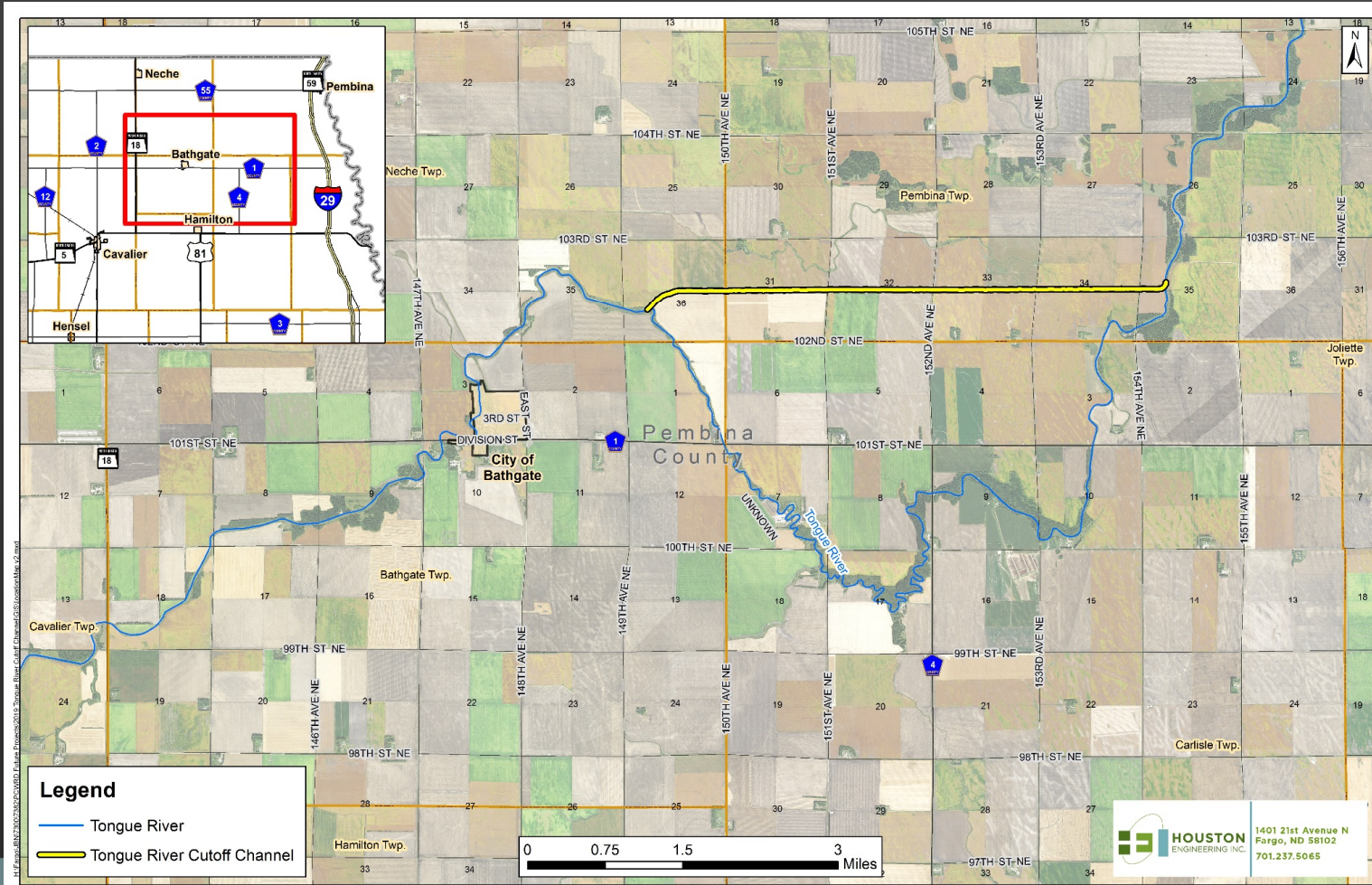


TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS PROJECT UPDATE

DECEMBER 15, 2020
PEMBINA COUNTY COMMISSION
CAVALIER, ND

TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

LOCATION MAP



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PROBLEMS TO ADDRESS



- Long-term geotechnical and structural stability of the cutoff channel
- Too much flow in the historic Tongue River channel downstream of flow split during spring runoff events.
- Not enough low flow in the historic Tongue River channel downstream of flow split during the summer months.

TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PHASE 1 – EXISTING CONDITIONS ASSESSMENT



1.A Field Survey and Site Visit

- Detailed and limited field survey of cutoff channel
- Contact Landowners to get highwater marks
- Site visit to evaluate areas of concern and take photos of the project

1.B Geotechnical Review of Cutoff Channel

- Site reconnaissance and field exploration
- Drill rig mobilization
- Classification and laboratory testing

1.C Structural Review of Concrete Drop Structure

- Review as-built plans of the existing drop structure
- Conduct field visit to evaluate the condition of the existing drop structure
- Upload photos and review data from field visit

1.D Existing Conditions Hydrology and Hydraulics Modeling

- Review existing HEC-HMS and HEC-RAS models for the Tongue River Watershed
- Upgrade, re-project, and truncate existing HEC-RAS model
- Import data into hydraulic model and modify model
- Run calibration simulations and synthetic event simulations

1.E Develop Existing Conditions Plans

- Develop cover sheet and location map
- Develop existing ground surface, alignment and profile from survey
- Create corridor and new surface for as-built channel geometry

1.F As-Built Hydrology and Hydraulics Modeling

- Import as-built cross sections into HEC-RAS model
- Run simulations that were done in task 1.D
- Review changes to water surface profiles from existing to as-built conditions

1.G Existing Conditions Land Rights

- Develop linework in AutoCAD using assumed sections corners and quarter corners
- Coordinate with client to get existing land rights
- Develop existing right-of-way linework in AutoCAD and add to plan sheets

PHASE 1 – EXISTING CONDITIONS ASSESSMENT

TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS



FIELD SURVEY AND SITE VISIT

- Survey data collected in the fall/winter of 2019 and the spring of 2020
- Survey Included
 - Channel cross sections in the historic Tongue River and in the Tongue River Cutoff Channel.
 - Critical elevations of drop structure
 - Elevations of rock weir near flow split
 - Survey of structures along historic Tongue River and Tongue River Cutoff Channel.
- Site visit was done in November of 2019.
 - Evaluated drop structure and flow split location
 - Met with landowners to discuss concerns and highwater marks used for calibration.

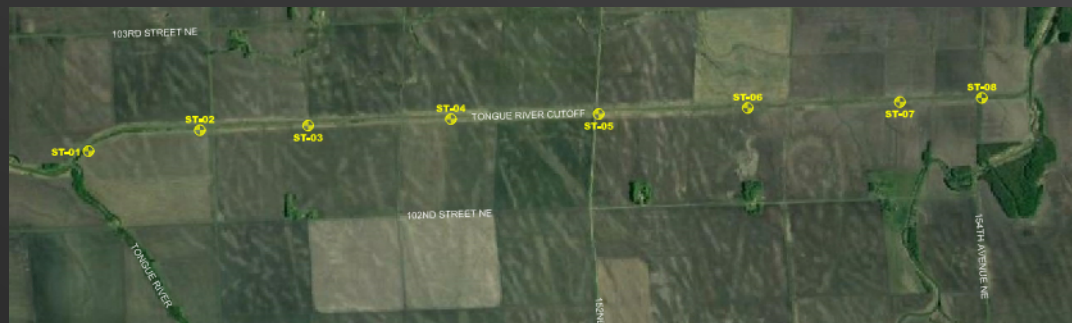


TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

GEOTECHNICAL REVIEW OF CUTOFF CHANNEL



- 8 Soil borings were completed in January of 2020
- Borings were collected with the purpose of performing various laboratory tests on the soils so that recommendations for channel side slopes and constructability could be made.
- 4 different soil types were encountered with the borings including Fill, Topsoil (CL), Alluvial (CL, ML), and Lacustrine (CH)



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

STRUCTURAL REVIEW OF CONCRETE DROP STRUCTURE



- Minor issues with joint separation between side wall and wing walls.
- Various other minor deficiencies noted at the structure.
- Overall, no critical deficiencies were found, and the structure appears to be in adequate condition.



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

HYDROLOGY AND HYDRAULICS



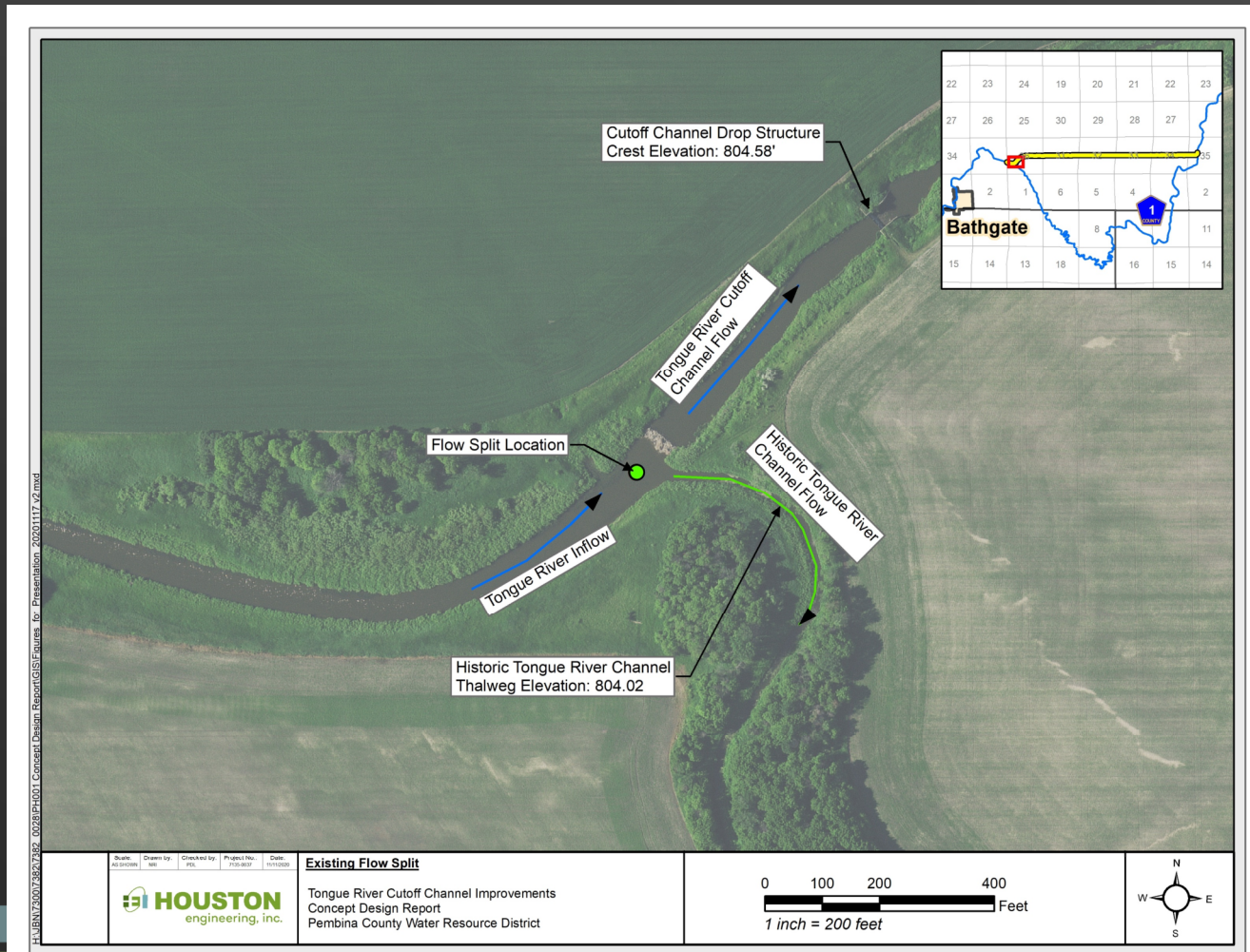
- Hydrology and Hydraulics modeling started from previous work done for Tongue River RCPP and Renwick Dam EAP.
- Survey data collected in the field was implemented into the hydraulic model.
- Calibrated models based on high water marks identified by locals.
- Used 4-day, NOAA Atlas 14 rainfall depths for 2-, 5-, 10-, 25-, 50- and 100-year rainfall events.

Return Period	NOAA Atlas 14 4-Day Rainfall Depth (Inches)	HEC-HMS 4-Day Rainfall Depth* (Inches)
2-Year	2.86	2.71
5-Year	3.54	3.35
10-Year	4.15	3.93
25-Year	5.04	4.77
50-Year	5.78	5.47
100-Year	6.55	6.20

* Average rainfall depth adjusted for areal reduction based on watershed size of 280.5 square miles

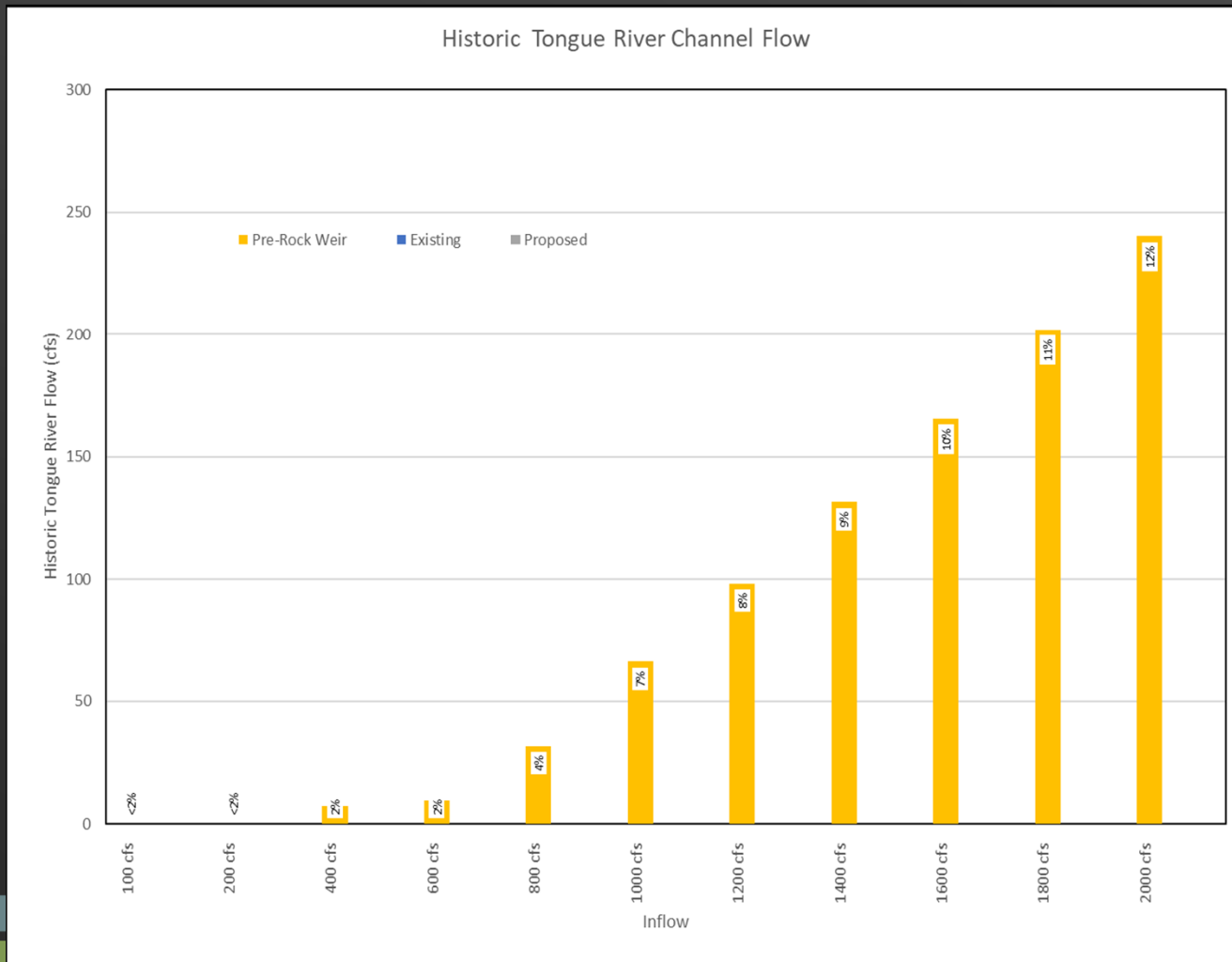
TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

HYDROLOGY AND HYDRAULICS



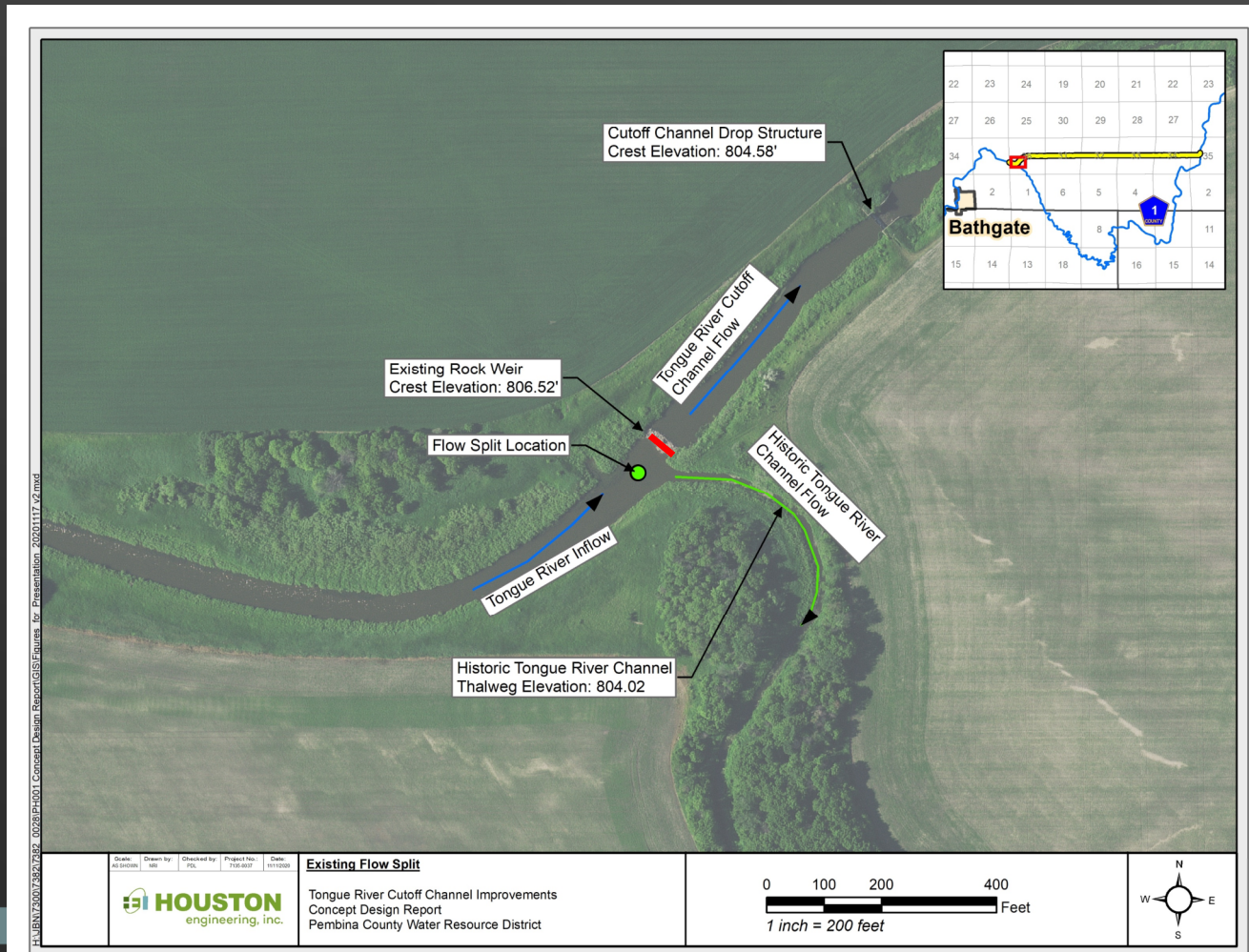
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HYDROLOGY AND HYDRAULICS



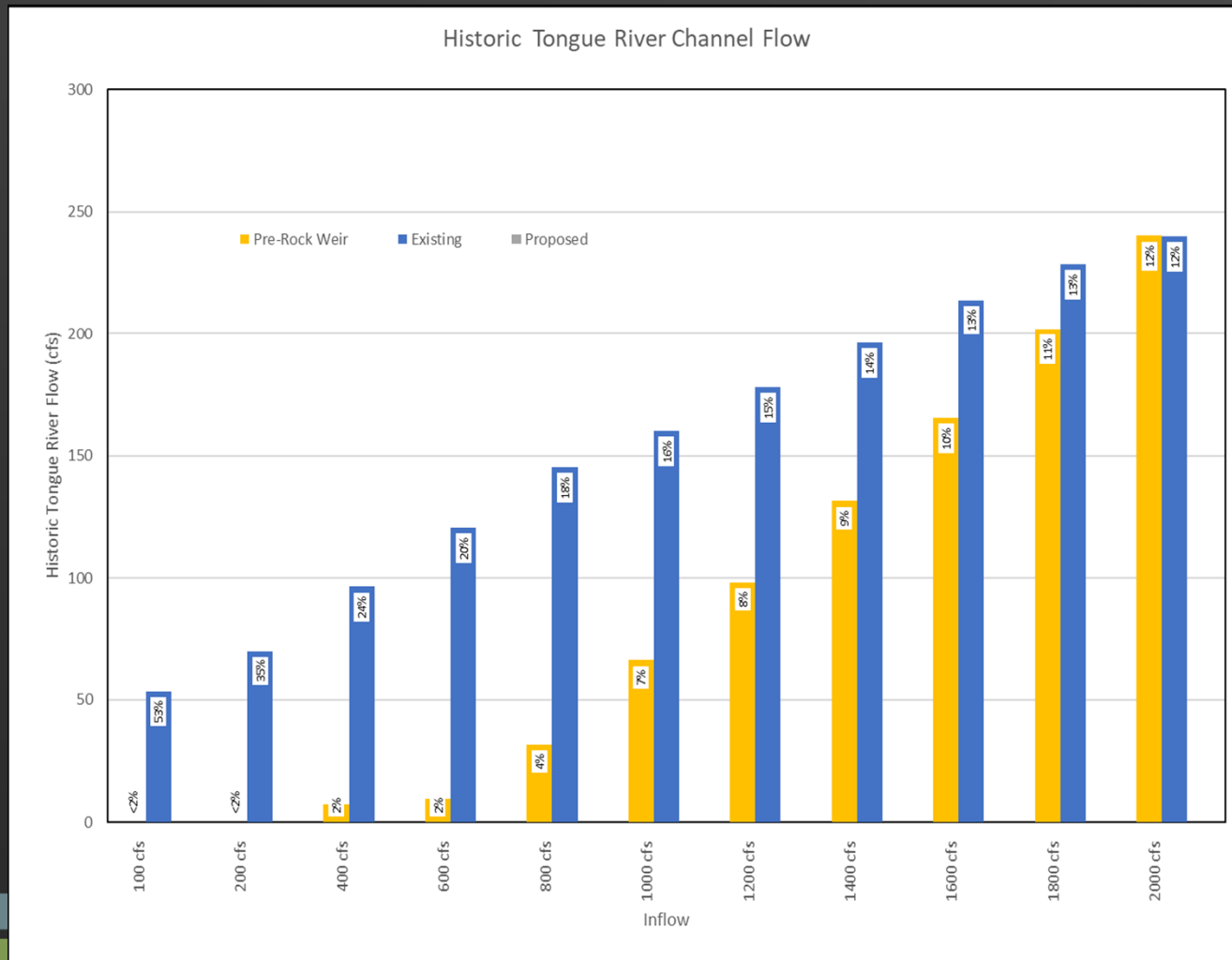
TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

HYDROLOGY AND HYDRAULICS



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

HYDROLOGY AND HYDRAULICS

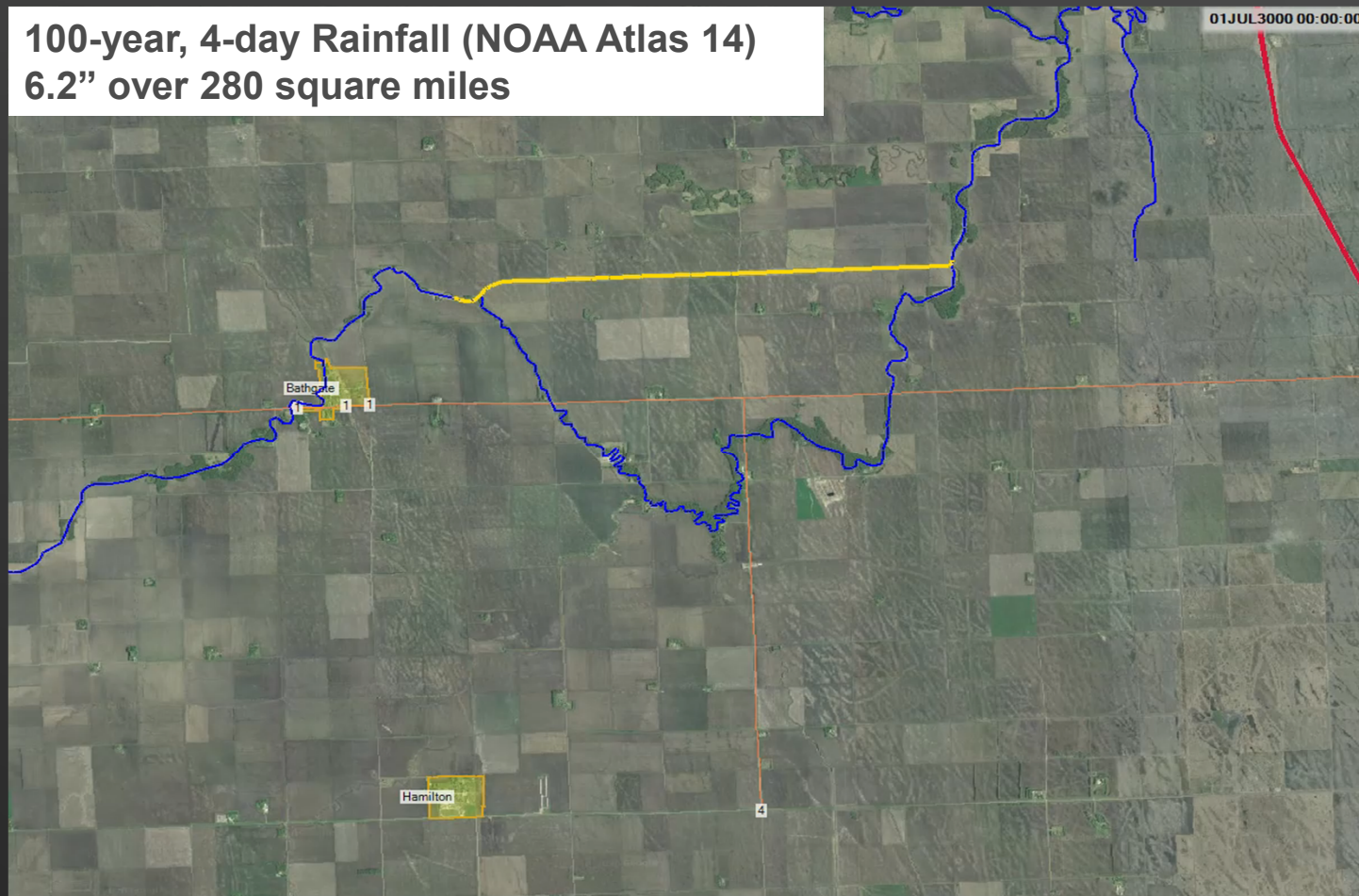


TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

HYDROLOGY AND HYDRAULICS



**100-year, 4-day Rainfall (NOAA Atlas 14)
6.2" over 280 square miles**



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PHASE 2 – IMPROVEMENT RECOMMENDATIONS



<p>2.A Slope Stability Assessment</p>	<ul style="list-style-type: none"> Stability analysis Recommendations addendum preparation Create technical memo for recommended side slopes and slope stability justification 	<p>PHASE 2 – IMPROVEMENT RECOMMENDATIONS</p>
<p>2.B Proposed Conditions Hydraulics and Hydrology Modeling</p>	<ul style="list-style-type: none"> Implement proposed channel shape and profile into hydraulic model Run hydraulic simulations with multiple tailwater scenarios Identify and implement alternative design elements into HEC-RAS model Develop displays to show changes from existing conditions 	
<p>2.C Structural Design and Cost Estimate</p>	<ul style="list-style-type: none"> Assess structural integrity of drop structure(s) Develop recommendation for changes to existing structures Draft summary of recommendations and cost estimate for structural improvements 	
<p>2.D Civil Design and Cost Estimate</p>	<ul style="list-style-type: none"> Develop proposed corridor and surface based on items 2.A and 2.B Adjust spoil heights using profile to balance excavation/fill material Measure seeding, R/W, and other dimensions to assist with cost estimate 	
<p>Present Client Information Meeting</p>		
<p>2.E Develop Preliminary Plan Set</p>	<ul style="list-style-type: none"> Add Proposed surfaces/profiles to plan sheets Develop riprap detail, structural detail, and typical section sheets Compile plan sheets, review plan set, and address redlines 	
<p>2.F Proposed Land Rights</p>	<ul style="list-style-type: none"> Use measurements from item 2.D and assign R/W widths per quarter section Develop existing R/W polygons from linework in AutoCAD Develop proposed R/W and construction easement polygons in AutoCAD 	
<p>Present Client Information Meeting</p>		

TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

SLOPE STABILITY ASSESSMENT AND CHANNEL CROSS SECTION

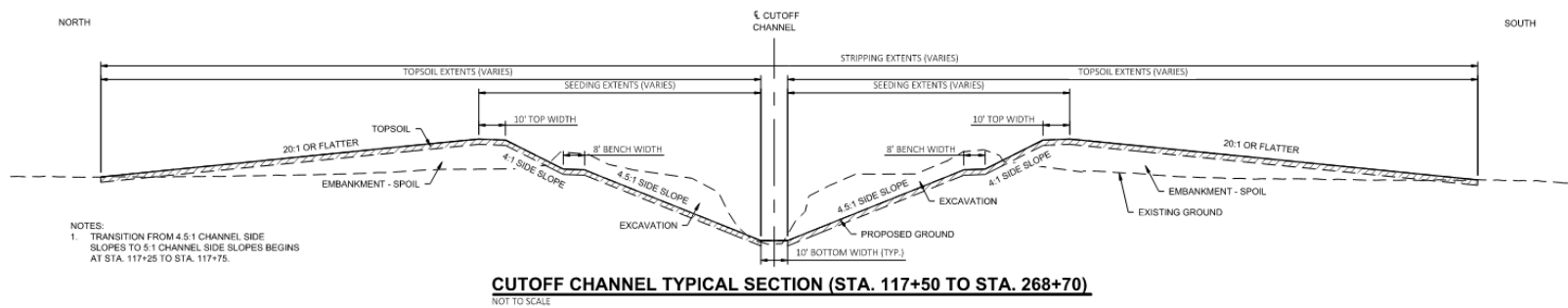
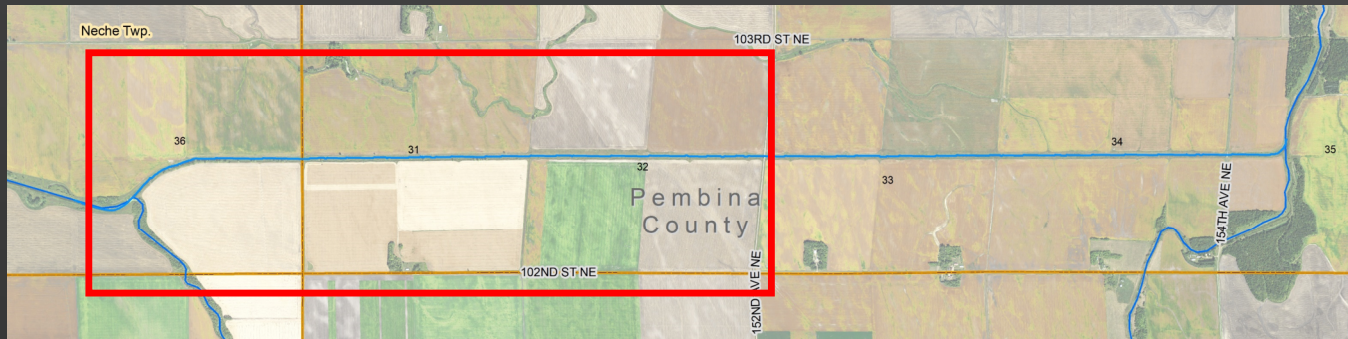


Channel Stability and Performance				
Location	Minimum Factor of Safety ^{A,B}			
	End of Construction	Long-Term	Flood	Drawdown
Cross Section 1 - 3H:1V	1.1	0.9	1.0	0.8
Cross Section 1 - 4H:1V	1.3	1.1	1.4	1.1
Cross Section 1 - 4.5H:1V	1.4	1.3	1.4	1.1
Cross Section 1 - 5H:1V	1.5	1.3	1.5	1.2
Cross Section 2 - 3H:1V	1.3	1.0	1.2	0.9
Cross Section 2 - 4H:1V	1.5	1.3	1.5	1.1
Cross Section 2 - 4.5H:1V	1.6	1.5	1.5	1.1
Cross Section 2 - 5H:1V	1.6	1.6	1.6	1.1
Cross Section 3 - 3H:1V	1.2	0.9	1.0	0.8
Cross Section 3 - 4H:1V	1.3	1.1	1.3	0.9
Cross Section 3 - 4.5H:1V	1.5	1.2	1.5	1.1
Cross Section 3 - 5H:1V	1.6	1.3	1.7	1.3

^A Minimum Acceptable Factor of Safety When Using Residual Parameters
 Short-Term Steady-State = 1.2
 Long-Term Steady-State = 1.3
 Drawdown = 1.0

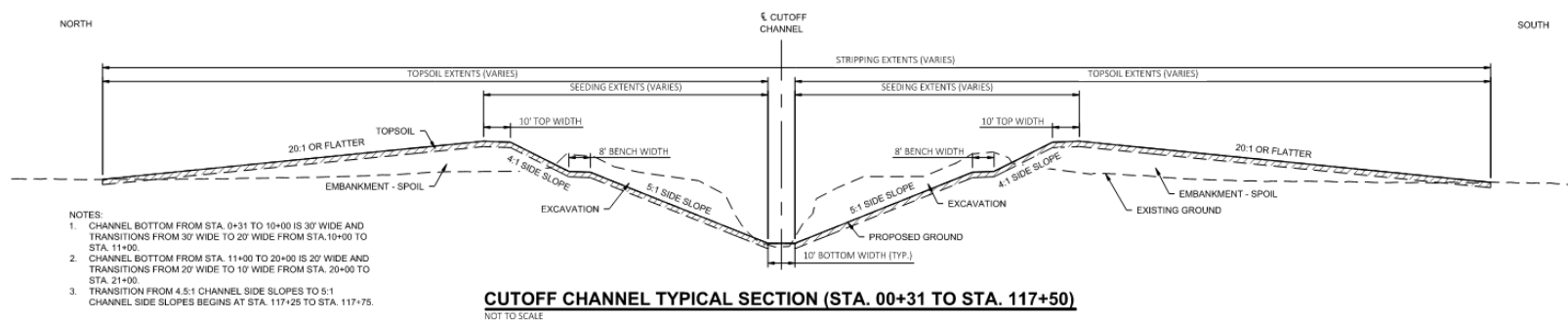
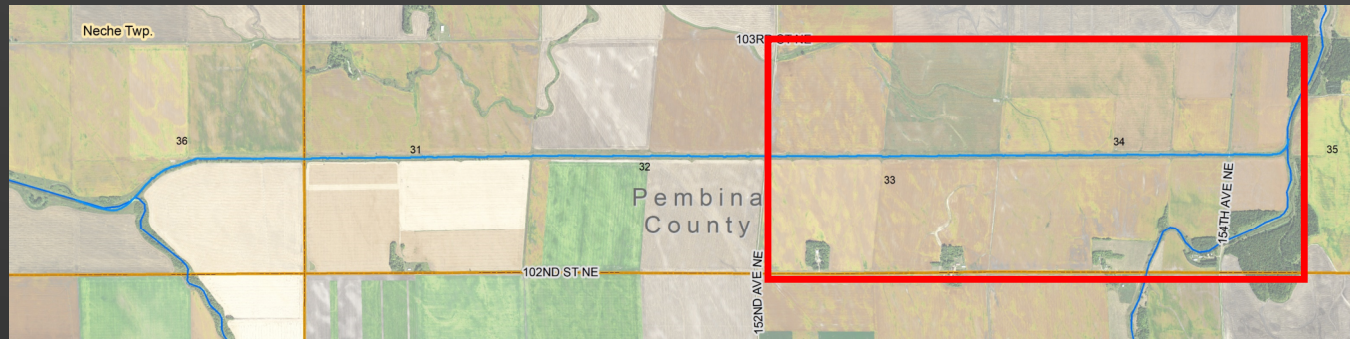
TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

SLOPE STABILITY ASSESSMENT AND CHANNEL CROSS SECTION



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

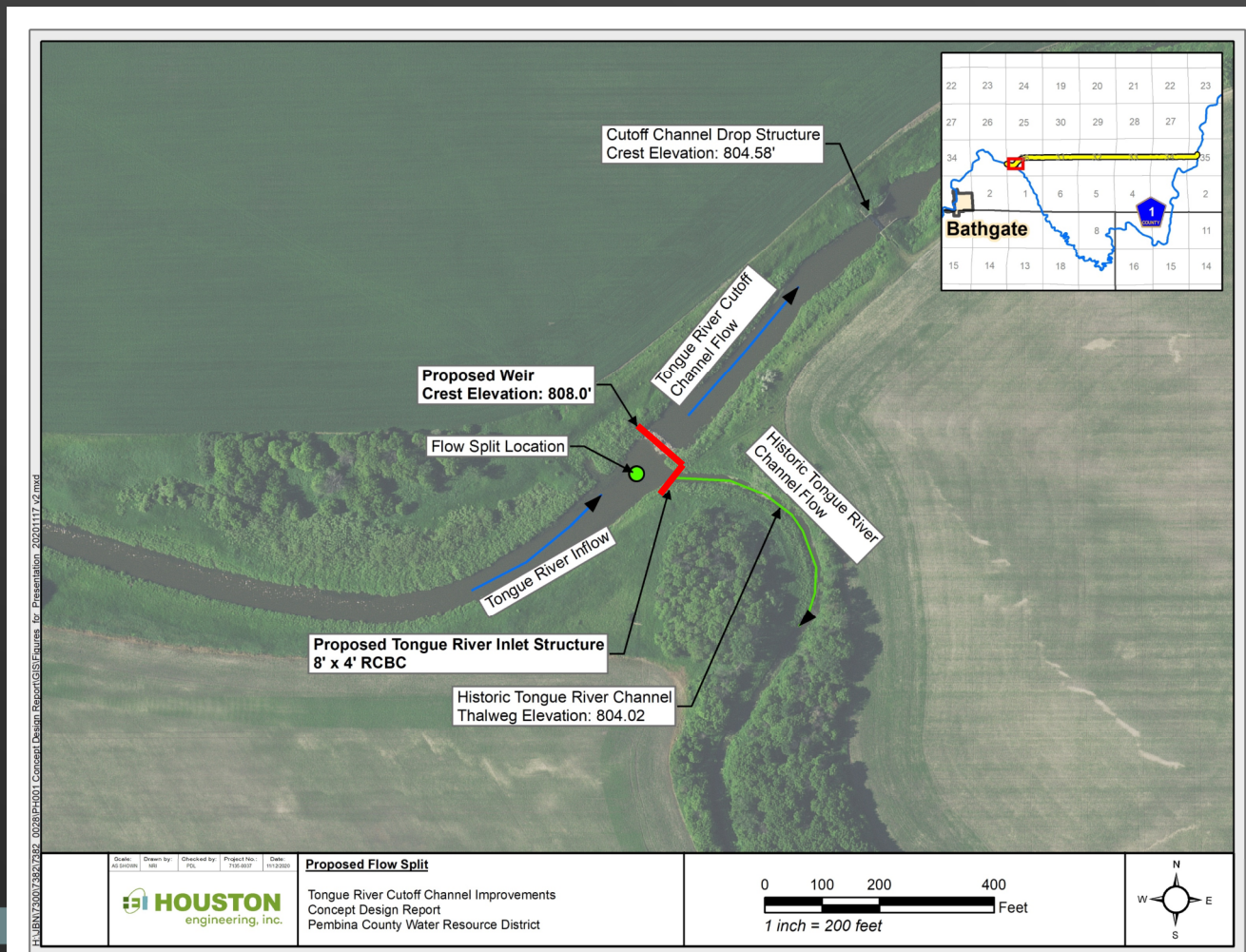
SLOPE STABILITY ASSESSMENT AND CHANNEL CROSS SECTION



- NOTES:
1. CHANNEL BOTTOM FROM STA. 0+31 TO 10+00 IS 30' WIDE AND TRANSITIONS FROM 30' WIDE TO 20' WIDE FROM STA. 10+00 TO STA. 11+00.
 2. CHANNEL BOTTOM FROM STA. 11+00 TO 20+00 IS 20' WIDE AND TRANSITIONS FROM 20' WIDE TO 10' WIDE FROM STA. 20+00 TO STA. 21+00.
 3. TRANSITION FROM 4.5:1 CHANNEL SIDE SLOPES TO 5:1 CHANNEL SIDE SLOPES BEGINS AT STA. 117+25 TO STA. 117+75.

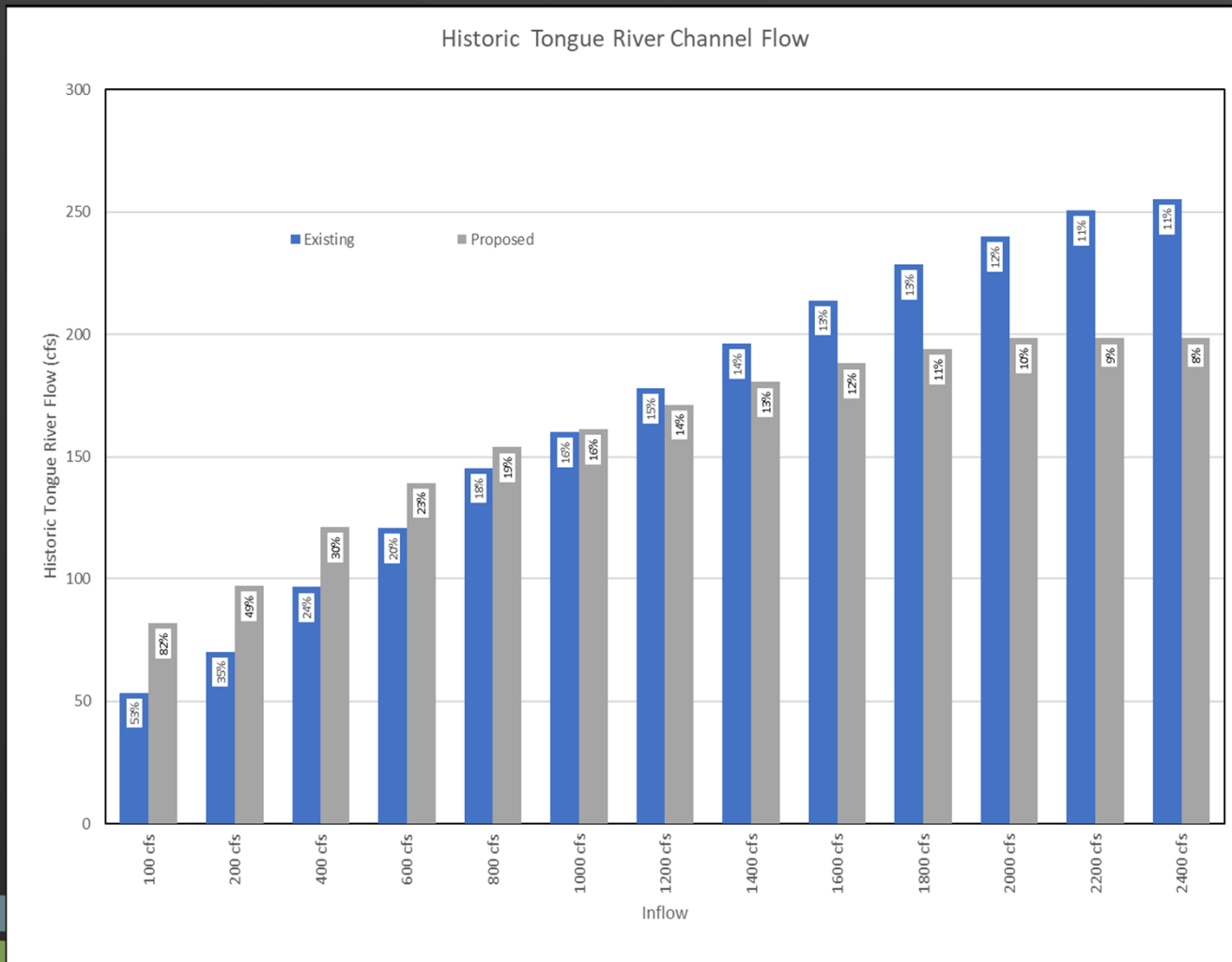
TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PROPOSED CONDITIONS HYDROLOGY AND HYDRAULICS



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PROPOSED CONDITIONS HYDROLOGY AND HYDRAULICS

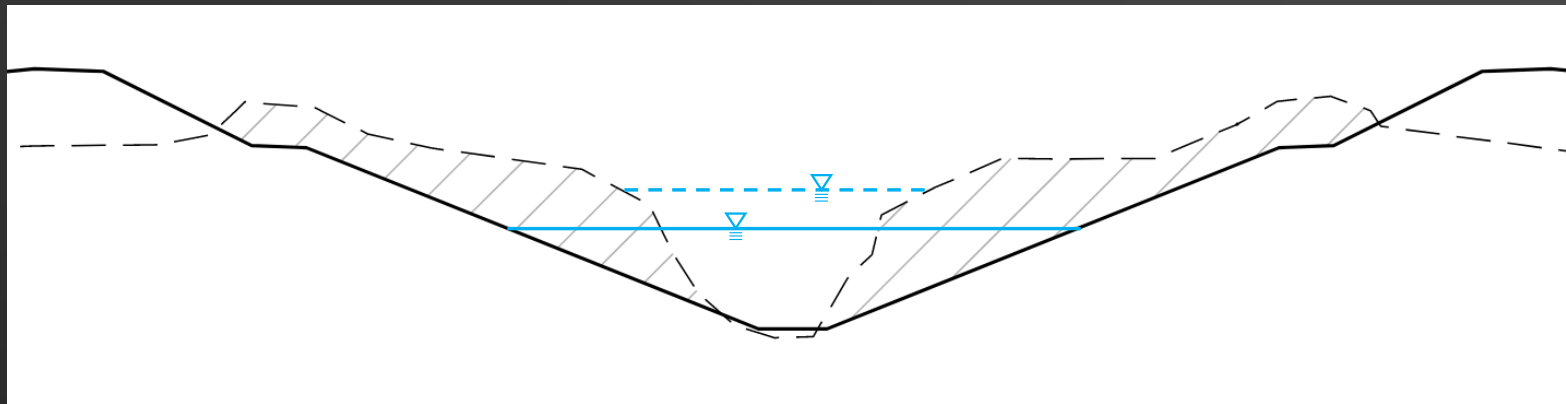


TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PROPOSED CONDITIONS HYDRAULICS

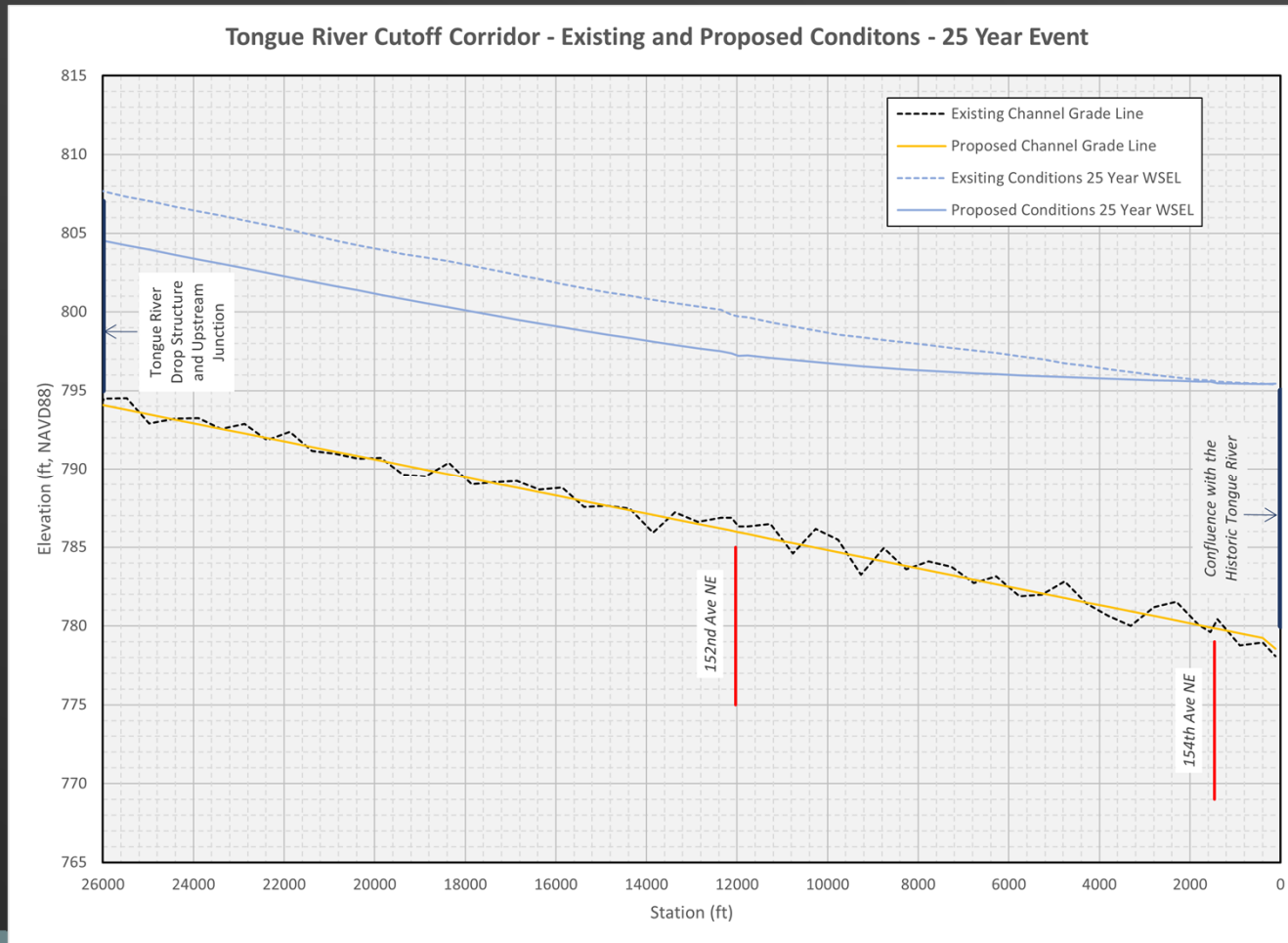


- Decreased flows through the Historic Tongue River Channel during large events because of inlet structure
- Slightly increased flow through the Tongue River Cutoff Channel
- Water surface elevation through the Tongue River Cutoff reduces slightly due to the increased cross-sectional area (increased hydraulic efficiency).



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PROPOSED CONDITIONS HYDROLOGY AND HYDRAULICS

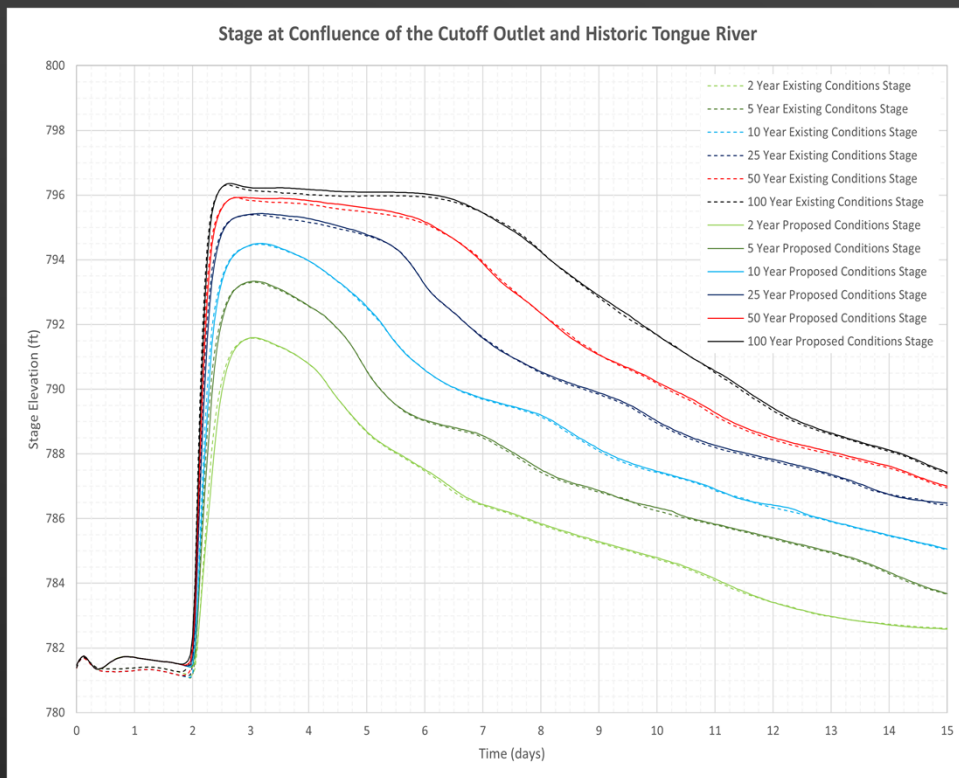


TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PROPOSED CONDITIONS HYDRAULICS



- Minimal impacts to downstream flooding



Maximum Stage at Downstream of Cutoff Channel (ft)			
Recurrence Interval	Existing Conditions	Proposed Conditions	Difference
2 Year	791.58	791.59	+ 0.01
5 Year	793.30	793.34	+ 0.04
10 Year	794.47	794.50	+ 0.03
25 Year	795.39	795.43	+ 0.04
50 Year	795.92	795.92	+ 0.00
100 Year	796.31	796.35	+ 0.04

TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

LAND RIGHTS



Township	Range	Section	Quarter	Existing R/W	Proposed R/W	Difference	Additional Acres
163N	53W	36	SW	198	242	44	1.54
163N	53W	36	NE	99	121	22	1.33
163N	53W	36	SE	99	121	22	1.33
163N	52W	31	NW	99	121	22	1.33
163N	52W	31	SW	99	121	22	1.33
163N	52W	31	NE	99	121	22	1.30
163N	52W	31	SE	99	121	22	1.30
163N	52W	32	NW	99	121	22	1.35
163N	52W	32	SW	99	121	22	1.35
163N	52W	32	NE	75	121	46	2.82
163N	52W	32	SE	99	121	22	1.35
163N	52W	33	NW	75	127	52	3.16
163N	52W	33	SW	99	127	28	1.70
163N	52W	33	NE	99	127	28	1.70
163N	52W	33	SE	75	127	52	3.16
163N	52W	34	NW	99	110	11	0.67
163N	52W	34	SW	99	110	11	0.67
163N	52W	34	NE	99	110	11	0.66
163N	52W	34	SE	99	110	11	0.66
163N	52W	35	NW	99	125	26	0.85
163N	52W	35	SW	99	125	26	0.85
TOTAL							30 Acres

TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

PRELIMINARY COST ESTIMATE



- Items driving the cost of the project
 - Excavation – 604,300 cubic yards
 - Stripping and Topsoiling – 469,200 cubic yards
 - Rock Weir and Sheet Pile
 - Historic Tongue River Inlet Culvert
 - Other (Legal, Engineering, Permitting, Etc.)
- Preliminary Cost:
 - TOTAL:.....\$5.0 – 5.5 Million
 - NDSWC Cost-Share (45%):.....\$2.0 – 2.3 Million
 - Local Remaining:.....\$3.0 – 3.2 Million

(PRELIMINARY/SUBJECT TO REVISION)
- Unknowns
 - Couldn't complete full inspection at the drop structure
 - Spoil placement – current estimate assumes placement adjacent to channel

TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

ADDITIONAL CONSIDERATIONS



- Snow plugging at Cutoff Channel inlet
- Lack of flow through Historic Tongue River caused by beaver dams.
 - Continue to address through Snag and Clear program
- Bridge stability issues at 152nd Avenue NE



TONGUE RIVER CUTOFF CHANNEL IMPROVEMENTS

QUESTIONS???

