

Lower Heart Flood Risk Reduction

Golf Course Options



September 9, 2024



Agenda

- 01** Introduction & Project Background
- 02** Engineering & Environmental Considerations
- 03** Conceptual Cost Comparison
- 04** Recommendation



01

Introduction & Project Background

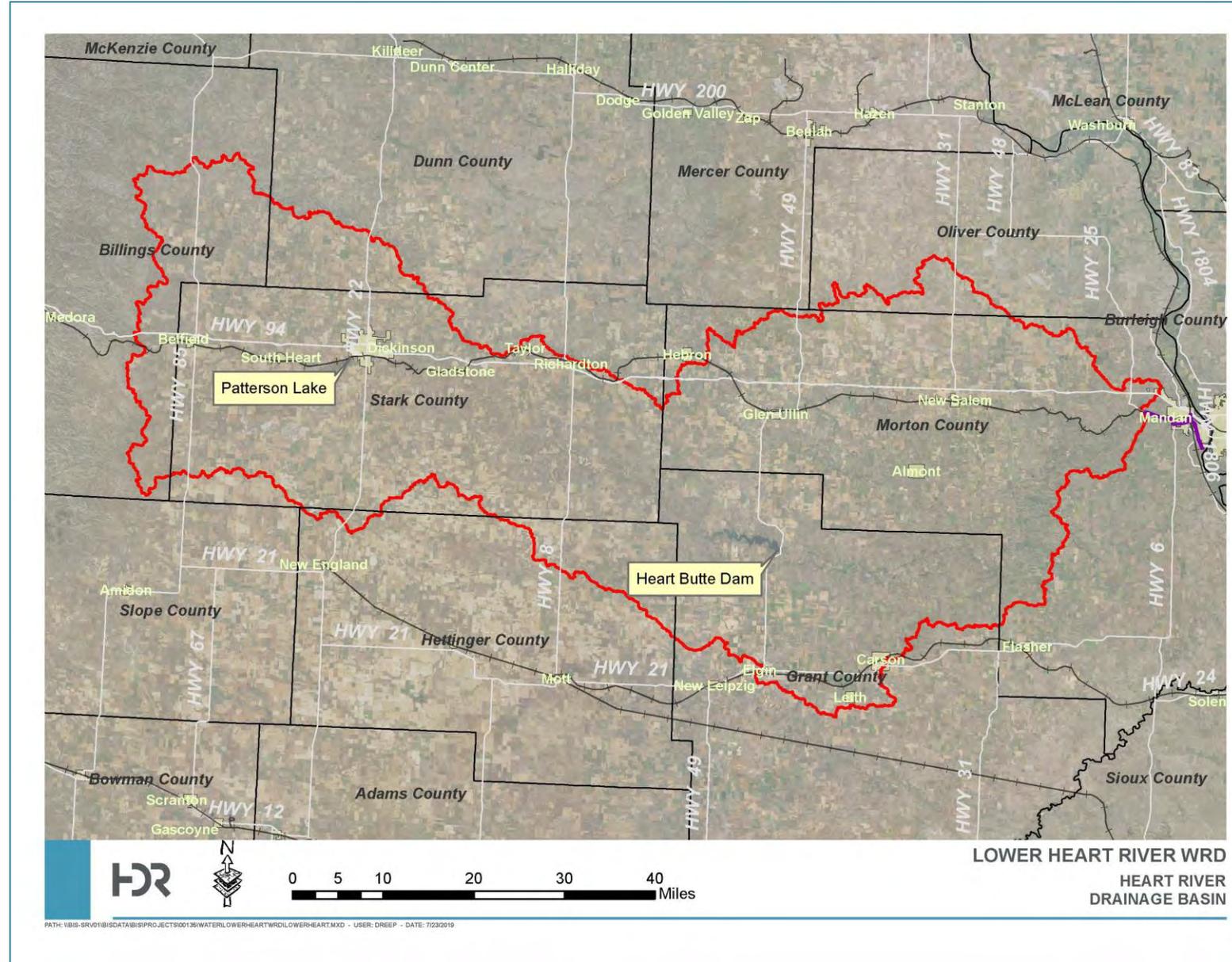
Mandan Flood Protection Project

- FEMA Driven Project
- Maintain Accredited Levee System
- Maintain Resilient Flood Protection
- Vital to Economic and Social Health of Mandan
 - 2,600 Residences and Businesses
 - Critical Infrastructure



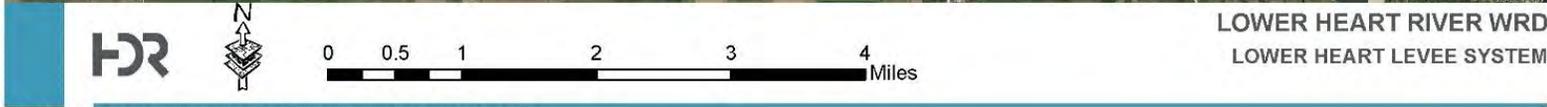
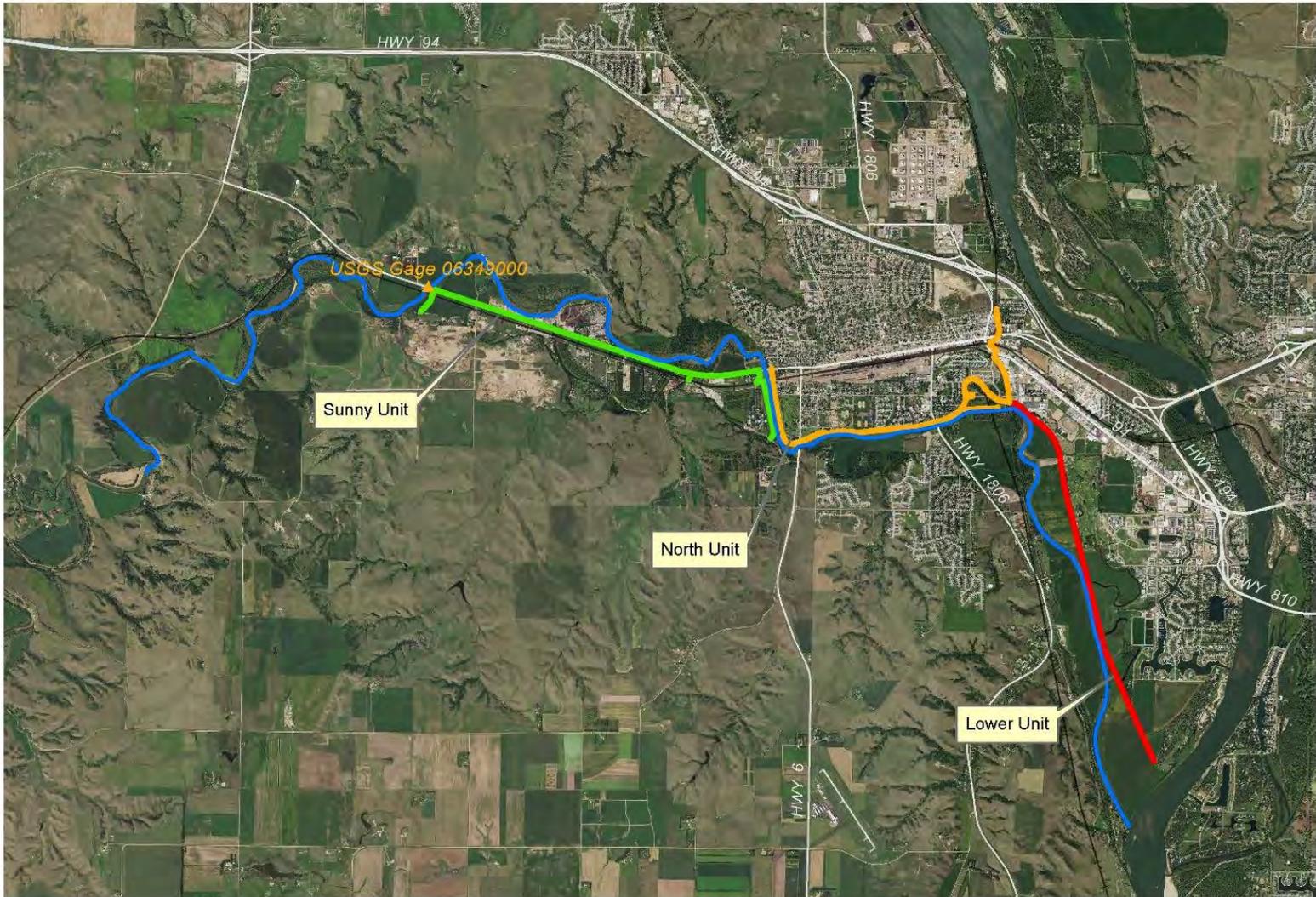
Heart River

- Originates in Billings County
- 3,310 Square Miles at Mandan
- Two reservoirs on the mainstem:
 - Dickinson Dam (Patterson Lake) - 1950
 - Heart Butte Dam (Lake Tschida) – 1949
- Susceptible to ice jams in Mandan.



Background

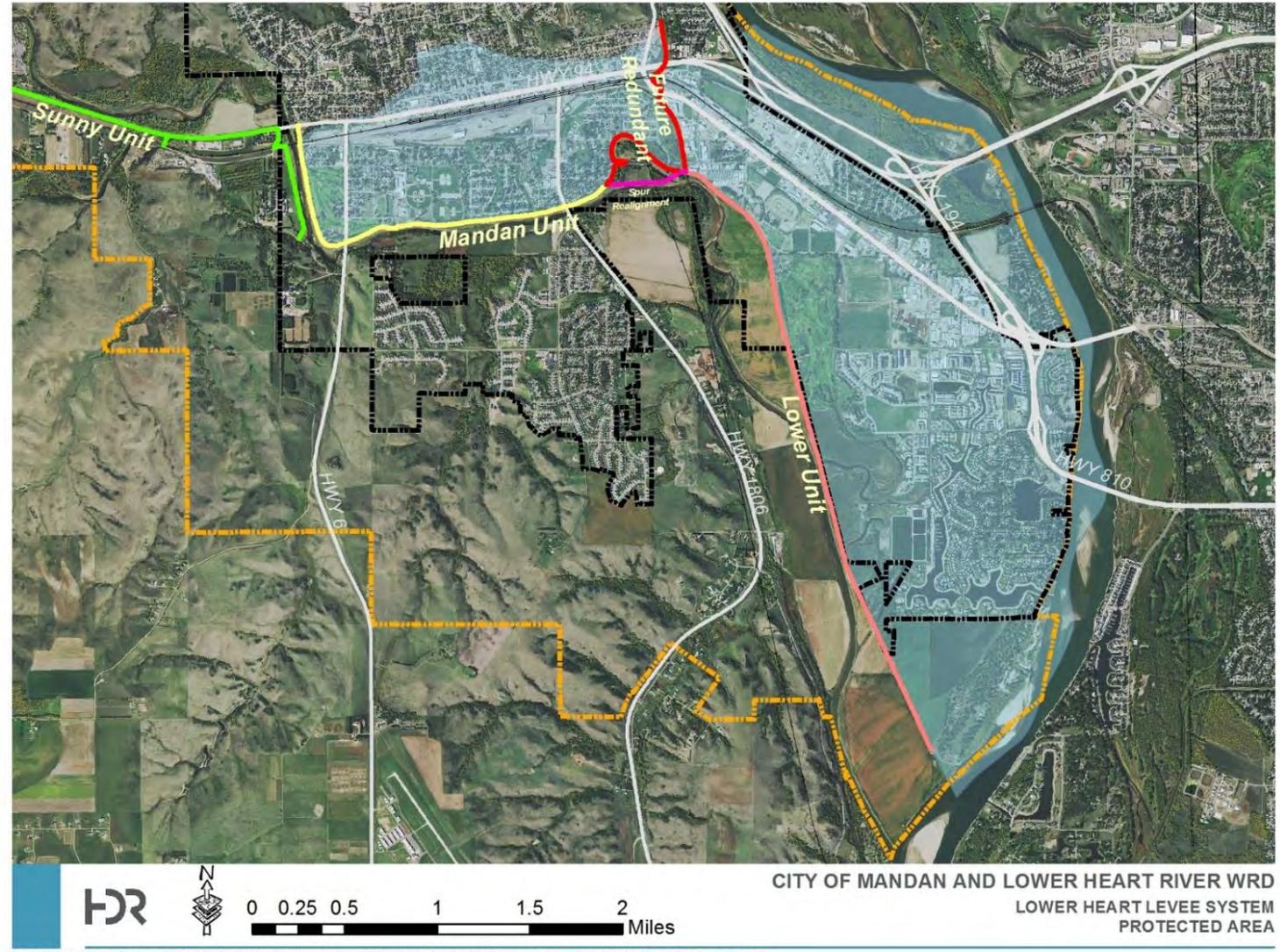
- Installed by USACE, Managed by Lower Heart WRD
- North (Mandan) Unit completed in 1949
- Lower and Sunny Units completed in 1959
- Provided flood protection during numerous flood events: 1950, 1952, 1997, 2009, 2019, and many more.



PATH: H:\GIS-SRV\118\SDATA\18\18\PROJECTS\200136\WATER\LOWERHEARTWRD\LOWERHEART.MXD - USER: DREEP - DATE: 7/23/2019

LOWER HEART LEVEE RECERTIFICATION

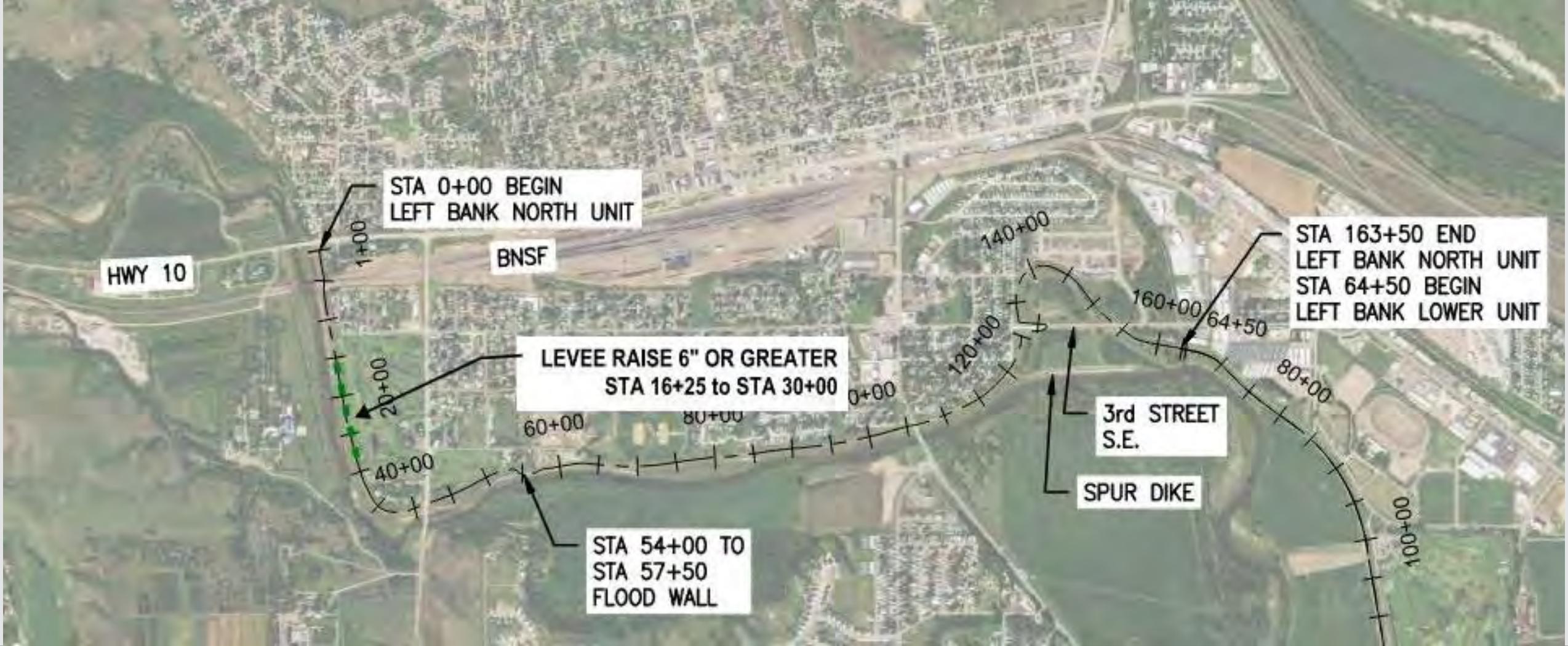
- Undergoing a FEMA re-accréditation process.
- 2012 FEMA study suggested significant portions have freeboard deficiencies.
- Geotechnical and internal drainage deficiencies are also present.
- Flood insurance economic impact is estimated at > **\$10M annually**.
- North (Mandan) and Lower Units Protect over 2,600 homes and businesses.



Background – Mandan Municipal Golf Course (Reach 6)



- New design flood elevation requires a levee raise to meet freeboard criteria next to the municipal golf course.
- Options to meet requirements include:
 - Install a landside seepage/stability berm
 - Install a seepage cutoff wall along the levee
 - Install pressure relief wells along the landward toe to intercept excessive seepage



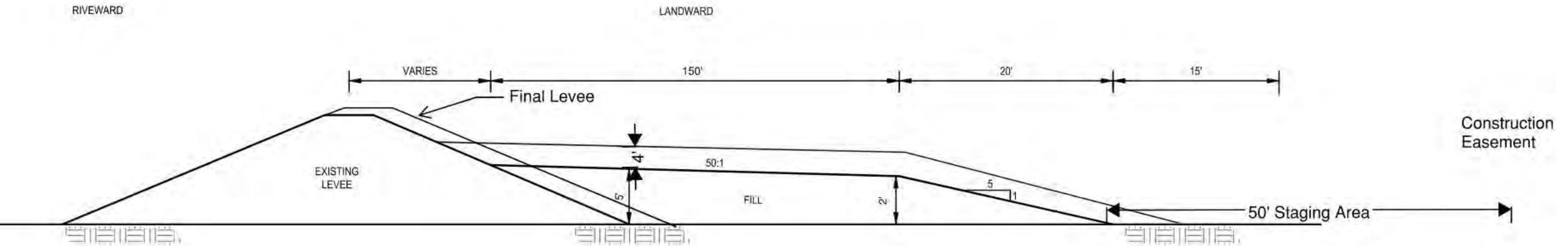
Vicinity Map

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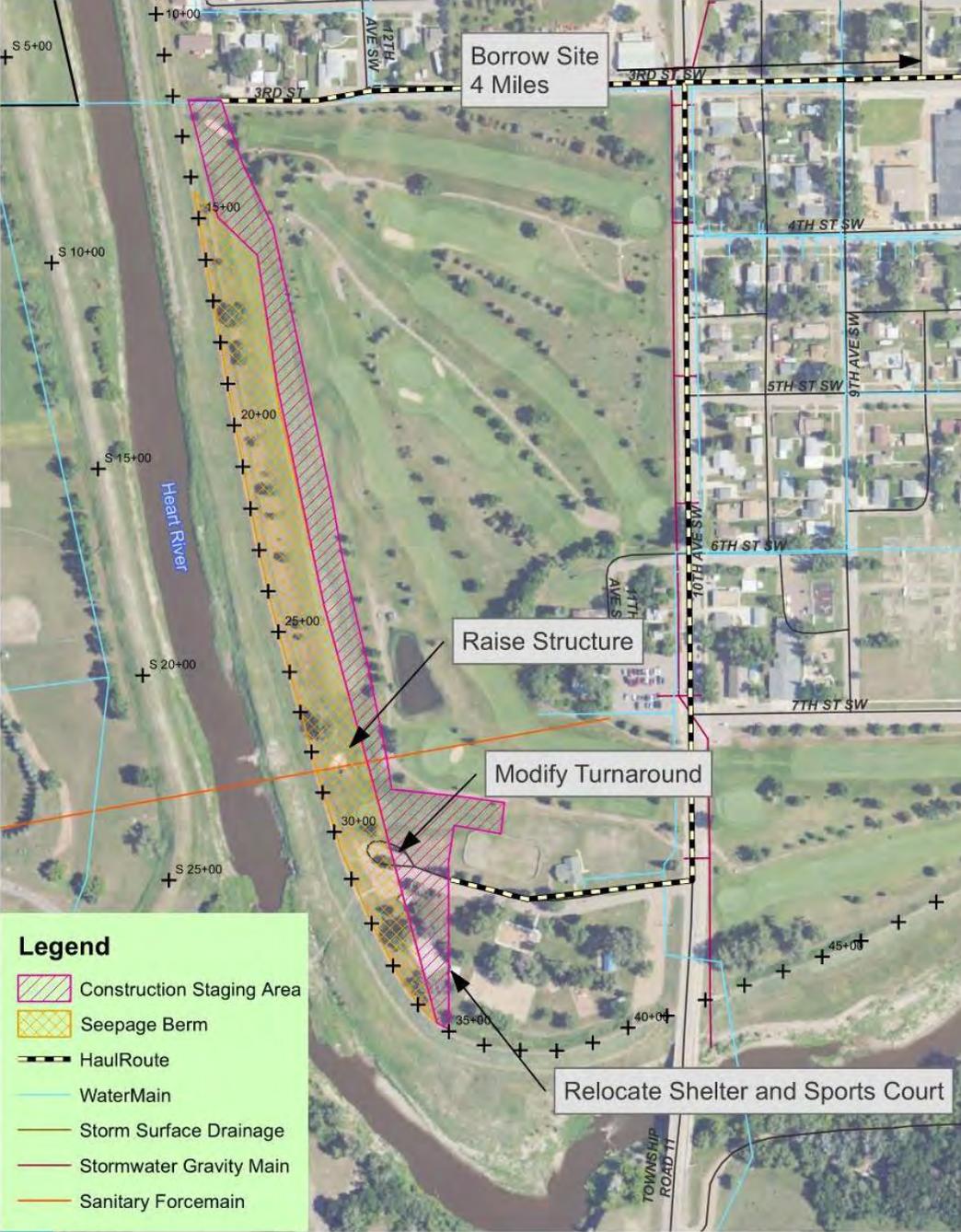
Engineering & Environmental Considerations

Landside Seepage/Stability Berm Option

- The berm would encompass most of the 4th fairway at the golf course
- All trees within 15 feet of the berm would have to be cleared or relocated



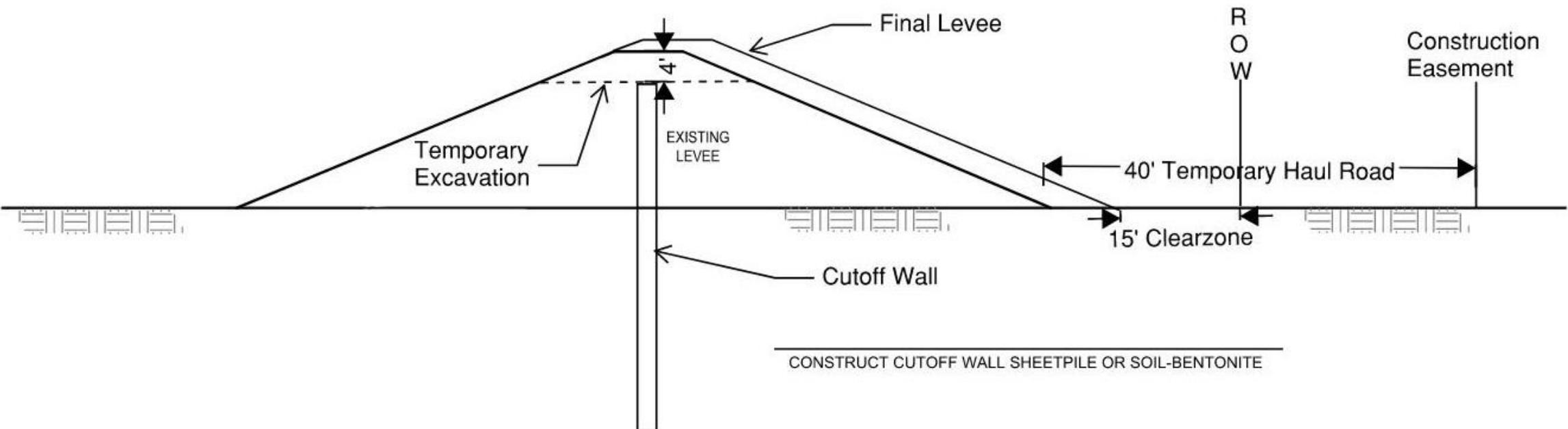
Seepage Stability Berm Option



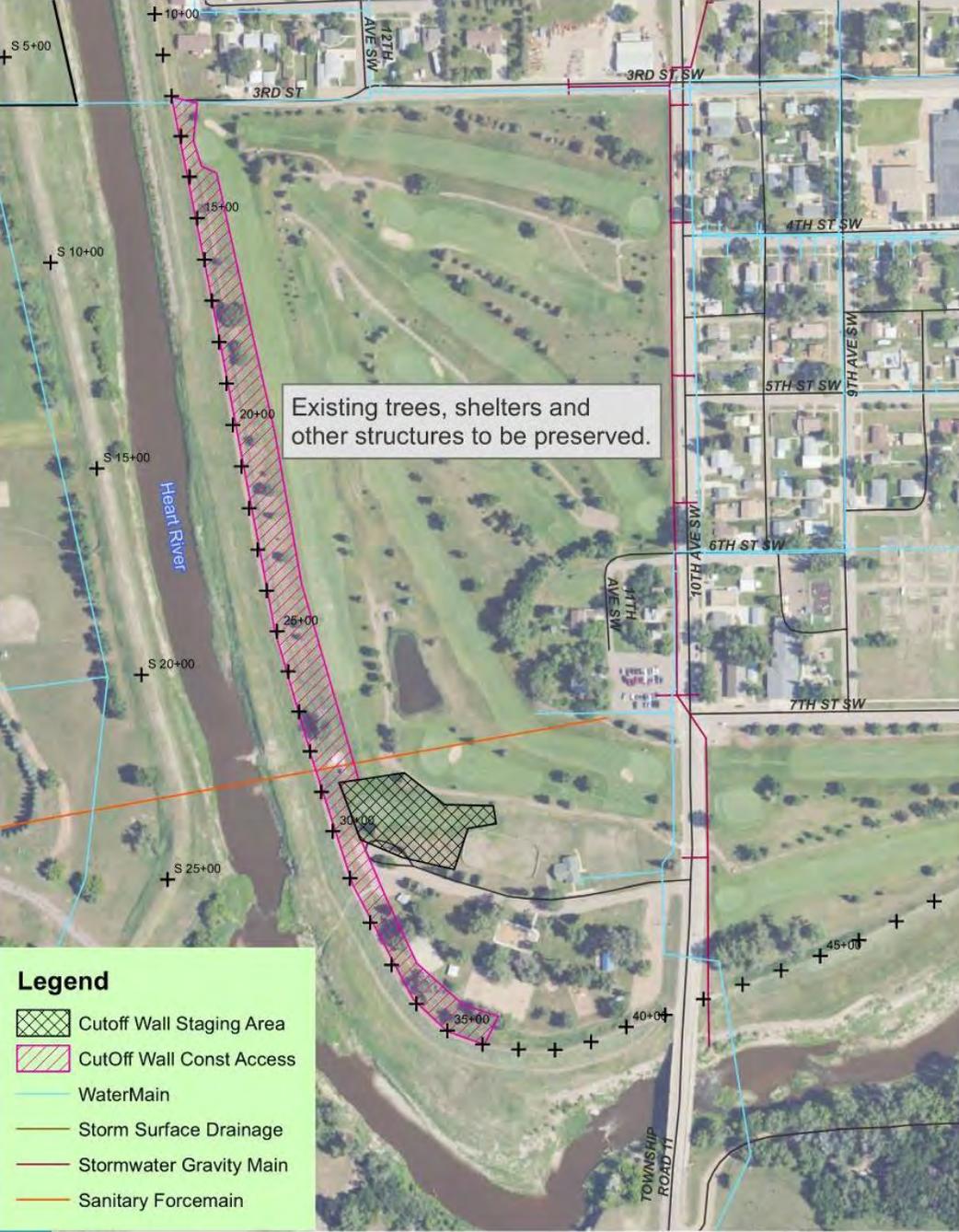
Pros	Cons
Low cost for long-term maintenance	Long-term easement/agreement required with Mandan Parks which would restrict uses on the seepage berm by the golf course in perpetuity (no trees, no buildings, etc.).
Passive system that does not require flood fighting operations.	Requires a re-design of Hole 4 by a specialty golf course designer and contractor.
Does not require a specialty contractor to construct.	Would likely eliminate the use of the Hole 4 for multiple years (~ 3) to allow for seepage berm construction, hole improvements, and re-establishment of the grass.
Imperfections in construction unlikely to affect reliability of performance	Community impact for trucking borrow material to site.
Minimal impacts to existing utilities	Requires relocation of picnic shelter and a sports court at Legion Park, which has limited space for relocations.

Seepage Cutoff Wall

- A soil-bentonite cutoff wall would be co-aligned with the centerline of the existing levee alignment and would consist of a bentonite slurry wall trench construction method.



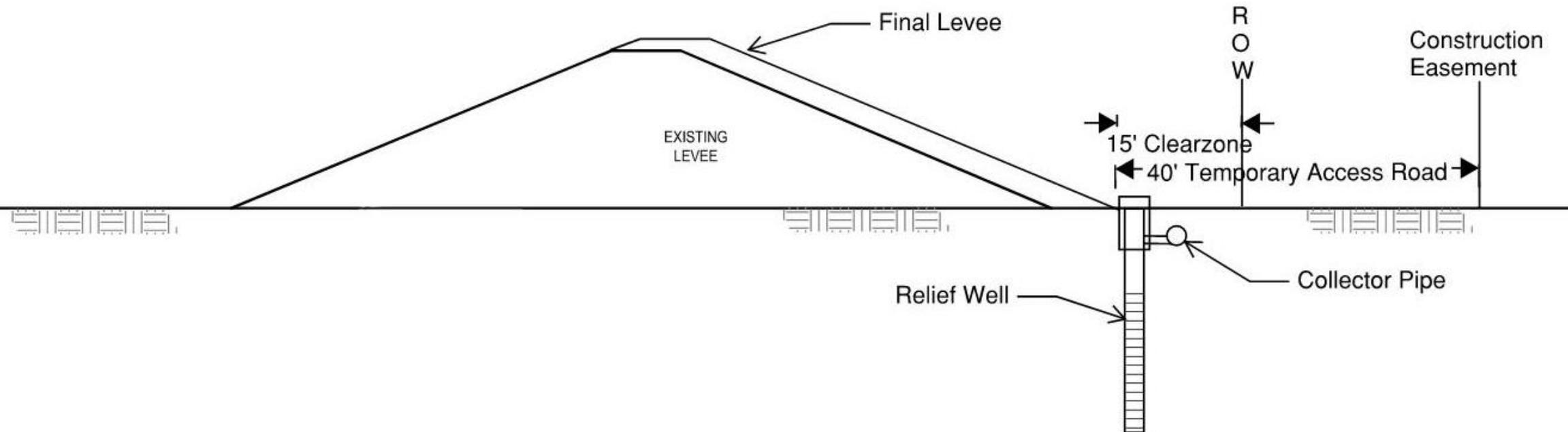
Seepage Cutoff Wall



Pros	Cons
Low cost for long-term maintenance	High cost for installation
Passive system that does not require flood fighting operations.	Would need to accommodate current Mandan Municipal golf course water intake.
No permanent impact to golf course or Legion Park.	Would need to accommodate future Mandan Municipal golf course water intake.
Does not require a modified easement to maintain.	Would need to accommodate existing Sanitary Force Main.
	Requires a specialty contractor to construct.
	Imperfections in construction likely to affect reliability of performance.
	Requires large staging area.
	High risk of unknown utility impacts.
	Potentially negative impacts to the levee extend beyond the area of the freeboard mitigation.
	Restricts groundwater flow toward river resulting in elevated groundwater landward of cutoff wall, having potentially negative impacts.
	Requires additional geotechnical investigation and design of utility relocations.

Pressure Relief Wells

- Expected to be constructed on the landside of the levee
- 22 wells total – minimal impacts to the golf course & park



Pressure Relief Wells



Pros	Cons
No permanent impact to municipal golf course or Legion Park.	High cost for long-term maintenance
Does not require revised easement for operation and maintenance	Requires routine testing and inspection
Least number of environmental impacts.	Requires active flood fighting operations to be effective
	Risk of vandalism
	Requires specialty contractor for installation and maintenance

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Conceptual Cost Comparison

Cost Comparison Golf Course Reach



Mitigation Option	Opinion of Probable Cost (Reach 6 only)
Seepage/Stability Berm	
Construction of Berm	\$ 1,900,000
Golf Course Mitigation	\$ 1,500,000
Long-Term Maintenance over 50 Years	\$ 0
Total	\$ 3,400,000
Cutoff Wall	
Construction of Cutoff Wall	\$ 5,800,000
Relocate Sanitary Sewer	\$ 70,000
Relocate Water Intake	\$ 1,600,000
Additional Engineering and Design	\$ 1,130,000
Long-Term Maintenance over 50 Years	\$ 0
Total	\$ 8,600,000
Pressure Relief Wells	
Construction of Wells	\$ 3,400,000
Construction of Collector System and Vault	\$ 1,200,000
Long-Term Maintenance over 50 Years	\$ 7,500,000
Total	\$ 12,100,000

Project Funding

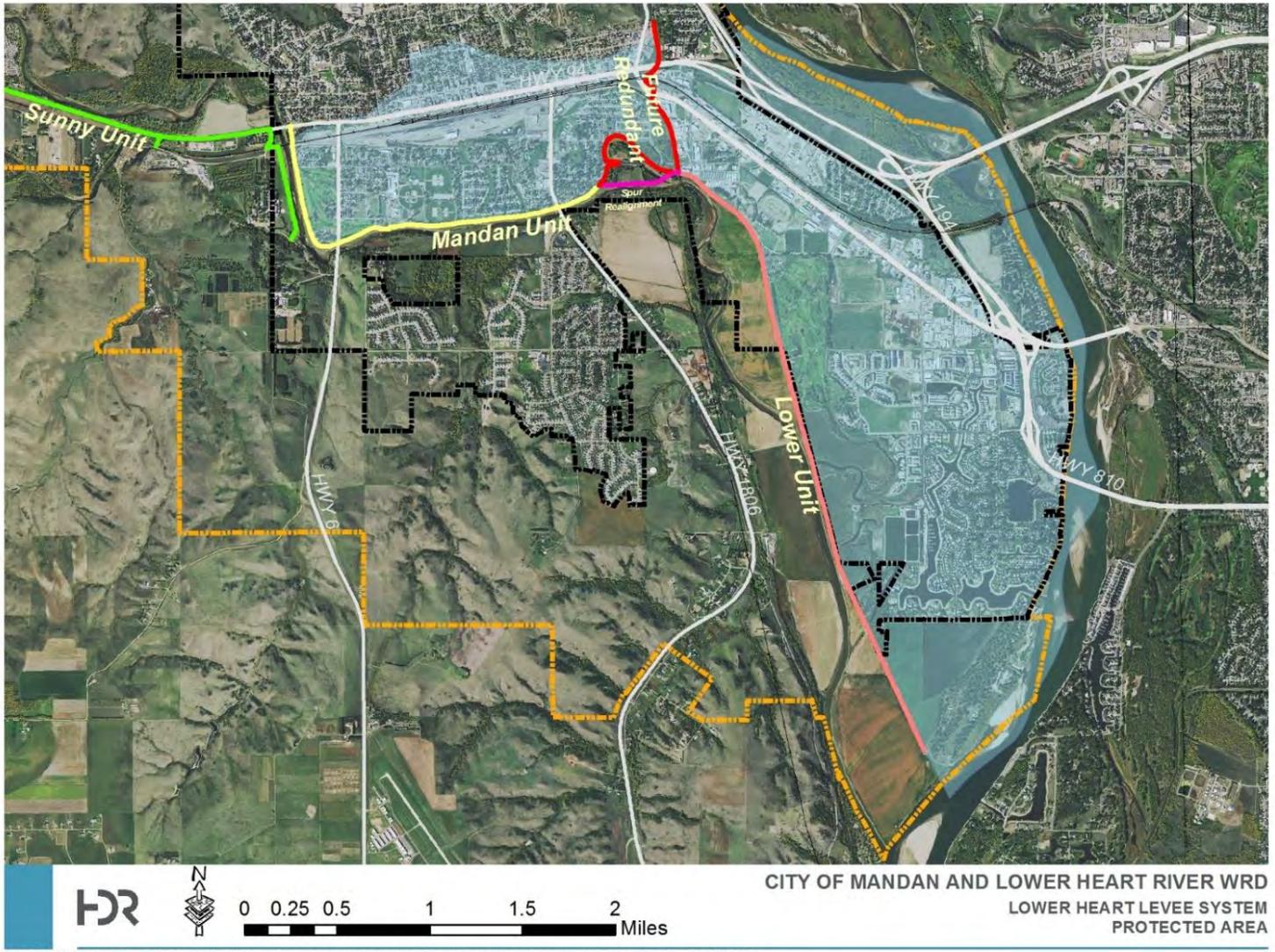
Project Cost Breakdown – Seepage Berm

Total Project Cost	\$25.2M
Federal Cost Share (Capped)	\$13.8M
State Cost Share (60% of Non-Federal)	\$ 6.8M
Local Cost Share (40% of Non-Federal)	\$ 4.6M
Inundated Area Cost Share (65%)	\$ 3.0M
Non-Inundated Area Cost Share (35%)	\$ 1.6M

Total Assessment Cost Breakdown

	Residential	Commercial	Ag
Inundated Area	\$1,050	\$1,310	N/A
Non-Inundated Area	\$250	\$315	\$250

Total payments spread over a 15-yr or 20-yr period



City Wide Assessment – Approved 2022



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Recommendation

Recommendation

HDR recommends the Board pursue the seepage/stability berm mitigation option due to the long-term reliability, ease of construction, and cost relative to the other options.

ADDITIONAL COMMENTS

- If complications due to impacts to the golf course are insurmountable, HDR recommends the cutoff wall option be pursued. Would result in project delays (~ 1 year and increased design and construction costs.
- HDR does not recommend installation of pressure relief wells due to the long-term cost and administrative burden.

Questions

Project Funding

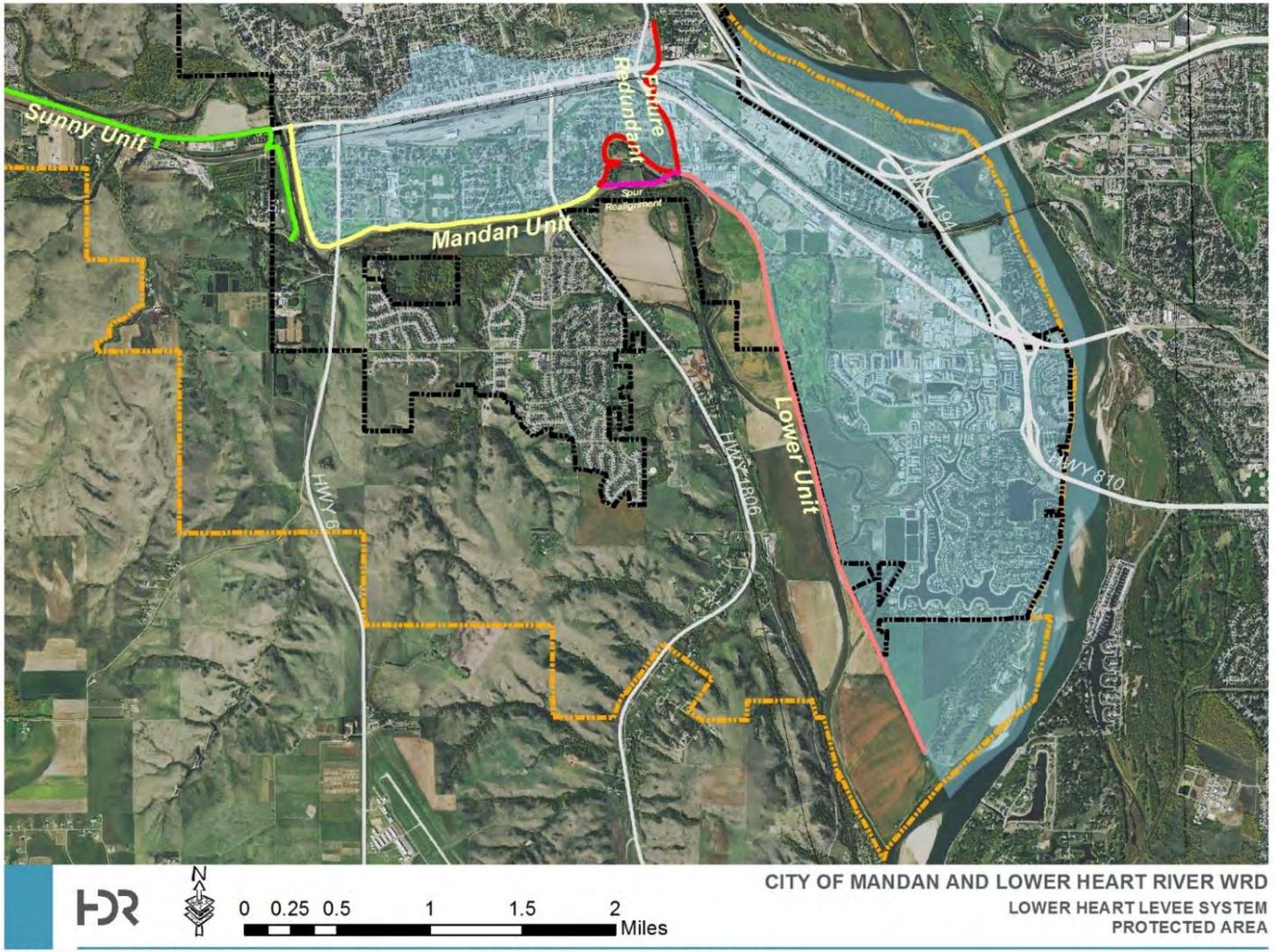
Project Cost Breakdown – Cutoff Wall

Total Project Cost	\$32.0M
Federal Cost Share (Capped)	\$13.8M
State Cost Share (60% of Non-Federal)	\$10.9M
Local Cost Share (40% of Non-Federal)	\$ 7.3M
Inundated Area Cost Share (65%)	\$ 4.7M
Non-Inundated Area Cost Share (35%)	\$ 2.6M

Total Assessment Cost Breakdown

	Residential	Commercial	Ag
Inundated Area	\$1,680	\$2,100	N/A
Non-Inundated Area	\$400	\$500	\$400

Total payments spread over a 15-yr or 20-yr period



City Wide Assessment – Approved 2022