FEASIBILITY STUDY FOR:

COUNTY DITCH 46:
FARIBAULT COUNTY, MINNESOTA
NOVEMEBER 2020

REPORT FOR:
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Project Scope

At your request, ISG completed a preliminary review of Faribault County Ditch No. 46 (CD 46). The scope included an examination of the existing CD 46, as well as recommendations for repairing and improving the existing open ditch and tile system. Maps of the CD 46 watershed and existing public open ditch and tile system is shown on the attached exhibits and is referenced herein.

It should be noted that some general assumptions were made during this analysis and minimal survey information was gathered. ISG received the original watershed map as well as the original bill of sale and legal description, showing the tile locations and sizes from Faribault County for the CD 46 system. Additional information may or may not modify our findings, but it is not anticipated that a significant change to our recommendation would result. If you or any landowners have tile maps or any other information that can aid us in future work, please feel free to share this information with us. A future survey will be necessary to verify these assumptions.

Watershed

Faribault County Ditch No. 46 open ditch lies in Emerald and Rome Township of Faribault County, Minnesota. The CD 46 mainline open ditch drains from the SE quarter of the SW quarter of Section 23 of Emerald Township and flows Northeast where it outlets into the East Branch of the Blue Earth River in the NE quarter of the SW quarter of Section 23 of Emerald Township. The mainline tile drains from the NE quarter of the SW quarter of Section 35 of Emerald Township and flows north where it outlets into the main open ditch in the SE quarter of the SW quarter of Section 23 of Emerald Township.

The CD 46 watershed consists primarily of gently rolling agricultural land which provides drainage to approximately 1,339 total acres. The watershed includes land from Sections 23, 26-27, and 34-35 of Emerald Township and Sections 2-3 of Rome Township. Elevations within the entire watershed range from approximately 1166 to 1206 Mean Sea Level (MSL) according to county LIDAR data.

The hydrologic soil classification for the land in the CD 46 watershed is predominantly type "C/D," which is considered as a dual hydrological soil group. This means that this soil has the potential to be adequately drained. The "D" in this group corresponds to the soil having over 40 percent clay and restricted water movement. The "C" classification refers to the drained condition. If adequately drained, water transmission through the soils is expected to be somewhat restricted and moderately high runoff potential can be anticipated wen soil is thoroughly wet.

History

Faribault County Ditch No. 46 was originally constructed in 1916 as a tile system with a short ditch section at its downstream end. It consisted of 12,600 feet of mainline tile with sizes ranging from 12-inch to 32-inch and slopes ranging from 0.10% to 0.50%. The system also included 17 Branches throughout the system with sizes ranging from 7-inch to 16-inch and 600-feet of open ditch.

In 1959 a repair of Branch No. 72 was completed. The repair included replacing 2,150 feet of tile with 1,450 feet of 10-inch tile and 700 feet of 8-inch tile at a flatter grade to match existing capacities. The current condition of this tile is unknown at this point.

Existing Conditions

The open ditch channel contains a typical trapezoidal channel designed to convey both surface and subsurface tile water throughout the watershed. Based on the historical plans of the area, the open ditch slope is 0.05% with a 4-foot bottom and is 600 feet long.

Drainage Capacity

The information in this document has been prepared with the original CD 46 alignment map and profile drawings. A close representation of the CD 46 watershed was created using this information in conjunction with LiDAR contours, Minnesota DNR Watershed lines, aerial photographs and USGS Stream-Stats.

The capacity of agricultural tile is expressed as a drainage coefficient, in inches per day (in/day), and is defined as the depth of water over the entire area of the upstream watershed that a tile can drain in a 24-hour period. For a system like CD 46, the industry standard drainage coefficient for buried tile is between 0.50 to 0.75 in/day. See Table 1 and Table 2 below for the As-Constructed tile inventory breakdown and Table 3 and Table 4 for the existing drainage capacity of the system based off the results from the televising. It was assumed that the existing conditions of the tile are currently performing at best 40% of the as-constructed condition.

Table 1. As-Constructed Drainage Coefficients

Area	ACSIC Size (in)	Repair Size (in)	ACSIC Slope (%)	Drainage Area (Acres)	ACSIC Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)
Main	32	36	0.10%	1333.2	0.28	0.38
	30	30	0.10%	1291.8	0.24	0.24
	30	30	0.10%	1138.6	0.27	0.27
	30	30	0.10%	1130.9	0.27	0.27
	30	30	0.10%	1052.2	0.29	0.29
	30	30	0.10%	904.3	0.34	0.34
	28	30	0.10%	756.5	0.34	0.41
	28	30	0.10%	654.2	0.39	0.47
	26	30	0.10%	654.2	0.32	0.47
	26	30	0.12%	430.5	0.54	0.79
	20	24	0.12%	403.7	0.28	0.46
	18	18	0.12%	372.9	0.23	0.23
	18	18	0.12%	289.1	0.30	0.30
	16	18	0.12%	250.0	0.25	0.35
	14	15	0.50%	195.3	0.46	0.56
	12	12	0.50%	180.5	0.33	0.33
	12	12	0.20%	73.9	0.51	0.51
	12	12	0.20%	60.0	0.63	0.63
Branch 0	12	12	0.10%	20.6	1.31	1.31
	12	12	0.60%	20.7	3.19	3.19
	10	10	0.60%	21.9	1.85	1.85
Branch 3	7	8	0.25%	3.6	2.81	4.01
Branch 4	8	8	0.20%	102.8	0.13	0.13
	8	8	0.20%	91.9	0.14	0.14
	7	8	0.20%	60.3	0.15	0.21
	7	8	0.60%	31.1	0.50	0.72
Branch 4+1	7	8	1.00%	10.7	1.88	2.69
Branch 4+10	7	8	0.50%	24.9	0.57	0.82
Branch 34	8	8	0.20%	75.1	0.17	0.17
	7	8	0.75%	21.6	0.81	1.16
Branch 34+11	7	8	0.35%	49.2	0.24	0.35

Table 2. As-Constructed Drainage Coefficients

Area	ACSIC Size (in)	Repair Size (in)	ACSIC Slope (%)	Drainage Area (Acres)	ACSIC Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)
Branch 47	16	18	0.10%	211.1	0.27	0.38
	14	15	0.10%	203.1	0.20	0.24
	14	15	0.10%	167.2	0.24	0.29
	12	12	0.10%	116.3	0.23	0.23
	10	10	0.10%	88.9	0.19	0.19
	10	10	0.20%	30.4	0.77	0.77
	7	8	0.50%	26.8	0.53	0.76
Branch 47+12	7	8	1.00%	2.6	7.92	11.31
Branch 47+17	7	8	1.30%	7.2	3.19	4.55
Branch 47+23	10	10	0.10%	37.3	0.44	0.44
	8	8	0.10%	34.0	0.27	0.27
Branch 58	12	12	0.10%	97.3	0.28	0.28
	10	10	0.10%	75.4	0.22	0.22
	7	8	2.00%	32.8	0.87	1.24
	7	8	0.25%	28.8	0.35	0.50
Branch 72	12	12	0.30%	144.0	0.32	0.32
	12	12	0.10%	135.7	0.20	0.20
	10	10	0.10%	5.3	3.14	3.14
Branch 72 (1959 Repair)	10	10	0.08%	88.5	0.17	0.17
	10	10	0.08%	75.3	0.20	0.20
	8	8	0.10%	26.1	0.35	0.35
Branch 75	12	12	0.20%	145.3	0.26	0.26
	10	10	0.20%	68.2	0.34	0.34
	8	8	0.20%	58.5	0.22	0.22
	7	8	0.20%	31.0	0.29	0.42
	7	8	1.00%	23.8	0.85	1.21
Branch 75+13	8	8	0.80%	37.0	0.70	0.70
	7	8	0.25%	12.3	0.82	1.17
Branch 78	8	8	1.00%	57.7	0.50	0.50
	8	8	0.20%	34.7	0.37	0.37
	7	8	0.20%	27.3	0.33	0.47
Branch 94	8	8	0.60%	90.6	0.25	0.25
	8	8	0.15%	74.8	0.15	0.15
	7	8	0.15%	69.0	0.11	0.16
	7	8	0.70%	56.7	0.30	0.43

Table 3. Existing Drainage Coefficients Based off Televising

Area	Existing Size (in)	Repair Size (in)	Existing Slope Slope (%)	Drainage Area (Acres)	Existing Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)
Main	32	36	0.10%	1333.2	0.17	0.38
	30	30	0.10%	1291.8	0.14	0.24
	30	30	0.10%	1138.6	0.16	0.27
	30	30	0.10%	1130.9	0.16	0.27
	30	30	0.10%	1052.2	0.18	0.29
	30	30	0.10%	904.3	0.21	0.34
	28	30	0.10%	756.5	0.20	0.41
	28	30	0.10%	654.2	0.24	0.47
	26	30	0.10%	654.2	0.19	0.47
	26	30	0.12%	430.5	0.32	0.79
	20	24	0.12%	403.7	0.17	0.46
	18	18	0.12%	372.9	0.14	0.23
	18	18	0.12%	289.1	0.18	0.30
	16	18	0.12%	250.0	0.15	0.35
	14	15	0.50%	195.3	0.28	0.56
	12	12	0.50%	180.5	0.20	0.33
	12	12	0.20%	73.9	0.31	0.51
	12	12	0.20%	60.0	0.38	0.63
Branch 0	12	12	0.10%	20.6	0.78	1.31
	12	12	0.60%	20.7	1.91	3.19
	10	10	0.60%	21.9	1.11	1.85
Branch 3	7	8	0.25%	3.6	1.68	4.01
Branch 4	8	8	0.20%	102.8	0.08	0.13
	8	8	0.20%	91.9	0.08	0.14
	7	8	0.20%	60.3	0.09	0.21
	7	8	0.60%	31.1	0.30	0.72
Branch 4+1	7	8	1.00%	10.7	1.13	2.69
Branch 4+10	7	8	0.50%	24.9	0.34	0.82
Branch 34	8	8	0.20%	75.1	0.10	0.17
	7	8	0.75%	21.6	0.49	1.16
Branch 34+11	7	8	0.35%	49.2	0.15	0.35

Table 4. Existing Drainage Coefficients Based off Televising

Area	Existing Size (in)	Repair Size (in)	Existing Slope Slope (%)	Drainage Area (Acres)	Existing Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)
Branch 47	16	18	0.10%	211.1	0.16	0.38
	14	15	0.10%	203.1	0.12	0.24
	14	15	0.10%	167.2	0.15	0.29
	12	12	0.10%	116.3	0.14	0.23
	10	10	0.10%	88.9	0.11	0.19
	10	10	0.20%	30.4	0.46	0.77
	7	8	0.50%	26.8	0.32	0.76
Branch 47+12	7	8	1.00%	2.6	4.75	11.31
Branch 47+17	7	8	1.30%	7.2	1.91	4.55
Branch 47+23	10	10	0.10%	37.3	0.27	0.44
	8	8	0.10%	34.0	0.16	0.27
Branch 58	12	12	0.10%	97.3	0.17	0.28
	10	10	0.10%	75.4	0.13	0.22
	7	8	2.00%	32.8	0.52	1.24
	7	8	0.25%	28.8	0.21	0.50
Branch 72	12	12	0.30%	144.0	0.19	0.32
	12	12	0.10%	135.7	0.12	0.20
	10	10	0.10%	5.3	1.89	3.14
Branch 72 (1959 Repair)	10	10	0.08%	88.5	0.10	0.17
	10	10	0.08%	75.3	0.12	0.20
	8	8	0.10%	26.1	0.21	0.35
Branch 75	12	12	0.20%	145.3	0.16	0.26
	10	10	0.20%	68.2	0.21	0.34
	8	8	0.20%	58.5	0.13	0.22
	7	8	0.20%	31.0	0.17	0.42
	7	8	1.00%	23.8	0.51	1.21
Branch 75+13	8	8	0.80%	37.0	0.42	0.70
	7	8	0.25%	12.3	0.49	1.17
Branch 78	8	8	1.00%	57.7	0.30	0.50
	8	8	0.20%	34.7	0.22	0.37
	7	8	0.20%	27.3	0.20	0.47
Branch 94	8	8	0.60%	90.6	0.15	0.25
	8	8	0.15%	74.8	0.09	0.15
	7	8	0.15%	69.0	0.07	0.16
	7	8	0.70%	56.7	0.18	0.43

The majority of the existing tiles of CD 46 are below the standard drainage coefficient values. Televising along the mainline tile from the outlet to approximately 1,550 feet upstream of the crossing with Highway 254 was completed in June of 2020, no branches were televised. Because of this we also analyzed the outlet capacities of each branch into the main. Below show the capacities of the branch outlets given the existing conditions.

The televising revealed a majority of the mainline is experiencing restrictions due to collapsed tile, sediment accumulation, and misaligned joints. These restrictions have lowered the drainage capacity of the system and put the system on brink of failure. Figures 1-8 below show pictures from the televising report.

Figure 1. Collapsed Mainline Tile

Figure 2. Broken Mainline Tile with Soil Visible

Figure 3. Collapsed Mainline Tile

Figure 4. Cracks Along Mainline Tile

Figure 5. Roots Coming into Mainline Tile

Figure 6. Broken and Misaligned Mainline Tile

Figure 7. Roots Coming into Mainline Tile

Figure 8. Broken Mainline Tile

Proposed Conditions

It is recommended that eventually the entire system should be repaired or improved. The repaired tile would be installed following the existing tile alignments matching the existing tile slopes and elevations. Additionally, in a repair the existing tile size will be used. if the existing size is not manufactured today, it will be upsized to the next available size. Options to improve the existing system were considered along with the costs for repairing the system. All improvement options are sized to achieve at least a drainage coefficient of 0.50 in/day for underground tiles.

Repair Option 1

It is proposed in Repair Option 1 to clean the mainline open ditch, as well as repair all tiles throughout the drainage system. The proposed buried tile will follow the original alignments and slopes in this repair. The repair will consist of cleaning 600 feet of 4-foot bottom open ditch as well as 1,500 feet of 36-inch tile, 6,500- feet of 30-inch tile, 700 feet of 24-inch tile, 3,800 feet of 18-inch tile, 1,500 feet of 15-inch tile, 5,000 feet of 12-inch tile, 6,350 feet of 10-inch tile, and 16,150 feet of 8-inch tile.

Improvement Option 1

It is proposed in Improvement Option 1 to clean the mainline open ditch and protect any tiles outlets into the open ditch. Option 1 also proposes to improve the entirety of the tile system. The mainline tile and branches would be replaced with 5,100 feet of 42-inch tile, 1,700 feet of 36-inch tile, 1,100 feet of 30-inch tile, 4,400 feet of 24-inch tile, 5,400 feet of 18-inch tile, 4,050 feet of 15-inch tile, 6,800 feet of 12-inch tile, and 12,950 feet of 10-inch tile. Because of the increase in tile size and capacity, storage is recommended for this option in order to reduce peak flows at the outlet of the system. Currently we recommend a 3-acre storage pond be placed within the system. Potential locations have been identified in the attached maps and will need to be discussed with landowners. See Table 5 and Table 6 below for the proposed drainage capacity of improvement option 1.

Table 5. Proposed Drainage Coefficients Improvement Option 1

Area	ACSIC Size (in)	Repair Size (in)	Proposed Size (in)	ACSIC Slope (%)	Proposed Slope (%)	Drainage Area (Acres)	ACSIC Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)	Proposed Drainage Coefficient (in/day)
Main	32	36	42	0.10%	0.08%	1333.24	0.28	0.38	0.51
	30	30	42	0.10%	0.08%	1291.8	0.24	0.24	0.53
	30	30	42	0.10%	0.06%	1138.6	0.27	0.27	0.52
	30	30	42	0.10%	0.06%	1130.85	0.27	0.27	0.52
	30	30	42	0.10%	0.06%	1052.2	0.29	0.29	0.56
	30	30	36	0.10%	0.09%	904.26	0.34	0.34	0.53
	28	30	36	0.10%	0.06%	756.45	0.34	0.41	0.50
	28	30	30	0.10%	0.11%	654.2	0.39	0.47	0.50
	26	30	30	0.10%	0.11%	654.15	0.32	0.47	0.60
	26	30	24	0.12%	0.16%	430.45	0.54	0.79	0.50
	20	24	24	0.12%	0.14%	403.68	0.28	0.46	0.50
	18	18	24	0.12%	0.12%	372.9	0.23	0.23	0.50
	18	18	24	0.12%	0.08%	289.05	0.30	0.30	0.53
	16	18	18	0.12%	0.25%	249.97	0.25	0.35	0.50
	14	15	18	0.50%	0.16%	195.27	0.46	0.56	0.51
	12	12	18	0.50%	0.14%	180.46	0.33	0.33	0.52
	12	12	12	0.20%	0.19%	73.85	0.51	0.51	0.50
	12	12	12	0.20%	0.13%	60.01	0.63	0.63	0.51
Branch 0	12	12	10	0.10%	0.06%	20.58	1.31	1.31	0.62
	12	12	10	0.60%	0.06%	20.67	3.19	3.19	0.62
	10	10	10	0.60%	0.06%	21.89	1.85	1.85	0.59
Branch 3	7	8	10	0.25%	0.06%	3.6	2.81	4.01	3.56
Branch 4	8	8	15	0.20%	0.12%	102.75	0.13	0.13	0.52
	8	8	15	0.20%	0.09%	91.89	0.14	0.14	0.50
	7	8	12	0.20%	0.13%	60.27	0.15	0.21	0.51
	7	8	10	0.60%	0.09%	31.07	0.50	0.72	0.50
Branch 4+1	7	8	10	1.00%	0.06%	10.74	1.88	2.69	1.19
Branch 4+10	7	8	10	0.50%	0.06%	24.93	0.57	0.82	0.51
Branch 34	8	8	12	0.20%	0.20%	75.06	0.17	0.17	0.51
	7	8	10	0.75%	0.06%	21.6	0.81	1.16	0.59
Branch 34+11	7	8	10	0.35%	0.23%	49.2	0.24	0.35	0.51

Table 6. Proposed Drainage Coefficients Improvement Option 1

Area	ACSIC Size (in)	Repair Size (in)	Proposed Size (in)	ACSIC Slope (%)	Proposed Slope (%)	Drainage Area (Acres)	ACSIC Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)	Proposed Drainage Coefficient (in/day)
Branch 47	16	18	24	0.10%	0.06%	211.11	0.27	0.38	0.63
	14	15	24	0.10%	0.06%	203.05	0.20	0.24	0.65
	14	15	18	0.10%	0.12%	167.23	0.24	0.29	0.52
	12	12	18	0.10%	0.06%	116.32	0.23	0.23	0.53
	10	10	15	0.10%	0.09%	88.89	0.19	0.19	0.52
	10	10	10	0.20%	0.09%	30.42	0.77	0.77	0.52
	7	8	10	0.50%	0.07%	26.77	0.53	0.76	0.52
Branch 47+12	7	8	10	1.00%	0.06%	2.55	7.92	11.31	5.02
Branch 47+17	7	8	10	1.30%	0.06%	7.22	3.19	4.55	1.77
Branch 47+23	10	10	12	0.10%	0.06%	37.32	0.44	0.44	0.56
	8	8	12	0.10%	0.06%	34.01	0.27	0.27	0.61
Branch 58	12	12	18	0.10%	0.06%	97.31	0.28	0.28	0.63
	10	10	15	0.10%	0.06%	75.41	0.22	0.22	0.50
	7	8	10	2.00%	0.10%	32.77	0.87	1.24	0.50
	7	8	10	0.25%	0.08%	28.76	0.35	0.50	0.51
Branch 72	12	12	18	0.30%	0.09%	143.98	0.32	0.32	0.52
	12	12	18	0.10%	0.08%	135.66	0.20	0.20	0.52
	10	10	10	0.10%	0.06%	5.26	3.14	3.14	2.44
Branch 72 (1959 Repair)	10	10	15	0.08%	0.08%	88.54	0.17	0.17	0.49
	10	10	15	0.08%	0.06%	75.26	0.20	0.20	0.50
	8	8	10	0.10%	0.07%	26.08	0.35	0.35	0.53
Branch 75	12	12	18	0.20%	0.09%	145.33	0.26	0.26	0.52
	10	10	12	0.20%	0.17%	68.22	0.34	0.34	0.51
	8	8	12	0.20%	0.12%	58.5	0.22	0.22	0.50
	7	8	10	0.20%	0.09%	31.01	0.29	0.42	0.51
	7	8	10	1.00%	0.06%	23.82	0.85	1.21	0.54
Branch 75+13	8	8	10	0.80%	0.13%	36.96	0.70	0.70	0.51
	7	8	10	0.25%	0.06%	12.28	0.82	1.17	1.04
Branch 78	8	8	12	1.00%	0.12%	57.69	0.50	0.50	0.51
	8	8	10	0.20%	0.11%	34.65	0.37	0.37	0.50
	7	8	10	0.20%	0.07%	27.32	0.33	0.47	0.51
Branch 94	8	8	12	0.60%	0.28%	90.59	0.25	0.25	0.50
	8	8	12	0.15%	0.20%	74.79	0.15	0.15	0.51
	7	8	12	0.15%	0.17%	69.04	0.11	0.16	0.51
	7	8	10	0.70%	0.30%	56.69	0.30	0.43	0.51

Improvement Option 2

It is proposed in Improvement Option 2 to clean the mainline open ditch and protect any tiles that outlet into the open ditch. Option 2 proposes to improve 8,400 feet of mainline tile that is in critical shape as observed in the televising. This includes 5,100 feet of 42-inch tile, 1,700 feet of 36-inch tile, 1,100 feet of 30-inch tile, and 500 feet of 24-inch tile. This option is just an improvement to the mainline tile that was televised. Likewise, as in improvement option 1, storage is recommended for this option in order to reduce peak flows at the outlet of the system, this is assumed if the rest of the system is improved in the future. Currently we recommend a 3-acre storage pond be placed within the system. Potential locations have been identified in the attached maps and will need to be discussed with landowners. See Table 7 below for the proposed drainage capacities for improvement option 2.

Table 7. Proposed Drainage Coefficients for Improvement Option 2

Area	ACSIC Size (in)	Repair Size (in)	Proposed Size (in)	ACSIC Slope (%)	Proposed Slope (%)	Drainage Area (Acres)	ACSIC Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)	Proposed Drainage Coefficient (in/day)
Main	32	36	42	0.10%	0.08%	1333.24	0.28	0.38	0.51
	30	30	42	0.10%	0.08%	1291.8	0.24	0.24	0.53
	30	30	42	0.10%	0.06%	1138.6	0.27	0.27	0.52
	30	30	42	0.10%	0.06%	1130.85	0.27	0.27	0.52
	30	30	42	0.10%	0.06%	1052.2	0.29	0.29	0.56
	30	30	36	0.10%	0.09%	904.26	0.34	0.34	0.53
	28	30	36	0.10%	0.06%	756.45	0.34	0.41	0.50
	28	30	30	0.10%	0.11%	654.2	0.39	0.47	0.50
	26	30	30	0.10%	0.11%	654.15	0.32	0.47	0.60
	26	30	24	0.12%	0.16%	430.45	0.54	0.79	0.50
	20	24	24	0.12%	0.14%	403.68	0.28	0.46	0.50

These options are summarized on the Improvement Maps attached with this report. The repair option and improvement option described above are a sample size of what can be done to repair or improve this system. Any and all branches can be added or removed as another option to best suit the landowners involved.

Multi-Purpose Drainage Management

Multi-purpose drainage management incorporates Best Management Practices (BMPs) which utilize effective measures aimed at reducing sediment and nutrient loading, and improving water quality. These BMPs are divided into three areas: preventative measures, control measures, and treatment measures. Preventative measures that can be applied throughout the watershed include crop rotation, cover crops, residue management, and nutrient management. These measures are aimed at controlling sediment, minimizing erosion and nutrient loss, and sustaining the soils health, all without dramatically changing the current land use of the landscape.

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

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

Conservative drainage practices, such as controlled drainage systems, provide an option for improving the water quality and reduce peak flow rates within a drainage system. Through utilization of control structures, these systems are designed to allow agricultural producers to regulate water levels in their fields. The water level in the ground can be lowered during planting and harvest seasons and allowed to rise during the growing season. Water and nutrients stored in the soil during the growing season can then be used by the crops during drier periods, potentially increasing yields.

Due to increased capacities, storage will need to be considered. Considering the size of the watershed and similar projects, if a complete improvement to the system is performed, approximately 3 acres of land will need to be implemented into storage. Further investigation and modeling will need to be done to determine the exact effects of a storage area on the outlet and downstream waters. Potential storage options have been identified and are included in the attached maps and cost estimates.

Cost/Separable Maintenance

When a separable portion of a larger system is in need of repair, the drainage statute, M.S.103E.215, subd. 6, allows the separation of the cost of repair from the cost of improvement of the project. The condition of the existing system should be investigated further to discern the eligibility for separable maintenance costs. If it is determined that the system is in disrepair, separable maintenance costs can be applied to the project including the difference in costs associated between pipe/ditch replacement and pipe/ditch improvement. Separable maintenance for this system includes standard open ditch cleaning, rip rap outlet protection on all tile outlets, seeding (buffer and sideslopes), and standard tile installation.

Tables 6, 7, and 8 summarize the costs of each option respectively. Detailed cost estimates are attached.

Table 8. Repair Option 1 Cost estimate

PROPOSED REPAIR OPTION 1 COST SUMMARY

Area	Repair Cost	
Mainline Open Ditch	$	16,423
Mainline Tile	$	763,327
Branch 0	$	80,333
Branch 3	$	11,659
Branch 4	$	67,385
Branch 4+1	$	9,562
Branch 4+10	$	38,642
Branch 34	$	69,564
Branch 34+11	$	22,256
Branch 47	$	153,986
Branch 47+12	$	14,431
Branch 47+17	$	19,047
Branch 47+23	$	33,931
Branch 58	$	98,248
Branch 72	$	48,820
Branch 72 (1959)	$	75,573
Branch 75	$	112,085
Branch 75+13	$	37,783
Branch 78	$	78,451
Branch 94	$	64,335
Subtotal without Road Crossings	**$**	**1,815,844**
Road Authority Cost	$	263,785
Damages Paid To Road Authority	$	24,673
Total Cost	**$**	**2,104,302**
Subtotal Landowner Cost	$	1,840,517
Total Project Costs for Landowners	**$**	**1,840,517**

Table 9. Proposed Improvement 1 Cost Estimate

PROPOSED IMPROVEMENT OPTION 1 COST SUMMARY

Area	Separable Maintenance	Improvement Cost	Net Cost
Mainline Open Ditch	$ 16,423	$ 16,423	$ -
Mainline Tile	$ 763,327	$ 1,009,451	$ 246,123
Branch 0	$ 80,333	$ 79,928	$ (405)
Branch 3	$ 11,659	$ 12,237	$ 578
Branch 4	$ 67,385	$ 79,176	$ 11,791
Branch 4+1	$ 9,562	$ 9,793	$ 231
Branch 4+10	$ 38,642	$ 42,131	$ 3,489
Branch 34	$ 69,564	$ 78,016	$ 8,452
Branch 34+11	$ 22,256	$ 24,091	$ 1,835
Branch 47	$ 153,986	$ 192,391	$ 38,405
Branch 47+12	$ 14,431	$ 15,331	$ 900
Branch 47+17	$ 19,047	$ 20,463	$ 1,416
Branch 47+23	$ 33,931	$ 37,102	$ 3,171
Branch 58	$ 98,248	$ 113,333	$ 15,085
Branch 72	$ 48,820	$ 55,594	$ 6,774
Branch 72 (1959)	$ 75,573	$ 84,908	$ 9,335
Branch 75	$ 112,085	$ 128,805	$ 16,720
Branch 75+13	$ 37,783	$ 41,542	$ 3,759
Branch 78	$ 78,451	$ 87,523	$ 9,072
Branch 94	$ 64,335	$ 73,029	$ 8,694
Storage Pond (3 AC)	$ -	$ 377,961	$ 377,961
Subtotal without Road Crossings	**$ 1,815,844**	**$ 2,579,231**	**$ 763,386**
Road Authority Cost	$ 263,785	$ 263,785	$ -
Damages Paid To Road Authority	$ 24,673	$ 83,709	$ 59,036.32
Total	$ 2,104,302	$ 2,926,725	$ 822,423
		Subtotal Landowner Costs	$ 2,662,940
		Net Costs	$ 822,423
		Total Project Costs for Landowners	**$ 2,662,940**

Table 10. Improvement Option 2 Cost Estimate

PROPOSED IMPROVEMENT OPTION 2 COST SUMMARY

Area	Separable Maintenance	Improvement Cost	Net Cost
Mainline Open Ditch	$ 15,933	$ 16,423	$ 490
Mainline Tile	$ 581,792	$ 791,675	$ 209,882
Storage Pond (3 AC)	$ -	$ 377,961	$ 377,961
Subtotal without Road Crossings	**$ 597,726**	**$ 1,186,059**	**$ 588,333**
Road Authority Cost	$ 118,262	$ 118,262	$ -
Damages Paid To Road Authority	$ 6,002	$ 6,002	$ -
Total	$ 721,989	$ 1,310,322	$ 588,333
		Subtotal Landowner Costs	$ 1,192,061
		Net Costs	$ 588,333
		Total Project Costs for Landowners	**$ 1,192,061**

Recommendation

Currently, the ACSIC tile system has a lower capacity than the industry standard. Upgrading the tile system would increase the capacity of the system to a drainage coefficient over 0.50 in/day for buried tile. The system is approximately 100-years old and in poor to failing condition, which is beyond the life expectancy for ditch systems like CD 46. These improvements would be a public benefit and contribute to the public welfare of this area.

Given the current condition of the system discovered while televising, it is recommending that actions to repair or improve the system be considered immediately. Drainage tile projects take between 1 and 4 years to complete the statutory processes and construct.

At a minimum, repairs to the entire mainline should be completed. This will repair the majority of the mainline to a capacity between a 1/4 and 3/8 inch/day drainage coefficient and will reinstall tiles to the same depth which only provides 3-4 feet of cover on top of the tile in the shallowest points. While this is still below today's industry standard a repair with these capacities could provide enough drainage to prevent flooding longer than 48 hours for the majority of the drainage system. Further modeling would be required to analyze the repair hydraulics.

Improvement Option 2 is recommended to replace the failing existing system, upsize the drainage system to a 0.50 inch/day drainage coefficient, and gain depth of the buried tile. Storage will likely be required with any improvement option to offset peak flow rates and improve water quality entering into the Blue Earth River.

Since the branches of the system were installed at the same time as the main, it's likely they are experiencing the same reduction in capacities due to the condition of the existing tile. Option 1 should be reviewed and considered by landowners throughout the system and review costs and capacities of each branch to be improved. Since the existing capacities of several of the branches do provide a 0.50 inch/day drainage coefficient, separable maintenance could be used to make the repair or improvement very cost effective.

It is recommended to provide this information with landowners throughout the CD 46 drainage system and discuss potential options at an informational meeting.

Sincerely,

Mark Origer, PE

Civil Engineer

Enclosures

FARIBAULT COUNTY
COUNTY DITCH No. 46

PROPOSED IMPROVEMENT OPTION 1 COST SUMMARY

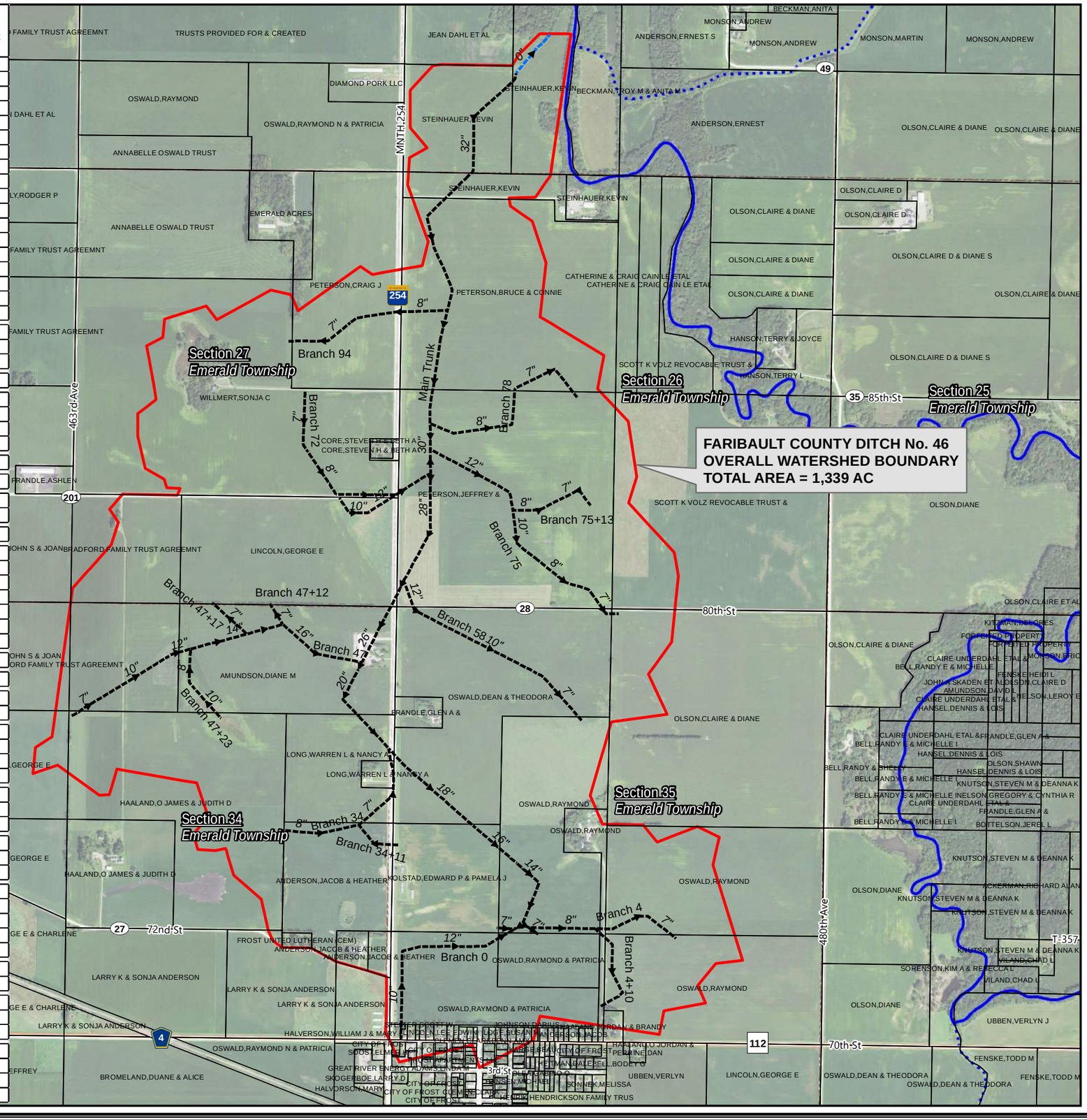
Area	Separable Maintenance	Improvement Cost	Net Cost
Mainline Open Ditch	$ 16,423	$ 16,423	$ -
Mainline Tile	$ 763,327	$ 1,009,451	$ 246,123
Branch 0	$ 80,333	$ 79,928	$ (405)
Branch 3	$ 11,659	$ 12,237	$ 578
Branch 4	$ 67,385	$ 79,176	$ 11,791
Branch 4+1	$ 9,562	$ 9,793	$ 231
Branch 4+10	$ 38,642	$ 42,131	$ 3,489
Branch 34	$ 69,564	$ 78,016	$ 8,452
Branch 34+11	$ 22,256	$ 24,091	$ 1,835
Branch 47	$ 153,986	$ 192,391	$ 38,405
Branch 47+12	$ 14,431	$ 15,331	$ 900
Branch 47+17	$ 19,047	$ 20,463	$ 1,416
Branch 47+23	$ 33,931	$ 37,102	$ 3,171
Branch 58	$ 98,248	$ 113,333	$ 15,085
Branch 72	$ 48,820	$ 55,594	$ 6,774
Branch 72 (1959)	$ 75,573	$ 84,908	$ 9,335
Branch 75	$ 112,085	$ 128,805	$ 16,720
Branch 75+13	$ 37,783	$ 41,542	$ 3,759
Branch 78	$ 78,451	$ 87,523	$ 9,072
Branch 94	$ 64,335	$ 73,029	$ 8,694
Storage Pond (3 AC)	$ -	$ 377,961	$ 377,961
Subtotal without Road Crossings	**$ 1,815,844**	**$ 2,579,231**	**$ 763,386**
Road Authority Cost	$ 263,785	$ 263,785	$ -
Damages Paid To Road Authority	$ 24,673	$ 83,709	$ 59,036
Total	$ 2,104,302	$ 2,926,725	$ 822,423
		Subtotal Landowner Costs	$ 2,662,940
		Net Costs	$ 822,423
		Total Project Costs for Landowners	**$ 2,662,940**

FARIBAULT COUNTY
COUNTY DITCH No. 46

PROPOSED IMPROVEMENT OPTION 2 COST SUMMARY

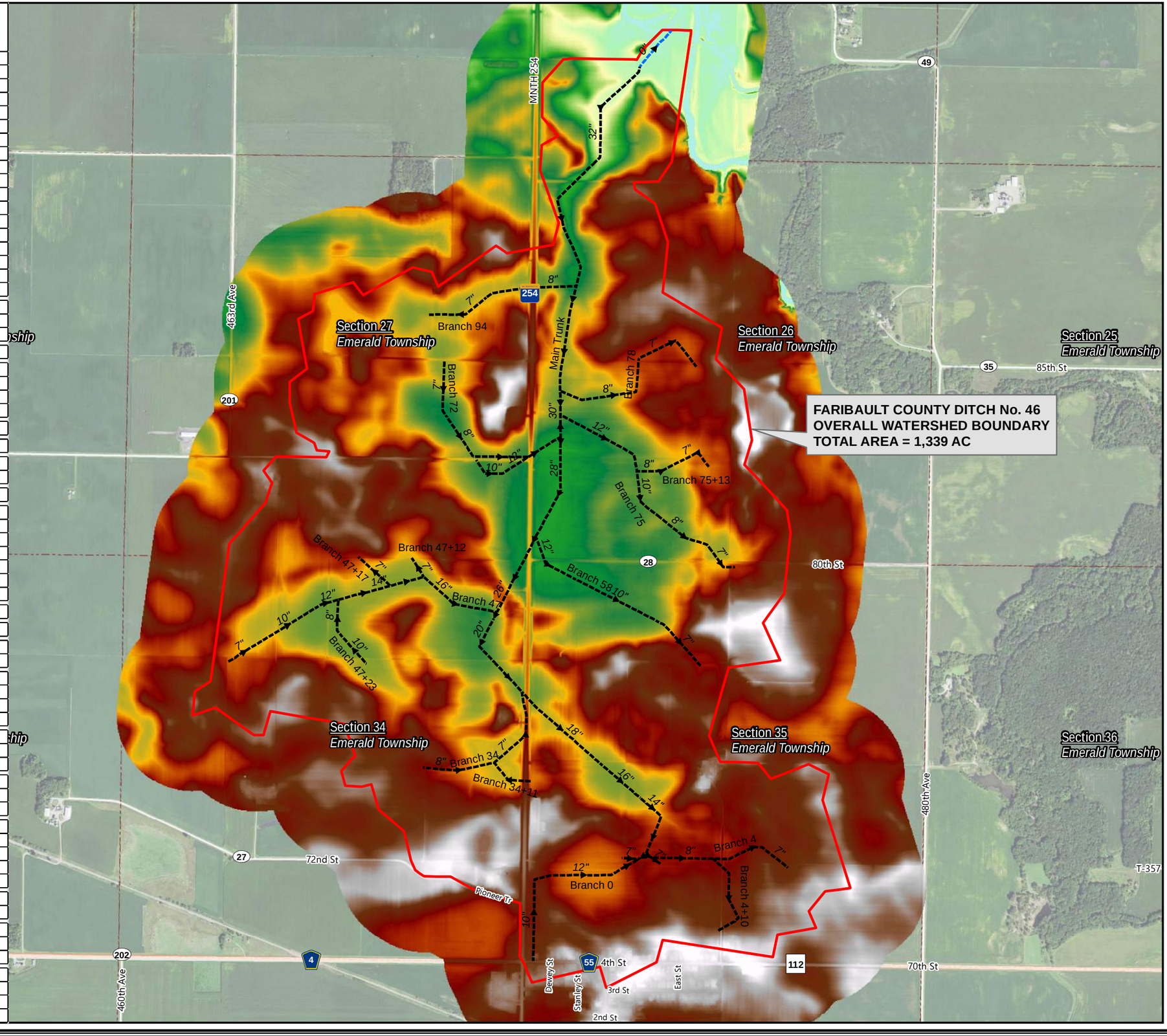
Area	Separable Maintenance	Improvement Cost	Net Cost
Mainline Open Ditch	$ 15,933	$ 16,423	$ 490
Mainline Tile	$ 581,792	$ 791,675	$ 209,882
Storage Pond (3 AC)	$ -	$ 377,961	$ 377,961
Subtotal without Road Crossings	**$ 597,726**	**$ 1,186,059**	**$ 588,333**
Road Authority Cost	$ 118,262	$ 118,262	$ -
Damages Paid To Road Authority	$ 6,002	$ 6,002	$ -
Total	$ 721,989	$ 1,310,322	$ 588,333
		Subtotal Landowner Costs	$ 1,192,061
		Net Costs	$ 588,333
		Total Project Costs for Landowners	**$ 1,192,061**

Area	ACSIC Size (in)	Repair Size (in)	ACSIC Slope (%)	Drainage Area (Acres)	ACSIC Drainage Coefficient (in/day)	Existing Drainage Coefficient (in/day)	Repair Drainage Coefficient (in/day)
Main	32	36	0.10%	1333.2	0.28	0.17	0.38
	30	30	0.10%	1291.8	0.24	0.14	0.24
	30	30	0.10%	1138.6	0.27	0.16	0.27
	30	30	0.10%	1130.9	0.27	0.16	0.27
	30	30	0.10%	1052.2	0.29	0.18	0.29
	30	30	0.10%	904.3	0.34	0.21	0.34
	28	30	0.10%	756.5	0.34	0.20	0.41
	28	30	0.10%	654.2	0.39	0.24	0.47
	26	30	0.10%	654.2	0.32	0.19	0.47
	26	30	0.12%	430.5	0.54	0.32	0.79
	20	24	0.12%	403.7	0.28	0.17	0.46
	18	18	0.12%	372.9	0.23	0.14	0.23
	18	18	0.12%	289.1	0.30	0.18	0.30
	16	18	0.12%	250.0	0.25	0.15	0.35
	14	15	0.50%	195.3	0.46	0.28	0.56
	12	12	0.50%	180.5	0.33	0.20	0.33
	12	12	0.20%	73.9	0.51	0.31	0.51
	12	12	0.20%	60.0	0.63	0.38	0.63
Branch 0	12	12	0.10%	20.6	1.31	0.78	1.31
	12	12	0.60%	20.7	3.19	1.91	3.19
	10	10	0.60%	21.9	1.85	1.11	1.85
Branch 3	7	8	0.25%	3.6	2.81	1.68	4.01
Branch 4	8	8	0.20%	102.8	0.13	0.08	0.13
	8	8	0.20%	91.9	0.14	0.08	0.14
	7	8	0.20%	60.3	0.15	0.09	0.21
	7	8	0.60%	31.1	0.50	0.30	0.72
Branch 4+1	7	8	1.00%	10.7	1.88	1.13	2.69
Branch 4+10	7	8	0.50%	24.9	0.57	0.34	0.82
Branch 34	8	8	0.20%	75.1	0.17	0.10	0.17
	7	8	0.75%	21.6	0.81	0.49	1.16
Branch 34+11	7	8	0.35%	49.2	0.24	0.15	0.35
Branch 47	16	18	0.10%	211.1	0.27	0.16	0.38
	14	15	0.10%	203.1	0.20	0.12	0.24
	14	15	0.10%	167.2	0.24	0.15	0.29
	12	12	0.10%	116.3	0.23	0.14	0.23
	10	10	0.10%	88.9	0.19	0.11	0.19
	10	10	0.20%	30.4	0.77	0.46	0.77
	7	8	0.50%	26.8	0.53	0.32	0.76
Branch 47+12	7	8	1.00%	2.6	7.92	4.75	11.31
Branch 47+17	7	8	1.30%	7.2	3.19	1.91	4.55
Branch 47+23	10	10	0.10%	37.3	0.44	0.27	0.44
	8	8	0.10%	34.0	0.27	0.16	0.27
Branch 58	12	12	0.10%	97.3	0.28	0.17	0.28
	10	10	0.10%	75.4	0.22	0.13	0.22
	7	8	2.00%	32.8	0.87	0.52	1.24
	7	8	0.25%	28.8	0.35	0.21	0.50
Branch 72	12	12	0.30%	144.0	0.32	0.19	0.32
	12	12	0.10%	135.7	0.20	0.12	0.20
	10	10	0.10%	5.3	3.14	1.89	3.14
Branch 72 (1959 Repair)	10	10	0.08%	88.5	0.17	0.10	0.17
	10	10	0.08%	75.3	0.20	0.12	0.20
	8	8	0.10%	26.1	0.35	0.21	0.35
Branch 75	12	12	0.20%	145.3	0.26	0.16	0.26
	10	10	0.20%	68.2	0.34	0.21	0.34
	8	8	0.20%	58.5	0.22	0.13	0.22
	7	8	0.20%	31.0	0.29	0.17	0.42
	7	8	1.00%	23.8	0.85	0.51	1.21
Branch 75+13	8	8	0.80%	37.0	0.70	0.42	0.70
	7	8	0.25%	12.3	0.82	0.49	1.17
Branch 78	8	8	1.00%	57.7	0.50	0.30	0.50
	8	8	0.20%	34.7	0.37	0.22	0.37
	7	8	0.20%	27.3	0.33	0.20	0.47
Branch 94	8	8	0.60%	90.6	0.25	0.15	0.25
	8	8	0.15%	74.8	0.15	0.09	0.15
	7	8	0.15%	69.0	0.11	0.07	0.16
	7	8	0.70%	56.7	0.30	0.18	0.43



Existing Watershed Map
County Ditch No 46
Faribault County, Minnesota
Tuesday, December 1, 2020

Area	ACSIC Size (in)	ACSIC Slope (%)	Drainage Area (Acres)	ACSIC Drainage Coefficient (in/day)
Main	32	0.10%	1333.2	0.28
	30	0.10%	1291.8	0.24
	30	0.10%	1138.6	0.27
	30	0.10%	1130.9	0.27
	30	0.10%	1052.2	0.29
	30	0.10%	904.3	0.34
	28	0.10%	756.5	0.34
	28	0.10%	654.2	0.39
	26	0.10%	654.2	0.32
	26	0.12%	430.5	0.54
	20	0.12%	403.7	0.28
	18	0.12%	372.9	0.23
	18	0.12%	289.1	0.30
	16	0.12%	250.0	0.25
	14	0.50%	195.3	0.46
	12	0.50%	180.5	0.33
	12	0.20%	73.9	0.51
	12	0.20%	60.0	0.63
Branch 0	12	0.10%	20.6	1.31
	12	0.60%	20.7	3.19
	10	0.60%	21.9	1.85
Branch 3	7	0.25%	3.6	2.81
Branch 4	8	0.20%	102.8	0.13
	8	0.20%	91.9	0.14
	7	0.20%	60.3	0.15
	7	0.60%	31.1	0.50
Branch 4+1	7	1.00%	10.7	1.88
Branch 4+10	7	0.50%	24.9	0.57
Branch 34	8	0.20%	75.1	0.17
	7	0.75%	21.6	0.81
Branch 34+11	7	0.35%	49.2	0.24
Branch 47	16	0.10%	211.1	0.27
	14	0.10%	203.1	0.20
	14	0.10%	167.2	0.24
	12	0.10%	116.3	0.23
	10	0.10%	88.9	0.19
	10	0.20%	30.4	0.77
	7	0.50%	26.8	0.53
Branch 47+12	7	1.00%	2.6	7.92
Branch 47+17	7	1.30%	7.2	3.19
Branch 47+23	10	0.10%	37.3	0.44
	8	0.10%	34.0	0.27
Branch 58	12	0.10%	97.3	0.28
	10	0.10%	75.4	0.22
	7	2.00%	32.8	0.87
	7	0.25%	28.8	0.35
Branch 72	12	0.30%	144.0	0.32
	12	0.10%	135.7	0.20
	10	0.10%	5.3	3.14
Branch 72 (1959)	10	0.08%	88.5	0.17
	10	0.08%	75.3	0.20
	8	0.10%	26.1	0.35
Branch 75	12	0.20%	145.3	0.26
	10	0.20%	68.2	0.34
	8	0.20%	58.5	0.22
	7	0.20%	31.0	0.29
	7	1.00%	23.8	0.85
Branch 75+13	8	0.80%	37.0	0.70
	7	0.25%	12.3	0.82
Branch 78	8	1.00%	57.7	0.50
	8	0.20%	34.7	0.37
	7	0.20%	27.3	0.33
Branch 94	8	0.60%	90.6	0.25
	8	0.15%	74.8	0.15
	7	0.15%	69.0	0.11
	7	0.70%	56.7	0.30



ISG

Existing Elevation Map

County Ditch No 46

Faribault County, Minnesota

Monday, November 30, 2020

Legend

CD 46 Drainage

- Existing Open Ditch
- Existing Tile
- CD 46 Watershed

Elevation (ft)

Value

- High : 1217.11
- Low : 1160.13

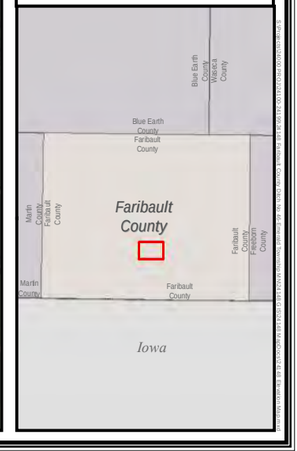
PN: 20-24148

Source:

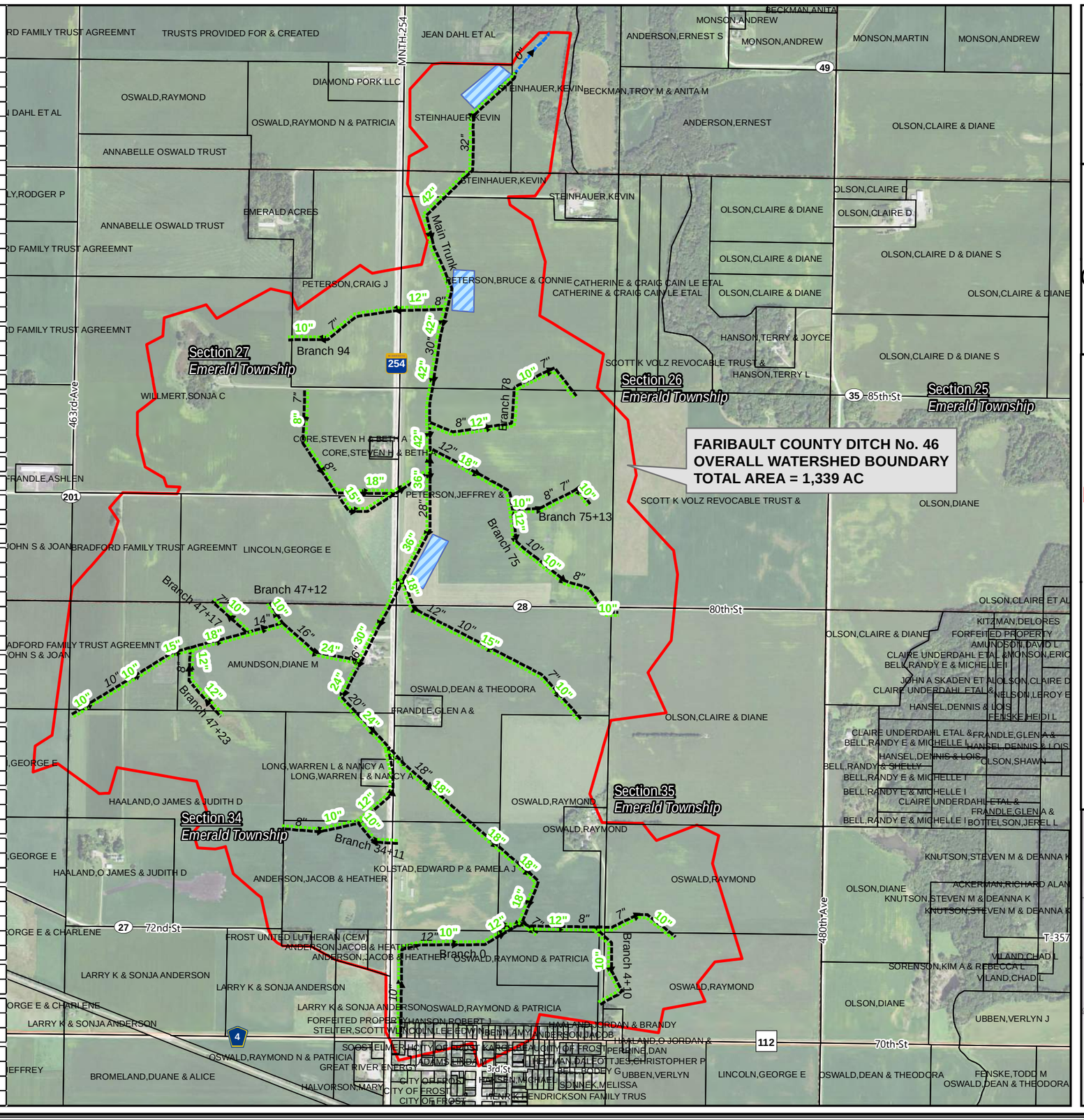
Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Faribault County, 12/16/2016)
Parcels (Faribault County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 325 650 1,300 Feet



Area	Repair Size (in)	Proposed Size (in)	ACSIC Slope (%)	Proposed Slope (%)	Drainage Area (Acres)	Repair Drainage Coefficient (in/day)	Proposed Drainage Coefficient (in/day)
Main	36	42	0.10%	0.08%	1333.24	0.38	0.51
	30	42	0.10%	0.08%	1291.8	0.24	0.53
	30	42	0.10%	0.06%	1138.6	0.27	0.52
	30	42	0.10%	0.06%	1130.85	0.27	0.52
	30	42	0.10%	0.06%	1052.2	0.29	0.56
	30	36	0.10%	0.09%	904.26	0.34	0.53
	30	36	0.10%	0.06%	756.45	0.41	0.50
	30	30	0.10%	0.11%	654.2	0.47	0.50
	30	30	0.10%	0.11%	654.15	0.47	0.60
	30	24	0.12%	0.16%	430.45	0.79	0.50
	24	24	0.12%	0.14%	403.68	0.46	0.50
	18	24	0.12%	0.12%	372.9	0.23	0.50
	18	24	0.12%	0.08%	289.05	0.30	0.53
	18	18	0.12%	0.25%	249.97	0.35	0.50
	15	18	0.50%	0.16%	195.27	0.56	0.51
	12	18	0.50%	0.14%	180.46	0.33	0.52
	12	12	0.20%	0.19%	73.85	0.51	0.50
	12	12	0.20%	0.13%	60.01	0.63	0.51
Branch 0	12	10	0.10%	0.06%	20.58	1.31	0.62
	12	10	0.60%	0.06%	20.67	3.19	0.62
	10	10	0.60%	0.06%	21.89	1.85	0.59
Branch 3	8	10	0.25%	0.06%	3.6	4.01	3.56
Branch 4	8	15	0.20%	0.12%	102.75	0.13	0.52
	8	15	0.20%	0.09%	91.89	0.14	0.50
	8	12	0.20%	0.13%	60.27	0.21	0.51
	8	10	0.60%	0.09%	31.07	0.72	0.50
Branch 4+1	8	10	1.00%	0.06%	10.74	2.69	1.19
Branch 4+10	8	10	0.50%	0.06%	24.93	0.82	0.51
Branch 34	8	12	0.20%	0.20%	75.06	0.17	0.51
	8	10	0.75%	0.06%	21.6	1.16	0.59
Branch 34+11	8	10	0.35%	0.23%	49.2	0.35	0.51
Branch 47	18	24	0.10%	0.06%	211.11	0.38	0.63
	15	24	0.10%	0.06%	203.05	0.24	0.65
	15	18	0.10%	0.12%	167.23	0.29	0.52
	12	18	0.10%	0.06%	116.32	0.23	0.53
	10	15	0.10%	0.09%	88.89	0.19	0.52
	10	10	0.20%	0.09%	30.42	0.77	0.52
	8	10	0.50%	0.07%	26.77	0.76	0.52
Branch 47+12	8	10	1.00%	0.06%	2.55	11.31	5.02
Branch 47+17	8	10	1.30%	0.06%	7.22	4.55	1.77
Branch 47+23	10	12	0.10%	0.06%	37.32	0.44	0.56
	8	12	0.10%	0.06%	34.01	0.27	0.61
Branch 58	12	18	0.10%	0.06%	97.31	0.28	0.63
	10	15	0.10%	0.06%	75.41	0.22	0.50
	8	10	2.00%	0.10%	32.77	1.24	0.50
	8	10	0.25%	0.08%	28.76	0.50	0.51
Branch 72	12	18	0.30%	0.09%	143.98	0.32	0.52
	12	18	0.10%	0.08%	135.66	0.20	0.52
	10	10	0.10%	0.06%	5.26	3.14	2.44
Branch 72 (1959 Repair)	10	15	0.08%	0.08%	88.54	0.17	0.49
	10	15	0.08%	0.06%	75.26	0.20	0.50
	8	10	0.10%	0.07%	26.08	0.35	0.53
Branch 75	12	18	0.20%	0.09%	145.33	0.26	0.52
	10	12	0.20%	0.17%	68.22	0.34	0.51
	8	12	0.20%	0.12%	58.5	0.22	0.50
	8	10	0.20%	0.09%	31.01	0.42	0.51
	8	10	1.00%	0.06%	23.82	1.21	0.54
Branch 75+13	8	10	0.80%	0.13%	36.96	0.70	0.51
	8	10	0.25%	0.06%	12.28	1.17	1.04
Branch 78	8	12	1.00%	0.12%	57.69	0.50	0.51
	8	10	0.20%	0.11%	34.65	0.37	0.50
	8	10	0.20%	0.07%	27.32	0.47	0.51
Branch 94	8	12	0.60%	0.28%	90.59	0.25	0.50
	8	12	0.15%	0.20%	74.79	0.15	0.51
	8	12	0.15%	0.17%	69.04	0.16	0.51
	8	10	0.70%	0.30%	56.69	0.43	0.51



Proposed Improvement Option 1 Map

County Ditch No 46

Faribault County, Minnesota

Tuesday, December 1, 2020

Legend

- Proposed Opt #1 Tile
- **CD 46 Drainage**
- Existing Open Ditch
- Existing Tile
- Parcels
- CD 46 Watershed
- Potential Storage

PN: 20-24148

Source:

Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Faribault County, 12/16/2016)
Parcels (Faribault County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 320 640 1,280 Feet

Area	Repair Size (in)	Proposed Size (in)	ACSIC Slope (%)	Proposed Slope (%)	Drainage Area (Acres)	Repair Drainage Coefficient (in/day)	Proposed Drainage Coefficient (in/day)
Main	36	42	0.10%	0.08%	1333.24	0.38	0.51
	30	42	0.10%	0.08%	1291.8	0.24	0.53
	30	42	0.10%	0.06%	1138.6	0.27	0.52
	30	42	0.10%	0.06%	1130.85	0.27	0.52
	30	42	0.10%	0.06%	1052.2	0.29	0.56
	30	36	0.10%	0.09%	904.26	0.34	0.53
	30	36	0.10%	0.06%	756.45	0.41	0.50
	30	30	0.10%	0.11%	654.2	0.47	0.50
	30	30	0.10%	0.11%	654.15	0.47	0.60
	30	24	0.12%	0.16%	430.45	0.79	0.50
	24	24	0.12%	0.14%	403.68	0.46	0.50
	18	24	0.12%	0.12%	372.9	0.23	0.50
	18	24	0.12%	0.08%	289.05	0.30	0.53

Proposed Improvement Option 2 Map

County Ditch No 46

Faribault County, Minnesota

Tuesday, December 1, 2020

Legend

- Proposed Opt #2 Tile
- **CD 46 Drainage**
- Existing Open Ditch
- Existing Tile
- Parcels
- CD 46 Watershed
- Potential Storage

FARIBAULT COUNTY DITCH No. 46
OVERALL WATERSHED BOUNDARY
TOTAL AREA = 1,339 AC

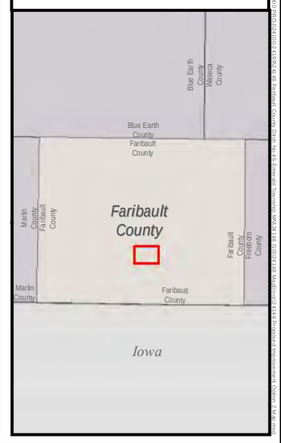
PN: 20-24148

Source:

Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Faribault County, 12/16/2016)
Parcels (Faribault County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 320 640 1,280 Feet



FARIBAULT COUNTY DITCH No. 46
OVERALL WATERSHED BOUNDARY
TOTAL AREA = 1,339 AC

MNTH 254
463rd Ave
460th Ave
480th Ave
90th St
85th St
80th St
72nd St
70th St
4th St
3rd St
Pioneer Tr
Dewey St
Stanley St
East St
T-357

Section 28
Emerald Township

Section 27
Emerald Township

Section 26
Emerald Township

Section 25
Emerald Township

Section 33
Emerald Township

Section 34
Emerald Township

Section 35
Emerald Township

Section 36
Emerald Township

Faribault County

37 49 254 201 36 35 28 27 357 202 4 55 112

Multi-Purpose Drainage Management Map

County Ditch No 46

Faribault County, Minnesota

Monday, November 30, 2020

Legend

- Watershed
- Potential Wetland Restorations
- Potential Storage
- Existing Open Ditch
- Existing Tile
- Grassed Waterways
- Controlled Drainage

PN: 20-24148

Source:

Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Faribault County, 12/16/2016)
Parcels (Faribault County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 320 640 1,280 Feet