Demonstration of the Rapid Assessment Tool:

Analysis of Canal Conditions

in Hidalgo County Irrigation District No. 1[1]

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A Report Prepared by:

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Summary

This report covers the ***canal condition evaluation*** component of RAT (Rapid Assessment Tool) as applied to Hidalgo County Irrigation District No. 1 (HCID1). This RAT component evaluates the overall condition of canals and specific conditions which indicate seepage and structural problems.

The Rapid Assessment Tool, currently under development, is a combination of surveys, data collection, mapping and limited direct measurement designed to provide a quick and cost-effective analysis of the conditions of the water distribution networks of irrigation districts.

In this study, 38 canal segments were evaluated in the portion of HCID1 shown in Figure 1 and Chart 1. Of the 38 segments, 18 segments were rated in ***fair condition***, and 15 segments were rated in ***poor condition*** or ***having serious problems***.

We also found that 9 canals had severe infestations of aquatic vegetation based on the percentage of water surface area covered by the plants. This report contains 8 figures, 9 charts, and 11 tables which provide details on the rating procedures and results.

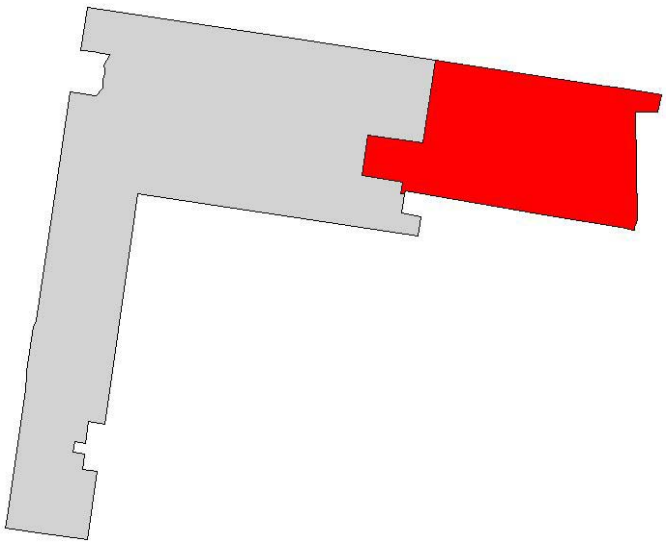

Figure 1. Hidalgo County Irrigation District No. 1. Canals were rated in the portion of the district highlighted in red.

Rapid Assessment Tool (RAT)

RAT is a combination of methodologies designed to provide a quick and cost-effective analysis of conditions within an irrigation district. The main objective is to define the extent and seriousness of problems contributing to poor conveyance efficiency and low on-farm water use efficiency.

RAT methodologies include surveys, rating of infrastructure, flow measurement, seepage loss tests, and GIS-based mapping and analysis, among other activities. These methodologies are still evolving. Two visual rating procedures have been developed:

- water supply conditions ("head conditions")
- canal conditions

The results of this study on canal conditions (and the one completed recently on water supply conditions in the Harlingen Irrigation District) will be used in the design of the next version of RAT. The overall goal of this effort is to provide information which will allow decision makers involved in irrigation resource management to assess and compare the rehabilitation needs of irrigation networks.

Canal Condition Evaluation

The ***Canal Condition Evaluation*** component of RAT includes visual rating methodologies on:

- the general condition of the canal
- conditions which indicate seepage or structural problems

Seven (7) factors are used in this procedure which may be grouped as follows:

- general condition
- presence of cracks (hairline, pencil-size, and large)
- amount of patchwork
- vegetation in canal and along embankment

RAT uses a two level-level approach to rate the canals as illustrated in Figure 2.

Level 1 factors (*General Condition*) indicate broadly whether cracks and vegetation exist.

Level 2 factors define both the coverage and intensity of the cracks and vegetation.

Tables 1 - 7 provide details on the 7 rating factors and definition of numerical values used. Figures 2 - 8 contain photographs which illustrate some of the rating criterion.

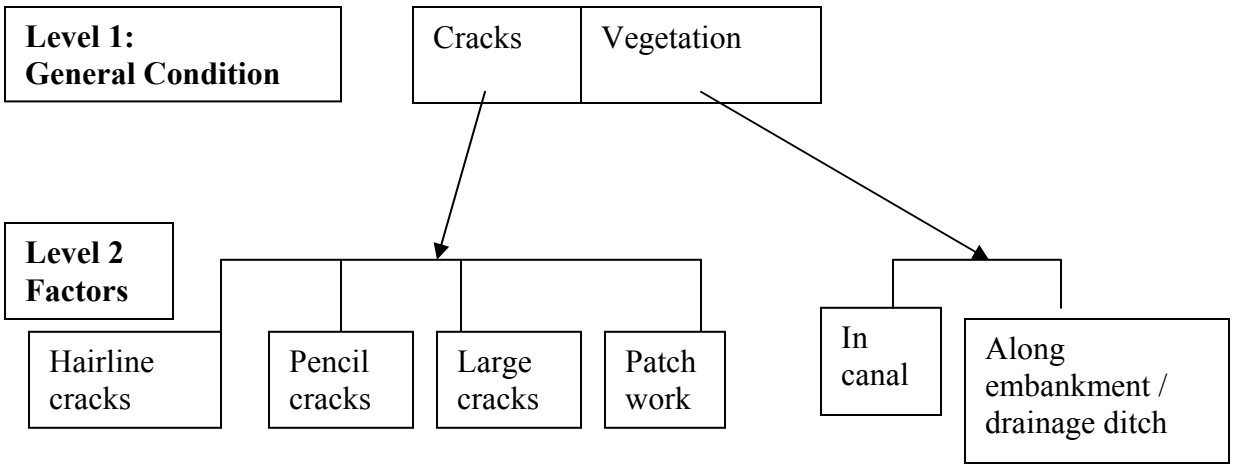

Figure 2. Two-level canal rating methodology.

Table 1. (A) General Condition	
rating	**definition**
1	Excellent – no visible cracks or vegetation
2	Good – having cracks greater than 10 ft and some weeds
3	Fair – cracks 5-10 ft apart, with moderate vegetation in canal and drainage ditch
4	Poor – cracks 3-5 ft apart, with dense vegetation in canal and drainage ditch
5	Serious Problems – visible large cracks less than 3 ft apart with lush vegetation

Table 2. (B) Hairline Cracks	
rating	**definition**
1	None to Sparse
2	Greater than 10 ft apart
3	5 – 10 ft apart
4	3 – 5 ft apart
5	Less than 3 ft apart

Table 3. (C) Pencil-size Cracks	
rating	**definition**
1	Sparse
2	Greater than 10 ft apart
3	5 – 10 ft apart
4	3 – 5 ft apart
5	Less than 3 ft apart

Table 4. (D) Large Cracks	
rating	**definition**
1	None to Sparse
2	Greater than 10 ft apart
3	5 – 10 ft apart
4	3 – 5 ft apart
5	Less than 3 ft apart

Table 5. (E) Noticeable amounts of maintenance & repair (patchwork)	
rating	**definition**
1	None to Sparse
2	A few areas
3	Sparse
4	Moderate
5	Severe

Table 6. (F) Vegetation growing in canal lining	
rating	**definition**
0	None
1	Sparse
2	Moderate
3	Dense

Table 7. (G) Vegetation in drainage ditch and along the outer embankment of the levee	
rating	**definition**
1	Normal; rain-fed weeds only
2	Canal fed grass or small weeds only
3	Moderate; bushes & some small to no trees with no water near levee or drain
4	Dense; more bushes & larger trees, little or no standing water, little or no aquatic vegetation
5	Dense and lush; bushes, trees, lots of aquatic vegetation with standing water

Figure 3. Example of large cracks (D), 5 to 10 feet apart.

Figure 4. Example of pencil-sized cracks (C), 3 to 5 feet apart.

Figure 5. The white marks on the right side of this canal highlight pencil-size cracks (C) spaced over 10 feet apart.

Figure 6. This canal has severe shifting of side walls, with pencil-size cracks (C) less than 5 feet apart.

Figure 7. This photograph shows hair-line cracks (B), less than 3 feet apart.

Figure 8. This canal has major damage to the right side wall and a large crack (D) which will eventually result in the wall falling into the canal.

Results and Analysis

Thirty-eight canal segments (totally about 18.2 miles of canal) were rated. Table 8 shows the general condition rating (criteria "A") of the 38 segments, along with some basic attribute data. Thirty-three (33) of the segments were rated as being in fair, poor or as having serious problems, as follows:

- **fair** - 18 segments (*general condition* rating of 3)
- **poor** - 11 segments (*general condition* rating of 4)
- **serous problems** - 4 segments (*general condition* rating of 5)

Table 9 gives the rating results for 5 of the factors, and Table 10 reports the vegetation rating results and estimated aquatic weed coverage.

Table 11 shows three possible combinations of rating criterion. This is the first step in our analysis to determine which factors are important in prediction of seepage loss rates. Work in progress includes various statistical tests to determine the relationship between rating and measured loss rate test results.

Table 8. General condition rating of 38 canal segments and basic attribute information.

Segment	Top Width (ft)	Length (ft)	General Condition (A)
1	7.00	1106.41	3
2	7.00	2595.31	3
3	7.00	5146.92	3
4	19.00	1647.79	5
5	19.00	2985.99	5
6	5.50	5215.24	3
7		2743.08	3
8	4.00	2561.71	4
9	4.50	3842.23	3
10	12.00	2668.12	3
11		3394.72	3
12	10.00	1270.37	2
13	4.00	4264.69	3
14	3.00	1387.75	2
15	3.50	1282.64	2
16	2.50	1289.15	2
17		3815.59	2
18		5144.47	3
19		5319.92	3
20		1364.23	3
21		1276.36	3
22		1700.34	4
23		2574.58	3
24		4471.03	3
25	2.50	1908.82	3
26		1449.17	3
27	5.00	1957.55	4
28	3.25	1918.42	5
29	3.17	1792.89	4
30		1458.27	4
31	3.50	985.75	4
32	3.50	982.81	5
33	8.33	2354.27	4
34	8.33	1719.67	4
35	7.00	2538.32	3
36	6.00	3312.12	4
37	6.33	2649.91	4
38	6.00	1794.56	4
	Total	95891.13	

Table 9. Rating results for 5 of the criterion used as defined in Tables 1-7.

Section #	General Condition (A)	Hairline Cracks (B)	Pencil Size Cracks (C)	Large Cracks (D)	Patchwork (E)
1	3	3	2	1	3
2	3	2	3	1	2
3	3	1	1	0	2
4	5	3	3	2	4
5	5	3	3	2	4
6	3	2	2	1	4
7	3	3	2	2	4
8	4	3	2	2	4
9	3	1	1	2	4
10	3	1	1	2	4
11	3	3	1	2	4
12	2	1	1	1	0
13	3	3	1	1	2
14	2	1	2	0	1
15	2	2	2	1	1
16	2	1	1	1	1
17	2	1	3	0	1
18	3	1	2	2	4
19	3	2	2	0	4
20	3	1	2	2	4
21	3	3	3	2	4
22	4	2	1	2	0
23	3	1	2	0	0
24	3	2	2	2	2
25	3	2	2	3	0
26	3	2	2	2	2
27	4	4	5	4	3
28	5	4	4	4	4
29	4	3	4	4	4
30	4	4	4	2	3
31	4	3	3	3	0
32	5	4	4	5	0
33	4	3	1	1	4
34	4	3	1	1	4
35	3	3	1	0	2
36	4	2	3	1	3
37	4	2	2	1	3
38	4	2	2	3	4

Table 10. Vegetative rating criterion results.

Section	Aquatic weed Converage (%)	Weeds in canal cracks (F)	Presence of drainage ditch	Weeds in ditch/along embankment (G)
1	100	2	Yes	1
2	2	1	Yes	5
3	0	1	Yes	1
4	0	2	Yes	5
5	0	2	Yes	5
6	50	1	Yes	1
7	0	1	Yes	2
8	0	1	Yes	2
9	0	1	Yes	3
10	0	1	Yes	3
11	0	0	No	0
12	0	1	No	0
13	0	0	No	0
14	0	1	Yes	1
15	0	1	Yes	1
16	0	1	Yes	1
17	0	1	Yes	1
18	100	2	Yes	2
19	0	1	Yes	1
20	0	1	Yes	1
21	100	2	Yes	2
22	0	1	Yes	2
23	0	1	Yes	2
24	0	1	Yes	4
25	0	0	No	0
26	0	0	No	0
27	0	0	No	0
28	0	0	No	0
29	0	0	No	0
30	0	0	No	0
31	0	0	No	0
32	0	0	No	0
33	90	2	Yes	5
34	0	1	Yes	4
35	80	1	Yes	3
36	80	1	Yes	1
37	90	1	Yes	1
38	100	1	Yes	1

Table 11. Combination of factors on a 10 to 1 scale (with 10 as the best)			
Section	**BCD**	**BCDE**	**ABCDE**
1	7.0	6.5	6.2
2	7.0	7.0	6.6
3	9.7	9.0	8.2
4	5.7	5.0	4.2
5	5.7	5.0	4.2
6	7.7	6.5	6.2
7	6.3	5.5	5.4
8	6.3	5.5	5.0
9	8.3	7.0	6.6
10	8.3	7.0	6.6
11	7.0	6.0	5.8
12	9.0	9.5	9.0
13	7.7	7.5	7.0
14	9.0	9.0	8.6
15	7.7	8.0	7.8
16	9.0	9.0	8.6
17	8.3	8.5	8.2
18	7.7	6.5	6.2
19	8.3	7.0	6.6
20	7.7	6.5	6.2
21	5.7	5.0	5.0
22	7.7	8.5	7.4
23	9.0	9.5	8.6
24	7.0	7.0	6.6
25	6.3	7.5	7.0
26	7.0	7.0	6.6
27	2.3	3.0	3.0
28	3.0	3.0	2.6
29	3.7	3.5	3.4
30	4.3	4.5	4.2
31	5.0	6.5	5.8
32	2.3	4.5	3.8
33	7.7	6.5	5.8
34	7.7	6.5	5.8
35	8.3	8.0	7.4
36	7.0	6.5	5.8
37	7.7	7.0	6.2
38	6.3	5.5	5.0

Charts

The following charts the canals highlighted based on the rating results.

Chart I. Identification of Canal Segments
Chart II. General Condition Rating
Chart III. Hairline Cracks Rating
Chart IV. Pencil-size Cracks Rating
Chart V. Large Cracks Rating
Chart VI. Maintenance and Repairs (extent of patch work).
Chart VII. Crack Combination - BCD (2, 3 and 4), normalized on a 10 to 1 scale (1 being the worst)
Chart VIII. Combination - BCDE, normalized on a 10 to 1 scale (1 being the worst)
Chart IX. Combination ABCDE, normalized on a 10 to 1 scale (1 being the worst)

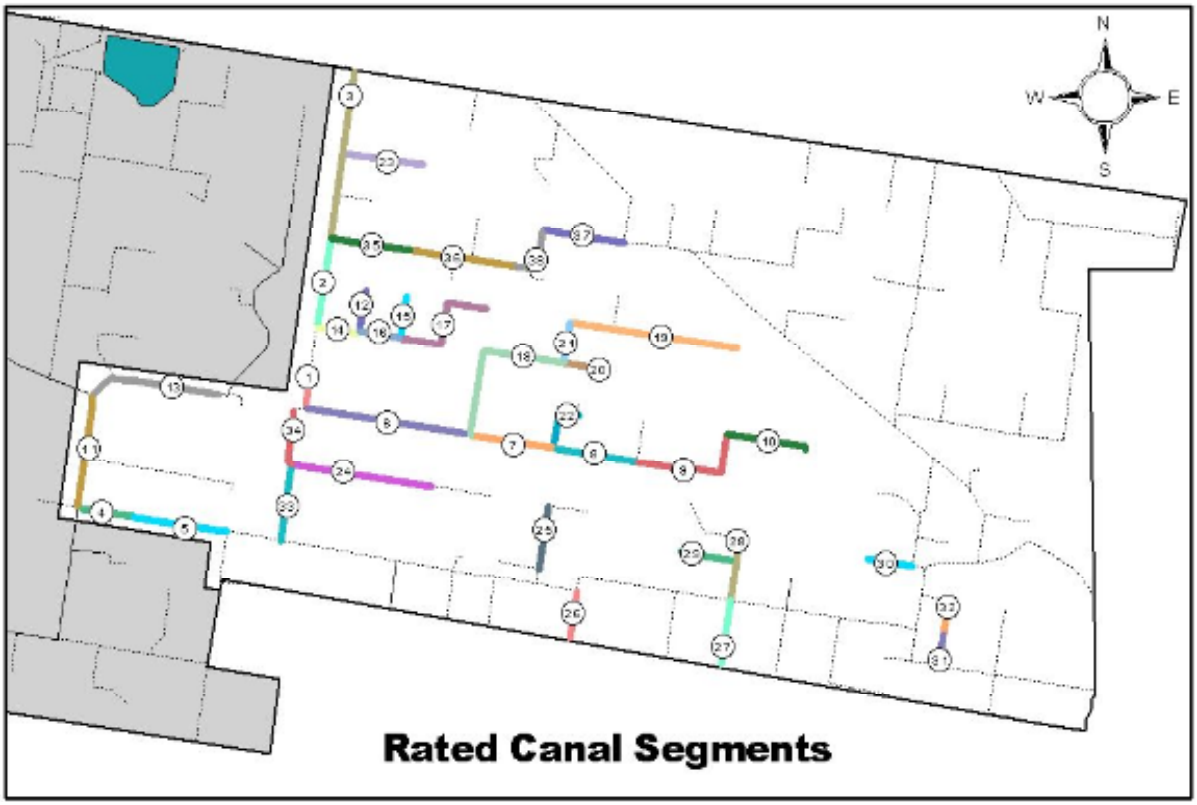

Chart I. Identification of Canal Segments Evaluated. All but two canals in this portion of the district were rated (indicated by solid lines). Dash lines show pipelines.

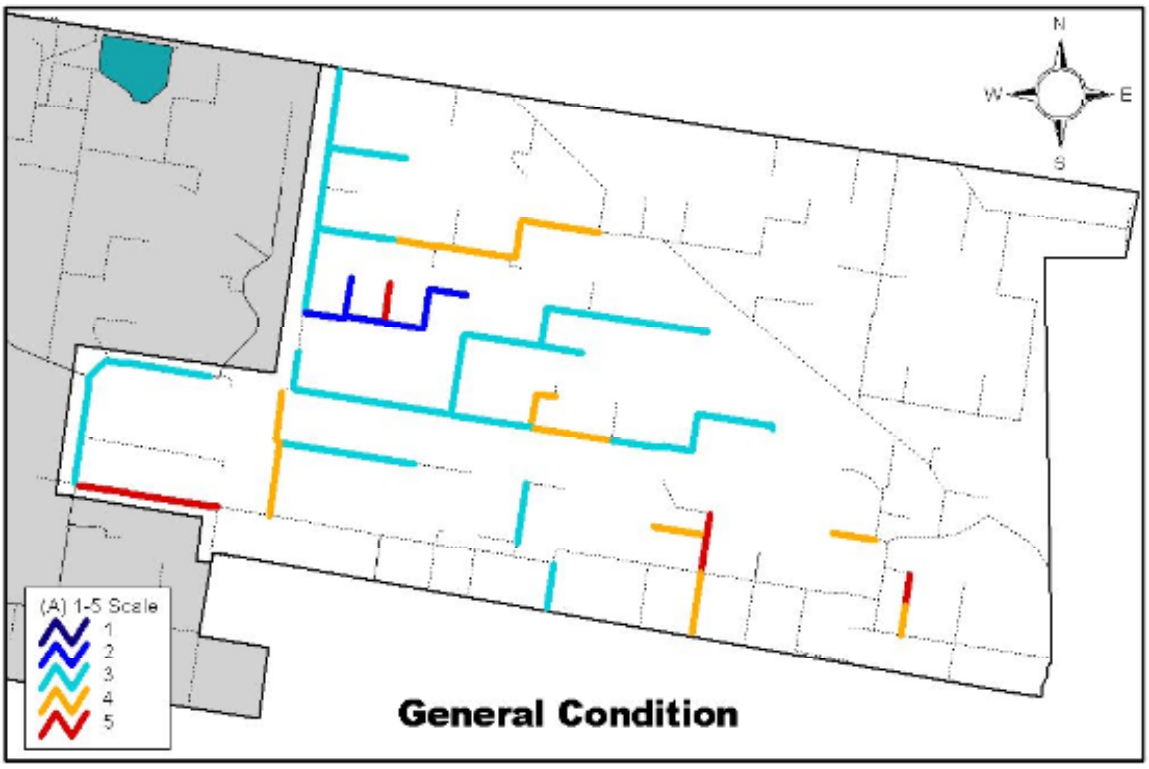

Chart II. General Condition Rating ("1" being the best condition).

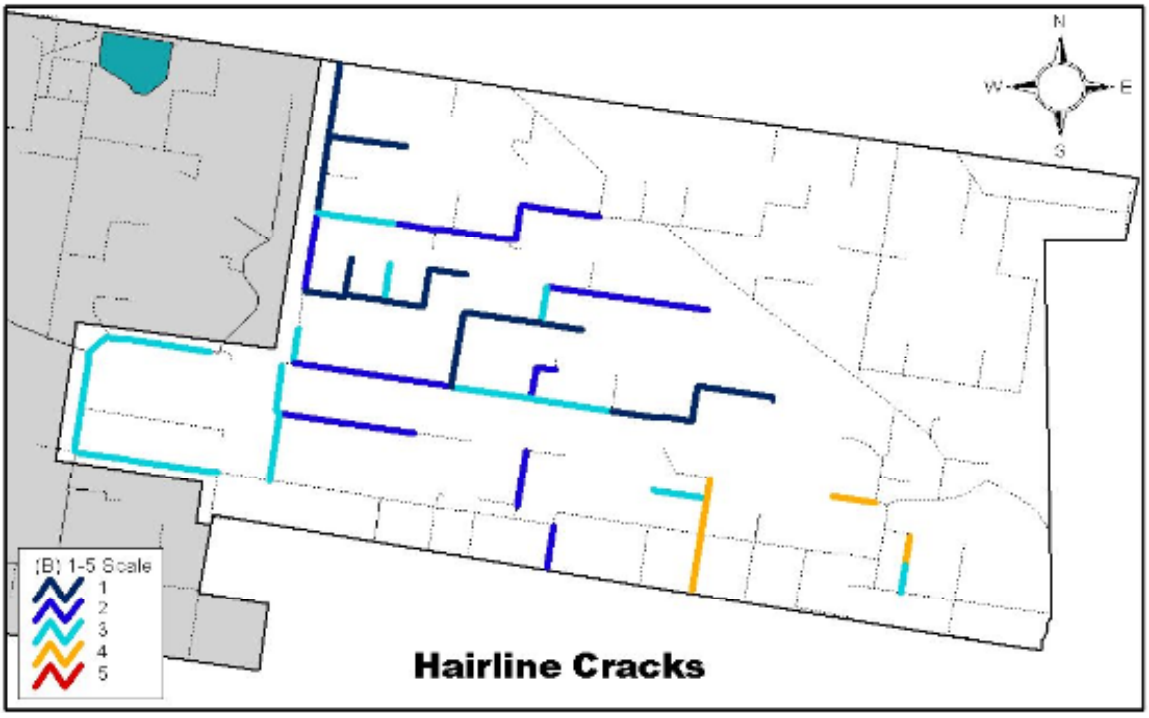

Chart III. Hairline Cracks Rating ("1" having the least).

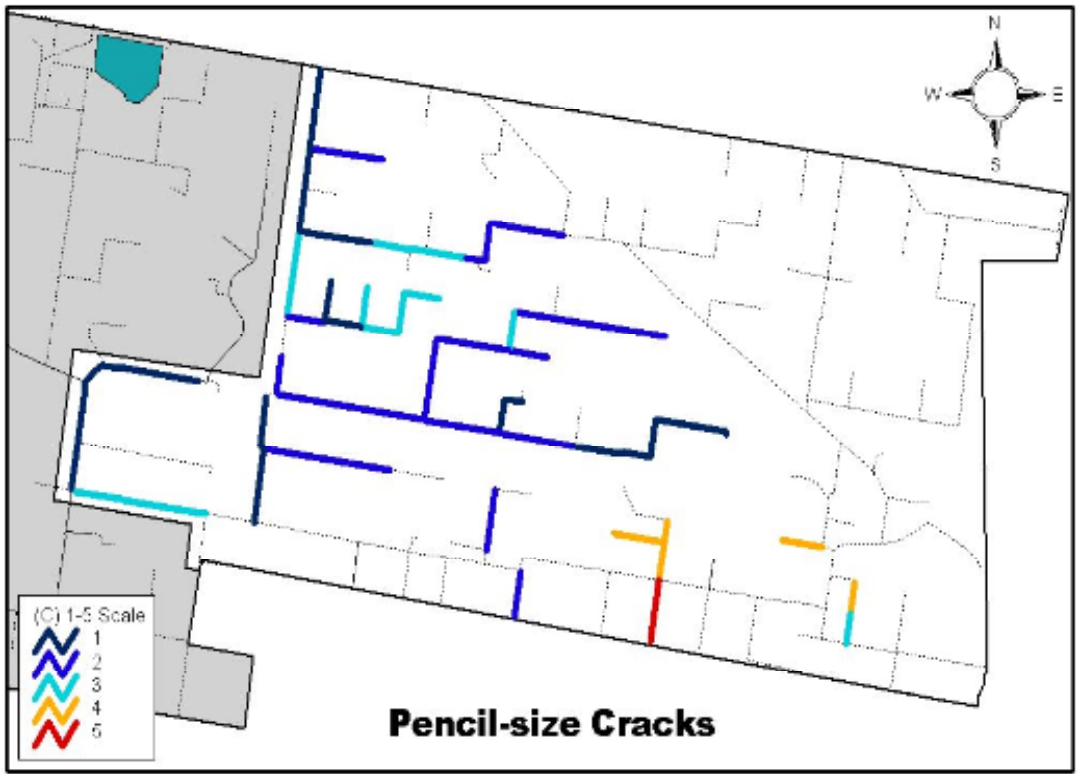

Chart IV. Pencil-size Cracks Rating ("1" having the least)

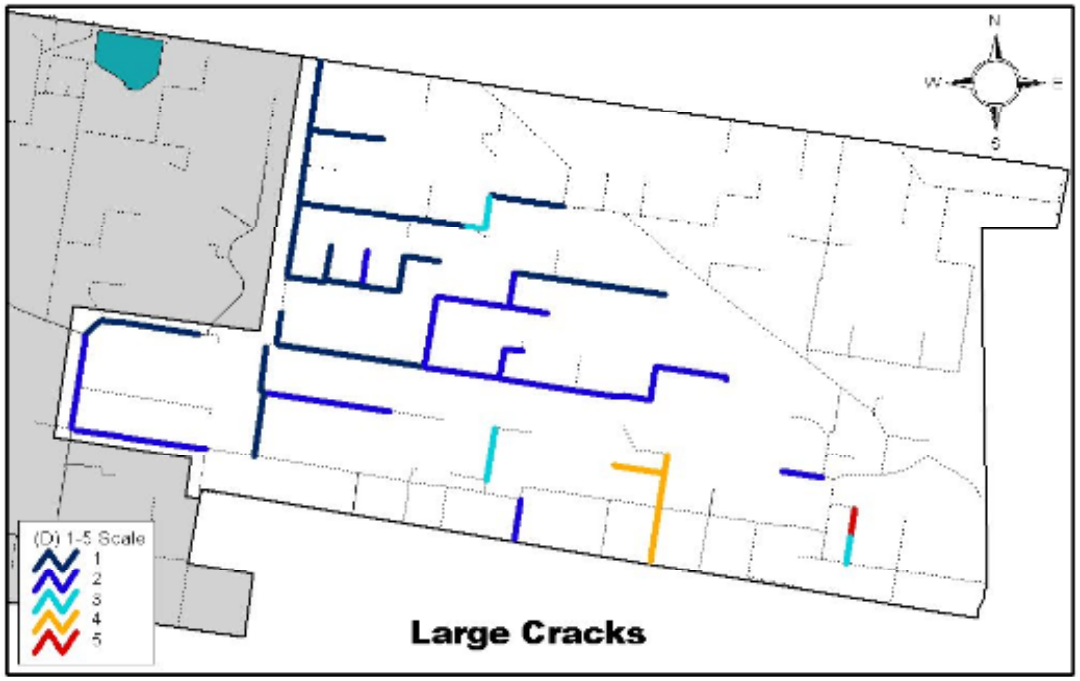

Chart V. Large Cracks Rating ("1" having the least).

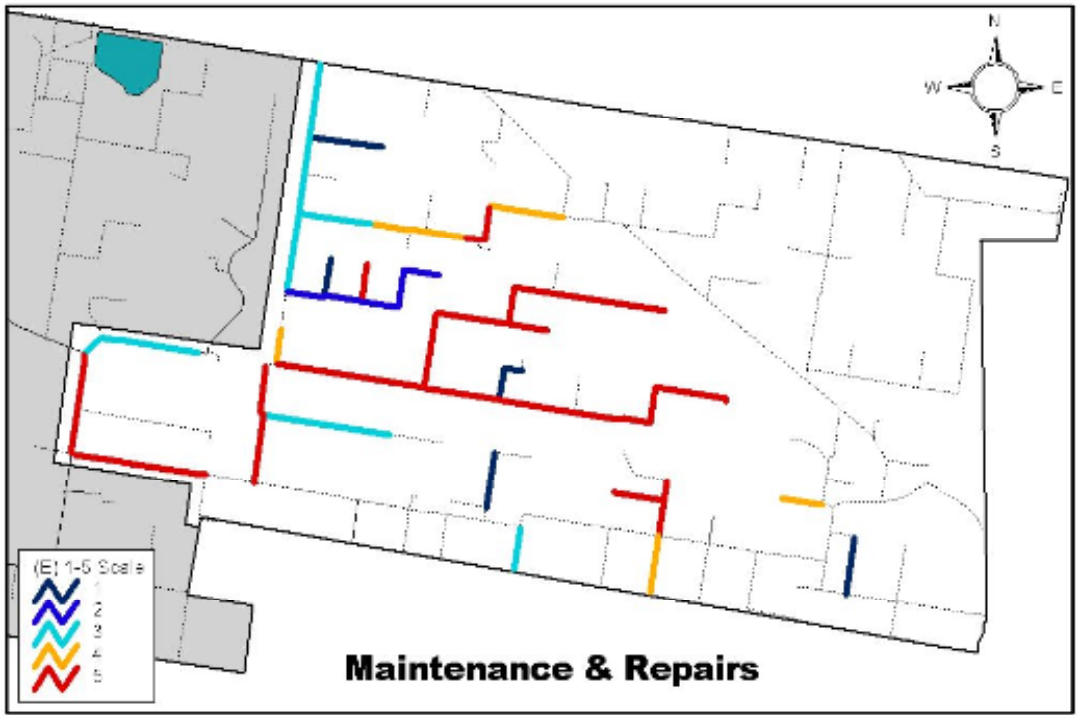

Chart VI. **Maintenance and Repairs (extent of patch work, with "1" having the least).**

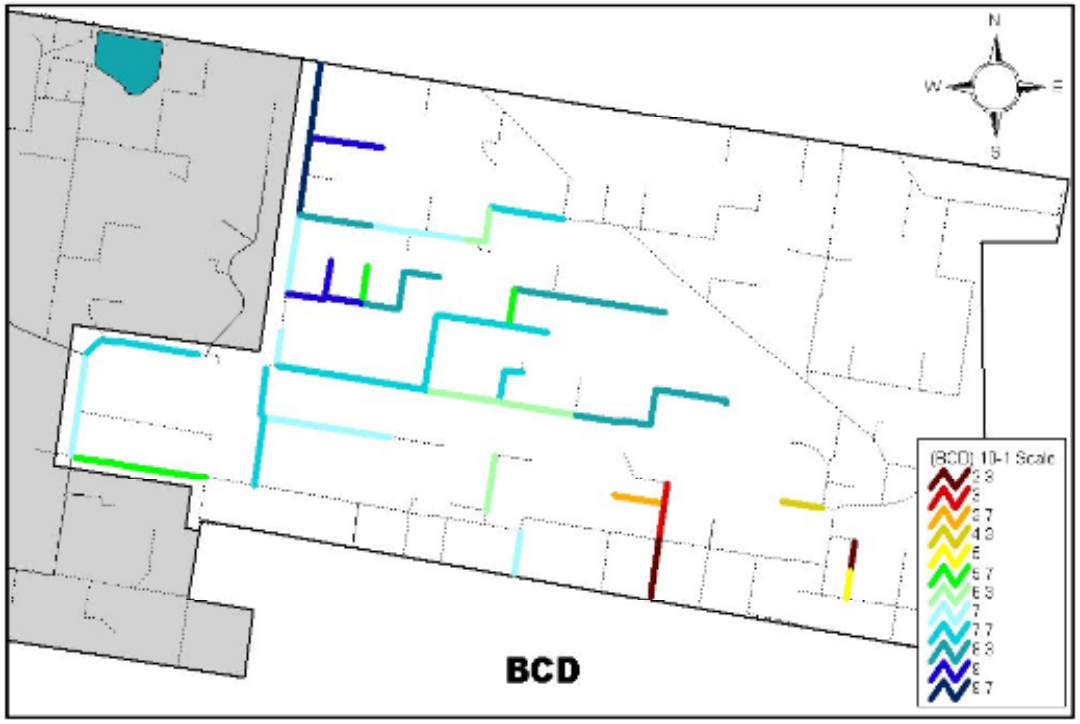

Chart VII. **Crack Combination BCD, normalized on a 10 to 1 scale ("10" being the best).**

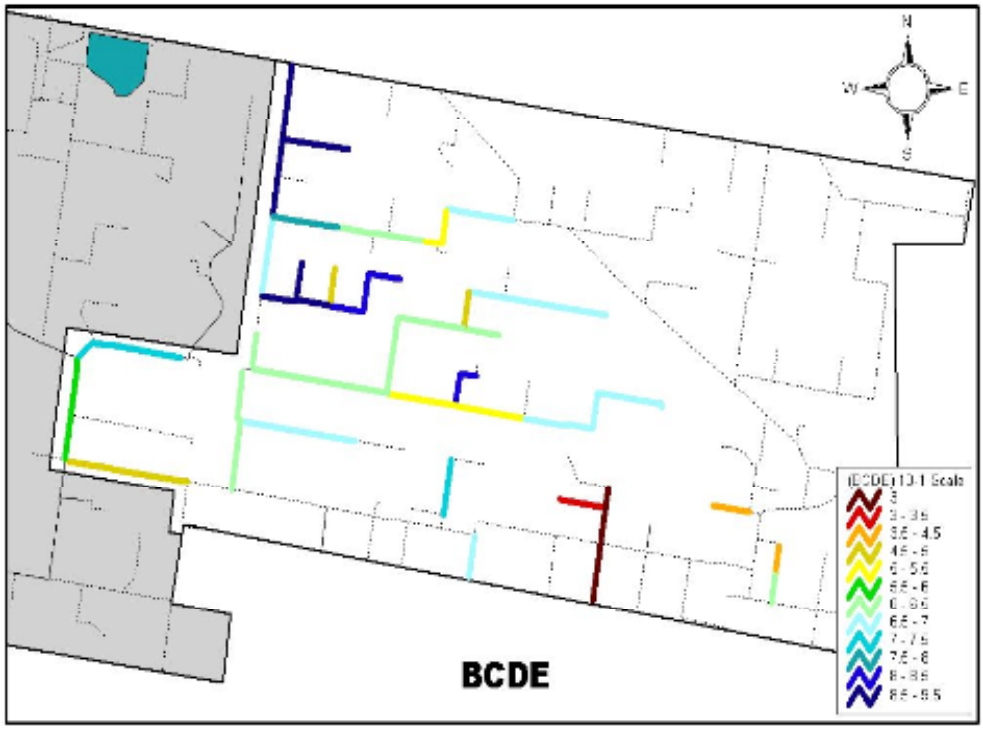

Chart VIII. Combination BCDE, normalized on a 10 to 1 scale ("10" being the best).

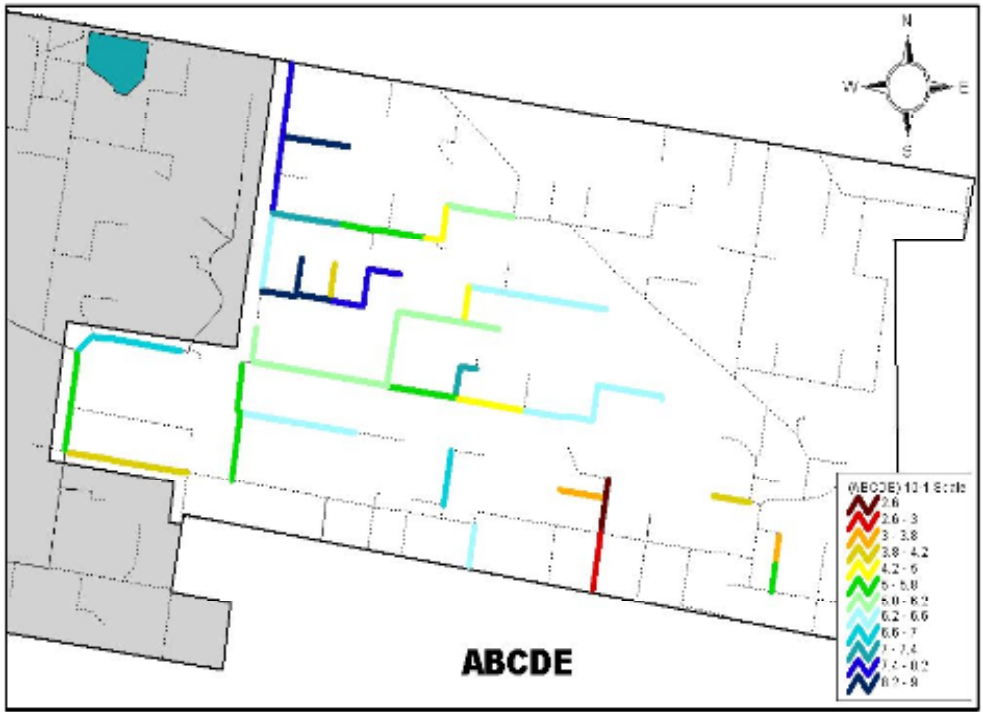

Chart IX. Combination ABCDE, normalized on a 10 to 1 scale (1 being the worst).

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Milton Henry, Graduate Extension Assistant
Daniel Wishard, Student Worker
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For more information, see the DMS Web site (http://dms.tamu.edu)