Seepage Loss Test Results

In Cameron County Irrigation District No. 2[1]

Report Prepared for

Cameron County Irrigation District No. 2

by

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December 18, 2002

[1] A portion of this study was funded by Texas Cooperative Extension through the Rio Grande Basin Initiative administered by the Texas Water Resources Institute of the Texas A&M University System with funds provided through a grant from Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 2001-001-45049-01149.

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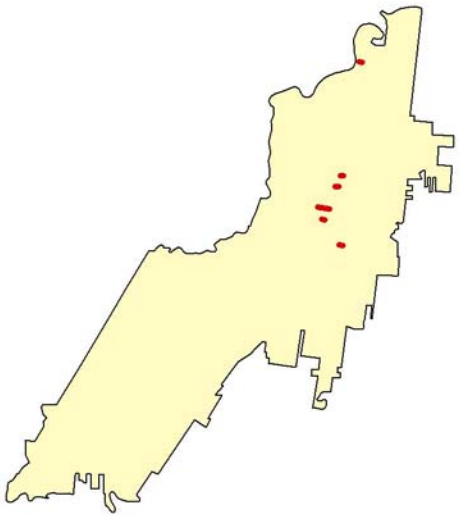
Summary

This report summarizes seepage loss tests conducted in Cameron County Irrigation District No. 2 (CCID2) on five canal segments located as shown on the right.



The results are summarized in Table 1 for the 5 tests conducted during Summer 2002 and a test performed previously in the district.

The locations of these tests are shown in more detailed on the attached map. Canals 23, 27, 33 and 35 are unlined canals supplied by main canal B. These canals run from main canal B east crossing Center Line Road and Brown Tract Road. Canal 55 is an unlined canal located 5 miles due north from canal 35 off of Brown Tract Road. Maximum operating depths range from 3 to 5 ft. Typically in this region, the normal operating depth is about 6 inches to a foot of the maximum.

Table 1: Seepage Loss Test Results for the project area described above of CCID2. All segments are earth-lined.

Test #	Segment	Soil Type	Top Width (ft)	Length (ft)	Ave Loss Seepage Rate (gal/ft^2/day)	Total Loss in Canal (ac-ft/mile) per day	per year
1	Canal 23	fine sandy clay loam	20	640	1.443	0.5178	188.99
2	Canal 27	clay loam	16	600	0.643	0.1872	68.33
3	Canal 33	fine sandy clay loam	18	740	1.674	0.5159	188.31
4	Canal 35	fine sandy clay loam	17	600	0.419	0.1297	47.35
5	Canal 55	clay loam	18.5	500	1.239	0.4276	156.09
**RM 1	Canal 29	clay loam	29	2530	1.27	0.5901	215.40

**Corrected test calculations for RM-1 (Region M Study – see http://dms.tamu.edu). This test is not discussed further in this report.

TEST METHOD

Loss rates were determined using the ponding method. In this method, the two ends of a canal segment are closed or sealed with earthen dams (Fig. 1), as are any valves or gates located in the test segment. Changes in water levels are recorded for at least 48 hours. One to three continuous-stage level recorders (Fig. 2) were used to supplement the 3 locations where stage levels were recorded manually. During the tests, canal dimensions and water span were also record and surveyed.

Figure 1. Earthen dam constructed on canal 55.

Soil Sampling and Groundwater Level Measurement

Two soil samples were taken of the canal embankment (or levee) and one in a field adjacent to the canal. One canal embankment (levee) sample was from inside the canal at or below the normal opporating water level, and the other at a location approximately 10 ft from the edge of the canal and 2 feet below the surface. Natural surrounding soil samples were taken in fields adjacent to the test area down to 12 foot of depth. In these tests, shallow groundwater was not found within 12 feet of the soil surface.

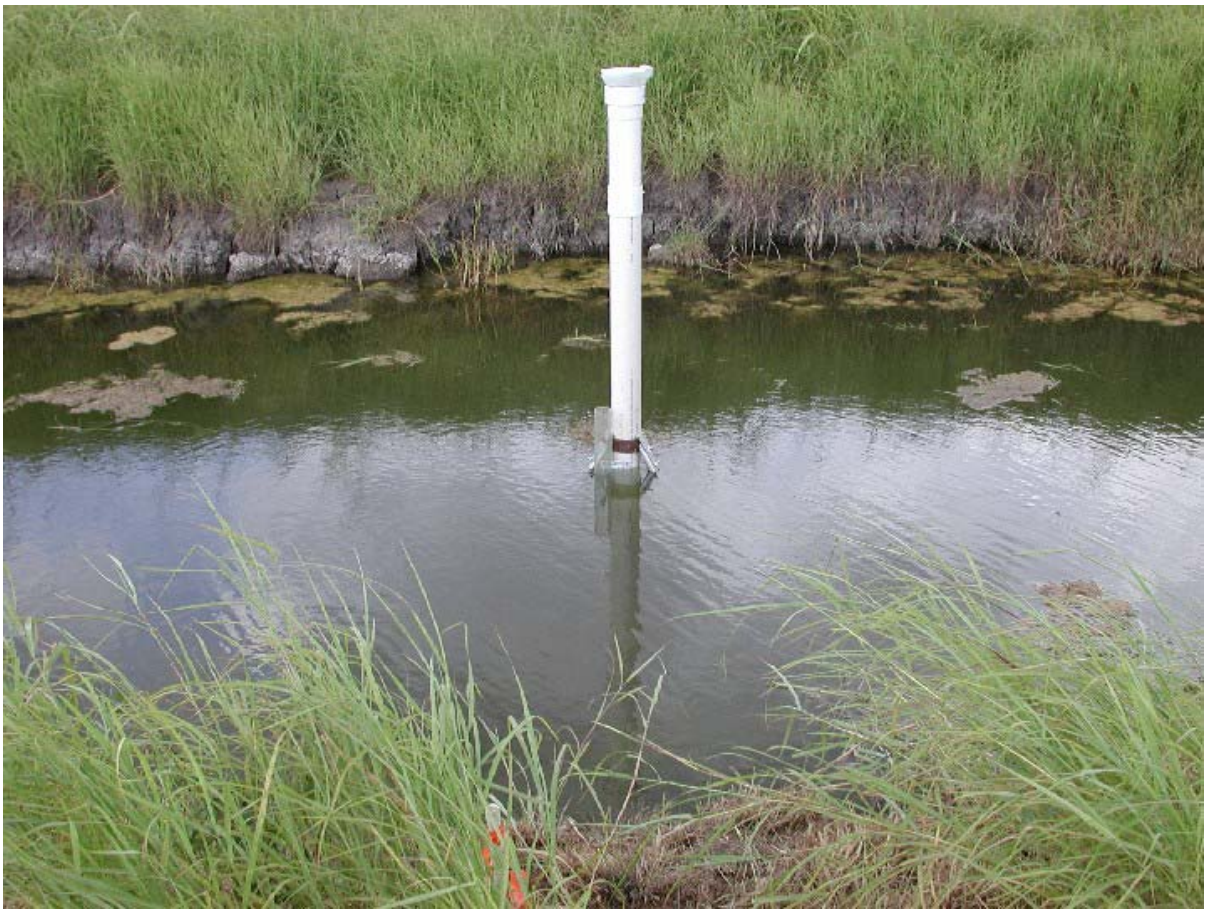


Figure 2. Continuous-stage level recorders on canal 55.

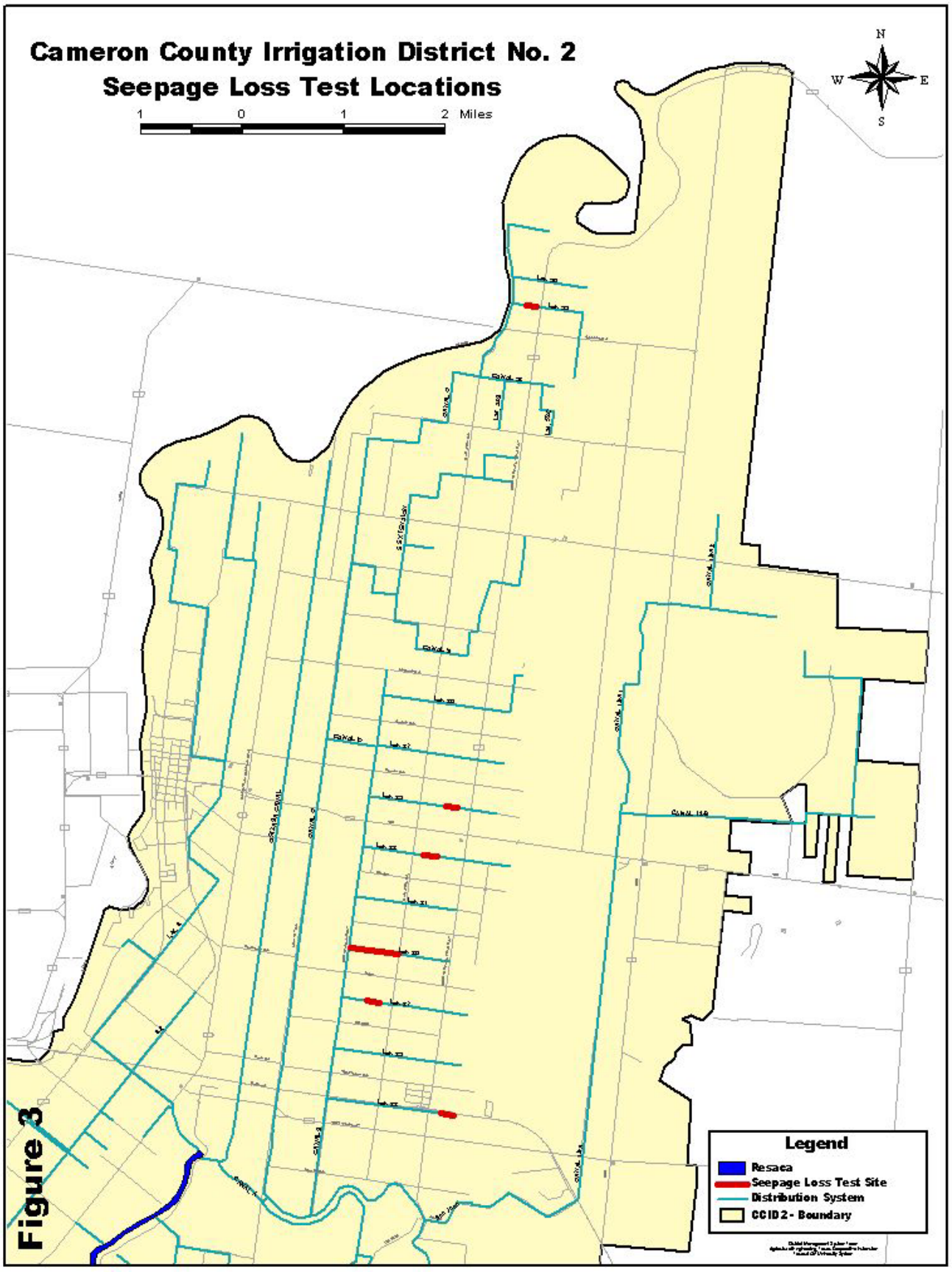


Figure 3 Test site location.

DETAILED TEST RESULTS

Tables 4 – 11 provide additional details on the test results and other information collected. For each canal, two tables are provided. The first table gives canal dimensions, testing dates and time, and stage level measurements. The second table gives the loss rated in 5 methods commonly used to characterize water loss in canals. Note: annual water loss rates assume that the canal is in service 365 days per year.

For each test segment, a chart is provided showing the measured canal profile compared to the expected canal profile. The expected profile was developed by fitting an equation to the measured data as shown.

Table 2. Test Information for Canal 23

District:	Cameron County Irrigation District 2	**Test ID:**	Canal 23
Canal:	Canal 23	**Lining Type:**	Earth
Top Width:	20 ft	**Date:**	June 18 – 20, 2002
Test Length:	640 ft	**Start Time:**	18:51
Total Depth:	3.5 ft	**Finish Time:**	14:01

Location: East of Brown Tract Rd, end of section.

Staff Gage Readings

	Date	SG1		SG2		SG3	
		Reading	Time	Reading	Time	Reading	Time
1	18-Jun	2.40	18:56	2.38	18:54	2.00	18:51
2	19-Jun	2.21	13:27	2.25	13:24	1.97	13:20
3		2.17	16:07	2.24	16:05	1.94	16:03
4		2.16	18:54	2.21	18:52	1.91	18:50
5	20-Jun	1.79	10:55	2.07	10:56	1.79	10:58
6		1.77	13:58	2.04	14:00	1.77	14:01

Table 3. Average Unit Area Loss Rate for Canal 23.

$ft^3/ft^2/hour$	ft/day	inches/day	$gal/ft^2/day$		acre-ft/mile/year	
			avg.	std. dev.	avg.	std. dev.
0.0080	0.193	2.31	1.443	0.730	188.99	95.426

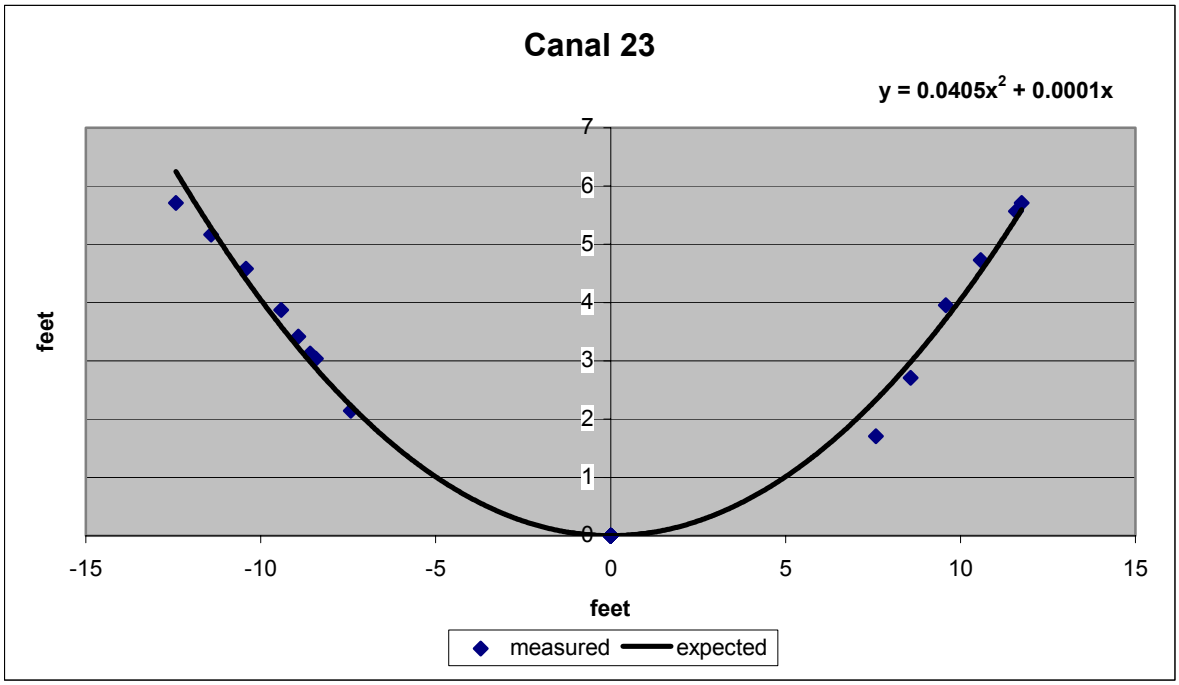


Figure 4. Cross-section of canal 23.

Figure 5. Canal 23

Table 4. Test Information for Canal 27

District:	Cameron County Irrigation District 2	**Test ID:**	Canal 27
Canal:	Canal 27	**Lining Type:**	Earth
Top Width:	16 ft	**Date:**	June 5 – 7, 2002
Test Length:	600 ft	**Start Time:**	15:03
Total Depth:	2.5 ft	**Finish Time:**	09:26

Location: East of Canal B and west of Center Line Rd.

Staff Gage Readings

		SG1		SG2		SG3		SG4		SG5	
	Date	Reading	Time	Reading	Time	Reading	Time	Reading	Time	Reading	Time
1	5-Jun	1.427	15:16	1.417	15:09	1.828	15:07	2.250	15:20	2.104	15:03
2		1.406	16:16	1.438	16:20	1.813	16:22	2.250	16:28	2.146	16:25
3	6-Jun	1.333	10:03	1.375	09:58	1.719	10:14	2.167	10:09	2.042	10:12
4		1.328	11:56	1.390	11:53	1.719	11:57	2.167	11:59	2.042	11:48
5		1.323	14:52	1.375	14:50	1.708	14:48	2.156	14:46	2.031	14:41
6		1.307	16:44	1.333	16:41	1.688	16:39	2.146	16:37	2.042	16:35
7	7-Jun	1.250	09:18	1.25	09:20	1.635	09:21	2.073	09:26	1.958	09:24

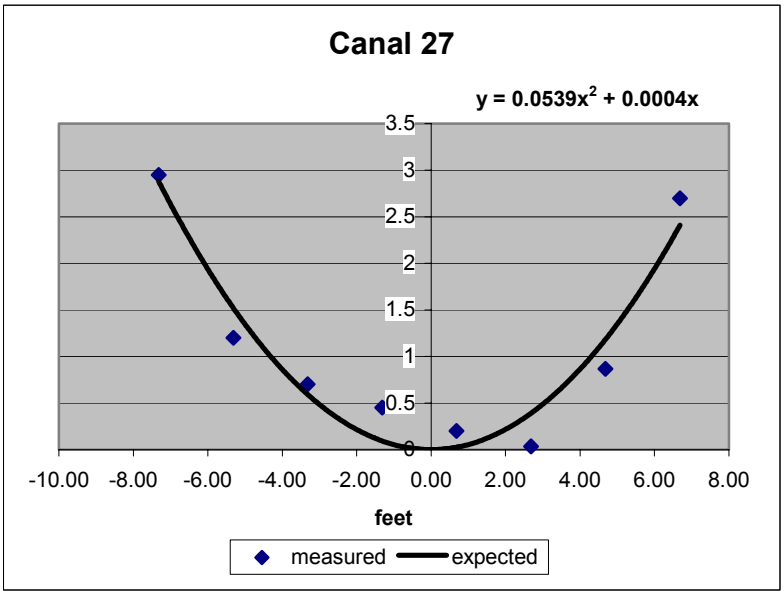


Figure 6. Cross-section of canal 27.

Table 5. Average Unit Area Loss Rate for Canal 27.

ft^3/ft^2/hour	**ft/day**	**inches/day**	**gal/ft^2/day**		**acre-ft/mile/year**	
			avg.	std. dev.	avg.	std. dev.
0.00358	0.0860	1.03	0.643	0.065	68.331	6.873

Table 6. Test Information for Canal 33

District:	Cameron County Irrigation District 2	**Test ID:**	Canal 33
Canal:	Canal 33	**Lining Type:**	Earth
Top Width:	18 ft	**Date:**	June 5 – 7, 2002
Test Length:	740 ft	**Start Time:**	17:01
Total Depth:	5 ft	**Finish Time:**	10:45

Location: East of Center Line Rd. and west of Brown Tract Rd. South of 106.

Staff Gage Readings

	Date	SG1		SG2		SG3	
		Readings	Time	Readings	Time	Readings	Time
1	5-Jun	1.396	17:01	2.708	17:05	1.771	17:07
2	6-Jun	1.198	10:23	2.500	10:25	1.635	10:28
3		1.115	13:54	2.458	13:55	1.542	13:58
4		0.958	16:06	1.531	16:10	2.458	16:12
5	7-Jun	0.979	10:42	2.271	10:44	1.333	10:45

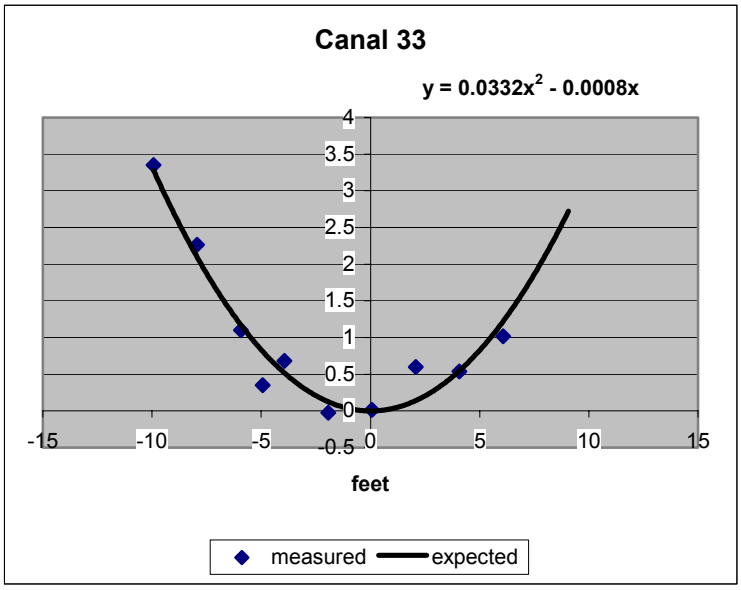


Figure 7. Cross-section for canal 33

Table 7. Average Unit Area Loss Rate for Canal 33.

$ft^3/ft^2/hour$	ft/day	inches/day	$gal/ft^2/day$		acre-ft/mile/year	
			avg.	std. dev.	avg.	std. dev.
0.00932	0.223	2.68	1.674	0.042	188.31	4.678

Table 8. Test Information for Canal 35

District:	Cameron County Irrigation District 2	**Test ID:**	Canal 35
Canal:	Canal 35	**Lining Type:**	Earth
Top Width:	17 ft	**Date:**	June 19 – 21, 2002
Test Length:	600 ft	**Start Time:**	19:22
Total Depth:	3.5 ft	**Finish Time:**	09:36

Location: East of Center Line Rd. and west of Brown Tract Rd. North of 106.

Staff Gage Readings

	Date	SG1		SG2		SG3	
		Readings	Time	Readings	Time	Readings	Time
1	19-Jun	2.46	19:25	2.49	19:22	3.09	19:23
2	20-Jun	2.42	10:36	2.48	10:38	3.04	10:39
3		2.40	13:46	2.46	13:44	3.02	13:42
4		2.40	15:11	2.46	15:10	3.02	15:08
5		2.40	17:46	2.44	17:46	3.02	17:42
6		2.40	18:50	2.44	18:52	3.02	18:53
7	21-Jun	2.36	09:39	2.40	09:37	2.98	09:36

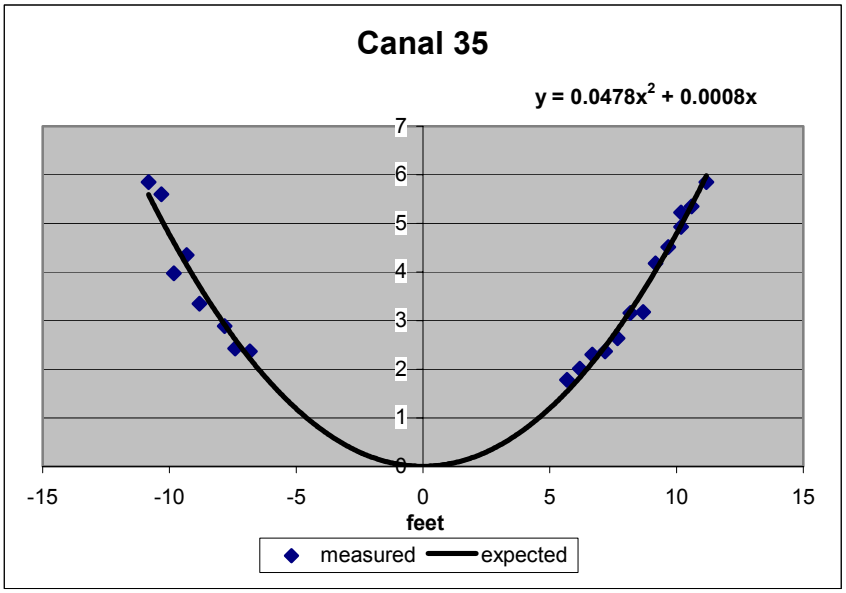


Figure 8. Cross-section of canal 35

Table 9. Average Unit Area Loss Rate for Canal 35.						
ft^3/ft^2/hour	**ft/day**	**inches/day**	**gal/ft^2/day**		**acre-ft/mile/year**	
			avg.	std. dev.	avg.	std. dev.
0.00233	0.056	0.67	0.419	0.042	47.345	4.721

Figure 9. Canal 35

Table 10. Test Information for Canal 55

District:	Cameron County Irrigation District 2	**Test ID:**	Canal 55
Canal:	Canal 55	**Lining Type:**	Earth
Top Width:	18.5 ft	**Date:**	August 7, 2002
Test Length:	500 ft	**Start Time:**	09:52
Total Depth:	4.5 ft	**Finish Time:**	15:16

Location: West of Brown Tract Rd. and north of Johnson Rd.

Staff Gage Readings

	Date	Readings	Time
1	7-Aug	3.22	09:52
2		3.20	10:57
3		3.20	11:54
4		3.18	15:16

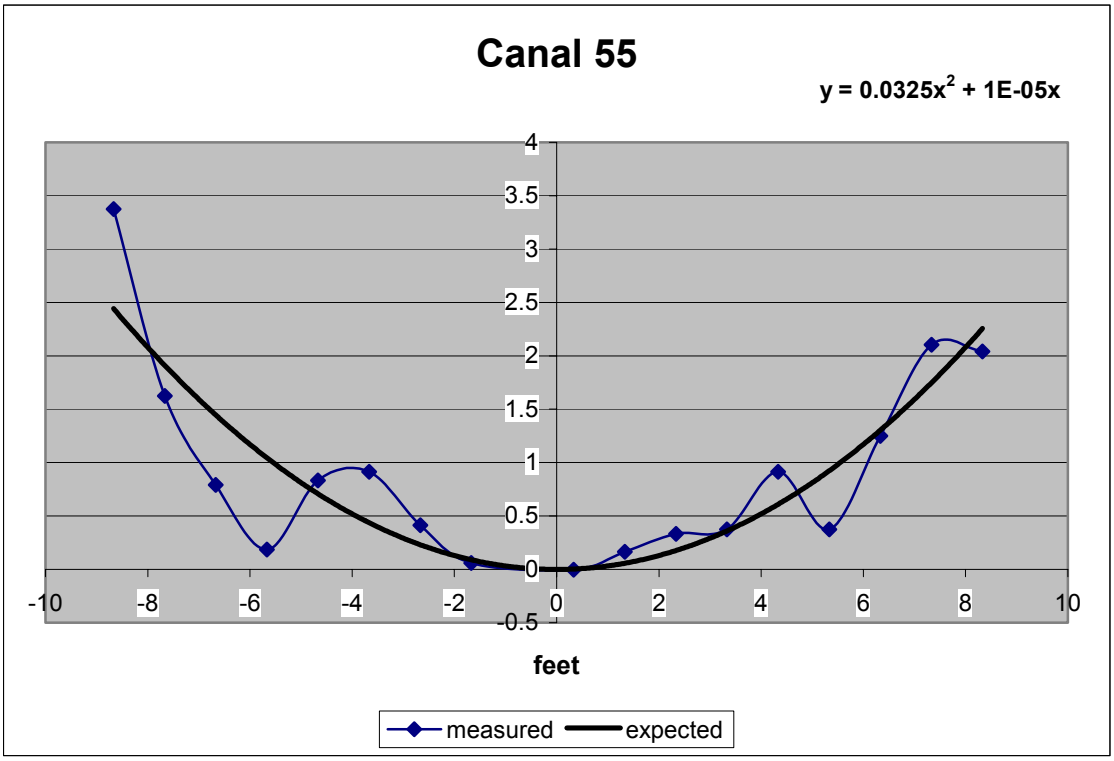


Figure 10. Cross-section of canal 55

Figure 11. Canal 55

Table 11. Average Unit Area Loss Rate for canal 55.

$ft^3/ft^2/hour$	ft/day	inches/day	$gal/ft^2/day$	acre-ft/mile/year
0.0069	0.166	1.99	1.239	156.089

Literature Review

Very little information has been reported in scientific literature on canal seepage and reduction from district rehabilitation projects. All the data that we have found for seepage rates versus lining type are given in Tables 12 and 13.

Table 12. Canal seepage rate reported in published studies.

Lining/soil type	**Seepage rate (gal/ft^2/day)**
Unlined[1]	2.21-26.4
Portland cement[2]	0.52
Compacted earth[2]	0.52
Brick masonry lined[3]	2.23
Earthen unlined[3]	11.34
Concrete[4]	0.74 - 4.0
Plactic[4]	0.08-3.74
Concrete[4]	0.06-3.22
Gunite[4]	0.06-0.94
Compacted earth[4]	0.07-0.6
Clay[4]	0.37-2.99
Loam[4]	4.49-7.48
Sand[4]	4.0-19.45

[1] DeMaggio (1990).
[2] U.S. Bureau of Reclamation (1963).
[3] Nayak, et al. (1996).
[4] Nofziger (1979).

Table 13. Canal seepage rates reported for the Lower Rio Grande Valley.

Soil Type	**Seepage Loss Rate (gal/ft^2 /day)**
clay	1.5
silty clay loam	2.24
clay loam	2.99
silt loam earth	4.49
loam	7.48
fine sandy loam	9.35
Sandy loam	11.22

Source: Texas Board of Water Engineers (1946).

Soil Descriptions[3]

General Soil Series

7 – Lyford-Raymondville-Lozano association: Nearly level, well drained and moderately well drained sandy clay loams, clay loams, and fine sandy loams.

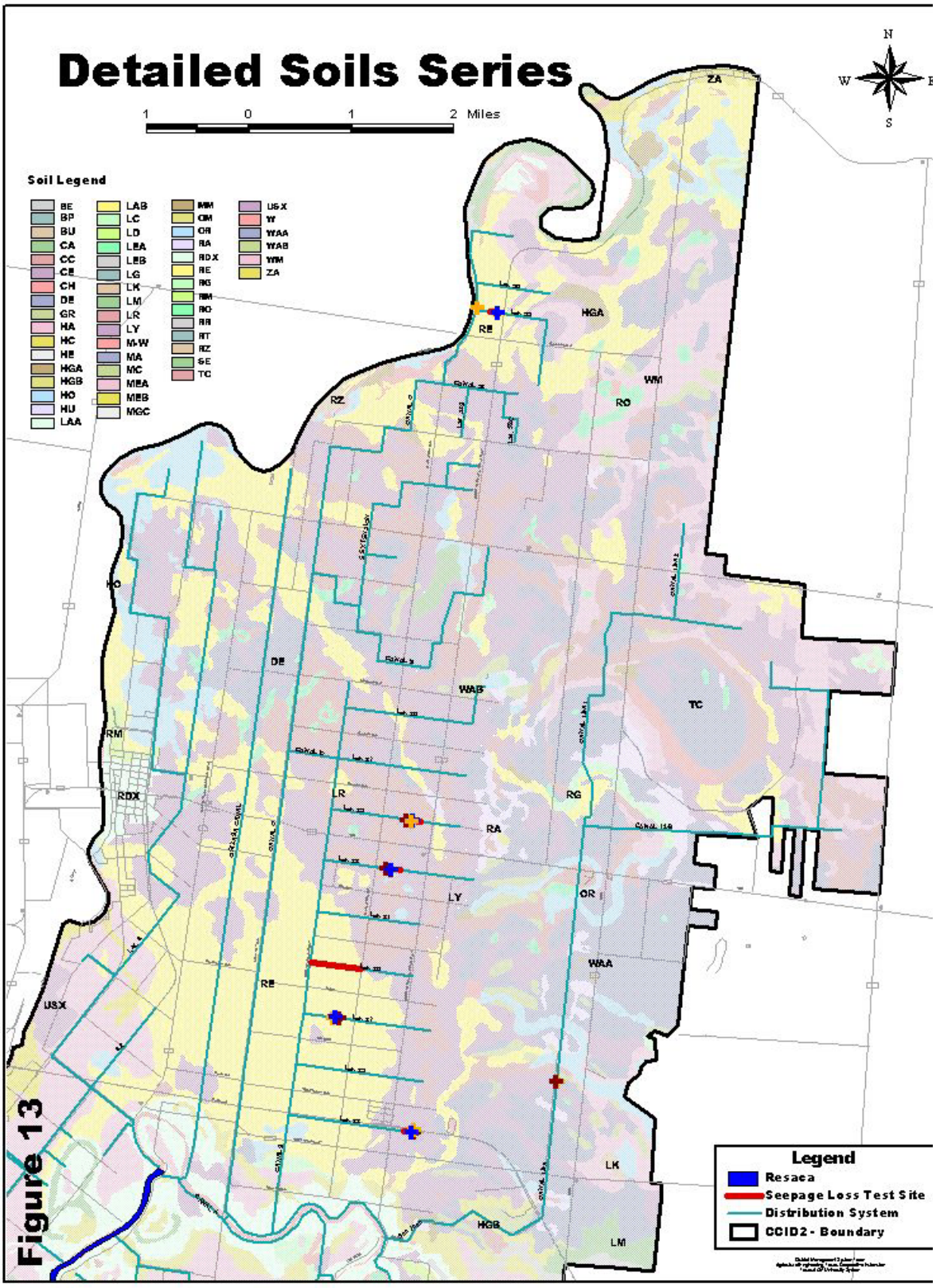
9 – Willacy-Raymondville association: Nearly level to gently sloping, well drained and moderately well drained sandy loams and clay loams.

13 – Mercedes association: Level to gently sloping, moderately well drained clays.

Table 14: Detailed Soil Units / Permeability	
Soil Unit[4]	**Permeability In\hr**
RE – Raymondville clay loam	0.20 – 0.63
LY – Lyford sandy clay loam	0.63 – 2.0
LR – Lozano fine sandy loam	2.0 – 6.3

Figure 12. Canal levee soil profile on canal 23.

[3] Soil Surveys of Cameron County, USDA, SCS, TAES (1979)
[4] See Detailed Soil Map (Figure 13).


Detailed Soils Series
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WM
ZA
Legend
Resaca
Seepage Loss Test Site
Distribution System
CCID2 - Boundary
Figure 13

Acknowledgements

DMS TEAM

Support provided by the DMS (District Management System) team of:

Martin Barroso, Extension Agricultural Technician
Noemi Perez, Extension Agricultural Technician
Gabriel Ortega, Extension Assistant
Bryan Treese, Extension Assistant (former)
Daniel Wishard, Student Worker
Brock Faulkner, Student Worker

CAMERON COUNTY IRRIGATION DISTRICT NO.2

Helpful planning and assistance in canal ponding tests was provided by the District office and field personnel, and canal riders.

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