The existing 48” pipe at this location was installed in 2011 to allow local drainage from the east and water that overflows from Roseau River another outlet to drain floodwaters from SD 72 to SD 95. This will be improved with a new installation consisting of new gated 48” culverts. Gates will be operated during floods to allow up to 10,000 acre-feet of floodwater to flow from north to south into the project via the diked inlet channel during the later part of the flood event, typically when overflow flooding from Roseau River is occurring. A reinforced spillway at 1021.15’ will allow additional flood water to flow over 280th St (road grade along Lat 1 SD 95) into the project.

State Ditch 72, Lateral 8 Structure

The existing 30” pipe at this location was installed in 2007 to allow water that overflows from Roseau River another outlet to drain floodwaters from SD 72 to SD 95. This will be a gated culvert. Normally the gate will be closed and opened only during floods to allow approximately 1,200 acre-feet of floodwater to flow from north to south into the project via the diked inlet channel during the later part of the flood event, typically when overflow flooding from Roseau River is occurring.

New State Ditch 95 Lateral 1

To maintain exterior drainage during operation of the KCWRP #11, a new Lateral 1 channel must be constructed to the south of the Diked Inlet. This new channel connects to the existing SD 95 Lat 1 at a point one mile east of the Roseau-Kittson County line and runs parallel to the Diked Inlet / Existing SD 95 Lat 1 until 160th Ave. This new channel is designed to convey local drainage and portions of the SD 95 Lat 1 drainage that exceeds either the Diked Inlet's flow capacity or the Impoundment's storage capacity. This criterion also creates the need for a gated structure at the upstream end of the channel. The existing ditch bottom elevation in SD 95 Lat 1 at 160th Ave is 1014.0' which equals the maximum impoundment pool elevation in Phase 1. Natural ground near 160th Ave and SD 95 Lat 1 is approximately 1020.0'. Phase 2 has a maximum impoundment pool elevation of 1015.5'. Therefore, the invert elevation for the gated structure into the new parallel SD 95 Lat 1 will be 1015.5' at the upstream end to allow for the phase 2 full pool to be contained and allow excess inflows to be bypassed above 1015.5'. The new realigned Lateral 1 will convey the 10-year event from the local 2 square mile drainage area. The channel will be trapezoidal in shape with an 8-foot wide bottom and 4H:1V side slopes. Minimum depth varies from 4 feet to 5.5 feet throughout the realigned reach.

Retention Area (Impoundment)

The Retention area is the 10.7 square miles of land owned by the Two Rivers Watershed District and proposed to be used to store flood waters. The north and west sides of the retention area is mainly very flat terrain, with up to 4 feet of peat soils on top of lean clay. The south and east sides of the retention area are bordered by a minimum maintenance road. The road consists of compacted spoil from the adjacent SD 95 Lat 1. This spoil road will be built up to form the south and east sides of the retention area and new embankment will be built on top of the existing peat (without stripping the peat) to form the north and west sides.

The existing area has a history of flooding, but only at depths less than 1 foot. The proposed Project will provide gated storage up to 6 feet deep (Phase 3).

Interior Pilot Channel:

To operate the Project, including filling and drawdown, a pilot channel is planned that connects the two outlet structures within the retention area and the Diked Inlet. Much of the retention area was previously farmed and has drainage to either SD 50 or SD 95 Lat 1. The new pilot channel will utilize portions of these existing ditches. A newly excavated channel will connect with the existing SD 95 Lat 1 and convey inflows into the retention area. This new channel will cross over the county line on the interior of the retention site and continue to the southwest towards SD 50.

Outlets

Two outlet structures will be constructed to allow outflows from the impoundment. A south outlet will discharge to Lateral 1 SD 95 (South Branch Two Rivers) and will consist of a 6'x6' concrete box culvert and a 12' x 28' concrete drop inlet. A west outlet will discharge to State Ditch 50 (Middle Branch Two Rivers) and will consist of a 4' reinforced concrete pipe with an 8' x 13.5' concrete drop inlet. An earthen emergency spillway will also be constructed for each outlet structure.

Design of the impoundment outlets references commonly used hydraulic and hydrologic models. The TR-60 model was used for sizing the gates, conduits, drop inlets, and emergency spillways. The HEC-HMS and EPA-SWMM models were primarily used to complete these calculations and test the sensitivity of each component. Additional detail on the outlet structure will be included in the Operating Plan (still under development).

Review of Modeling and Plans

HEI worked with Project Engineer over the course of a year to review plans and update modeling efforts completed in support of the KCWRP #11. The project's Engineers report was completed in 2017 and significant changes in the design have been made since that time. As a result of HEI's review of the modeling and plans, HEI recommended several revisions to the modeling to bring them to the level of the current design. HEI worked through a few rounds of revisions to the modeling and plans with the Project Engineer, prior to getting to the point where recommendations could be made.

The ditch systems in the vicinity of the project have less than a 10-year design, so 5 and 10-year flood events were used to evaluate the changes expected between the existing and proposed "with project" conditions. The attached maps in **Appendix C** show the flooding with and without the project. Areas that show up as "blue" are inundated under the existing conditions and will not be inundated under the with project conditions, areas that show up as red are inundated under the proposed conditions but not under the existing conditions, and areas that show up as purple are inundated under the existing and proposed conditions. (Note: The red along SD 72 Lateral 11 is an artifact of the way that area was modeled and should not be viewed as an adverse impact.)

For the SD 72 benefitting area, the impact to drainage are two fold: an outlet would be provided for some of the overflow from the Roseau River when those events affect the Juneberry Road area and local drainage can be slightly improved. Modeling was reviewed and it appears that under most conditions during the duration of the 5-year, 10-year and 50-year floods, benefits in drainage can be experienced on Lateral 6 (Huseby) and Lateral 8 (Wang) as shown on the graphs in **Appendix D**. The TRWD will need to operate gates to achieve these benefits. When water levels are higher in the Diked Inlet channel than water levels north of 280th ST, gates will need to be closed so that water is not diverted into the SD 72 system. Benefits to the SD 72 system can be gained any time the water level is higher on the north side of 280th ST. Blockages in the Diked inlet will reduce the benefits to the SD 72 system, so blockages will need to be removed to maximize benefits. Any flapgated inlet pipes through 280th ST will also provide benefits to the SD 72 system.

Lateral 12 as originally constructed drains north to the SD 72 Main. At the present time a 72" CMP culvert provides some drainage going south into SD 95. The upper end of this ditch will be disconnected from Lateral 1 of SD 95. The first few hundred feet of the south end of Lateral 12 will be drained into the impoundment as it will be within the diked Inlet. The drainage to the area north of the north embankment of the Diked Inlet will follow along the north and west side of the Klondike impoundment via the impoundment's external drainage ditch. This connection will maintain the original benefits for Lateral 12. The upper portion of Lateral 12 is not needed at this time as the lands adjacent to the Lateral 12 affected by the project are managed for wildlife.

The project will provide benefits to the SD 72 system during times of crossover water leaving the Roseau River and flowing south via SD 69 and SD 72 laterals toward the SD95 system. In general, water in the SD 95 system has subsided 14 days prior to any crossover waters coming overland from the SD 69 system. Any capacity left in the Klondike impoundment can be used to reduce duration of flooding on the SD 72 system during these crossover events.

For the SD 95 system, the projects benefits to the system are experienced in three areas: upstream of the Diked Inlet, along the Diked Inlet, and downstream of the impoundment.

In the area downstream of the impoundment, for most events more than 80 square miles of the existing drainage area will be routed through the impoundment. The impoundment can hold the entire runoff volume for the 50-year

flood event. While it does not have a significant effect on peak flows at the outlet of the impoundment, it greatly reduces the duration of high flows as shown in the hydrographs shown in **Appendix E**.

Drainage will be improved for drainage upstream of the diked inlet. The capacity of the channel will be improved to provide 10-year flood protection.

In the stretch of SD 95 Lateral 1 where the channel is being routed south. This portion of Lateral 1 to be realigned to the south of the Diked Inlet will also provide better drainage benefits to landowners along that portion of the SD 95 system. Much of this section of ditch has 2-year flood capacity or less. With the project in place, that portion of the channel is expected to have at least 10-year capacity. Flows in excess of the 50-year event will begin to partially bypass the Diked Inlet channel into the new realigned SD 95 Lateral 1, but it is important to note that Lateral 1 bears the full impact of those flows under the existing conditions.

Review of Road Impacts

HEI reviewed the plan for roads in the project area. Most roads in the project area are minimum maintenance roads. The current plan is to install roadways with 20-foot top widths and 5H:1V (interior to the impoundment and diked inlet and 4H:1V on the exterior slopes. Roads with a 20-foot top width (as shown in Figure 2 below) are proposed on the south side of the impoundment (in Section 27, along the south side of Sections 22, 23, and 24 of Klondike Township), and along the east side of the impoundment (along the east side of Sections 1,12,13, and 24 of Klondike Township).

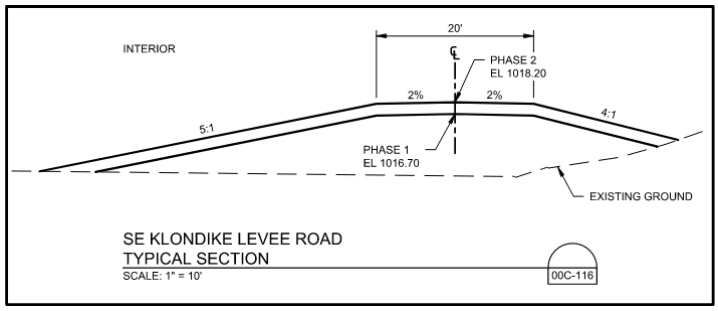

FIGURE 2: TYPICAL KLONDIKE IMPOUNDMENT ROAD EMBANKMENT SECTION (SOURCE: HDR)

Along the diked inlet, a minimum maintenance road is proposed on the south side of the diked inlet along the south line of Sections 31 of Juneberry Township, the northeast corner of Section 6 of Polonia Township, and along the north side of Sections 1, 2, 3, 4, and 5 of Polonia Township. 280th ST will be built as a minimum maintenance road in Sections 31 and 32 of Juneberry Township with a 20-foot top width. Further east in Sections 33, 34, 35, and 36 of Juneberry Township, 280th ST will be rebuilt with a 24-foot top width. Here slopes will be 4H:1V on the north side of the road and 3H:1V on the south side of the road as shown in the figure below.

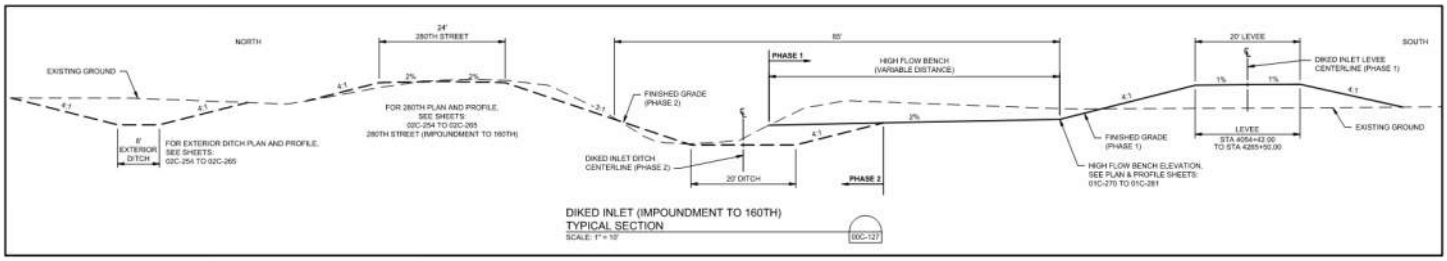

FIGURE 3: TYPICAL ROAD SECTIONS ALONG DIKED INLET (SOURCE: HDR)

A new improved 280th ST north road ditch will be constructed which should improve road drainage along 280th ST. These road modifications would generally be improvements over the roads that currently exist in the project area today. In general, the existing roads are narrower with steeper sideslopes than what is being proposed. The proposed roads would meet the current design standards for roads of this classification and average daily traffic.

Along the Diked inlet there is one area on 120th Ave that has an overflow section. While this area is reinforced with riprap, this area will need to be reviewed after significant runoff events to ensure the road is maintained.

While the design plans provided are preliminary, signage should be provided in future plans that address safety for the traveling public so that they are aware of the changes that are proposed. An example would be a "Road May Flood" sign for the low water crossing. Speed warning may also be

Findings and Recommendations

Based on the design and review of the rerouting and impounding of State Ditches 72 and 95 waters, I make the following findings and recommendations:

State Ditch 72

1. The impact on SD 72 will be limited largely to small drainage benefits for the landowners along Branch 6 and 8. The culvert improvements in these locations will allow Roseau River breakout flows to pass more easily through 280th ST which will provide some relief to the ditch during extreme flooding conditions.
2. No additional ditch easement is required along the SD 72 system to facilitate the proposed culvert work.
3. The operation plan will need to implement gate closures on a timely basis to maximize any drainage benefits for the SD 72 system. If water is higher in the diked inlet feature than water to the north of 280th ST, gates will need to be closed to ensure that SD 72 is not adversely affected.
4. The proposed project does not adversely impact drainage and will maintain drainage benefits for the SD72 benefitting landowners.
5. During extreme flood events when flooding is occurring from interbasin flows from the Roseau River, the KCWRP #11 provides an opportunity to provide relief to the SD 72 system. The project provides an opportunity to reduce the duration of flooding resulting from interbasin flows.

State Ditch 95

1. The proposed project will improve water quality by reducing sediment and nutrient loadings to the ditch and the South Branch of the Two Rivers through the impoundment of floodwaters on the ditch. The reduction in sediment entering the ditch system should reduce the need for maintenance.
2. The proposed project does not adversely impact drainage and will maintain drainage benefits for the SD 95 benefitting landowners.
3. The proposed project reduces peak discharge duration at its outlet by providing significant additional floodwater storage in the proposed impoundment site.
4. The TRWD plans to acquire the necessary R/W to move the SD 95 Lateral 1 alignment. The proposed project right-of-way shown on cross-section in the preliminary plans (Sheets 00C-329 to 00C-342) appear to be inadequate to provide at least the 1-rod buffer as required by MN Statute 103E.021. This will need

to be revised as part of the land acquisition. The typical Section on Sheet 00C-402 does show a typical section with adequate permanent ditch easement.

5. The overflow section at 120th Avenue should be reviewed after overtopping events and repaired if erosion occurs. Maintenance responsibility for this crossing should be part of the long-term maintenance of KCWRP #11.

6. The TRWD should maintain roads slopes along project features such as the Diked inlet and the impoundment since these areas are integral to the KCWRP #11. The road authority would continue to maintain the road top once accepted at the conclusion of construction.

7. Proper permanent signage should be provided along road realignments to make the traveling public aware of changes to the road.

8. Through the delay in the release of water from the impoundment by many days after the main runoff event, landowners downstream of the impoundment should see better drainage opportunity.

If you have any questions or comments, feel free to give me a call at (701) 499-2055.

Sincerely,

HOUSTON ENGINEERING, INC.

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Direct: 701.499.2055
ejones@houstoneng.com

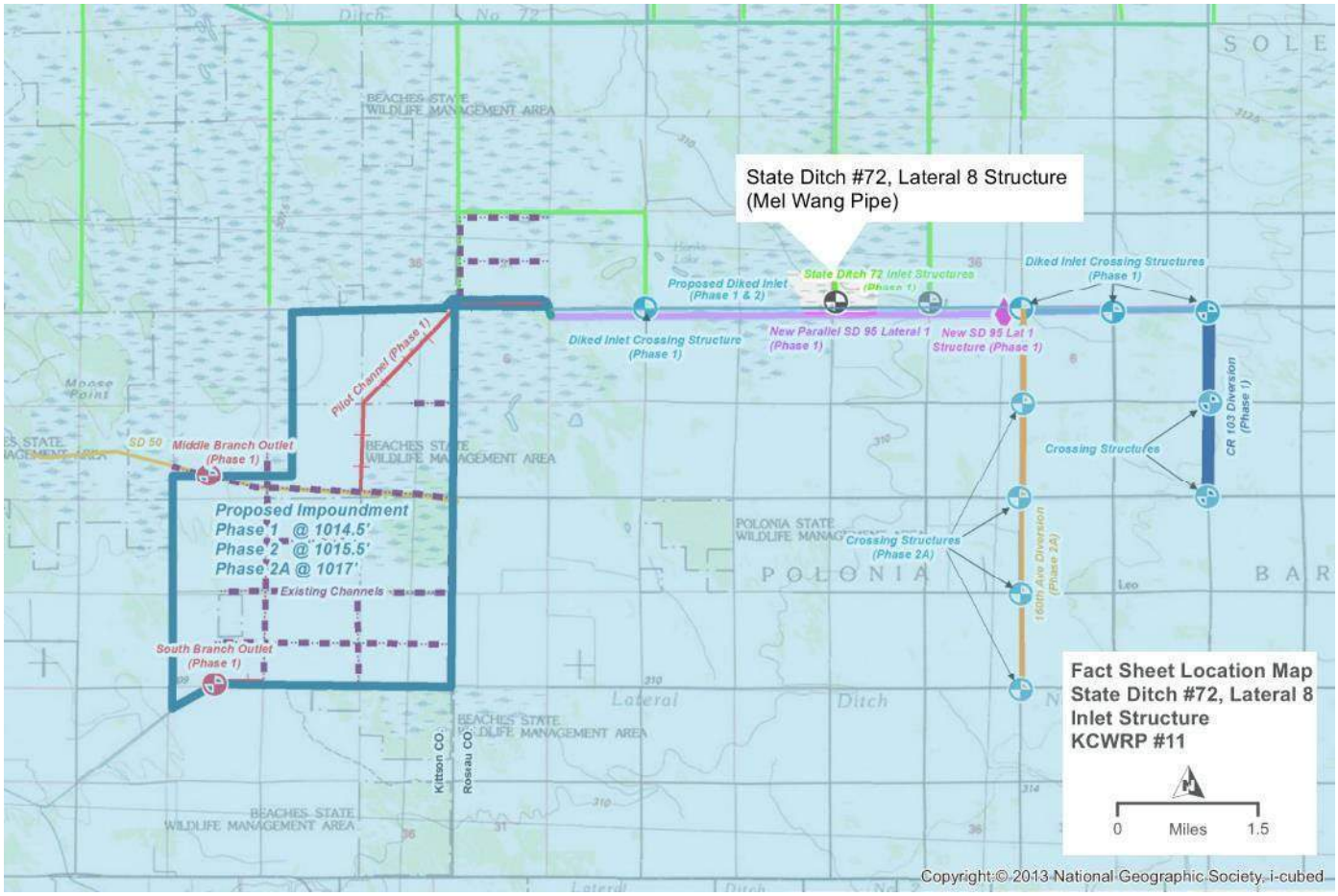
Appendix A

Two Rivers Watershed District
Klondike Clean Water Retention Project #11

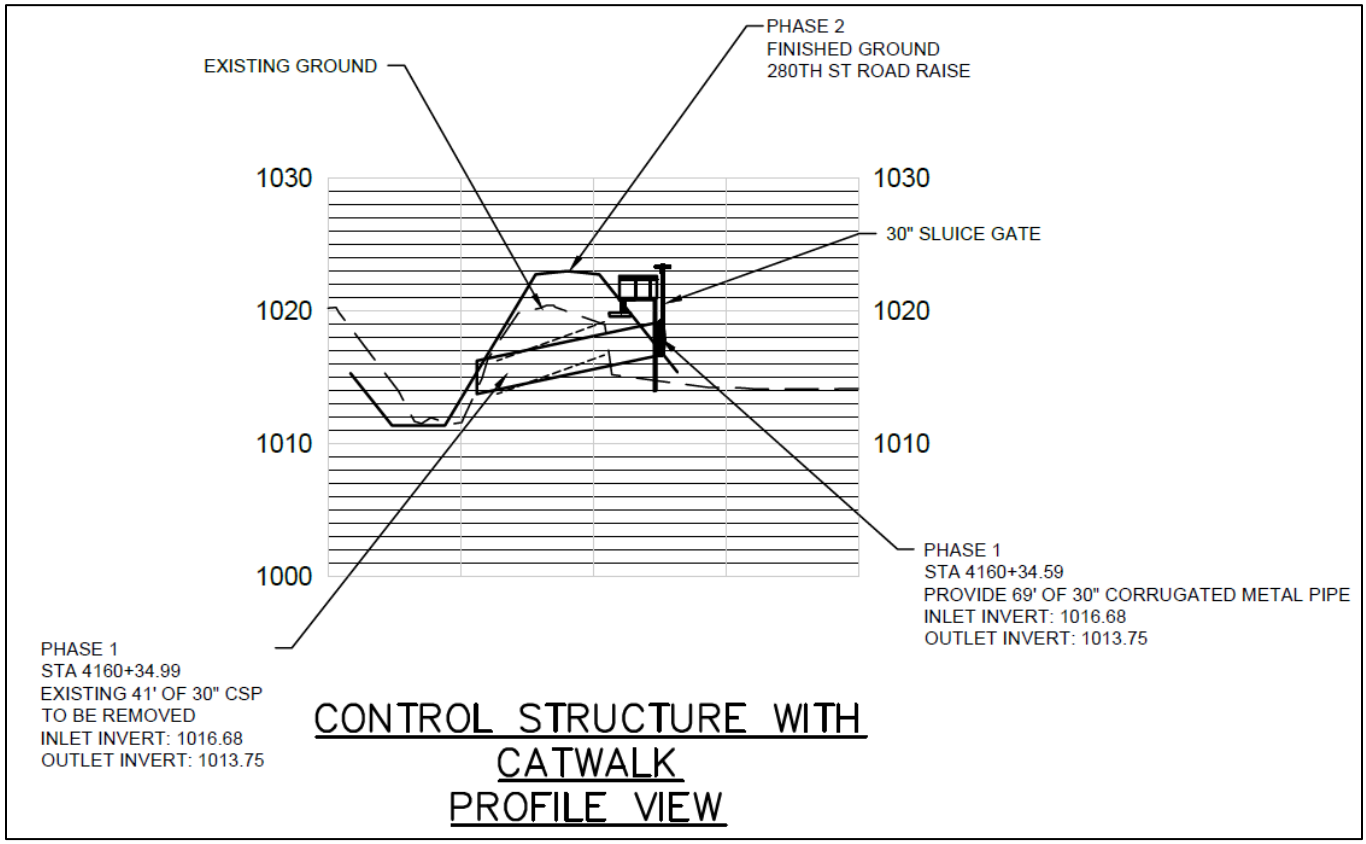
Fact Sheet – 10/1/22

State Ditch #72, Lateral 8 Structure
(Mel Wang Pipe)

The existing 30" pipe at this location was installed in 2007 to allow water that overflows from Roseau River another outlet to drain floodwaters from SD 72 to SD 95. This will be a gated culvert and will be operated only during floods to allow approximately 1,200 acre feet of floodwater to flow from north to south into the project via the diked inlet channel during the later part of the flood event, typically when overflow flooding from Roseau River is occurring.



Ditch Name	Drainage Authority	Location Description	Proposed Impact	Purpose of Proposed Impact
State Ditch 72 Lateral 8	Joint - Roseau and Kittson Counties	SW corner of Section 35 T162N R44W (Juneberry Twp)	Culvert Lengthened - The existing gated structure that connects SD 72 Lat 8 to SD 95 Lat 1 will be extended to allow for Diked Inlet construction and 280th St to be altered	The existing structure size and elevation has been set by the State in order to maintain a public water (wetland). Future operations of this gate are to be determined through permitting process

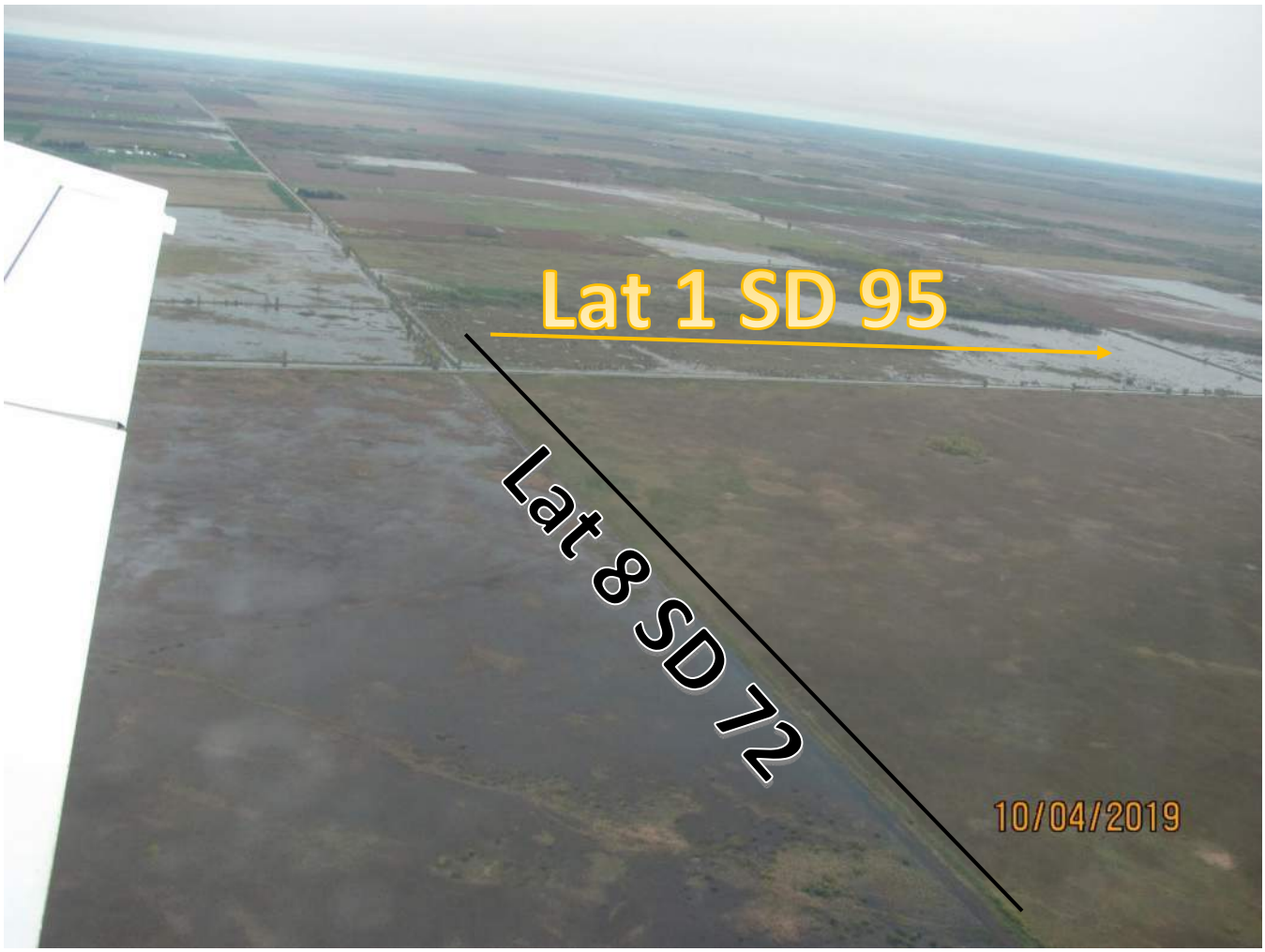



LANDOWNER: COUNTY OF ROSEAU
N
EXISTING RIGHT-OF-WAY
SECTION LINE
SD 72 LAT 8
EXISTING RIGHT-OF-WAY
PHASE 1
STA 4160+34.99
EXISTING 41' OF 30" CSP
TO BE REMOVED
INLET INVERT: 1016.68
OUTLET INVERT: 1013.75
PHASE 1
STA 4160+34.59
PROVIDE 69' OF 30" CORRUGATED METAL PIPE
INLET INVERT: 1016.68
OUTLET INVERT: 1013.75
INSTALL NEW CATWALK AND SCREW GATE
280TH ST
4158+00
4159+00
4160+00
4161+00
4162+00
4163+00
4164+00
4165+00
4166+00
PHASE 1
STA 4160+08.31
EXISTING 59' OF 24" CSP
TO BE REMOVED
INLET INVERT: 1012.30
OUTLET INVERT: 1011.80
PHASE 1
STA 4160+70.31
EXISTING 46' OF 18" CSP
TO BE REMOVED
INLET INVERT: 1013.57
OUTLET INVERT: 1012.97

Lat 8 SD 72 – Existing Mel Wang Pipe looking to the north

Lat 8 SD 72 – Existing Mel Wang Pipe looking to the north

Mel Wang Ditch – looking south. Lat 1 SD 95 runs through the middle of the photo from left to right



Two Rivers Watershed District
Klondike Clean Water Retention Project #11

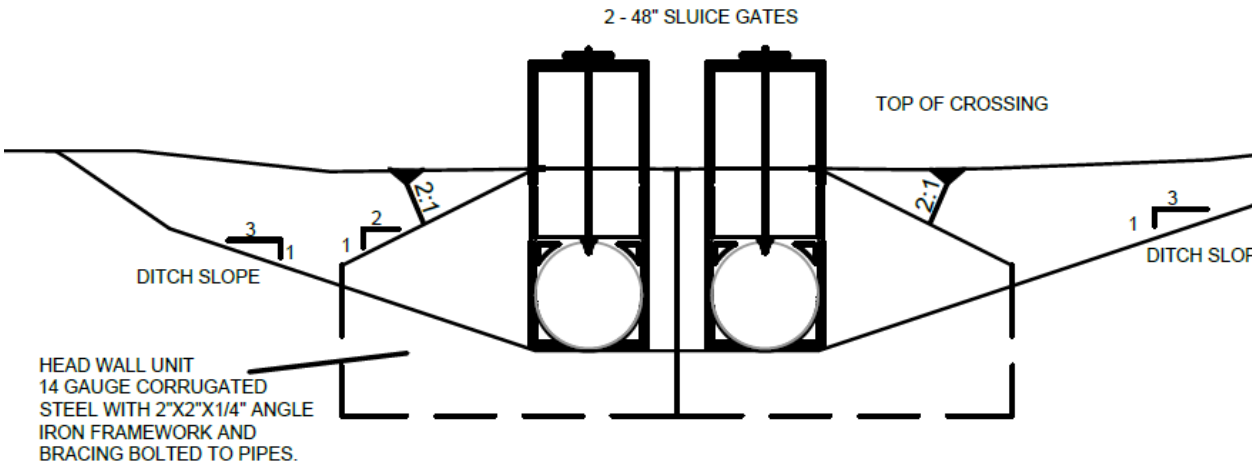
Fact Sheet – 10/1/22

State Ditch #72, Lateral 6 Structure (Huseby Pipe)

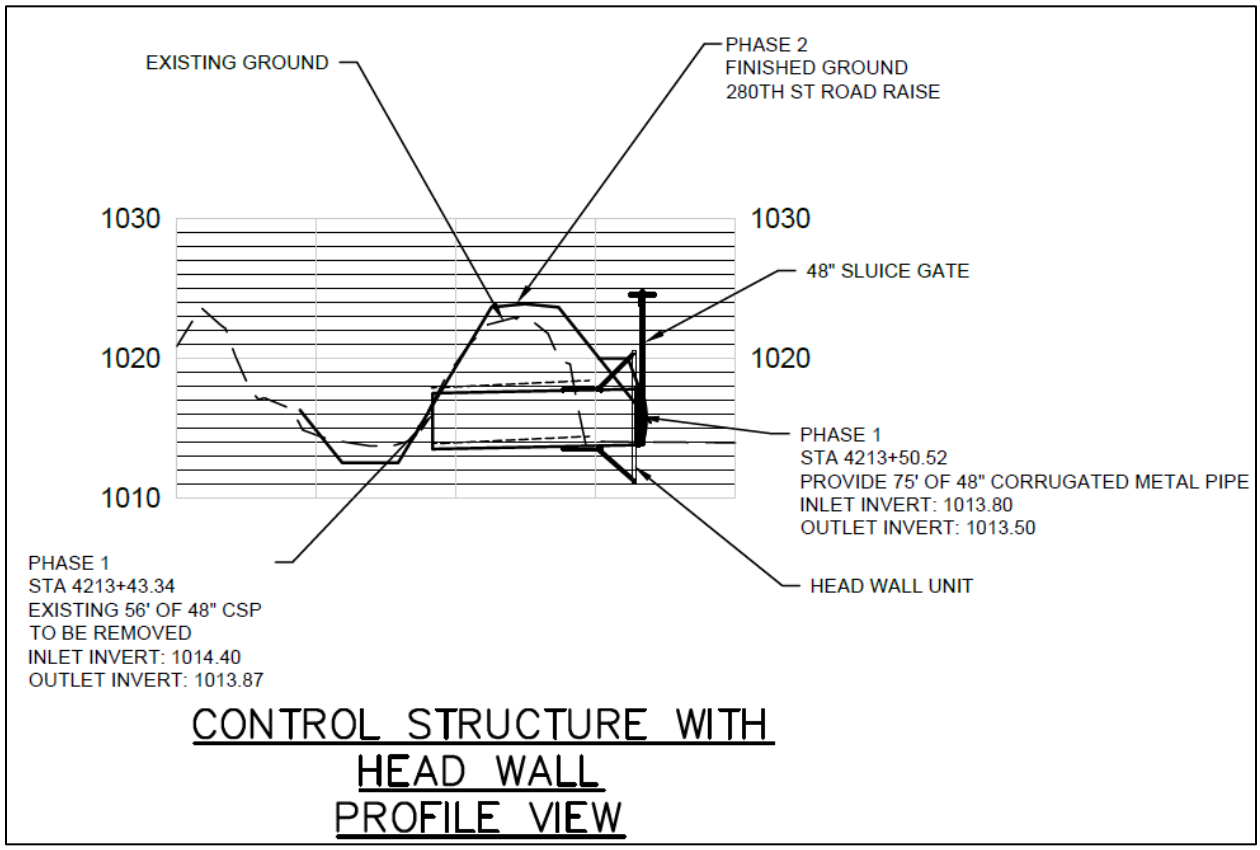
The existing 48” pipe at this location replaced a 24” pipe and was installed in 2011 to allow local drainage from the east and water that overflows from Roseau River a better outlet to drain floodwaters from SD 72 to SD 95.

This will be improved to consist of two gated 48” culverts. The normal position will be one gate fully open and one gate closed. During floods both will be opened to allow up to 10,000 acre feet of floodwater to flow from north to south into the project via the diked inlet channel during the later part of the flood event, typically when overflow flooding from Roseau River is occurring. A reinforced spillway at 1021.15’ will allow additional flood water to flow over 280th St (95 grade) into the project.

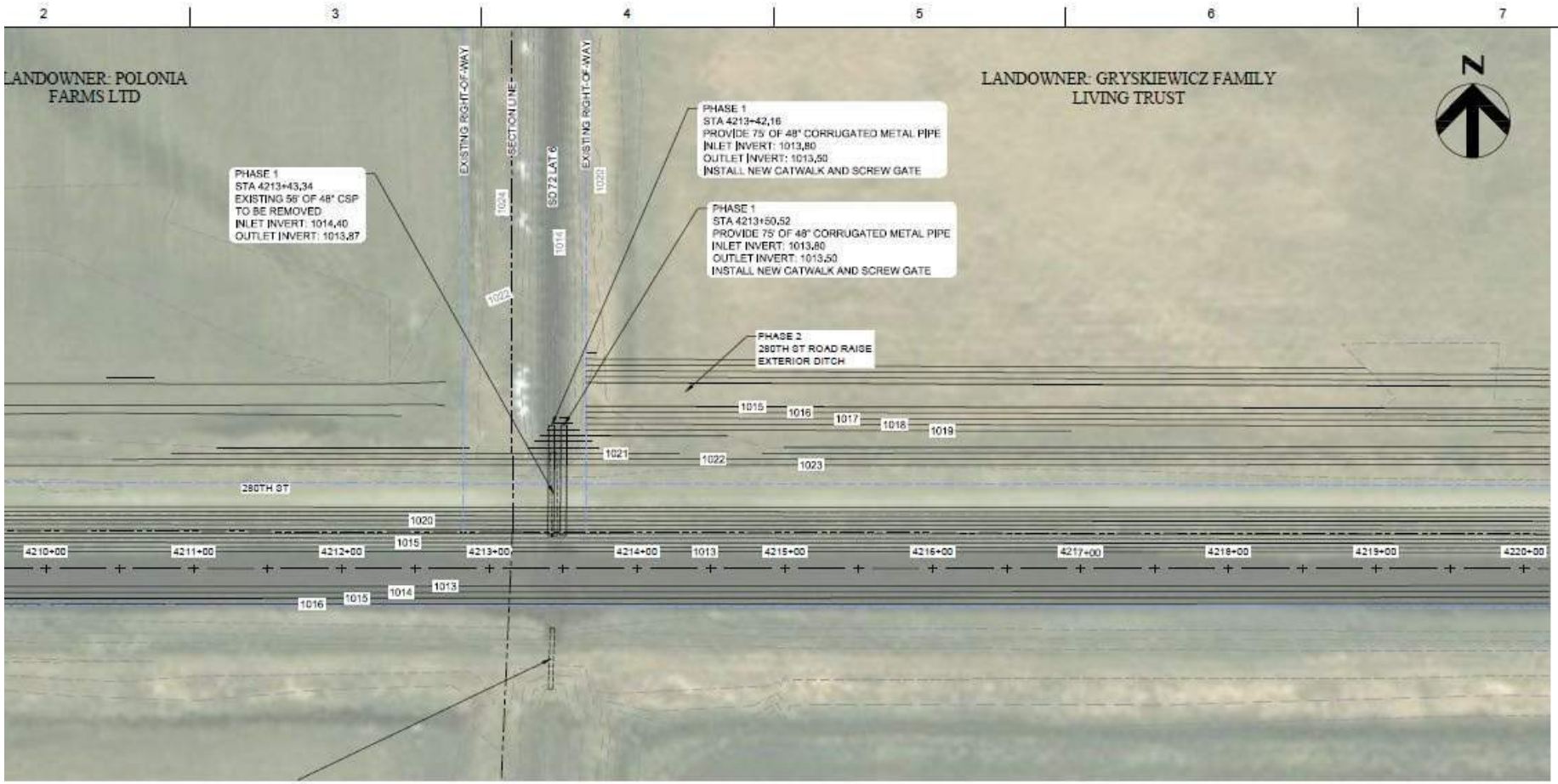
Ditch Name	Drainage Authority	Location Description	Proposed Impact	Purpose of Proposed Impact
State Ditch 72 Lateral 6	Joint - Roseau and Kittson Counties	SW corner of Section 36 T 162N R44W (Juneberry Twp)	Inlet flows from SD 72 - The existing structure that connects SD 72 Lat 6 to SD 95 Lat 1 will be removed and replaced with two gated, 48-inch culverts	The inlet structures are necessary to reduce flooding in the SD 72 system and allow flows into the Diked Inlet. Gates on this structure allow for enhanced operations by the TRWD for flood damage reduction



CONTROL STRUCTURE WITH HEAD WALL ELEVATION



CONTROL STRUCTURE WITH HEAD WALL PROFILE VIEW


2
3
4
5
6
7
LANDOWNER: POLONIA FARMS LTD
LANDOWNER: GRYSKIEWICZ FAMILY LIVING TRUST
N
EXISTING RIGHT-OF-WAY
SECTION LINE
SD72 LAT 6
EXISTING RIGHT-OF-WAY
PHASE 1
STA 4213+43,34
EXISTING 56' OF 48" CSP
TO BE REMOVED
INLET INVERT: 1014,40
OUTLET INVERT: 1013,87
PHASE 1
STA 4213+42,16
PROVIDE 75' OF 48" CORRUGATED METAL PIPE
INLET INVERT: 1013,80
OUTLET INVERT: 1013,50
INSTALL NEW CATWALK AND SCREW GATE
PHASE 1
STA 4213+50,52
PROVIDE 75' OF 48" CORRUGATED METAL PIPE
INLET INVERT: 1013,80
OUTLET INVERT: 1013,50
INSTALL NEW CATWALK AND SCREW GATE
PHASE 2
280TH ST ROAD RAISE
EXTERIOR DITCH
280TH ST
4210+00
4211+00
4212+00
4213+00
4214+00
4215+00
4216+00
4217+00
4218+00
4219+00
4220+00

Lat 6 SD 72 – Existing Huseby Pipe looking to the north

Lat 6 SD 72 – Existing Huseby Pipe looking to the north

Outlet end of Huseby Pipe into SD 95 Lat 1 Ditch – looking south. Sediment buildup in Lat 1 to be removed.

Two Rivers Watershed District
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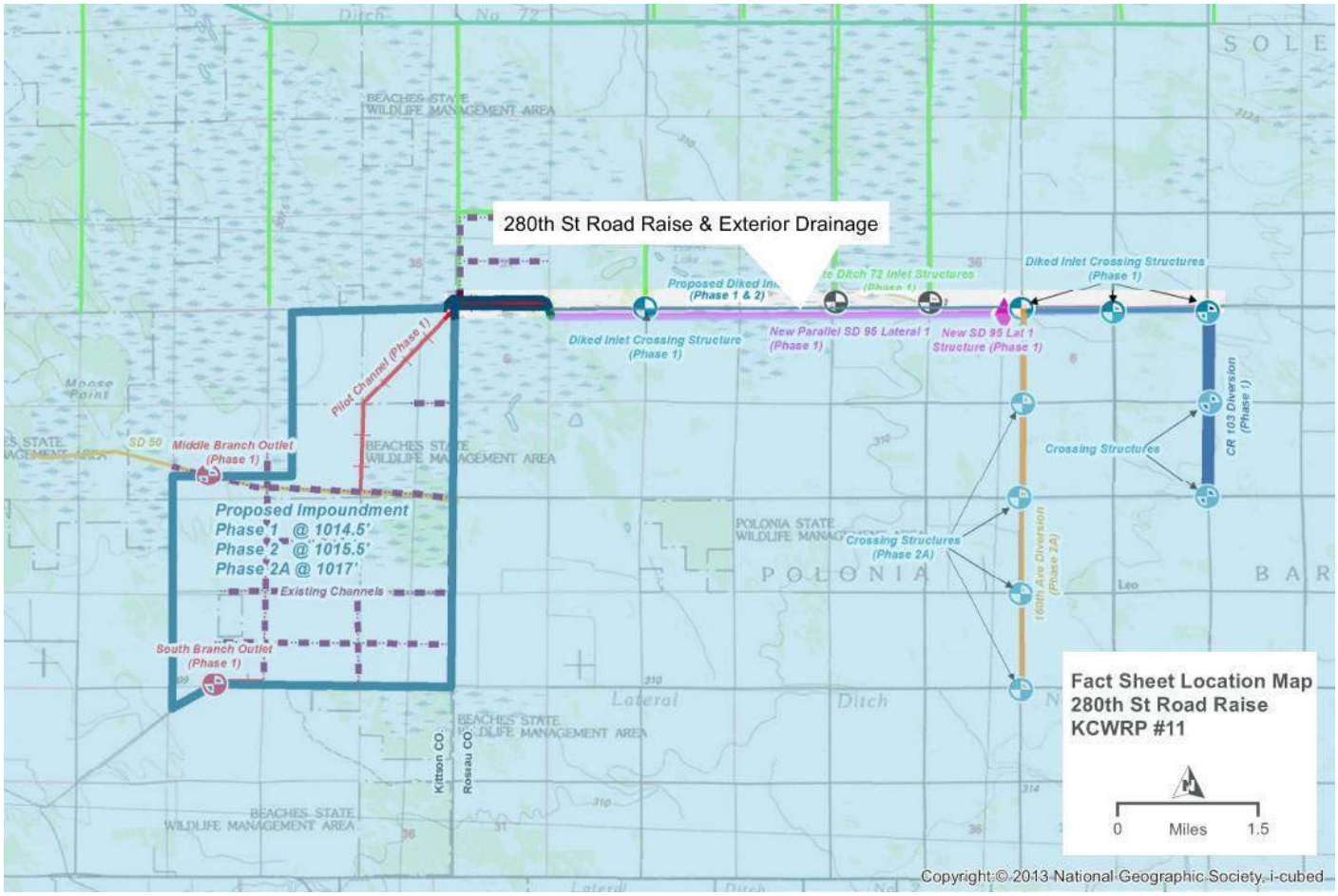
280th St Road Raise & Exterior Drainage (95 Grade)

The existing 280th St is located on the north side of Lat 1 SD 95 and on the township lines between Soler/Barto and June Berry/Polonia. Phase 2 of the project includes altering the existing road to create the northern boundary of the Diked Inlet.

280th St is a gravel road from 120th Ave to the east, and a minimum maintenance road from 120th Ave to the west. The road acts as a dam during flood events.

Existing pipes through 280th St will be removed and replaced with new culverts, and flap gates (traps) will be installed on the south (outlet) end of each culvert. An exterior drainage ditch will provide local drainage along all privately-owned lands and will outlet into Lat 11 or 12 of SD 72.



Road Name	Road Type	Location Description	Proposed Impact	Purpose of Proposed Impact
280th St (Juneberry Unorganized/Polonia Township)	Township Road, Minimum Maintenance, Vegetated Surface	From the intersection near the SW corner of Section 31, T162N R44W (Juneberry Twp) and extending 1.0 mile east to the SE corner of Section 31 T162N R44W	Alter - The road will be modified and raised to become a watertight levee. See figure for typical detail “S Christianson Levee Rd"	This new proposed levee will control impounded waters. As a secondary purpose, the top of the levee will provide a driving surface for maintenance or local traffic only.
280th St (Juneberry Unorganized/Polonia Township)	Township Road, Minimum Maintenance, Vegetated Surface	From the SE corner of Section 31 T162N R44W (Juneberry Twp) extending 1.0 mile east to the intersection with 120th Ave	Alter - The existing road will be modified to convey the Diked Inlet inflows. At 120th Ave the Ditch Crossing will be removed, and a new Crossing will be installed that can convey Diked Inlet inflows. A new 20-foot levee will be built on the south of the Diked Inlet. See figure for typical detail "Diked Inlet (Impoundment to 120th)" and "120th Avenue Crossing"	The Diked Inlet will be constructed with capacity to fill the impoundment, and store water up to the maximum pool elevation. After the Project is constructed the local traffic may cross the Diked Inlet under normal, low-flow conditions. During flooding events the crossing will be submersed. Traffic can utilize the new 20-foot top levee on the south side, or the modified existing road on the north side depending on where they need to travel.
280th St (Juneberry Unorganized/Polonia Township)	Township Road, Gravel Surface	From the intersection with 120th Ave near the SW corner of Section 33 T162N R44W (Juneberry Twp) extending east for 4.0 miles to the intersection with 160th Ave near the SE corner of Section 36 T162N R44W	Alter - The Existing road will be modified and raised in some portions to accommodate the Diked Inlet construction. See figure for typical detail "DIKED INLET (120TH TO 160TH)"	The Diked Inlet will be constructed with capacity to fill the impoundment, and store water up to the maximum pool elevation. The existing road will need to be raised and/or reconstructed in various places along the Diked Inlet. The road will have a 4" Class 5 aggregate surface when Project is complete.

Figure 1. Typical Section of Diked Inlet (Impoundment to 120th Ave) - Altering Existing 280th St

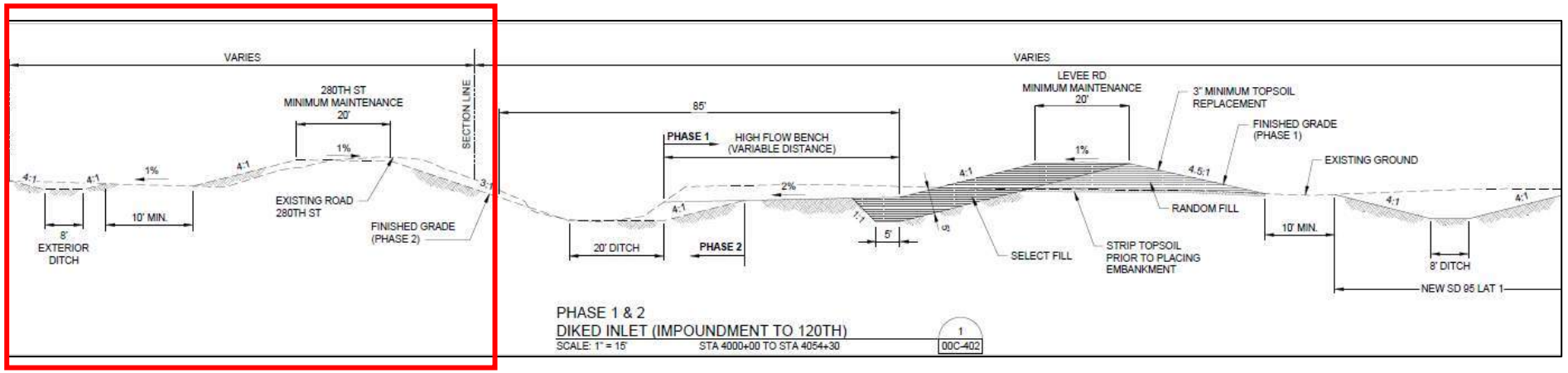
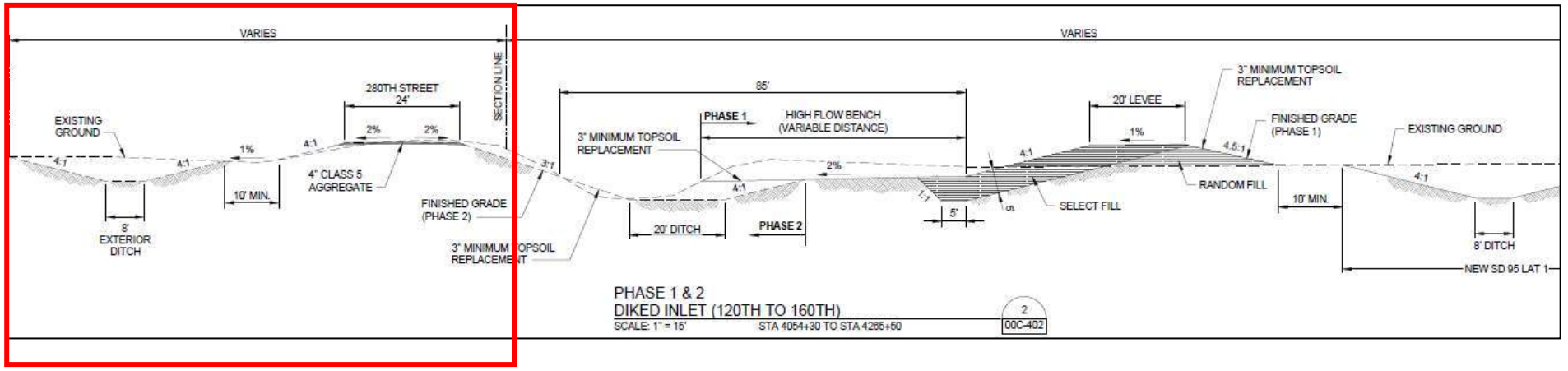


Figure 2. Typical Section of Diked Inlet (120th to 160th Ave) - Altering Existing 280th St



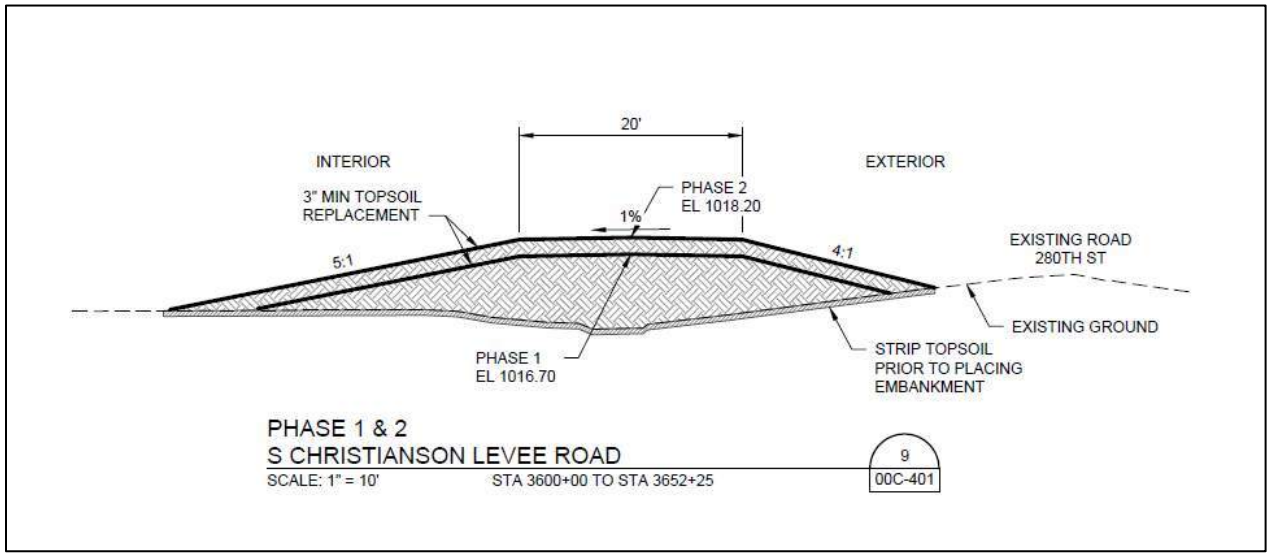


Figure 3. Typical Section of Proposed S Christianson Levee Road - Altering Existing 280th St

280th St Looking West – Fall of 2019

Two Rivers Watershed District
Klondike Clean Water Retention Project #11

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Retention Area

The Retention area is the 10.7 square miles of land that the Watershed owns and proposes to be used to store flood waters. The north and west sides of the retention area is mainly very flat terrain, with up to 4 feet of peat soils on top of lean clay. The south and east sides of the retention area are bordered by a minimum maintenance road. The road consists of compacted spoil from the adjacent SD 95 Lat 1. This spoil road will be built up to form the south and east sides of the retention area and new embankment will be built on top of the existing peat (without stripping the peat) to form the north and west sides.

The existing area has a history of flooding, but only at depths less than 1 foot. The proposed Project will provide gated storage up to 6 feet deep (Phase 3). More detailed information can be found in the Operating Plan.

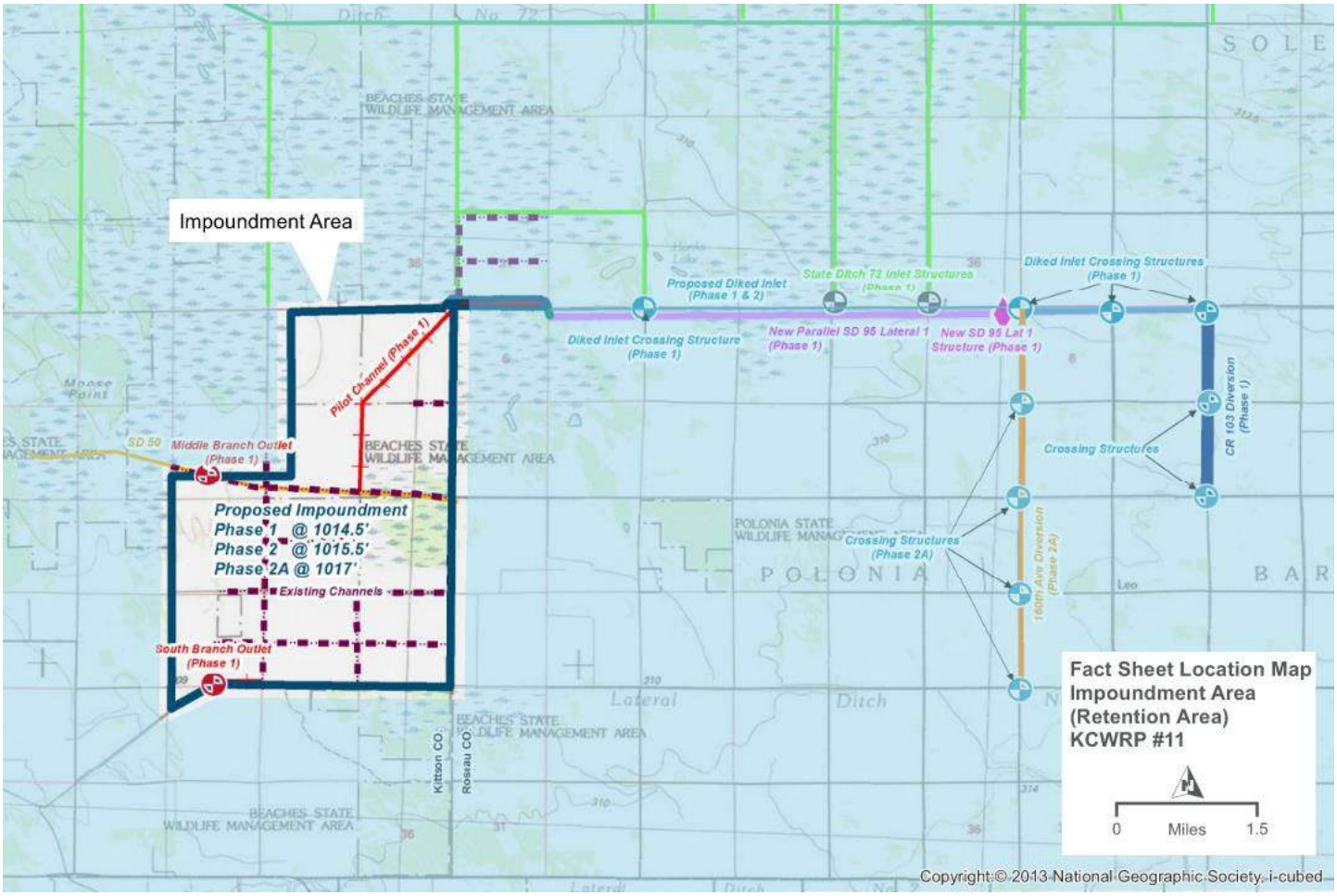


Figure 1. Typical Section of Proposed S Christianson Levee Road - Altering Existing 280th St

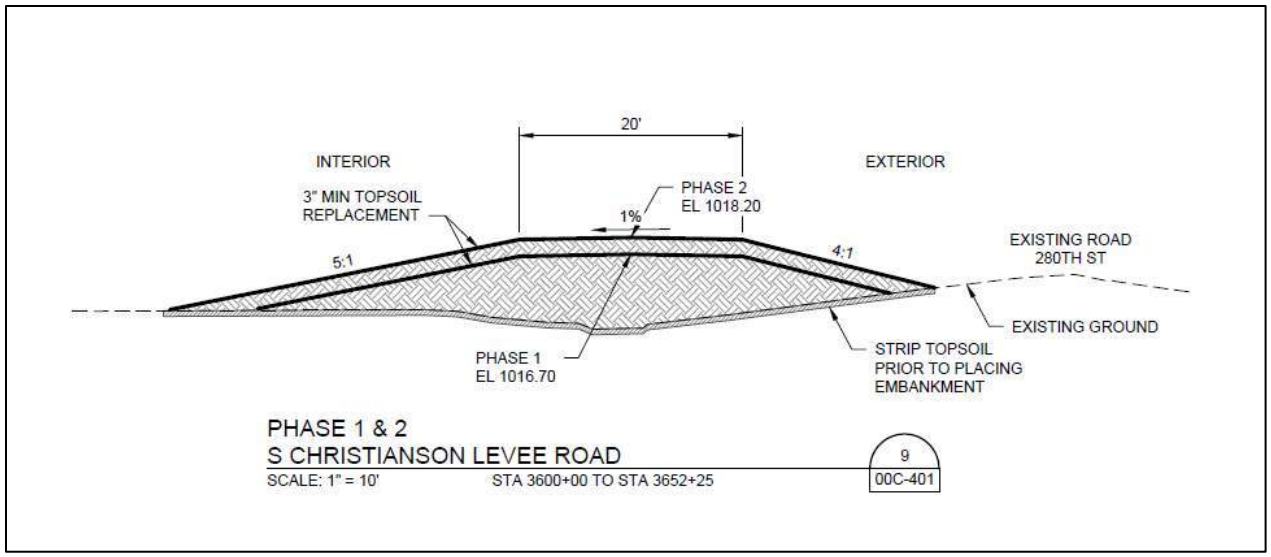
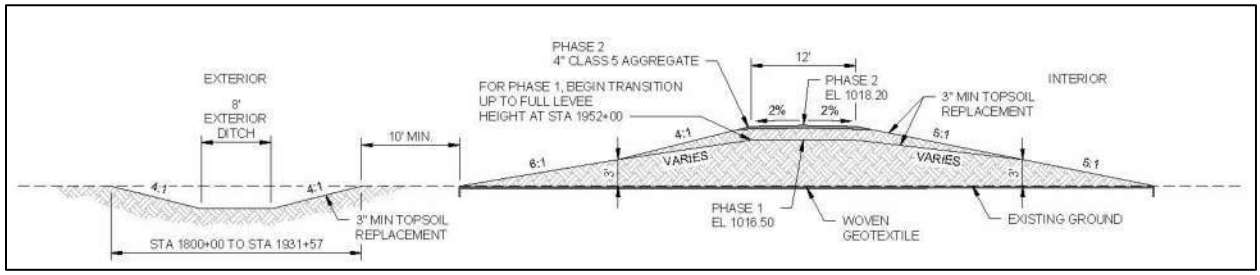
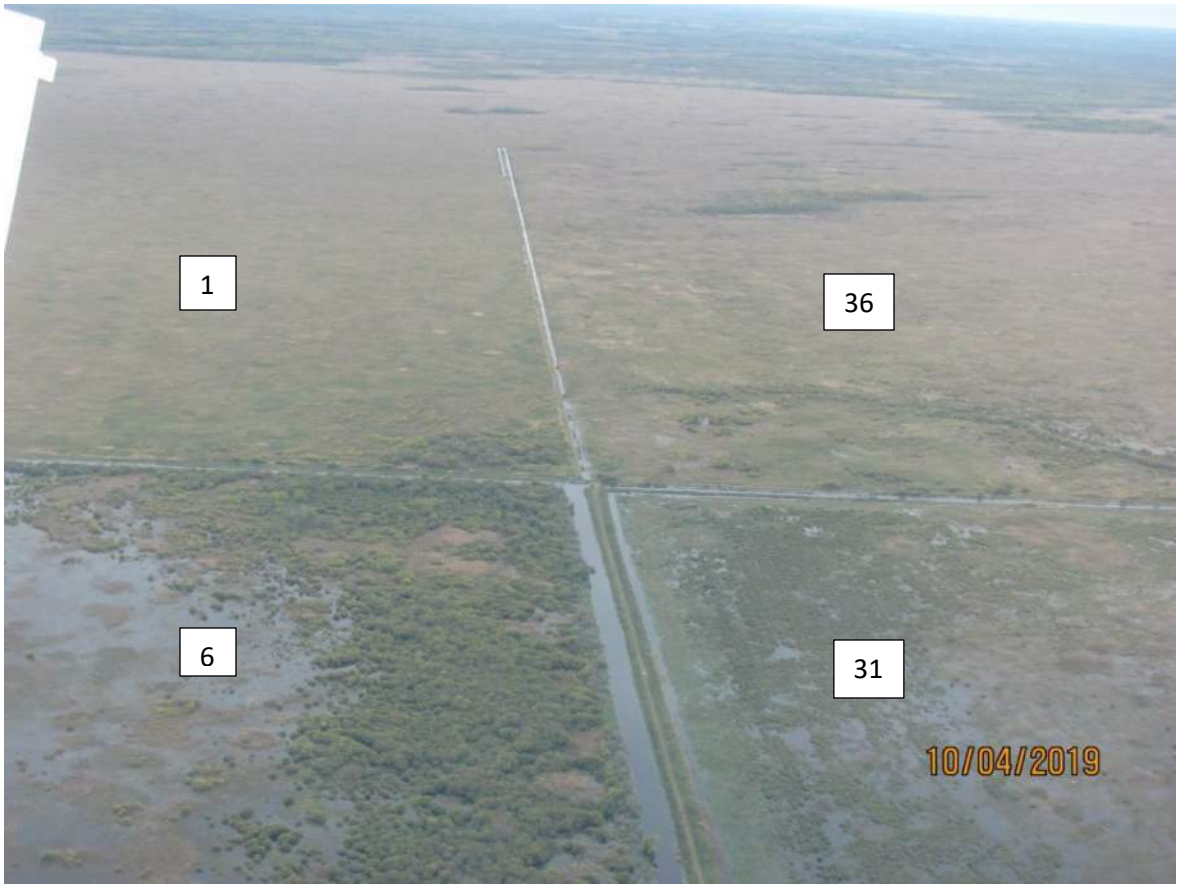


Figure 2. Typical Northwest Levee Section on Peat





Looking west – Roseau County & Lat1 SD95 in foreground & Kittson County in rear.

Looking north – section 23, Klondike Township, Kittson County. Lat1 SD95 in foreground

Two Rivers Watershed District
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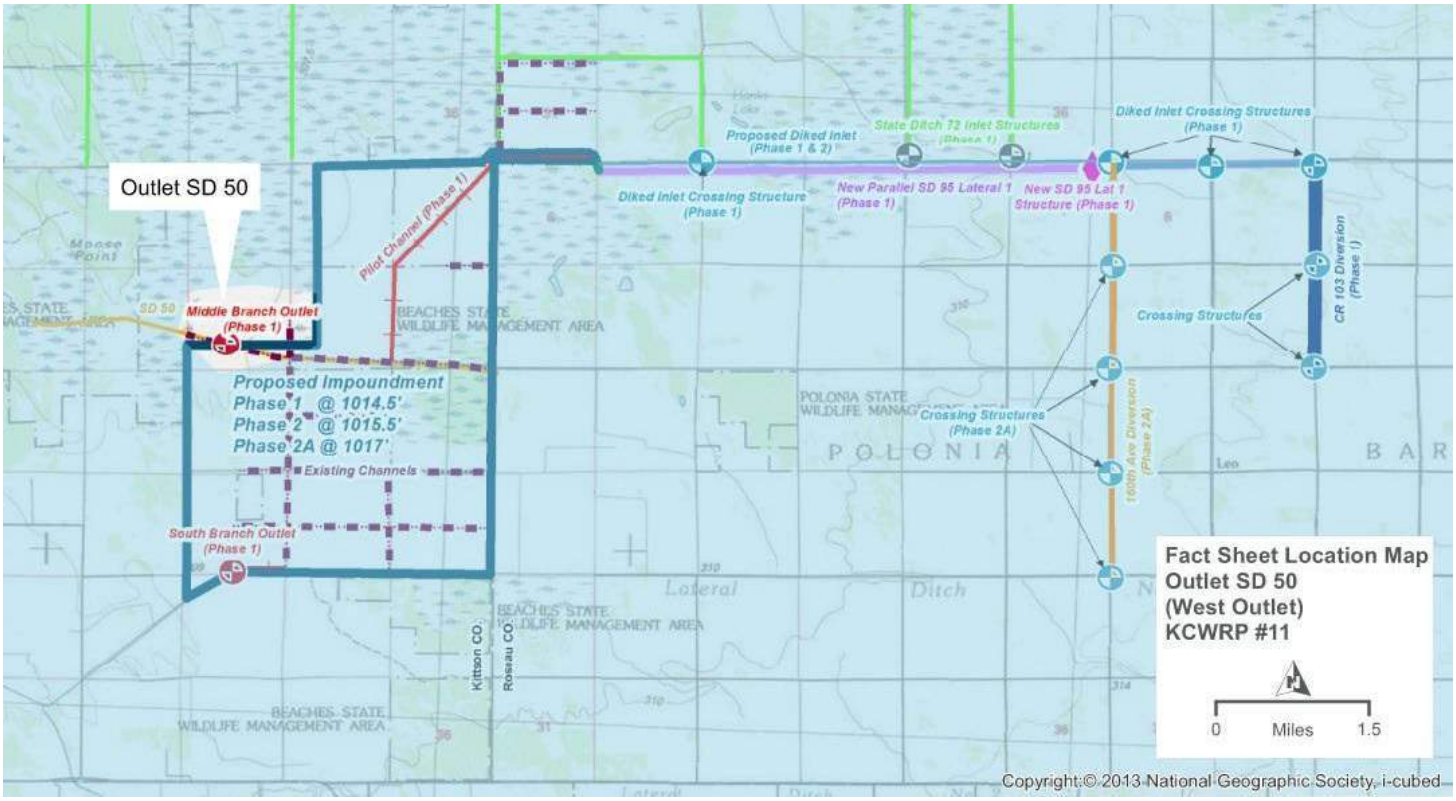
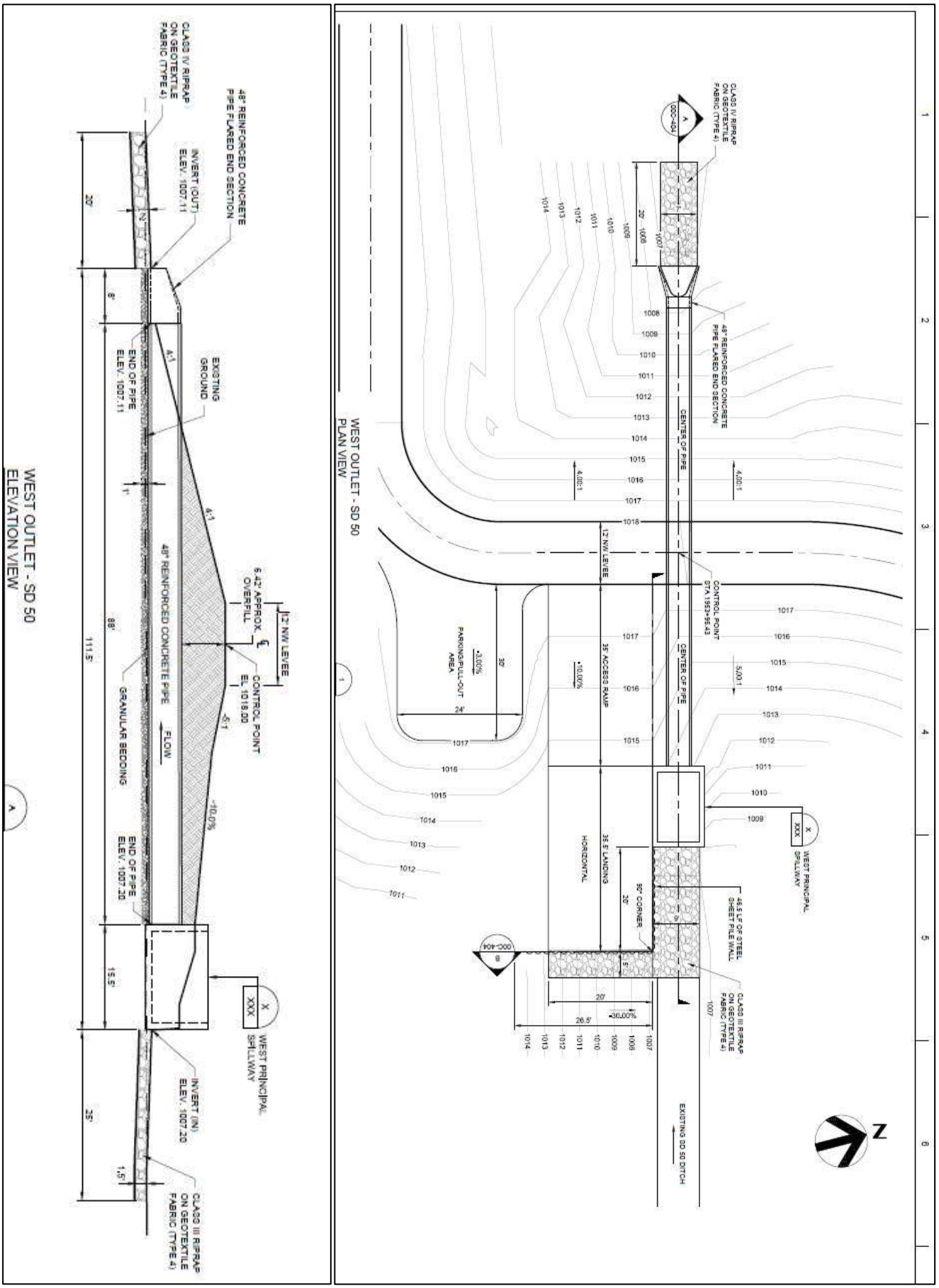
Outlet SD 50
(West Outlet)

The proposed gated structure is within SD 50, located 3 miles west of the Roseau Kittson County line. Large scale flooding currently occurs downstream of the proposed impoundment on the Middle Branch of the Two Rivers in the vicinity of section 17 of Hazelton Township in Kittson County. This project will nearly prevent this flooding from happening and will moderate flows on the Middle Branch.

Design of the impoundment outlets references TR-60 for sizing the gates, conduits, drop inlets, and emergency spillways. HEC-HMS and EPA-SWMM were primarily used to complete these calculations and test the sensitivity of each component. Additional detail on the outlet structure is included in the Operating Plan.



Structure	Gate Size [WxH]	Culvert Size	Concrete Riser Size	Top of Concrete	Gate opening Invert
W Outlet	(1) - 6' x 4'	(1) - 4' RC Pipe	8' x 13.5'	1015.5'	1007.2’


WEST OUTLET - SD 50
PLAN VIEW
WEST OUTLET - SD 50
ELEVATION VIEW
48" REINFORCED CONCRETE PIPE FLARED END SECTION
CLASS IV RIPRAP ON GEOTEXTILE FABRIC (TYPE 4)
CENTER OF PIPE
CONTROL POINT STA 1953+95.43
12' NW LEVEE
35' ACCESS RAMP
+10.00%
PARKING/PULL-OUT AREA
+3.00%
HORIZONTAL
35' LANDING
90° CORNER
WEST PRINCIPAL SPILLWAY
XXX
456 S.F. OF STEEL SHEET PILE WALL
CLASS III RIPRAP ON GEOTEXTILE FABRIC (TYPE 4)
EXISTING SD 50 DITCH
INVERT (OUT) ELEV. 1007.11
INVERT (IN) ELEV. 1007.20
END OF PIPE ELEV. 1007.11
END OF PIPE ELEV. 1007.20
EXISTING GROUND
6.42' APPROX. OVERFILL
CONTROL POINT EL. 1018.00
48" REINFORCED CONCRETE PIPE
GRANULAR BEDDING
FLOW
-10.0%
4:1
5:1
111.5'
88'
20'
8'
15.5'
25'
1.5'
N

2002 Flooding showing downstream damages in Hazelton Township, Kittson County from crossover flooding and breakouts on Middle Branch Two Rivers

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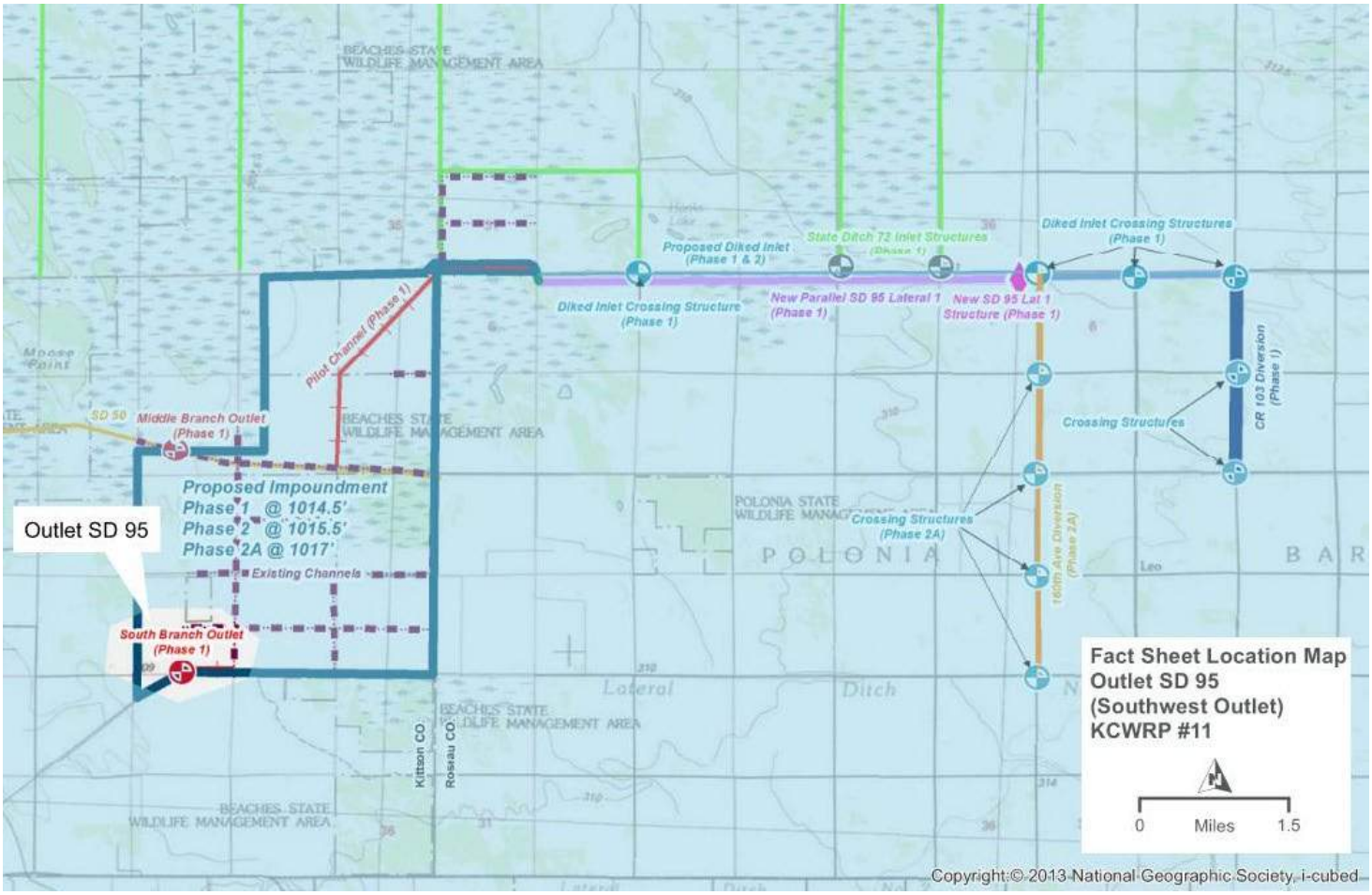
Outlet SD 95
(Southwest Outlet)

The proposed gated structure is adjacent to SD 95 Lat 1, located 2.5 miles west of the Roseau Kittson County line.

Design of the impoundment outlets references TR-60 for sizing the gates, conduits, drop inlets, and emergency spillways. HEC-HMS and EPA-SWMM were primarily used to complete these calculations and test the sensitivity of each component. Additional detail on the outlet structure is included in the Operating Plan.



Structure	Gate Size [WxH]	Culvert Size	Concrete Riser Size	Top of Concrete	Gate opening Invert
SW Outlet	(1) - 6' x 6'	(1) - 6' x 6' RC Box	12' x 28'	1015.5'	1006.1’

Roseau County in foreground; Lat1 Br4 SD95 - Kittson County in background; Lat1 SD95

5. THE BAR SIZES SHOWN IN THIS PLAN ARE IN U.S. CUSTOMARY DESIGNATIONS.
6. REFER TO THE REMAINDER OF GRADING PLAN FOR THE SUBSURFACE UTILITY INFORMATION.
7. BARS MARKED WITH THE SUFFIX "E" SHALL BE EPOXY COATED IN ACCORDANCE WITH SPEC. 3301
EXISTING SD 95 DITCH
HORIZ.
CENTER BARREL
PRECAST CONCRETE END SECTION
CLASS IV RIPRAP ON GEOTEXTILE FABRIC (TYPE 4)
20' SE LEVEE ROAD
CONTROL POINT STA 1030+00
SOUTHWEST PRINCIPAL SPILLWAY
CLASS III RIPRAP ON GEOTEXTILE FABRIC (TYPE 4)
PILOT CHANNEL
CLASS III RIPRAP ON GEOTEXTILE FABRIC (TYPE 4)
END OF APRON ELEV. 1006.01
PRECAST CONCRETE END SECTION
12' APRON
GRANULAR FILTER
END OF BARREL ELEV. 1006.02
4.84' APPROX. OVERFILL
6'X8' PRECAST CONCRETE BOX CULVERT
FLOW
78' BARREL LENGTH
END OF BARREL ELEV. 1006.10
4.8' APPROX. OVERFILL
5.05' APPROX. OVERFILL
CONTROL POINT EL 1018.20
20' SE LEVEE ROAD
30' PRINCIPAL SPILLWAY
INVERT (IN) ELEV. 1006.10
SOUTHWEST PRINCIPAL SPILLWAY
EXISTING GROUND
CLASS III RIPRAP ON GEOTEXTILE FABRIC (TYPE 4)
SOUTHWEST OUTLET - SD 95
ELEVATION VIEW

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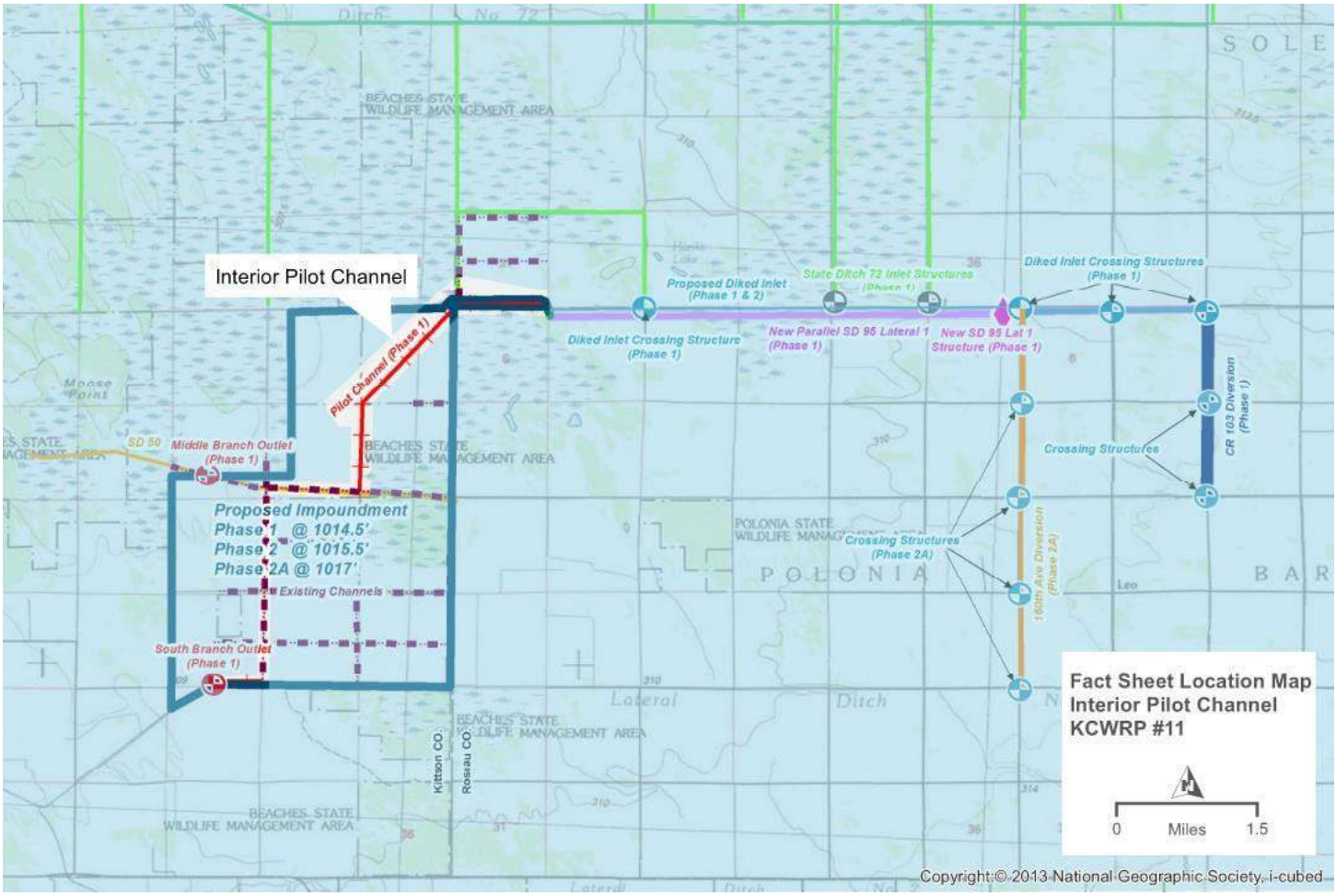
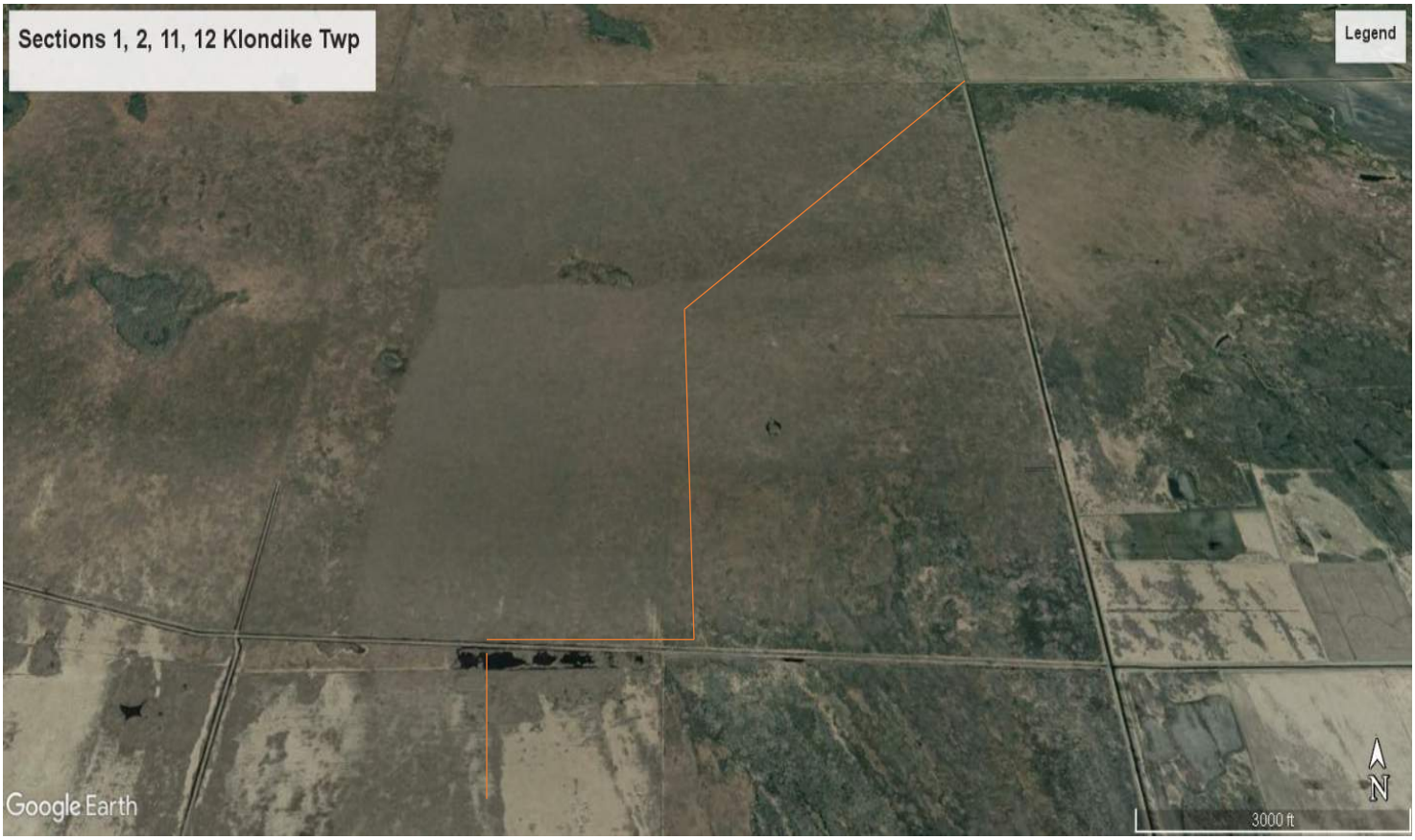
Interior Pilot Channel

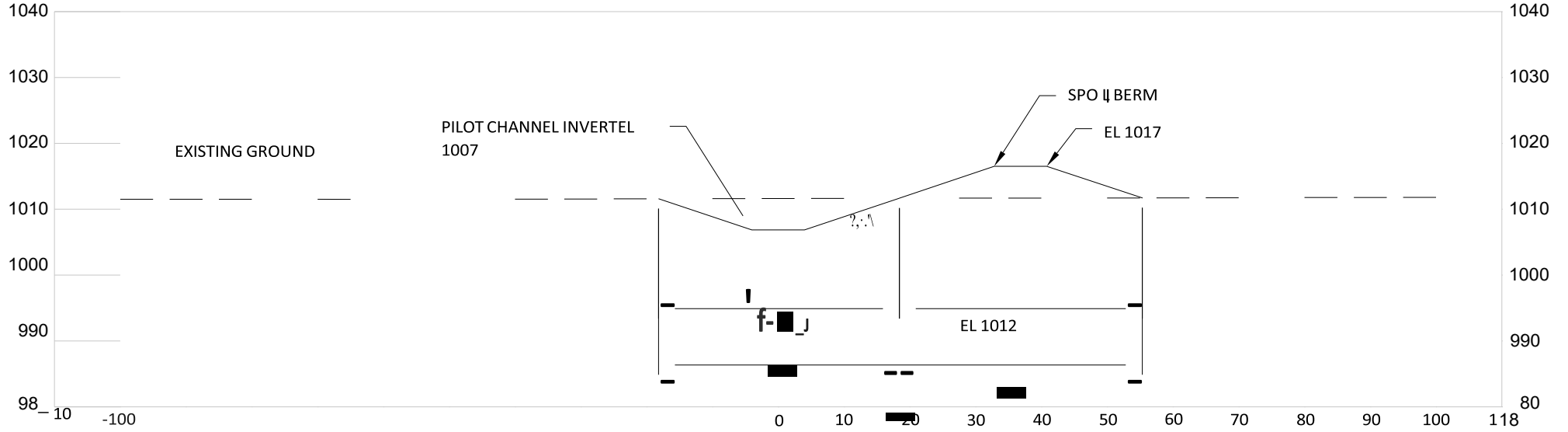
To operate the Project, including filling and drawdown, a pilot channel is required that connects the two outlet structures with the retention areas and the Diked Inlet. Much of the retention area was previously farmed and has drainage to either SD 50 or SD 95 Lat 1. The new pilot channel will utilize portions of these existing ditches. A newly excavated channel will connect with the existing SD 95 Lat 1 and convey inflows to the retention area to the north of 280th St at one mile east of the Roseau-Kittson County line (Section 31, June Berry Township). This new channel will cross over the county line on the interior of the retention site and continue to the southwest towards SD 50.




Sections 1, 2, 11, 12 Klondike Twp
Legend
Google Earth
N
3000 ft

KCWRP #11
PILOT CHANNEL
N-T-S

420+00



Two Rivers Watershed District
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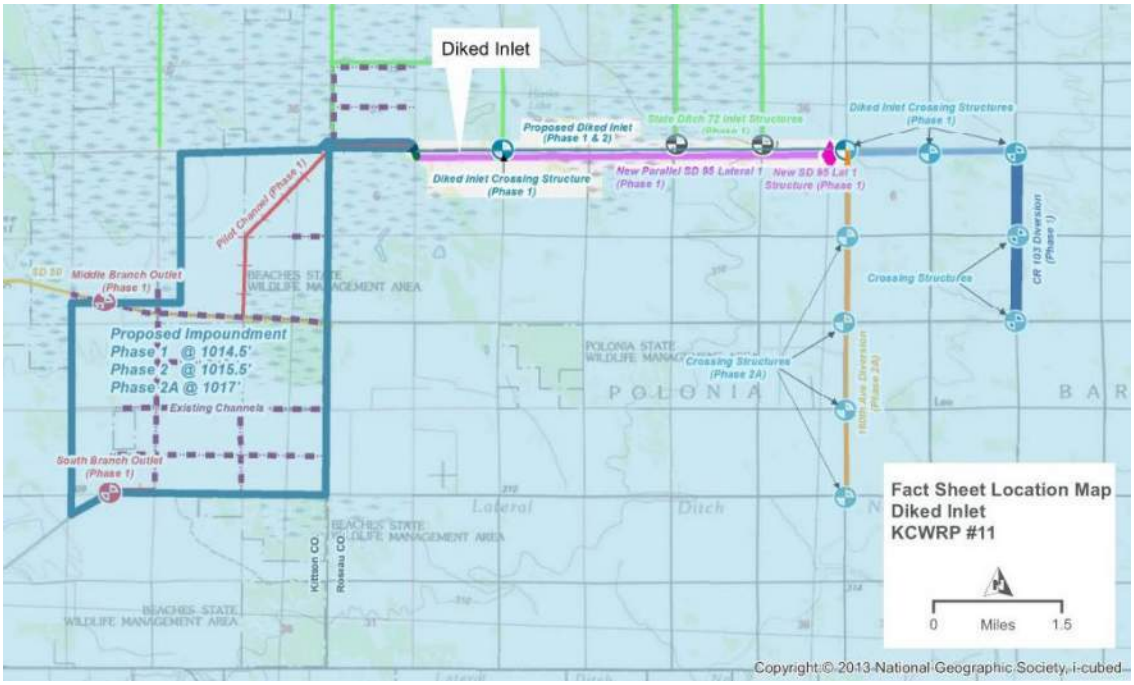
Diked Inlet
(On SD 95 Lat 1)

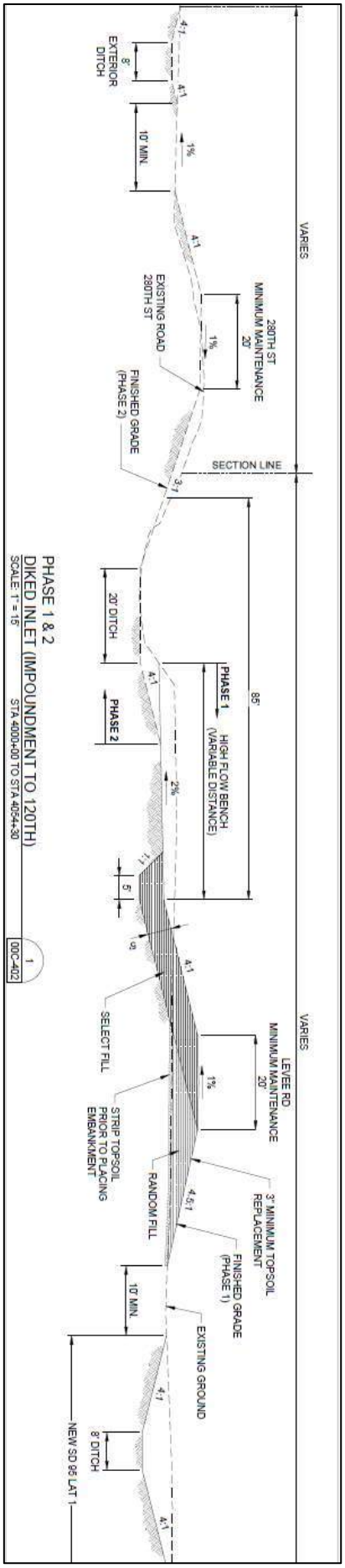
The Diked Inlet is an extension of the Retention Area. It has a two-stage channel design that utilizes the existing SD 95 Lat 1 for low flows.

The SD 95 Lat 1 in Roseau County has a drainage area that extends east to the former Badger Creek. TRWD owns and operates the Ross # 7 project at the upstream portion of the drainage area. The existing SD 95 Lat 1 has a positive grade going east to west of approximately 1 foot per mile (0.02%). It also passes through a higher ridge in the vicinity of 120th Ave. The natural ground has even less elevation change from east to west. West of 120th Ave, the topography falls and remains very flat between 1011 and 1012 feet.

The topography in the Project area has only 1 foot of elevation difference per mile. Hydraulically, for the Diked Inlet to convey flows from upstream during a flood event, the water surface elevation must rise on the upstream end of the channel and create a positive energy grade going east to west. When this happens naturally with the existing ditch system in place, the water surface rises until it is no longer contained within the banks of SD 95 Lat 1 and it inundates the surrounding lands. By constructing an embankment along the south side of SD 95 Lat 1 with continuous protection from the upstream end of the Project all the way to the retention area, the Diked Inlet can convey these flood events without water breaking out and inundating the lands adjacent to the Project.

The current legal ditch has capacity for less than a 10-year rainfall. The landowners along SD 95 Lat 1 petitioned for improvement of the ditch up to a 10-year capacity, but the petition was denied due to an inadequate outlet. The existing SD 95 Lat 1 can convey flows below natural ground up to a 2-year, 24-hour event as the low flow portion of the Diked Inlet. Events greater than a 2-year, 24-hour will be conveyed above ground in the high flow channel created by 280th St and the Diked Inlet embankment.




PHASE 1 & 2
DIKED INLET (IMPOUNDMENT TO 120TH)
SCALE: 1" = 15'
STA 4000+00 TO STA 4054+30
1
000-402
8' EXTERIOR DITCH
4:1
10' MIN.
1%
VARIES
EXISTING ROAD 280TH ST
280TH ST MINIMUM MAINTENANCE 20'
FINISHED GRADE (PHASE 2)
SECTION LINE
3:1
20' DITCH
PHASE 1
PHASE 2
85'
HIGH FLOW BENCH (VARIABLE DISTANCE)
2%
1:1
5'
SELECT FILL
STRIP TOPSOIL PRIOR TO PLACING EMBANKMENT
LEVEE RD MINIMUM MAINTENANCE 20'
RANDOM FILL
4.5:1
3" MINIMUM TOPSOIL REPLACEMENT
FINISHED GRADE (PHASE 1)
EXISTING GROUND
NEW SD 96 LAT 1
8' DITCH

Lat1 SD95 - Looking East
Kittson Co. foreground & Roseau Co. Background - Peatland Twp section 36 in lower left

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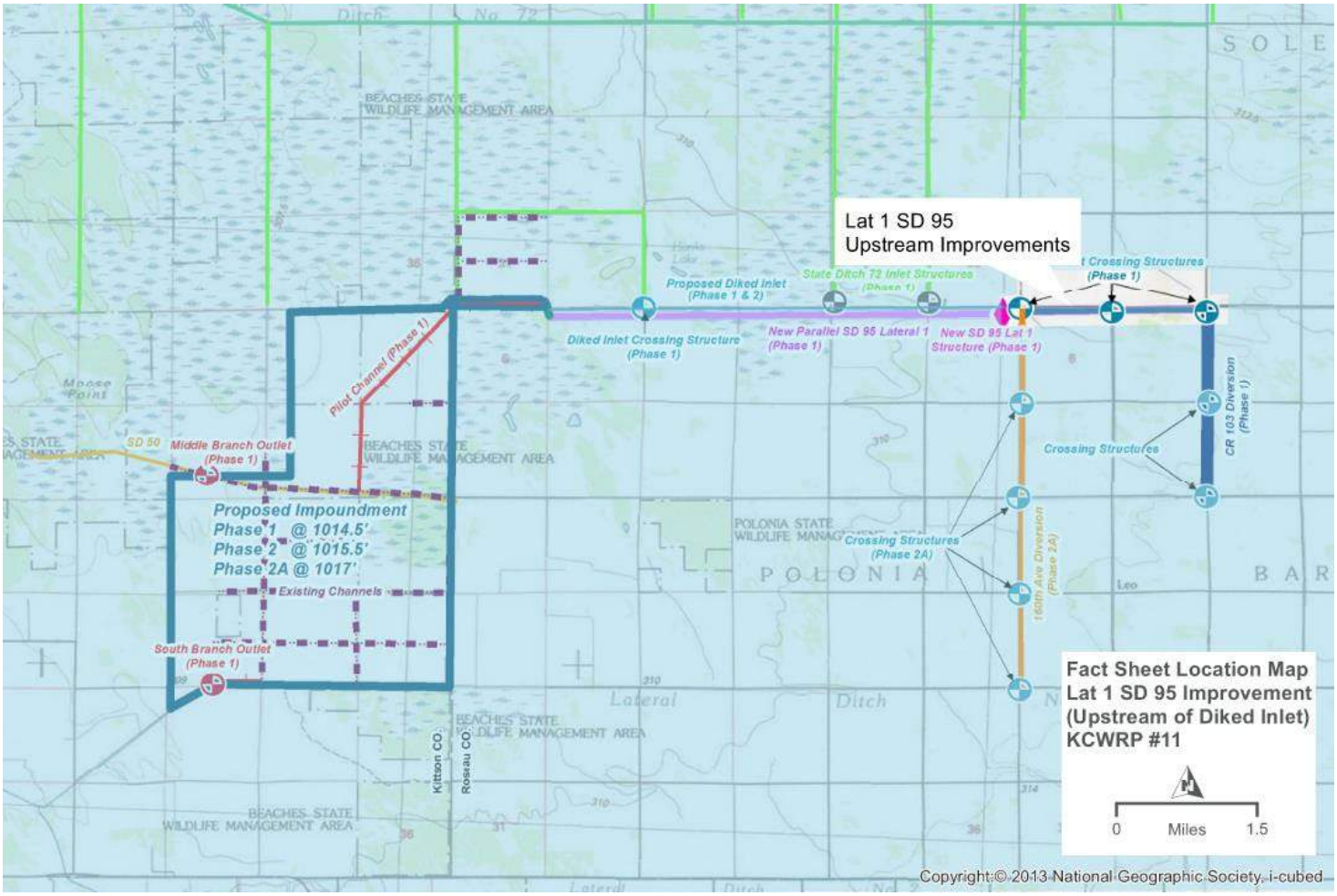
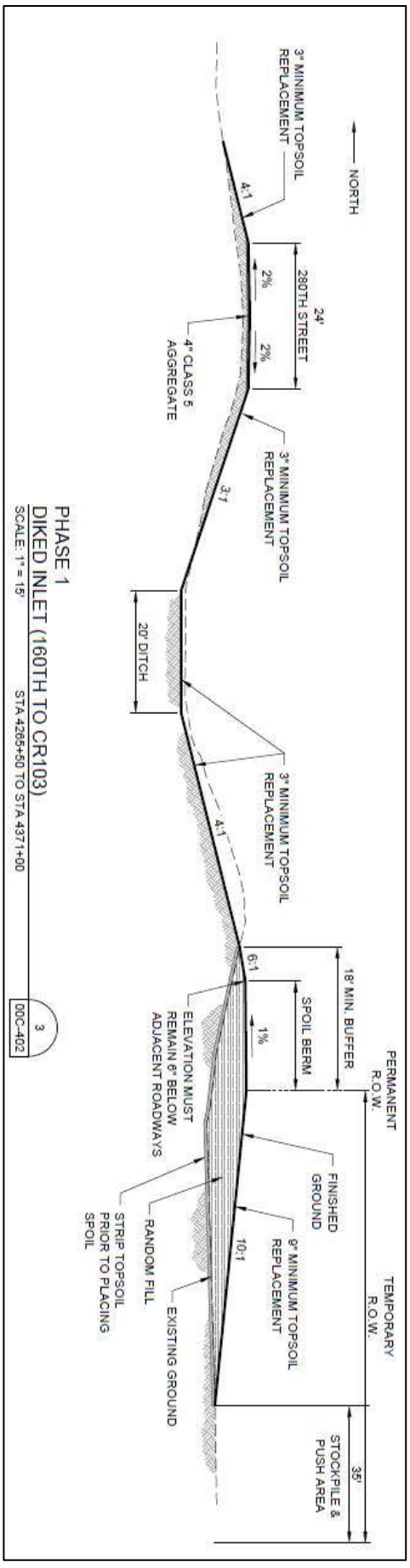
Lat 1 SD 95 Upstream Improvements

The Diked Inlet as an extension of the Retention Area extends only as far as 160th Ave (six miles east of the Roseau Kittson county line). From 160th Ave to CR 103 the existing SD 95 Lat 1 has inconsistent bottom widths and grades. This two-mile section of Lat 1 SD 95 will be improved in Phase 1.

In Phase 1, with a consistent 20' bottom width, 4:1 side slope (field side), and greater than .03% grade, the channel will convey the 50-year, 24-hour event from both upstream drainage areas (Lateral 1 and CR 103 diversion). The existing road side slope is 2.5:1 which appears unstable, due to the slope failures observed during survey. Phase 3 would further expand this channel to a 35' bottom width, which would have capacity to carry the 100-year, 10-day event from SD 95 Lat 1 (1,400 cfs).




NORTH
3" MINIMUM TOPSOIL REPLACEMENT
4:1
2%
24'
280TH STREET
2%
4" CLASS 5 AGGREGATE
3" MINIMUM TOPSOIL REPLACEMENT
3:1
20' DITCH
3" MINIMUM TOPSOIL REPLACEMENT
4:1
6:1
18' MIN. BUFFER
SPOIL BERM
1%
PERMANENT R.O.W.
TEMPORARY R.O.W.
ELEVATION MUST REMAIN 6" BELOW ADJACENT ROADWAYS
FINISHED GROUND
9" MINIMUM TOPSOIL REPLACEMENT
10:1
STRIP TOPSOIL PRIOR TO PLACING SPOIL
RANDOM FILL
EXISTING GROUND
35'
STOCKPILE & PUSH AREA
PHASE 1
DIKED INLET (160TH TO CR103)
SCALE: 1" = 15'
STA 4265+50 TO STA 4371+00
3
DDC-402

Looking south – Section 6 Barto Twp Roseau Co. Lat1 SD95 in foreground

Two Rivers Watershed District
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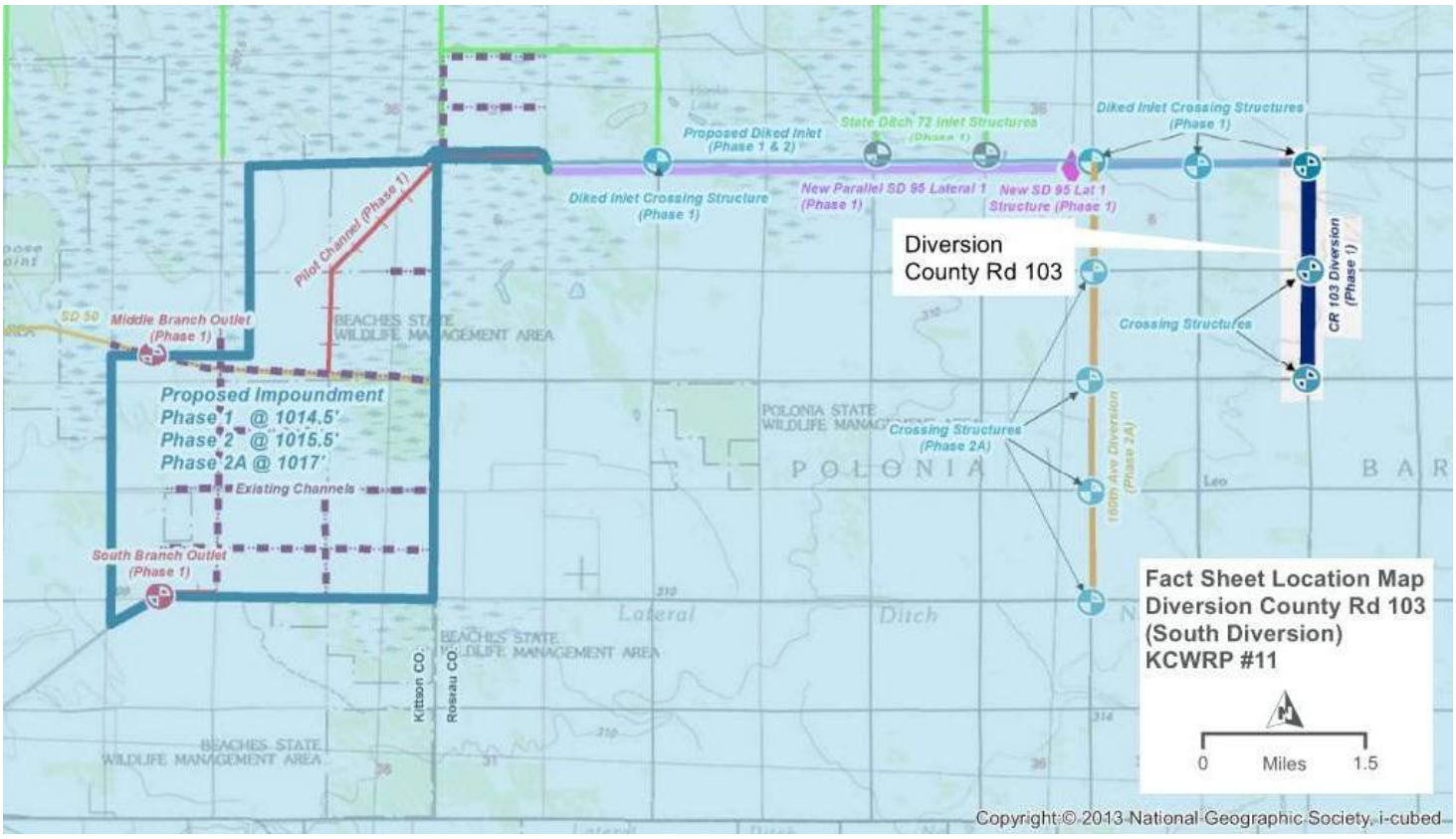
Diversion County Road 103

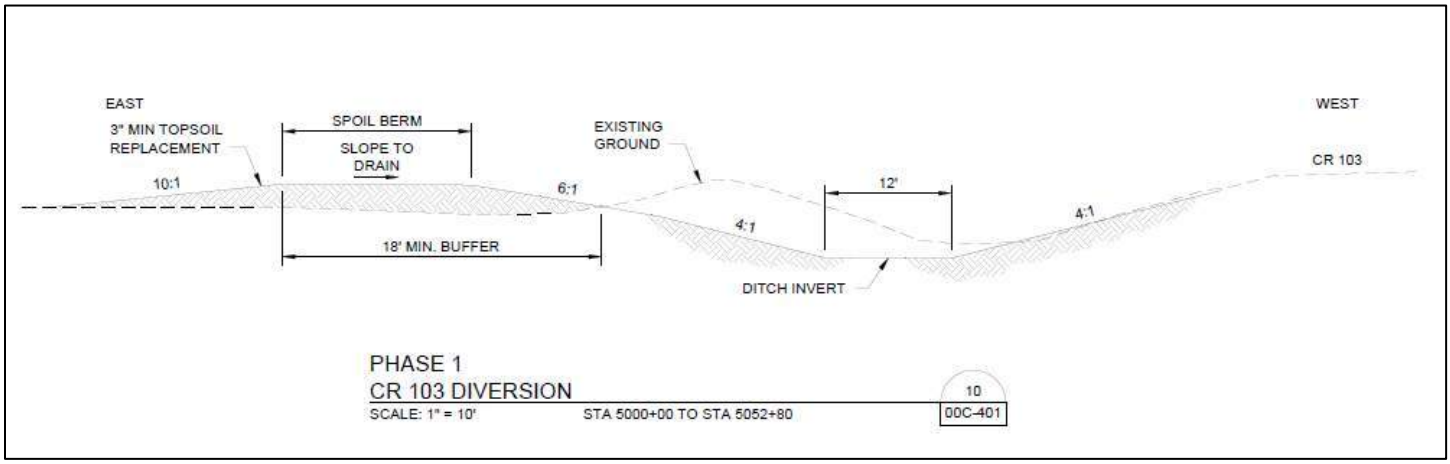
A new channel that will divert flows out of SD 95 Lat 1 Br 3 to the north and into the Diked Inlet will be constructed along the east side of County Road 103 (CR 103).

The existing ditch is only about 2 feet below natural ground along CR 103, and less than 5 feet below the edge of the road. The bottom width is 3 to 8 feet. There is a berm on the field side of the ditch when it gets near SD 95 Lat 1. Otherwise, the land to the east is unprotected from breakouts.

This diversion is planned for Phase 1 and designed for a 50-year capacity. The drainage area for Br 3 Lat 1 SD 95 at this diversion is 14.7 square miles. The diversion will pick up an additional 2.75 square miles of drainage area before reaching SD 95 Lat 1, which normally reaches SD 95 Lat 1 by going under CR 103 and across private lands.

The diversion inlet culverts are proposed to be higher than the existing ditch. Therefore, a 2-year, 24-hour runoff event will bypass this diversion through the existing culvert in Br 3 Lat 1 SD 95. Flap gates on the north end (diversion outlet) will prevent flows from leaving SD 95 Lat 1 and keep flows from entering the Diked Inlet when water levels reach elevations higher than the CR 103 Diversion. This design will keep post-project flooding conditions the same or better than the existing condition.





Looking south at Roseau Co Rd 103. Section 4 Barto Twp on left; Section 5 Barto Twp on right

Two Rivers Watershed District
Klondike Clean Water Retention Project #11
Fact Sheet – 10/1/22

Exterior Drainage for Lat 1 SD 95
"New SD 95 Lat 1"

To maintain exterior drainage during operation of the KCWRP #11, a new channel must be constructed to the south of the Diked Inlet. This new channel connects to the existing SD 95 Lat 1 at a point one mile east of the Roseau-Kittson county line and runs parallel to the Diked Inlet / Existing SD 95 Lat 1 until 160th Ave. This new channel is designed to convey local drainage and portions of the SD 95 Lat 1 drainage that exceeds either the Diked Inlet's flow capacity or the Impoundment's storage capacity. This criterion also creates the need for a gated structure at the upstream end of the channel. The existing ditch bottom elevation in SD 95 Lat 1 at 160th Ave is 1014.0' which equals the maximum impoundment pool elevation in Phase 1. Natural ground near 160th Ave and SD 95 Lat 1 is approximately 1020.0'. Phase 2 has a maximum impoundment pool elevation of 1015.5'. Therefore, the invert elevation for the gated structure into the new parallel SD 95 Lat 1 will be 1015.5' at the upstream end to allow for the phase 2 full pool to be contained and allow excess inflows to be bypassed above 1015.5'.

Existing Conditions

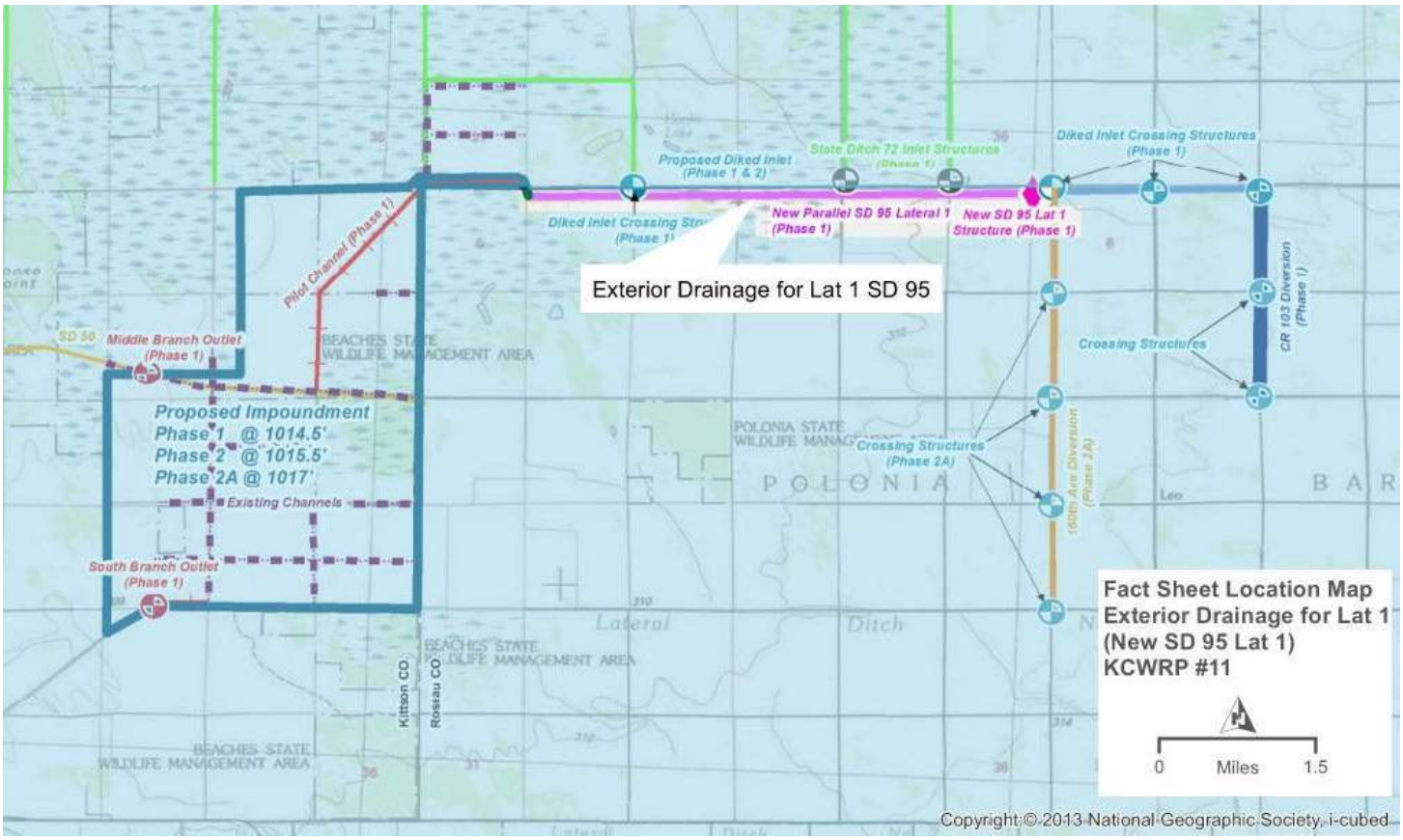
This will be new excavation. Natural ground at the westernmost (downstream) point of the new channel is at elevation 1013, and the existing SD 95 Lat 1 at this point is 1008'. However, just under a half-mile to the east, there is a ridge that begins and reaches an elevation of 1017.6 near 120th Ave. The drainage area west of 120th Ave is 1.7 square miles. The eastside of the ridge then falls back down to below elevation 1016 at a point approximately two miles east of the downstream end. This point has a 2-square-mile drainage area that will be entirely conveyed by the new channel. There is only one road that will be intersected with this new channel (120th Ave), but there are existing dikes and existing spoil berm that currently serve as an access for ATVs or foot traffic. Some land is used for pasture and is enclosed by a fence. Several culverts exist that convey runoff into SD 95 Lat 1 from the south. These drainage areas will be summarized below and will provide the design flows for this new channel.

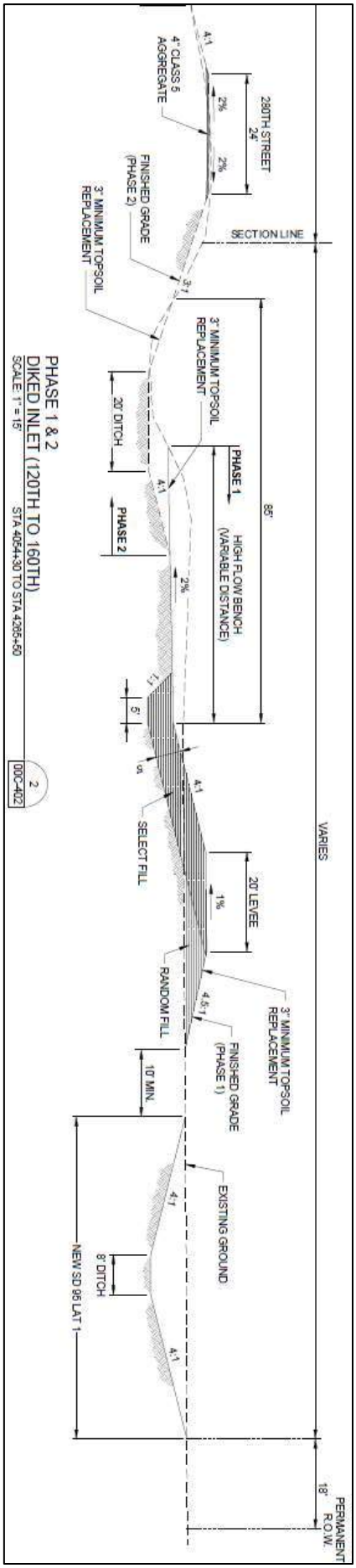
Location	10-Year Peak Flow (cfs)	Sum of upstream peak flows (cfs) (w/bypass +65 cfs)	New Lateral 1 Station (Upstream)
SD 95 Lat 1 near County Line/Impoundment	41.0	144.8 (210)	510+80
3 miles east of county line (130th Ave)	48.8	103.8 (169)	564+00
Between 160th Ave and Huseby ditch outlet	32.9	55 (120)	669+00
Ditch on east side of 160th Ave	22.1		
Upstream drainage area for SD 95 Lat 1	573.9 (controlled by Diked Inlet)		

New SD 95 Lat 1 Design

Summing the peak flows would give a conservative estimate of a 10-year event peak flow, equaling 144.8 cfs, assuming the Diked Inlet is available to convey all upstream flows. In the KCWRP outlet sizing models, which assume a full impoundment and subsequent probable maximum precipitation event, the Diked Inlet bypasses some flows through the inlet structure and into this new channel. That peak flow is approximately 65 cfs. The design of this new channel will include this extra capacity, which is above the standard 10-year capacity for agricultural drainage. Obviously, during a probable maximum precipitation event, there will be excess runoff that uses this channel; however, the local areas will still have better drainage than existing conditions would allow. Ditch inverts were chosen to accommodate the existing side inlet pipes.

Sta Start	Sta End	Bottom Width (ft)	Grade (%)	Min depth (ft)	Start Elev	End Elev	Design Capacity (cfs)
400+00	458+00	8	.02	5.5	1008.4	1009.5	210
458+00	510+80	8	.02	5.5	1009.5	1010.5	210
510+80	564+00	8	.02	5	1010.5	1011.5	169
564+00	617+50	8	.03	4	1011.5	1013.25	124
617+50	669+00	8	.03	4	1013.25	1015.0	124




4:1
4" CLASS 5 AGGREGATE
2%
2%
280TH STREET 24'
FINISHED GRADE (PHASE 2)
3" MINIMUM TOPSOIL REPLACEMENT
3:1
SECTION LINE
3" MINIMUM TOPSOIL REPLACEMENT
20' DITCH
PHASE 1
PHASE 2
4:1
85'
HIGH FLOW BENCH (VARIABLE DISTANCE)
2%
1:1
5'
4:1
SELECT FILL
20' LEVEE
1%
RANDOM FILL
4.5:1
3" MINIMUM TOPSOIL REPLACEMENT
FINISHED GRADE (PHASE 1)
10' MIN.
EXISTING GROUND
4:1
8' DITCH
NEW SD 95 LAT 1
4:1
VARIES
18'
PERMANENT R.O.W.
PHASE 1 & 2
DIKED INLET (120TH TO 160TH)
SCALE: 1" = 15'
STA 4054+30 TO STA 4265+50
2
DDC-402

Lat1 SD95 at Roseau County Road 103 – looking west
The ‘New’ 95 will be located on the south (left in this photo) side of the existing ditch

Appendix B

Caribou Twp.
Cannon Twp.
Kittson
Roseau
Soler Twp.
Polonia Twp.
Percy Twp.
Diked Inlet
Klondike Impoundment
CR103 Diversion
Roseau River
Two Rivers River
Ditch 69 Grade
Soler 4
JD 33 Northerly Flow
JD 31
JD 31 Br
JD 32 Lat 4
SD 72
SD 72 Lat 9
SD 72 Lat 10
SD 72 Lat 7
SD 72 Lat 5
SD 72 Lat 3
SD 72 Lat 2
SD 72 Lat 1
SD 72 Lat 4
SD 72 Lat 8
SD 72 Lat 6
SD 72 Lat 11
SD 72 Lat 12
SD 72 Lat 13
SD 72 Lat 14
SD 95 Lat 1
SD 95 Lat 1 Br 1
SD 95 Lat 1 Br 2
SD 95 Lat 1 Br 3
SD 95 Lat 1 Br 4
SD 95 Lat 1 Br 5
SD 50
UT-1
UT-3
UT-4
UT-5
UT-6
UT-13
UT-31
T-74
T-224
T-316
T-349
T-36
T-446
T-505
T-65
KCD 11
KCD 15
KCD 18
KCD 23
350th St
340th St
330th St
320th St
310th St
300th St
290th St
280th St
270th St
260th St
250th St
240th St
230th St
415th Ave
440th Ave
430th Ave
420th Ave
410th Ave
400th Ave
450th Ave
231st St
120th Ave
110th Ave
130th Ave
140th Ave
150th Ave
160th Ave
170th Ave
180th Ave
190th Ave
200th Ave
210th Ave
240th Ave
Camel Back Rd
County 4
County 7
County 10
County 24
County 25
County 54
County 60
County 26
County 103
County 101
County 102
County 23
County 2

N

SD72 Benefit Area
State Ditch 50
Ditches
MN_Counties
City
Township
Sections

SD72 Benefits
Joint Ditch Authority of Roseau and Kittson Counties

Scale:	Drawn by:	Checked by:	Project No :	Date:	Sheet:
AS SHOWN	ESN	ESJ	6279-0009	10/3/2023	1 of 1

HOUSTON engineering, inc.

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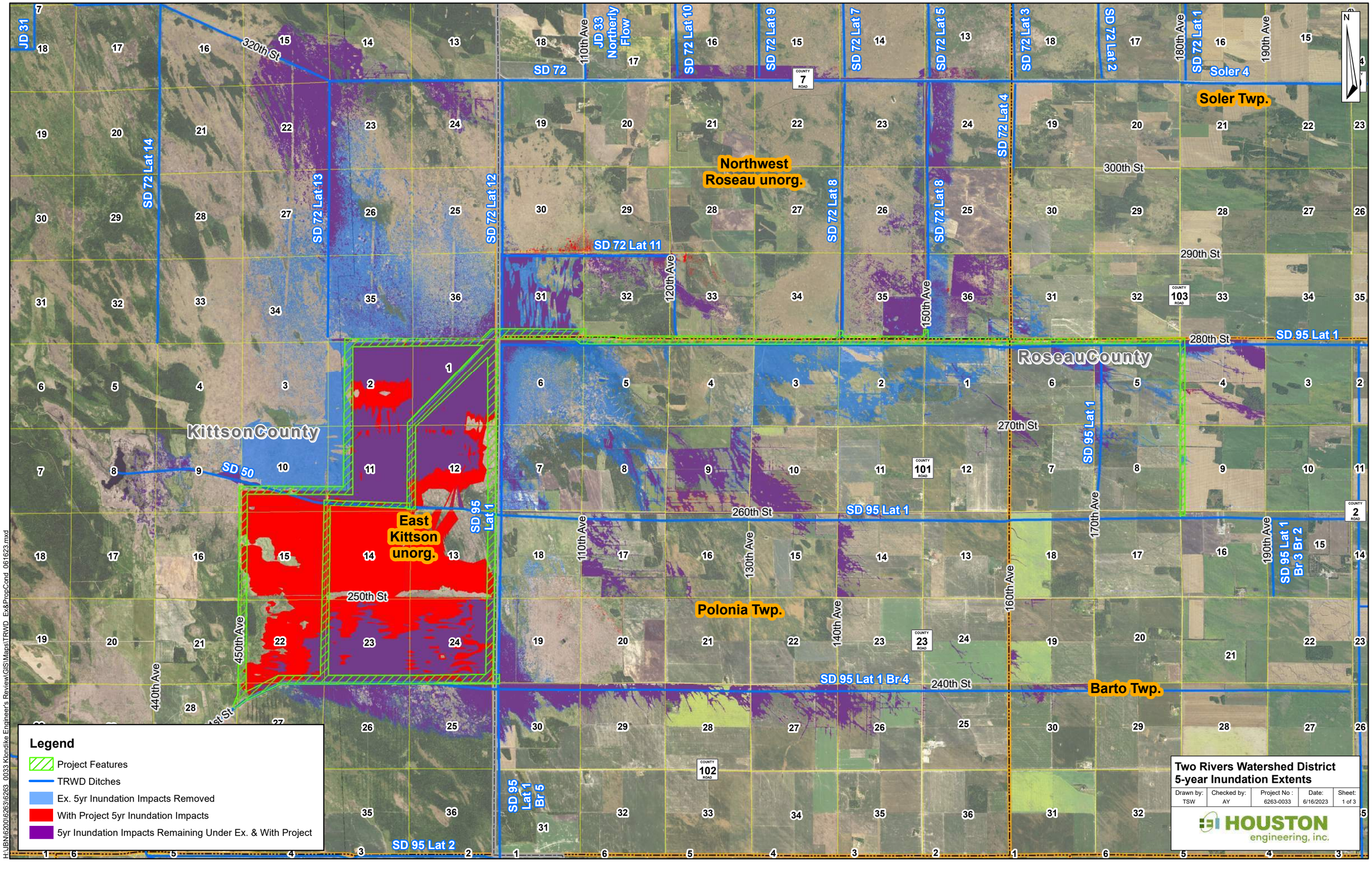
Appendix C



Legend

- Project Features
- TRWD Ditches
- Ex. 5yr Inundation Impacts Removed
- With Project 5yr Inundation Impacts
- 5yr Inundation Impacts Remaining Under Ex. & With Project

Two Rivers Watershed District
5-year Inundation Extents

Drawn by:	Checked by:	Project No :	Date:	Sheet:
TSW	AY	6263-0033	6/16/2023	1 of 3

HOUSTON engineering, inc.

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JD 31
320th St
SD 72
110th Ave
JD 33 Northerly Flow
SD 72 Lat 10
SD 72 Lat 9
SD 72 Lat 7
SD 72 Lat 5
SD 72 Lat 3
SD 72 Lat 2
180th Ave
SD 72 Lat 1
190th Ave
Soler 4
Soler Twp.
SD 72 Lat 14
SD 72 Lat 13
SD 72 Lat 12
Northwest Roseau unorg.
SD 72 Lat 8
SD 72 Lat 4
300th St
SD 72 Lat 11
120th Ave
150th Ave
290th St
280th St
SD 95 Lat 1
RoseauCounty
270th St
SD 95 Lat 1
KittsonCounty
SD 50
East Kittson unorg.
SD 95 Lat 1
260th St
SD 95 Lat 1
110th Ave
130th Ave
170th Ave
190th Ave
SD 95 Lat 1 Br 3 Br 2
250th St
Polonia Twp.
160th Ave
140th Ave
450th Ave
440th Ave
SD 95 Lat 1 Br 4
240th St
Barto Twp.
SD 95 Lat 1 Br 5
SD 95 Lat 2

COUNTY 7 ROAD
COUNTY 103 ROAD
COUNTY 101 ROAD
COUNTY 2 ROAD
COUNTY 23 ROAD
COUNTY 102 ROAD

N

Legend

- Project Features
- TRWD Ditches
- Ex. 10yr Inundation Impacts Removed
- With Project 10yr Inundation Impacts
- 10yr Inundation Impacts Remaining Under Ex. & With Project

Two Rivers Watershed District
10-year Inundation Extents

Drawn by:	Checked by:	Project No :	Date:	Sheet:
TSW	AY	6263-0033	6/16/2023	2 of 3

HOUSTON engineering, inc.

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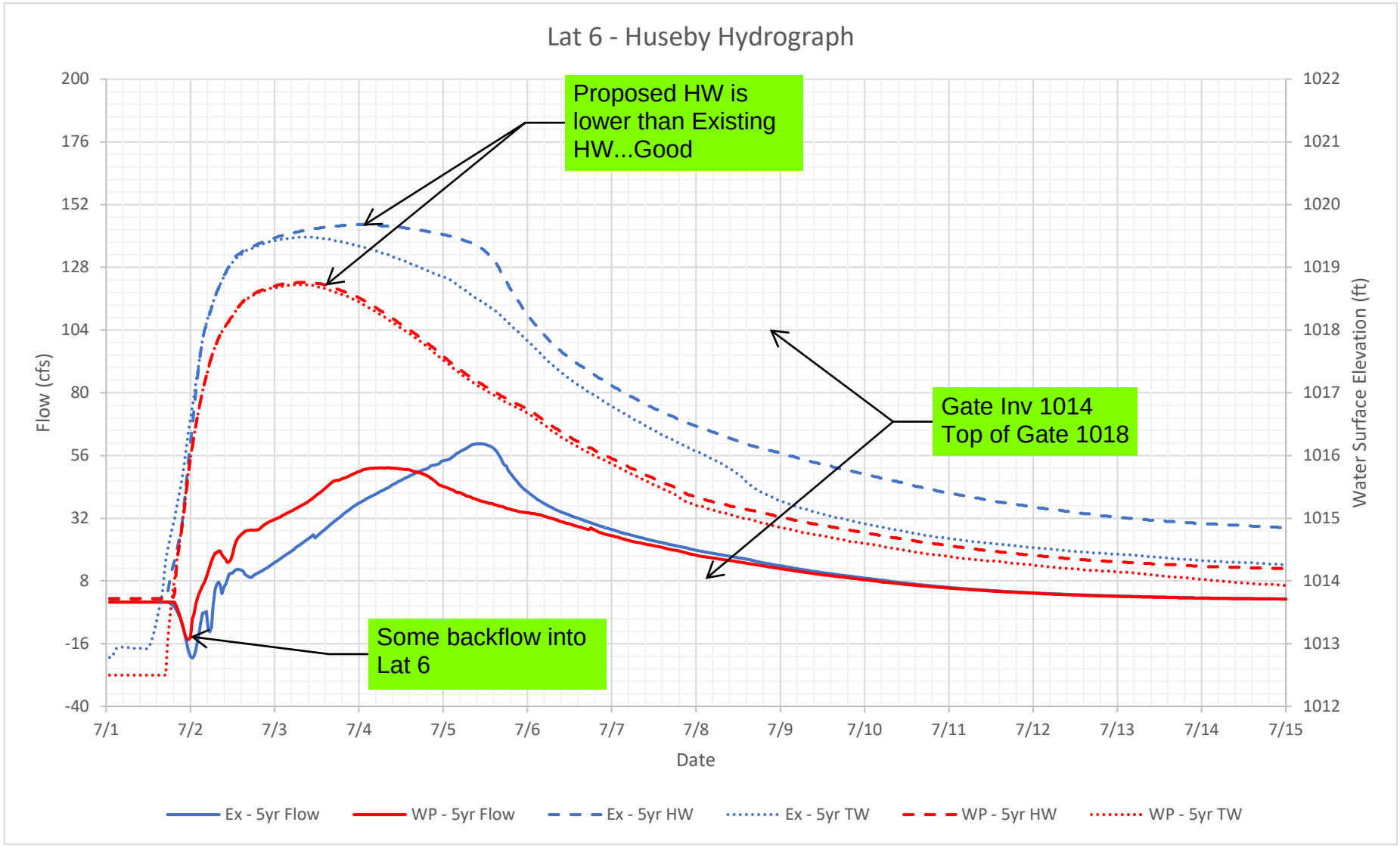
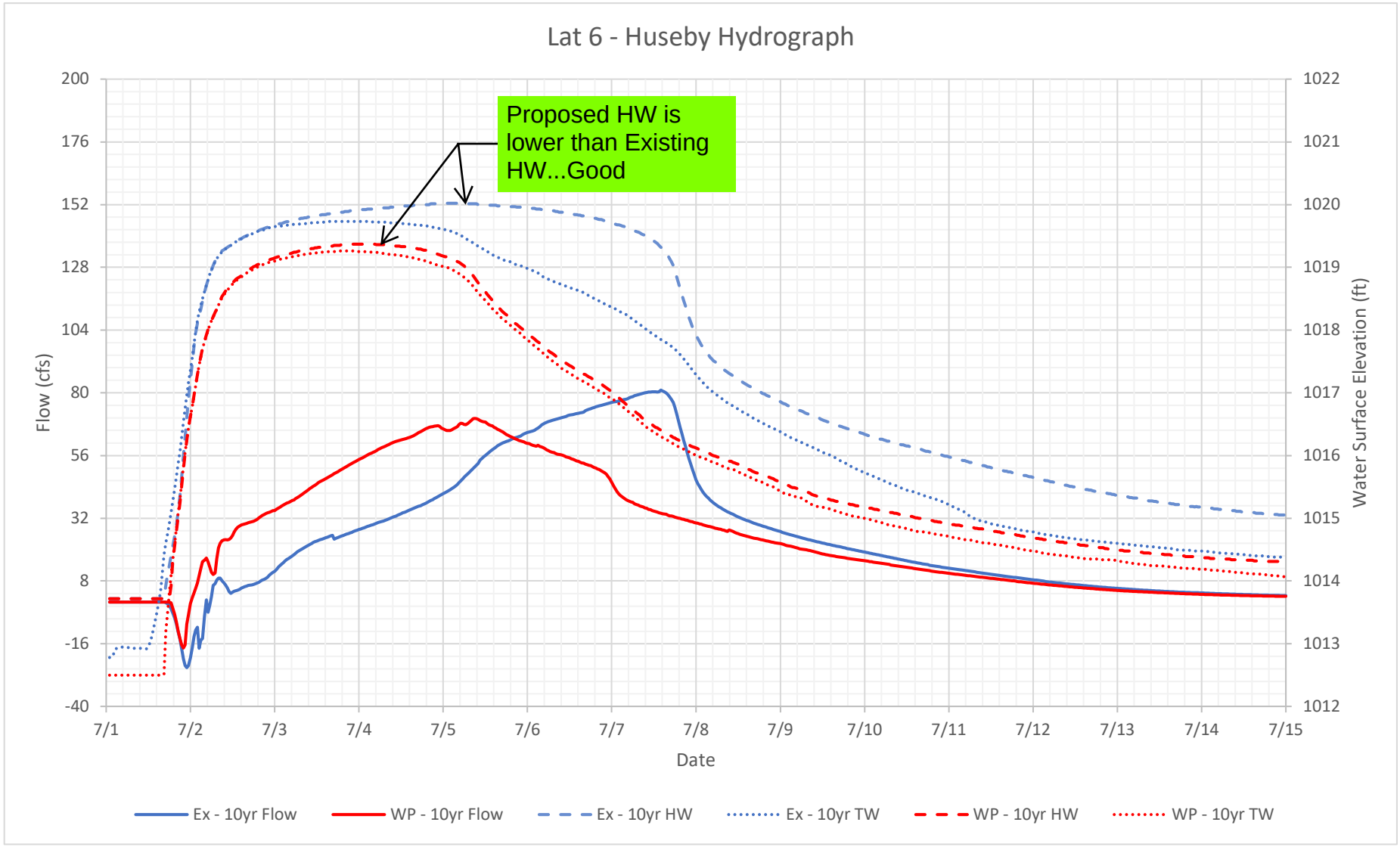
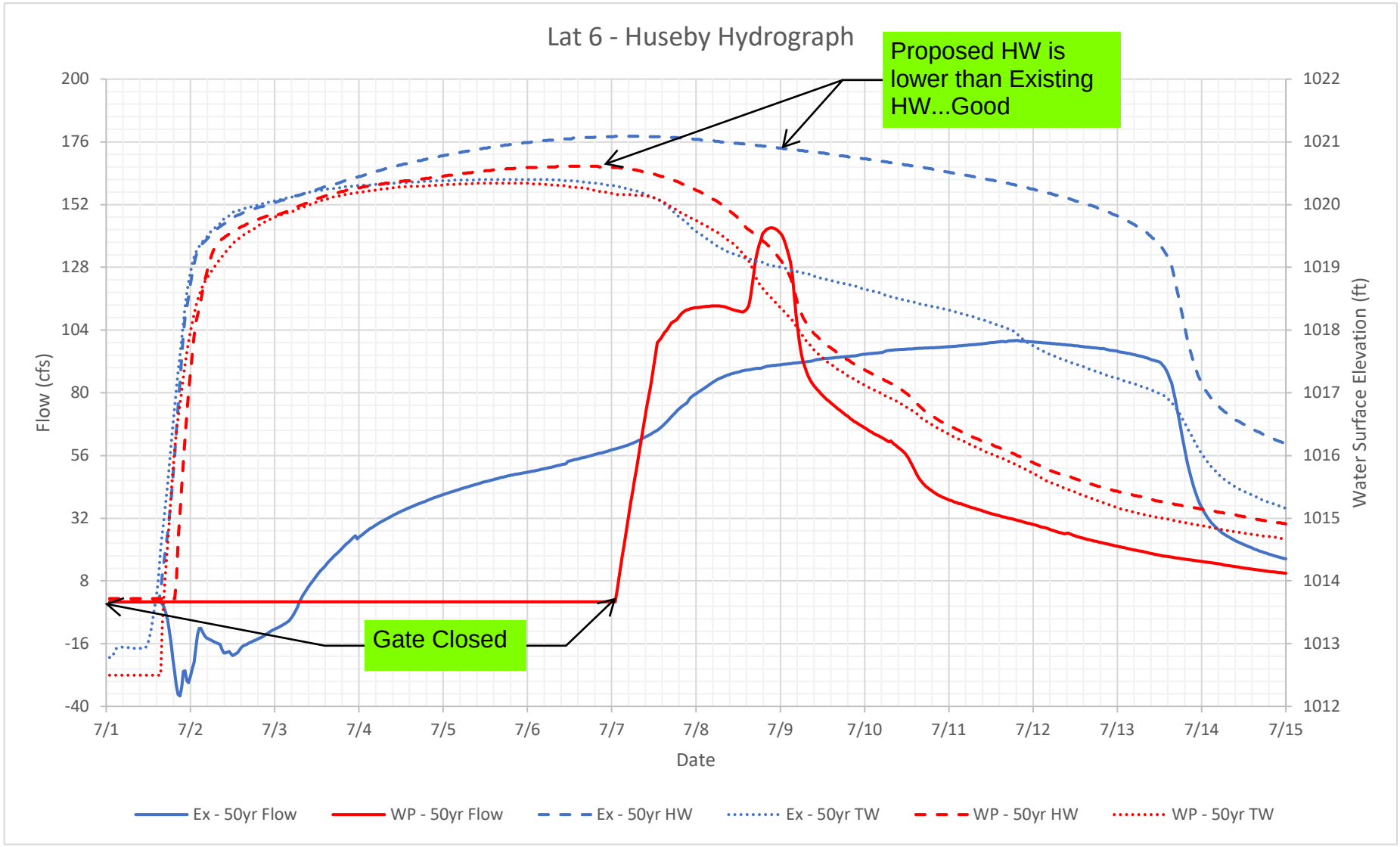
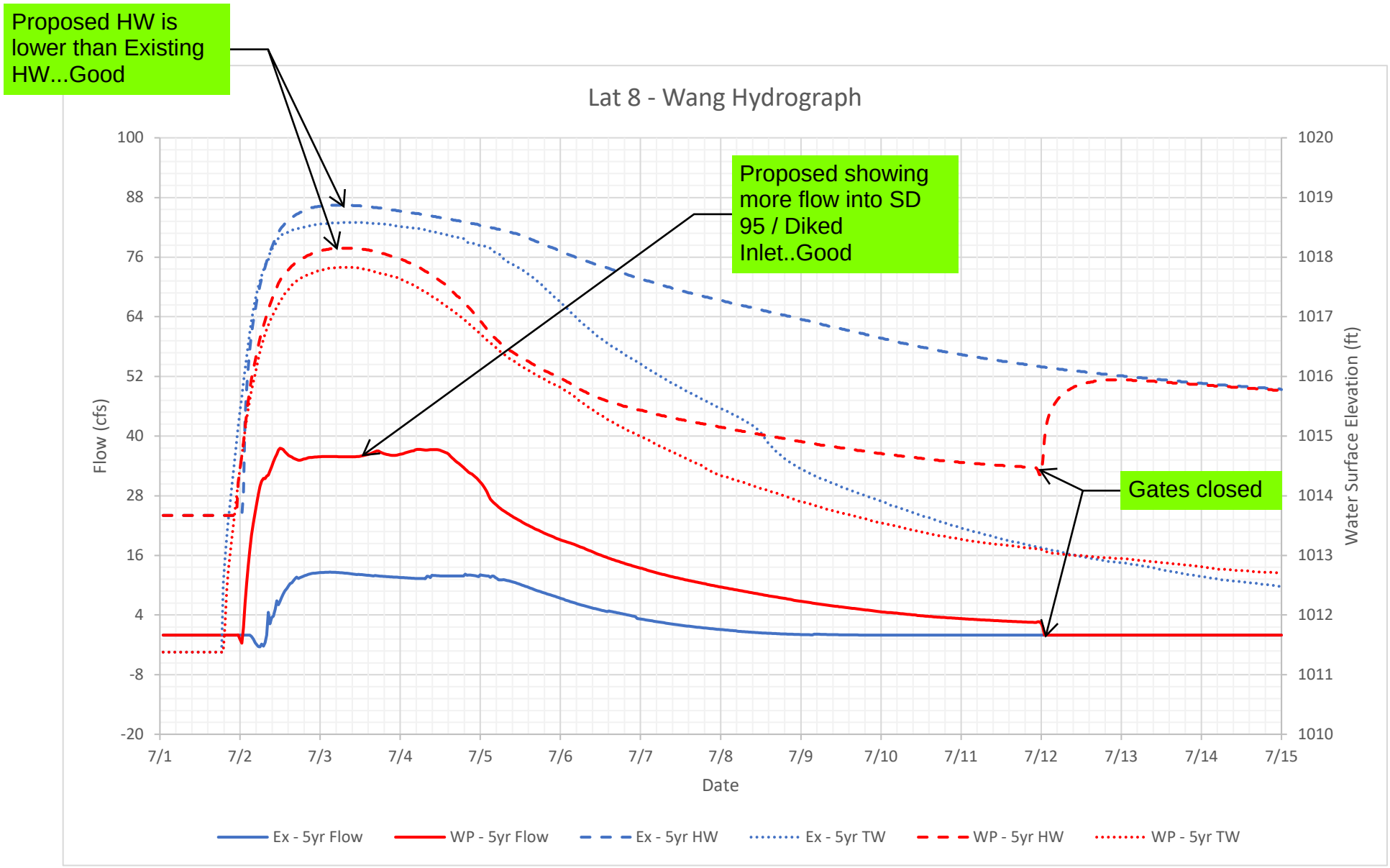
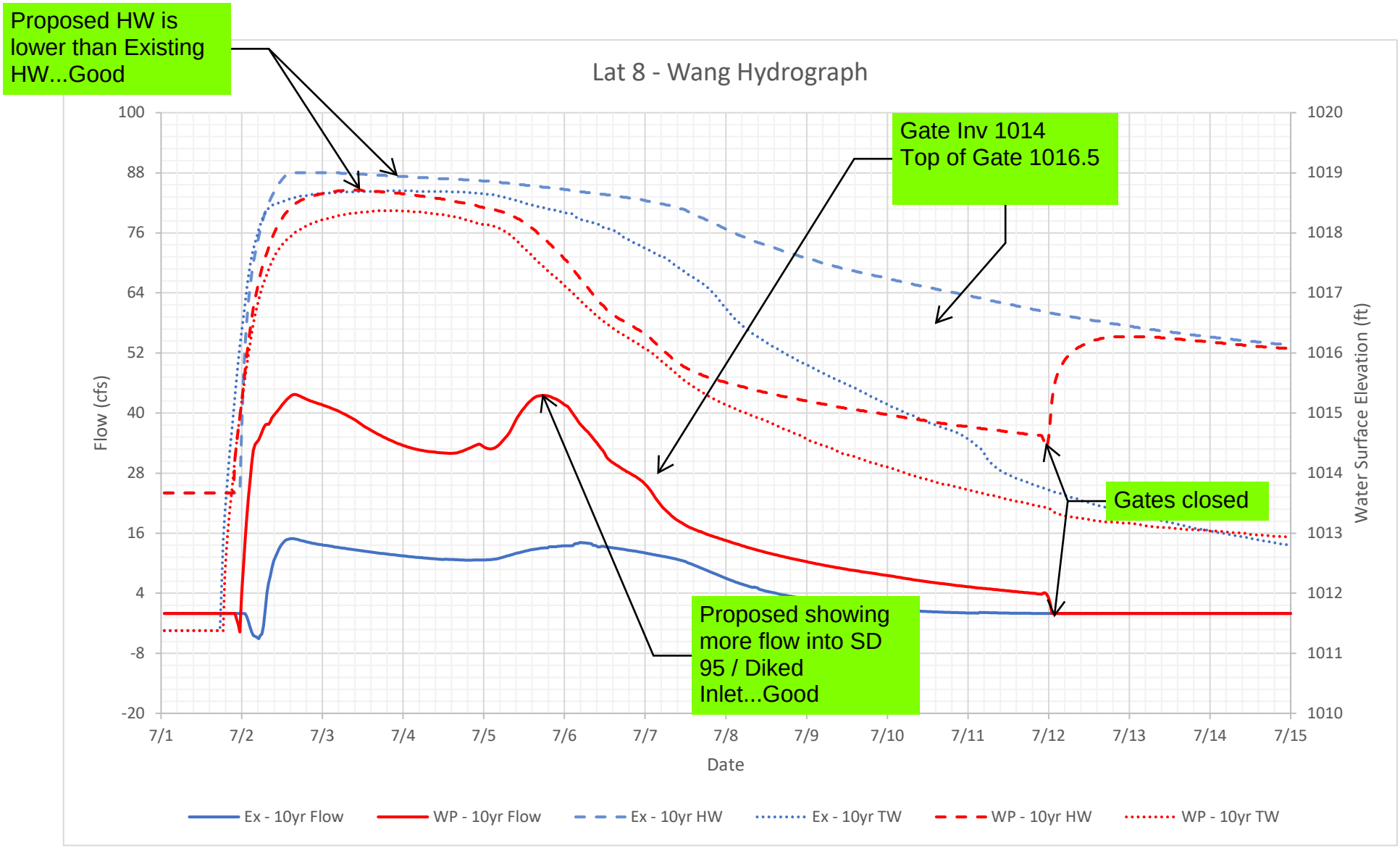
Appendix D

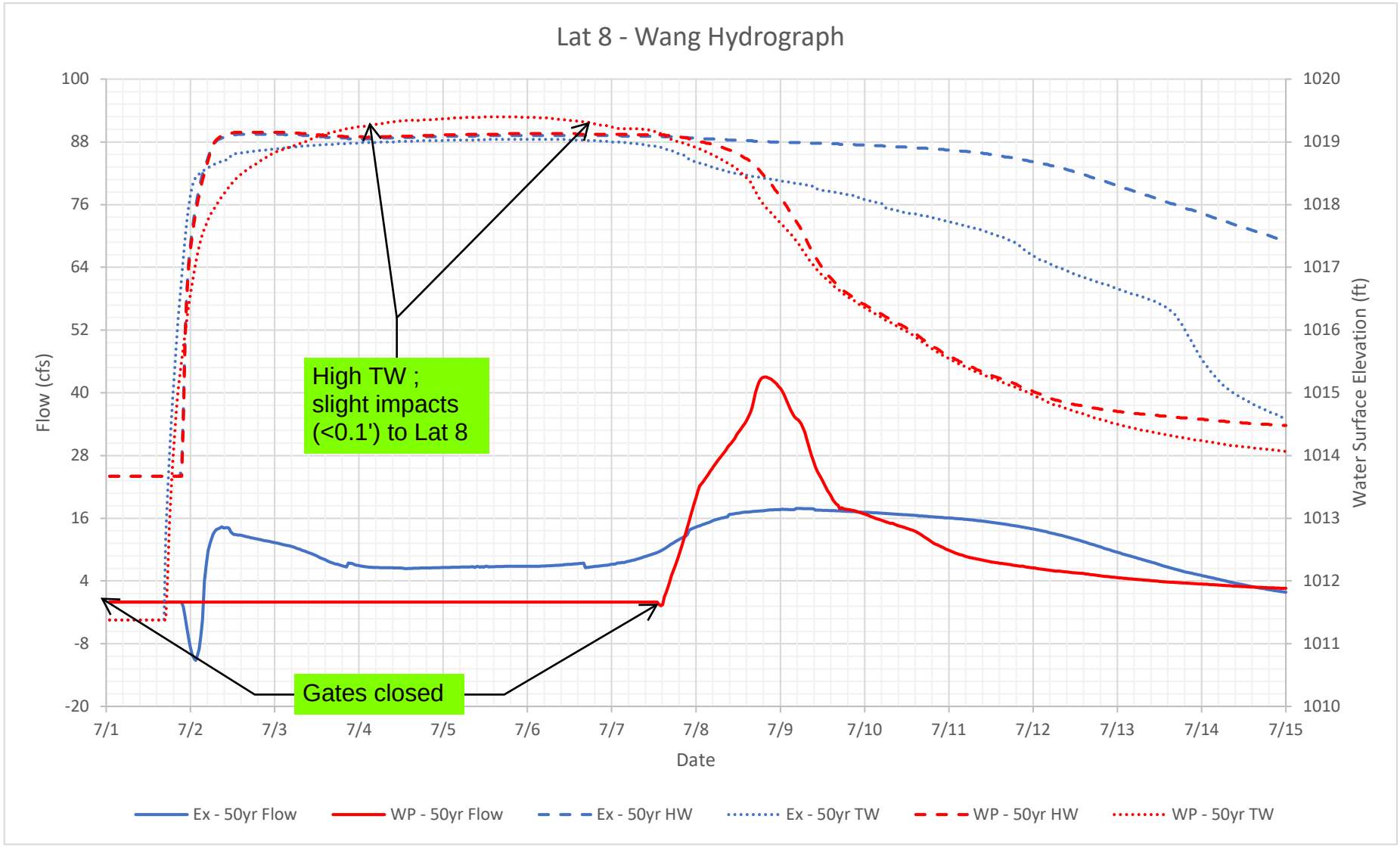

Lat 6 - Huseby Hydrograph
Proposed HW is lower than Existing HW...Good
Gate Inv 1014
Top of Gate 1018
Some backflow into Lat 6
Flow (cfs)
Water Surface Elevation (ft)
Date
200
176
152
128
104
80
56
32
8
-16
-40
1022
1021
1020
1019
1018
1017
1016
1015
1014
1013
1012
7/1
7/2
7/3
7/4
7/5
7/6
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
Ex - 5yr Flow
WP - 5yr Flow
Ex - 5yr HW
Ex - 5yr TW
WP - 5yr HW
WP - 5yr TW


Lat 6 - Huseby Hydrograph
Proposed HW is lower than Existing HW...Good
Flow (cfs)
Water Surface Elevation (ft)
Date
200
176
152
128
104
80
56
32
8
-16
-40
1022
1021
1020
1019
1018
1017
1016
1015
1014
1013
1012
7/1
7/2
7/3
7/4
7/5
7/6
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
Ex - 10yr Flow
WP - 10yr Flow
Ex - 10yr HW
Ex - 10yr TW
WP - 10yr HW
WP - 10yr TW


Lat 6 - Huseby Hydrograph
Proposed HW is lower than Existing HW...Good
Gate Closed
Flow (cfs)
Water Surface Elevation (ft)
Date
200
176
152
128
104
80
56
32
8
-16
-40
1022
1021
1020
1019
1018
1017
1016
1015
1014
1013
1012
7/1
7/2
7/3
7/4
7/5
7/6
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
Ex - 50yr Flow
WP - 50yr Flow
Ex - 50yr HW
Ex - 50yr TW
WP - 50yr HW
WP - 50yr TW

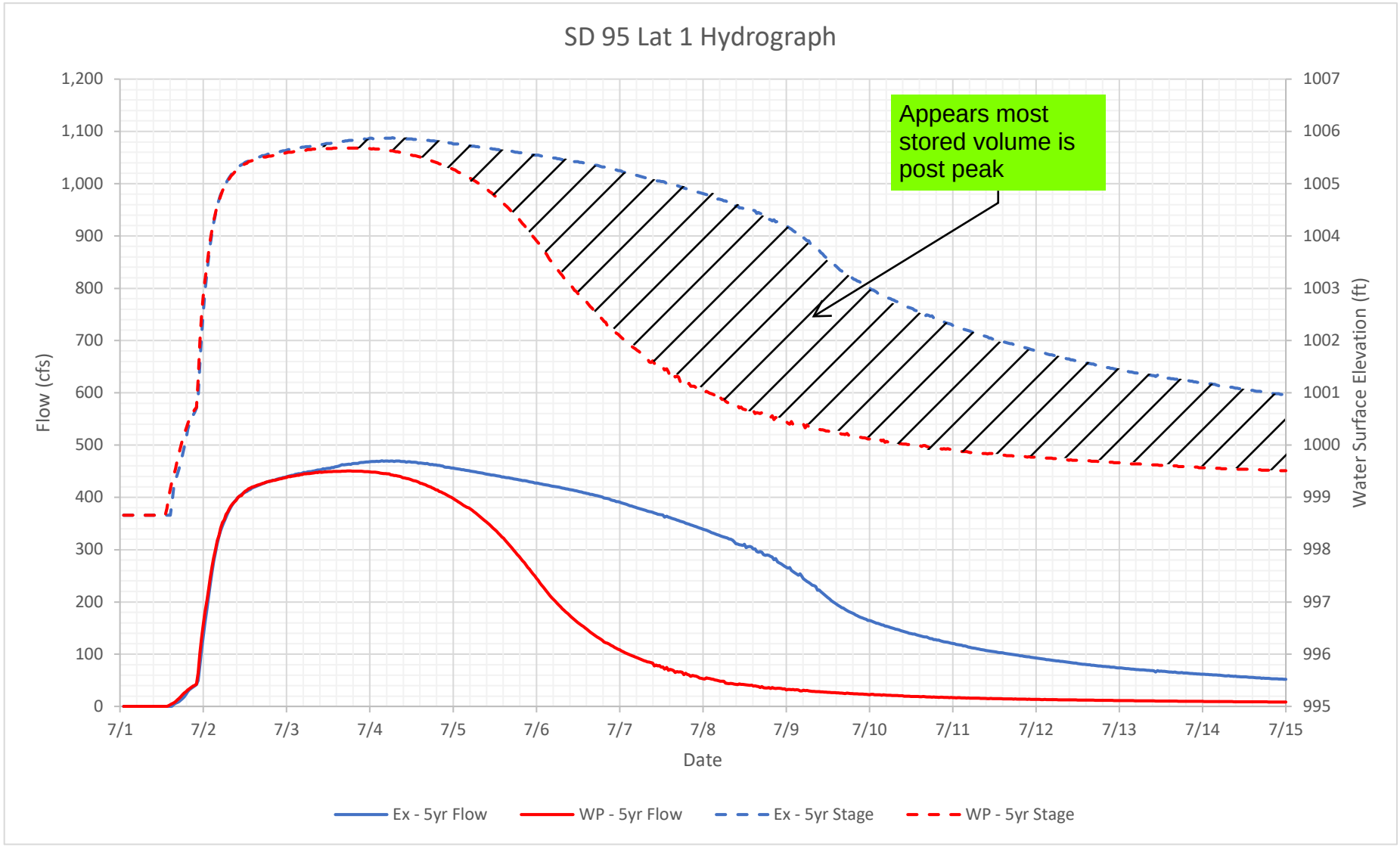

Proposed HW is lower than Existing HW...Good
Lat 8 - Wang Hydrograph
Proposed showing more flow into SD 95 / Diked Inlet..Good
Gates closed
Flow (cfs)
Water Surface Elevation (ft)
Date
100
88
76
64
52
40
28
16
4
-8
-20
1020
1019
1018
1017
1016
1015
1014
1013
1012
1011
1010
7/1
7/2
7/3
7/4
7/5
7/6
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
Ex - 5yr Flow
WP - 5yr Flow
Ex - 5yr HW
Ex - 5yr TW
WP - 5yr HW
WP - 5yr TW


Proposed HW is lower than Existing HW...Good
Lat 8 - Wang Hydrograph
Gate Inv 1014
Top of Gate 1016.5
Gates closed
Proposed showing more flow into SD 95 / Diked Inlet...Good
Flow (cfs)
Water Surface Elevation (ft)
Date
100
88
76
64
52
40
28
16
4
-8
-20
1020
1019
1018
1017
1016
1015
1014
1013
1012
1011
1010
7/1
7/2
7/3
7/4
7/5
7/6
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
Ex - 10yr Flow
WP - 10yr Flow
Ex - 10yr HW
Ex - 10yr TW
WP - 10yr HW
WP - 10yr TW

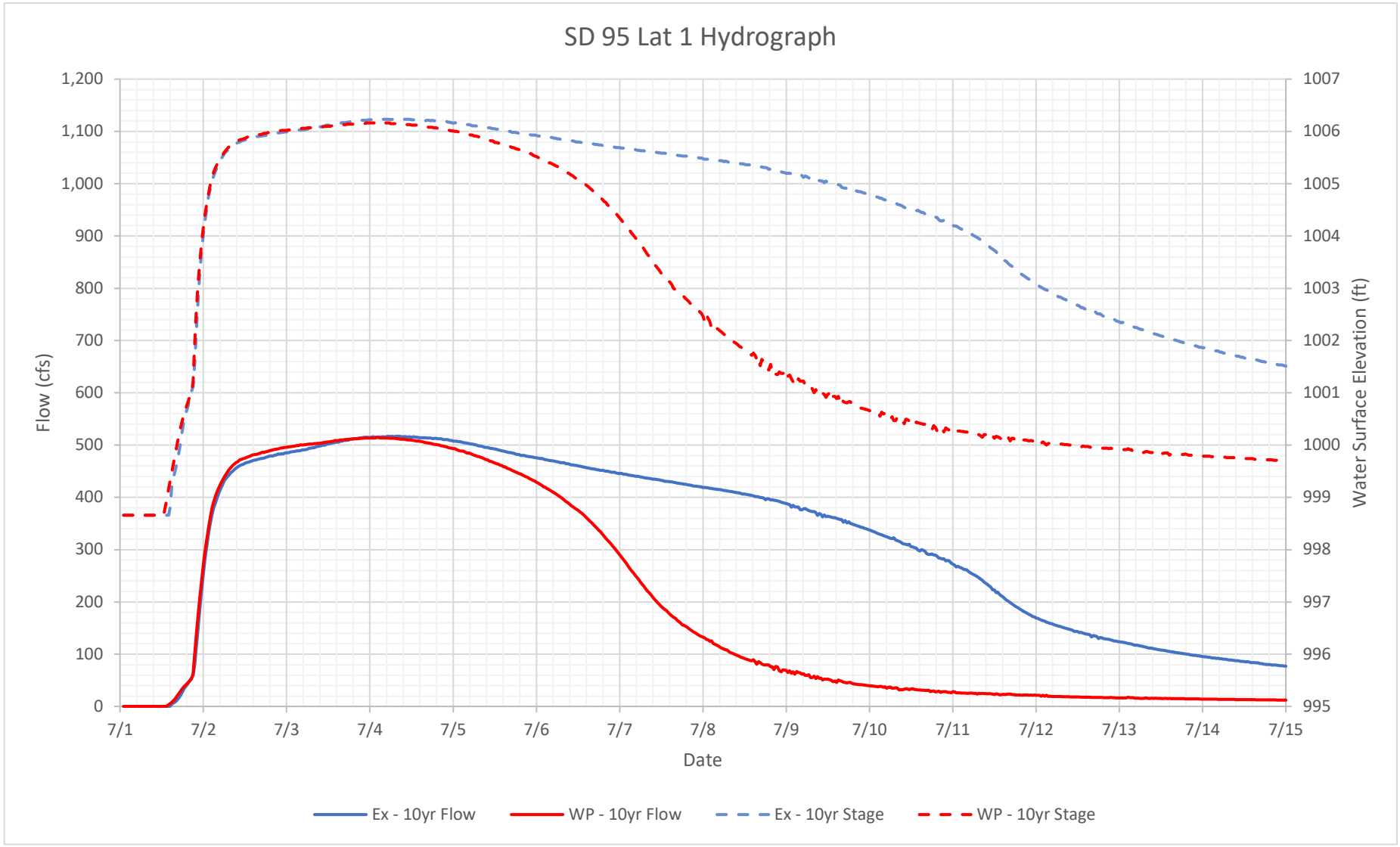

Lat 8 - Wang Hydrograph
Flow (cfs)
Water Surface Elevation (ft)
Date
100
88
76
64
52
40
28
16
4
-8
-20
1020
1019
1018
1017
1016
1015
1014
1013
1012
1011
1010
7/1
7/2
7/3
7/4
7/5
7/6
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
High TW ; slight impacts (<0.1') to Lat 8
Gates closed
Ex - 50yr Flow
WP - 50yr Flow
Ex - 50yr HW
Ex - 50yr TW
WP - 50yr HW
WP - 50yr TW

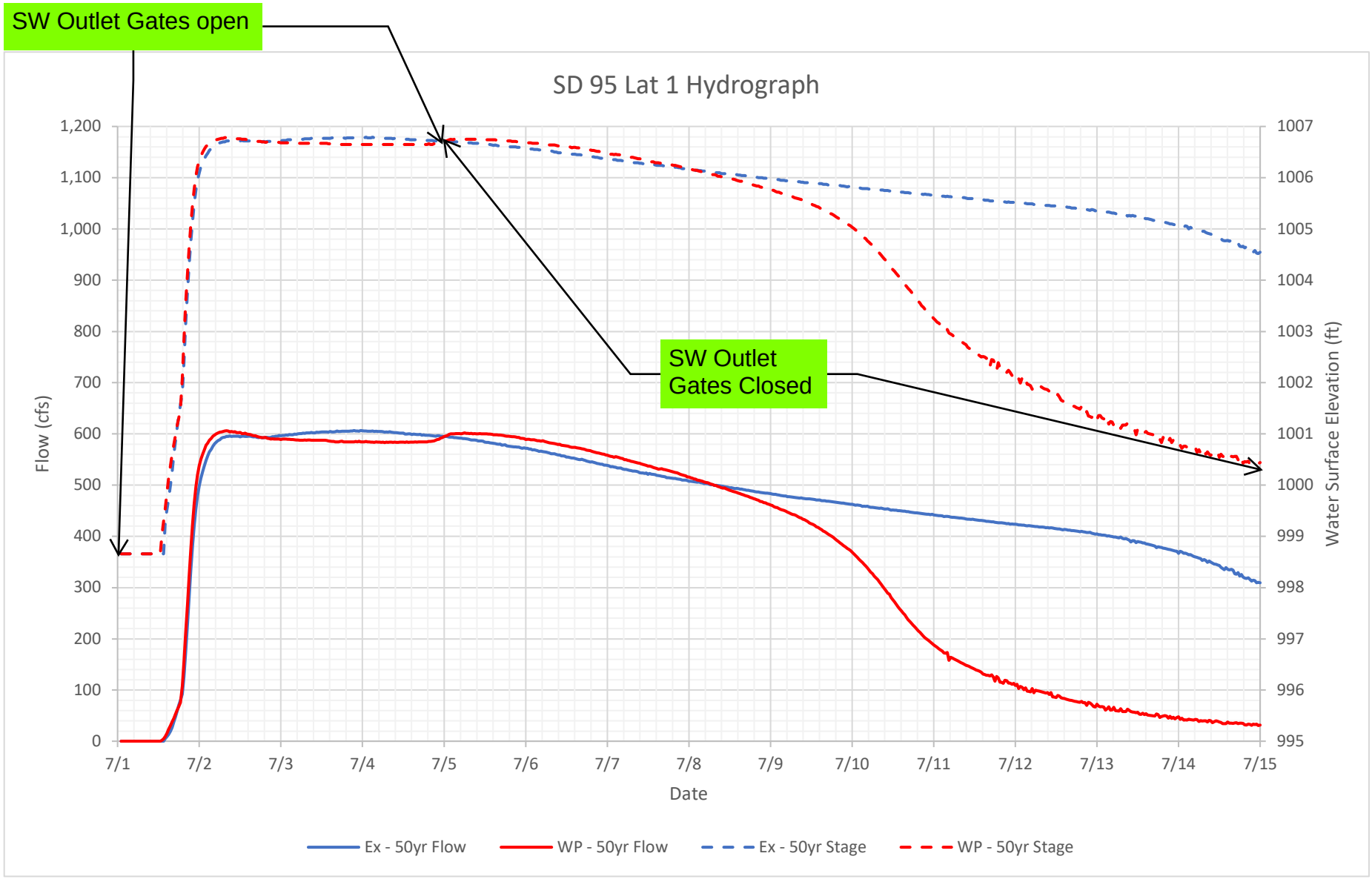
Appendix E

SW Outlet Gates closed for entire simulation



SW Outlet Gates closed for entire simulation




SW Outlet Gates open
SD 95 Lat 1 Hydrograph
SW Outlet Gates Closed
Flow (cfs)
Water Surface Elevation (ft)
Date
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
1007
1006
1005
1004
1003
1002
1001
1000
999
998
997
996
995
7/1
7/2
7/3
7/4
7/5
7/6
7/7
7/8
7/9
7/10
7/11
7/12
7/13
7/14
7/15
Ex - 50yr Flow
WP - 50yr Flow
Ex - 50yr Stage
WP - 50yr Stage