



**BOLTON  
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Engineer's Report for

# Proposed Tile Improvements

Drainage District No. 48

Worth County, Iowa

2023

**Submitted by:**

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# Certification

Engineer's Report

for

Proposed Tile Improvements

Drainage District No. 48  
Worth County, Iowa  
0A1.125900

2023



I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa. My renewal date is December 31, 2024.

By: Jacob Hagan  
Jacob Hagan, P.E.  
License No. 25738

Date: 3/10/23

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## I. INTRODUCTION

### Scope of Work

In 2021, the Board of Supervisors requested an investigation and report of recommended tile improvements of the Drainage District No. 48 facilities and appointed Bolton & Menk, Inc. to complete the necessary survey, study, plan and report. This report addresses the request for improvements.

### Location

The watershed of Drainage District No. 48 covers approximately 2,145 acres in Sections 27, 28, 32, 33 and 34 of Brookfield and Sections 4, 5, 8, and 9 of Danville Township in Worth County, Iowa. The district is southwest of Northwood, almost entirely east of I-35, draining into Willow Creek 2,000 LF northeast of the intersection of Wheelerwood Road and 390<sup>th</sup> Street.

Drainage District No. 48 consists of a main tile totaling over 16,500 LF of tile ranging in size from 36” to 12”, as well as many lateral tiles totaling nearly 32,000 LF. The lands currently listed for benefit by DD 48 are listed on the current assessment schedule on file in the Auditor’s Office. A list of all the lateral tiles is shown the next page.

### History

Drainage District No. 48 was established in 1920 after a petition was filed by the Worth County Secondary Roads. This district constructed more lateral tiles than typical. Many of which are small serving only one pothole on one landowner’s land.

Below are listed items that have occurred since the establishment of the district.

- 1920-1-3 Engineer’s Report filed. Original engineer’s opinion of cost: approximately \$62,000.
- 1920-3-18 Construction Bids received.
- 1921-8-28 Classification Report filed.
- 1949-5-1 Engineer recommends relaying the lower 1,000 feet of the main tile and replacing any broken pieces with available new 33-inch tile. Work completed by November.
- 1967-7-1 Petition noting inadequate drainage and requesting construction of new tile from the outlet to the east of the I-35 right-of-way. This due to the newly under construction interstate effecting a “freeze” on all future changes to size and grade below I-35. No record of work being done.
- 1976-10-21 Contract signed for outlet repair and rip rap install. Work completed by December.



*Figure 1: Ponding south of 390th Street*



Existing DD 48 Lateral Tiles

<b>Main</b>	Lateral 1				
	Lateral 2	2A	2A1		
		2B	2B1	2B1-A	
		2C	2C1	2C1-A	
				2C1-B	
			2C2	2C2-A	2C2-A-1
				2C2-B	2C2-B-1
			2C3		
		2C4			
		2C5			
		2C6			
		2C7			
		2D			
		2E	2E1		
	2F				
	2G				
	2H				
	2I				
	Lateral 3				
	Lateral 4	4A	4A1		
4A2					
4A3					
4B					
4C					
4D					
4E					
4F					
Lateral 5					
Lateral 6					
Lateral 7					
Lateral 8					
Lateral 9					
Lateral 10	10A				
Lateral 11					
Lateral 12					
Lateral 13					
Lateral 14					
Lateral 15	15A				
	15B				
Lateral 16					
Lateral 18					
Lateral 19					

## II. INVESTIGATION

Survey of the tile system and watershed was made in spring 2022 and winter of 2023. The records of the district were reviewed and the original plans located. A visual survey of the lands in the district showed several wet areas and lands not being row cropped.

Studying the original plans and profiles, we have estimated the drainage coefficient (Dc) for the existing tile system. The majority of the tile in this district were designed with a coefficient of approximately 1/4" / acre / day, which is 50% of the recommended modern design. There are some laterals that are close to or at the current recommended 1/2" drainage coefficient. The drainage coefficient represents the depth of excess water removed from the surface of the watershed in a 24-hour period. The modern standard of 1/2" of water removed from the surface area of the watershed in 24 hours (1/2" Dc) has been in use since the mid-1950's.

Overall, the drainage district system was constructed to be very comprehensive. Nearly, every pothole in the watershed was provided a tile. These small lateral tiles were largely 6" tile and are sized well even by today's standards. One must study the entire system, as the current situation is the main and larger lateral tiles were sized to 1/4" Drainage Coefficient, and the smaller laterals must use these larger laterals as outlets. This is effectively limiting the capacity of the smaller well sized laterals to the 1/4" drainage coefficient of their outlets.

The coefficients and percent of modern capacity, as shown on the next two pages, assume the tile is clean, straight and unrestricted. However, due to the age of this system, it is likely that the actual capacity of the existing system is roughly 80-90% of that shown on the table above. The highlighted sections are recommended to be replaced.



Figure 2/ Intake in the road ditch of 390th St.



Figure 3/ Existing Tile Outlet

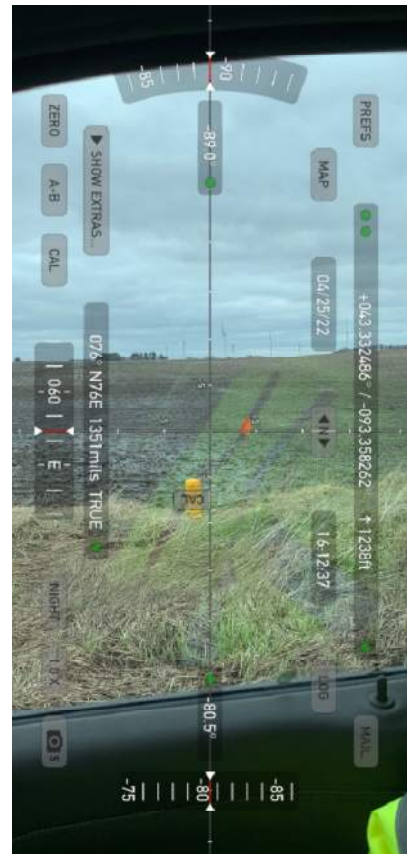


Figure 4/ Intake North of 400th St.

Existing DD 14 Tile Capacities			
Facility	Size & Grade (Diameter @ %)	D <sub>c</sub> * (Inches/Acre/Day)	% of ½" D <sub>c</sub> (Modern Standard)
Main	36" @ 0.12%	0.26	52%
Main	24" @ 0.16%	0.22	44%
Main	22" @ 0.16%	0.21	42%
Main	20" @ 0.20%	0.30	60%
Main	18" @ 0.24%	0.24	48%
Main	15" @ 0.15%	0.20	40%
Main	12" @ 0.15%	0.45	90%
Main	8" @ 0.10%	0.33	66%
Lat. 1	6" @ 0.20%	1.50	300%
Lat. 2	24" @ 0.18%	0.21	42%
Lat. 2	18" @ 0.10%	0.18	36%
Lat. 2	14" @ 0.30%	.51	102%
Lat. 2	8" @ 1.30%	1.43	286%
Lat. 2A	8" @ 0.50%	0.28	56%
Lat. 2B	10" @ 0.20%	0.22	44%
Lat. 2B1	8" @ 0.10%	0.21	42%
Lat. 2B1-A	6" @ 0.70%	2.80	560%
Lat. 2C	16" @ 0.20%	0.19	38%
Lat. 2C	15" @ 0.31%	0.43	86%
Lat. 2C	12" @ 0.40%	0.67	134%
Lat. 2C	10" @ 0.15%	0.53	106%
Lat. 2C1	10" @ 0.68%	0.48	96%
Lat. 2C1	8" @ 0.20%	0.23	46%
Lat. 2C2	12" @ 0.14%	0.30	60%
Lat. 2C2	8" @ 0.14%	0.77	144%
Lat. 2C2-A	8" @ 0.50%	0.60	120%
Lat. 2C2-B	8" @ 0.20%	0.44	88%
Lat. 2C2-A-1	6" @ 0.30%	2.44	488%
Lat. 2C2-B-1	6" @ 0.30%	1.22	244%
Lat. 2C3	10" @ 0.20%	0.33	66%
Lat. 2C4	6" @ 0.20%	0.60	120%
Lat. 2C5	6" @ 1.00%	1.67	334%
Lat. 2C6	6" @ 0.75%	2.32	464%
Lat. 2C7	6" @ 1.00%	4.46	892%
Lat. 2D	6" @ 0.30%	0.37	74%

Facility	Size & Grade (Diameter @ %)	D <sub>c</sub> * (Inches/Acre/Day)	% of ½" D <sub>c</sub> (Modern Standard)
Lat. 2E	12" @ 0.60%	0.64	128%
Lat. 2E-1	6" @ 0.30%	0.41	82%
Lat. 2F	6" @ 0.35%	2.64	528%
Lat. 2G	6" @ 0.20%	0.09	18%
Lat. 2H	6" @ 0.30%	0.43	86%
Lat. 2I	6" @ 0.20%	0.37	74%
Lat. 2J	6" @ 1.50%	5.46	1,092%
Lat. 3	6" @ 0.30%	1.22	244%
Lat. 4	15" @ 0.10%	0.16	32%
Lat. 4	12" @ 0.14%	0.20	40%
Lat. 4	10" @ 0.14%	0.17	34%
Lat. 4	8" @ 0.14%	0.13	26%
Lat. 4A	10" @ 0.27%	0.28	56%
Lat. 4A	8" @ 0.27%	0.31	62%
Lat. 4A1	8" @ 0.20%	0.64	128%
Lat. 4A2	6" @ 0.56%	1.25	250%
Lat. 4A3	6" @ 0.10%	0.71	142%
Lat. 4B	6" @ 0.70%	0.75	150%
Lat. 4C	6" @ 0.50%	1.58	316%
Lat. 4D	6" @ 0.20%	1.20	240%
Lat. 4E	6" @ 0.25%	0.74	148%
Lat. 4F	6" @ 0.20%	0.26	52%
Lat. 5	6" @ 0.20%	2.00	400%
Lat. 6	6" @ 1.00%	1.67	334%
Lat. 7	6" @ 2.20%	3.30	660%
Lat. 8	6" @ 1.50%	2.34	468%
Lat. 9	6" @ 0.25%	1.67	334%
Lat. 10	8" @ 0.25%	0.37	74%
Lat. 10A	6" @ 0.20%	1.50	300%
Lat. 11	6" @ 0.20%	0.46	92%
Lat. 12	6" @ 0.30%	0.81	162%
Lat. 13	8" @ 0.20%	0.43	86%
Lat. 13	6" @ 0.65%	0.54	108%
Lat. 14	6" @ 1.00%	0.21	42%
Lat. 15	12" @ 0.20%	0.73	146%
Lat. 15	8" @ 1.00%	1.80	360%

### III. FARM PROGRAM COMPLIANCE

#### Farm Program Wetland Conservation Rules

The farm program wetland conservation rules are regulated by the USDA Farm Service Agency. The USDA Natural Resources Conservation Service provides technical assistance. This technical assistance includes policing for program violations and making certified wetland determinations. We have made requests of landowners receiving benefits from the proposed improvements to secure certified wetland determinations from the USDA/NRCS and to provide them to the district. Only landowners or their authorized agents may request the determinations. Some have not yet provided this information.

The USDA has recently adopted a few new interpretations of the farm program wetland conservation rules which are applicable here.

- For any improvements constructed by a drainage district, the NRCS will make a rebuttable assumption that every farmed wetland in the drainage district will be converted. (This assumption can be appealed by the impacted landowners, but not by the drainage district.)
- Mitigation of converted farmed wetland must compensate for all lost wetland functions and must also be made at a minimum acre for acre basis.
- A plan for the mitigation of all converted farmed wetland in the drainage district must be approved by the NRCS prior to the beginning of the construction of the improvements. After all opportunities for appeals are exhausted, the farmed wetland not covered by that mitigation plan would be found converted and the landowner and tenant would be in technical violation of the farm program. Penalties can be avoided when a drainage district causes the conversion, but only at the price of abandoning farming of the converted farmed wetlands or ceasing to participate in the farm program.
- The planned mitigation must be in place and functioning no later than the completion of the project which converts the farmed wetlands.

If a landowner does not request a certified wetland determination and he happens to end up with a converted farmed wetland, he will find himself in technical violation of the farm program rules and be subject to a USDA claim for the forfeiture and possibly refund of farm program payments when the work commences.

The Board of Supervisors may approve and authorize construction of the proposed improvements without accruing risk to the district from farm program wetland conservation rules violations. Obviously, the Board will want to know the wetlands status of all landowners and to help to keep them all in farm program compliance, but the Board cannot allow the failure of an individual landowner to share wetland information to influence the very important decisions it is charged to make for all of the benefitted landowners. However, by the rules, the program penalties will fall solely to the owners of the converted farmed wetlands for which compensatory mitigation is not secured. It is fully up to the landowner to cooperate with the district toward keeping himself/herself in farm program compliance.

#### Converted Wetland Mitigation Alternatives

Since 1987, the USDA has assumed jurisdiction over the conversion (or improved drainage) of what has become commonly termed “farmed wetland”. It being the rebuttable assumption of the current USDA policies that all farmed wetlands will be converted and that acre-for-acre mitigation will be necessary to put the converted farmed wetlands back into production, the decision process is made a little easier—although mitigation is much costlier.

Mitigation options include the purchase of wetland credits in a mitigation bank. Mitigation banks are not common and their credits are expensive. We understand that the Iowa Agriculture Mitigation Bank, Inc. has available credits for farmed wetlands in this area of the

state. Another alternative is for the district to self-mitigate, wherein a mitigation plan to use a suitable site inside or outside the district on which to create wetlands for mitigation of impacted wetlands is developed for review and approval by the NRCS.

Farm program rules clearly provide that when a farmed wetland is converted by a drainage district the conversion act is attributed to the owner of the farmed wetland. However, the farm program rules also clearly provide that the owner of the converted farmed wetland may remain eligible for farm program benefits by opting to not farm the converted farmed wetland. If for some reason mitigation is delayed, this can be a temporary solution for the farmed wetland owners in a drainage district. It is also an option for those who choose not to report certified farmed wetland determinations and for which mitigation will not be provided.

#### Conservation Reserve Program Complications

We note that there may be areas of CRP along the proposed new drains alignments. There are some manageable drawbacks that must be addressed by the owners of affected CRP tracts.

The CRP includes an option to enroll farmed wetland and prior converted cropland where the underlying tile drains are disabled and a wetland cover is created. It has been our experience that if the disabled tile is not restored, the USDA may allow the land to stay in the CRP until the contract expires. However, only the landowner can seek and secure this waiver.

But, if a CRP site includes a certified farmed wetland and the USDA determines that it will be converted by the tile improvement project, the alternative of leaving the farmed wetland sit idle does not exist and mitigation will need to be secured immediately. The drainage district could make some reasonable accommodations, such as sealed pipe joints or an altered alignment, to help the owner, but it will be up to the owner to work with the USDA in securing immediate mitigation. Perhaps taking additional steps to make the CRP site wetter will be possible for the landowner.

#### CRP Damage Waivers

The destruction of CRP vegetation by construction activities places the landowner in technical violation of farm program conservation rules. The penalties can include loss of the CRP contract, forfeiture of back CRP payments and financial penalties. To avoid these penalties, landowners are advised to request a waiver from the USDA Farm Service Agency County Committee. The county committee will grant waivers for ditch or tile work if CRP vegetation restoration, in compliance with NRCS requirements, is timely done after the work is complete. If the project is authorized, all CRP owners in the path of construction must independently seek the FSA County Committee waivers. This process should be initiated immediately if the project is authorized.

#### Nesting Season Restrictions

The CRP rules also restrict disturbances during the primary nesting season, which covers the period of May 15 to August 1. Recent relaxations of this rule, although specific to drainage district maintenance of open ditches having CRP buffers, likely would now favor allowing tile installation work without penalty on CRP during the primary nesting season. It makes no sense for a drainage district to wait for up to 3 months during ideal work weather. This is another situation where only the landowner can seek and secure the needed waiver.

## IV. CLEAN WATER ACT COMPLIANCE

Dredging and filling of “waters of the United States” (WOTUS) is regulated under Section 404 of the Clean Water Act. In the 1990’s the USEPA & USACE adopted rules to extend section 404 jurisdiction to isolated wetlands, including farmed wetlands. For a few years it became necessary to get CWA Sec 404 permits for drainage district improvements where farmed wetland conversions were expected. Drainage districts were helped at the time with the issuance of a memorandum of



understanding entered into by 4 regulatory agencies. This agreement gave the NRCS primacy in mapping and regulating wetlands on agricultural land. Great relief came in 2001 when the U.S. Supreme Court ruled that isolated wetlands were not subject to CWA Sec 404 jurisdiction.

However, in 2012 the USEPA launched an aggressive rulemaking procedure to reestablish jurisdiction of isolated wetlands by revising the definition of “waters of the United States” (WOTUS) to include isolated wetlands. This massive rule change became effective on August 28, 2015. However, a temporary stay was imposed by the Sixth Circuit Court of Appeals in October 2015 and that stay remains in effect at this time and for an unknown period.

It is all but certain that if it were to be unleashed the WOTUS rule would 1) expand CWA Sec 404 jurisdiction to include all isolated farmed wetlands and even drained prairie potholes, 2) identify more jurisdictional wetland than has the USDA identified under the farm program and 3) demand more stringent and costly mitigation for the conversion of farmed wetland. That is assuming drainage improvements will be allowed at all – a scary thought but one that is applicable from a plain reading of the CWA Section 404(b)(1) guidelines which requires proof of inability to avoid draining a wetland before it can be drained and mitigated.

We are reasonably confident that until the WOTUS rule stay is lifted there are no CWA Section 404 jurisdictional wetlands found in the benefited area and that only the farm program wetland rules are in play. In addition, the new EPA chief has announced that the EPA will abandon the WOTUS rule and launch a new rule-making effort. Hopefully that rule will be less intrusive for drainage district landowners in the prairie pothole region.

## V. WATER QUALITY

The hydrologic impacts to tile drainage entail a complex interaction of processes dependent upon landscape, climatic, and human influences, watershed scale, soil permeability, and rainfall event size. There is a popular and often accepted idea that an increase in subsurface drainage facilities adds to an increase in both peak and total flow values, thereby increasing flooding. Recently published research from the University of Iowa’s IIHR – Hydroscience and Engineering Center refutes that perception. This University of Iowa report was the result of a water model study of the Clear Creek Watershed in Iowa and Johnson Counties and found that an increase in field tile and subsurface drainage decreases peak flows for most storm events. The field scale DRAINMOD model was used in the research in conjunction with a simplified routing equation to analyze the impact of tile drains in the Clear Creek Watershed.

However, additional steps are required to slow, impound, or infiltrate water to receive benefits in water quality. Water quality is a growing topic throughout the nation and more recently throughout Iowa. The particle loads and nutrient levels within drainage water is a concern that is receiving increased scrutiny. Processes and reduction practices are being developed and incorporated on farms and into projects throughout Iowa which reduce nitrogen loss and improve water quality. Enhancement of water quality is possible through many different drainage applications that can see both immediate and long-term benefits.

We encourage the landowners of this District to consider multi-purpose drainage management, which incorporates Best Management Practices (BMPs) which utilize effective measures aimed at reducing sediment and nutrient loading and improving water quality. These BMPs are divided into three (3) areas: preventative measures, control measures, and treatment measures.

**Preventative measures** that can be applied throughout the watershed including crop rotation, cover crops, residue management, and nutrient management. These measures are aimed at controlling sediment, minimizing erosion and nutrient loss, and sustaining the soils health, all without dramatically changing the current land use of the landscape.

**Control measures** are practices aimed at improving water quality directly associated with the flow of water by reducing peak flows, providing in-stream storage, sedimentation, and nutrient uptake. Examples of control measures include alternative tile intakes, grassed waterways, two (2) stage ditches, water control structures, and controlled subsurface drainage. These practices are directly linked to the conveyance of subsurface tile water or open channel ditch flow.

The function of **treatment measures** is to improve water quality by directly removing sediment and nutrients from the subsurface or surface water flow throughout a watershed. Examples of treatment measures include surge basins (storage ponds), filter/buffer strips, wetland restorations, woodchip bioreactors, and water and sediment control basins (WASCOBs).

These practices may be incorporated to either the public or private drainage systems. Funding options are available to landowners through the Environmental Quality Incentives Program (EQIP) and the Iowa Water Quality Initiative. EQIP is a voluntary program that provides financial assistance to individual landowners for various conservative practices as identified above. Also, the State of Iowa, through the Iowa Water Quality Initiative, provides cost share funds to participating landowners to voluntarily install nutrient reduction practices.

A unique opportunity may exist when a wetland is created within the district for the treatment of the tile and/or surface waters of the watershed. A properly sized and created wetland may be able to be utilized as a mitigation site for any farmed wetlands that are found within the drainage district. With the possibility of a large share of the created wetland being funded by the Iowa Water Quality Initiative program, any potential farmed wetlands could be mitigated at a much-reduced cost.

If there is landowner interest in any of these water quality features and funding options, further study and review would be required to select, site, and fund the water quality measures appropriate for the area.

## VI. PROPOSED WORK

### Tile Improvement

The investigation has confirmed the need for drainage relief within the district. Modern farming practices rely upon well drained soils to achieve maximum productivity. The standard design for drainage tile in northern Iowa is the ½” Dc. This standard is adequate for the majority of drainage districts in Worth County and is a cost-effective design to maximize the productivity of today’s farming practices. The ½” Dc would provide double the drainage capacity of the existing DD 48 Main Tile and Laterals and would be a substantial improvement for the lands in Drainage District No. 48.

When determining which tiles we recommend to be replaced, we looked at three criteria; are they are undersized, serve more than one landowner, and serve as outlets for additional tile. There are tiles that are undersized, however, if they didn’t meet the other two criteria we did not include them in this recommendation, as they would be less cost-effective to replace. We have prepared alignments and sizing for other lateral tiles, including Laterals 4A and 10 that could be added to this report if there is landowner interest in those areas. In the end, we recommend replacement of the Main, upper Lateral 2, Lower Lateral 2C, and Lateral 4 with a system designed according to modern standards.

The smaller lateral tiles and private tile systems currently sized to meet the ½” drainage coefficient would benefit from the proposed improvements allowing them the opportunity to take advantage of their capacity, whereas now, those lateral tiles are limited to the capacity of the downstream main and larger lateral tiles that serve as the outlet.



The proposed improvement plan is to divide the district into two areas, the north and the south. Each area will be served by its own tile. The south will be served by a new Lateral 2 and the old main west of the interstate, while the north will be served by a new main tile. The removal of the north lands off the old main brings the drainage coefficient of the old main serving the south to meet the recommended ½” drainage coefficient.

The proposed tiles will generally follow similar routes as the existing tiles following the valleys of the district. Each proposed tile route is described below.

- The Main Tile would outlet approximately ½ mile upstream of the current outlet. From this outlet, it crosses Interstate 35 and then closely follows the existing tile with a simplified path; the main alternates running north and northeast following the valleys. It crosses under 400<sup>th</sup> Street and Jonquil Ave before terminating in the NE NW of Seciton of Section 34. Total length is 12,650 LF.
- Lateral 2 outlets into the existing main at station 23+64 of the main. Generally following the old tile path, it heads southeast crossing 350<sup>th</sup> St. and ending just south of 390<sup>th</sup> Street. The proposed length to be replaced is approximately 5,000 LF.
- Lateral 2C outlets at Station 24+24 of Lateral 2. It runs northeast ending in the SW NW of section 4.
- Lateral 4 outlets at Station 53+68 of the Main. It runs northeast, then turning east crossing under Jonquil Street. The total length of Lateral 4 is approximately 4,700 LF.

The preliminary plans included in this report shows the proposed tile routes in more detail.

Where the existing tile is crossed, the upstream end will be connected to the proposed main and the downstream end will be capped to allow the tile to continue functioning as a collector to bring smaller private tile to the new main. The function of the existing tile will be replaced by the new system and it is recommended that the existing facilities be abandoned as district facilities. Maintenance of these tiles will be turned over to the landowners following completion of the project. The final construction plans will include a detail showing how private tiles will be connected to the new tile.

It is recommended that this new tile be constructed using tongue and groove reinforced concrete pipe (RCP). RCP is recommended over dual wall HDPE pipe for several reasons including, less demanding installation requirements, assured smooth walls, and proven longevity of the material. To comply with the manufacturers recommended installation methods, the dual wall HDPE pipe would need to be completely encased in crushed rock. The inclusion of this bedding envelope raises the cost of the dual wall HDPE installation above the typical installation cost of RCP and this increase in rock can cause additional compaction hauling the rock along the route. RCP also does not deform under the weight of the soil. In cases where dual wall HDPE has been used, such deformation stresses the liner, causing rippling and detachment. Finally, the existing rigid wall tile mains found throughout north central Iowa were constructed of clay or concrete and these materials have shown their durability over the past 100 years. The US Army Corps of Engineer’s estimates the useful life of RCP pipes at 250 years, while HDPE pipe’s useful life is estimated at 50 years.

Each lateral tile improvement will be paid for by the lands that it benefits. For example, a landowner on Lateral 2 will not pay for the Main Tile (north) work as his land does not benefit from the Main Tile (north) and vice versa is also true. The recommended improvement is designed to be as cost-effective as possible providing the recommended drainage coefficient utilizing the existing tiles as much as possible to save costs.

The table on the next page shows the breakdown of only the estimated construction costs for each facility of the proposed improvements. Please be reminded that assessments are based upon benefits, and that following reclassification some highly benefited parcels will likely bear 2 to 2 ½ times the average assessments. A complete opinion of probable total costs is included in Appendix C of this report.

Estimated Construction Costs Summary			
Facility	Estimated Construction Cost (\$)	Acres Served (ac)	Cost per Acre (\$/ac)
<b>Improvement</b>			
Main Tile (North)	\$824,000	1,042	\$790
Lateral 2 (South)	\$354,000	1,113	\$318
Lateral 2C (South)	\$91,000	390	\$222
Lateral 4 (North)	\$208,000	282	\$710

We recommend Lateral 2 purchase the old main west of the interstate from the new north main. Assuming the existing tile is at 70% of its service life, the benefit of removing the north lands would be the cost of a 36" tile multiplied by 30% for the remaining life equaling \$55,000. The south lands would then be assessed this \$55,000, or \$52 per acre.

#### Utilities

Overhead and buried power lines and other utility lines likely parallel or cross the tile at various locations. Extra care will need to be taken when working under or near these utility lines. The contractor will be responsible to use Iowa One Call to notify utility companies and to cooperate in the locating, marking, and protection of these facilities.

#### Road Crossing

One interstate, three gravel county secondary and one hardtop county primary road crossings are required as part of the recommended improvement. It is assumed that all the gravel road crossings will be open cut, while the paved road crossings will be bored. The table below summarizes the road crossings which are part of the proposed tile improvement.

Tile Road Crossings					
Road	Control Agency	Type	Facility	Station	Diameter
I-35	Iowa DOT	Bore	Main	4+52	30"
400 <sup>th</sup> Street	Worth County	Open Cut	Main	24+95	30"
Jonquil Ave	Worth County	Open Cut	Main	112+86	18"
390 <sup>th</sup> Street	Worth County	Bore	Lat. 2	49+35	24"
Jonquil Ave	Worth County	Open Cut	Lat. 4	46+38	12"

Iowa Code Section 468 requires that all costs of primary and secondary road crossing are to be paid from funds available to the entity that controls the road. The estimated cost to the Iowa DOT is \$202,000. The total estimated cost to the Worth County Secondary Roads is \$82,000.

#### Work Limits

The district will need an area to install the tile. The extent of the work limits on the tile will be finalized when the final construction plans are developed, but it will typically be out to 50-100 feet from the tile centerline on the side or sides on which work will be done. Landowners will be entitled to compensation for damages in the work area.

## VII. EXISTING SCHEDULE REVIEW

### Benefited Lands Not Now Assessed

There are approximately 2,216 acres that benefit from Drainage District No. 48, of which approximately 13 acres have never been assessed for benefits from district facilities. This area is shown on Benefitted Lands Map in Appendix B of this report. Annexation is expected to cost approximately \$2,000.

### Existing Assessment Schedule Review

Drainage District No. 48 uses the original schedule developed in 1920. This schedule doesn't list acres for each parcel and all the facilities are included in this single assessment schedule. Appendix B contains a list of all lands benefited by each of the proposed facilities. Appendix B also contains a map showing the existing benefited units assessed per acre and classification for each parcel in the currently assessed area of DD 48. Regardless if this improvement is approved, the Board of Trustees has appointed us to make a new classification schedule for Drainage District No. 48.

It has become common practice with reclassification to separate all facilities within a district into individual schedules to prevent landowners who receive no benefit from a particular named facility from having to pay to maintain that facility. It is recommended that the proposed tiles be divided into separate maintenance schedules to make the cost of future repairs more equitable.

Before a decision is made, an estimate for the cost of a proposed project for each benefitted parcel can be made available. The Board may direct the engineer to develop a pre-classification similar to what the benefit commission would consider at the end of the project, but to less detail. A pre-classification of this type could be developed for approximately \$5,000. Please be reminded that a pre-classification is a rough estimate only. The final approved distribution would still be subject to review by the commission appointed by the Board, and the final changes be made by the Board at the reclassification hearing at the end of the project.

### General Classification Methodology

The process of reclassification uses several factors to equitably spread project costs based upon benefits received. The three common factors are: Use; Proximity; and Wetness.

The Use Factor considers how much of the facility is required to bring an outlet to a particular location. The more a facility is used by any given property, the higher the Use Factor on that property. A parcel using one mile of a facility should pay less than a parcel using 5 miles of the facility.

The Proximity Factor considers the portion of the outlet provided. Lands nearer to the ditch receive a higher assessment because they have easy access to district facilities. Lands farther from the facility must invest in additional private drainage to access the facility. A 40 acre tract which is crossed by a ditch should pay more than a 40-acre tract a mile away which must build a private system to reach the open ditch.

The Wetness Factor accounts for the soil types' varying natural wetness and need for drainage. Wet soils in a pothole are high because the soils have more need for drainage than drier soils on the hill tops.

Other considerations may be necessary to achieve equitable assessments.

## VIII. DISCUSSIONS & RECOMMENDATIONS

This report confirms the need to improve the drainage efficiency and capacity of the Drainage District No. 48 drainage system. The work described herein can accomplish that improvement.

**Improvement Recommended.** The improvements proposed will provide the drainage capacity needed for modern farming practices. We find that the proposed improvements will be practicable, feasible, and beneficial to the public.

**Annexation Recommended.** Approximately 13 acres appear to benefit from district facilities but have not been assessed for maintenance costs of the facilities. For these lands to now be assessed to help pay for future maintenance, it is necessary to bring them into the Drainage District No. 48 benefited area. The benefited lands listed in Appendix B include these lands.

**Reclassification Recommended.** The existing assessment schedule is inequitable and should be reclassified, separating the several district facilities into separate maintenance schedules at the same time. Reclassification is expected to cost approximately \$5 per acre for each schedule developed.

**Installment Payments.** Iowa drainage district law provides that large improvement assessments may be paid in no less than ten nor more than twenty annual installments at the discretion of the Board of Supervisors. We anticipate that the Board will spread assessments of the magnitude contemplated in this report over twenty years. If we assume that the Board will allow twenty annual installments at 8% interest, the costs for all benefited lands would be about \$85 per acre per year for all the recommended improvements. Please be reminded that assessments are based upon benefits and that following reclassification some highly benefited parcels will likely bear 2 to 2½ times the average assessments.

The average price received by Iowa corn growers in the last 5 years when adjusted for inflation has been \$5.07/bushel. Assuming corn averages \$5.00/bushel over the next 20 years and using only the increase in revenue from an assumed 10% yield increase for the north lands, an average assessment for the recommended ½” Dc could be repaid in approximately 12 years. Assuming a 5% yield increase for the south lands, the payback period is approximately 13 years. These improvements would likely continue to function well for another century bringing continued benefit to future generations and owners.

It is recommended that the Board of Supervisors of Worth County, acting as trustees for Drainage District No. 48, take appropriate action with legal guidance to accomplish the following:

- Tentatively approve this Engineer’s Report.
- Conduct a public hearing on the proposed improvements, including discussions regarding annexation and reclassification.
- Adopt the improvement plan, modified as deemed appropriate to satisfy the needs of the district.
- Direct the Engineer to prepare the necessary plans and specifications and to proceed toward a bid letting.
- Initiate procedures to annex benefited lands to Drainage District No. 48.
- Initiate reclassification procedures.

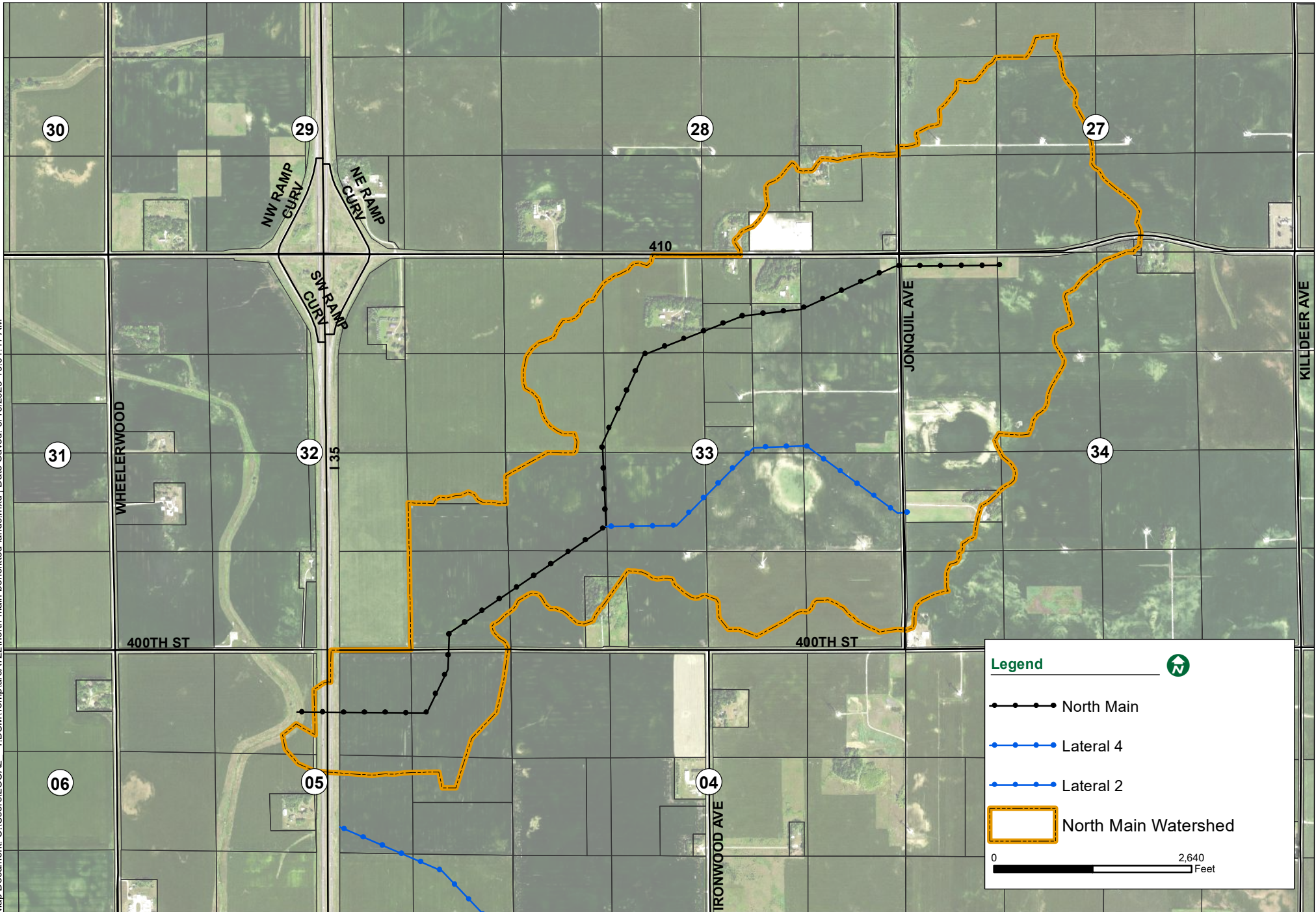
Respectfully submitted,

**Bolton & Menk, Inc.**

Appendix A: Existing Schedule Review  
& Benefitted Lands Schedule



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**Legend**

- North Main
- Lateral 4
- Lateral 2
- North Main Watershed

0 2,640 Feet

**NORTH MAIN BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
BERGE FARMS LLC	0632400005	32-99-21	SECTION:32 TOWNSHIP:99 RANGE:21 N 1/2 NE SE BROOKFIELD	1.6
BLUESTEM TRUST, TRUSTEES	0627300002	27-99-21	SECTION:27 TOWNSHIP:99 RANGE:21 NE SW BROOKFIELD	32.4
BLUESTEM TRUST, TRUSTEES	0627300004	27-99-21	SECTION:27 TOWNSHIP:99 RANGE:21 SE SW BROOKFIELD	37.55
BLUESTEM TRUST, TRUSTEES	0627400002	27-99-21	SECTION:27 TOWNSHIP:99 RANGE:21 SW SE EXC PAR BROOKFIELD	7.9
HELGESON, DAVID J TRUST & GLORIA J TRUST	0627100004	27-99-21	SECTION:27 TOWNSHIP:99 RANGE:21 SE NW BROOKFIELD	2
HOLSTAD, MARK A & MARY L	0634300007	34-99-22	34 99 21 PAR "A" SW SW	0.6
JOHNSON, LARRY REVOCABLE TRUST	0633400003	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SW SE BROOKFIELD	28.7
JOHNSON, LARRY REVOCABLE TRUST	0633400004	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE SE BROOKFIELD	25.6
JOHNSON, LARRY REVOCABLE TRUST	1005200001	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 NW NE EX PAR DANVILLE	30.9
JOHNSON, LARRY REVOCABLE TRUST	1005200002	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 SW NE EX PAR DANVILLE	5.6

**NORTH MAIN BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
JOHNSON, LARRY REVOCABLE TRUST	1005200003	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 FRL NE NE DANVILLE	34.2
JOHNSON, LARRY REVOCABLE TRUST	1005200004	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 N 1/2 SE NE DANVILLE	4.3
JOHNSON, SUSAN MARIE	0633300009	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 PAR IN S 1/2 SW BROOKFIELD	4.2
KIEWIET FARMS LLLP	0632400003	32-99-21	SECTION:32 TOWNSHIP:99 RANGE:21 NW SE EXC PARS BROOKFIELD	0
KIEWIET FARMS LLLP	0632400004	32-99-21	SECTION:32 TOWNSHIP:99 RANGE:21 SW SE EXC PAR BROOKFIELD	0
KING JR, RALEIGH S & SMITH, CONNIE P	0627400007	27-99-21	27-99-21 PAR. IN SW SE	1.4
KING, RALEIGH S JR & SMITH, CONNIE P	0627400006	27-99-21	27-99-21 PAR SW SE 27-99-21(.40) & PAR NW NE 34-99-21 (.12)	0.2
LEERAR, JEFFREY A	1005100002	05-98-21	5-98-21 FRL. NE NW	3
LEERAR, JEFFREY A	1005100005	05-98-21	5-98-21 SE NW EX PAR	1
MATZEN, STEVE ET AL & DARLENE M L/E	0633200004	33-99-21	33-99-21 NW SW NE	10
MATZEN, STEVE ET AL & DARLENE M L/E	0633200005	33-99-21	33-99-21 N 1/2 SW SW NE	5.0
MATZEN, STEVE ET AL & DARLENE M L/E	0633200014	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 PAR IN NW NE BROOKFIELD	18.92
MOHLER, G. RUSSELL & JULIE A.	0628400005	28-99-21-11-1-2-22	28 99 21 PAR. 11 1/2X14 RDS.IN SE COR. SE SE	0.93
MYLI, SUZANNE 1/3 INT LE 1/12	0633100001	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NW NW BROOKFIELD	9.7



**NORTH MAIN BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
MYLI, SUZANNE 1/3 INT LE 1/12	0633100002	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NE NW BROOKFIELD	35.9
MYLI, SUZANNE 1/3 INT LE 1/12	0633100003	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SW NW BROOKFIELD	25.2
MYLI, SUZANNE 1/3 INT LE 1/12	0633100004	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE NW BROOKFIELD	40
MYLI, SUZANNE 52/180 INT L/E 13/180	0633200009	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NE NW NE BROOKFIELD	9.23
MYLI, SUZANNE 52/180 INT L/E 13/180	0633200012	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NE NE BROOKFIELD	37.49
MYLI, SUZANNE 52/180 INT L/E 13/180	0633200013	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE NE BROOKFIELD	39
PETERSON, MARLENE D TRUST	0627300001	27-99-21	SECTION:27 TOWNSHIP:99 RANGE:21 NW SW BROOKFIELD	20.2
PETERSON, MARLENE D TRUST	0627300003	27-99-21	SECTION:27 TOWNSHIP:99 RANGE:21 SW SW BROOKFIELD	37.49
PETERSON, MARLENE D TRUST	0628400019	28-99-21	SECTION:28 TOWNSHIP:99 RANGE:21 SE SE EX PARS BROOKFIELD	30.2
PETERSON, MARLENE D TRUST	0633200006	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 S 1/2 SW SW NE BROOKFIELD	5

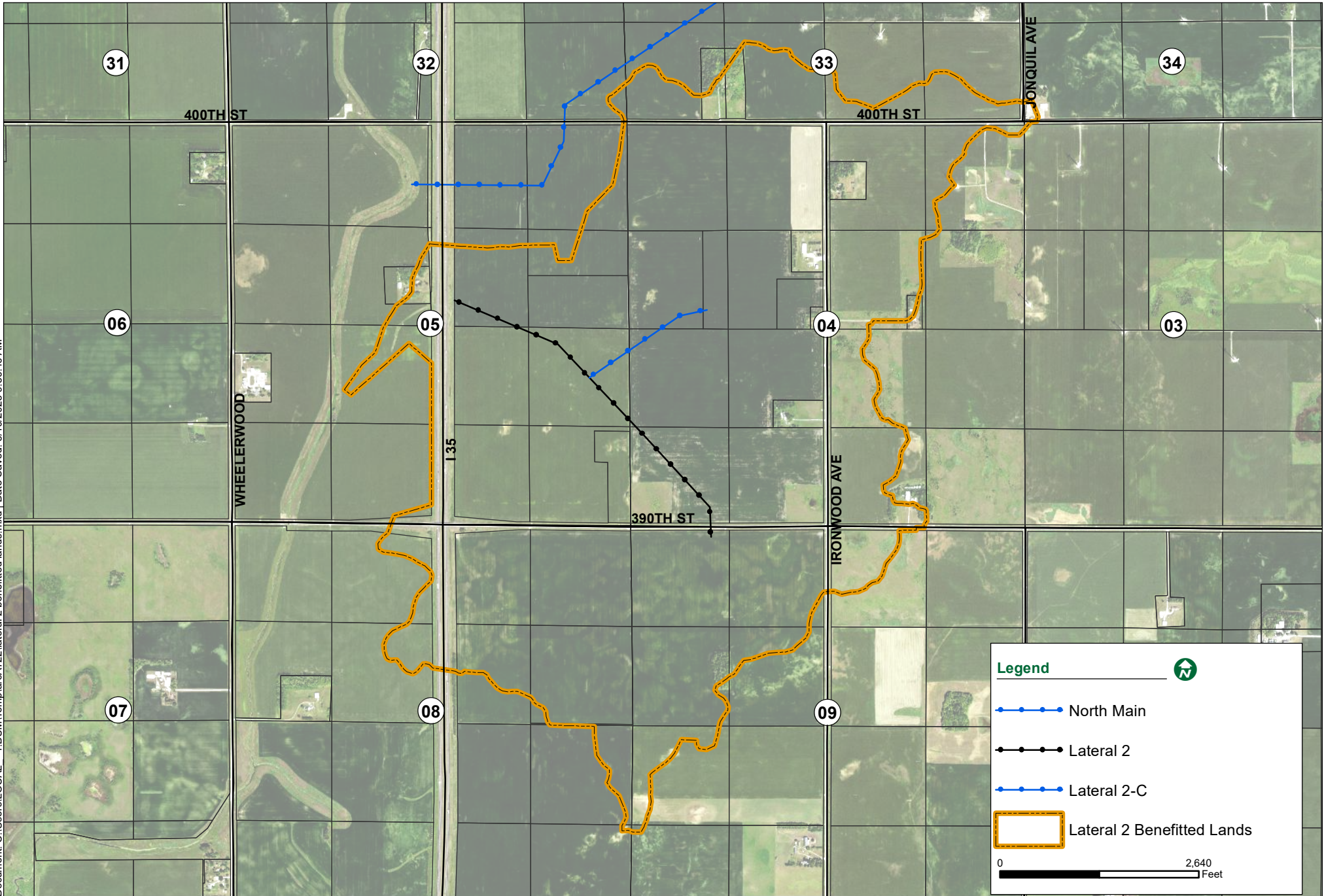
**NORTH MAIN BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
PETERSON, MARLENE D TRUST	0633200007	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 E 20' NW NW NE BROOKFIELD	0.3
PETERSON, MARLENE D TRUST	0633200010	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE NW NE BROOKFIELD	9.9
PETERSON, MARLENE D TRUST	0633200011	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 E 1/2 SW NE BROOKFIELD	20.2
PETERSON, MARLENE D TRUST	0633400001	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NW SE BROOKFIELD	40
PETERSON, MARLENE D TRUST	0633400002	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NE SE BROOKFIELD	39
REDSTEM TRUST, TRUSTEES	0634100001	34-99-21	SECTION:34 TOWNSHIP:99 RANGE:21 NW NW BROOKFIELD	37.49
REDSTEM TRUST, TRUSTEES	0634100002	34-99-21	SECTION:34 TOWNSHIP:99 RANGE:21 NE NW BROOKFIELD	29.6
REDSTEM TRUST, TRUSTEES	0634100003	34-99-21	34-99-21 SW NW	39
REDSTEM TRUST, TRUSTEES	0634100004	34-99-21	34-99-21 SE NW	16.1
REDSTEM TRUST, TRUSTEES	0634200001	34-99-21	SECTION:34 TOWNSHIP:99 RANGE:21 NW NE EXC PAR BROOKFIELD	0.8
REDSTEM TRUST, TRUSTEES	0634300002	34-99-21	34-99-21 NE SW	1.3
REDSTEM TRUST, TRUSTEES	0634300005	34-99-21	34-99-21 NW SW EXC TRACT "A"	22.7
ROTHOVE, PATRICIA H TRUST	0634300006	34-99-21	SECTION:34 TOWNSHIP:99 RANGE:21 TRACT "A" IN NW SW BROOKFIELD	10.4

**NORTH MAIN BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
SCHACHT, RONALD E & DENISE A	0628400016	28-99-22	SECTION:28 TOWNSHIP:99 RANGE:21 PAR "B" IN SE BROOKFIELD	2.9
TWEETEN, ROGER	0634300008	34-99-21	34 99 21 SW SW EX PAR "A"	8.5
WORTH COUNTY FARM ASSOC., INC	0632400006	32-99-21	32-99-21 S 1/2 NE SE	20
WORTH COUNTY FARM ASSOC., INC	0632400007	32-99-21	32-99-21 SE SE	37.5
WORTH COUNTY FARM ASSOC., INC	0633300001	33-99-21	33-99-21 NW SW	38.1
WORTH COUNTY FARM ASSOC., INC	0633300002	33-99-21	33-99-21 NE SW	40
WORTH COUNTY FARM ASSOC., INC	0633300005	33-99-21	33-99-21 SW SW EX. PAR.	19.8
WORTH COUNTY FARM ASSOC., INC	0633300007	33-99-21	33-99-21 SE SW EX. PAR.	12.4
IOWA DOT				9.5
WORTH COUNTY SECONDARY ROADS				26.5
<b>Total</b>				<b>1027.4</b>

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**LATERAL 2 BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
BENDICKSON, DREW	1009200001	09-98-21	SECTION:09 TOWNSHIP:98 RANGE:21 NW NE DANVILLE	14
BRATRUD, DANIEL H & GERALDINE K	1004200007	4-98-21	4 98 21 PAR. IN SE COR. SW NE	0.9
BRUNSVOLD, HAROLD N	1009300001	9-98-21	9 98 21 NW SW	14.1
BRUNSVOLD, HAROLD N	1009300003	9-98-21	9 98 21 SW SW	0.3
BUTLER, HEATHER JO	1004100006	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 PAR 220' X 272' IN SE NW DANVILLE	1.12
BUTLER, HEATHER JO	1004100012	4-98-21	4 98 21 PAR "B" IN SE SE NW	0.16
FABER, HELEN F REV TRUST	1008200001	8-98-21	8 98 21 NW NE EX. PAR.	28.3
FABER, HELEN F REV TRUST	1008200002	8-98-21	8 98 21 SW NE EX. PAR.	17.4
FABER, HELEN F TRUST	1008200003	8-98-21	8 98 21 NE NE	38.33
FABER, HELEN F TRUST	1008200004	8-98-21	8 98 21 SE NE EX. S. 1 RD.	39.1
FABER, HELEN F TRUST	1008200005	8-98-21	8 98 21 S. 1 RD. NE EX. PAR.	0.4
FABER, HELEN F TRUST	1009100001	9-98-21	9 98 21 NW NW	38.34
FABER, HELEN F TRUST	1009100002	9-98-21	9 98 21 NE NW	35.6
HANNA, RANDALL D	1008100002	08-98-21	SECTION:08 TOWNSHIP:98 RANGE:21 NE NW EXC PAR DANVILLE	7.4
HANNA, RANDALL D	1008100004	08-98-21	SECTION:08 TOWNSHIP:98 RANGE:21 SE NW DANVILLE	7.6
HOLSTAD, MARK A & MARY L	0634300007	34-99-21	34 99 21 PAR "A" SW SW	0.8
JOHNSON, LARRY REVOCABLE TRUST	0633400003	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SW SE BROOKFIELD	9.9

**LATERAL 2 BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
JOHNSON, LARRY REVOCABLE TRUST	0633400004	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE SE BROOKFIELD	11.6
JOHNSON, LARRY REVOCABLE TRUST	1004100001	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NW NW DANVILLE	42.5
JOHNSON, LARRY REVOCABLE TRUST	1004100002	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NE NW DANVILLE	40.77
JOHNSON, LARRY REVOCABLE TRUST	1005200002	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 SW NE EX PAR DANVILLE	24.1
JOHNSON, LARRY REVOCABLE TRUST	1005200003	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 FRL NE NE DANVILLE	8.5
JOHNSON, LARRY REVOCABLE TRUST	1005200004	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 N 1/2 SE NE DANVILLE	14.1
JOHNSON, LARRY REVOCABLE TRUST	1005200005	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 S 1/2 SE NE DANVILLE	20
JOHNSON, LARRY REVOCABLE TRUST	1005300002	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 NE SW DANVILLE	8.6
JOHNSON, LARRY REVOCABLE TRUST	1005300004	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 SE SW EX PAR DANVILLE	0.9
JOHNSON, LARRY TRUST	1005400001	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 NW SE EX PAR DANVILLE	30.3

**LATERAL 2 BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
JOHNSON, LARRY TRUST	1005400002	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 NE SE DANVILLE	40
JOHNSON, LARRY TRUST	1005400003	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 SW SE EX PAR DANVILLE	28.53
JOHNSON, LARRY TRUST	1005400004	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 SE SE EX PAR DANVILLE	28
JOHNSON, LARRY TRUST	1005400005	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 PAR IN SE SE DANVILLE	10.33
JOHNSON, STEVEN D	1005100006	5-98-21	5 98 21 PAR IN SE NW	2.9
JOHNSON, SUSAN MARIE	0633300009	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 PAR IN S 1/2 SW BROOKFIELD	8.2
LAWSON, JOHN D & MAGGIE A	1004300006	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 PAR A IN NE SW DANVILLE	1.8
LAWSON, JOHN D & MAGGIE A	1004300006	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 PAR A IN NE SW DANVILLE	5.57
LEERAR, JEFFREY A	1005100005	5-98-21	5-98-21 SE NW EX PAR	4.1
LESTRUD, EDNA M	1009100003	09-98-21	SECTION:09 TOWNSHIP:98 RANGE:21 SW NW DANVILLE	37.5
LESTRUD, EDNA M	1009100004	09-98-21	SECTION:09 TOWNSHIP:98 RANGE:21 SE NW DANVILLE	9.1
MAR-DAN ENTERPRISES INC	1004200005	4-98-21	4 98 21 SE NE	0.3
MAR-DAN ENTERPRISES INC	1004200006	4-98-21	4 98 21 SW NE EX. PAR.	33.3
MAR-DAN ENTERPRISES INC	1004300003	4-98-21	4 98 21 SW SW	38.34

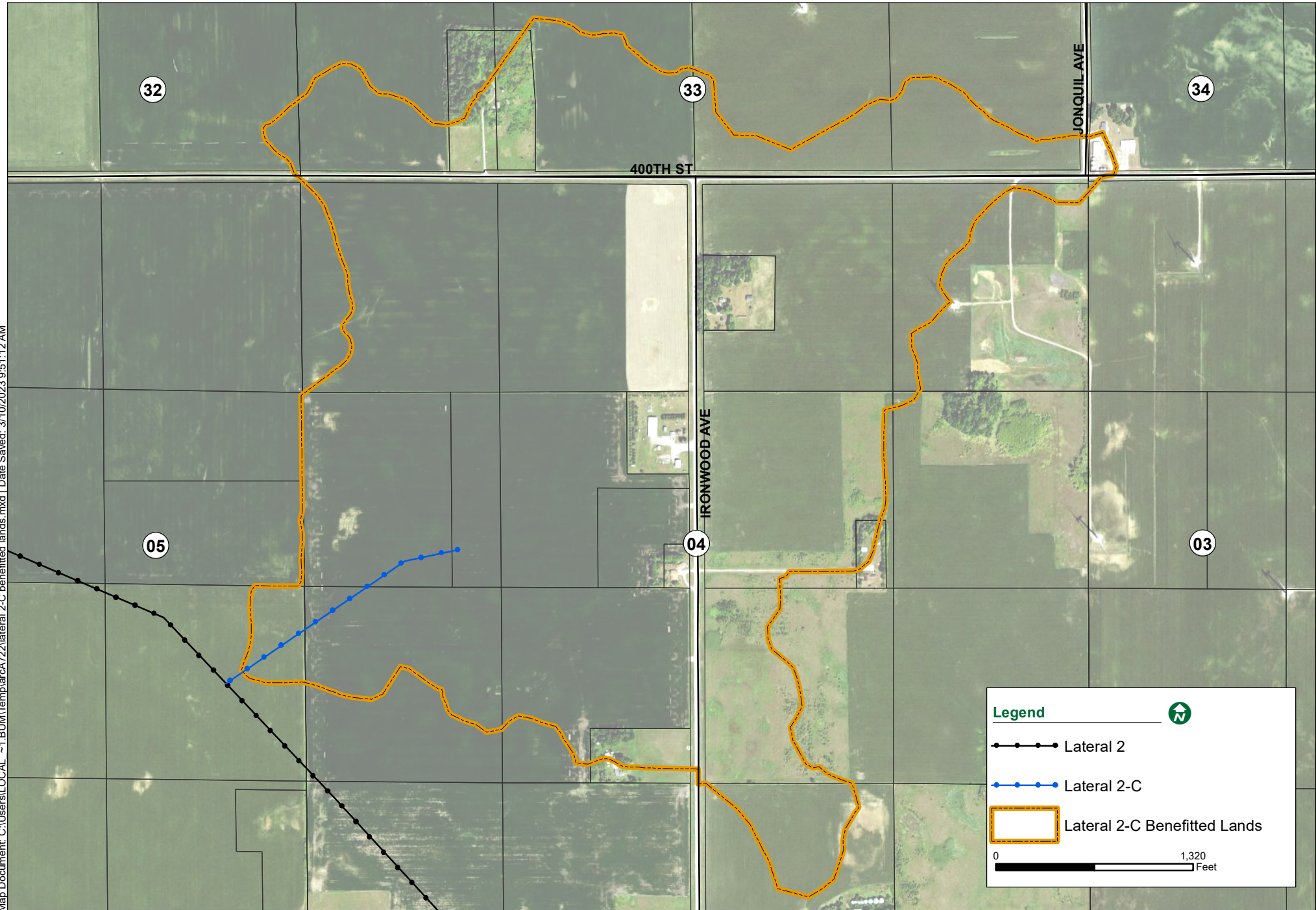
**LATERAL 2 BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
MAR-DAN ENTERPRISES INC	1004300004	4-98-21	4 98 21 SE SW	36.86
MAR-DAN ENTERPRISES INC	1004400001	4-98-21	4 98 21 NW SE	17.4
MAR-DAN ENTERPRISES INC & BRATRUD, MARVIN L & SHIRLEY A	1004400003	4-98-21	4 98 21 SW SE	28
PLOW BACK LLC	1008400002	08-98-21	SECTION:08 TOWNSHIP:98 RANGE:21 NE SE DANVILLE	9.7
PLOW BACK LLC	1008400004	08-98-21	SECTION:08 TOWNSHIP:98 RANGE:21 SE SE DANVILLE	0.2
ROTHOVE, MELVIN	1004100008	4-98-21	4 98 21 PAR. IN SW NW	10
ROTHOVE, MELVIN	1004100009	4-98-21	4 98 21 SE NW EX PARS	24
ROTHOVE, MELVIN	1004100011	4-98-21	4 98 21 SE SE NW EX. TRACT220'X272' & EX PAR B	7.97
ROTHOVE, MELVIN F.	1004100007	4-98-21	4 98 21 SW NW EX PAR	30
ROTHOVE, MELVIN F.	1004300001	4-98-21	4 98 21 NW SW	40
ROTHOVE, MELVIN F.	1004300005	4-98-21	4 98 21 NE SW EX PAR	32.92
ROTHOVE, TODD	1004100010	4-98-21	4-98-21 PAR IN SE NW4- 98-21	5.24
THOMPSON, ALLAN J.	1004200001	4-98-21	4 98 21 PAR. IN NW NE	5.51
TWEETEN, BRIAN	1004200003	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NE NE DANVILLE	12.8
TWEETEN, BRIAN & JULIE	1003100001	3-98-21	3 98 21 FRL. NW NW	0.1
TWEETEN, ROGER	1004200002	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NW NE EXC PAR DANVILLE	35.32
WORTH COUNTY FARM ASSOC., INC	0632400007	32-99-21	32-99-21 SE SE	1.5
WORTH COUNTY FARM ASSOC., INC	0633300005	33-99-21	33-99-21 SW SW EX. PAR.	12.3
WORTH COUNTY FARM ASSOC., INC	0633300007	33-99-21	33-99-21 SE SW EX. PAR.	21



**LATERAL 2 BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

<b>Deedholder(s)</b>	<b>Parcel Number</b>	<b>S-T-R</b>	<b>Legal Description</b>	<b>Benefited Area (ac)</b>
IOWA DOT				40.6
WORTH COUNTY SECONDARY ROADS				43.0
			<b>Total</b>	<b>1117.5</b>



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**LATERAL 2C BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

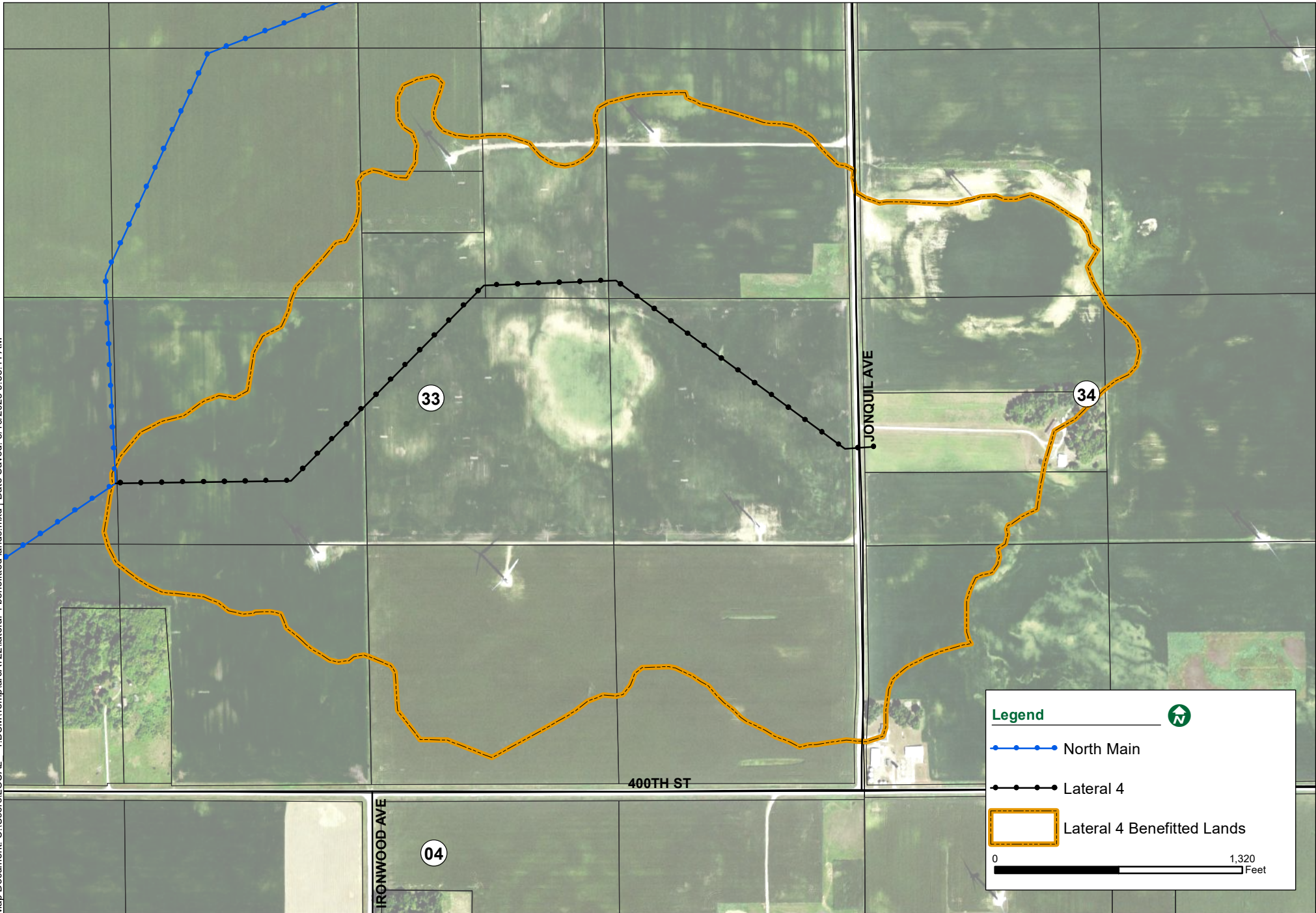
Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
BRATRUD, DANIEL H & GERALDINE K	1004200007	4-98-21	4 98 21 PAR. IN SE COR. SW NE	0.9
BUTLER, HEATHER JO	1004100006	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 PAR 220' X 272' IN SE NW DANVILLE	1.12
BUTLER, HEATHER JO	1004100012	4-98-21	4 98 21 PAR "B" IN SE SE NW	0.16
HOLSTAD, MARK A & MARY L	0634300007	34-99-21	34 99 21 PAR "A" SW SW	0.8
JOHNSON, LARRY REVOCABLE TRUST	0633400003	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SW SE BROOKFIELD	9.9
JOHNSON, LARRY REVOCABLE TRUST	0633400004	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE SE BROOKFIELD	11.6
JOHNSON, LARRY REVOCABLE TRUST	1004100001	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NW NW DANVILLE	34.7
JOHNSON, LARRY REVOCABLE TRUST	1004100002	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NE NW DANVILLE	40.77
JOHNSON, LARRY REVOCABLE TRUST	1005200004	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 N 1/2 SE NE DANVILLE	0.1
JOHNSON, LARRY REVOCABLE TRUST	1005200005	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 S 1/2 SE NE DANVILLE	0.3
JOHNSON, LARRY TRUST	1005400002	05-98-21	SECTION:05 TOWNSHIP:98 RANGE:21 NE SE DANVILLE	5.5
JOHNSON, SUSAN MARIE	0633300009	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 PAR IN S 1/2 SW BROOKFIELD	8.2

**LATERAL 2C BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
LAWSON, JOHN D & MAGGIE A	1004300006	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 PAR A IN NE SW DANVILLE	3.8
MAR-DAN ENTERPRISES INC	1004200005	4-98-21	4 98 21 SE NE	0.3
MAR-DAN ENTERPRISES INC	1004200006	4-98-21	4 98 21 SW NE EX. PAR.	33.3
MAR-DAN ENTERPRISES INC	1004400001	4-98-21	4 98 21 NW SE	17.4
MAR-DAN ENTERPRISES INC & BRATRUD, MARVIN L & SHIRLEY A	1004400003	4-98-21	4 98 21 SW SE	10.4
ROTHOVE, MELVIN	1004100008	4-98-21	4 98 21 PAR. IN SW NW	10
ROTHOVE, MELVIN	1004100009	4-98-21	4 98 21 SE NW EX PARS	24
ROTHOVE, MELVIN	1004100011	4-98-21	4 98 21 SE SE NW EX. TRACT220'X272' & EX PAR B	7.97
ROTHOVE, MELVIN F.	1004100007	4-98-21	4 98 21 SW NW EX PAR	29.5
ROTHOVE, MELVIN F.	1004300001	4-98-21	4 98 21 NW SW	22.4
ROTHOVE, MELVIN F.	1004300005	4-98-21	4 98 21 NE SW EX PAR	27.6
ROTHOVE, TODD	1004100010	4-98-21	4-98-21 PAR IN SE NW4- 98-21	5.24
THOMPSON, ALLAN J.	1004200001	4-98-21	4 98 21 PAR. IN NW NE	5.51
TWEETEN, BRIAN	1004200003	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NE NE DANVILLE	12.8
TWEETEN, BRIAN & JULIE	1003100001	3-98-21	3 98 21 FRL. NW NW	0.1
TWEETEN, ROGER	1004200002	04-98-21	SECTION:04 TOWNSHIP:98 RANGE:21 FRL NW NE EXC PAR DANVILLE	35.32
WORTH COUNTY FARM ASSOC., INC	0632400007	32-99-21	32-99-21 SE SE	1.5
WORTH COUNTY FARM ASSOC., INC	0633300005	33-99-21	33-99-21 SW SW EX. PAR.	12.3
WORTH COUNTY FARM ASSOC., INC	0633300007	33-99-21	33-99-21 SE SW EX. PAR.	21
WORTH COUNTY SECONDARY ROADS				20.0
<b>Total</b>				<b>414.5</b>



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**LATERAL 4 BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
HOLSTAD, MARK A & MARY L	0634300007	34-99-21	34 99 21 PAR "A" SW SW	0.6
JOHNSON, LARRY REVOCABLE TRUST	0633400003	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SW SE BROOKFIELD	28.7
JOHNSON, LARRY REVOCABLE TRUST	0633400004	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE SE BROOKFIELD	25.6
MATZEN, STEVE ET AL & DARLENE M L/E	0633200004	33-99-21	33-99-21 NW SW NE	2.9
MATZEN, STEVE ET AL & DARLENE M L/E	0633200005	33-99-21	33-99-21 N 1/2 SW SW NE	5
MYLI, SUZANNE 1/3 INT LE 1/12	0633100004	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE NW BROOKFIELD	2.1
MYLI, SUZANNE 52/180 INT L/E 13/180	0633200013	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 SE NE BROOKFIELD	28.8
PETERSON, MARLENE D TRUST	0633200006	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 S 1/2 SW SW NE BROOKFIELD	5
PETERSON, MARLENE D TRUST	0633200011	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 E 1/2 SW NE BROOKFIELD	12.2
PETERSON, MARLENE D TRUST	0633400001	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NW SE BROOKFIELD	40
PETERSON, MARLENE D TRUST	0633400002	33-99-21	SECTION:33 TOWNSHIP:99 RANGE:21 NE SE BROOKFIELD	39
REDSTEM TRUST, TRUSTEES	0634100003	34-99-21	34-99-21 SW NW	14.2
REDSTEM TRUST, TRUSTEES	0634300002	34-99-21	34-99-21 NE SW	1.3
REDSTEM TRUST, TRUSTEES	0634300005	34-99-21	34-99-21 NW SW EXC TRACT "A"	22.7

**LATERAL 4 BENEFITED AREA  
DRAINAGE DISTRICT NO. 48  
WORTH COUNTY, IA**

Deedholder(s)	Parcel Number	S-T-R	Legal Description	Benefited Area (ac)
ROTHOVE, PATRICIA H TRUST	0634300006	34-99-21	SECTION:34 TOWNSHIP:99 RANGE:21 TRACT "A" IN NW SW BROOKFIELD	10.4
TWEETEN, ROGER	0634300008	34-99-21	34 99 21 SW SW EX PAR "A"	8.5
WORTH COUNTY FARM ASSOC., INC	0633300001	33-99-21	33-99-21 NW SW	0.5
WORTH COUNTY FARM ASSOC., INC	0633300002	33-99-21	33-99-21 NE SW	28.7
WORTH COUNTY FARM ASSOC., INC	0633300005	33-99-21	33-99-21 SW SW EX. PAR.	0.1
WORTH COUNTY FARM ASSOC., INC	0633300007	33-99-21	33-99-21 SE SW EX. PAR.	11.6
WORTH COUNTY SECONDARY ROADS				4.6
			<b>Total</b>	<b>292.5</b>

## Appendix B: Engineer's Opinion of Probable Cost



**Drainage District No. 48**  
**Proposed Drainage Improvements**  
**Worth County, Iowa**  
**OPINION OF PROBABLE COSTS**  
**Friday, March 10, 2023**



**Real People. Real Solutions.**

**Construction Division 1--Main (North Lands)**

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
101	Class IV R.C.P., 30" Dia.	LF	3,172	\$75	\$237,900
102	Class III R.C.P., 30" Dia.	LF	1,824	\$70	\$127,680
103	Class IV R.C.P., 24" Dia.	LF	3,250	\$58	\$188,500
104	Class III R.C.P., 24" Dia.	LF	350	\$54	\$18,900
105	Class V R.C.P., 18" Dia.	LF	200	\$45	\$9,000
106	Class IV R.C.P., 18" Dia.	LF	1,850	\$45	\$83,250
107	Class III R.C.P., 18" Dia.	LF	1,533	\$42	\$64,386
108	24" on 30" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$960	\$960
109	12" on 30" Dia. R.C.P. Tee, Fabrication Only	EA	3	\$960	\$2,880
110	18" on 30" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$960	\$960
111	18" on 24" Dia. R.C.P. Tee, Fabrication Only	EA	2	\$730	\$1,460
112	24" on 24" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$730	\$730
113	12" on 24" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$730	\$730
114	15" on 18" Dia. R.C.P. Tee, Fabrication Only	EA	2	\$575	\$1,150
115	12" on 18" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$575	\$575
116	12" on 12" Dia. R.C.P. Tee, Fabrication Only	EA	3	\$480	\$1,440
117	30" Dia., R.C.P. Elbow Section, Fabrication Only	EA	8	\$600	\$4,800
118	24" Dia., R.C.P. Elbow Section, Fabrication Only	EA	4	\$500	\$2,000
119	18" Dia., R.C.P. Elbow Section, Fabrication Only	EA	2	\$430	\$860
120	30" to 24" Dia., R.C.P. Reducer Section, Fabrication Only	EA	1	\$1,980	\$1,980
121	24" to 18" Dia., R.C.P. Reducer Section, Fabrication Only	EA	1	\$1,425	\$1,425
122	24" Dia., R.C.P. Endcap	EA	5	\$250	\$1,250
123	18" Dia., R.C.P. Endcap	EA	3	\$180	\$540
124	15" Dia., R.C.P. Endcap	EA	2	\$145	\$290
125	12" Dia., R.C.P. Endcap	EA	4	\$125	\$500
126	Old to New Main Drains, All Sizes, Installation Only	EA	10	\$500	\$5,000
127	Lateral Tile Connections, 10" Dia. or Smaller	EA	27	\$400	\$10,961
128	Lateral Tile Connections, 12" Dia. or Larger	EA	3	\$500	\$1,522
129	Tile Trench Stabilization and Cradling Rock	TN	244	\$35	\$8,540
131	Administration of Erosion Management Plan	LS	1	\$500	\$500
132	Silt Fence Install and Remove	LF	610	\$3.00	\$1,830
133	Spot Tile Exploration	HR	10	\$200	\$2,000
134	Mobilization	LS	1	\$39,200	\$39,200

**Estimated Division 1 Subtotal \$824,000**  
**Average Dollars Per Acre \$790**

**Drainage District No. 48**  
**Proposed Drainage Improvements**  
**Worth County, Iowa**  
**OPINION OF PROBABLE COSTS**  
**Friday, March 10, 2023**



**Real People. Real Solutions.**

**Construction Division 2--Lateral 2 (South Lands)**

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
201	Class III R.C.P., 36" Dia.	LF	900	\$85	\$76,500
202	Class III R.C.P., 30" Dia.	LF	1,400	\$70	\$98,000
203	Class III R.C.P., 24" Dia.	LF	2,421	\$54	\$130,734
204	36" on 36" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$1,150	\$1,150
205	24" on 36" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$1,150	\$1,150
206	18" on 30" Dia. R.C.P. Tee, Fabrication Only	EA	2	\$960	\$1,920
207	12" on 30" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$960	\$960
208	24" on 24" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$730	\$730
209	18" on 24" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$730	\$730
210	12" on 24" Dia. R.C.P. Tee, Fabrication Only	EA	2	\$730	\$1,460
211	12" on 12" Dia. R.C.P. Tee, Fabrication Only	EA	3	\$480	\$1,440
212	30" Dia., R.C.P. Elbow Section, Fabrication Only	EA	2	\$600	\$1,200
213	24" Dia., R.C.P. Elbow Section, Fabrication Only	EA	2	\$500	\$1,000
214	36" to 30" Dia., R.C.P. Reducer Section, Fabrication Only	EA	1	\$2,320	\$2,320
215	30" to 24" Dia., R.C.P. Reducer Section, Fabrication Only	EA	1	\$1,980	\$1,980
216	24" Dia., R.C.P. Endcap	EA	4	\$250	\$1,000
217	18" Dia., R.C.P. Endcap	EA	4	\$180	\$720
218	12" Dia., R.C.P. Endcap	EA	3	\$125	\$375
219	Old to New Main Drains, All Sizes, Installation Only	EA	6	\$500	\$3,000
220	Lateral Tile Connections, 10" Dia. or Smaller	EA	11	\$400	\$4,249
221	Lateral Tile Connections, 12" Dia. or Larger	EA	1	\$500	\$590
222	Tile Trench Stabilization and Cradling Rock	TN	94	\$35	\$3,290
223	Administration of Erosion Management Plan	LS	1	\$500	\$500
224	Silt Fence Install and Remove	LF	240	\$3.00	\$720
225	Spot Tile Exploration	HR	7	\$200	\$1,400
225	Purchasing Old 36" Downstream Main	LS			\$55,000
226	Mobilization	LS	1	\$16,900	\$16,900

**Estimated Division 2 Subtotal \$409,000**  
**Average Dollars Per Acre \$367**

**Construction Division 3--Lateral 2-C (South Lands)**

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
301	Class III R.C.P., 18" Dia.	LF	1,890	\$42	\$79,380
302	18" on 18" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$575	\$575
303	15" on 18" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$575	\$575
304	18" Dia., R.C.P. Elbow Section, Fabrication Only	EA	2	\$430	\$860
305	18" Dia., R.C.P. Endcap	EA	1	\$180	\$180
306	15" Dia., R.C.P. Endcap	EA	1	\$145	\$145
307	Old to New Main Drains, All Sizes, Installation Only	EA	1	\$500	\$500
308	Lateral Tile Connections, 10" Dia. or Smaller	EA	4	\$400	\$1,701
309	Tile Trench Stabilization and Cradling Rock	TN	38	\$35	\$1,330
310	Administration of Erosion Management Plan	LS	1	\$500	\$500
311	Silt Fence Install and Remove	LF	90	\$3.00	\$270
312	Spot Tile Exploration	HR	1	\$200	\$200
313	Mobilization	LS	1	\$4,300	\$4,300

**Estimated Division 3 Subtotal \$91,000**  
**Average Dollars Per Acre \$232**

**Drainage District No. 48**  
**Proposed Drainage Improvements**  
**Worth County, Iowa**  
**OPINION OF PROBABLE COSTS**

Friday, March 10, 2023



**Real People. Real Solutions.**

**Construction Division 4--Lateral 4 (North Lands)**

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
401	Class IV R.C.P., 18" Dia.	LF	850	\$45	\$38,250
402	Class III R.C.P., 18" Dia.	LF	1,350	\$42	\$56,700
403	Class IV R.C.P., 12" Dia.	LF	150	\$36	\$5,400
404	Class III R.C.P., 12" Dia.	LF	2,276	\$34	\$77,384
405	12" on 18" Dia. R.C.P. Tee, Fabrication Only	EA	2	\$575	\$1,150
406	12" on 12" Dia. R.C.P. Tee, Fabrication Only	EA	5	\$480	\$2,400
407	18" Dia., R.C.P. Elbow Section, Fabrication Only	EA	2	\$430	\$860
408	12" Dia., R.C.P. Elbow Section, Fabrication Only	EA	6	\$380	\$2,280
409	18" to 12" Dia., R.C.P. Reducer Section, Fabrication Only	EA	1	\$1,190	\$1,190
410	18" Dia., R.C.P. Endcap	EA	1	\$180	\$180
411	12" Dia., R.C.P. Endcap	EA	5	\$125	\$625
412	Old to New Main Drains, All Sizes, Installation Only	EA	3	\$500	\$1,500
413	Lateral Tile Connections, 10" Dia. or Smaller	EA	10	\$400	\$4,163
414	Lateral Tile Connections, 12" Dia. or Larger	EA	1	\$500	\$578
415	Tile Trench Stabilization and Cradling Rock	TN	93	\$35	\$3,255
417	Administration of Erosion Management Plan	LS	1	\$500	\$500
418	Silt Fence Install and Remove	LF	230	\$3.00	\$690
419	Spot Tile Exploration	HR	3	\$200	\$600
420	Mobilization	LS	1	\$9,900	\$9,900

**Estimated Division 4 Subtotal \$208,000**  
**Average Dollars Per Acre \$736**

**Construction Division 5--County Secondary Roads**

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
501	Class IV R.C.P., 30" Dia.	LF	78	\$75	\$5,850
502	Drain Tile, Trenchless, Steel, 5/16" Wall, 24" Dia.	LF	99	\$500	\$49,500
503	Class IV R.C.P., 18" Dia.	LF	67	\$45	\$3,015
504	Class IV R.C.P., 12" Dia.	LF	165	\$36	\$5,940
505	Hickenbottom Intake, 12" Dia.	EA	10	\$400	\$4,000
506	Tile Trench Stabilization and Cradling Rock	TN	102	\$35	\$3,570
507	Seeding and Fertilizing (Rural)	LS	1	\$1,000	\$1,000
508	Traffic Control	LS	1	\$2,000	\$2,000
509	Silt Fence-Install and Remove	LF	300	\$3	\$900
510	Exploratory Excavation	HR	10	\$200	\$2,000
511	Mobilization	LS	1	\$3,900	\$3,900

**Estimated Division 5 Subtotal \$82,000**

**Drainage District No. 48**  
**Proposed Drainage Improvements**  
**Worth County, Iowa**  
**OPINION OF PROBABLE COSTS**  
**Friday, March 10, 2023**



**Real People. Real Solutions.**

**Construction Division 6--Interstate 35 Boring**

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
601	Drain Tile, Trenchless, Steel, 5/16" Wall, 32" Dia.	LF	306	\$600	\$183,600
602	Tile Trench Stabilization and Cradling Rock	TN	153	\$35	\$5,355
603	Seeding and Fertilizing (Rural)	LS	1	\$1,000	\$1,000
604	Traffic Control	LS	1	\$2,000	\$2,000
605	Silt Fence-Install and Remove	LF	60	\$3	\$180
606	Exploratory Excavation	HR	2	\$200	\$400
607	Mobilization	LS	1	\$9,600	\$9,600

**Estimated Division 6 Subtotal \$202,000**

**Subtotal of Construction Divisions 1 - 6 \$1,816,000**

**Construction Contingency \$91,000**

**Total Estimated Construction Cost \$1,907,000**

**Less Estimated Road Construction Costs Paid by Others \$284,000**

**Total Estimated Assessable Construction Cost \$1,623,000**

Work Area Rental (65.0 ac) \$65,000

Other Damages \$48,000

**Basic Engineering Services**

Survey, Study & Report, Meetings & Hearing \$70,000

Construction Plans, Specifications, & Bid Letting \$10,000

Construction Engineering Services \$55,000

Legal Services, Publications, Mailings, Etc. \$19,000

Finance, Interest & Contingency \$95,000

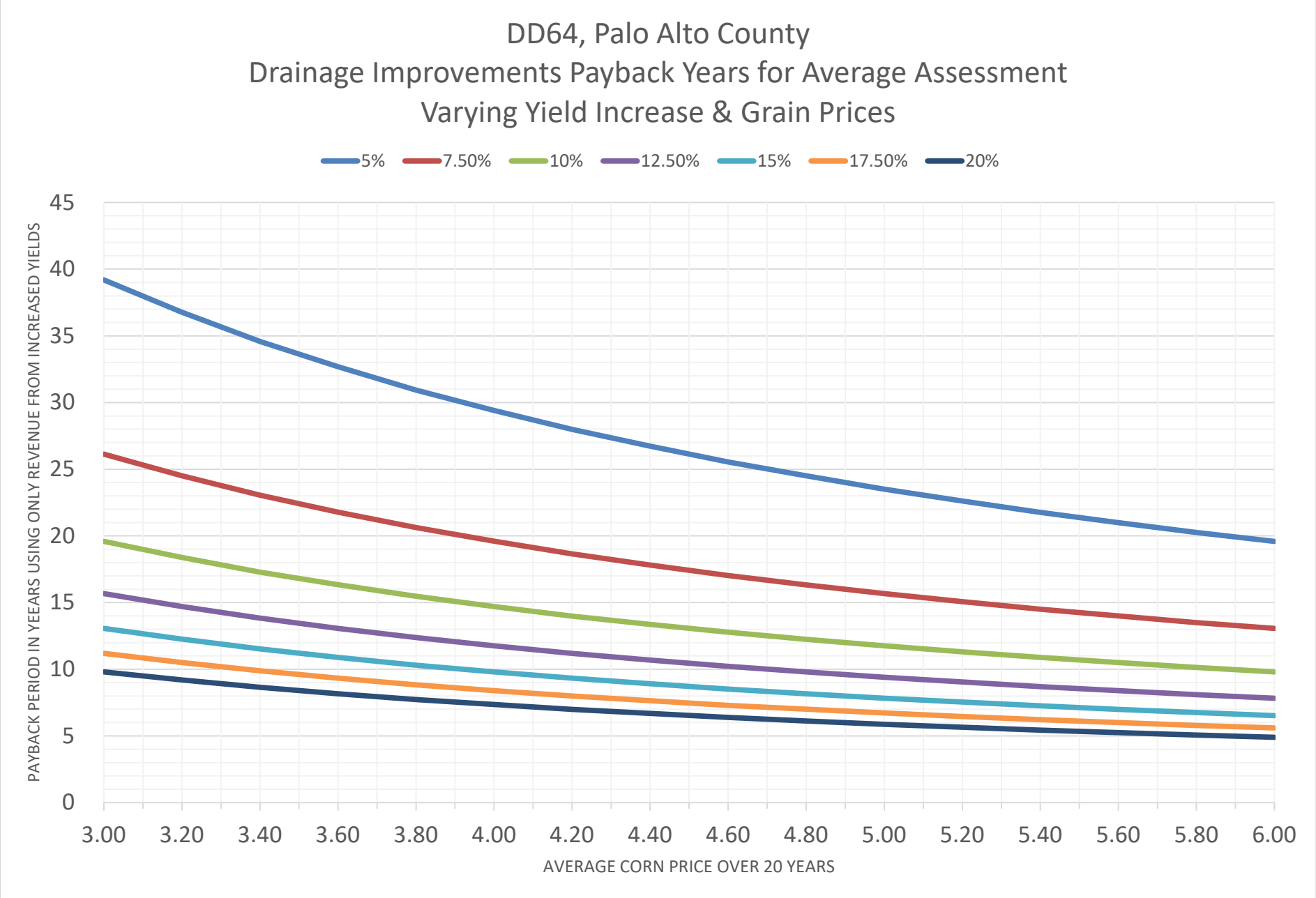
**Total Estimated Assessable Project Cost \$1,985,000**

Estimated Average Cost Per Benefited Acre (2,145 ac) \$925

Estimated Average Cost Per Acre Per Year at 8% interest (10 years) \$133

Estimated Average Cost Per Acre Per Year at 8% interest (20 years) \$85

# Appendix C - Payback Analysis of Drainage District System Replacement Costs



Assumed Rotation CCB: Soybean Price: 260% of Corn.

# Appendix C - Payback Analysis of Drainage District System Replacement Costs

Drainage District:

**DD48 North**

ACRES IN DD	Enter>	<b>1,042</b>	ac
% Corn Acreage	Enter>	<b>63</b>	%
% Soybeans Acreage	Enter>	<b>33</b>	%
% Other (Roads, Etc)		<b>3</b>	%
Base Corn Yield	Enter>	<b>193</b>	bu/a
Base Soybeans Yield	Enter>	<b>55</b>	bu/a
Total Increase in Yield, Corn			bu
Total Increase in Yield, Soybeans			bu

Average Yield Improvement Due to Better Drainage Outlet, %							
2.5	5	7.5	10	12.5	15	17.5	20
3,167	6,335	9,502	12,670	15,837	19,005	22,172	25,339
473	946	1,418	1,891	2,364	2,837	3,310	3,782

Enter Estimated Average Annual Yield Increase Over the Next 20 Years, % (See Footnote)	<b>1.5%</b>
Avg Price of Corn Next 20 Years	\$ 5.87
Avg Price of Soybeans Next 20 Years	\$ 14.08

<< The historic annual yield increase for corn in Iowa has been 2.1% since the 1930's, using less is a conservative assumption

From Corn	
From Soybean	
Total	
Increased Revenue/acre	
Increased Revenue/acre over the anticipated life of the facility (100 years)	

Annual Increase in Revenue							
\$ 18,593	\$ 37,186	\$ 55,778	\$ 74,371	\$ 92,964	\$ 111,557	\$ 130,149	\$ 148,742
\$ 6,657	\$ 13,314	\$ 19,971	\$ 26,629	\$ 33,286	\$ 39,943	\$ 46,600	\$ 53,257
\$ 25,250	\$ 50,500	\$ 75,750	\$ 101,000	\$ 126,249	\$ 151,499	\$ 176,749	\$ 201,999
\$ 24	\$ 48	\$ 73	\$ 97	\$ 121	\$ 145	\$ 170	\$ 194
\$ 2,423	\$ 4,846	\$ 7,270	\$ 9,693	\$ 12,116	\$ 14,539	\$ 16,962	\$ 19,386

Assessment	per ac	% of Avg
Very High Assessment		
<b>\$2,910</b>	per ac	250% of Avg
High Assessment		
<b>\$2,328</b>	per ac	200% of Avg
Above Average Assessment		
<b>\$1,746</b>	per ac	150% of Avg
Average Assessment		
<b>\$1,164</b>	per ac	100% of Avg
Low Assessment		
<b>\$582</b>	per ac	50% of Avg
Very Low Assessment		
<b>\$291</b>	per ac	25% of Avg

Payback Period For Revenues From Only Yield Increase (Years)							
120.1	60.0	40.0	30.0	24.0	20.0	17.2	15.0
96.1	48.0	32.0	24.0	19.2	16.0	13.7	12.0
72.1	36.0	24.0	18.0	14.4	12.0	10.3	9.0
48.0	24.0	16.0	12.0	9.6	8.0	6.9	6.0
24.0	12.0	8.0	6.0	4.8	4.0	3.4	3.0
12.0	6.0	4.0	3.0	2.4	2.0	1.7	1.5
<b>2.5</b>	<b>5</b>	<b>7.5</b>	<b>10</b>	<b>12.5</b>	<b>15</b>	<b>17.5</b>	<b>20</b>

# Appendix C - Payback Analysis of Drainage District System Replacement Costs

## Drainage District Law Allows For Payment of Assessments in 20 Annual Installments

Assuming a 1.5% annual yield improvement over 20 years for corn currently priced at \$5 and soybeans at \$12

A <b>very high</b> cost assessment (250% of average) would be paid off in	20.0	years on a 15% average yield increase.
A <b>high</b> cost assessment (200% of average) would be paid off in	19.2	years on a 12.5% average yield increase.
An <b>above avg</b> cost assessment (150% of average) would be paid off in	18.0	years on a 10% average yield increase.
An <b>average</b> cost assessment (100% of average) would be paid off in	16.0	years on a 7.5% average yield increase.
A <b>low</b> cost assessment (50% of average) would be paid off in	12.0	years on a 5% average yield increase.
A <b>very low</b> cost assessment (25% of average) would be paid off in	12.0	years on a 2.5% average yield increase.

### Yield Improvements on 40 acres if Drowned Areas

		Percent Increase over Current Conditions					
		Percent of Average Yield Achieved by Improvements					
		50%	60%	70%	80%	90%	100%
Drowned Area ac	1	1.3%	1.5%	1.8%	2.1%	2.3%	2.6%
	2.5	3.3%	4.0%	4.7%	5.3%	6.0%	6.7%
	5	7.1%	8.6%	10.0%	11.4%	12.9%	14.3%
	7.5	11.5%	13.8%	16.2%	18.5%	20.8%	23.1%
	10	16.7%	20.0%	23.3%	26.7%	30.0%	33.3%
	15	30.0%	36.0%	42.0%	48.0%	54.0%	60.0%

Assumes Avg. Co. Yield on Non-Drowned Area

### Future Prices to Reflect Annual Yield Change Trend

Corn	\$5.00	
Soybeans	\$12.00	
<u>Price Adj. for Yield Change</u>		
Average Annual Yield Change	CORN 20-Year Avg. Price	SOYBEANS 20-Year Avg Price
0.0%	\$5.00	\$12.00
0.5%	\$5.26	\$12.63
1.0%	\$5.55	\$13.32
1.5%	\$5.87	\$14.08
2.0%	\$6.21	\$14.92
2.5%	\$6.60	\$15.83
3.0%	\$7.02	\$16.84
3.5%	\$7.47	\$17.94

### Existing Farm Yield vs. Potential Farm Yield

		Current Average Corn Yield over Entire Field bu/ac					
		90	110	130	150	170	190
Average Field Yield with Improvement bu/ac	90	0.0%					
	100	11.1%					
	110	22.2%	0.0%				
	120	33.3%	9.1%				
	130	44.4%	18.2%	0.0%			
	140	55.6%	27.3%	7.7%			
	150	66.7%	36.4%	15.4%	0.0%		
	160	77.8%	45.5%	23.1%	6.7%		
	170	88.9%	54.5%	30.8%	13.3%	0.0%	
	180	100.0%	63.6%	38.5%	20.0%	5.9%	
	190	111.1%	72.7%	46.2%	26.7%	11.8%	0.0%
200	122.2%	81.8%	53.8%	33.3%	17.6%	5.3%	



# Appendix C - Payback Analysis of Drainage District System Replacement Costs

## Payback Years for Average Yield Improvements for Range of Average Grain Prices

### Proposed Drainage Improvements in Drainage District No. 64

#### Assumptions

Long-term Soybean/Corn price ratio is 2.6

Average assessment of \$1,164/acre

1.5% average annual yield improvement due to causes other than better drainage.

A flat grain price is assumed in this analysis.

#### Average Current Grain

##### Price Used Over

##### Payback Period

		Average Yield Response Due to Drainage Improvements						
Corn	Soybeans	5%	7.50%	10%	12.50%	15%	17.50%	20%
3.00	7.80	39.19	26.13	19.60	15.68	13.06	11.20	9.80
3.20	8.32	36.77	24.52	18.39	14.71	12.26	10.51	9.19
3.40	8.84	34.58	23.05	17.29	13.83	11.53	9.88	8.64
3.60	9.36	32.68	21.79	16.34	13.07	10.89	9.34	8.17
3.80	9.88	30.93	20.62	15.47	12.37	10.31	8.84	7.73
4.00	10.40	29.41	19.61	14.70	11.76	9.80	8.40	7.35
4.20	10.92	27.99	18.66	13.99	11.19	9.33	8.00	7.00
4.40	11.44	26.73	17.82	13.37	10.69	8.91	7.64	6.68
4.60	11.96	25.55	17.03	12.78	10.22	8.52	7.30	6.39
4.80	12.48	24.50	16.33	12.25	9.80	8.17	7.00	6.13
5.00	13.00	23.50	15.67	11.75	9.40	7.83	6.72	5.88
5.20	13.52	22.61	15.08	11.31	9.05	7.54	6.46	5.65
5.40	14.04	21.76	14.51	10.88	8.71	7.25	6.22	5.44
5.60	14.56	20.99	14.00	10.50	8.40	7.00	6.00	5.25
5.80	15.08	20.26	13.51	10.13	8.10	6.75	5.79	5.06
6.00	15.60	19.59	13.06	9.80	7.84	6.53	5.60	4.90

#### Footnotes:

It is important to note that after it is paid for, the drainage system will continue to foster improved crop yields for more than a century

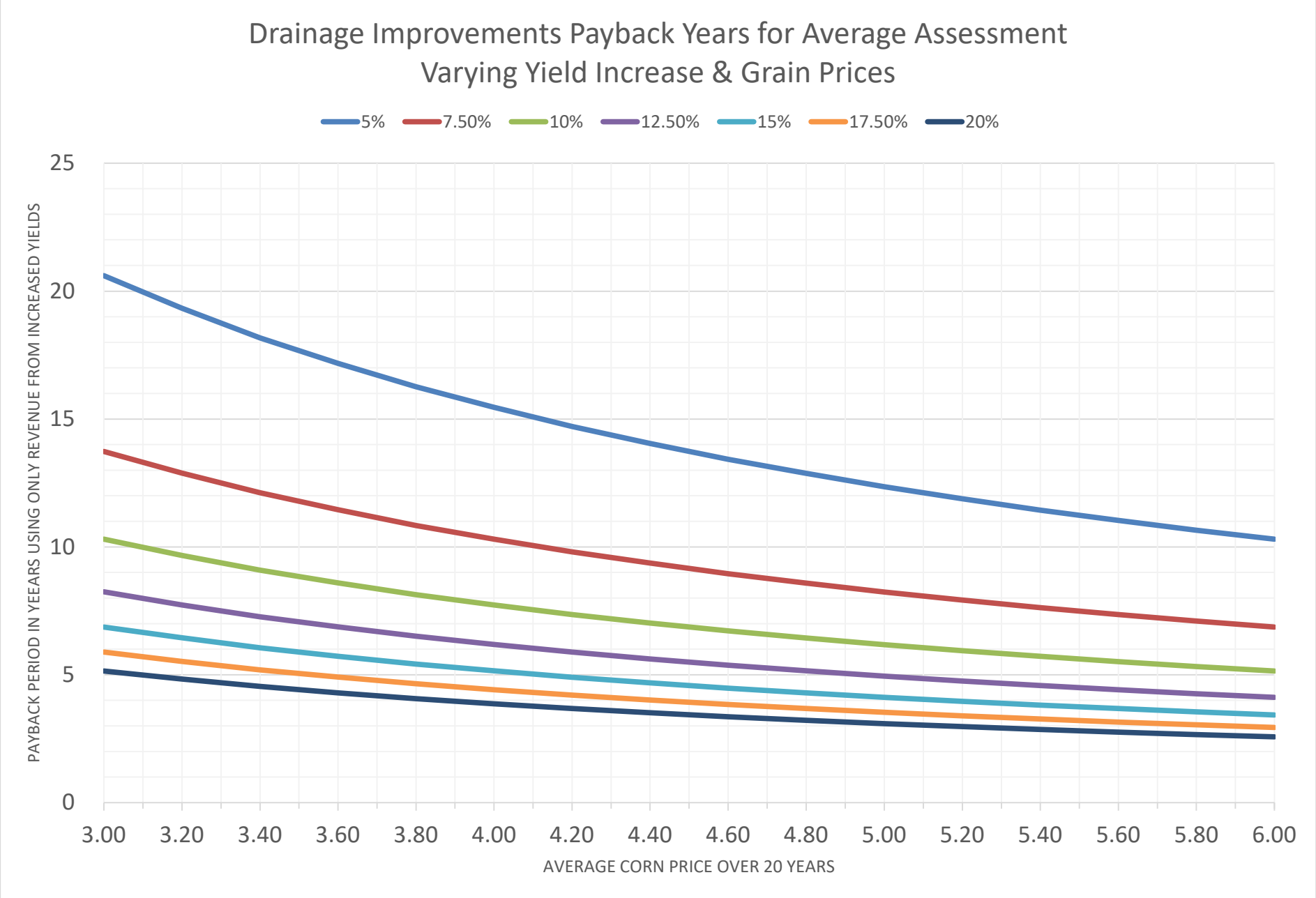
No credit is given in the above calculations for an immediate increase in land value resulting from the improved productivity

The average annual yield increase is intended to reflect through price adjustment the long term historic yield increase trend rather than to predict future grain price changes. In effect this analysis uses a stagnant current grain price tied to a reliable yield improvement trend. An entry of 0% assumes no average yield improvement or price increase over the next twenty years.

#### Appendix C

This worksheet is based upon one prepared by Dr. Stewart Melvin, ISU Extension Agricultural Engineer, Retired

# Appendix C - Payback Analysis of Drainage District System Replacement Costs



Assumed Rotation CCB: Soybean Price: 260% of Corn.

# Appendix C - Payback Analysis of Drainage District System Replacement Costs

Drainage District:

**DD48 South**

ACRES IN DD	Enter>	<b>1,174</b>	ac
% Corn Acreage	Enter>	<b>63</b>	%
% Soybeans Acreage	Enter>	<b>33</b>	%
% Other (Roads, Etc)		<b>3</b>	%
Base Corn Yield	Enter>	<b>193</b>	bu/a
Base Soybeans Yield	Enter>	<b>55</b>	bu/a
Total Increase in Yield, Corn			bu
Total Increase in Yield, Soybeans			bu

Average Yield Improvement Due to Better Drainage Outlet, %							
2.5	5	7.5	10	12.5	15	17.5	20
3,569	7,137	10,706	14,275	17,843	21,412	24,981	28,549
533	1,065	1,598	2,131	2,664	3,196	3,729	4,262

Enter Estimated Average Annual Yield Increase Over the Next 20 Years, % (See Footnote)	<b>1.5%</b>
Avg Price of Corn Next 20 Years	\$ 5.87
Avg Price of Soybeans Next 20 Years	\$ 14.08

<< The historic annual yield increase for corn in Iowa has been 2.1% since the 1930's, using less is a conservative assumption

From Corn	
From Soybean	
Total	
Increased Revenue/acre	
Increased Revenue/acre over the anticipated life of the facility (100 years)	

Annual Increase in Revenue							
\$ 20,948	\$ 41,896	\$ 62,844	\$ 83,792	\$ 104,740	\$ 125,688	\$ 146,637	\$ 167,585
\$ 7,500	\$ 15,001	\$ 22,501	\$ 30,002	\$ 37,502	\$ 45,003	\$ 52,503	\$ 60,004
\$ 28,449	\$ 56,897	\$ 85,346	\$ 113,794	\$ 142,243	\$ 170,691	\$ 199,140	\$ 227,588
\$ 24	\$ 48	\$ 73	\$ 97	\$ 121	\$ 145	\$ 170	\$ 194
\$ 2,423	\$ 4,846	\$ 7,270	\$ 9,693	\$ 12,116	\$ 14,539	\$ 16,962	\$ 19,386

Assessment Level	Value	Unit	Percentage of Avg
Very High Assessment	<b>\$1,530</b>	per ac	250% of Avg
High Assessment	<b>\$1,224</b>	per ac	200% of Avg
Above Average Assessment	<b>\$918</b>	per ac	150% of Avg
Average Assessment	<b>\$612</b>	per ac	100% of Avg
Low Assessment	<b>\$306</b>	per ac	50% of Avg
Very Low Assessment	<b>\$153</b>	per ac	25% of Avg

Payback Period For Revenues From Only Yield Increase (Years)							
2.5	5	7.5	10	12.5	15	17.5	20
63.1	31.6	21.0	15.8	12.6	10.5	9.0	7.9
50.5	25.2	16.8	12.6	10.1	8.4	7.2	6.3
37.9	18.9	12.6	9.5	7.6	6.3	5.4	4.7
25.2	12.6	8.4	6.3	5.0	4.2	3.6	3.2
12.6	6.3	4.2	3.2	2.5	2.1	1.8	1.6
6.3	3.2	2.1	1.6	1.3	1.1	0.9	0.8
<b>2.5</b>	<b>5</b>	<b>7.5</b>	<b>10</b>	<b>12.5</b>	<b>15</b>	<b>17.5</b>	<b>20</b>

# Appendix C - Payback Analysis of Drainage District System Replacement Costs

## Drainage District Law Allows For Payment of Assessments in 20 Annual Installments

Assuming a 1.5% annual yield improvement over 20 years for corn currently priced at \$5 and soybeans at \$12

A <b>very high</b> cost assessment (250% of average) would be paid off in	10.5	years on a 15% average yield increase.
A <b>high</b> cost assessment (200% of average) would be paid off in	10.1	years on a 12.5% average yield increase.
An <b>above avg</b> cost assessment (150% of average) would be paid off in	9.5	years on a 10% average yield increase.
An <b>average</b> cost assessment (100% of average) would be paid off in	8.4	years on a 7.5% average yield increase.
A <b>low</b> cost assessment (50% of average) would be paid off in	6.3	years on a 5% average yield increase.
A <b>very low</b> cost assessment (25% of average) would be paid off in	6.3	years on a 2.5% average yield increase.

### Future Prices to Reflect Annual Yield Change Trend

Corn	\$5.00	
Soybeans	\$12.00	
	<u>Price Adj. for Yield Change</u>	
Average Annual Yield Change	CORN 20-Year Avg. Price	SOYBEANS 20-Year Avg Price
0.0%	\$5.00	\$12.00
0.5%	\$5.26	\$12.63
1.0%	\$5.55	\$13.32
1.5%	\$5.87	\$14.08
2.0%	\$6.21	\$14.92
2.5%	\$6.60	\$15.83
3.0%	\$7.02	\$16.84
3.5%	\$7.47	\$17.94

### Yield Improvements on 40 acres if Drowned Areas

Percent Increase over Current Conditions							
Percent of Average Yield Achieved by Improvements							
Drowned Area ac		50%	60%	70%	80%	90%	100%
	1	1.3%	1.5%	1.8%	2.1%	2.3%	2.6%
	2.5	3.3%	4.0%	4.7%	5.3%	6.0%	6.7%
	5	7.1%	8.6%	10.0%	11.4%	12.9%	14.3%
	7.5	11.5%	13.8%	16.2%	18.5%	20.8%	23.1%
	10	16.7%	20.0%	23.3%	26.7%	30.0%	33.3%
15	30.0%	36.0%	42.0%	48.0%	54.0%	60.0%	

Assumes Avg. Co. Yield on Non-Drowned Area

### Existing Farm Yield vs. Potential Farm Yield

Current Average Corn Yield over Entire Field bu/ac							
Average Field Yield with Improvement bu/ac		90	110	130	150	170	190
	90	0.0%					
	100	11.1%					
	110	22.2%	0.0%				
	120	33.3%	9.1%				
	130	44.4%	18.2%	0.0%			
	140	55.6%	27.3%	7.7%			
	150	66.7%	36.4%	15.4%	0.0%		
	160	77.8%	45.5%	23.1%	6.7%		
	170	88.9%	54.5%	30.8%	13.3%	0.0%	
	180	100.0%	63.6%	38.5%	20.0%	5.9%	
190	111.1%	72.7%	46.2%	26.7%	11.8%	0.0%	
200	122.2%	81.8%	53.8%	33.3%	17.6%	5.3%	

# Appendix C - Payback Analysis of Drainage District System Replacement Costs

## Payback Years for Average Yield Improvements for Range of Average Grain Prices

### Proposed Drainage Improvements

#### Assumptions

Long-term Soybean/Corn price ratio is 2.6

Average assessment of \$612/acre

1.5% average annual yield improvement due to causes other than better drainage.

A flat grain price is assumed in this analysis.

#### Average Current Grain

##### Price Used Over

##### Payback Period

Price Used Over		Average Yield Response Due to Drainage Improvements						
Corn	Soybeans	5%	7.50%	10%	12.50%	15%	17.50%	20%
3.00	7.80	20.60	13.73	10.30	8.24	6.87	5.89	5.15
3.20	8.32	19.33	12.89	9.66	7.73	6.44	5.52	4.83
3.40	8.84	18.17	12.12	9.09	7.27	6.06	5.19	4.54
3.60	9.36	17.18	11.45	8.59	6.87	5.73	4.91	4.29
3.80	9.88	16.26	10.84	8.13	6.50	5.42	4.65	4.06
4.00	10.40	15.46	10.30	7.73	6.18	5.15	4.42	3.86
4.20	10.92	14.71	9.81	7.35	5.88	4.90	4.20	3.68
4.40	11.44	14.05	9.37	7.02	5.62	4.68	4.01	3.51
4.60	11.96	13.43	8.95	6.71	5.37	4.48	3.84	3.36
4.80	12.48	12.88	8.59	6.44	5.15	4.29	3.68	3.22
5.00	13.00	12.35	8.24	6.18	4.94	4.12	3.53	3.09
5.20	13.52	11.89	7.92	5.94	4.75	3.96	3.40	2.97
5.40	14.04	11.44	7.63	5.72	4.58	3.81	3.27	2.86
5.60	14.56	11.03	7.36	5.52	4.41	3.68	3.15	2.76
5.80	15.08	10.65	7.10	5.32	4.26	3.55	3.04	2.66
6.00	15.60	10.30	6.87	5.15	4.12	3.43	2.94	2.57

#### Footnotes:

It is important to note that after it is paid for, the drainage system will continue to foster improved crop yields for more than a century

No credit is given in the above calculations for an immediate increase in land value resulting from the improved productivity

The average annual yield increase is intended to reflect through price adjustment the long term historic yield increase trend rather than to predict future grain price changes. In effect this analysis uses a stagnant current grain price tied to a reliable yield improvement trend. An entry of 0% assumes no average yield improvement or price increase over the next twenty years.

#### Appendix C

# Proposed Plans



# PRELIMINARY PLANS FOR DRAINAGE DISTRICT NO. 48 DRAINAGE REPAIRS & IMPROVEMENTS WORTH COUNTY, IOWA 2023

SHEET LIST TABLE	
SHEET NUMBER	SHEET TITLE
A.01	TITLE SHEET
A.02	LANDOWNER PLAT
M.01 - M.05	PLAN & PROFILE - DD No. 48 - PROPOSED MAIN
M.06 - M.07	PLAN & PROFILE - DD No. 48 - PROPOSED LATERAL 2
M.08	PLAN & PROFILE - DD No. 48 - PROPOSED LATERAL 2-C
M.09 - M.10	PLAN & PROFILE - DD No. 48 - PROPOSED LATERAL 4
V.01	PLAN & PROFILE - BORING UNDER INTERSTATE 35

### GOVERNING SPECIFICATIONS

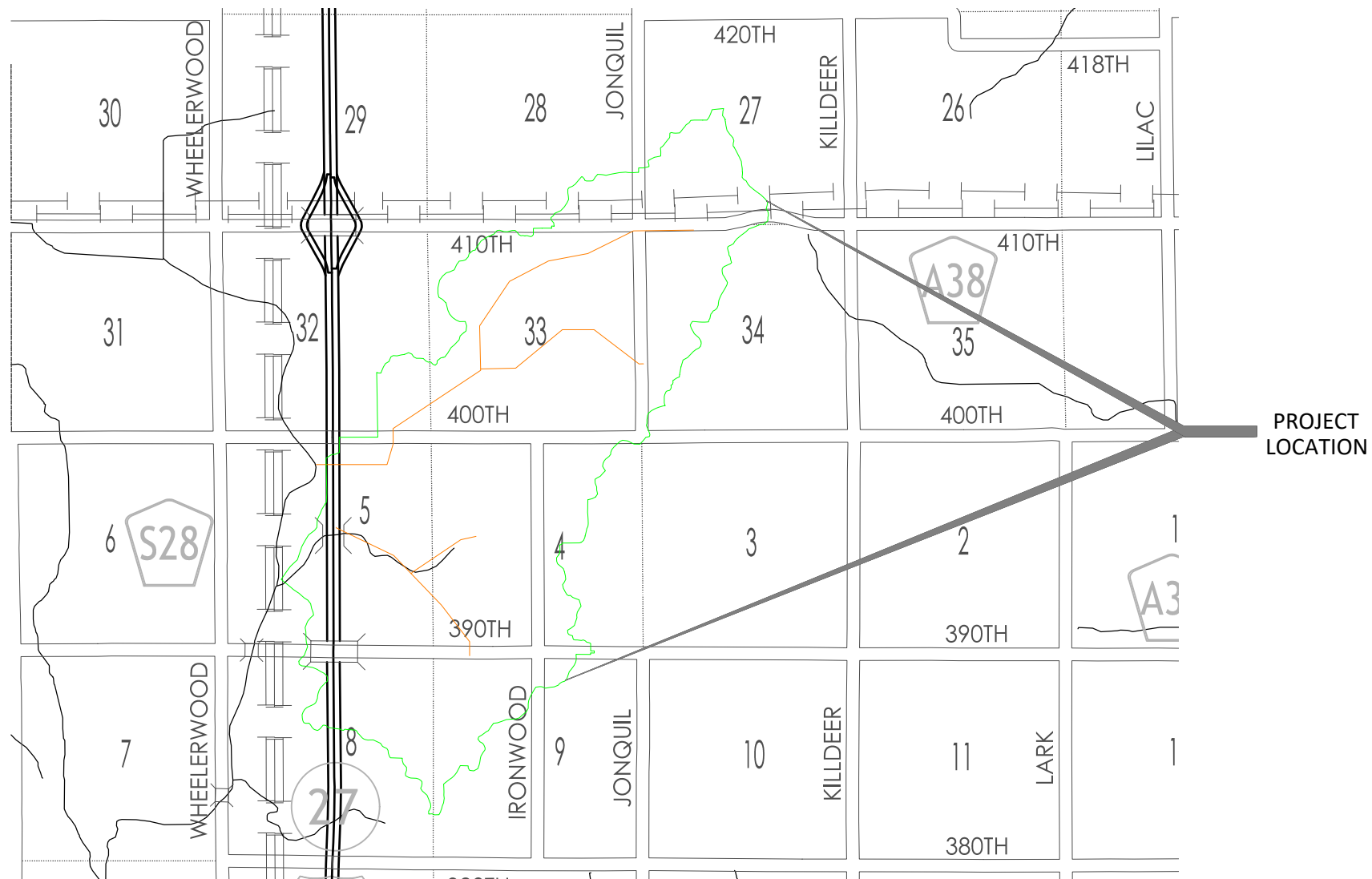
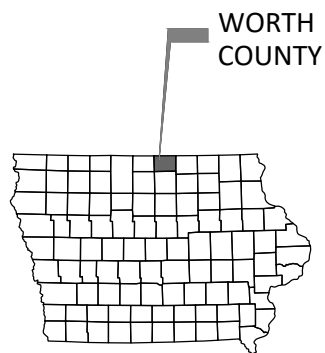
THE 2023 EDITION OF THE "IOWA STATEWIDE URBAN STANDARD SPECIFICATIONS FOR PUBLIC IMPROVEMENTS" SHALL GOVERN.

IOWA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGE CONSTRUCTION", SERIES 2023 AND ALL CURRENT GENERAL SUPPLEMENTAL SPECIFICATIONS AND MATERIALS INSTRUCTIONAL MEMORANDUM SHALL GOVERN AS REFERENCED.

ALL APPLICABLE FEDERAL, STATE, AND LOCAL LAWS AND ORDINANCES WILL BE COMPLIED WITH IN THE CONSTRUCTION OF THIS PROJECT.



THE SUBSURFACE UTILITY INFORMATION IN THIS PLAN IS UTILITY QUALITY LEVEL D. THIS UTILITY QUALITY LEVEL WAS DETERMINED ACCORDING TO THE GUIDELINES OF CI/ASCE 38-02, ENTITLED "STANDARD GUIDELINES FOR THE COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA."



DATUM EQUATION 1920 DATUM + 1114.68 = NAVD 88	PROJECT DATUM: STATE PLANE HORIZONTAL: IOWA NORTH VERTICAL: NAD 1988
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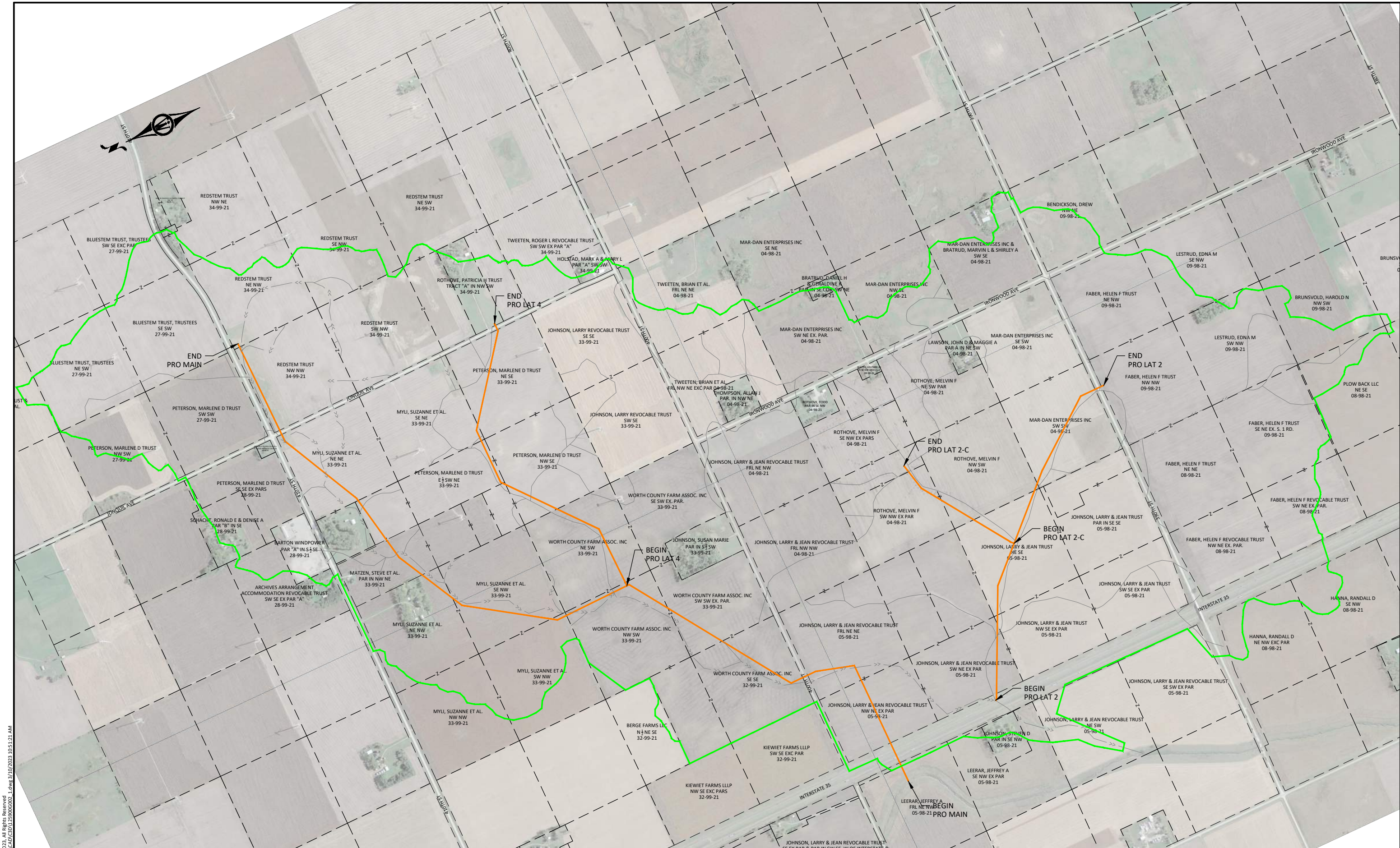


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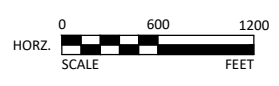
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CLIENT PROJ. NO.			

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WORTH COUNTY, IOWA	A.01
TITLE SHEET	





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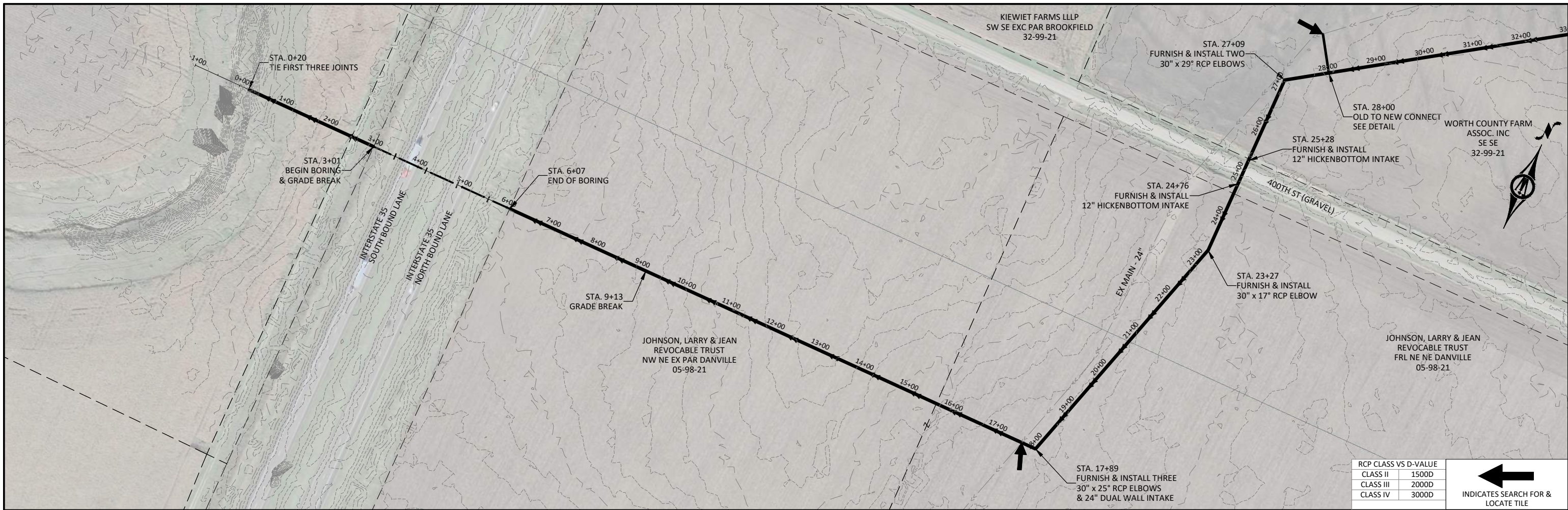
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TJB			
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**DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS**  
 WORTH COUNTY, IOWA  
**LANDOWNER PLAT**

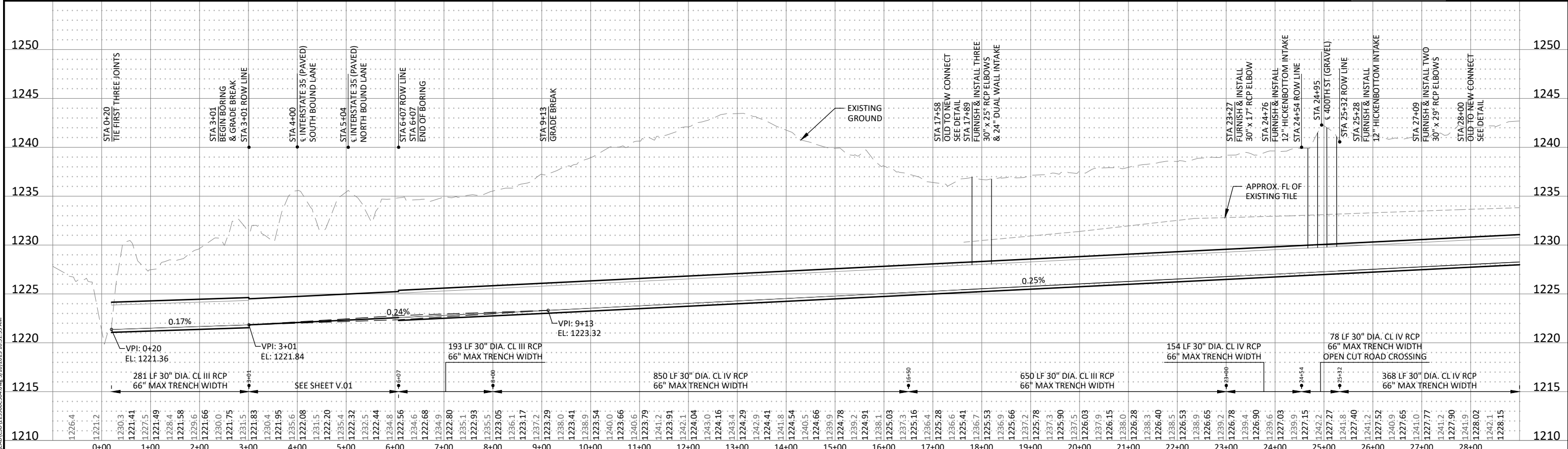
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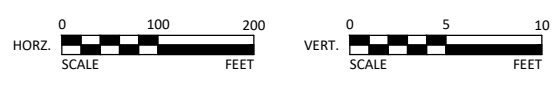


RCP CLASS VS D-VALUE	
CLASS II	1500D
CLASS III	2000D
CLASS IV	3000D

← INDICATES SEARCH FOR & LOCATE TILE



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DESIGNED	REV	DESCRIPTION	DATE
TJB			
TJB			
CLIENT PROJ. NO.			

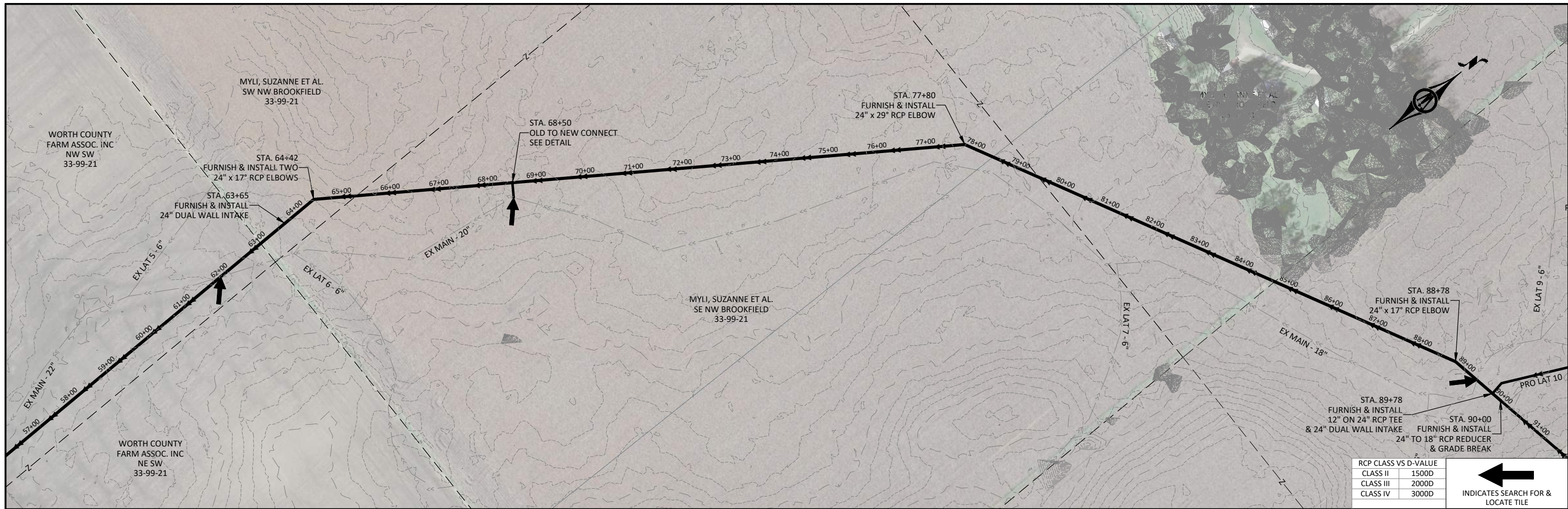
**DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS**  
 WORTH COUNTY, IOWA  
 PLAN & PROFILE - DD NO. 48 - PROPOSED MAIN

SHEET  
**M.01**

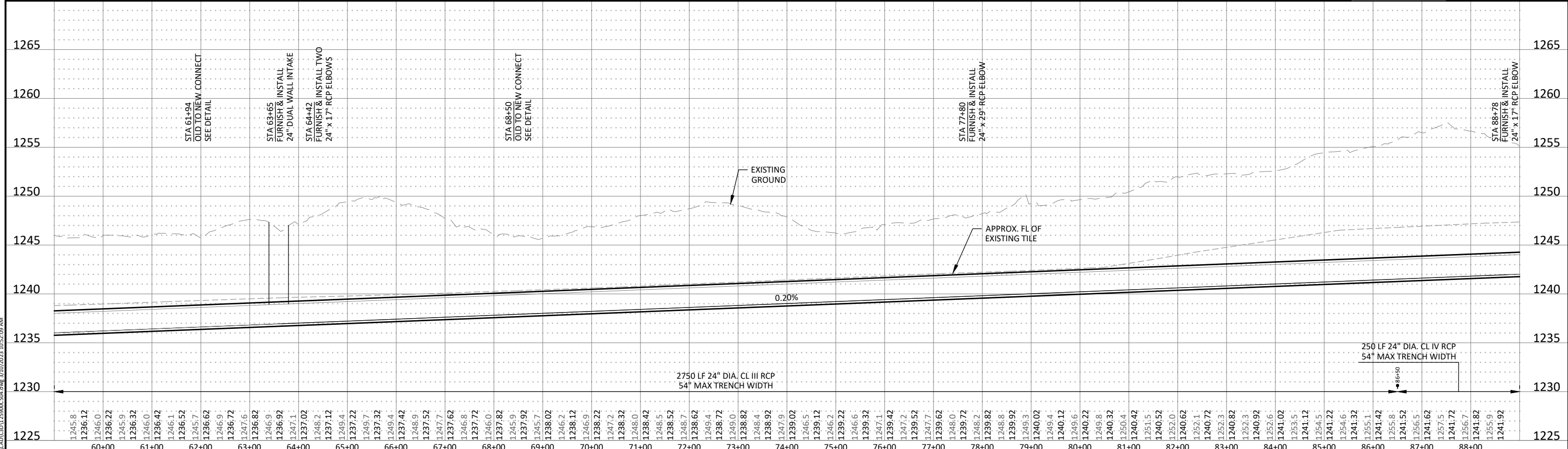




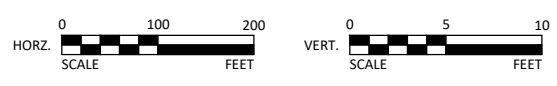




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CLASS IV	3000D



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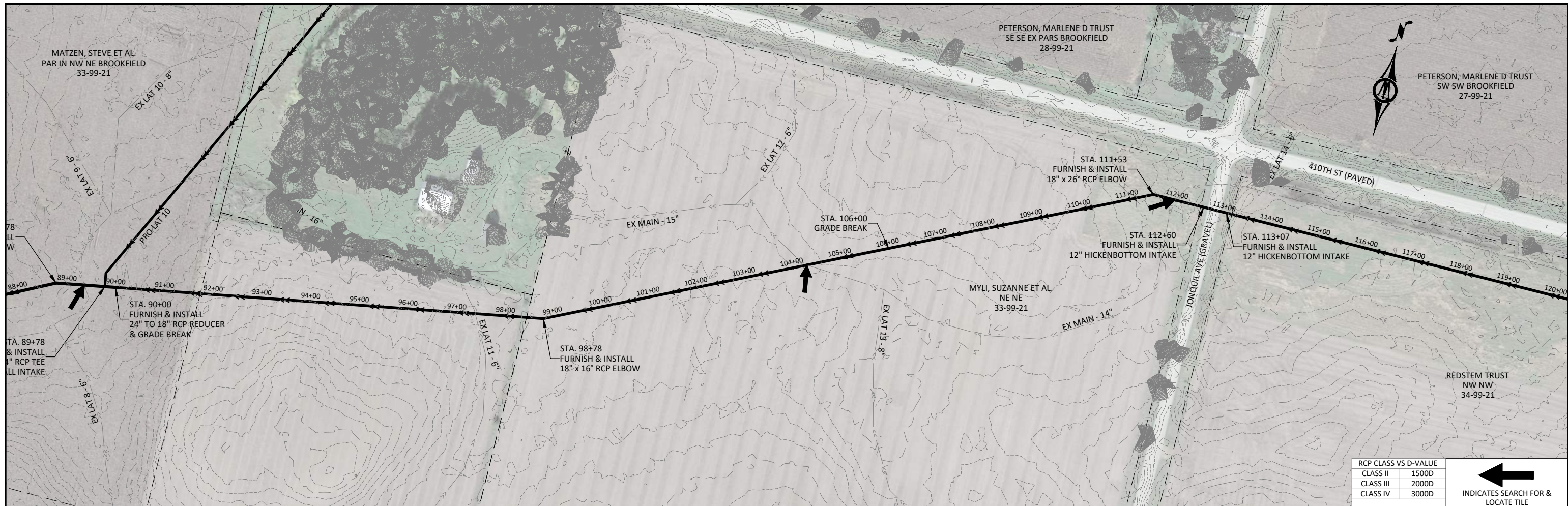
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TJB			
TJB			

**DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS**  
WORTH COUNTY, IOWA  
**PLAN & PROFILE - DD NO. 48 - PROPOSED MAIN**

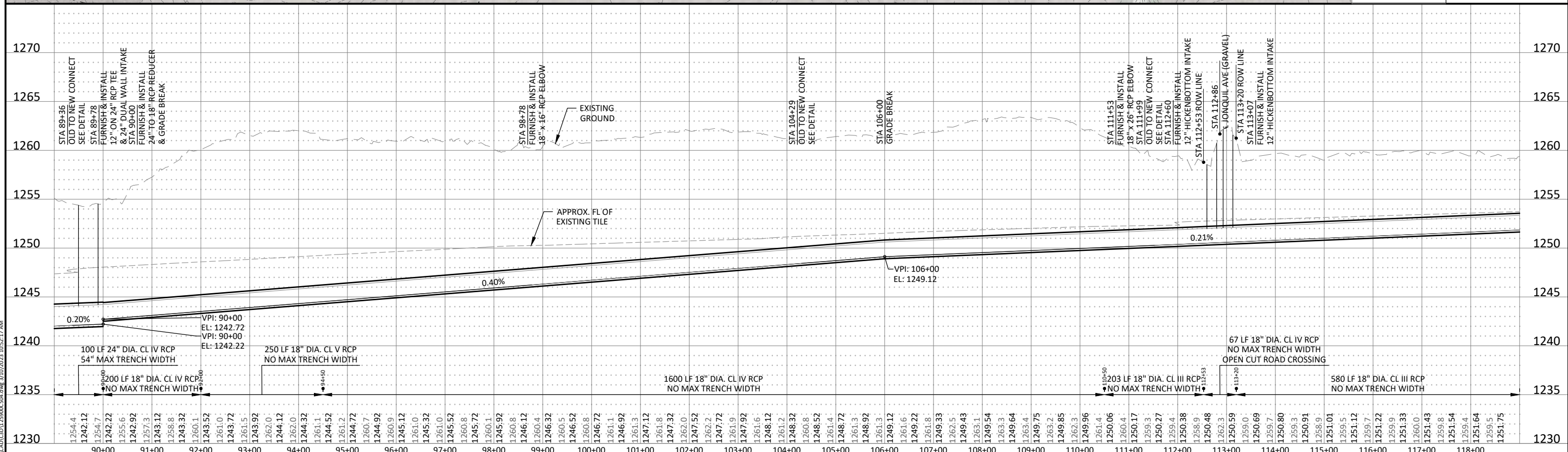
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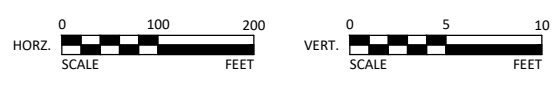


RCP CLASS VS D-VALUE	
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CLASS III	2000D
CLASS IV	3000D

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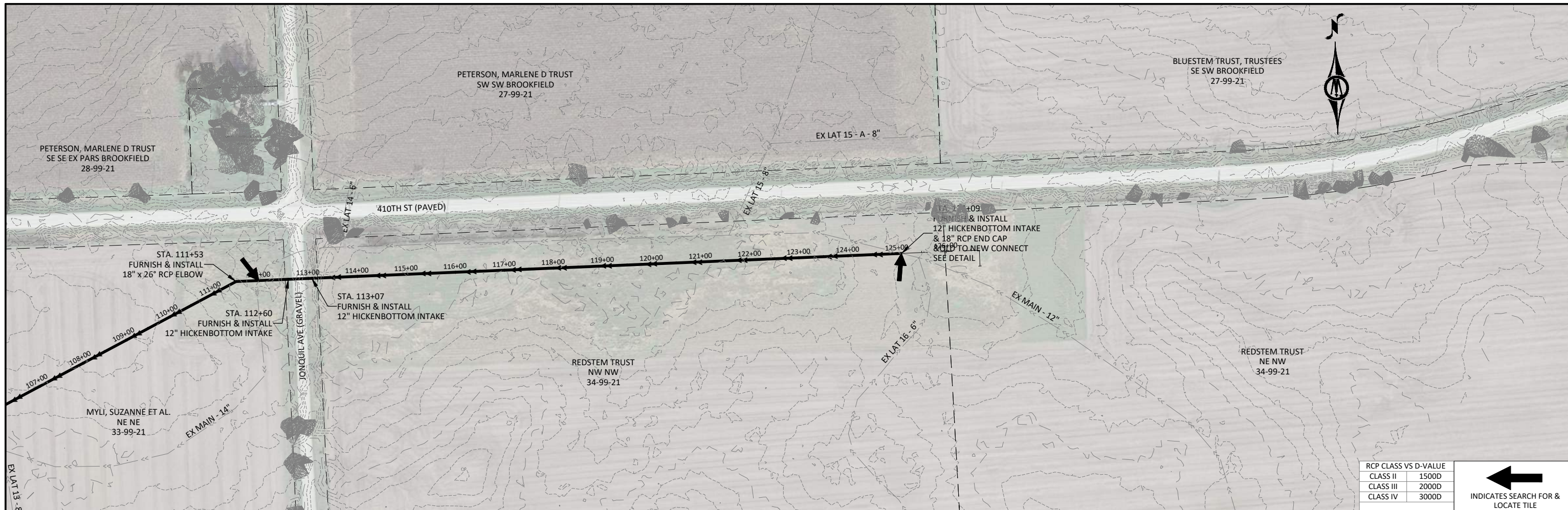


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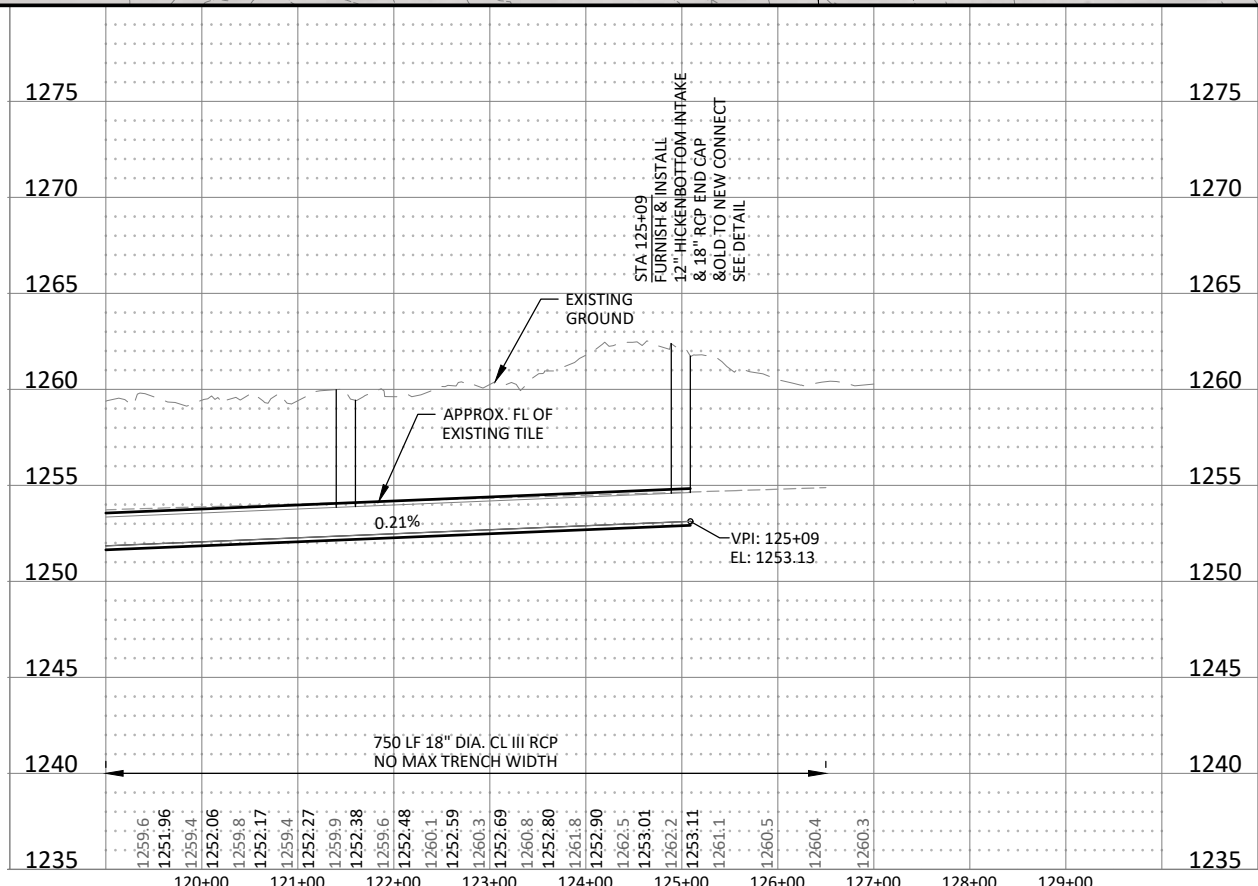
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TJB			

DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS  
 WORTH COUNTY, IOWA  
 PLAN & PROFILE - DD NO. 48 - PROPOSED MAIN  
 SHEET M.04

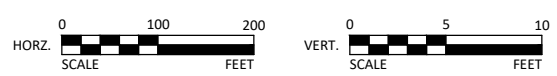




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CLASS IV	3000D



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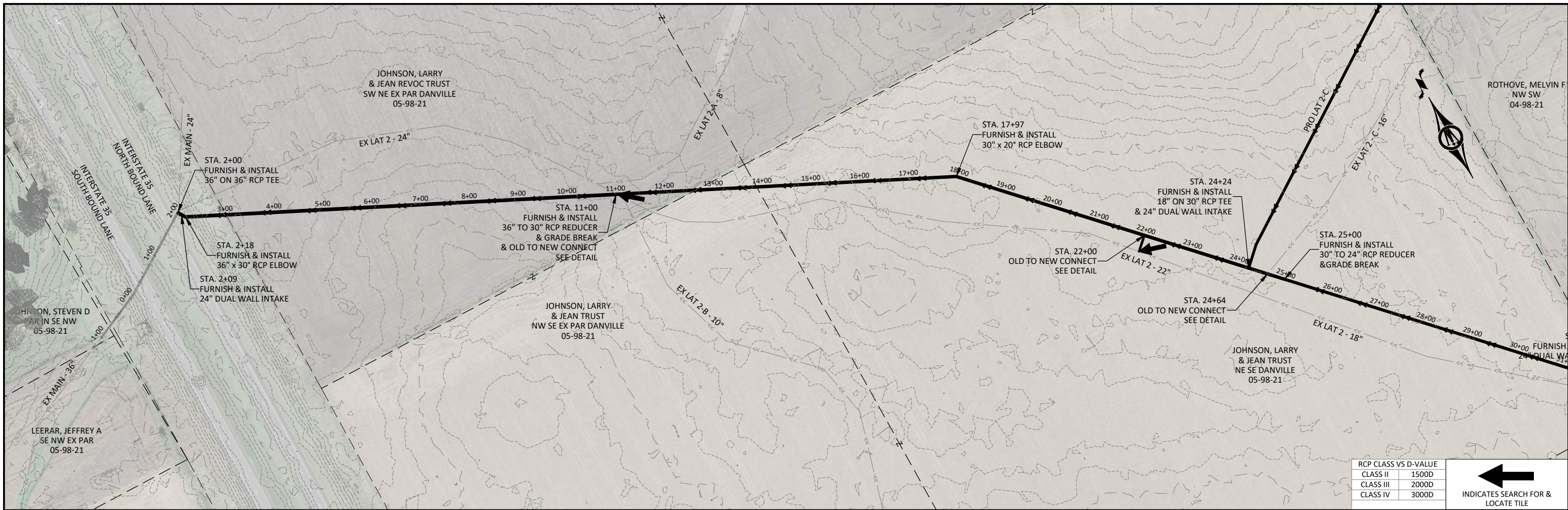
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 Email: jefferson@bolton-menk.com  
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**DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS**  
 WORTH COUNTY, IOWA  
 PLAN & PROFILE - DD NO. 48 - PROPOSED MAIN

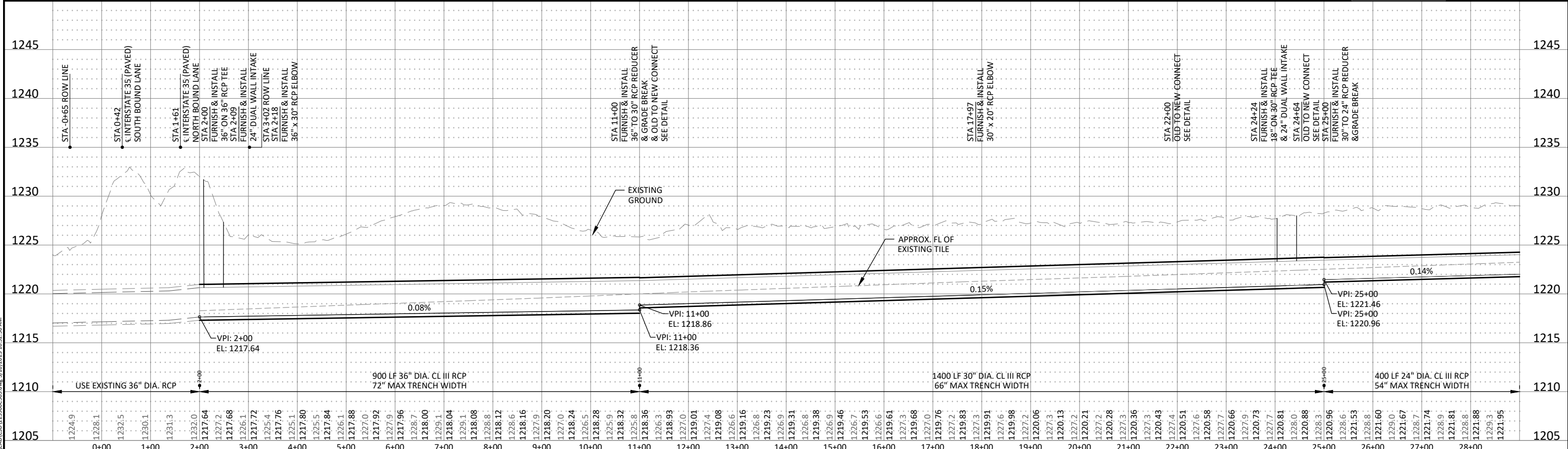
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**M.05**



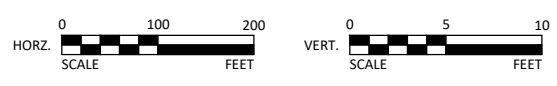


RCP CLASS VS D-VALUE	
CLASS II	1500D
CLASS III	2000D
CLASS IV	3000D

← INDICATES SEARCH FOR & LOCATE TILE



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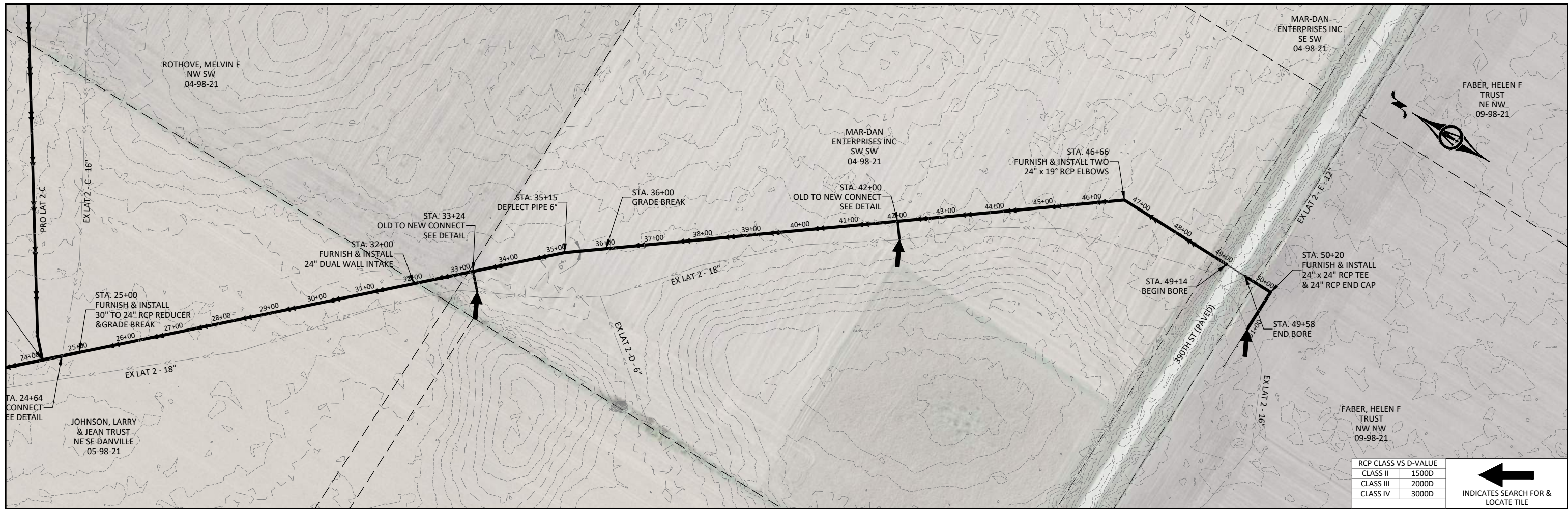


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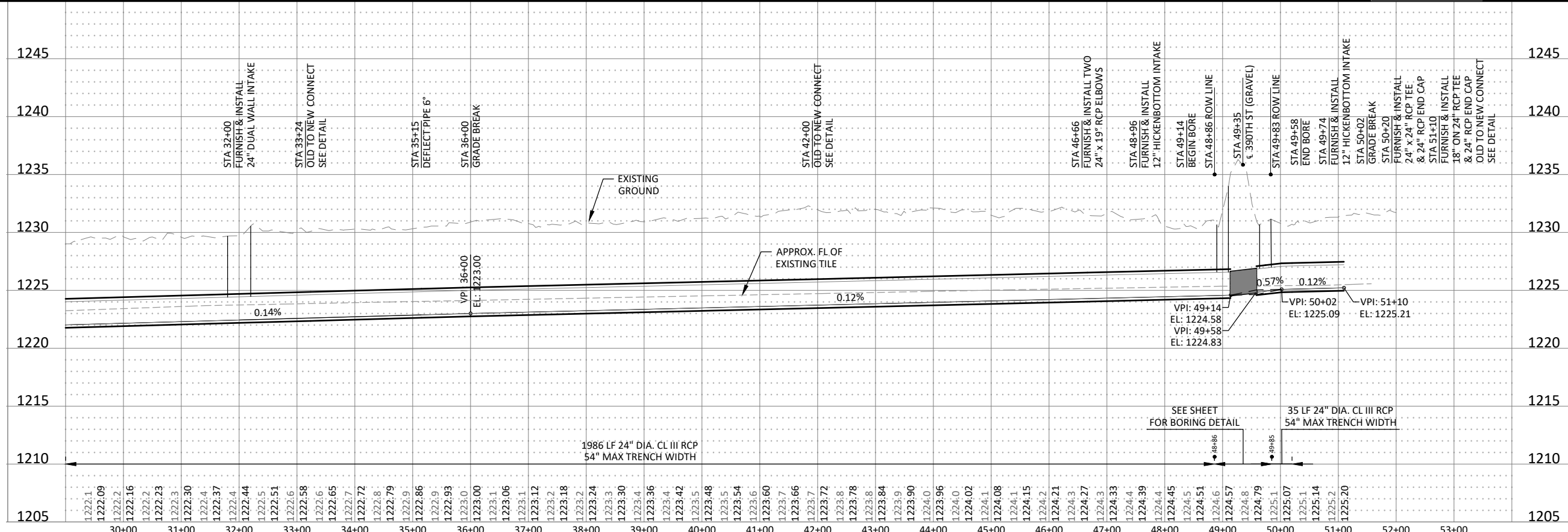
DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS  
WORTH COUNTY, IOWA  
PLAN & PROFILE - DD NO. 48 - PROPOSED LATERAL 2  
SHEET M.06



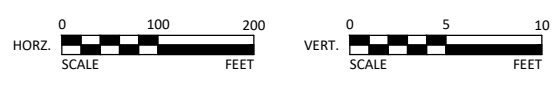


RCP CLASS VS D-VALUE	
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CLASS III	2000D
CLASS IV	3000D

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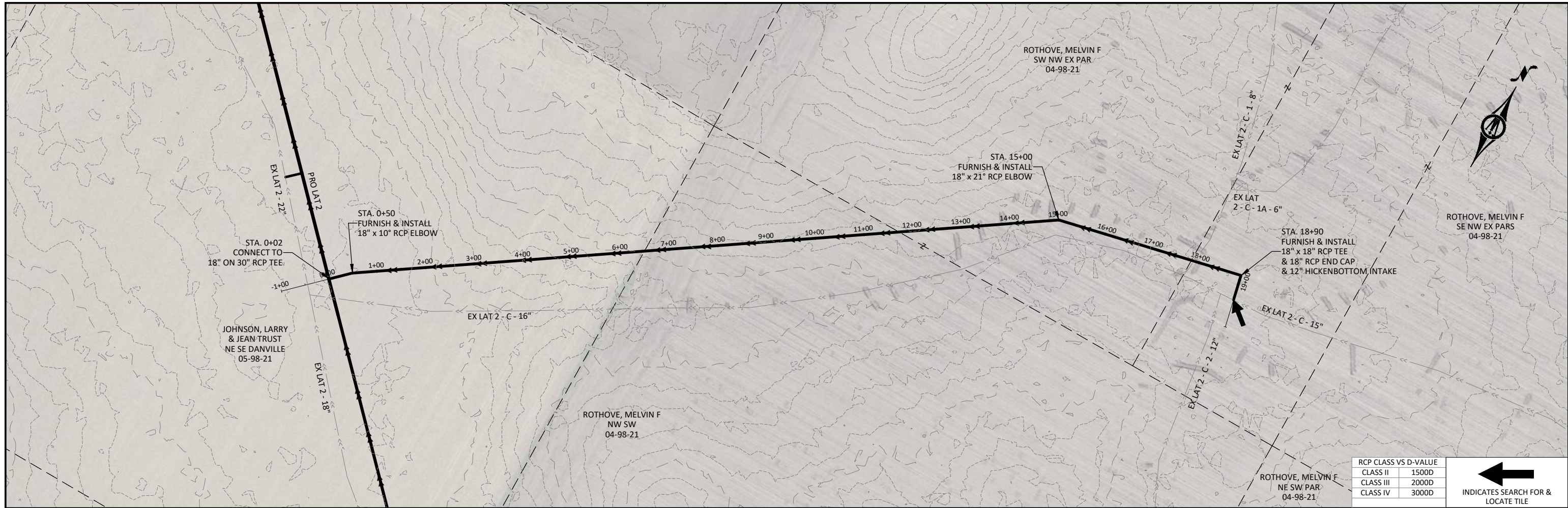
300 WEST MCKINLEY ST, P.O. BOX 68  
 JEFFERSON, IOWA 50129  
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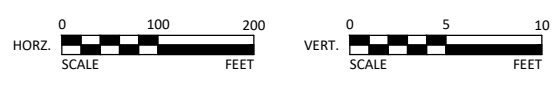
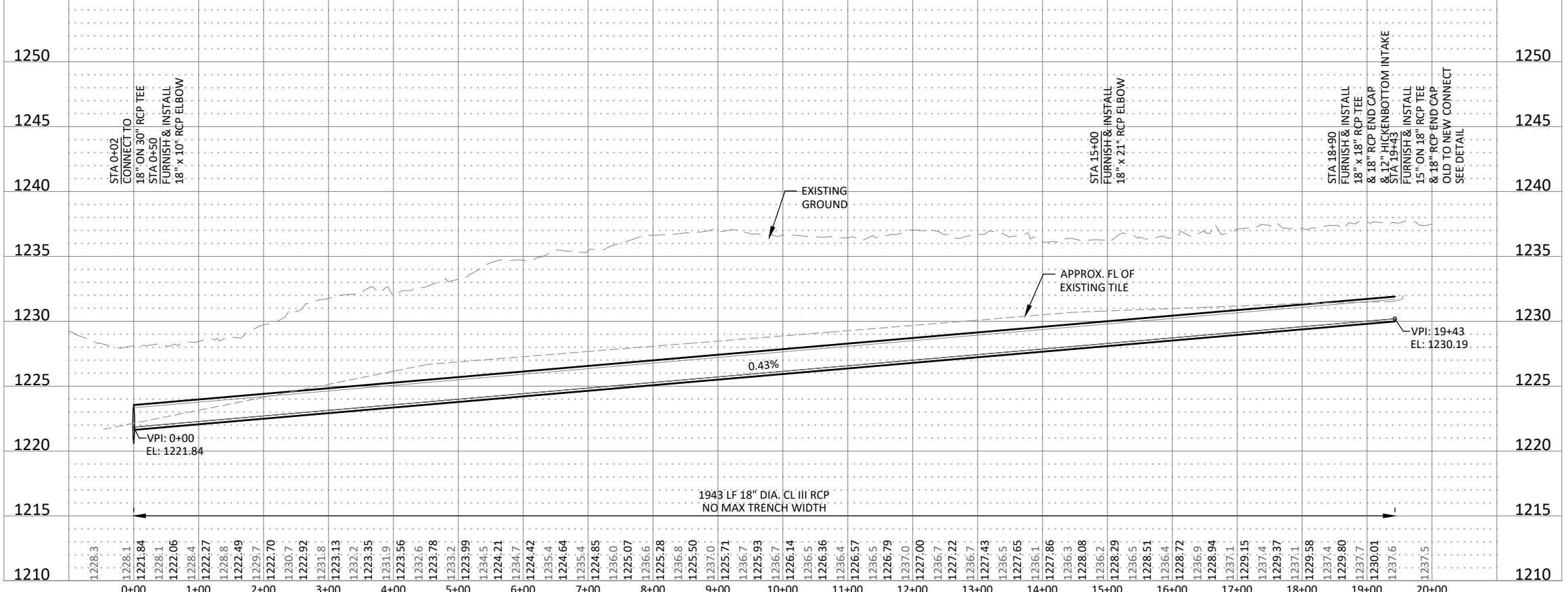
DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS  
 WORTH COUNTY, IOWA  
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SHEET  
**M.07**





RCP CLASS VS D-VALUE	
CLASS II	1500D
CLASS III	2000D
CLASS IV	3000D



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 WORTH COUNTY, IOWA  
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**M.08**

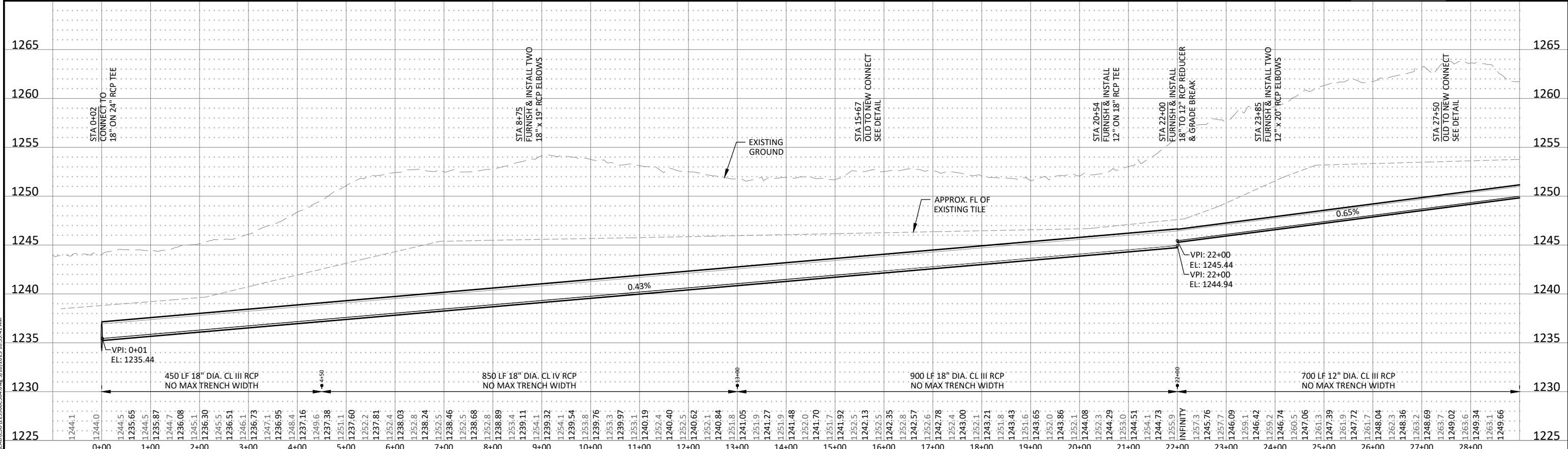
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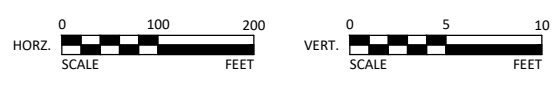


RCP CLASS VS D-VALUE	
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CLASS III	2000D
CLASS IV	3000D

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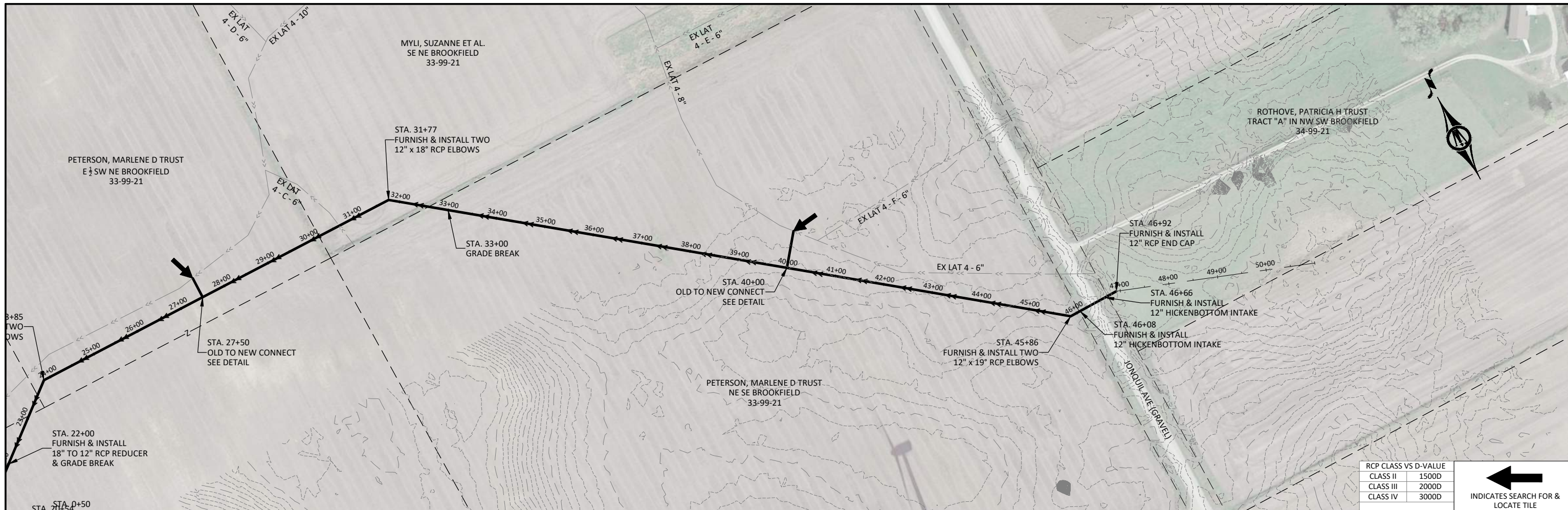
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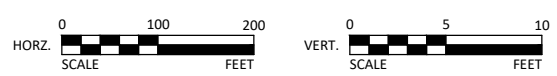
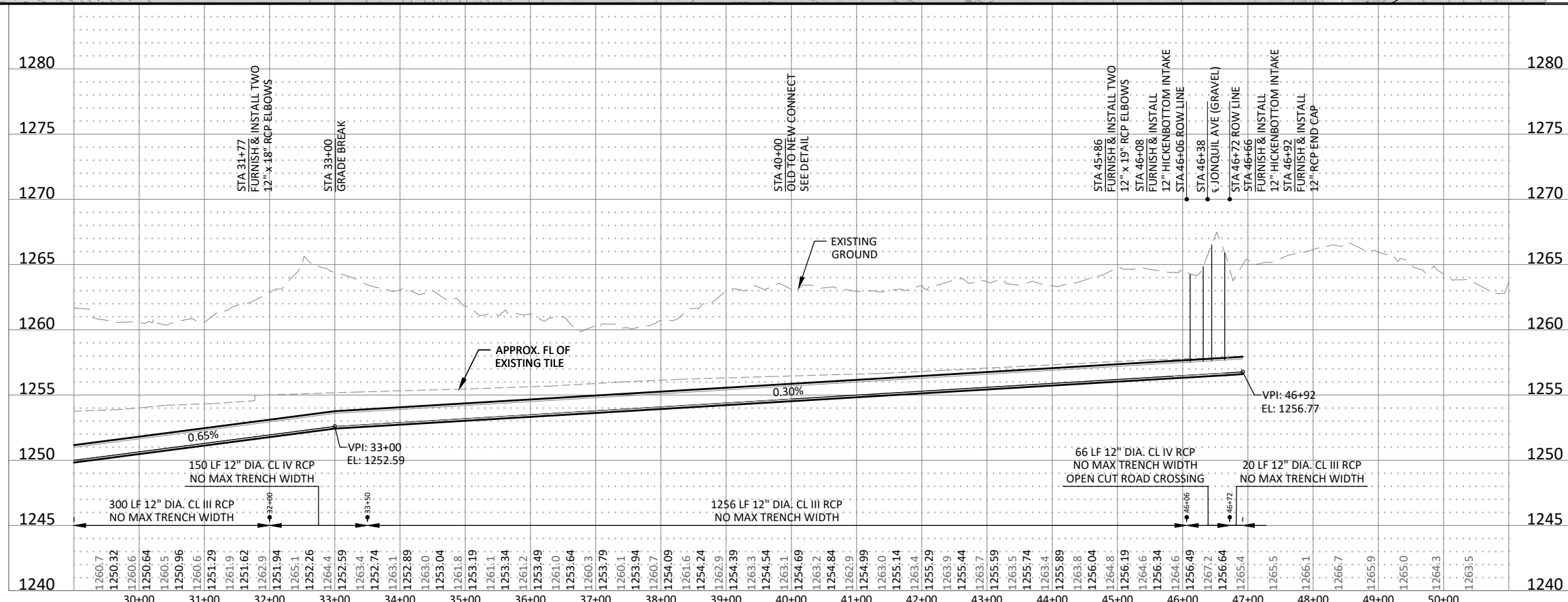
DRAINAGE DISTRICT No. 48 DRAINAGE REPAIRS AND IMPROVEMENTS  
WORTH COUNTY, IOWA  
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M.09





RCP CLASS VS D-VALUE	
CLASS II	15000
CLASS III	20000
CLASS IV	30000



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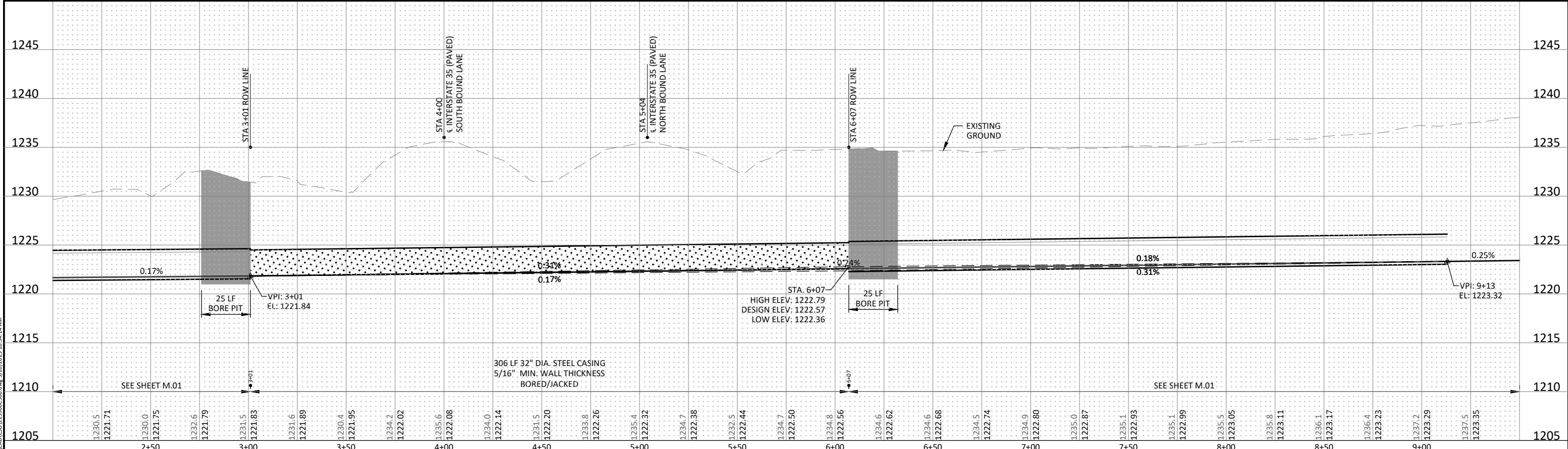
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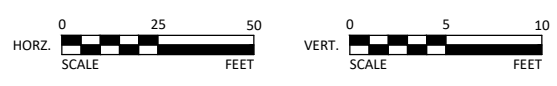
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**M.10**

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**WORTH COUNTY, IOWA**  
**INTERSTATE 35 BORING DETAIL**

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