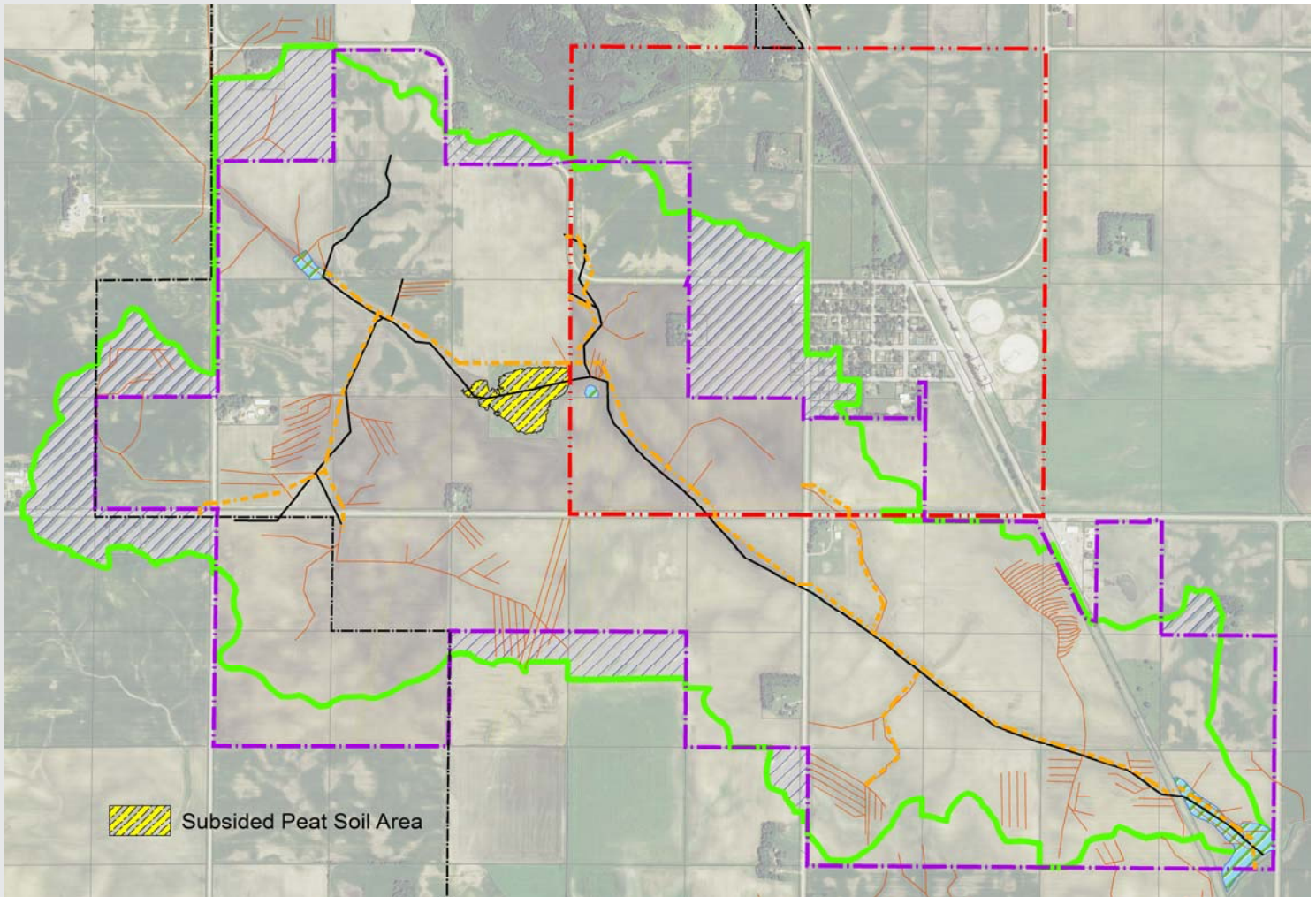




Engineer's Report for Proposed Tile Improvements

Drainage District No. 18 Worth County, Iowa 2016

P12.108902



Submitted by:
Bolton & Menk, Inc.
218 11th St SW Plaza
Spencer, IA 51301
P: 712-580-5075

Certification

Engineer's Report

Proposed Tile Improvements

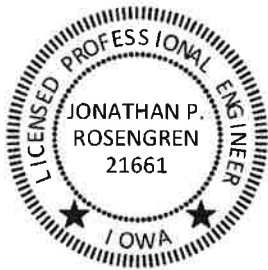
Drainage District No. 18

Worth County, Iowa

P12.108902

2016

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, 2016.



By: _____

Jonathan P. Rosengren
Jonathan P. Rosengren, P.E.
License No. 21661

Date: _____

April 18, 2016

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- Appendix C: Opinion of Probable Costs
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I. Introduction

A. Scope of Work

On July 2, 2014 a petition signed by a landowner in Drainage District No. 18 was filed with the Board of Supervisors requesting investigation of necessary repairs or improvements needed to bring drainage relief to lands of the petitioners. The Board appointed Bolton & Menk, Inc. to complete the necessary survey, study, plan and report. This report addresses the petitioners' request for repairs or improvements to the tile system within Drainage District No. 18. A copy of the petition is contained in Appendix A of this report.

B. Location

The watershed of Drainage District No. 18 covers approximately 1,416 acres in Sections 28-33 of Bristol Township (T-99-N, R-22-W) in Worth County, Iowa. The outlet of Drainage District No. 18 is an open ditch originally constructed by Drainage District No. 7 which drains to Drainage District No. 23. All water from Drainage District No. 18 is carried away by the DD 23 Main Open Ditch. Existing Drainage District No. 18 facilities include the Main Tile, and Laterals 1, 1A, 2, 3, 4 and 4A. These facilities are shown on the attached plans.

C. History

1914-7-7 Petition for drainage improvements signed by T. S. Huso and T. H. Bakken representing lands encompassing the S $\frac{3}{4}$ of Section 29, E $\frac{1}{2}$ of Section 30 and N $\frac{1}{2}$ of Section 33

1914-7-8 Field B. Forbes appointed as design engineer

1914-7-13 Engineer's Report filed recommending $\frac{1}{2}$ " Dc for wetland area (15% of watershed area)

1914-9-4 DD 18 established, F. B. Forbes, John J. Simons and W. L. Thomson appointed as appraisers, appraisers report filed

1914-9-14 Bid Letting:

1914 Bid Letting Low Bidders		
Bidder	Bid	Sections
J. S. R. Hansen	\$2,542.13	Burying & Fill
J. S. R. Hansen	\$90.00	Headwall
American Brick & Tile Co.	\$4,495.00	Furnishing Tile
B. E. Shriver & Co.	\$373.33	Hauling Tile
Construction Total	\$7,500.33	

1914-9-18 F. R. Lyford, L. D. Snyder, H. L. Christianson appointed for classification

1914-9-29 Classification Report filed

1914-11-25 F. R. Lyford, construction engineer, recommends modifications to Lateral 3, extending it to the N $\frac{1}{2}$ SW NW Section 29 using 8" @ 4' deep to provide outlet to N $\frac{1}{2}$ SW NW and NW NW of Section 29

1914-11-27 Hearing on extension, notices waived by landowners, assessments raised to account for new line

1957-6-10 Notice of Common Outlet in DD 7 which needs repairs to “*expeditiously carry off the combined waters of said District No. 7 and Districts No. 18, No. 27 and No. 31*”

1958-12-10 Hearing on common outlet charge for repair of DD 7 Main Open Ditch

Division of costs confirmed at hearing as follows:

1958 DD 7 Common Outlet Division		
District	Acres in District	Percent of Total Repair Cost
DD 7	4,000	74.9%
DD 18	1,340	16.7%
DD 27 & 31	920	8.4%
Total Acres	6,260	

2008-6-16 Petition filed to relocate 16” Main Tile out of low ground in center of Section 29

2009-1-12 Engineer’s Report filed by Jim Hyde recommending improvement to ½” Dc for entire watershed, Petitioner requests petition be withdrawn

2014-4-28 Approval for City of Joice wastewater lagoons to discharge to DD 7 Main Open Ditch in Section 33

2014-7-2 Petition for drainage relief filed

2014-9-2 Modification to previous approval allowing the City of Joice to discharge no more than 2 cfs over one week period twice per year to the DD 18 Main Tile in Section 33 east of the railroad bridge rather than to DD 7 Main Open Ditch

II. Investigation

In August of 2015, survey was made of the existing tile system within Drainage District No. 18 and survey of the outlet channel was taken from the survey made for the DD 23 open ditch repairs completed in 2015. In addition to survey of the existing system, review of the engineer’s reports and plans on file with the district was also made. The surveyed datum elevation equation was verified using these original plans and review of historical issues provided background for the problems experienced today.

Peat soils subsidence has the potential to expose tile or risk blow outs and other damage to district and private tile. Typical peat subsidence is between 25-35 % of the installed depth of a drain. The surveyed elevations shown on the original plans were reviewed to determine if areas of peat subsidence exist along the district facilities.

One reach of tile in the E ½ of the SW ¼ of Section 29 shows signs of peat subsidence. The land at this location is currently idled under a CRP contract. The ground surface in this reach appears to have subsided approximately 2.5 feet since the tile was constructed in 1914. The loss of this 2.5 feet has reduced the cover over the pipe from 4 feet to approximately 1.5 feet, making it possible for normal field operations to damage the tile. See the location marked on plan sheet A.03.

The certified wetland determination for this area shows this peat ground to be non-wetland, which will be of benefit both to the landowner and the district. All other reaches of tile show little sign of peat subsidence.

Existing Drains Performance Capacities. The size and coefficient of each reach of tile in the district is shown below. The coefficient represents the depth of water removed from the surface of the watershed in a 24 hour period. The modern standard of ½” of water removed from the surface area of the watershed in 24 hours (½” Dc) has been in use since the 1950’s.

Existing Drainage Coefficients			
Facility	Diameter / Grade (Inches @ %)	D _c (Inches/Acre/Day)	% of ½” D _c (Modern Standard)
Main Tile 0-12	20” @ 0.10%	0.07” (1/15”)	15%
Main Tile 12-40	18” @ 0.40%	0.12” (1/8”)	24%
Main Tile 40-61	18” @ 0.20%	0.09” (1/10”)	19%
Main Tile 61-75	18” @ 0.10%	0.08” (1/12”)	16%
Main Tile 75-97	18” @ 0.10%	0.09” (1/10”)	19%
Main Tile 97-116	16” @ 0.10%	0.09” (1/10”)	19%
Main Tile 116-128	16” @ 0.10%	0.11” (1/9”)	22%
Main Tile 128-150	14” @ 0.10%	0.12” (1/8”)	25%
Lateral 1 Tile	10” @ 0.50%	0.23” (1/4”)	47%
Lateral 1A Tile	6” @ 0.50%	0.51” (1/2”)	103%
Lateral 2 Tile	6” @ 0.70%	0.48” (1/2”)	96%
Lateral 3 Tile	10” @ 0.10%	0.11” (1/9”)	22%
Lateral 4 Tile	8” @ 0.70%	0.18” (1/6”)	36%
Lateral 4A Tile	8” @ 0.80%	0.25” (1/4”)	51%

**Manning’s n value assumed to be 0.013*

The coefficients and percent of modern capacity above 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 10-20% less than that shown on the table above.

The majority of the tile in this district were designed with a coefficient of approximately 0.1”/acre/day which is 20% of the recommended minimum modern design. It appears that the tile was designed to only drain the lowest wettest areas in the district. The estimated capacities of the existing main and laterals would provide the ½” Dc to those acres drawn as swampland on the original plat.

This design matches some statements we have found in other counties where prior to establishment of a district it was common to pasture the hill tops and the lowlands were swamp. The intended goal of tile drainage was to pasture the swamps and farm the pasture. Since DD 18 was established in 1914 land use has changed dramatically and pattern tile has been added throughout the watershed, not just in the low lands. Both of these changes have increased the demand on the main tile beyond the capacity it is capable of removing.

Watershed Changes. Review of several aerial photos and discussions with landowners reveals that a large portion of the land west of Aspen Ave within the watershed have been privately tiled west into DD 3. This area is shown on sheet A.02 of the included plans. Normally, areas such as this

would still shed surface water onto DD 18 facilities, but in this case, there is no road culvert so all water must be taken to DD 3 through the subsurface tile.

Our investigation finds that the DD 18 tile system is too small for the demands of modern farming practices placed upon the tile. Further, we find that due to age and its shallow depth it is not feasible or practical to rely upon the old drain to provide any supplemental water removal capacity. We also find that the structural integrity and therefore the capacity of the tile is likely compromised by subsided peat in the E ½ of the SW ¼ of Section 29.

III. Farm Program Compliance

A. 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.

B. 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 actually made a little easier—although mitigation is made more costly.

Mitigation options include the purchase of wetland credits in a mitigation bank. Mitigation banks are not common and their credits are not cheap. There are no agricultural mitigation banks serving this area with available credits. New sites for mitigation are currently being sought by the Iowa Agriculture Mitigation Bank, Inc. and it is possible that an eligible bank may be established nearby within the next few years. 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.

A third alternative is to have the district pay the owner of a converted farmed wetland a portion of the cost for mitigation. The landowner may then either purchase mitigation on his own or let the land lay idle until mitigation is acquired.

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.

C. Mitigation Policy of the Worth County Board of Supervisors

How drainage districts address mitigation is relatively new and a statewide standard practice has not yet evolved. This includes how the costs of the mitigation are paid. In several counties the mitigation costs have often been shared between the district and the owners of the converted farmed wetlands, when wetland mitigation credits were available. In other counties mitigation has been left entirely to the owners of the converted farmed wetlands. Each drainage district’s circumstances are different and the board of supervisors need the flexibility to address mitigation on a case by case basis.

The justification for the sharing of the costs is that although the owner of a farmed wetland directly benefits from the mitigation needed to make his wet property more productive; the district’s project cannot be permitted and proceed until mitigation is addressed. Even if a farmed wetland owner must pay all of the cost of mitigation, passing it through his drainage district enables him to pay for it over the period of installment payments set by the Board of Supervisors.

The Worth County Board of Supervisors along with several other counties, recently adopted a resolution which spells out how farmed wetlands will be dealt with for drainage districts under their supervision when drainage improvements are considered. This resolution is provided in Appendix A.

The resolution provides that if an improvement project is authorized the drainage district will exercise the third mitigation alternative described above. The owners of all farmed wetlands known at the time of the hearing and which the USDA eventually determines will be converted by the drainage district project will be credited or paid up to \$7,500 per acre of converted farmed wetland. This is intended to offset a part of the cost of mitigation.

With no currently available mitigation, in order to retain farm program eligibility the converted farmed wetland owner will need to forego cropping of the converted farmed wetland. When mitigation comes available in the future the landowner could purchase mitigation and resume farming of the converted farmed wetland, or opt to leave the converted wetland site permanently idle.

D. Self-Mitigation Plan a Possibility

An alternative which is not typically available, is for the district to self-mitigate converted farmed wetlands. The large peat pothole discussed in the Investigation section of this report may be a suitable and easily established and maintained mitigation site. The site is approximately 12.5 acres and is currently enrolled in a temporary conservation easement.

In discussions with the landowner, it is known that the certified determination for this farm shows this area as non-wetland and therefore the entire pothole could be used for mitigation of converted wetland. It is also known that the intent of the landowner is to return this piece to crop production once drainage is reestablished. However, it may be possible for the district to purchase the site for use as mitigation of converted ag wetlands in this district and other districts.

The landowner would benefit as he could sell the wettest area at a good price, while helping to ease the decision to approve the project. If the site were purchased by the district, this area would also be removed from his taxes and he would not be forced to pay assessments on what would likely be the highest assessed piece of land in the district.

The district and landowners of other farmed wetlands in the district would benefit as this option would probably be less costly to them and to the district. Any acres not used in mitigating the needs of DD 18 could be sold to other districts or area landowners to ultimately reduce project costs.

We have raised for discussion this interesting possibility but we do not recommend it as a component of this project. Further considerations, regulatory agency consultations, wetland mitigation needs, surveys, and economic analysis is required. However, if the landowner is interested we advise that the district take a serious look at this intriguing possibility.

E. Farmed Wetlands in Benefitted Area

As of the date of this report we have received certified wetland determinations for approximately 72% of the impacted watershed area. 9.08 acres of wetland have been reported in the benefitted watershed at this time. We encourage all who have appeal rights to do so. It will be important for any other owners of farmed wetland to provide their certified wetland determination before the public hearing is closed.

For this report a farmed wetland area of 0.5% of the benefitted area with no provided determinations (1.84 acres) plus the acres of farmed wetland reported in the areas covered by the provided determinations (9.08 acres) will be used to estimate the cost of mitigation. We have assumed mitigation costs of \$15,000 per acre. Using the board's mitigation policy, the estimated cost to the district for mitigation will be \$81,900.

These acres and cost estimate could vary substantially as more or fewer acres could be reported or a landowner could forego qualifying for mitigation assistance. Substantial changes should be reflected in a revised cost estimate which should be made at the time of the public hearing, after all determinations to be provided are in.

It is known that a significant backlog of determination requests currently exists within the NRCS system. We understand that approximately 900 requested determinations remain uncompleted across the state which may be part of the reason for so few wetland determinations provided to the district at this time. As this backlog is worked through, more determinations will likely come into the district. If a farmed wetland is found on one of these

new determinations, we strongly recommend that the landowner immediately request a reconsideration and inform the district, as removing these farmed wetland labels is beneficial to both the landowner and district.

The NRCS has recently changed criteria for wetland conversion analysis, now requiring that an intake must have existed inside the wetland at some time in the past in order for the full tile capacity rather than the limited soil permeability to be used toward converting that wetland. If a request for reconsideration to the NRCS is made, it is imperative to provide as much information regarding tile and intakes (whether currently existing or previously removed) as possible. This is the only way for existing tile records to be placed before the NRCS and be then given consideration in later appeals.

F. Conservation Reserve Program Complications

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.

G. CRP and/or Buffer Damage Waivers

The destruction of CRP vegetation by construction activities places the landowner in 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 must 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 done. 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.

H. Nesting Season Restrictions

The CRP rules also restrict disturbances during the primary nesting season, which covers the period of May 15 to August 1 in Worth County. 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 remains in effect for an unknown period.

It is all but certain that the WOTUS rule will 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 has 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.

V. Proposed Work

The investigation has confirmed the need for drainage relief in the district. Modern farming practices rely upon well drained soils to achieve maximum productivity. This standard applies to land with surface relief and shallow ponding. This standard is contained in the Iowa Drainage Guide and has been in place since the 1950’s. We recommend full replacement of the existing Drainage District No. 18 tile system with a system designed according to modern standards.

The proposed new main will outlet to the improved channel in the NE SE of Section 33 near the existing DD 18 outlet. From this location the main will generally follow the course of the existing Main Tile running north and west approximately two miles to the west side of Section 29. From this point the Main will turn south and run approximately ¼ mile and extend through 410th St to the NW NW of Section 32.

The outlet for the City of Joice wastewater treatment plant has been connected to the Main Tile near the railroad tracks in Section 33. Though this outlet is limited to 2 cfs of flow twice each year for a week each time, it does add additional burden to the proposed new main. The design of the Main Tile includes additional capacity to account for the wastewater plant outlet without impairing the drainage needs of other landowners in the district.

Seven additional laterals are proposed with this project, they are generally described as follows:

Branch A connects to the proposed main in the SW NW of Section 33 and runs south approximately ¼ of a mile and provides an outlet to the pothole in the NW SW of Section 33. Aerial photography indicates that this portion of area may be tiled across the watershed line to outlet in the DD 8 Main Open Ditch in the SE SW of Section 33. If this is the case, this area should be annexed into DD 8 in order for the owner to pay a fair portion of the assessment of each district.

Branch B connects to the proposed main in the NW NW of Section 33 and runs north and west approximately ½ mile to provide an outlet to the SE SE of Section 29. It appears that a tile runs west and south through the ridge in this parcel and the improved outlet may be unnecessary. Landowner information regarding the drainage is needed.

Branch C connects to the proposed main in the NW SE of Section 29 and runs north approximately ¼ mile to the SE NW of Section 29. This area is currently served by Lateral No. 1.

Branch C1 connects to the proposed Branch C in the NW SE of Section 29 and runs west approximately 300 feet to the NE corner of the NE SW of Section 29. This area is currently served by Lateral No. 1A.

Branch D connects to the proposed main in the NW SW of Section 29 and runs approximately 500 feet north to the south line of the SW NW of Section 29. This area is currently served by Lateral No. 2.

Branch E connects to the proposed main in the NW SW of Section 29 and runs north and west approximately 800 feet to the SE corner of the SE NE of Section 30. This area is currently served by Lateral No. 3.

Branch F connects to the proposed main in the SE SE of Section 30 and runs west approximately ¼ mile through Aspen Ave then crosses south through 410th St to the NW NE of Section 31. This area is currently served by Lateral Nos. 4 and 4A.

The proposed tile will cross the existing district tile at several locations. 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 all existing facilities be abandoned as district facilities. Maintenance responsibilities for these tile will be turned over to the landowners following completion of the project.

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 about five times the drainage capacity of the existing DD 18 Main Tile and Laterals and would be a substantial improvement for the lands in Drainage District No. 18.

The recommended ½” Dc design for the Main Tile will range in size from 36” at the outlet in the improved creek to 12” diameter at the end in Section 32. The majority of the laterals are proposed as 10” single wall plastic with Branch D proposed as 18” concrete.

The estimated project cost for the recommended ½” Dc tile system is \$1,300,000 or \$918/acre for lands currently in the district. A detailed opinion of probable cost is included in appendix C of this report. A summary of the probable construction costs for each proposed lateral is shown below.

Estimated Facility Costs – ½” Dc				
Facility	Diameter	Estimated Construction Cost	Benefited Acres	Cost per Acre
Main Tile	36” to 12”	\$873,000	1,416	\$617
Branch A	10”	\$21,000	48	\$438
Branch B	10”	\$44,000	87	\$506
Branch C	12” to 10”	\$28,000	157	\$178
Branch C1	10”	\$3,000	19	\$158
Branch D	10”	\$8,000	23	\$348
Branch E	18”	\$23,000	151	\$152
Branch F	10”	\$26,000	123	\$211

Six paved county secondary road crossings, three gravel county secondary road crossing and one railroad crossing are required as part of the proposed work. It is assumed that gravel crossings will be open cut and the paved secondary roads and railroad crossings will be bored. Iowa Code Section 468 requires that all costs of primary and secondary road crossings are to be paid from funds available to the entity that controls the road. Recent court decisions have established that railroads are responsible for the costs of bridges only and not for drain tile. The table below summarizes the road crossings which are part of the proposed tile improvement.

Road Crossings					
Road	Control Agency	Facility	Station	Type	Diameter
Railroad	Chicago & Northwestern	Main	14+08	Bored	38"
Cardinal Ave	Worth County	Main	62+21	Bored	38"
410 th St	Worth County	Main	76+75	Bored	34"
410 th St	Worth County	Main	145+88	Bored	26"
410 th St	Worth County	Branch B	14+89	Bored	14"
Cardinal Ave	Worth County	Branch B	21+12	Bored	14"
415 th St	Worth County	Branch C	10+76	Open Cut	12"
Lake St	Worth County	Branch C	16+76	Open Cut	12"
Aspen Ave	Worth County	Branch E	13+03	Open Cut	12"
410 th St	Worth County	Branch E	15+44	Bored	14"

Estimated cost of Secondary Road Crossings for the ½” Dc is \$223,000

The cost to the Secondary Roads for the paved road crossings could be reduced to allowing the crossings to be open cut. The estimated cost to the Secondary Roads for the crossings as proposed is \$209,000 for the half inch diameter coefficient. If the paved roads are open cut the estimated cost is reduced to \$119,000. Maintenance costs of the open cut crossings will be greater than if they were bored, but only for a few years.

The cost of the railroad boring will be paid by the landowners in the district. The cost of this boring is included in the construction cost summary above.

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 corrugated plastic pipe association’s installation standards, the dual wall HDPE pipe would need to be completely encased in crushed rock or densely packed good soil. The inclusion of this bedding envelope raises the cost of the dual wall HDPE installation above the typical installation cost of RCP. RCP also does not deform under the weight of the soil. In cases where dual wall HDPE has been used without the rock envelope, the load triggered deformations stress the smooth 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. We expect a much longer service life from today’s RCP products.

The district will need an area within which to perform the proposed work. The work limits will typically be set out to 50 feet from the tile on each side but wider where the cut depth exceeds twelve (12) feet. Landowners will be entitled to compensation for damages within the work area. It is recommended that whenever possible, a landowner should not crop the work area and instead should request fair rent for the land. Compensation for use of and damages within the temporary

work area is normally determined at the project completion hearing. This is included in the cost estimate.

VI. Assessment Schedule Review

The process of reclassification uses several factors to equitably spread project costs based upon benefits received. Three of the primary factors are Use, Proximity and Wetness.

The Use Factor takes into account 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 assessment on that property. A 40 acre tract using 200 feet of the tile should benefit less than a 40 acre tract using 2 miles of the tile.

The Proximity Factor takes into account access to the facility. Lands nearer to the tile or ditch receive a higher assessment because they have easy access to district facilities. Lands farther from the facility must invest in additional private mains or other means to access the facility. A 40 acre tract which is crossed by a tile should benefit relatively more than a 40 acre tract a mile away which must build a private system to reach the tile.

The Wetness Factor accounts for the soils natural wetness and need for drainage. Wet soils in a pothole have more need for drainage than drier soils on the hill tops. A very poorly drained Okoboji soil should be assessed more than a well drained Clarion soil.

The reclassification process also makes use of adjustment factors assigned to different areas of a watershed which are drained against the natural course of drainage or properties which shed a larger amount of water. Roads and city streets are constructed of impervious materials and are graded intentionally to shed the water as quickly as possible and should therefore be assessed relatively more than similar ag land.

A. Benefited Lands not now Assessed

There are approximately 1,416 acres within the Drainage District No. 18 watershed, of which 210 acres have never been assessed for benefits from district facilities. This area is shown on Sheet A.02 of the proposed plans. In September 2014, the Board of Supervisors approved connection of the outlet from the Joice wastewater treatment plant to the DD 18 Main Tile near the railroad tracks. This area is included in the recommended annexation area, and should be assessed for the benefits derived from DD 18.

It would be cost effective to do this annexation as part of the proposed project. Most landowners now in the district would likely support the annexation; those being annexed would likely be opposed. It should be emphasized to the owners of the annexed lands that assessments are based upon relative benefits and that if this benefit is small, the assessment it also relatively small.

B. Existing Assessment Schedule Review

Drainage District No. 18 has not been reclassified since the original assessment schedule was setup in 1914, and the maintenance activities for all 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 18. As can be seen on this map, the heaviest assessments fall on the wet ground in along the west edge of Section 29 and the east edge of Section 30. Also noticeable are the several existing tile in Section 29.

The method of developing the existing assessment schedule appears to use a method very common in the early years of drainage districts. All land through which the district tile passes is assumed to receive the same benefit. As the classifications are reviewed along the

main tile, the land directly at the outlet has the same classification as the land at the end of the tile. The former uses approximately 100 feet of the tile, the other needed more than 2 miles of tile to be constructed.

A glaring error in the existing schedule is the SE SW of Section 29. This 40 acres was originally assessed as a single 40 acre tract. At some point in the past it was divided into a 1.59 acre farmstead and the remaining 37.58 acres remains farmed. When this parcel was split, the agreed assessment division was flipped so that the acreage has a classification of 58% and the 38 acres of farmland has a classification of 3%. This works out as the acreage paying \$22 in assessment for every \$1 of assessment paid by the by the 38 acres of farmland. Also worth noting is the S ½ SE NW which is a 20 acre tract ½ mile from the outlet which pays as much as entire 40 acre tracts at the upper end of the tile.

The several laterals on the same main schedule leads to another obvious inequity. Relatively few lands receive benefits from each of these facilities, yet farms over a mile away pay to maintain them.

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 facility from having to pay to maintain that facility. It is recommended that the proposed tile be divided into separate maintenance schedules to make the cost of future repairs more equitable.

To correct all of the inequities described above it is recommended that the entire system of drains be reclassified. This recommendation stands even if it is decided not to construct improvements at this time.

VII. Discussions & Recommendations

This report confirms the need to improve the drainage efficiency and capacity of the Drainage District No. 18 drainage system. The work described herein can accomplish that improvement. The improvements proposed will provide the drainage capacity needed for modern farming practices. The estimated assessable cost of the recommended ½" Dc improvement is \$1,300,000. We find that the proposed project will be practicable, feasible, and beneficial to the public.

Annexation Recommended. Approximately 15% of the lands now served by Drainage District No. 18 (210 acres) appear to benefit from district facilities, but have not been assessed for maintenance costs of the facilities. In order for these lands to now be assessed to help pay for future maintenance it is necessary to bring them into the Drainage District No. 18 benefited area. The benefited lands listed in Appendix B include these lands which are marked with a footnote.

Annexation required reports, notices and hearings and is expected to cost approximately \$5,000. For the proposed improvement, annexed lands should bring more dollars into the district than it would cost to annex them. In order for these lands to be assessed to help pay for future maintenance there would be no better time to bring them into the district. It is recommended the 210 acres outside of Drainage District No. 18 which would benefit from the proposed improvements be annexed.

Reclassification Recommended. The existing assessment schedule is inequitable in many ways 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 for a total of \$10,000 to \$15,000.

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 5% interest, the recommended improvement costs for all benefited lands would be about \$64 per acre per year. Please be reminded that assessments are based upon benefits and that following reclassification some highly benefited parcels will likely bear up to twice the average assessment for the combined system of drains.

Included in Appendix C is a financial analysis of the probable costs and the likely payback period for different assessment thresholds and different yield increases resulting from this project. The financial analysis uses current commodity prices and average yields from the Ag Decision Maker website maintained by Iowa State. Varying yield increases have been used to estimate pay back periods for a range of possible assessments. Iowa State University and University of Minnesota research indicates a likely average yield increase between 10% and 25% for an improvement of this type.

Assuming the indicated rotation, a corn average price of \$3.00 and soybeans \$7.80 over the next twenty years and normal yield improvement trends and using only the increase in revenue from an assumed 10% yield increase, an average assessment for the recommended ½” Dc could be repaid in approximately 17 years. The value of the land will also be improved.

It is recommended that the Board of Supervisors of Worth County, acting as trustees for Drainage District No. 18, 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.
- Consider the recommendation to provide mitigation assistance to owners of farmed wetland that will be converted by the project.
- Adopt the recommended 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. 18.
- Initiate reclassification procedures.

Respectfully submitted,

Bolton & Menk, Inc.



Jonathan P. Rosengren, P.E.

Appendix A: Petition & Mitigation Policy of Worth County Board of Supervisors

PETITION FOR REPAIRS

To The Board of Supervisors,

Worth County, Iowa

I wish to call your attention to the necessity for repairs to:

Drainage District No. 18, Lateral No. Main, which is located in
Section _____, Bristol Township, and ask that the said matter
be investigated and repairs made as soon as possible.

Thank you.

Name: Paul Tombl Date: 7-2-14

Phone Number: 641-590-1764

Other information/comments:

Main Reviewed and improved. It is currently undersized.

Resolution No. 02.02.2015A

**Policy Regarding the Mitigation of Converted Farmed Wetlands in Benefited Areas of
Drainage District Improvement Projects in Worth County**

WHEREAS the Board of Supervisors is charged under the law to conduct studies and to consider at public hearing, together with the owners of the benefited lands, the adoption of drainage improvements by and for drainage districts in the county.

WHEREAS drainage district improvements may be found by the USDA to cause the conversion of farmed wetlands subject to wetland conservation rules of the federal farm program and thereby cause the owners of the converted wetlands to be subjected to heavy penalties for violations of the program rules.

WHEREAS the Board believes it is important to establish a balanced and consistent policy that supports the inclusion of mitigation for converted farmed wetlands in drainage district projects and provides that drainage districts may choose to share the costs of mitigation with the owners of the converted farmed wetlands.

WHEREAS the Board anticipates that several drainage districts will in 2015 and later consider improvements which will, if approved at public hearing, result in the conversion of farmed wetlands in the benefited areas and the Board has learned that there is no affordable converted wetland mitigation currently available, but that mitigation is also anticipated to be available in the future.

WHEREAS farm program rules allow the owners and tenants of farmed wetland converted by drainage districts to avoid program penalties and retain eligibility if they do not crop the area of the converted farmed wetland.

WHEREAS the Board believes it is important for drainage districts to continue to support mitigation of farmed wetlands converted by drainage district improvement projects when affordable mitigation is not available so that the projects may be considered for approval and, if approved, be constructed all in a timely manner.

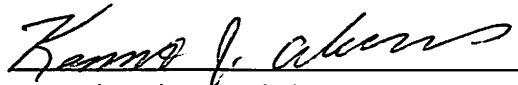
IT IS HEREBY RESOLVED that for all proposed drainage district improvements projects in the county that will hereafter be considered for adoption at public hearing in the county and which are under the sole jurisdiction of the Board, and subject to the following conditions, the drainage district will provide, from the drainage district's funds, a mitigation offset fee or credit of up to \$7,500 per farmed wetland acre to each owner of farmed wetland that will be converted by the drainage district project, the funds then to be used toward the owners' independent pursuit of compensatory mitigation if so desired.

- Condition 1. The drainage district determines either through a jurisdictional determination of the Corps of Engineers or by the opinion of the drainage district's appointed engineer that the farmed wetland is not subject to regulation under Section 404 of the federal Clean Water Act. [Note: If a farmed wetland is subject to Clean Water Act jurisdiction then the drainage district will be directly responsible for the regulatory agency project permits and associated mitigation requirements and no mitigation offset fee or credit will be provided under this policy.]

- Condition 2. An owner of a farmed wetland that may be converted by the proposed project must timely provide to the drainage district a copy of a USDA issued or approved certified wetland determination for land in the benefited area. So that the added cost of the mitigation offset may be included in the board's considerations, this documentation must be placed on file with the county before the time that the board finalizes its decision at public hearing to approve the construction of drainage improvements in the district. If the farmed wetland documentation is not timely provided then no mitigation offset fee or credit will be provided by the drainage district.
- Condition 3. The owner of a farmed wetland must exhaust the reasonable options available through the local or area USDA staff to minimize the size of the farmed wetland as may be available to them at or after the time of their receipt of the notice of the public hearing. If this is not done the Board reserves the option to independently assess the accuracy of the claimed farmed wetland acres and to reduce or eliminate the mitigation offset fee or credit provided for under this policy.
- Condition 4. Before credits or payments for a mitigation offset will be released to a farmed wetland owner the owner must provide a statement in writing from the USDA that the farmed wetland will be converted by the drainage district project and that continued cropping of the farmed wetland after it is converted will affect the owner's farm program eligibility. This statement is required even if the landowner is currently not a farm program participant.
- Condition 5. If a project is not completed and federal or state laws or regulations change prior to the release of the mitigation offsets provided for herein, and it has been determined that the drainage district may no longer transfer compensatory mitigation responsibilities to the farmed wetland owners in the manner provided for under this policy, then the mitigation offsets will be canceled. [Note: This will trigger a reevaluation of the mitigation needs of the project.]


The Board may alter this policy for each drainage district project as may be needed to accomplish the intent of the resolution, to account for unusual circumstances, to comply with changing laws and regulations, and to promote fairness.

Adopted and approved this 2nd day of February 2015.

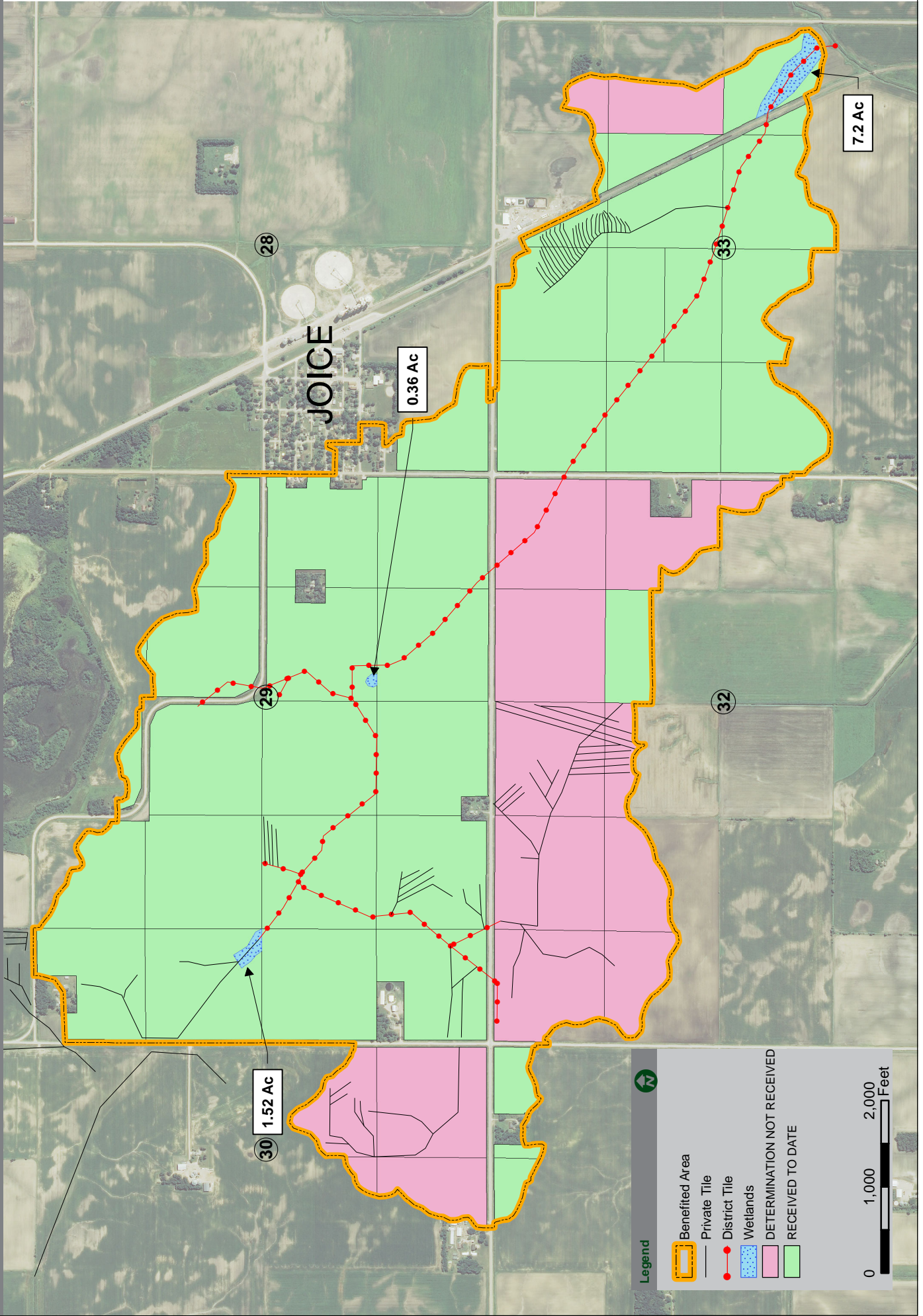


Kenneth J. Abrams, Chairman
Board of Supervisors
Worth County, Iowa

ATTEST:



Jacki A. Backhaus, Worth County Auditor

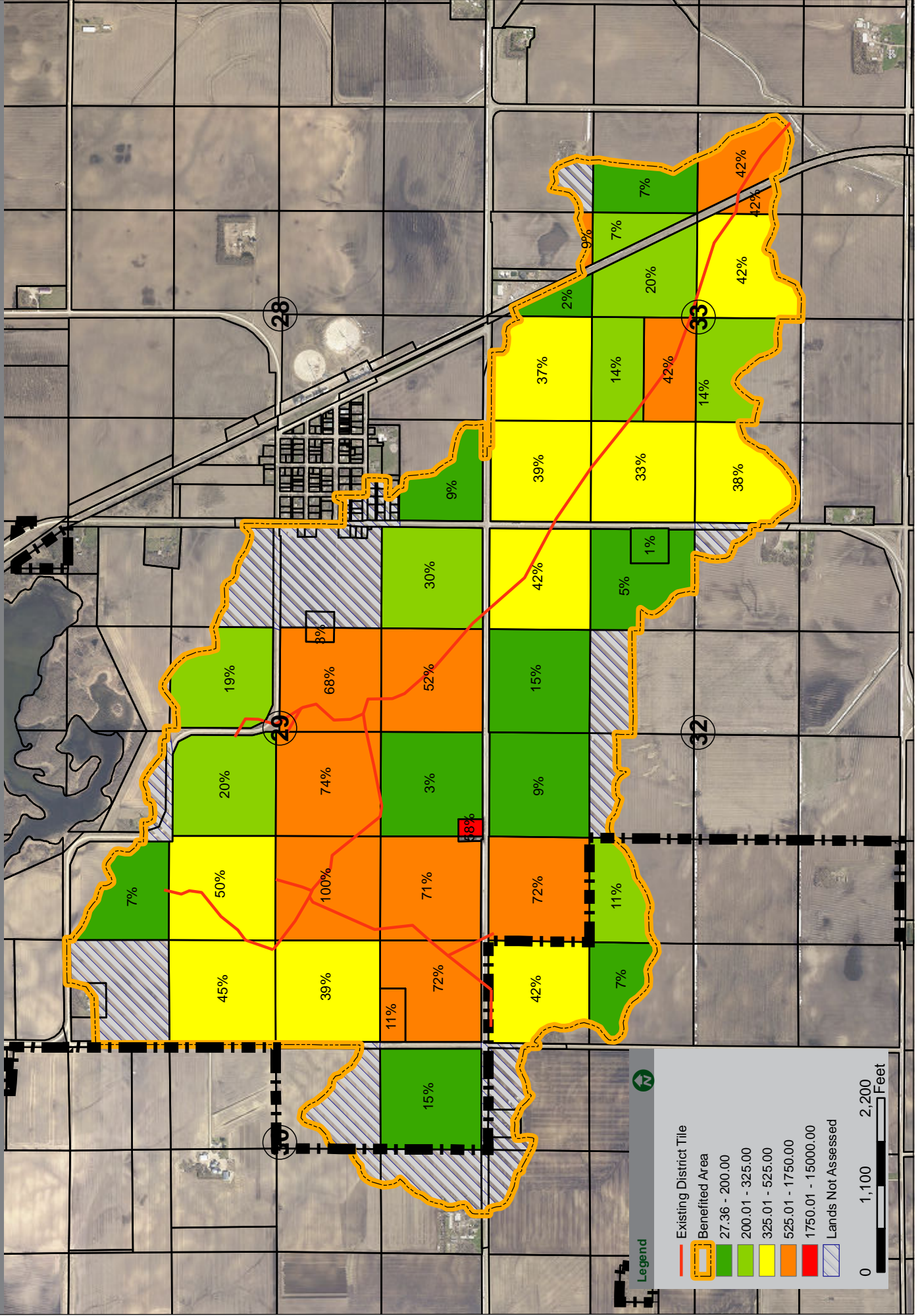


Legend

- Benefited Area
- Private Tile
- District Tile
- Wetlands
- DETERMINATION NOT RECEIVED
- RECEIVED TO DATE

0 1,000 2,000 Feet

Appendix B: Benefited Lands



**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Main Tile

Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Percent	
				Benefited Acres	Currently Assessed Area
ABBEY, ROBERT GENE TST UND 1/2 & VALEDA F. TRUST UND 1/2	0531100004*	31-99-22	NE NW	5.9	0.41%
ABBEY, ROBERT GENE TST UND 1/2 & VALEDA F. TRUST UND 1/2	0531200002*	31-99-22	NW NE EX. PAR.	10.1	0.70%
				16.0	1.11%
ANDERSON, ELLEN	0529426007*	29-99-22	PAR. IN NE SE	0.26	0.02%
ANDERSON, ELLEN	0529426008*	29-99-22	PAR. IN NE SE	0.26	0.02%
				0.52	0.04%
ARNESON, CURTIS & DILLA	0528313004*		J & A SUB-DIV. LOT 4,BLK. 1	0.23	0.02%
BEVERLY LAND COMPANY	0528352001	28-99-22	SW SW EX. PAR.	19.7	1.37%
BEVERLY LAND COMPANY	0533100001	33-99-22	NW NW	40.00	2.77%
BEVERLY LAND COMPANY	0533100002	33-99-22	SW NW	40.00	2.77%
BEVERLY LAND COMPANY	0533100003	33-99-22	NE NW EX. RR.	36.2	2.51%
BEVERLY LAND COMPANY	0533100004	33-99-22	N 1/2 SE NW	20.00	1.39%
BEVERLY LAND COMPANY	0533100005	33-99-22	S 1/2 SE NW	20.00	1.39%
BEVERLY LAND COMPANY	0533200002	33-99-22	NW NE W. OF RR.	7.0	0.49%
BEVERLY LAND COMPANY	0533200005	33-99-22	SW NE W. OF RR.	26.67	1.85%
BEVERLY LAND COMPANY	0533300001	33-99-22	NW SW	29.6	2.05%
BEVERLY LAND COMPANY	0533300002	33-99-22	NE SW	24.2	1.68%
				263.37	18.27%
BRANDT, KENNETH & CYNTHIA L.	0530400004	30-99-22	PAR. IN SE SE	5.14	0.36%
BUTLER, BRENT A & HEATHER J	0528309001*		ORIGINAL TOWN - JOICE BLOCK:12 LOT:1 & 2	0.2	0.01%
CARTER, ROGER L. & LYNDA P.	0529401002	29-99-22	PAR. IN NW SE	1.47	0.10%
CARTER, ROGER L. & LYNDA P.	0529426001*	29-99-22	PAR. IN NE SE	1.65	0.11%
				3.12	0.22%
CITY OF JOICE	0533200006	33-99-22	SW NE E OF RR	10.12	0.70%
DE VRIES, DAVID M. & SANDRA M.	0528309002*		ORIG. LOTS 3 & 4,BLK. 12	0.2	0.01%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Main Tile

Landowner(s)	Parcel No.	Sec-Twp-		Description	Benefited Acres	Percent
		Rng				Currently Assessed Area
DORN, DOROTHY A.	0531200005	31-99-22		SE NE	17.3	1.20%
DORN, DOROTHY A.	0532100003	32-99-22		SW NW	19.6	1.36%
					36.9	2.56%
EVANS, BETTY J	0532200001	32-99-22		NW NE	40.00	2.77%
EVANS, BETTY J	0532400004*	32-99-22		NE SE	4.6	0.32%
					44.6	3.09%
EVANS, ERIC A. & LORI A.	0532200003*	32-99-22		SW NE	16.3	1.13%
FIVE STAR COOPERATIVE	0533200009	33-99-22		NW NE E OF RR EXC PAR	2.1	0.15%
FLORENCE, JASON JON	0529300004	29-99-22		PAR IN SW SW	0.47	0.03%
FLORENCE, JASON JON	0529300005	29-99-22		PAR IN SE SW	1.72	0.12%
					2.19	0.15%
FUNK, CHRISTEN A.	0528309004*			ORIG. LOTS 11 & 12,BLK. 12	0.32	0.02%
GESME, MARILYN	0529426006*	29-99-22		PAR. IN NE SE	0.26	0.02%
HANNA, MARK D & BELINDA I JT 1/2 INT	0532200002	32-99-22		NE NE	40.00	2.77%
HANNA, MARK D & BELINDA I JT 1/2 INT	0532200005	32-99-22		SE NE EXC PAR	28.5	1.98%
					68.5	4.75%
HEAGEL, CHAD C. & GLORIA I.	0528313006*			J & A SUB-DIV. LOT10, BLK. 1	0.23	0.02%
HEINTZMAN, JON & MELISSA	0528351004*			J & A SUB-DIV. LOT 4,BLK. 2	0.1	0.01%
HOLT, MARILYN	0529426003*	29-99-22		PAR 91'X 140' IN NE SE	0.29	0.02%
JORTH, RANDY R & CINDY J	0528313010*			JORTH & ANDERSON SUB BLOCK:1 LOT:6	0.24	0.02%
JORTH, RANDY R. & CINDY J	0528313009*			J & A SUB-DIV. LOT 7,BLK. 1	0.23	0.02%
					0.47	0.03%
LANGFALD, RONALD & ARDIS	0531200001*	31-99-22		PARCEL IN NW NE	2.8	0.19%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Main Tile

Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
LEONARD, JULIE ANN & ANDERSON, JAMES ALLEN	0532100004*	32-99-22	SE NW	10.2	0.71%
LIEN, MARDENE S.	0528313011*		JORTH & ANDERSON SUB BLOCK:1 LOT:LOTS 1 & 2	0.46	0.03%
LINDFLOTT, RICHARD A. & ROBERT D.	0533400001	33-99-22	NW SE EX. RR.	32.6	2.26%
LINDFLOTT, RICHARD A. & ROBERT D.	0533400002	33-99-22	NE SE EX. RR.	22.3	1.55%
				54.9	3.81%
LUEDTKE, DEANNA L REVOCABLE TRUST	0528309003*		ORIGINAL TOWN - JOICE BLOCK:12 LOT:5 & 6	0.3	0.02%
MALLOY, MARCUS E.	0532200006	32-99-22	PAR. IN SE NE	5.20	0.36%
MOE, DAVID R. & CAROL P.C.	0528351001*		J & A SUBDIV. LOT 1,BLK 2	0.24	0.02%
MOE, DAVID R. & CAROL P.C.	0528351002*		J & A SUB-DIV. LOT 2BLK. 2	0.24	0.02%
MOE, DAVID R. & CAROL P.C.	0528351003*		J & A SUB-DIV. LOT 3,BLK. 2	0.24	0.02%
				0.72	0.05%
OLSON, EDWARD E. & JULIA & LEILA	0529300001	29-99-22	NW SW	40.00	2.77%
OLSON, EDWARD E. & JULIA & LEILA	0530400002	30-99-22	SW SE EXC. PAR.	39.70	2.75%
OLSON, EDWARD E. & JULIA & LEILA	0530400003	30-99-22	NE SE EXC. PAR.	39.70	2.75%
OLSON, EDWARD E. & JULIA & LEILA	0530400005	30-99-22	SE SE EX. PARCELS	34.56	2.40%
OLSON, EDWARD E. & JULIA & LEILA	0530300002*	30-99-22	NE SW	2.6	0.18%
OLSON, EDWARD E. & JULIA & LEILA	0530300004*	30-99-22	SE SW	17.7	1.23%
OLSON, EDWARD E. & JULIA & LEILA	0530400001*	30-99-22	NW SE EXC. PAR.	19.0	1.32%
				193.26	13.41%
PETERSON, KEVIN L	0528313003*		JORTH & ANDERSON SUB BLOCK:1 LOT:3	0.23	0.02%
PETERSON, LARRY D & KATHRYN A	0529426004*	29-99-22	PAR IN E 1/2 SE	0.47	0.03%
POLEY, GARFIELD E. & DEBRA J.	0529426005*	29-99-22	PT. E 1/2 SE	0.54	0.04%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Main Tile

Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Percent	
				Benefited Acres	Currently Assessed Area
RAMSEY, NORMA M	0533200007	33-99-22	SE NE	18.6	1.29%
RAMSEY, NORMA M	0533200004*	33-99-22	NE NE	5.6	0.39%
				24.2	1.68%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100001	29-99-22	NW NW	24.9	1.73%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100002	29-99-22	SW NW	40.00	2.77%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100005	29-99-22	SE NW	40.00	2.77%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529300002	29-99-22	NE SW	40.00	2.77%
				144.90	10.05%
SELL, JAMES E. & JUDY A.	0528309006*		ORIG. LOTS 8 & 9,BLK. 12, EX. W 4 1/2'	0.31	0.02%
SHAFFER, RICHARD J & JAYNE	0528313005*		JORTH & ANDERSON SUB BLOCK:1 LOT:5	0.24	0.02%
SMITH, JEREMY L & LIEN, CARRIE S	0528309007*		ORIG. LOT 7, BLK. 12	0.16	0.01%
SWANSON, DEREK & JAMIE	0530200006*	30-99-22	PAR IN NE NE EXC PAR	1.9	0.13%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529200006	29-99-22	SW NE	32.2	2.23%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529300003	29-99-22	SW SW EXC PAR	39.53	2.74%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529300006	29-99-22	SE SW EXC PAR	38.28	2.66%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529401001	29-99-22	NW SE EX PAR	38.53	2.67%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529451001	29-99-22	SW SE	40.00	2.77%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529476001	29-99-22	SE SE	40.00	2.77%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0532100001	32-99-22	NW NW	40.01	2.78%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0532100002	32-99-22	NE NW	39.98	2.77%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529100004*	29-99-22	PT NE NW	4.5	0.31%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Main Tile

Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529200004*	29-99-22	SE PT NW NE	0.5	0.03%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529200010*	29-99-22	SE NE EX PAR	14.9	1.03%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529426002*	29-99-22	NE SE EXC PARS	35.53	2.46%
				363.96	25.25%
TENOLD, PAUL A & TERESA L	0531200004	31-99-22	NE NE	34.7	2.41%
THORSON, CRAIG A.	0528313007*		J & A SUB-DIV. LOT 9,BLK. 1	0.23	0.02%
Unknown	0529426009*	29-99-22	Natural Gas Terminal	0.04	0.00%
VETTER, EMILY ET AL 1/2 & JONES FAMILY TRUST 1/2	0530200005	30-99-22	SE NE EXC. PAR.	39.70	2.75%
VETTER, EMILY ET AL 1/2 & JONES FAMILY TRUST 1/2	0530200007*	30-99-22	NE NE EX PARS	30.1	2.09%
				69.8	4.84%
VONHAGEN, DENNIS D.	0528309005*		ORIG. W 4 1/2' LOT 9& ALL LOT 10, BLK. 12	0.18	0.01%
WONSMOS, JOHN H. & JUDITH V.	0528313008*		J & A SUB-DIV. LOT 8,BLK. 1	0.23	0.02%
Railroad		0-0-0		7.2	0.50%
City of Joice Streets and Alleys		0-0-0		2.1	0.15%
Worth County Secondary Roads		0-0-0		51.2	3.55%
Totals for all Benefited Lands				1441.59	100.00%

**BENEFITED LANDS SCHEDULE
 PROPOSED TILE IMPROVEMENTS
 DRAINAGE DISTRICT NO. 18
 WORTH COUNTY, IOWA**

Lateral A					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
BEVERLY LAND COMPANY	0533300001	33-99-22	NW SW	29.5	61.10%
BEVERLY LAND COMPANY	0533100002	33-99-22	SW NW	17.3	35.85%
				46.8	96.95%
Worth County Secondary Roads		0-0-0		1.5	3.05%
			Totals for all Lateral A Benefited Lands	48.2	100.00%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Lateral B					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
ANDERSON, ELLEN	0529426007*	29-99-22	PAR. IN NE SE	0.24	0.28%
ANDERSON, ELLEN	0529426008*	29-99-22	PAR. IN NE SE	0.24	0.28%
				0.48	0.55%
ARNESON, CURTIS & DILLA	0528313004*		J & A SUB-DIV. LOT 4,BLK. 1	0.23	0.27%
BEVERLY LAND COMPANY	0528352001	28-99-22	SW SW EX. PAR.	19.68	22.70%
BEVERLY LAND COMPANY	0533100001	33-99-22	NW NW	21.09	24.33%
BEVERLY LAND COMPANY	0533100003	33-99-22	NE NW EX. RR.	2.76	3.18%
				43.53	50.22%
BUTLER, BRENT A & HEATHER J	0528309001*		ORIGINAL TOWN - JOICE BLOCK:12 LOT:1 & 2	0.21	0.24%
City of Joice Streets and Alleys		0-0-0		2.09	2.41%
DE VRIES, DAVID M. & SANDRA M.	0528309002*		ORIG. LOTS 3 & 4,BLK. 12	0.20	0.23%
FUNK, CHRISTEN A.	0528309004*		ORIG. LOTS 11 & 12,BLK. 12	0.32	0.37%
GESME, MARILYN	0529426006*	29-99-22	PAR. IN NE SE	0.24	0.28%
HEAGEL, CHAD C. & GLORIA I.	0528313006*		J & A SUB-DIV. LOT10, BLK. 1	0.23	0.27%
HEINTZMAN, JON & MELISSA	0528351004*		J & A SUB-DIV. LOT 4,BLK. 2	0.10	0.12%
JORTH, RANDY R & CINDY J	0528313010*		JORTH & ANDERSON SUB BLOCK:1 LOT:6	0.24	0.28%
JORTH, RANDY R. & CINDY J	0528313009*		J & A SUB-DIV. LOT 7,BLK. 1	0.23	0.27%
				0.47	0.54%
LIEN, MARDENE S.	0528313011*		JORTH & ANDERSON SUB BLOCK:1 LOT:LOTS 1 & 2	0.46	0.53%
LUEDTKE, DEANNA L REVOCABLE TRUST	0528309003*		ORIGINAL TOWN - JOICE BLOCK:12 LOT:5 & 6	0.26	0.30%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Lateral B					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
MOE, DAVID R. & CAROL P.C.	0528351001*		J & A SUBDIV. LOT 1,BLK 2	0.24	0.28%
MOE, DAVID R. & CAROL P.C.	0528351002*		J & A SUB-DIV. LOT 2BLK. 2	0.24	0.28%
MOE, DAVID R. & CAROL P.C.	0528351003*		J & A SUB-DIV. LOT 3,BLK. 2	0.24	0.28%
				0.72	0.83%
PETERSON, KEVIN L	0528313003*		JORTH & ANDERSON SUB BLOCK:1 LOT:3	0.23	0.27%
POLEY, GARFIELD E. & DEBRA J.	0529426005*	29-99-22	PT. E 1/2 SE	0.54	0.62%
SELL, JAMES E. & JUDY A.	0528309006*		ORIG. LOTS 8 & 9,BLK. 12, EX. W 4 1/2'	0.31	0.36%
SHAFFER, RICHARD J & JAYNE	0528313005*		JORTH & ANDERSON SUB BLOCK:1 LOT:5	0.24	0.28%
SMITH, JEREMY L & LIEN, CARRIE S	0528309007*		ORIG. LOT 7, BLK. 12	0.16	0.18%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529476001	29-99-22	SE SE	24.13	27.84%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529426002*	29-99-22	NE SE EXC PARS	4.76	5.49%
				28.89	33.33%
THORSON, CRAIG A.	0528313007*		J & A SUB-DIV. LOT 9,BLK. 1	0.23	0.27%
Unknown	0529426009*	29-99-22	Natural Gas Terminal	0.04	0.05%
VONHAGEN, DENNIS D.	0528309005*		ORIG. W 4 1/2' LOT 9& ALL LOT 10, BLK. 12	0.18	0.21%
WONSMOS, JOHN H. & JUDITH V.	0528313008*		J & A SUB-DIV. LOT 8,BLK. 1	0.23	0.27%
Worth County Secondary Roads		0-0-0		6.09	7.03%
Totals for all Lateral B Benefited Lands				86.7	100.00%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Lateral C					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
CARTER, ROGER L. & LYNDA P.	0529401002	29-99-22	PAR. IN NW SE	1.5	0.94%
CARTER, ROGER L. & LYNDA P.	0529426001*	29-99-22	PAR. IN NE SE	1.7	1.05%
				3.1	1.99%
HOLT, MARILYN	0529426003*	29-99-22	PAR 91'X 140' IN NE SE	0.3	0.18%
PETERSON, LARRY D & KATHRYN A	0529426004*	29-99-22	PAR IN E 1/2 SE	0.5	0.30%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100001	29-99-22	NW NW	1.6	1.03%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100005	29-99-22	SE NW	29.8	19.00%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529300002	29-99-22	NE SW	7.5	4.77%
				38.9	24.80%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529200006	29-99-22	SW NE	32.1	20.48%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529401001	29-99-22	NW SE EX PAR	21.7	13.84%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529100004*	29-99-22	PT NE NW	4.5	2.84%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529200004*	29-99-22	SE PT NW NE	0.5	0.30%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529200010*	29-99-22	SE NE EX PAR	14.9	9.48%
TENOLD, ARLYN & JUDITH REVOCABLE TRUST	0529426002*	29-99-22	NE SE EXC PARS	26.5	16.91%
				100.2	63.85%
Worth County Secondary Roads				13.9	8.88%
Totals for all Lateral C Benefited Lands				156.9	100.0%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Lateral C1					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100005	29-99-22	SE NW	11.3	60.12%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529300002	29-99-22	NE SW	7.5	39.88%
Totals for all Lateral C1 Benefited Lands				18.8	100.00%

Lateral D					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
OLSON, EDWARD E. & JULIA & LEILA	0529300001	29-99-22	NW SW	4.4	19.13%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100002	29-99-22	SW NW	10.4	45.18%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100005	29-99-22	SE NW	6.6	28.39%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529300002	29-99-22	NE SW	1.7	7.31%
Totals for all Lateral D Benefited Lands				18.7	80.87%
Totals for all Lateral D Benefited Lands				23.1	100.00%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Lateral E					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
OLSON, EDWARD E. & JULIA & LEILA	0529300001	29-99-22	NW SW	1.9	1.27%
OLSON, EDWARD E. & JULIA & LEILA	0530400003	30-99-22	NE SE EXC. PAR.	19.6	12.99%
				21.5	14.27%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100001	29-99-22	NW NW	23.3	15.44%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100002	29-99-22	SW NW	30.1	20.01%
SCHLADER, RAYMOND C -LIVING TR & ARLENE -LIVING TR	0529100005	29-99-22	SE NW	1.7	1.13%
				55.1	36.57%
SWANSON, DEREK & JAMIE	0530200006*	30-99-22	PAR IN NE NE EXC PAR	1.87	1.24%
VETTER, EMILY ET AL 1/2 & JONES FAMILY TRUST 1/2	0530200005	30-99-22	SE NE EXC. PAR.	38.70	25.69%
VETTER, EMILY ET AL 1/2 & JONES FAMILY TRUST 1/2	0530200007*	30-99-22	NE NE EX PARS	30.1	20.01%
				68.8	45.70%
Worth County Secondary Roads		0-0-0		3.34	2.22%
Totals for all Lateral E Benefited Lands				150.6	100.00%

**BENEFITED LANDS SCHEDULE
PROPOSED TILE IMPROVEMENTS
DRAINAGE DISTRICT NO. 18
WORTH COUNTY, IOWA**

Lateral F					
Landowner(s)	Parcel No.	Sec-Twp- Rng	Description	Benefited Acres	Percent Currently Assessed Area
ABBAY, ROBERT GENE TST UND 1/2 & VALEDA F. TRUST UND 1/2	0531100004*	31-99-22	NE NW	5.9	4.78%
ABBAY, ROBERT GENE TST UND 1/2 & VALEDA F. TRUST UND 1/2	0531200002*	31-99-22	NW NE EX. PAR.	10.1	8.20%
				16.0	12.99%
BRANDT, KENNETH & CYNTHIA L.	0530400004	30-99-22	PAR. IN SE SE	1.3	1.07%
LANGFALD, RONALD & ARDIS	0531200001*	31-99-22	PARCEL IN NW NE	2.8	2.31%
OLSON, EDWARD E. & JULIA & LEILA	0530400002	30-99-22	SW SE EXC. PAR.	37.3	30.33%
OLSON, EDWARD E. & JULIA & LEILA	0530400005	30-99-22	SE SE EX. PARCELS	17.5	14.25%
OLSON, EDWARD E. & JULIA & LEILA	0530300002*	30-99-22	NE SW	2.64	2.14%
OLSON, EDWARD E. & JULIA & LEILA	0530300004*	30-99-22	SE SW	17.7	14.41%
OLSON, EDWARD E. & JULIA & LEILA	0530400001*	30-99-22	NW SE EXC. PAR.	19.01	15.44%
				94.3	76.56%
Worth County Secondary Roads		0-0-0		8.7	7.07%
			Totals for all Lateral F Benefited Lands	123.1	100.00%

Appendix C: Opinion of Probable Costs

**Engineer's Opinion of Probable Cost
Proposed Tile Improvements
Drainage District No. 18
Worth County, Iowa
2016**

Construction Division 1--Tile Work on Private Lands					
<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
101	1500D R.C.P., 12" Dia.	LF	2,615	\$20	\$52,300
102	2000D R.C.P., 12" Dia.	LF	510	\$23	\$11,730
103	1500D R.C.P., 18" Dia.	LF	798	\$24	\$19,152
104	2000D R.C.P., 24" Dia.	LF	2,478	\$35	\$86,730
105	2000D R.C.P., 30" Dia.	LF	4,615	\$46	\$212,290
106	2000D R.C.P., 33" Dia.	LF	1,313	\$56	\$73,528
107	2000D R.C.P., 36" Dia.	LF	6,160	\$58	\$357,280
108	Heavy Duty CPDT Single Wall, 10" Dia.	LF	4,530	\$10	\$45,300
109	2000D R.C.P. Apron Section, 36" Dia.	EA	1	\$675	\$675
110	12" on XX" Dia. R.C.P. Tee, Fabrication Only	EA	14	\$345	\$4,830
111	24" on XX" Dia. R.C.P. Tee, Fabrication Only	EA	1	\$370	\$370
112	12" Dia., R.C.P. Elbow Section, Fabrication Only	EA	14	\$355	\$4,970
113	18" Dia., R.C.P. Elbow Section, Fabrication Only	EA	1	\$365	\$365
114	24" Dia., R.C.P. Elbow Section, Fabrication Only	EA	4	\$390	\$1,560
115	30" Dia., R.C.P. Elbow Section, Fabrication Only	EA	7	\$445	\$3,115
116	33" Dia., R.C.P. Elbow Section, Fabrication Only	EA	4	\$470	\$1,880
117	36" Dia., R.C.P. Elbow Section, Fabrication Only	EA	12	\$535	\$6,420
117	12" Dia., R.C.P. Reducer, Fabrication Only	EA	2	\$535	\$1,070
117	24" Dia., R.C.P. Reducer, Fabrication Only	EA	1	\$535	\$535
117	33" Dia., R.C.P. Reducer, Fabrication Only	EA	1	\$535	\$535
117	36" Dia., R.C.P. Reducer, Fabrication Only	EA	1	\$535	\$535
118	Lateral Tile Connections, 10" Dia. or Smaller	EA	80	\$200	\$16,000
119	Lateral Tile Connections, 12" Dia. or Larger	EA	14	\$400	\$5,600
120	Tile Trench Stabilization and Cradling Rock	TN	425	\$25	\$10,625
121	Administration of Erosion Management Plan	LS	1	\$3,000	\$3,000
122	Seeding of Temporary Stabilization	AC	11	\$500	\$5,295
123	Silt Fence Install and Review	LF	990	\$3	\$2,475
124	Spot Tile Exploration	HR	25	\$150	\$3,750
125	Fence Cuts	EA	8	\$250	\$2,000
126	Mobilization	LS	1	\$15,500	\$15,500
Estimated Division 2 Subtotal					\$949,000

**Engineer's Opinion of Probable Cost
Proposed Tile Improvements
Drainage District No. 18
Worth County, Iowa
2016**

Construction Division 2--Bored Secondary Roads Crossings (Worth County)

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
201	Steel Casing, 0.25" Wall, Jacked and Bored, 14" Diameter	LF	228	\$300	\$68,400
202	Steel Casing, 0.25" Wall, Jacked and Bored, 26" Diameter	LF	80	\$350	\$28,000
203	Steel Casing, 0.25" Wall, Jacked and Bored, 34" Diameter	LF	78	\$450	\$35,100
204	Steel Casing, 0.25" Wall, Jacked and Bored, 38" Diameter	LF	78	\$500	\$39,000
205	2000D R.C.P., 12" Dia.	LF	50	\$35	\$1,725
206	2000D R.C.P., 24" Dia.	LF	15	\$53	\$788
207	2000D R.C.P., 33" Dia.	LF	9	\$84	\$756
208	2000D R.C.P., 36" Dia.	LF	12	\$87	\$1,044
209	Tile Trench Stabilization and Cradling Rock	TN	230	\$25	\$5,750
210	Seeding and Fertilizing (Rural)	LS	1	\$3,750	\$3,750
211	Traffic Control	LS	1	\$3,750	\$3,750
212	Silt Fence-Install and Remove	LF	700	\$3	\$2,100
213	Mobilization	LS	1	\$19,000	\$19,000
Estimated Division 2 Subtotal					\$209,000

Construction Division 3--Open cut Secondary Roads Crossings (Worth County)

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
301	2000D R.C.P., 12" Dia.	LF	322	\$35	\$11,109
302	Tile Trench Stabilization and Cradling Rock	TN	60	\$25	\$1,500
303	Seeding and Fertilizing (Rural)	LS	0	\$3,750	\$0
304	Traffic Control	LS	0	\$3,750	\$0
305	Silt Fence-Install and Remove	LF	300	\$3	\$900
306	Mobilization	LS	0	\$200	\$0
Estimated Division 3 Subtotal					\$14,000

Construction Division 4--Bored Railroad Crossing

<u>Item</u>	<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
401	Steel Casing, 0.34" Wall, Jacked and Bored, 38" Diameter	LF	100	\$550	\$55,000
402	Tile Trench Stabilization and Cradling Rock	TN	50	\$25	\$1,250
403	Seeding and Fertilizing (Rural)	LS	1	\$3,750	\$3,750
404	Railroad Protective Liability Insurance Provisions	LS	1	\$3,750	\$3,750

**Engineer's Opinion of Probable Cost
Proposed Tile Improvements
Drainage District No. 18
Worth County, Iowa
2016**

405	Silt Fence-Install and Remove	LF	100	\$3	\$300
406	Mobilization	LS	1	\$6,400	<u>\$6,400</u>

Estimated Division 4 Subtotal \$70,000

Subtotal of Construction Divisions 1, 2, 3 AND 4 \$1,242,000

Construction Contingency \$62,000

Total Estimated Construction Cost \$1,304,000

Less Estimated Secondary Roads Construction Costs Paid by Others \$223,000

Total Estimated Assessable Construction Cost \$1,081,000

Construction Related Damages

Work Area Rental (33.7 ac)	\$13,500
Other Damages	\$33,000

Basic Engineering Services

Survey, Study & Report. Meetings & Hearing	\$37,000
Wetland Regulations Administration	\$3,000
Construction Plans, Specifications, & Bid Letting	\$15,000
Construction Engineering Services	\$35,000

Legal Services, Publications, Mailings, Etc..

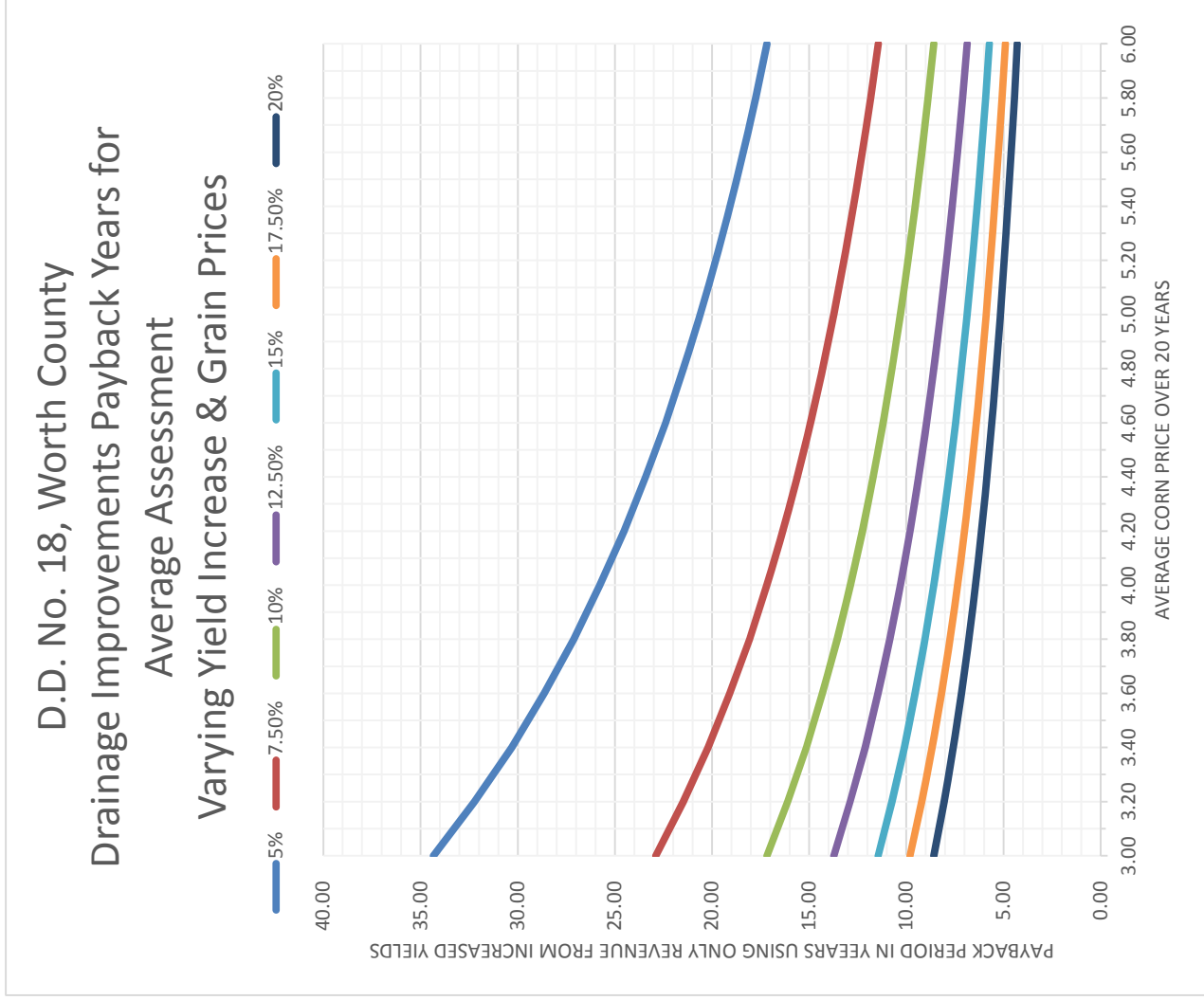
Farmed Wetland Mitigation Assistance (3.0 ac X \$7,500/ac)	\$16,200
Finance, Interest & Contingency	<u>\$61,100</u>

Total Estimated Assessable Project Cost \$1,300,000

Estimated Average Cost Per Currently Assessed Acre (1,206 ac)	\$1,078
Estimated Average Cost Per Acre Per Year (10 years)	\$137
Estimated Average Cost Per Acre Per Year (20 years)	\$82

Estimated Average Cost Per Benefited Acre (1,416 ac)	\$918
Estimated Average Cost Per Acre Per Year (10 years)	\$117
Estimated Average Cost Per Acre Per Year (20 years)	\$70

Appendix C - Payback Analysis of Drainage District System Replacement Costs



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

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

Drainage District: **DD 18**

ACRES IN DD	Enter>	1,416	ac
% Corn Acreage	Enter>	63	%
% Soybeans Acreage	Enter>	33	%
% Other (Roads, Etc)	Enter>	4	%
Base Corn Yield	Enter>	173	bu/a
Base Soybeans Yield	Enter>	50	bu/a
Total Increase in Yield, Corn	bu		
Total Increase in Yield, Soybeans	bu		

Enter Estimated Average Annual Yield Increase Over the Next 20 Years, % (See Footnote)	1.5%
Avg Price of Corn Next 20 Years	\$ 3.93
Avg Price of Soybeans Next 20 Years	\$ 9.88

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

Very High Assessment	\$2,295	per ac	250% of Avg
High Assessment	\$1,836	per ac	200% of Avg
Above Average Assessment	\$1,377	per ac	150% of Avg
Average Assessment	\$918	per ac	100% of Avg
Low Assessment	\$459	per ac	50% of Avg
Very Low Assessment	\$230	per ac	25% of Avg

Average Yield Improvement Due to Better Drainage Outlet, %							
2.5	5	7.5	10	12.5	15	17.5	20
3,858	7,716	11,575	15,433	19,291	23,149	27,008	30,866
584	1,168	1,752	2,336	2,921	3,505	4,089	4,673

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

Annual Increase in Revenue						
\$15,163	\$30,326	\$45,489	\$60,652	\$75,815	\$90,977	#####
\$ 5,771	\$11,542	\$17,313	\$23,084	\$28,855	\$34,625	\$40,396
\$20,934	\$41,868	\$62,801	\$83,735	#####	#####	#####
\$ 15	\$ 30	\$ 44	\$ 59	\$ 74	\$ 89	\$ 103
\$ 1,478	\$ 2,957	\$ 4,435	\$ 5,914	\$ 7,392	\$ 8,870	\$10,349

Payback Period For Revenues From Only Yield Increase (Years)						
155.2	77.6	51.7	38.8	31.0	25.9	22.2
124.2	62.1	41.4	31.0	24.8	20.7	17.7
93.1	46.6	31.0	23.3	18.6	15.5	13.3
62.1	31.0	20.7	15.5	12.4	10.3	8.9
31.0	15.5	10.3	7.8	6.2	5.2	4.4
15.5	7.8	5.2	3.9	3.1	2.6	2.2

Average Yield Improvement Due to Better Drainage Outlet, %							
2.5	5	7.5	10	12.5	15	17.5	20

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 \$3.35 and soybeans at \$8.42

- A very high cost assessment (250% of average) would be paid off in 25.9 years on a 15% average yield increase.
- A high cost assessment (200% of average) would be paid off in 24.8 years on a 12.5% average yield increase.
- An above avg cost assessment (150% of average) would be paid off in 23.3 years on a 10% average yield increase.
- An average cost assessment (100% of average) would be paid off in 20.7 years on a 7.5% average yield increase.
- A low cost assessment (50% of average) would be paid off in 15.5 years on a 5% average yield increase.
- A very low cost assessment (25% of average) would be paid off in 15.5 years on a 2.5% average yield increase.

Yield Improvements on 40 acres if Drowned Areas

Drowned Area ac		Percent Increase over Current Conditions					
		Percent of Average Yield Achieved by Improvements					
		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

Future Prices to Reflect

Annual Yield Change Trend		Price Adj. for Yield Change	
Corn Today	\$3.35	CORN	20-Year Avg Price
Beans Today	\$8.42	SOYBEANS	20-Year Avg Price
Average Annual Yield Change			
0.0%	\$3.35		\$8.42
0.5%	\$3.53		\$8.86
1.0%	\$3.72		\$9.35
1.5%	\$3.93		\$9.88
2.0%	\$4.16		\$10.47
2.5%	\$4.42		\$11.11
3.0%	\$4.70		\$11.81
3.5%	\$5.01		\$12.59

Existing Farm Yield vs. Potential Farm Yield

Average Field Yield with Improvement bu/ac	Current Average Corn Yield over Entire Field 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 in Worth County Drainage District No. 18

Assumptions

Long-term Soybean/Corn price ratio is 2.6

Average assessment of \$918/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	Soybeans	Average Yield Response Due to Drainage Improvements																
		5%	7.50%	10%	12.50%	15%	17.50%	20%										
Corn																		
3.00	7.80	34.34	22.89	17.17	13.74	11.45	9.81	8.59										
3.20	8.32	32.22	21.48	16.11	12.89	10.74	9.21	8.06										
3.40	8.84	30.30	20.20	15.15	12.12	10.10	8.66	7.57										
3.60	9.36	28.64	19.09	14.32	11.46	9.55	8.18	7.16										
3.80	9.88	27.11	18.07	13.55	10.84	9.04	7.74	6.78										
4.00	10.40	25.77	17.18	12.88	10.31	8.59	7.36	6.44										
4.20	10.92	24.52	16.35	12.26	9.81	8.17	7.01	6.13										
4.40	11.44	23.42	15.62	11.71	9.37	7.81	6.69	5.86										
4.60	11.96	22.39	14.93	11.19	8.96	7.46	6.40	5.60										
4.80	12.48	21.47	14.31	10.73	8.59	7.16	6.13	5.37										
5.00	13.00	20.60	13.73	10.30	8.24	6.87	5.88	5.15										
5.20	13.52	19.82	13.21	9.91	7.93	6.61	5.66	4.95										
5.40	14.04	19.07	12.71	9.54	7.63	6.36	5.45	4.77										
5.60	14.56	18.40	12.26	9.20	7.36	6.13	5.26	4.60										
5.80	15.08	17.75	11.83	8.88	7.10	5.92	5.07	4.44										
6.00	15.60	17.17	11.45	8.58	6.87	5.72	4.91	4.29										

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

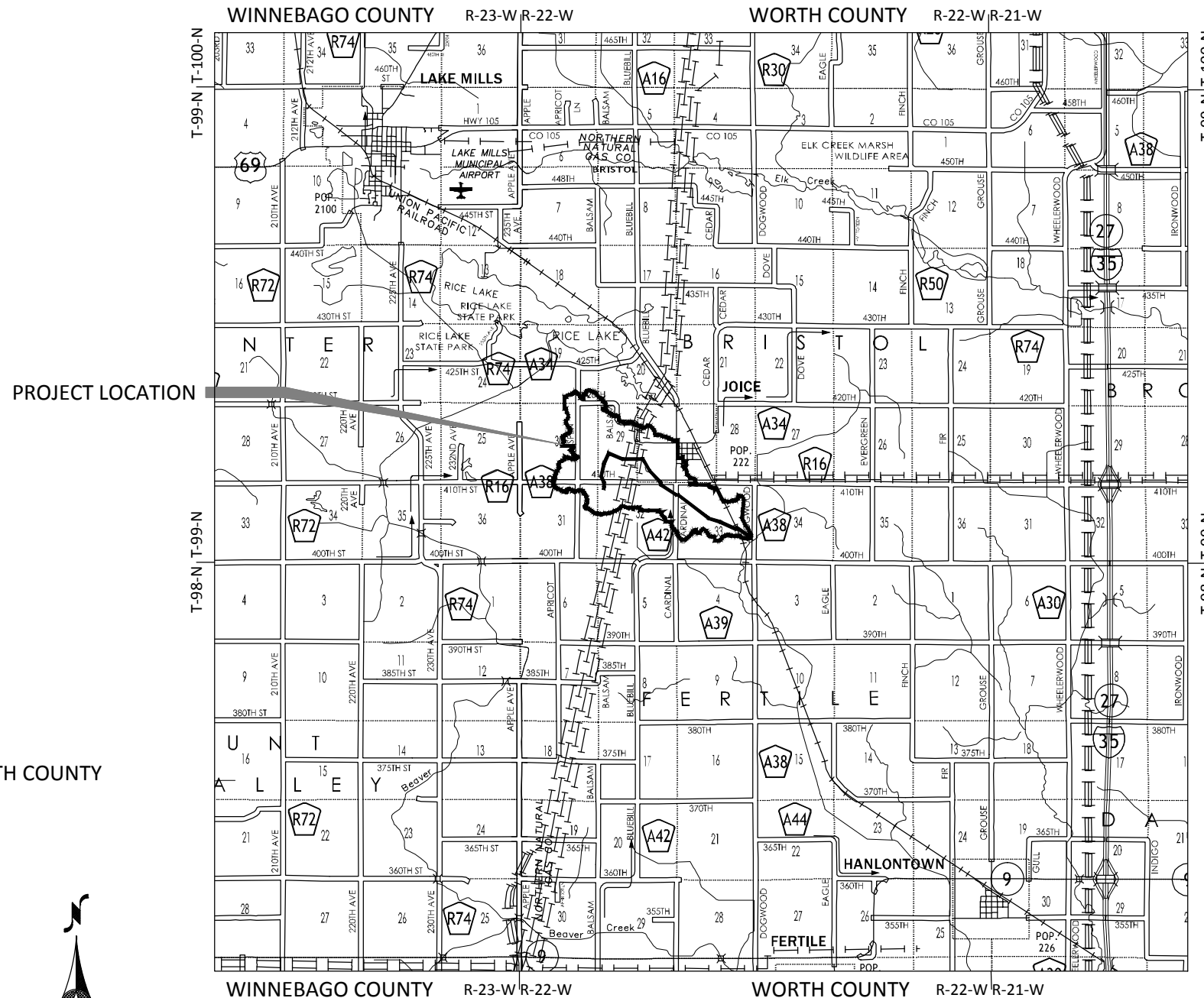
This worksheet is based upon one prepared by Dr. Stewart Melvin, ISU Extension Agricultural Engineer, Retired

Proposed Plans

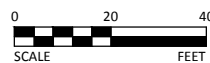
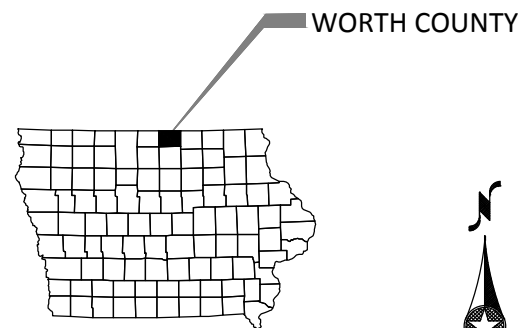
WORTH COUNTY, IOWA

PRELIMINARY PLANS FOR DRAINAGE DISTRICT NO. 18 PROPOSED TILE IMPROVEMENTS 2016

PLAN REVISIONS		
DATE	SHEET NUMBER	APPROVED BY



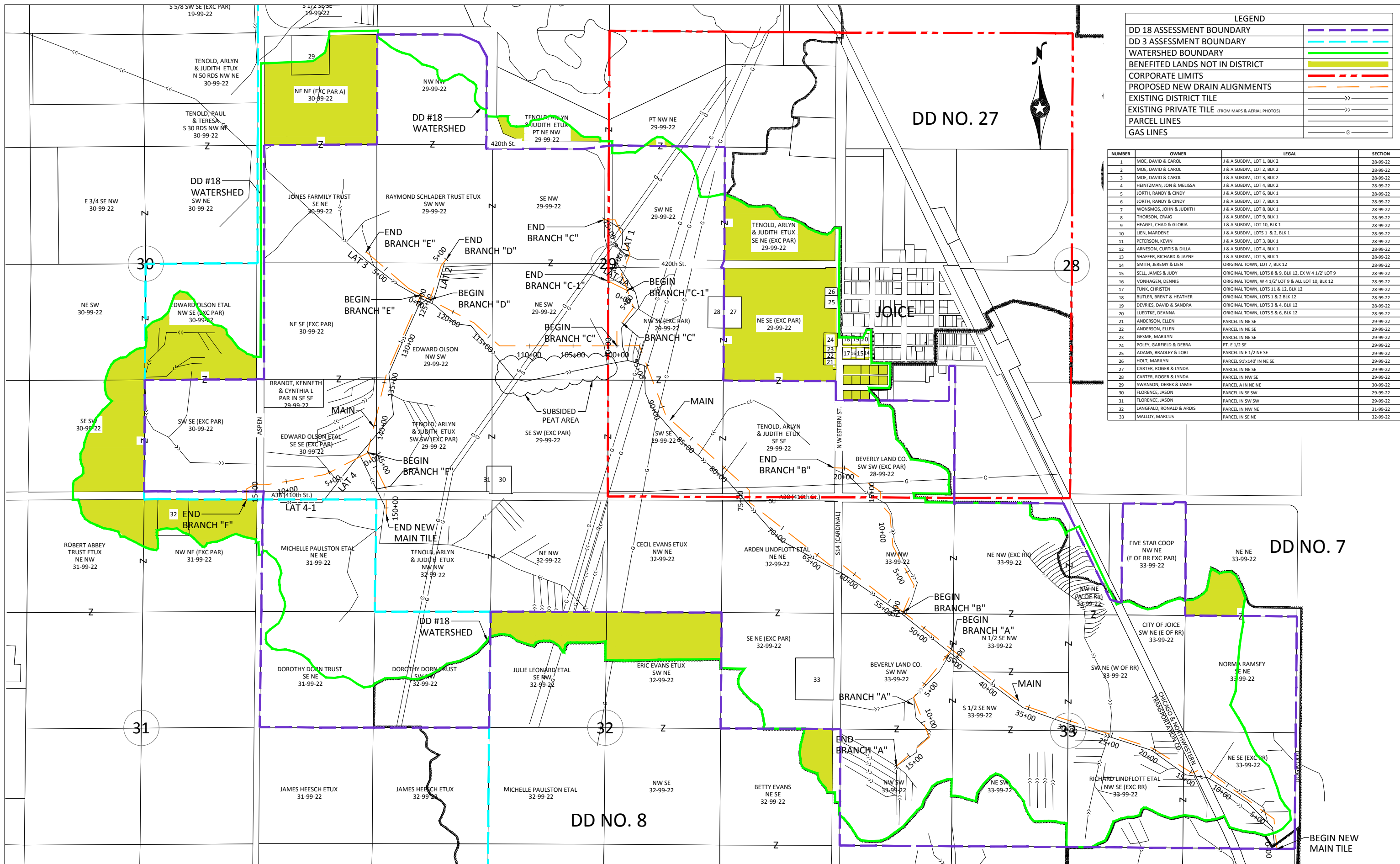
SHEET LIST TABLE	
SHEET NUMBER	SHEET TITLE
A.01	TITLE SHEET
A.03	LANDOWNER PLAT
G.01	ALIGNMENT GEOMETRY
M.01-M.05	PLAN & PROFILE - MAIN TILE
M.06	PLAN & PROFILE - BRANCH A
M.07	PLAN & PROFILE - BRANCH B
M.08	PLAN & PROFILE - BRANCH C & C-1
M.09	PLAN & PROFILE - BRANCH D & E
M.10	PLAN & PROFILE - BRANCH F
V.01	ROAD CROSSING BORING - C & NW RAILROAD & S14 - MAIN TILE
V.02	ROAD CROSSING BORING - A38 - MAIN TILE
V.03	ROAD CROSSING BORING - A38 & N WESTERN ST. - BRANCH B
V.04	ROAD CROSSING BORING - A38 - BRANCH F



I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

JONATHAN P. ROSENGREN
 REG. NO. 21661 DATE: _____
 MY LICENSE RENEWAL DATE IS DECEMBER 31, 2016
 PAGES OR SHEETS COVERED BY THIS SEAL:
 ALL SHEETS

PROJECT DATUM: STATE PLANE	DATUM EQUATIONS	DATUM EQUATION FOR DRAINAGE DISTRICT NO. 18 1914 DATUM + 1216.17 = 2014 DATUM	SHEET A.01
HORIZONTAL: IOWA NORTH	VERTICAL: NAD 1983		
WORTH COUNTY, IOWA		DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS	
TITLE SHEET			



LEGEND	
DD 18 ASSESSMENT BOUNDARY	
DD 3 ASSESSMENT BOUNDARY	
WATERSHED BOUNDARY	
BENEFITED LANDS NOT IN DISTRICT	
CORPORATE LIMITS	
PROPOSED NEW DRAIN ALIGNMENTS	
EXISTING DISTRICT TILE	
EXISTING PRIVATE TILE (FROM MAPS & AERIAL PHOTOS)	
PARCEL LINES	
GAS LINES	

NUMBER	OWNER	LEGAL	SECTION
1	MOE, DAVID & CAROL	J & A SUBDIV., LOT 1, BLK 2	28-99-22
2	MOE, DAVID & CAROL	J & A SUBDIV., LOT 2, BLK 2	28-99-22
3	MOE, DAVID & CAROL	J & A SUBDIV., LOT 3, BLK 2	28-99-22
4	HEINTZMAN, JON & MELISSA	J & A SUBDIV., LOT 4, BLK 2	28-99-22
5	JORTH, RANDY & CINDY	J & A SUBDIV., LOT 6, BLK 1	28-99-22
6	JORTH, RANDY & CINDY	J & A SUBDIV., LOT 7, BLK 1	28-99-22
7	WONSMOS, JOHN & JUDITH	J & A SUBDIV., LOT 8, BLK 1	28-99-22
8	THORSON, CRAIG	J & A SUBDIV., LOT 9, BLK 1	28-99-22
9	HEAGEL, CHAD & GLORIA	J & A SUBDIV., LOT 10, BLK 1	28-99-22
10	LIEN, MARDENE	J & A SUBDIV., LOTS 1 & 2, BLK 1	28-99-22
11	PETERSON, KEVIN	J & A SUBDIV., LOT 3, BLK 1	28-99-22
12	ARNESON, CURTIS & DILLA	J & A SUBDIV., LOT 4, BLK 1	28-99-22
13	SHAFFER, RICHARD & JAYNE	J & A SUBDIV., LOT 5, BLK 1	28-99-22
14	SMITH, JEREMY & LIEN	ORIGINAL TOWN, LOT 7, BLK 12	28-99-22
15	SELL, JAMES & JUDY	ORIGINAL TOWN, LOTS 8 & 9, BLK 12, EX W 4 1/2' LOT 9	28-99-22
16	VONHAGEN, DENNIS	ORIGINAL TOWN, W 4 1/2' LOT 9 & ALL LOT 10, BLK 12	28-99-22
17	FUNK, CHRISTEN	ORIGINAL TOWN, LOTS 11 & 12, BLK 12	28-99-22
18	BUTLER, BRENT & HEATHER	ORIGINAL TOWN, LOTS 1 & 2, BLK 12	28-99-22
19	DEVRIES, DAVID & SANDRA	ORIGINAL TOWN, LOTS 3 & 4, BLK 12	28-99-22
20	LUEDTKE, DEANNA	ORIGINAL TOWN, LOTS 5 & 6, BLK 12	28-99-22
21	ANDERSON, ELLEN	PARCEL IN NE SE	29-99-22
22	ANDERSON, ELLEN	PARCEL IN NE SE	29-99-22
23	GESME, MARILYN	PARCEL IN NE SE	29-99-22
24	POLY, GARFIELD & DEBRA	PT. E 1/2 SE	29-99-22
25	ADAMS, BRADLEY & LORI	PARCEL IN E 1/2 NE SE	29-99-22
26	HOLT, MARILYN	PARCEL 91'x140' IN NE SE	29-99-22
27	CARTER, ROGER & LYNDA	PARCEL IN NE SE	29-99-22
28	CARTER, ROGER & LYNDA	PARCEL IN NW SE	29-99-22
29	SWANSON, DEREK & JAMIE	PARCEL A IN NE NE	30-99-22
30	FLORENCE, JASON	PARCEL IN SE SW	29-99-22
31	FLORENCE, JASON	PARCEL IN SW SW	29-99-22
32	LANGFALD, RONALD & ARDIS	PARCEL IN NW NE	31-99-22
33	MALLOY, MARCUS	PARCEL IN SE NE	32-99-22



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DESIGNED: JPR
 DRAWN: CLH
 CHECKED: DDE

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 Consulting Engineers & Surveyors
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 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

REV.	BY	DATE

WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 LANDOWNER PLAT

SHEET
A.03

DD NO. 18 MAIN TILE						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	293.62'	0+51.00'	3+44.62'	N4937363.29',E3953819.13'	N4937332.63',E3954111.15'
2	Line	993.49'	3+44.62'	13+38.11'	N4937332.63',E3954111.15'	N4936528.09',E3954694.03'
3	Line	140.34'	13+38.11'	14+78.45'	N4936528.09',E3954694.03'	N4936401.90',E3954632.62'
4	Line	533.84'	14+78.45'	20+12.29'	N4936401.90',E3954632.62'	N4935949.27',E3954915.65'
5	Line	1538.21'	20+12.29'	35+50.49'	N4935949.27',E3954915.65'	N4934489.66',E3955401.06'
6	Line	2608.04'	35+50.49'	61+58.54'	N4934489.66',E3955401.06'	N4932425.05',E3956994.56'
7	Line	141.81'	61+58.54'	63+00.35'	N4932425.05',E3956994.56'	N4932283.24',E3956995.55'
8	Line	1178.88'	63+00.35'	74+79.23'	N4932283.24',E3956995.55'	N4931352.83',E3957719.50'
9	Line	137.04'	74+79.23'	76+16.27'	N4931352.83',E3957719.50'	N4931352.99',E3957856.54'
10	Line	1275.73'	76+16.27'	88+92.00'	N4931352.99',E3957856.54'	N4930400.81',E3958705.57'
11	Line	853.39'	88+92.00'	97+45.39'	N4930400.81',E3958705.57'	N4930097.95',E3959503.41'
12	Line	1593.28'	97+45.39'	113+38.67'	N4930097.95',E3959503.41'	N4928504.67',E3959500.90'
13	Line	395.66'	113+38.67'	117+34.34'	N4928504.67',E3959500.90'	N4928210.91',E3959765.95'
14	Line	681.08'	117+34.34'	124+15.41'	N4928210.91',E3959765.95'	N4927607.75',E3960082.28'
15	Line	972.03'	124+15.41'	133+87.44'	N4927607.75',E3960082.28'	N4927216.89',E3959192.30'
16	Line	924.00'	133+87.44'	143+11.45'	N4927216.89',E3959192.30'	N4927002.64',E3958293.48'
17	Line	476.00'	143+11.45'	147+87.45'	N4927002.64',E3958293.48'	N4927213.18',E3957866.57'
18	Line	200.55'	147+87.45'	149+88.00'	N4927213.18',E3957866.57'	N4927213.59',E3957666.02'

DD NO. 18 Branch "A"						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	697.84'	0+00.00'	6+97.84'	N4933658.84',E3956042.31'	N4933223.48',E3955496.93'
2	Line	488.76'	6+97.84'	11+86.60'	N4933223.48',E3955496.93'	N4933403.55',E3955042.54'
3	Line	498.40'	11+86.60'	16+85.00'	N4933403.55',E3955042.54'	N4933028.39',E3954714.44'

DD NO. 18 Branch "B"						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	325.00'	0+00.00'	3+25.00'	N4933104.69',E3956470.00'	N4933232.15',E3956768.97'
2	Line	513.21'	3+25.00'	8+38.21'	N4933232.15',E3956768.97'	N4932988.57',E3957220.69'
3	Line	366.76'	8+38.21'	12+04.97'	N4932988.57',E3957220.69'	N4932953.90',E3957585.81'
4	Line	158.18'	12+04.97'	13+63.16'	N4932953.90',E3957585.81'	N4932845.05',E3957700.60'
5	Line	143.13'	13+63.16'	15+06.28'	N4932845.05',E3957700.60'	N4932845.70',E3957843.72'
6	Line	472.21'	15+06.28'	19+78.49'	N4932845.70',E3957843.72'	N4932455.41',E3958109.53'
7	Line	147.51'	19+78.49'	21+26.00'	N4932455.41',E3958109.53'	N4932307.91',E3958111.31'

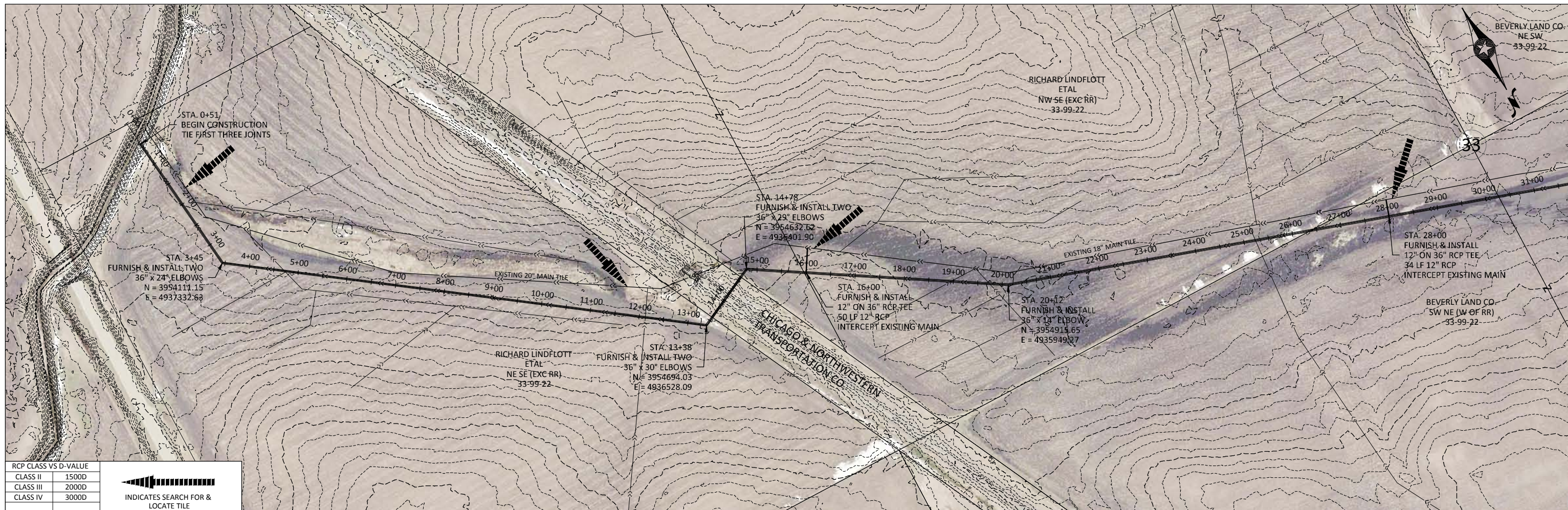
DD NO. 18 Branch "C"						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	179.98'	0+00.00'	1+79.98'	N4929843.34',E3959503.01'	N4929843.34',E3959682.99'
2	Line	320.34'	1+79.98'	5+00.32'	N4929843.34',E3959682.99'	N4930031.56',E3959942.20'
3	Line	406.41'	5+00.32'	9+06.72'	N4930031.56',E3959942.20'	N4929892.56',E3960324.10'
4	Line	243.65'	9+06.72'	11+50.37'	N4929892.56',E3960324.10'	N4929993.27',E3960545.96'
5	Line	428.43'	11+50.37'	15+78.81'	N4929993.27',E3960545.96'	N4929821.85',E3960938.60'
6	Line	139.19'	15+78.81'	17+18.00'	N4929821.85',E3960938.60'	N4929682.66',E3960939.11'

DD NO. 18 Branch "C-1"						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	269.00'	0+00.00'	2+69.00'	N4929963.27',E3960129.84'	N4929722.73',E3960250.27'

DD NO. 18 Branch "D"						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	411.66'	0+00.00'	4+11.66'	N4927709.96',E3960028.68'	N4927839.52',E3960419.42'
2	Line	88.34'	4+11.66'	5+00.00'	N4927839.52',E3960419.42'	N4927897.29',E3960486.25'

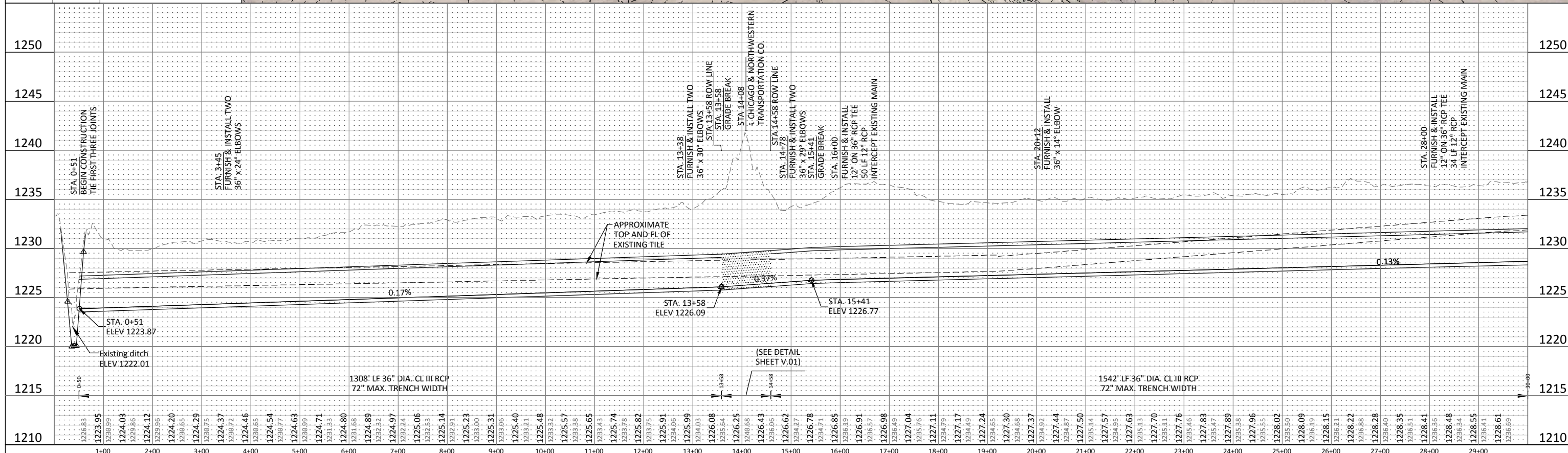
DD NO. 18 Branch "E"						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	160.00'	0+00.00'	1+60.00'	N4927607.75',E3960082.28'	N4927466.05',E3960156.60'
2	Line	640.00'	1+60.00'	8+00.00'	N4927466.05',E3960156.60'	N4926981.43',E3960574.61'

DD NO. 18 Branch "F"						
No.	Type	Length	Start Station	End Station	Start Point	End Point
1	Line	552.56'	0+00.00'	5+52.56'	N4927007.45',E3958283.73'	N4926514.13',E3958034.81'
2	Line	687.28'	5+52.56'	12+39.84'	N4926514.13',E3958034.81'	N4925836.93',E3957917.57'
3	Line	135.16'	12+39.84'	13+75.00'	N4925836.93',E3957917.57'	N4925701.77',E3957917.78'
4	Line	97.02'	13+75.00'	14+72.02'	N4925701.77',E3957917.78'	N4925617.67',E3957869.40'
5	Line	135.98'	14+72.02'	16+08.00'	N4925617.67',E3957869.40'	N4925617.55',E3957733.42'



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

INDICATES SEARCH FOR & LOCATE TILE



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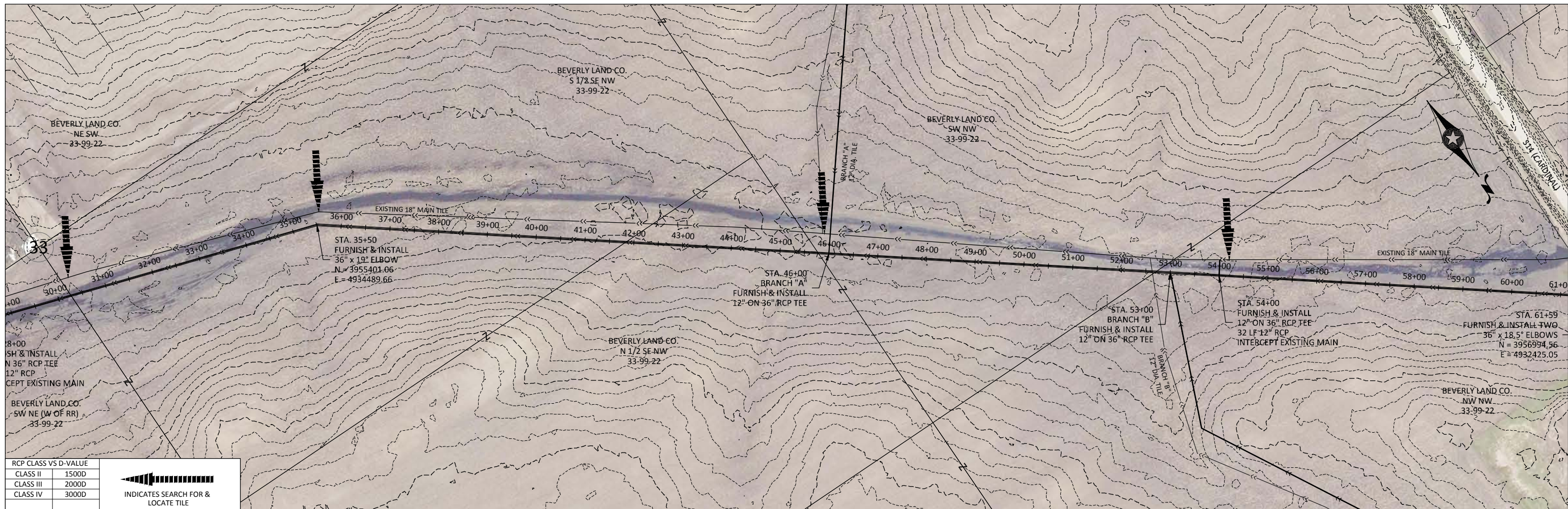
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 DRAWN: CLH
 CHECKED: DDE

BOLTON & MENK, INC.
 Consulting Engineers & Surveyors
 MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN
 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

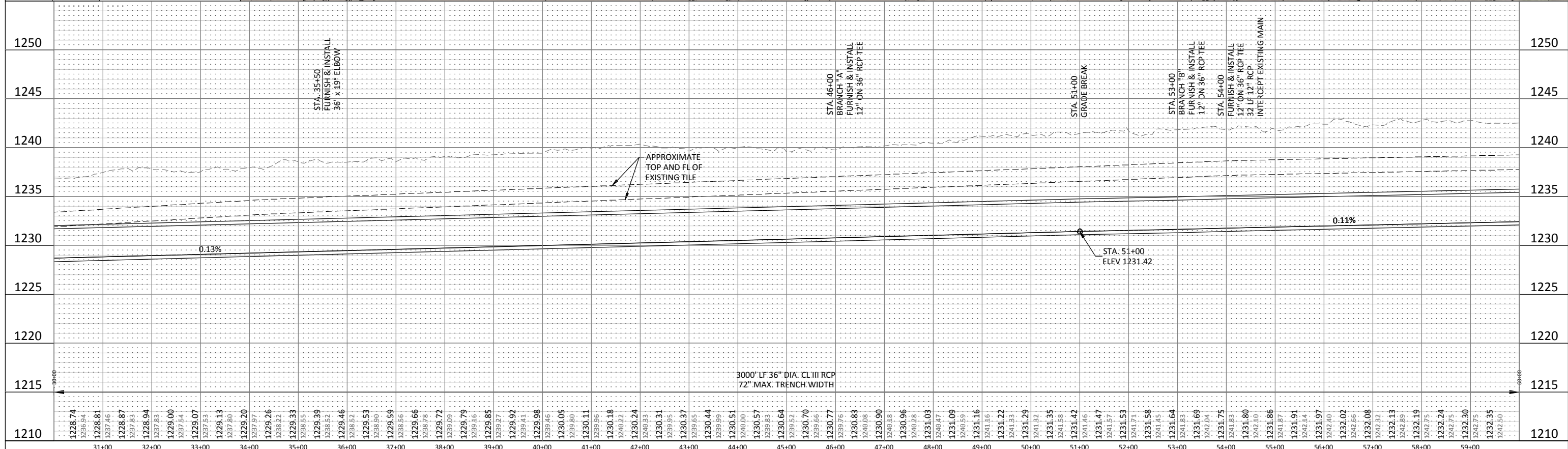
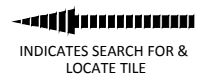
REV.	BY	DATE

WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 PLAN & PROFILE - MAIN TILE
 0+00-30+00

SHEET
M.01

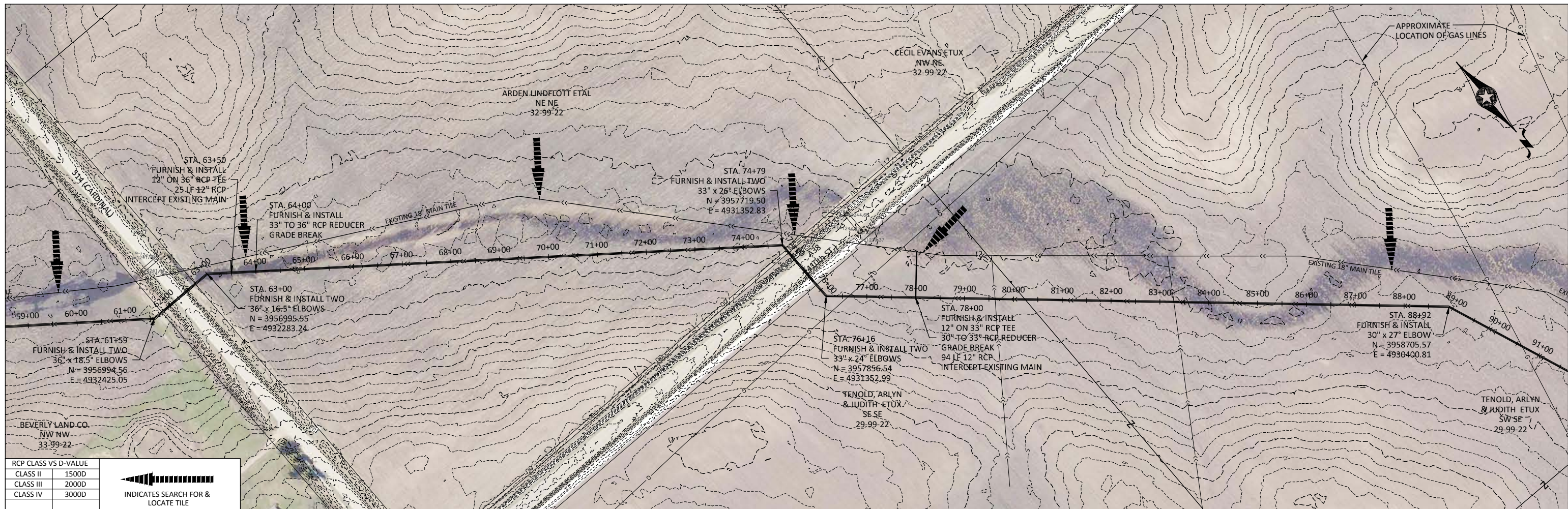


RCP CLASS VS D-VALUE	
CLASS II	15000
CLASS III	20000
CLASS IV	30000



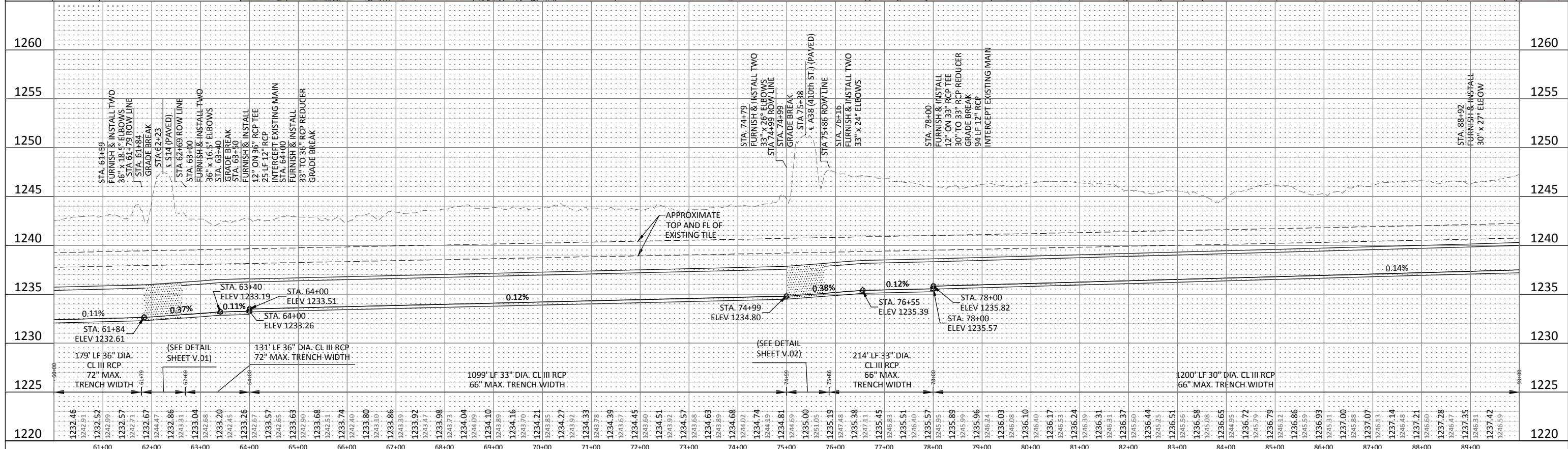
DESIGNED: JPR DRAWN: CLH CHECKED: DDE	BOLTON & MENK, INC. Consulting Engineers & Surveyors MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND	REV.	BY	DATE	WORTH COUNTY, IOWA DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS PLAN & PROFILE - MAIN TILE 30+00-60+00	SHEET M.02

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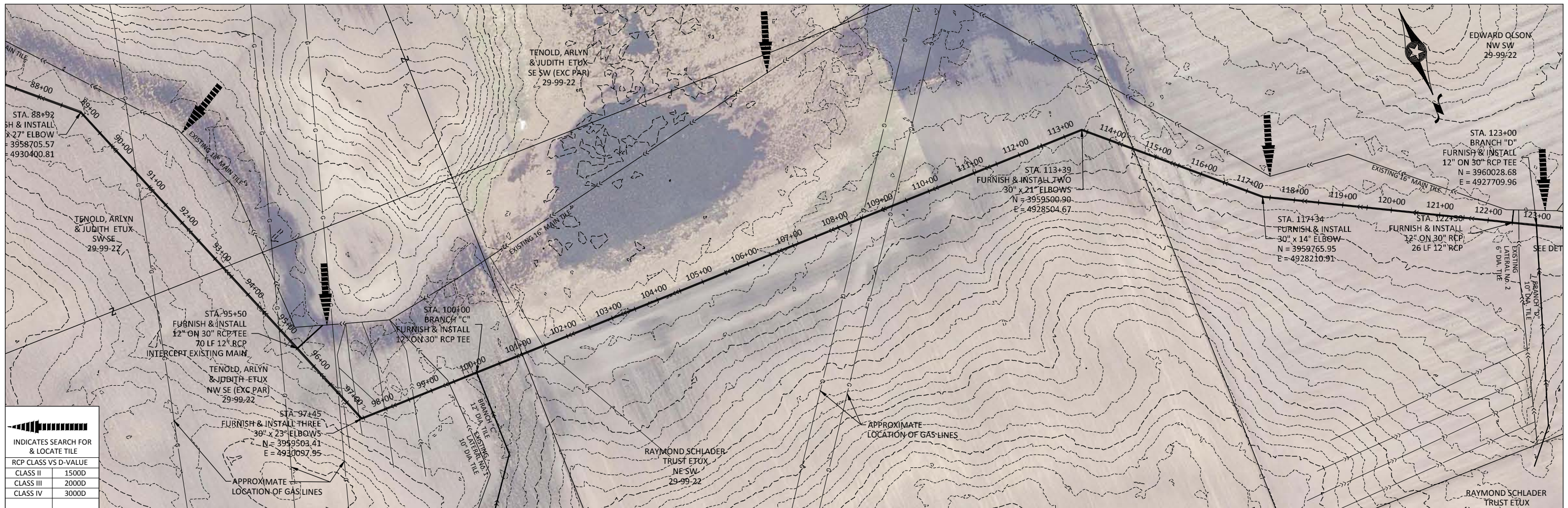


RCP CLASS VS D-VALUE	
CLASS II	15000
CLASS III	20000
CLASS IV	30000

INDICATES SEARCH FOR & LOCATE TILE

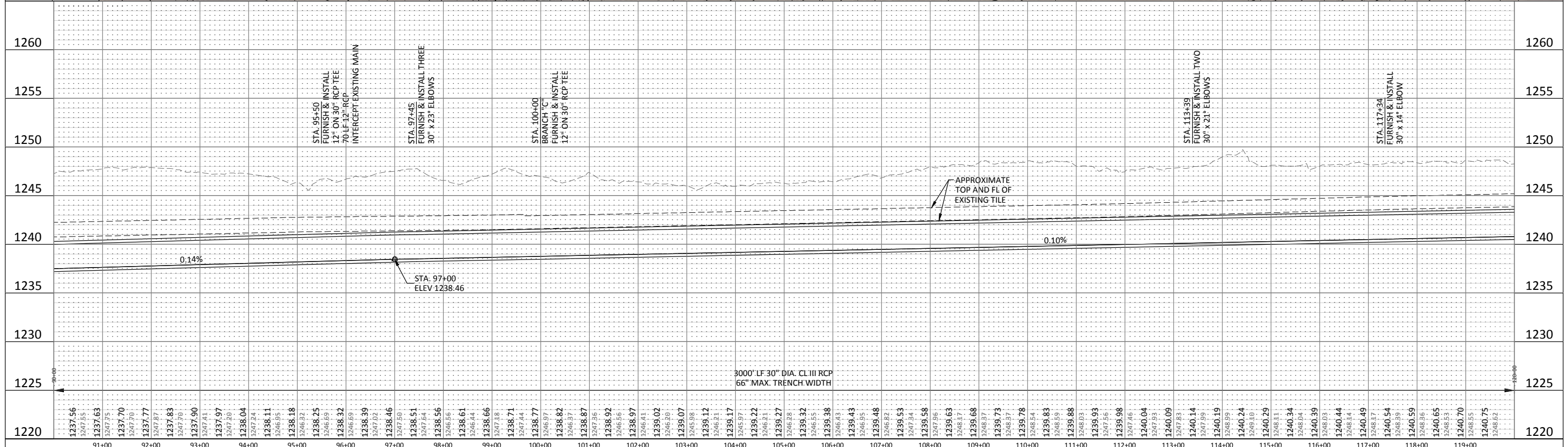


DESIGNED: JPR DRAWN: CLH CHECKED: DDE	BOLTON & MENK, INC. Consulting Engineers & Surveyors MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND			REV. BY DATE	WORTH COUNTY, IOWA DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS	SHEET M.03
	PLAN & PROFILE - MAIN TILE 60+00-90+00					
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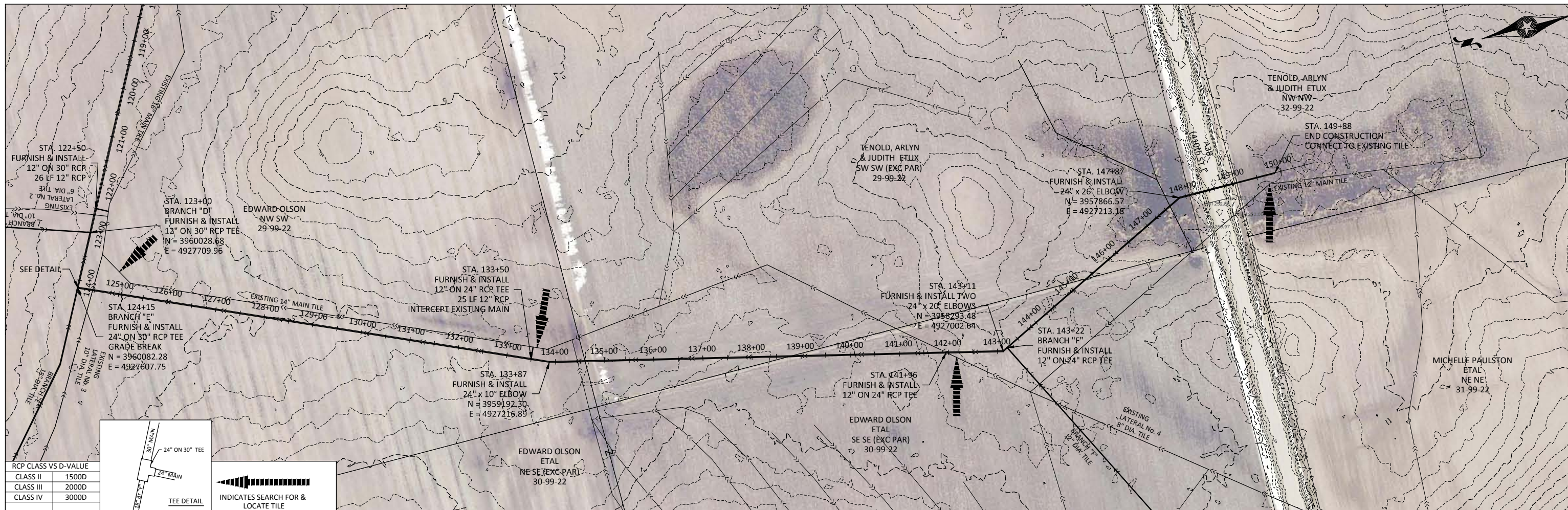
INDICATES SEARCH FOR & LOCATE TILE

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

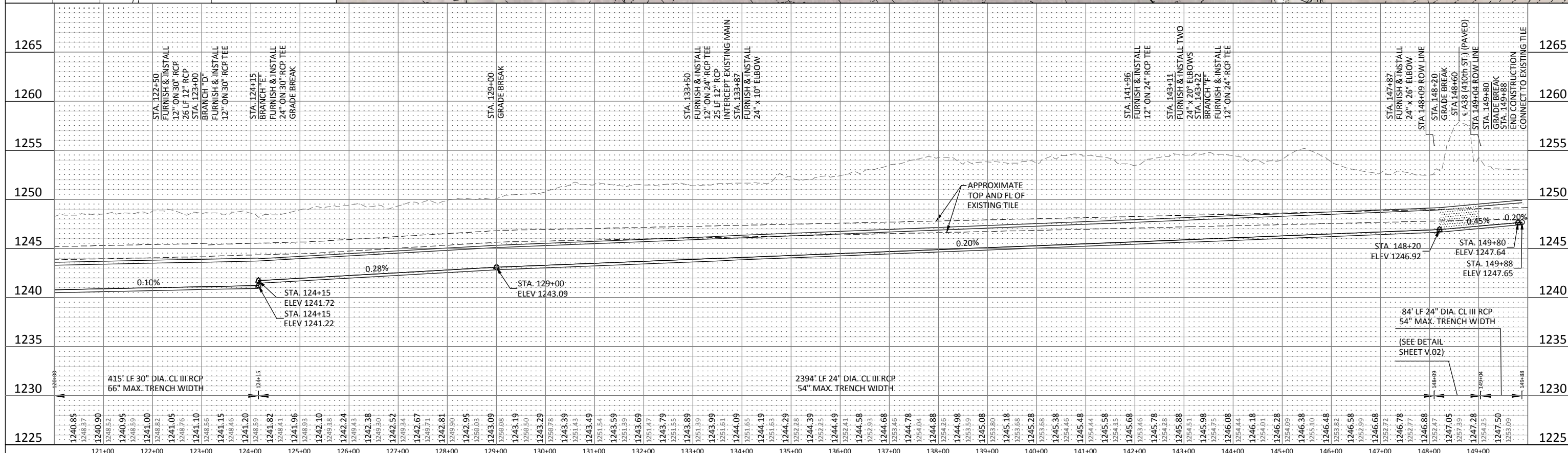
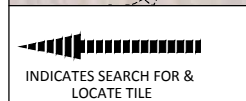
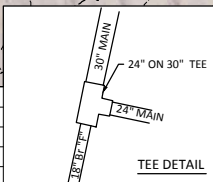


0 100 200 HORZ. SCALE FEET		0 5 10 VERT. SCALE FEET		DESIGNED: JPR DRAWN: CLH CHECKED: DDE	BOLTON & MENK, INC. Consulting Engineers & Surveyors MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND	REV. BY DATE	WORTH COUNTY, IOWA DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS		SHEET M.04
PLAN & PROFILE - MAIN TILE 90+00-120+00									

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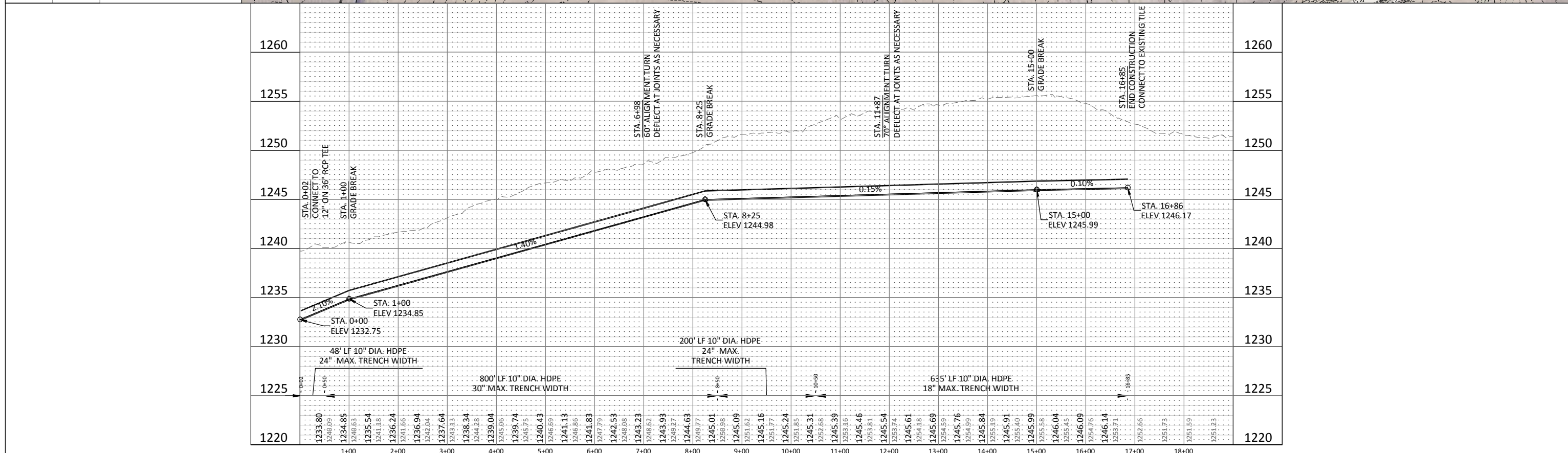
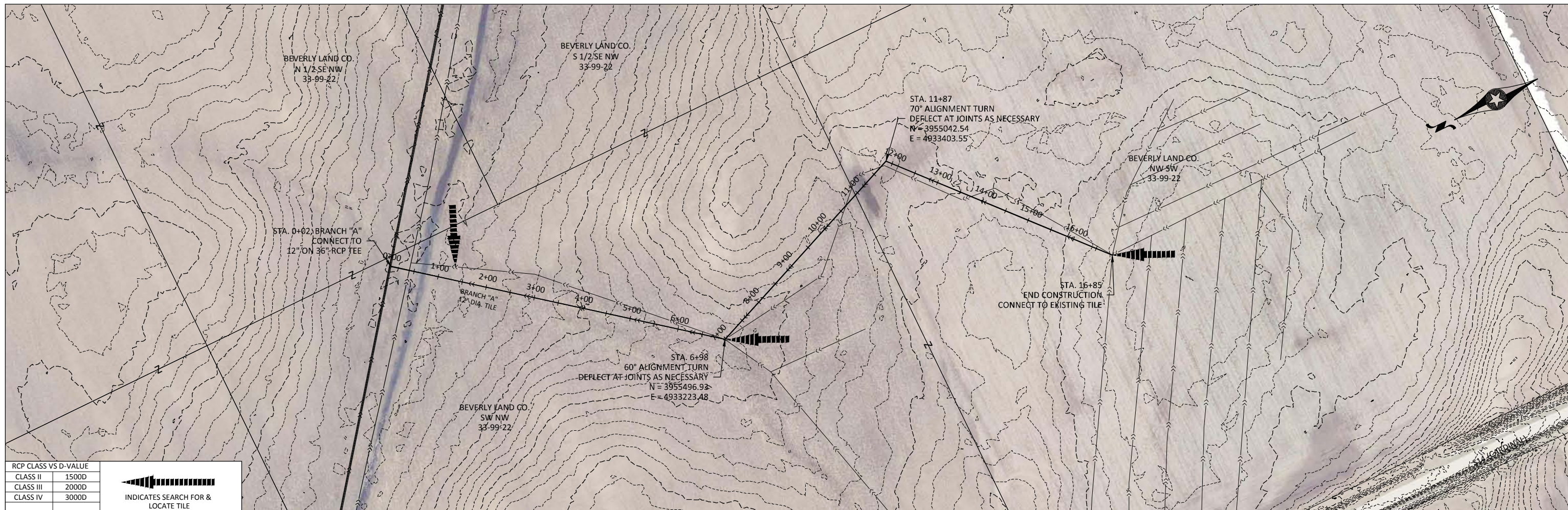


RCP CLASS VS D-VALUE	
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CLASS III	20000
CLASS IV	30000



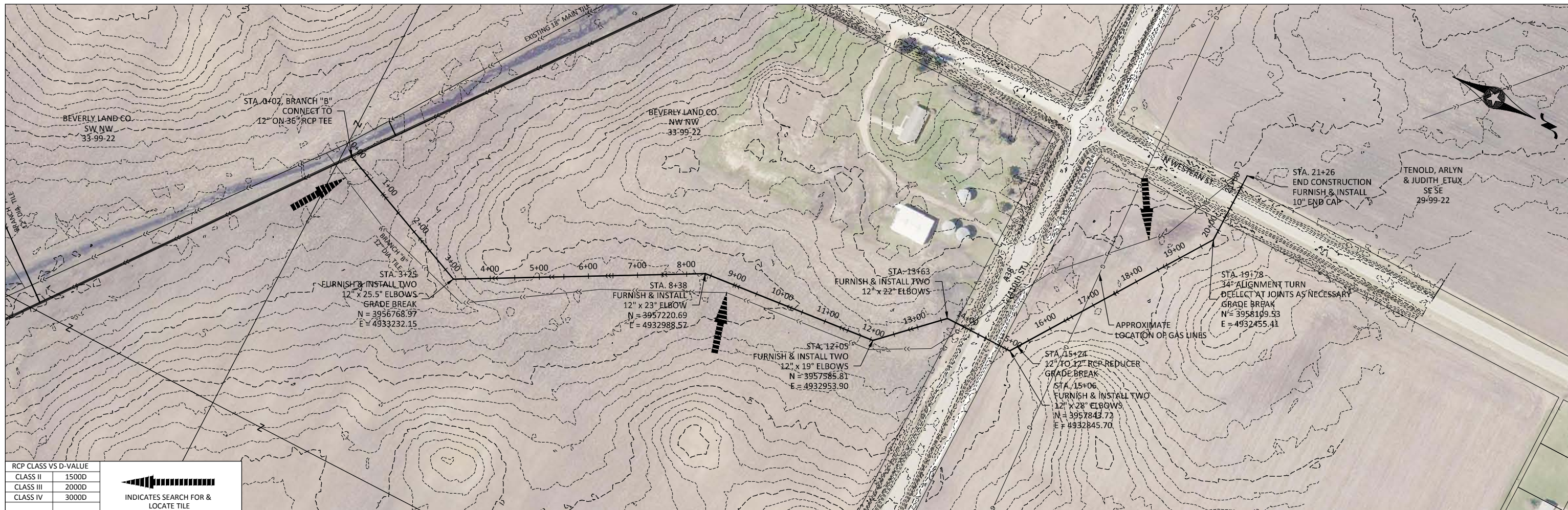
HORZ. SCALE 0 100 200 FEET VERT. SCALE 0 5 10 FEET		DESIGNED: JPR DRAWN: CLH CHECKED: DDE	BOLTON & MENK, INC. Consulting Engineers & Surveyors MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND	REV. BY DATE _____ _____ _____	WORTH COUNTY, IOWA DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS PLAN & PROFILE - MAIN TILE 120+00-147+22	SHEET M.05
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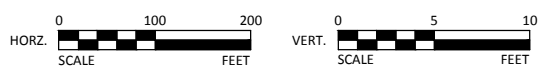
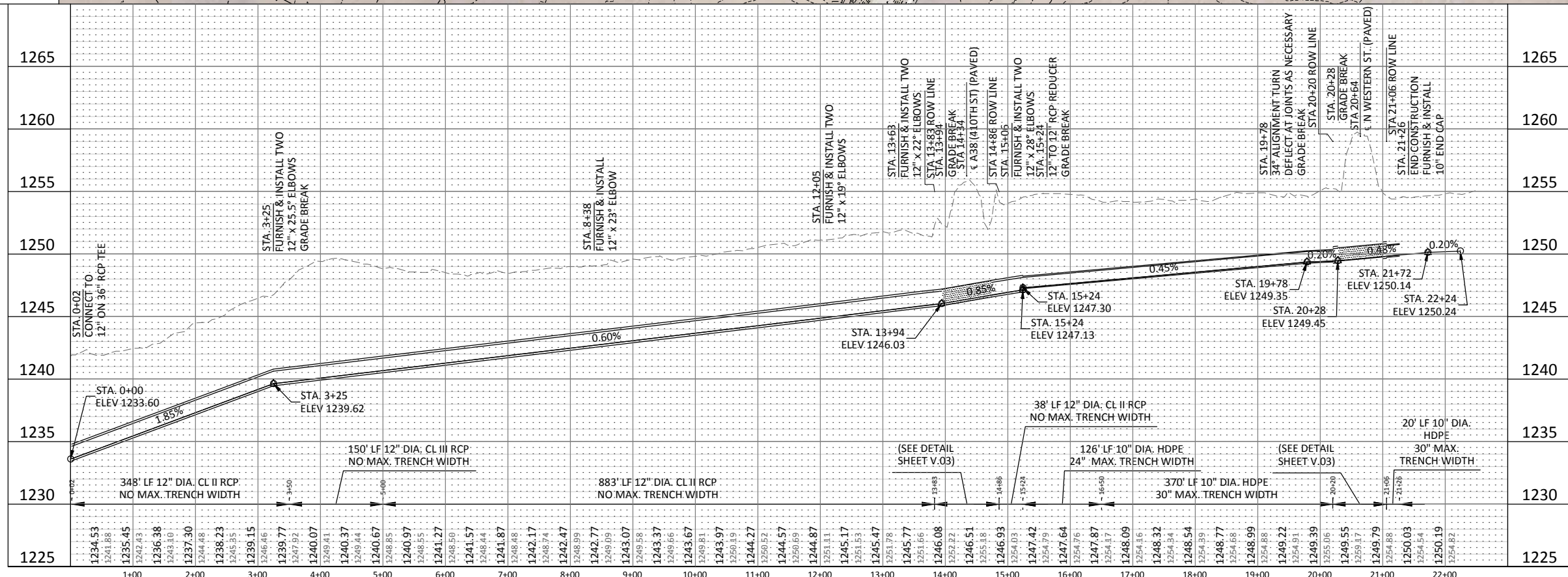
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RCP CLASS VS D-VALUE	
CLASS II	15000
CLASS III	20000
CLASS IV	30000

INDICATES SEARCH FOR & LOCATE TILE



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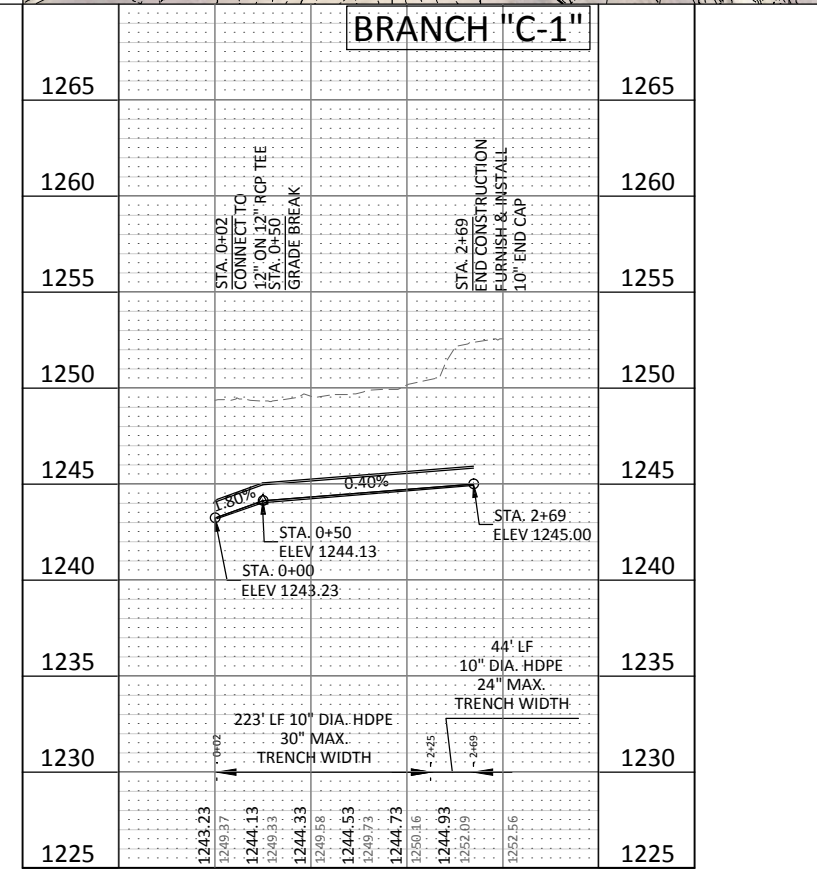
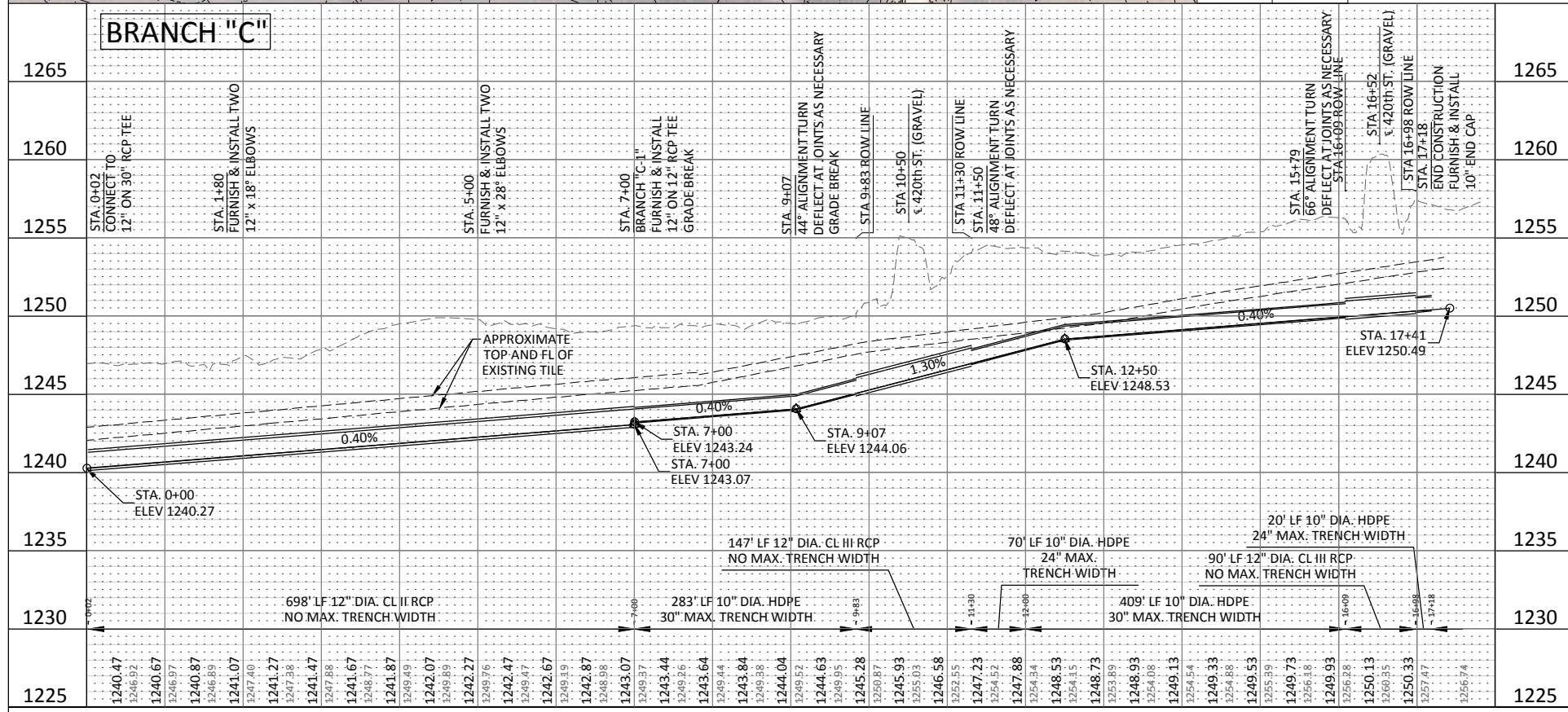
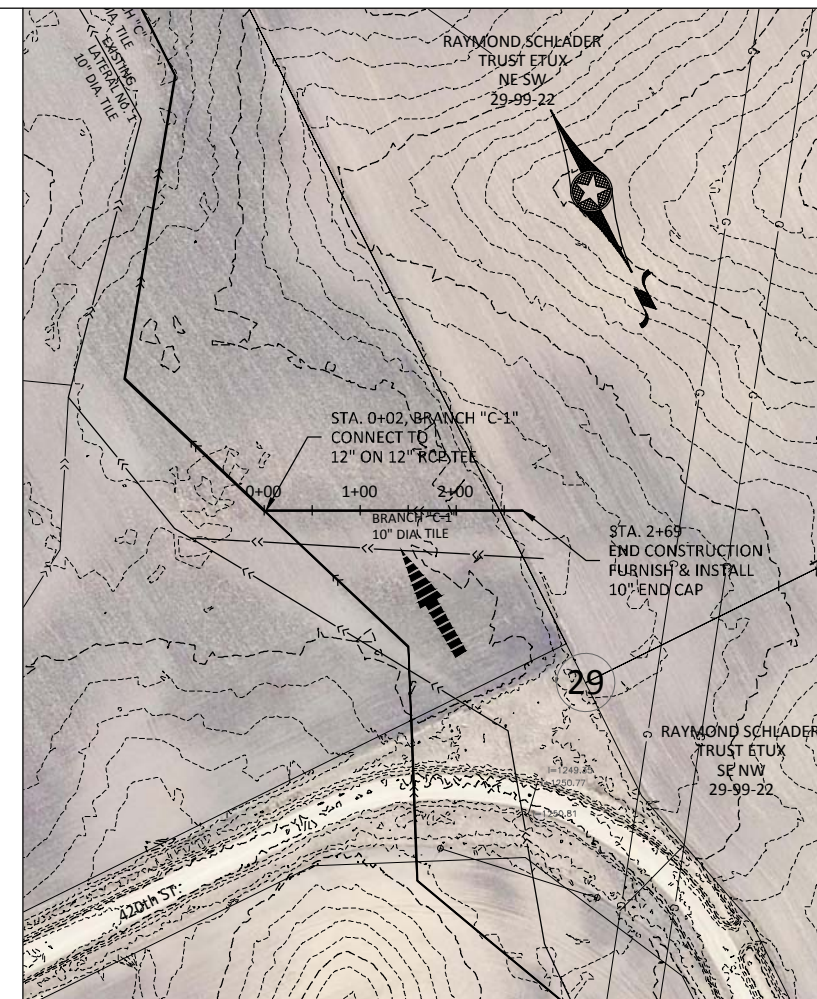
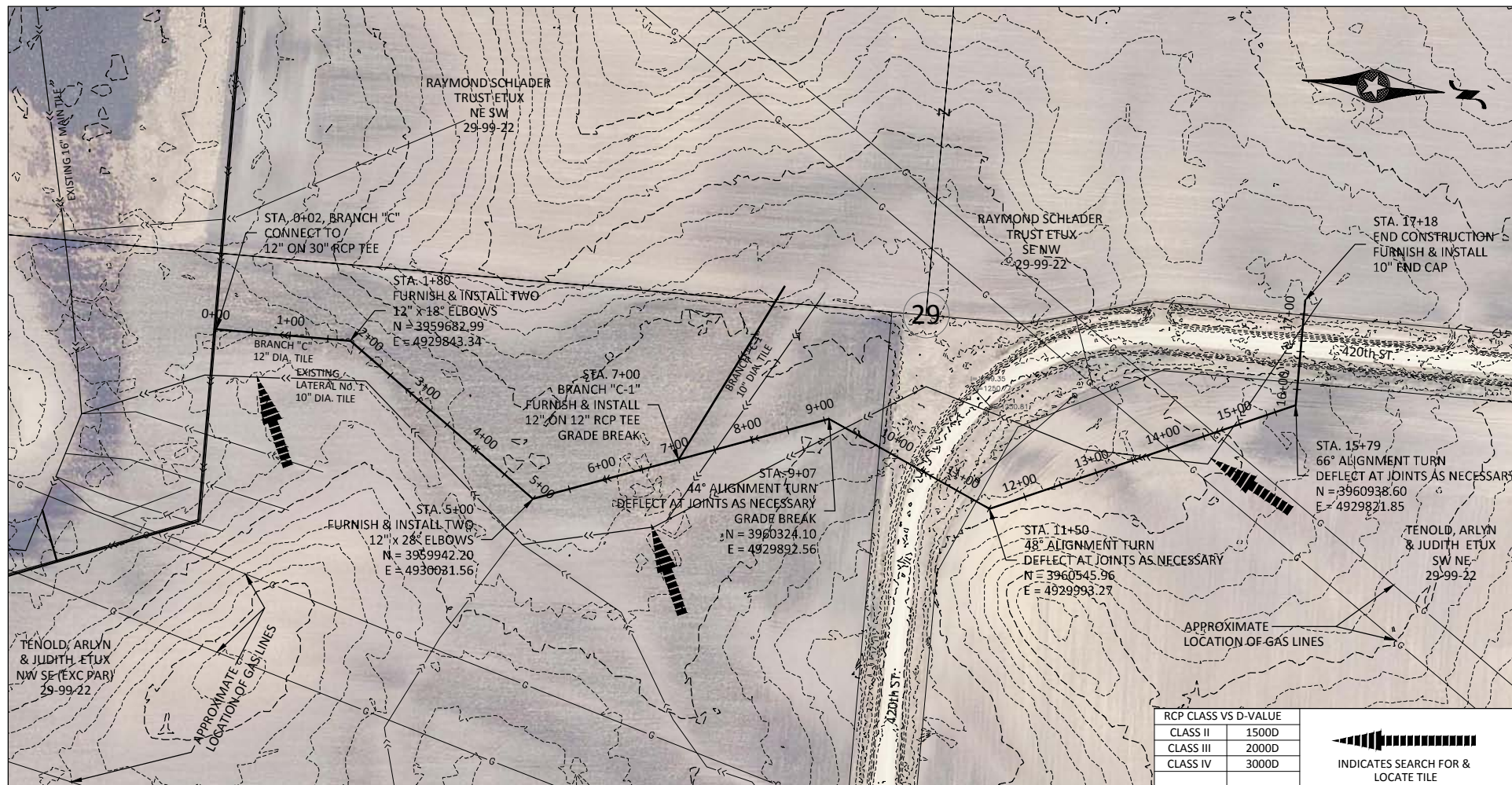
DESIGNED: JPR
 DRAWN: CLH
 CHECKED: DDE

BOLTON & MENK, INC.
 Consulting Engineers & Surveyors
 MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN
 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

REV.	BY	DATE

WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 PLAN & PROFILE - BRANCH B
 0+00-21+77

SHEET
M.07



HORIZ. SCALE: 1" = 100'

VERT. SCALE: 1" = 5'

DESIGNED: JPR

DRAWN: CLH

CHECKED: DDE

BOLTON & MENK, INC.

Consulting Engineers & Surveyors

MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

REV.	BY	DATE

WORTH COUNTY, IOWA

DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS

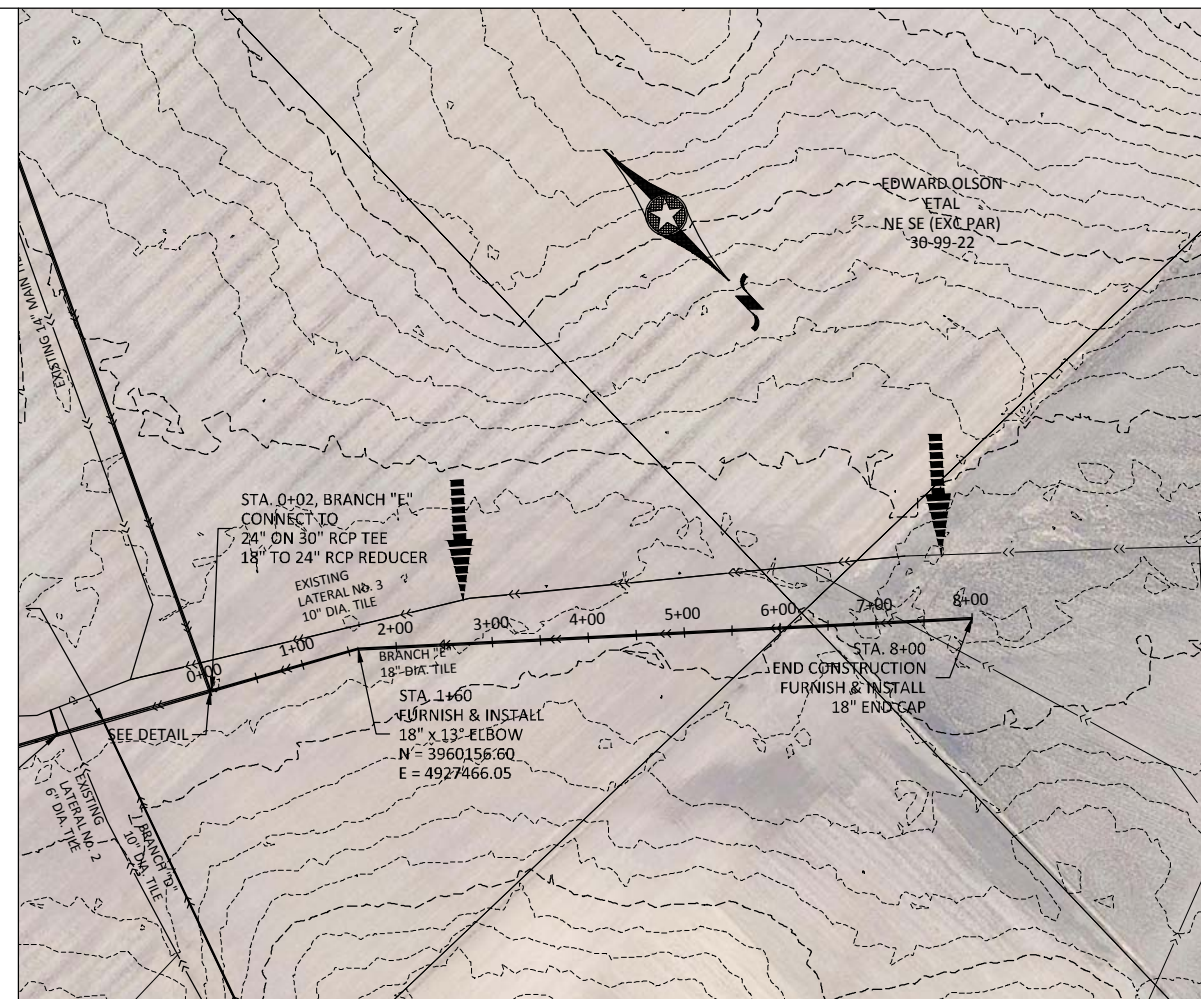
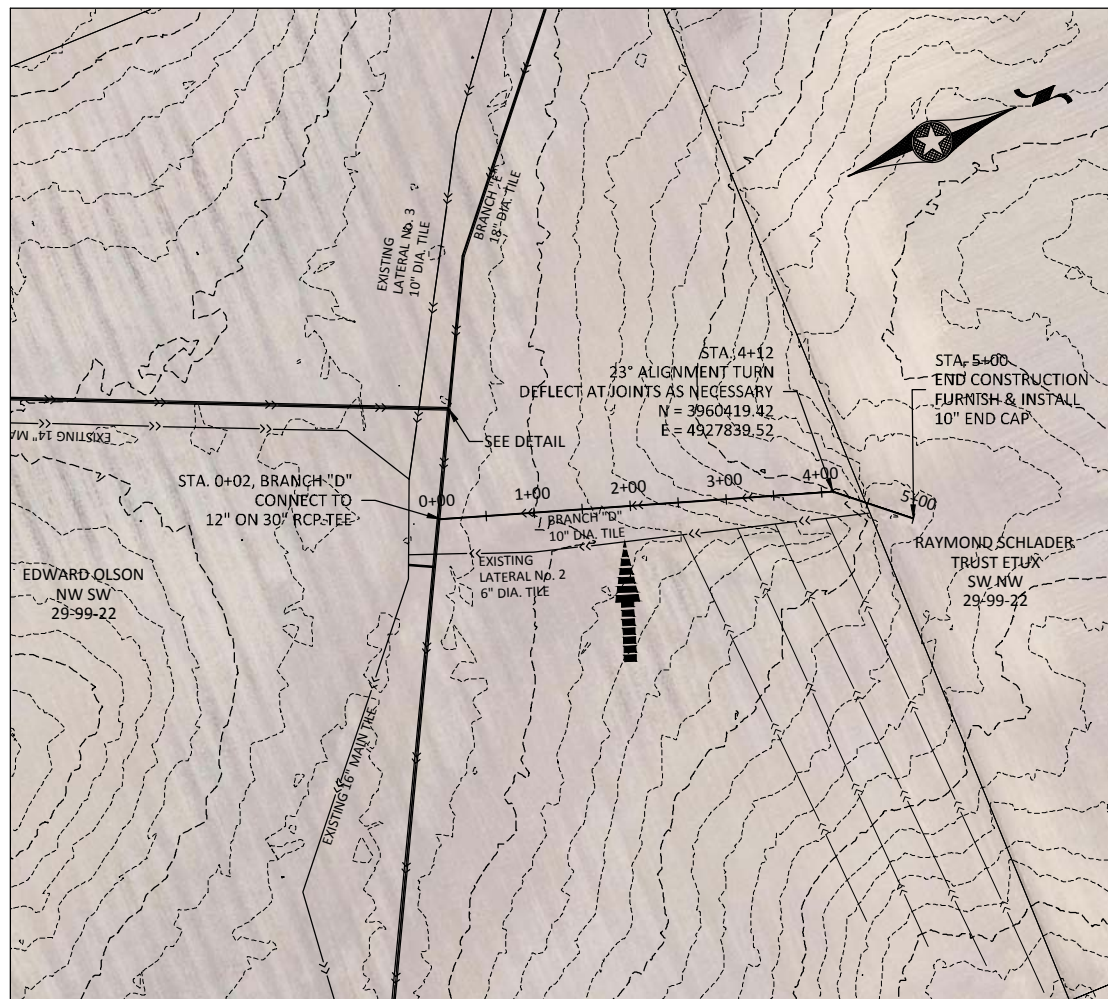
PLAN & PROFILE - BRANCH C & C-1

0+00-17+37 0+00-2+74


SHEET

M.08

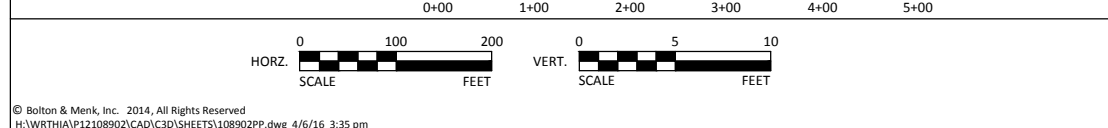
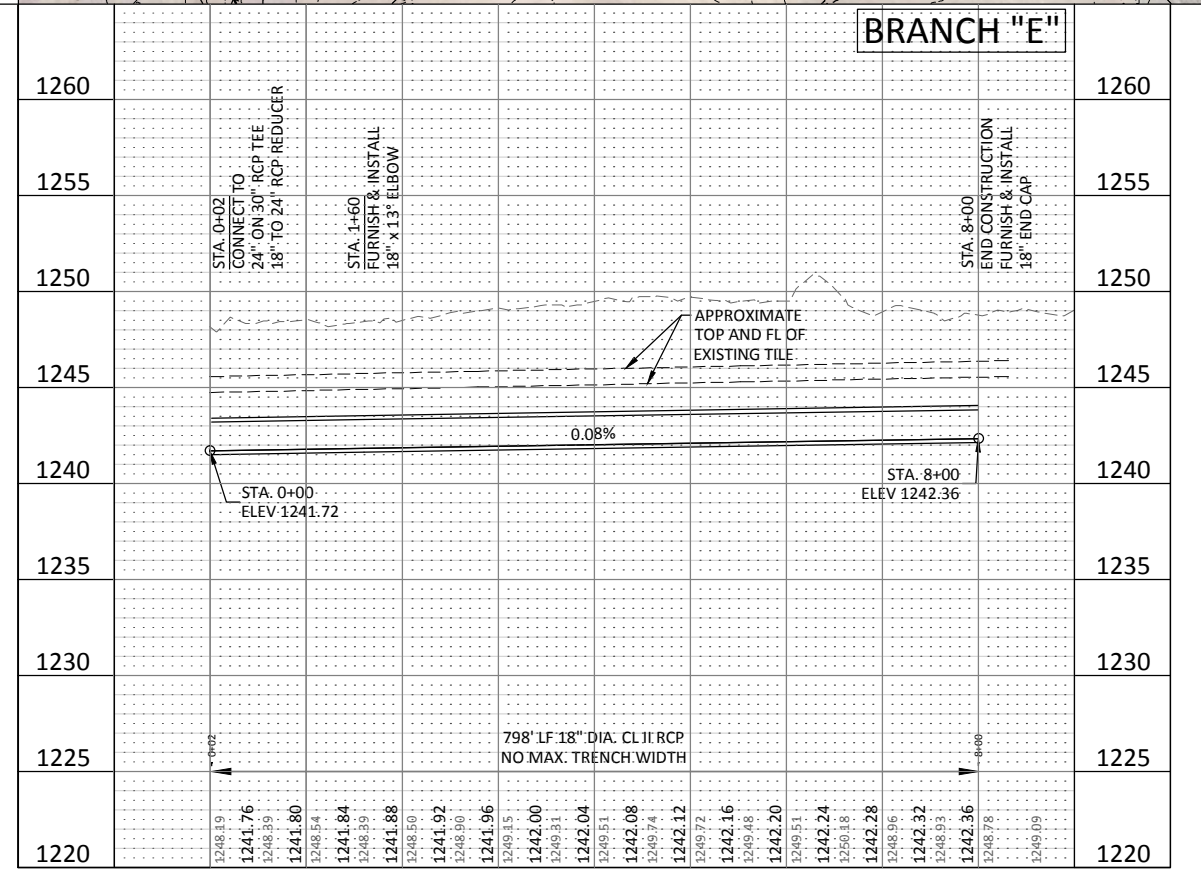
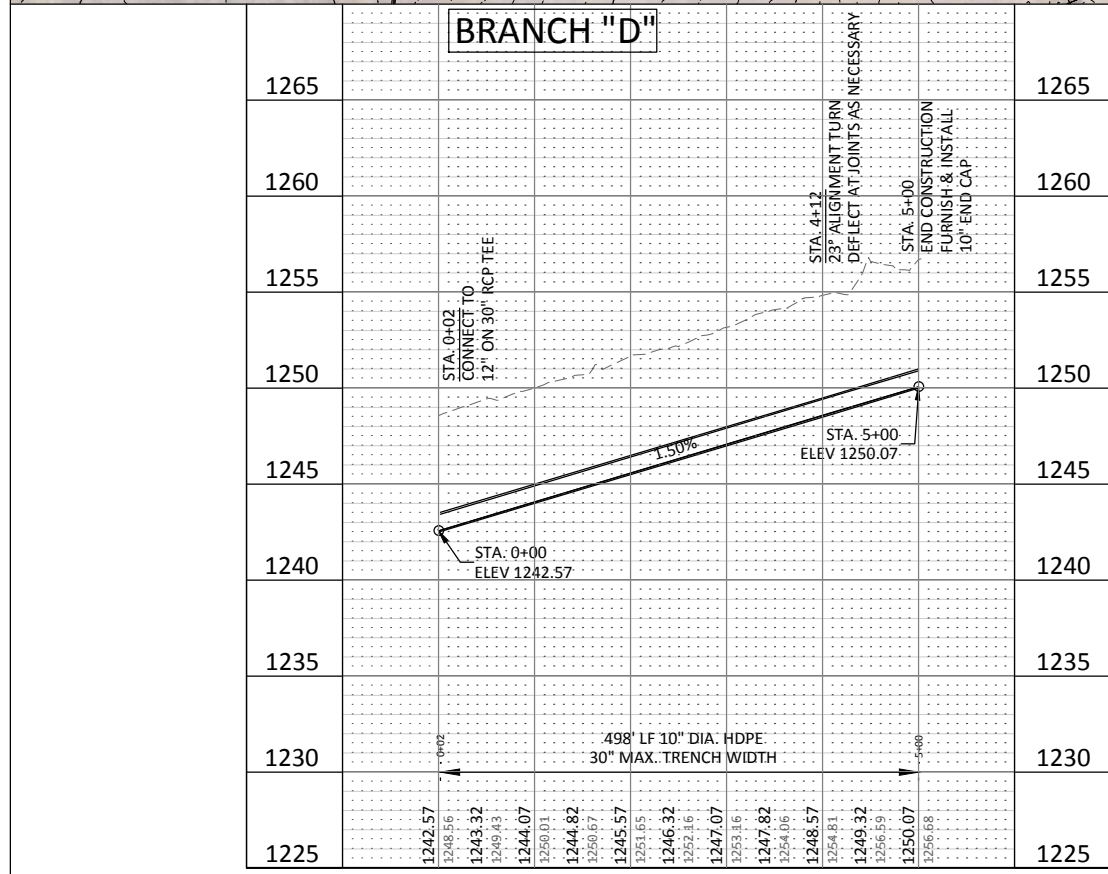
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RCP CLASS VS D-VALUE	
CLASS II	1500D
CLASS III	2000D
CLASS IV	3000D

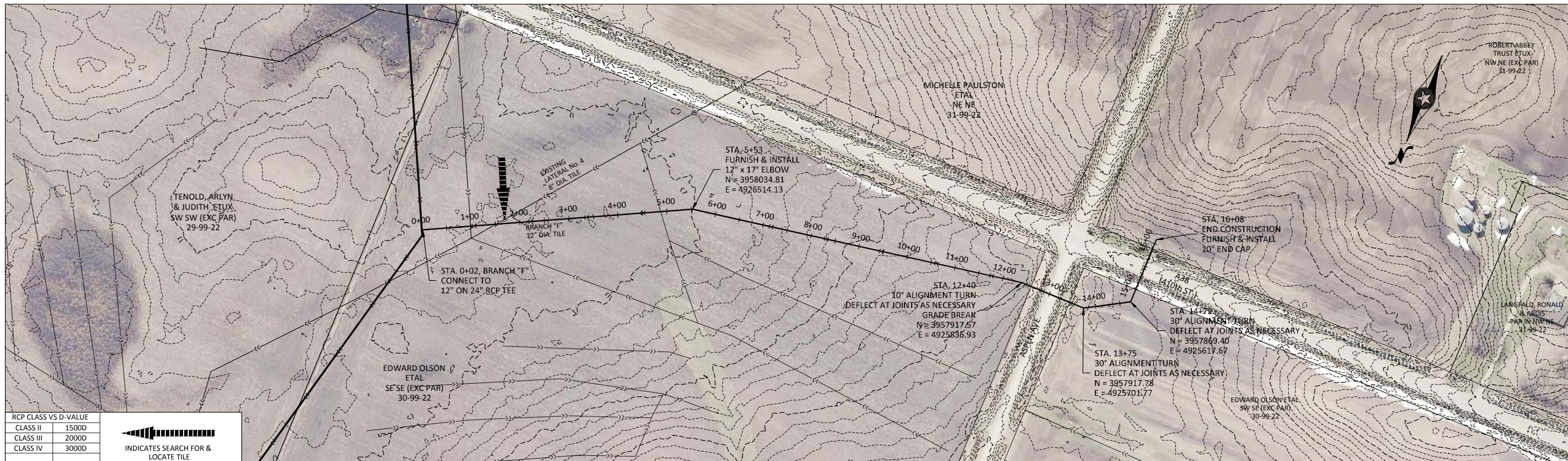


 INDICATES SEARCH FOR & LOCATE TILE



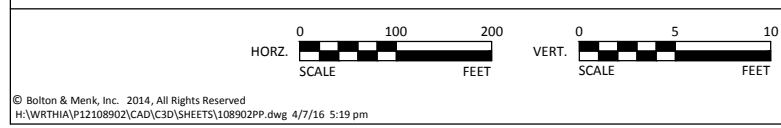
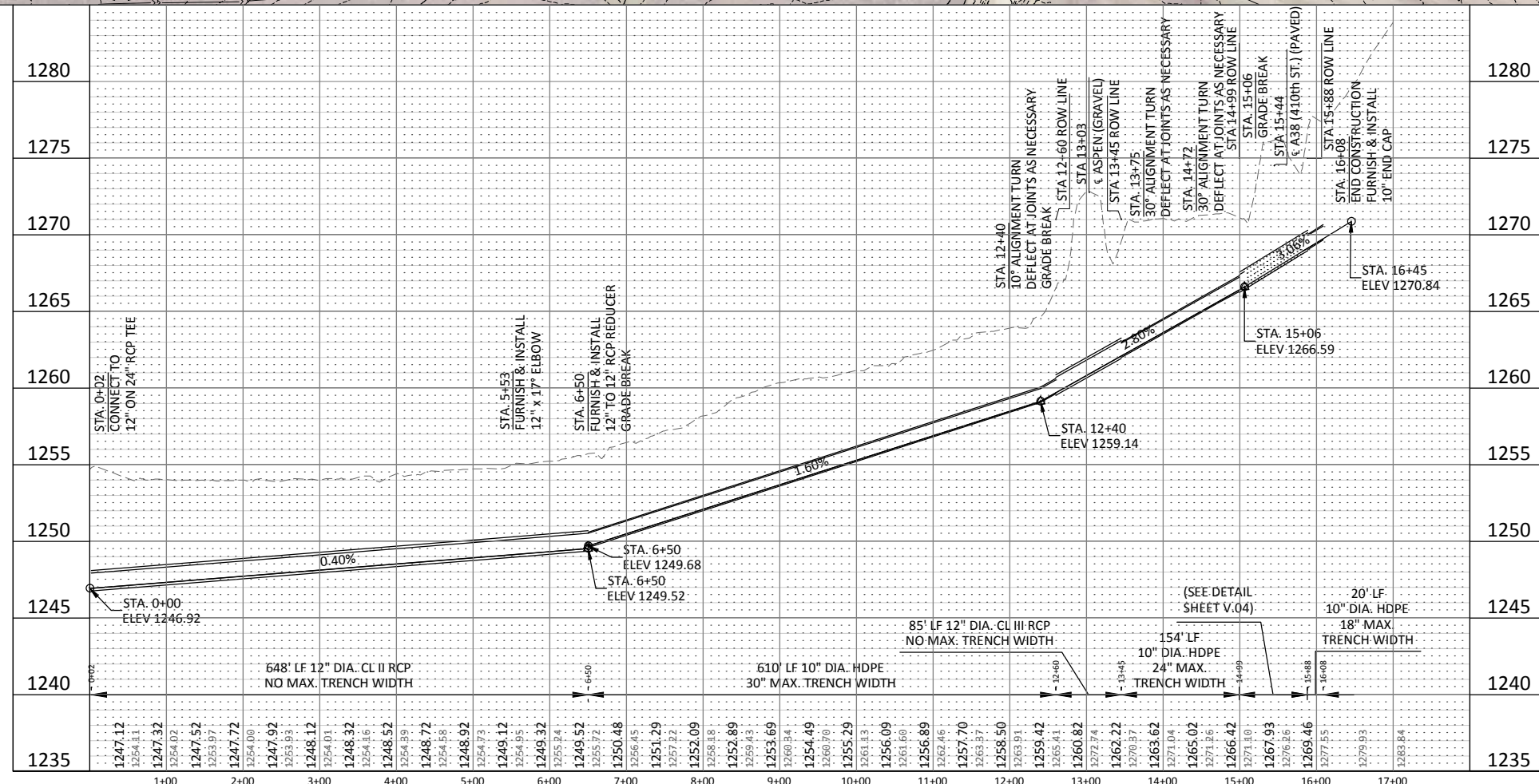
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DESIGNED JPR	 BOLTON & MENK, INC. Consulting Engineers & Surveyors MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND	REV.	BY	DATE	WORTH COUNTY, IOWA DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS PLAN & PROFILE - BRANCH D & E 0+00-5+00 0+00-8+00	SHEET M.09
DRAWN CLH						
CHECKED DDE						



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

INDICATES SEARCH FOR & LOCATE TILE



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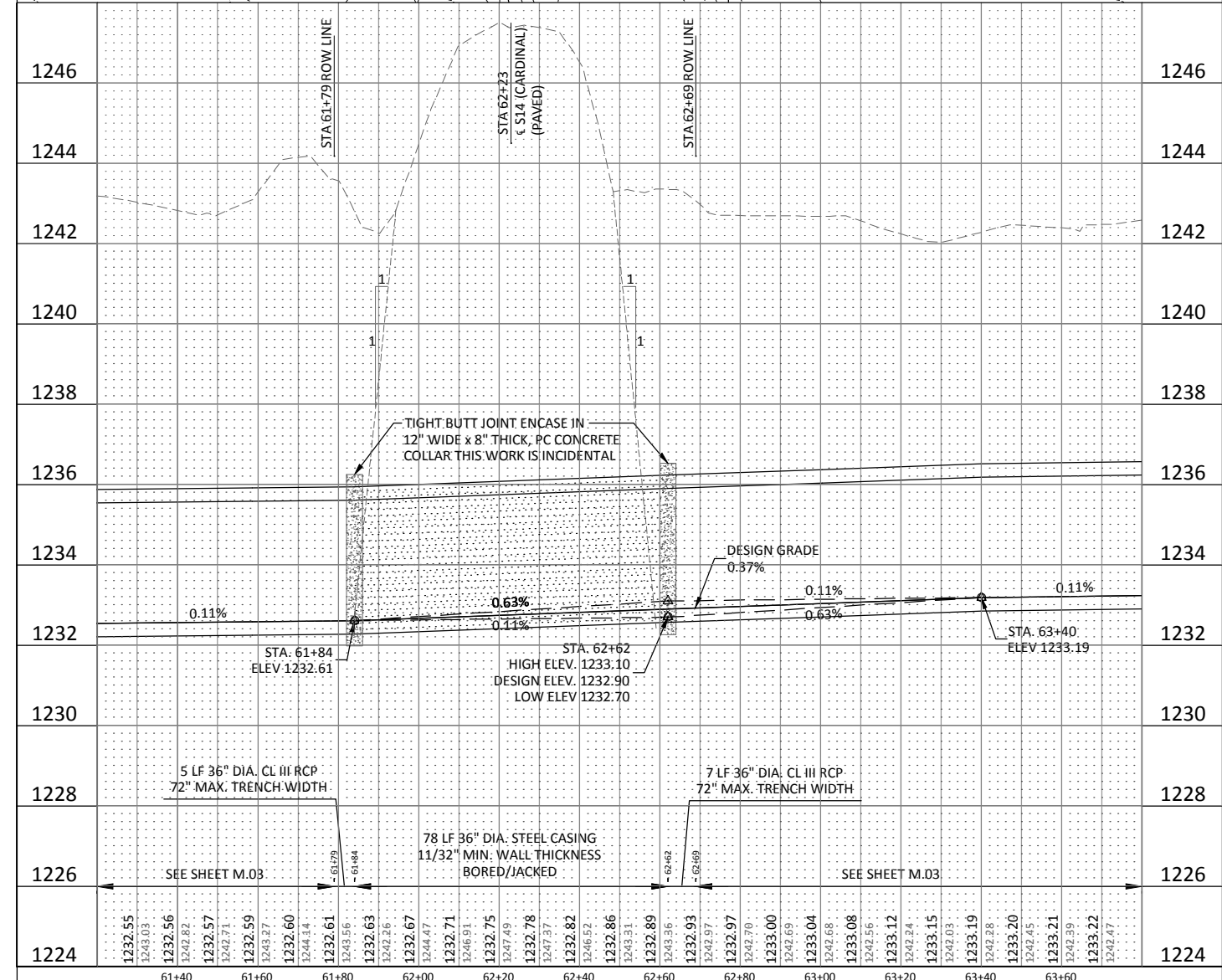
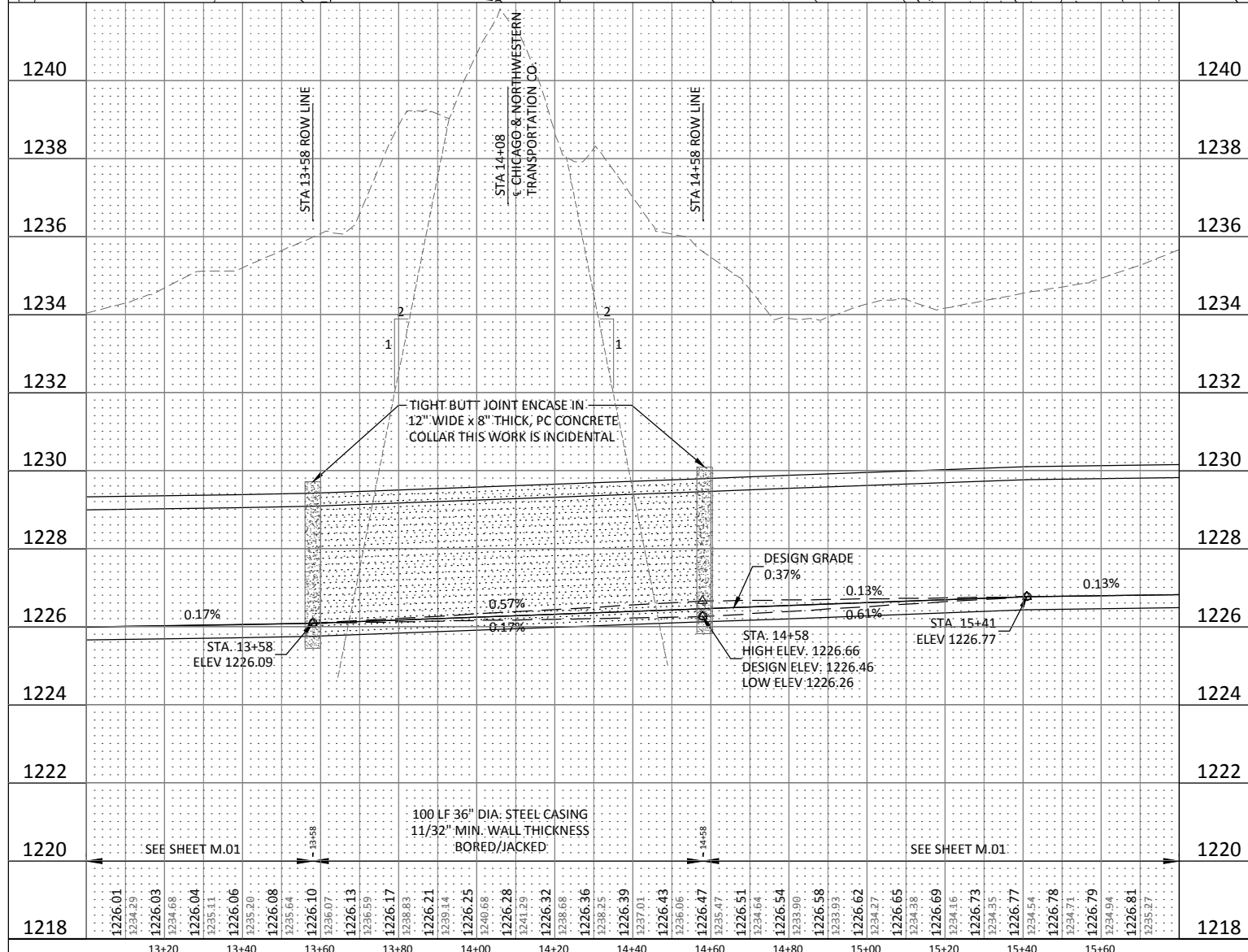
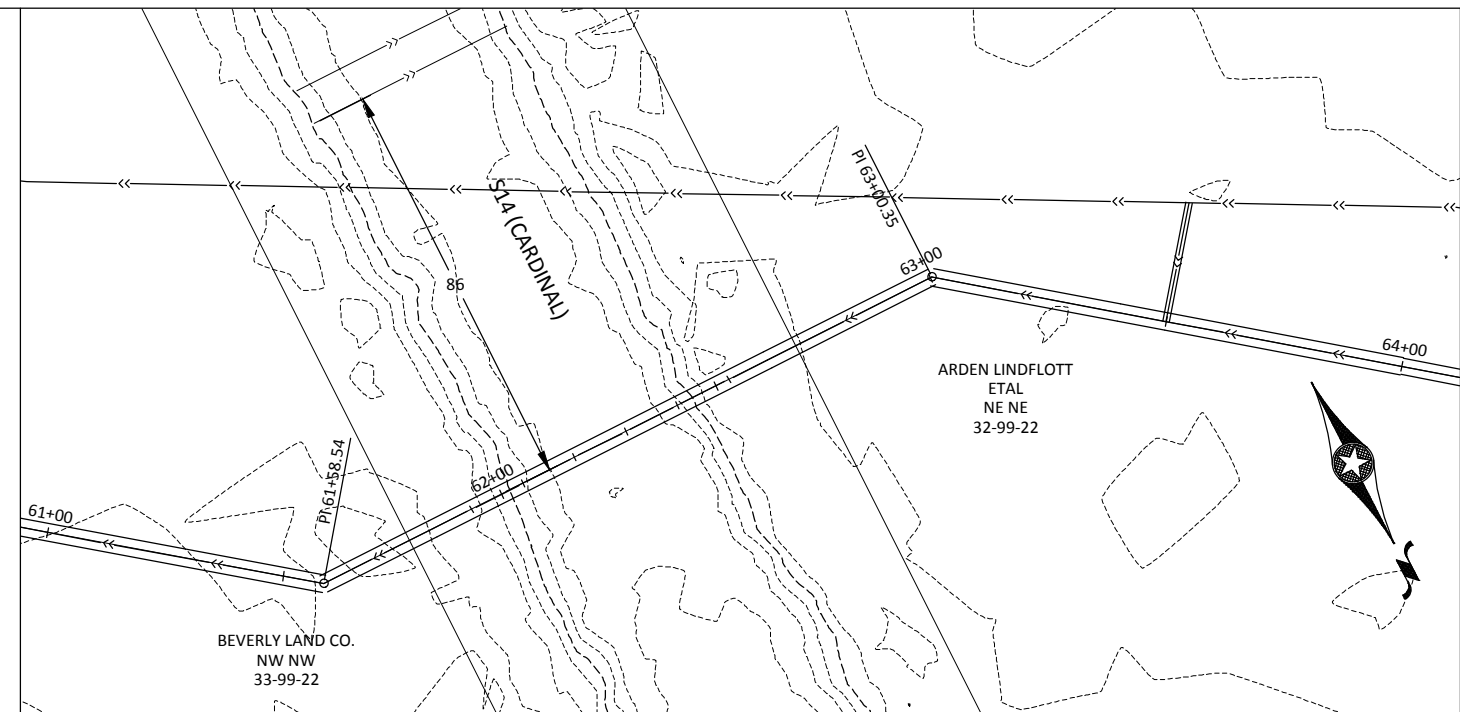
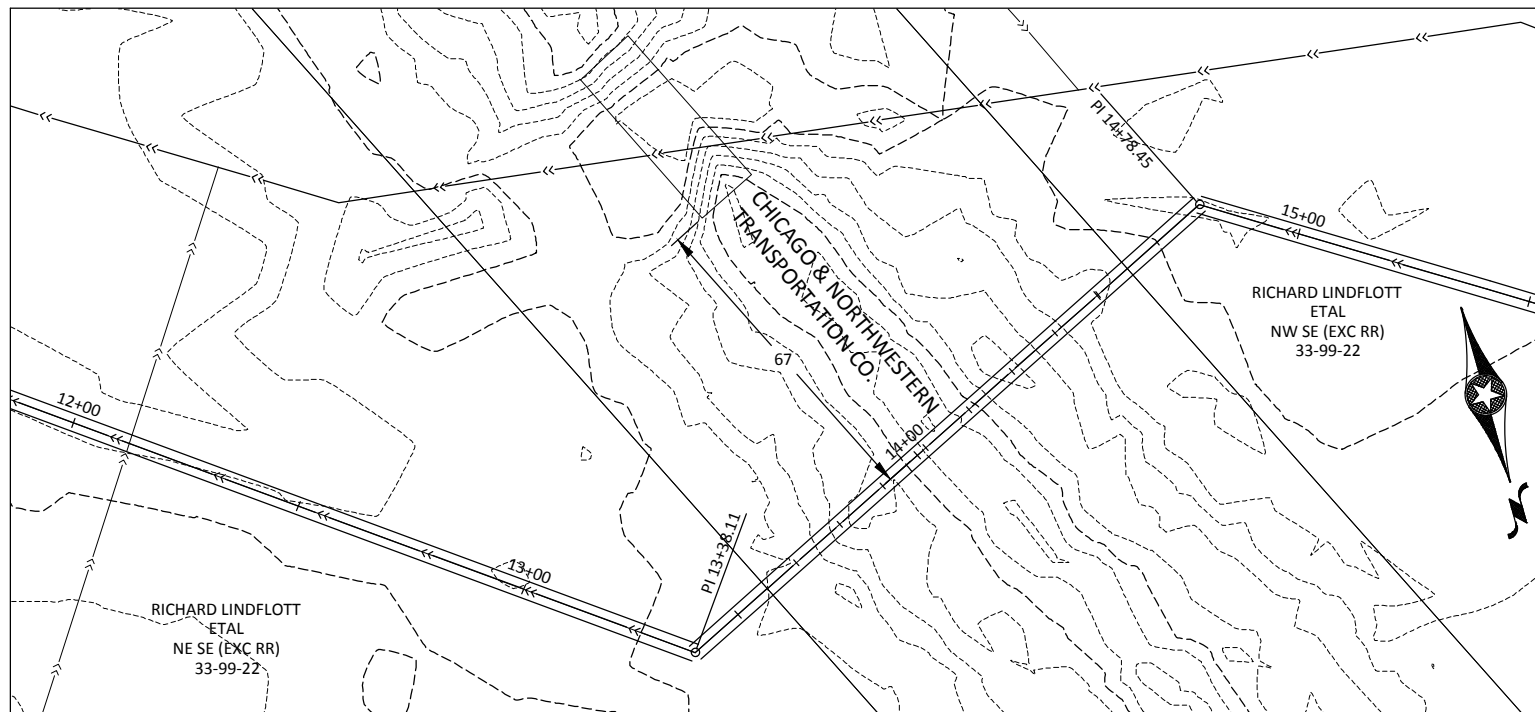
DESIGNED: JPR
 DRAWN: CLH
 CHECKED: DDE

BOLTON & MENK, INC.
 Consulting Engineers & Surveyors
 MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN
 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

REV.	BY	DATE

WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 PLAN & PROFILE - BRANCH F
 0+00-16+45

SHEET
M.10



DESIGNED: JPR
 DRAWN: CLH
 CHECKED: DDE

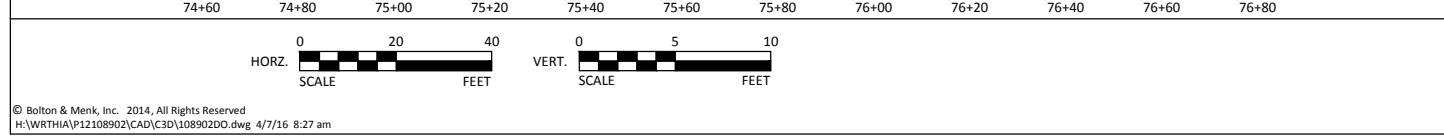
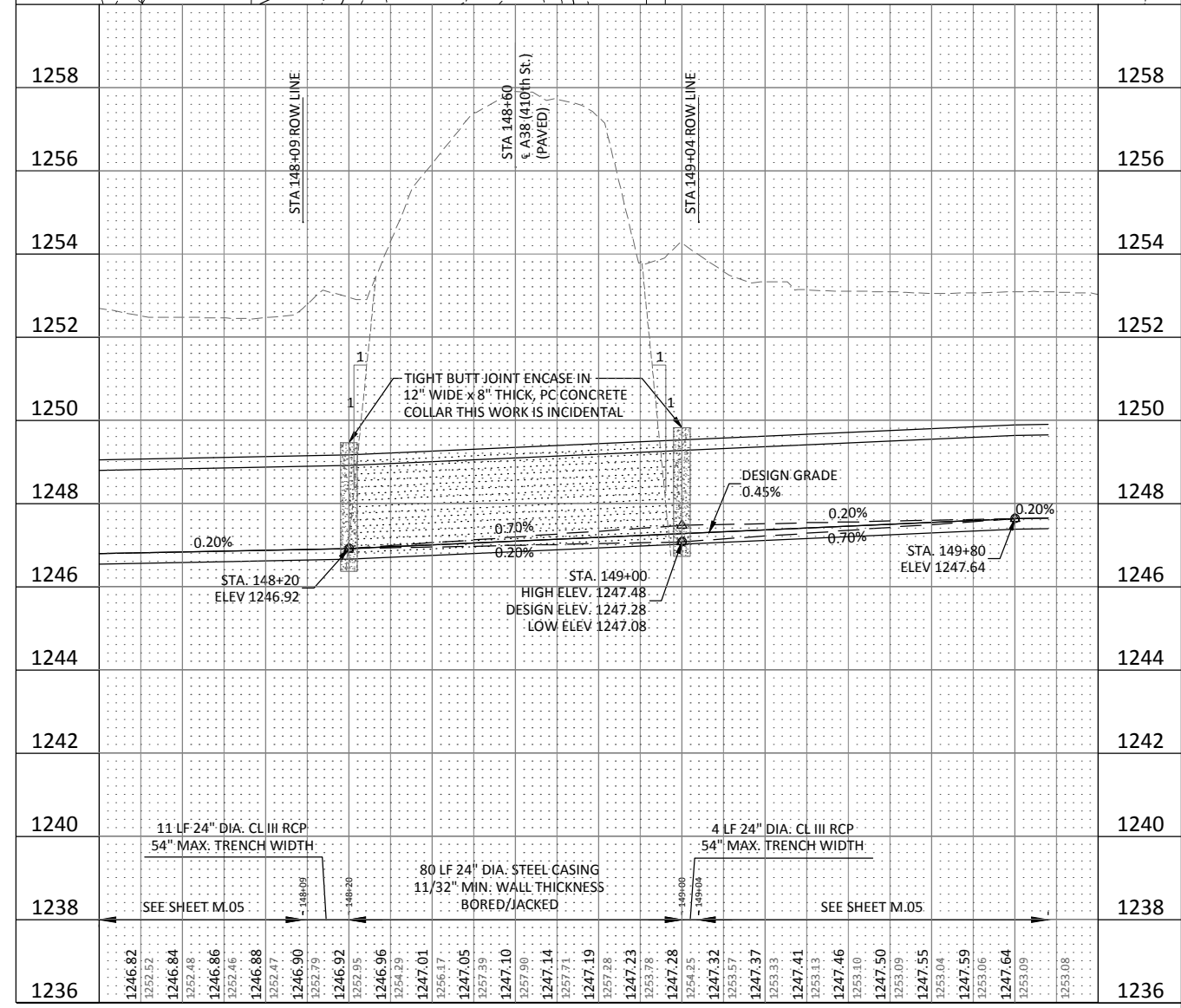
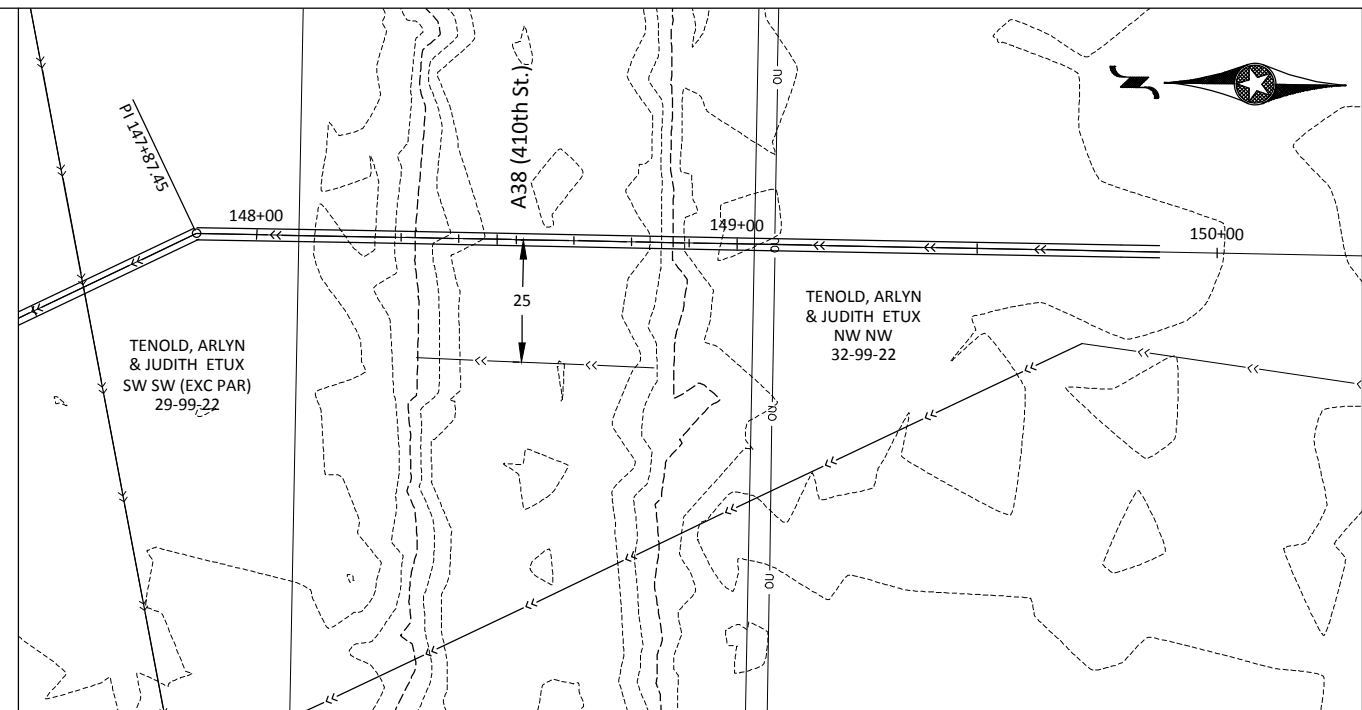
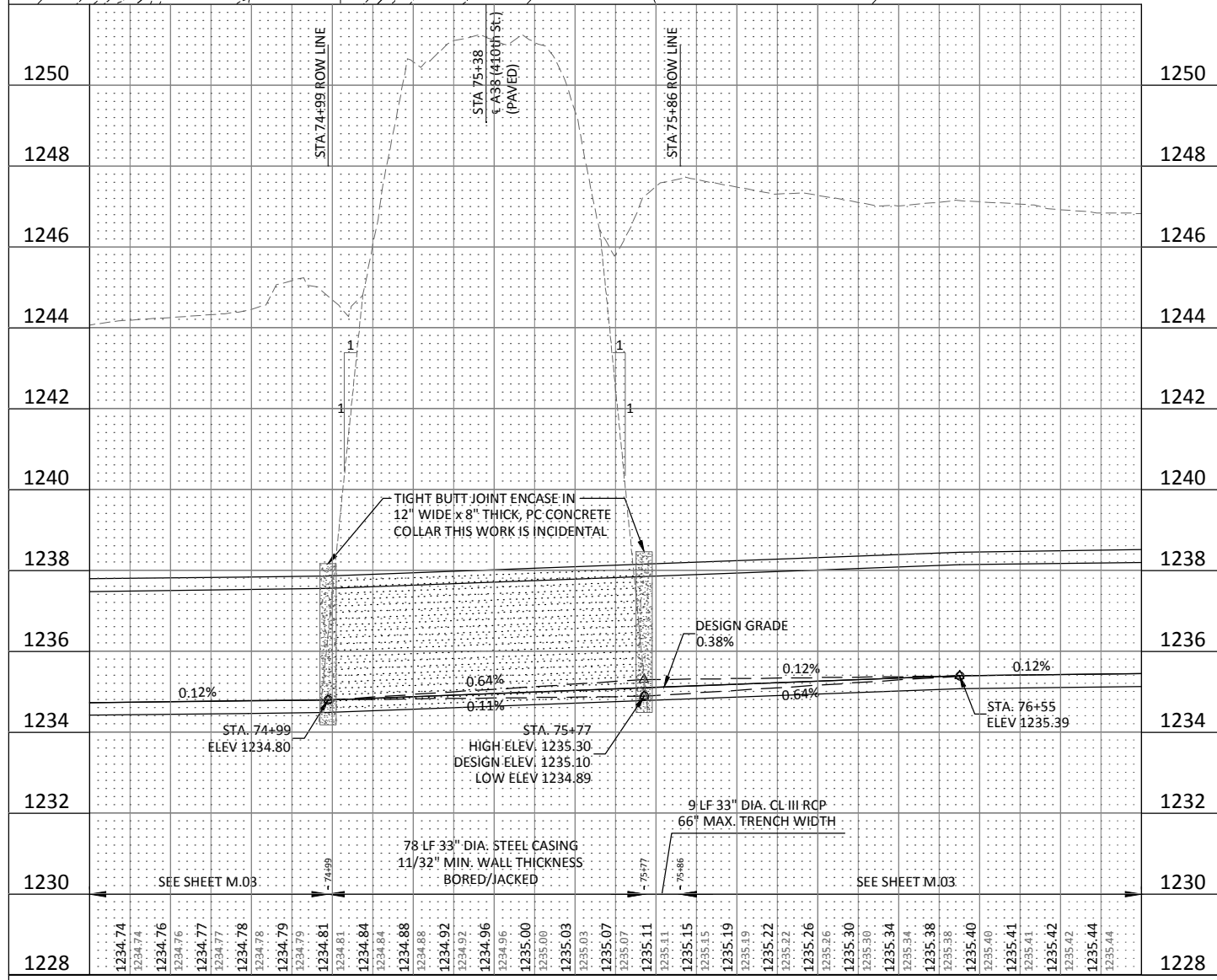
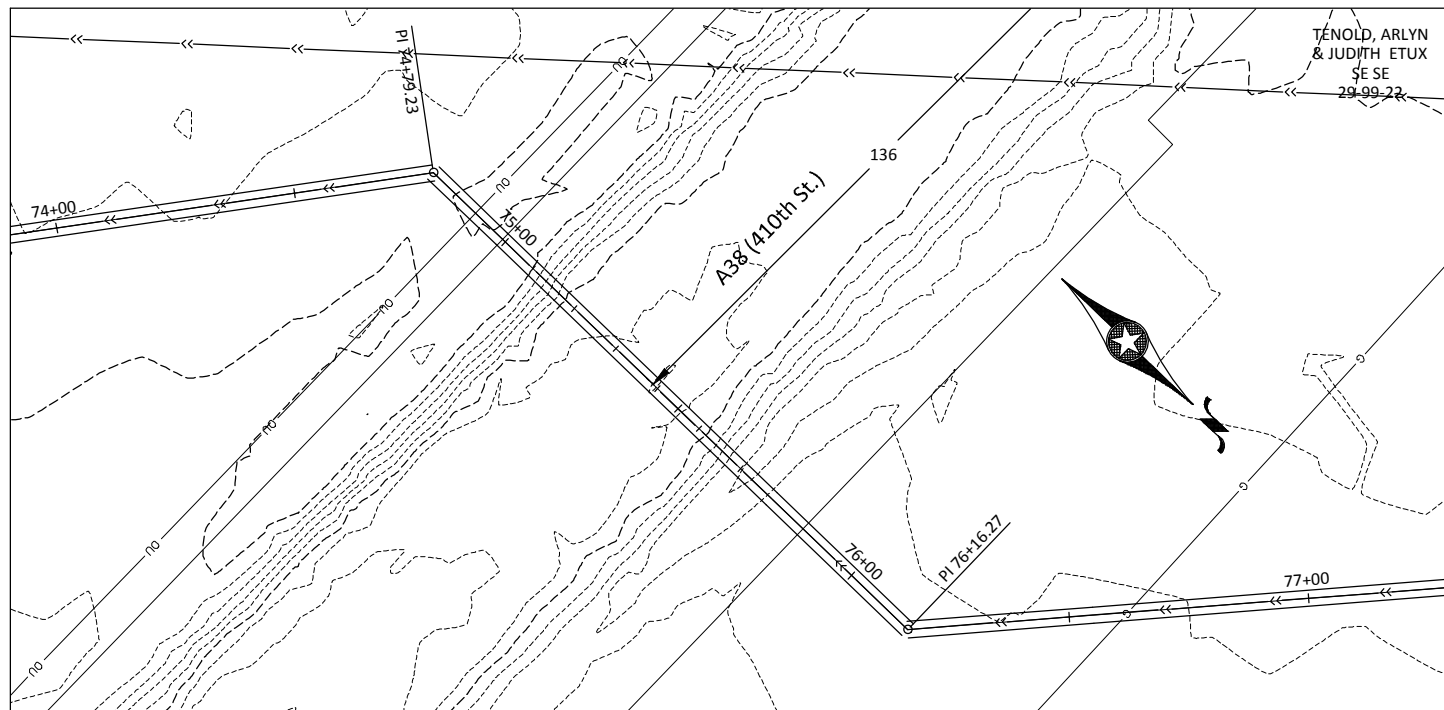
HORIZ. SCALE: 0 20 40 FEET
 VERT. SCALE: 0 5 10 FEET

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 Consulting Engineers & Surveyors
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 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

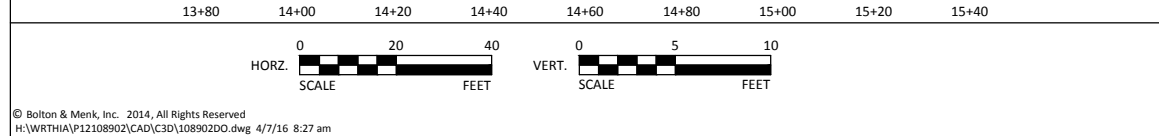
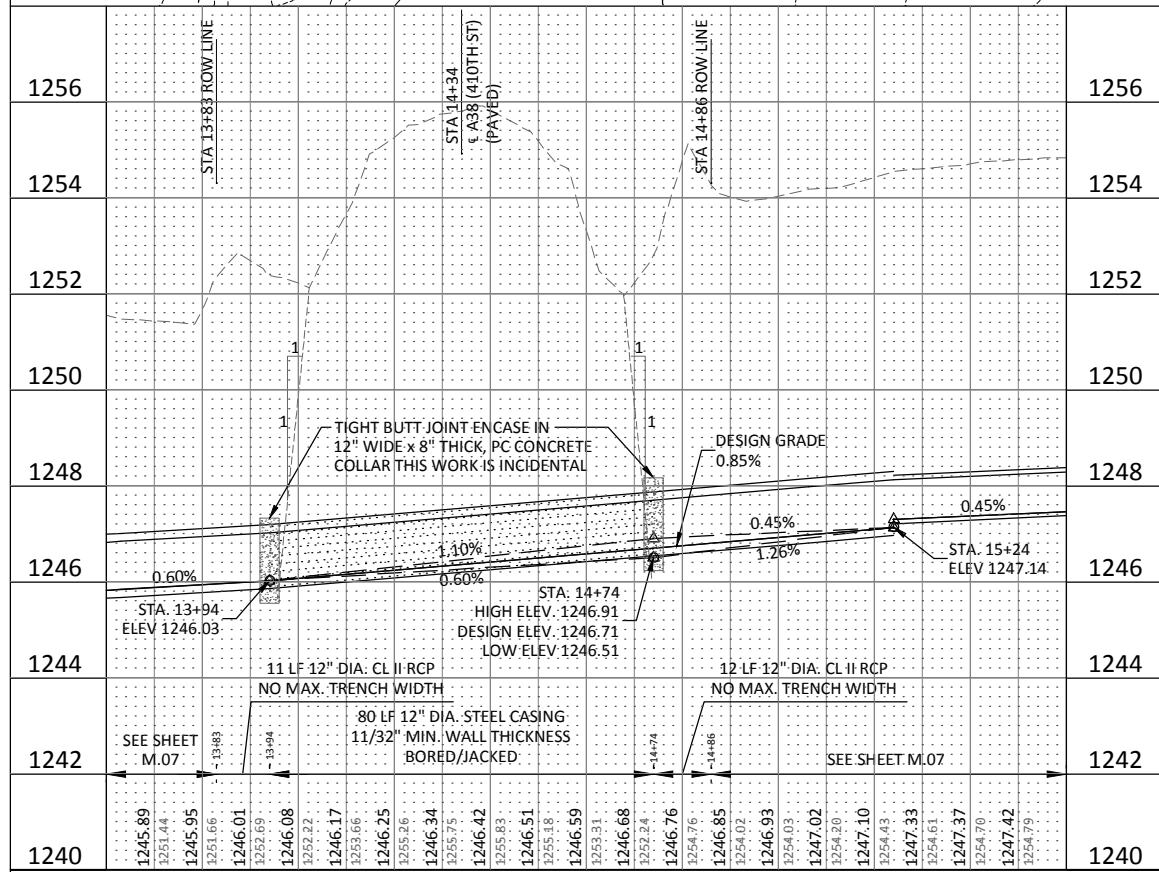
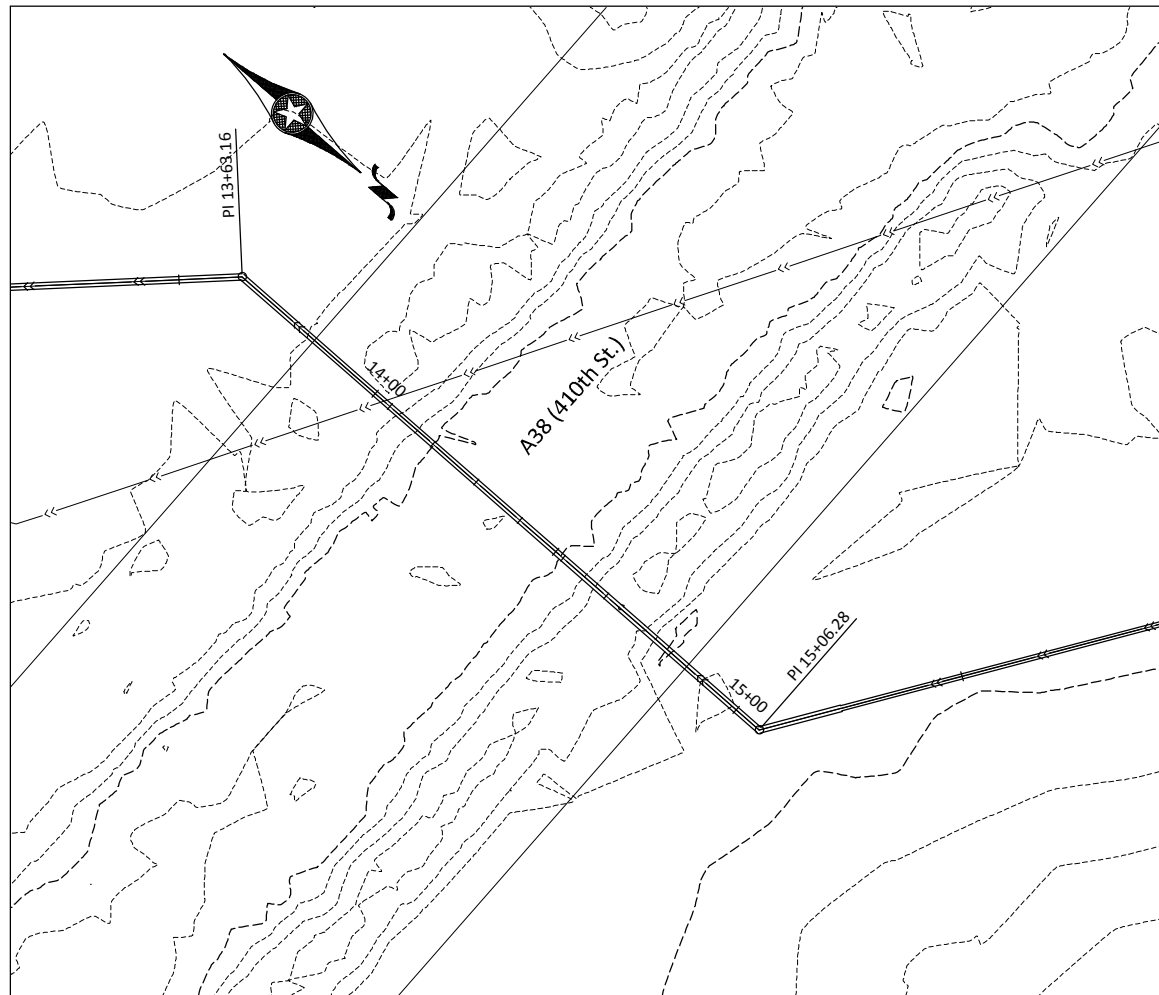
WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 ROAD CROSSING BORING - C & NW RAILROAD & S14 - MAIN TILE

SHEET: V.01



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DESIGNED JPR	BOLTON & MENK, INC. Consulting Engineers & Surveyors MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND	REV.	BY	DATE	WORTH COUNTY, IOWA DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS ROAD CROSSING BORING - A38 - MAIN TILE	SHEET
DRAWN CLH						V.02
CHECKED DDE						



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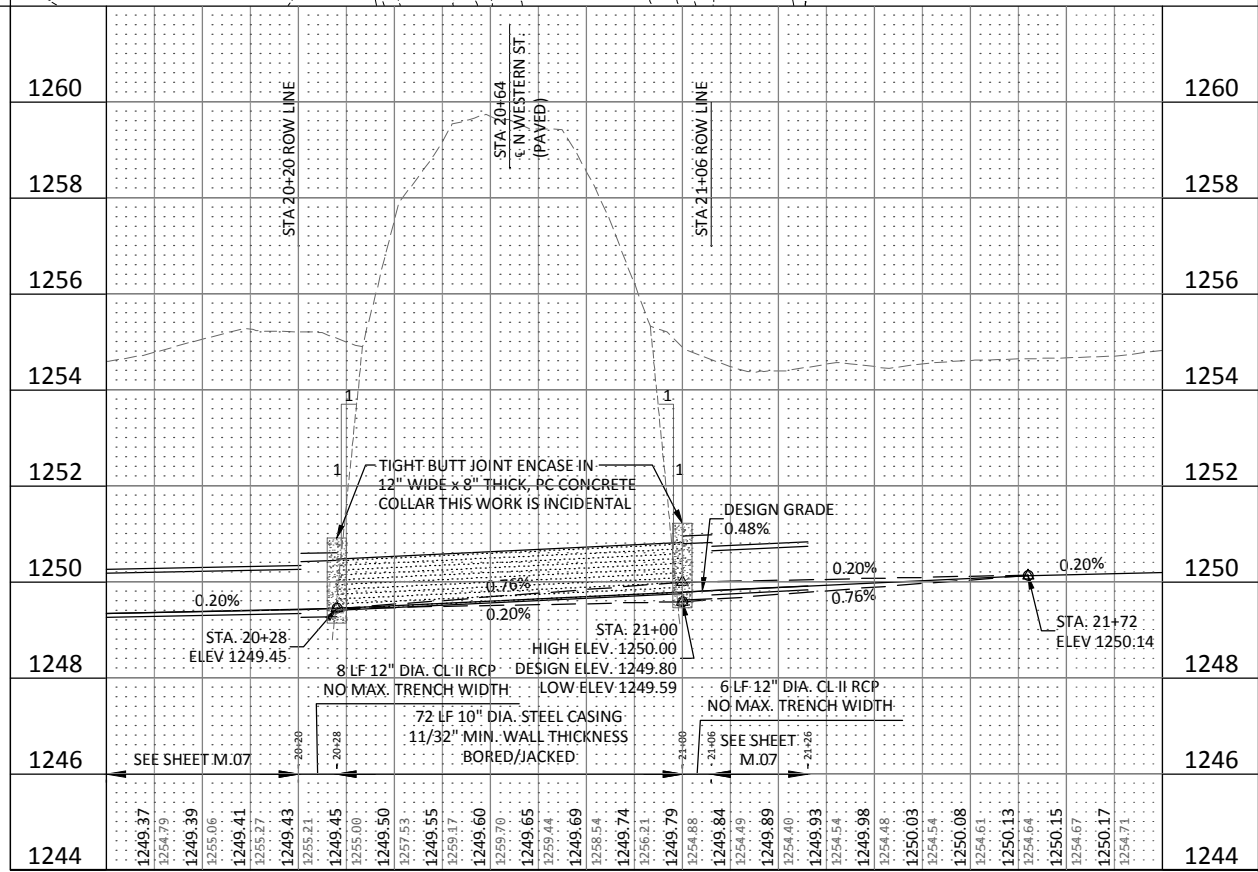
DESIGNED: JPR
 DRAWN: CLH
 CHECKED: DDE

BOLTON & MENK, INC.
 Consulting Engineers & Surveyors
 MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN
 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

REV.	BY	DATE

WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 ROAD CROSSING BORING - A38 & N WESTERN ST. - BRANCH B

SHEET
V.03



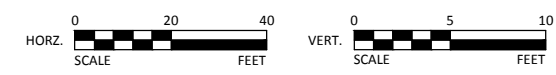
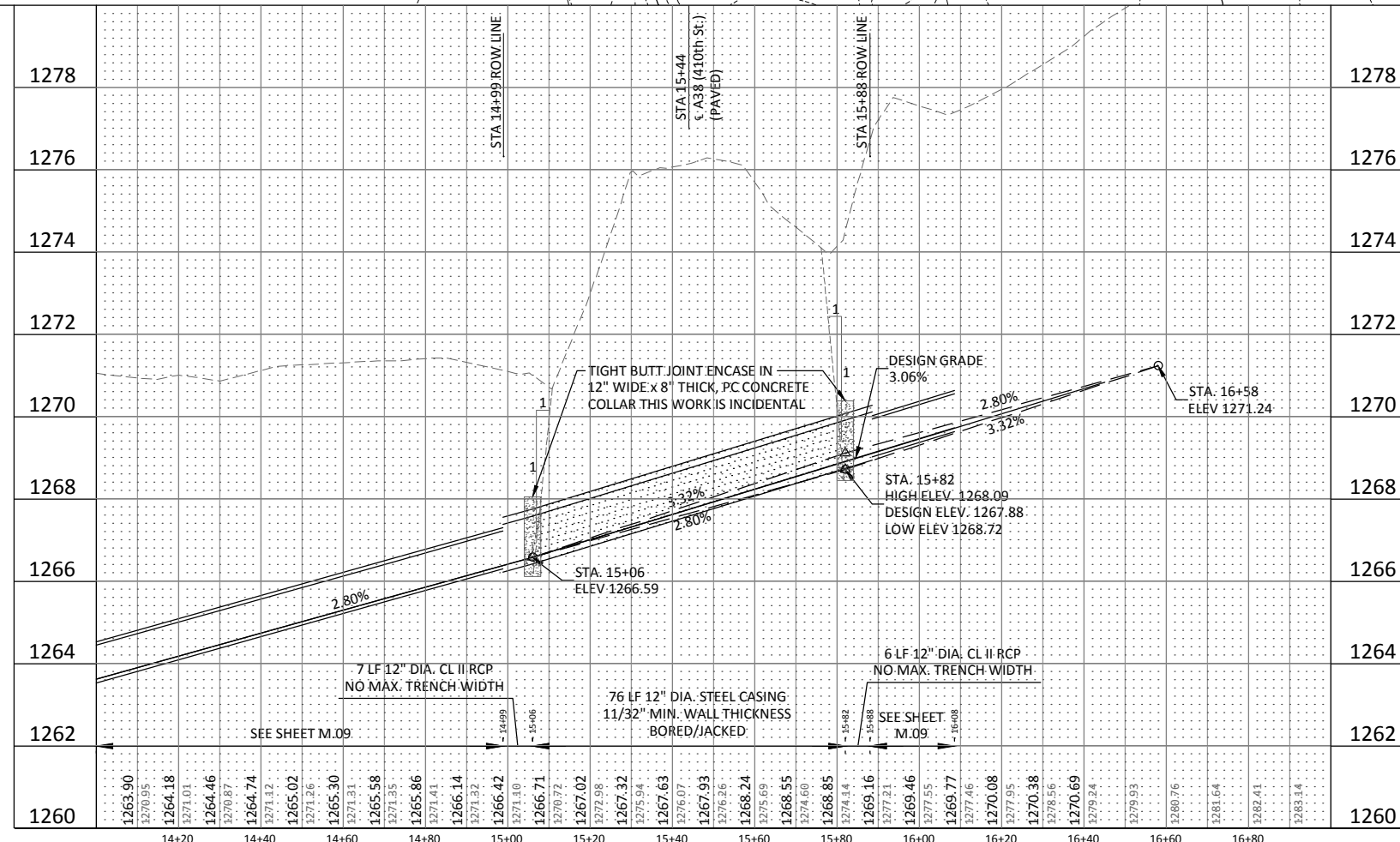
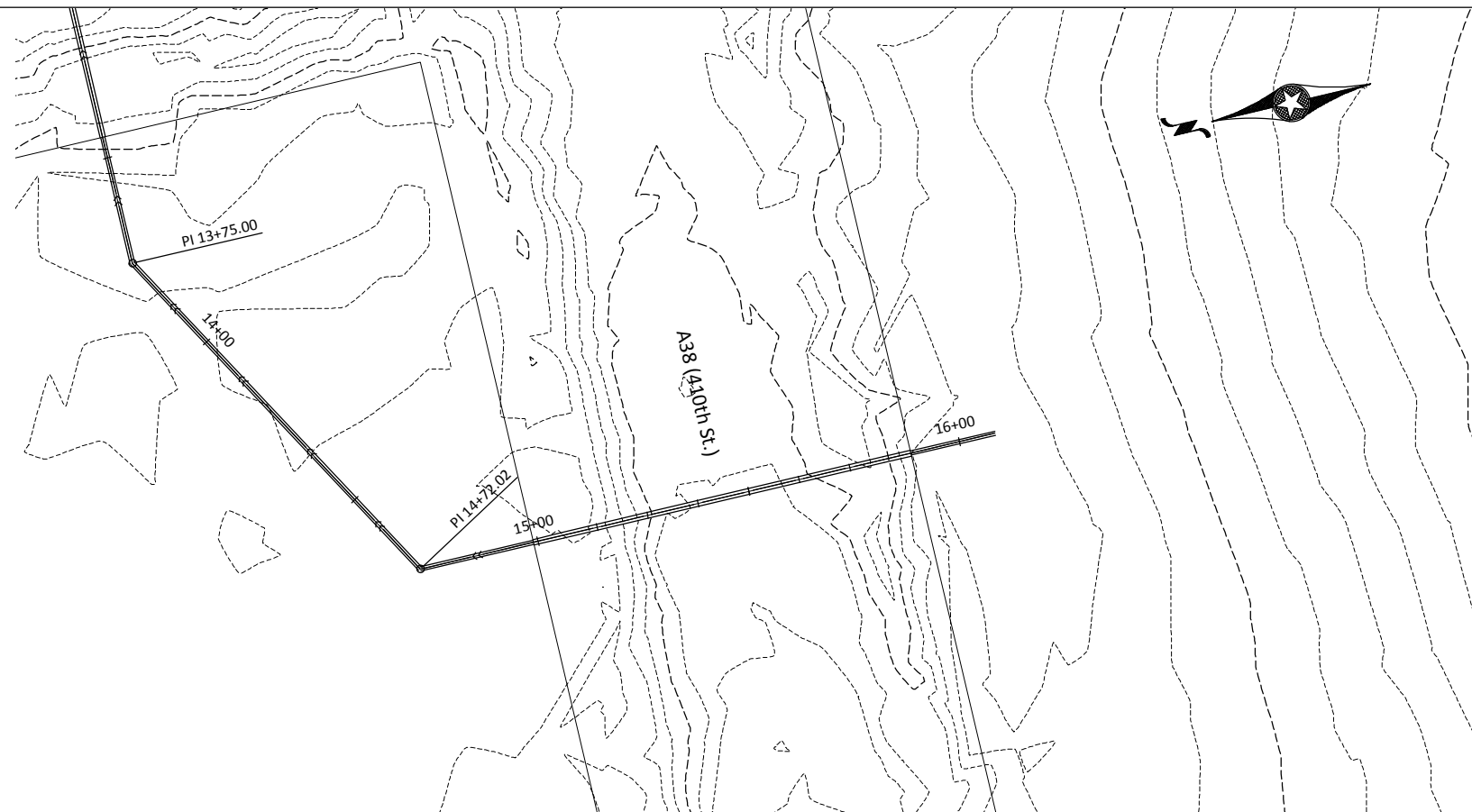
DESIGNED: JPR
 DRAWN: CLH
 CHECKED: DDE

BOLTON & MENK, INC.
 Consulting Engineers & Surveyors
 MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN
 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

REV.	BY	DATE

WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 ROAD CROSSING BORING - A38 & N WESTERN ST. - BRANCH B

SHEET
V.03



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 DRAWN: CLH
 CHECKED: DDE

BOLTON & MENK, INC.
 Consulting Engineers & Surveyors
 MANKATO, MN FAIRMONT, MN SLEEPY EYE, MN BURNSVILLE, MN WILLMAR, MN
 CHASKA, MN RAMSEY, MN MAPLEWOOD, MN BAXTER, MN ROCHESTER, MN
 AMES, IA SPENCER, IA DES MOINES, IA FARGO, ND

REV.	BY	DATE

WORTH COUNTY, IOWA
 DRAINAGE DISTRICT NO. 18 TILE IMPROVEMENTS
 ROAD CROSSING BORING- A38 - BRANCH F

SHEET
V.04

Services Provided:

Civil and Municipal Engineering

Water and Wastewater Engineering

Traffic and Transportation Engineering

Aviation Planning and Engineering

Water Resources Engineering

Coatings Inspection Services

Landscape Architecture Services

Surveying and Mapping

Geographic Information System Services

Funding Assistance

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