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Ponding Test Results
Seepage and Total Losses
Main Canal B
Hidalgo County Irrigation District No. 16

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February 17, 2004

Texas Water Resources Institute
make every drop count

PONDING TEST RESULTS

SEEPAGE AND TOTAL LOSSES

MAIN CANAL B

HIDALGO COUNTY IRRIGATION DISTRICT NO. 16

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February 17, 2004

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Main Canal B, Hidalgo County Irrigation District No.16

SUMMARY

This report summarizes the results of two ponding tests conducted in Hidalgo County Irrigation District No. 16 (HCID16) to measure losses in segments of Main Canal B. Photographs of the two segments are shown in Figures 1 and 3. Ponding Test 16HC1 took place during July 18-20, 2003 and Test 16HC2 during October 22-24, 2003.

The Main Canal B is a concrete-lined canal that composes a portion of the main water supply network of the district. The canal extends from east of FM 2221 (or Jara Chinas Road) to Tom Gill Road (16th St.) after which it jogs north and continues along the district's western border (see Fig. 3). The two test segments were located as follows:

- Test Segment 16HC1 – from the beginning of Main Canal B to the first downstream check structure
- Test Segment 16HC2 – from west of Iowa Road to the south side of FM 2221

Test results are summarized in Tables 1 and 2 and were as follows:

- The average seepage loss rate measured for Test Segment 16HC2 was 1.4 gal/ft^2/day.
- Test Segment 16HC2 had at least three leaking turnout gates which contributed to the total loss rate of 1.es of 1.9 gal/ft^2/day.
- At normal operating depths in the Main Canal B, leakage from one of the gates was measured at 169 gal/day or a potential loss of 2.3 ac-in/yr (Table 3).

Table 1. Summary of ponding test results of Main Canal B.

Test ID	Soil*	Length (ft)	Width (ft)	Test Type	Loss rate Gal/ft^2/day	Total Loss in Canal (ac-ft/mile) per day	per year
16HC1	fine sandy loam	3703	4.9	total**	1.89	0.53	192.4
16HC2	fine sandy loam	1000	5.5	seepage	1.41	0.33	121.3

* soil type of the surrounding area from the Soil Survey for Hidalgo County (USDA 1978)
** leaking gates located within the test segment contributed to losses

Table 2. Average loss rates measured in Main Canal B expressed in terms of the change in water level.

Test ID	ft/hr	ft/day	in/hr	in/day
16HC1	0.014	0.333	0.17	3.99
16HC2	0.010	0.241	0.12	2.89

Figure 1. Photograph of test segment 16HC1 of the Main Canal B.

Figure 2. District Map and locations of test segments.

Figure 3. Photograph of the installation of a staff gauge in Test Segment 16HC2.

MATERIALS AND METHODS

Canal loss rates were measured using the ponding method. In this method, the two ends of a canal segment are closed or sealed with earthen dams as shown in Figure 4. Once sealed, water elevations are taken for approximately 48 hours. Three to six staff gauges (Fig. 5) were placed in each test segment, and stage levels were recorded manually. Canal dimensions and water spans were also surveyed during the test.

The tests are classified as follows:

- Test segment 16HC2 did not contain valves or gates within the canal; thus, the seepage rate was measured.
- Test segment 16HC1 contained several leaking turnout valves (Fig. 6); thus, we classify this as a total loss test since the gates contributed to the measured losses.

During the ponding test, we measured the leakage rate of one gate by catching the water in a graduated beaker as shown in Figures 7 and 8. Measurement details are given in Table 3.

Tables 4 and 5 provide details on the test segments, data collected and recorded changes in water depths during the tests. The canal cross-sections at each of the staff gauges are illustrated in Figures 9 - 14 for test 16HC1, and Figures 15 - 17 for test 16HC2. Also shown on these charts are the water depths at the beginning of the test.

Figure 4. Photograph of district's backhoe constructing earthen dam for a ponding test.

Figure 5. Staff gauge in canal next to earthen dam.

Table 3. Turnout gate leakage measurements during ponding test 16HC1. As expected, the leakage rate decreases as the water level in the canal falls.

Date/Time	measurement time (min)	liters	l/min	leakage rate (gpm)
Jul 17	1.67	0.740	0.444	0.117
Jul 18 15:55	5.0	1.625	0.325	0.086
Jul 8 17:38	5.0	1.540	0.308	0.081
Jul 19 12:00	5.0	0.900	0.180	0.048
Jul 19 18:00	5.0	0.890	0.178	0.047
Jul 20 14:00	5.0	0.720	0.144	0.038

Figure 6. Turnout gate located in test segment 16HC1.

Figure 7. Measuring the leakage rate through a turnout gate inside a standpipe.

Figure 8. Close up of the graduated beaker used to measure gate leakage.

TEST RESULTS

Table 4. Data for Test 16HC1: Main Canal B.

District: Hidalgo County Irrigation District No. 16	**Test ID:** 16HC1
Canal: Main Canal B	**Lining Type:** Lined
Starting Water Span Widths (feet): **A:** 12.8, **B**: 12.54, **C**: 13.1, **D**: 13.8, **E**: 12.7, **F**:14.0	**Date:** July 18-20, 2003
Test Segment Length: 3700 feet	**Start Time:** 3:31 pm **Finish Time:** 4:07pam
Test Starting Depths (feet): **A**: 3.75 , **B**: 3.94, **C**: 4.18 **D**: 4.45 , **E**: 4.43, **F**: 4.73	
Location: At the start of Main Canal B and stops at the next downstream check structure.	

Staff Gage Readings

Date	A		B		C	
	Time	**Feet**	**Time**	**Feet**	**Time**	**Feet**
Jul 18	**15:31**	**4.73**	**15:34**	**2.41**	**15:35**	**4.95**
	16:26	**4.72**	**16:28**	**2.38**	**16:30**	**4.94**
	17:24	**4.68**	**17:25**	**2.36**	**17:26**	**4.91**
Jul 19	**11:45**	**4.39**	**11:47**	**2.06**	**11:48**	**4.62**
	17:50	**4.3**	**17:51**	**1.98**	**17:52**	**4.55**
Jul 20	**13:43**	**4.08**	**13:46**	**1.75**	**13:48**	**4.31**
	16:08	**4.05**	**16:07**	**1.72**	**16:06**	**4.28**
True depth adjustment factor (ft)		**-0.98**		**1.53**		**-0.77**

Table 4 (continued from page 9).

Staff Gage Readings						
Date	**D**		**E**		**F**	
	Time	**Feet**	**Time**	**Feet**	**Time**	**Feet**
Jul 18	**15:37**	**5.21**	**15:39**	**5.21**	**15:40**	**2.98**
	16:32	**5.20**	**16:33**	**5.20**	**16:35**	**2.96**
	17:28	**5.17**	**17:30**	**5.17**	**17:31**	**2.94**
Jul 19	**11:49**	**4.89**	**11:50**	**4.90**	**11:51**	**2.64**
	17:53	**4.81**	**17:54**	**4.80**	**17:55**	**2.55**
Jul 20	**13:52**	**4.59**	**13:53**	**4.58**	**13:55**	**2.33**
	16:05	**4.55**	**16:04**	**4.54**	**16:03**	**2.32**
True depth adjustment factor (ft)		**-0.76**		**-0.78**		**1.75**

Figure 9. Cross-section at Staff Gauge A, 16HC1.

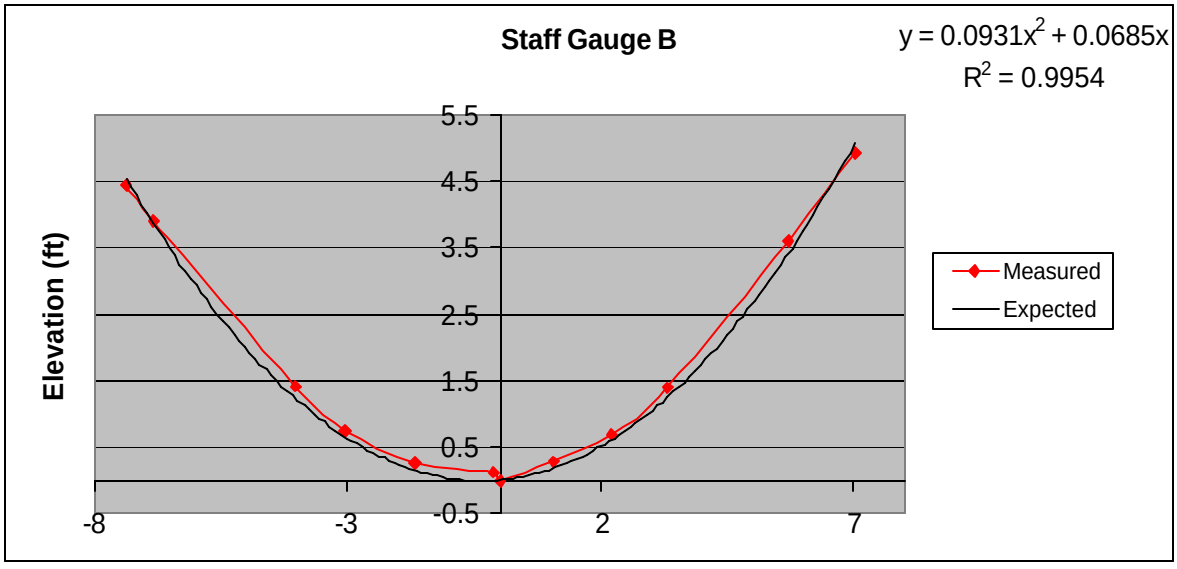

Figure 10. Cross-section at Staff Gauge B, 16HC1.

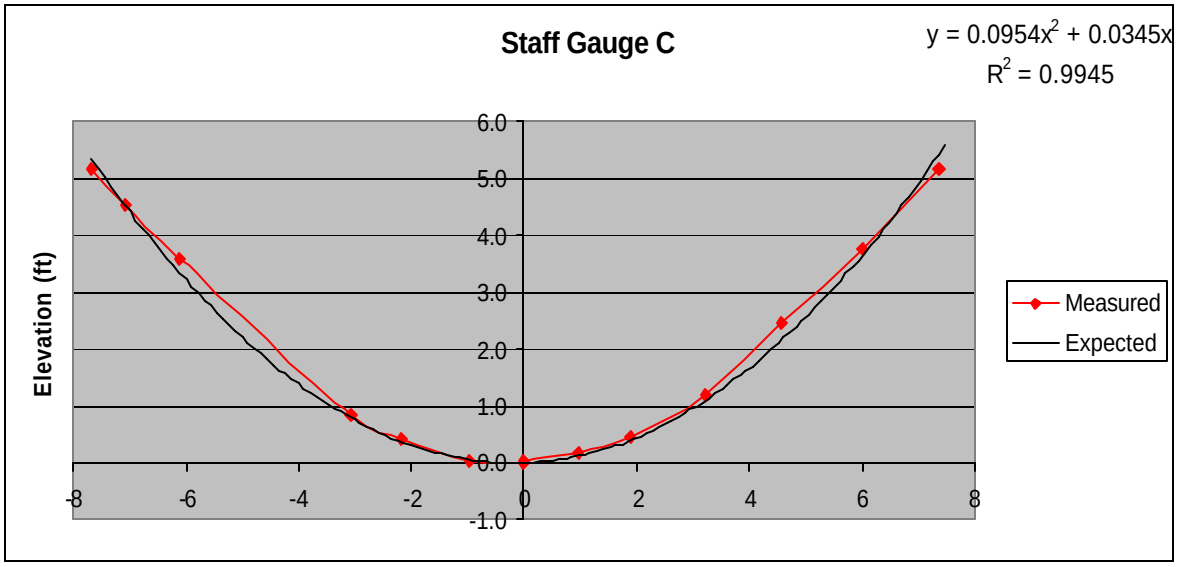

Figure 11. Cross-section at Staff Gauge C, 16HC1.

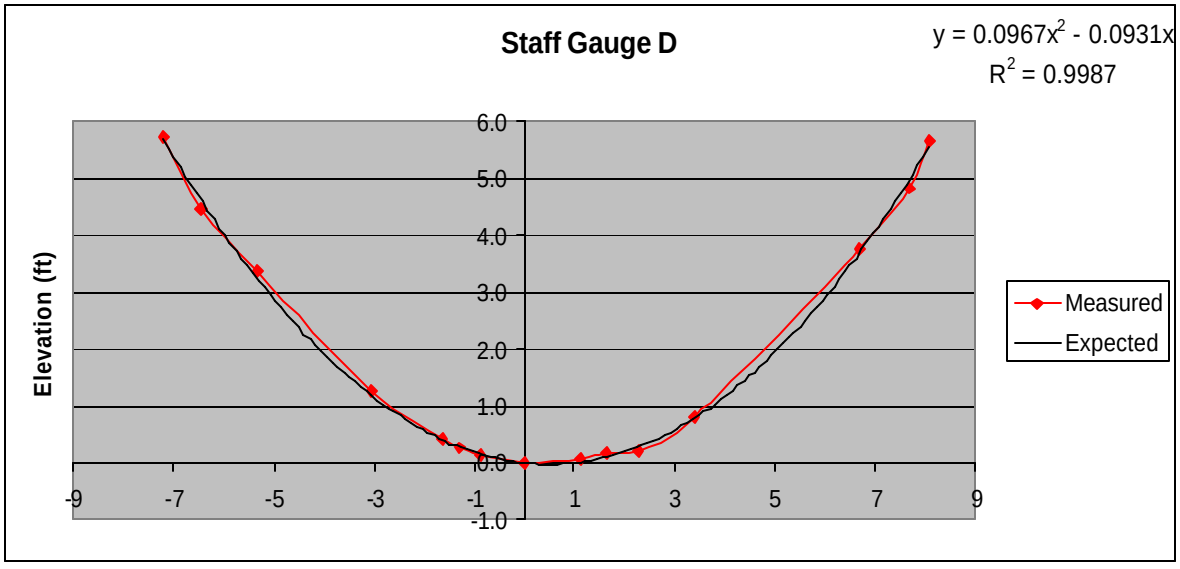

Figure12. Cross-section at Staff Gauge D, 16HC1.

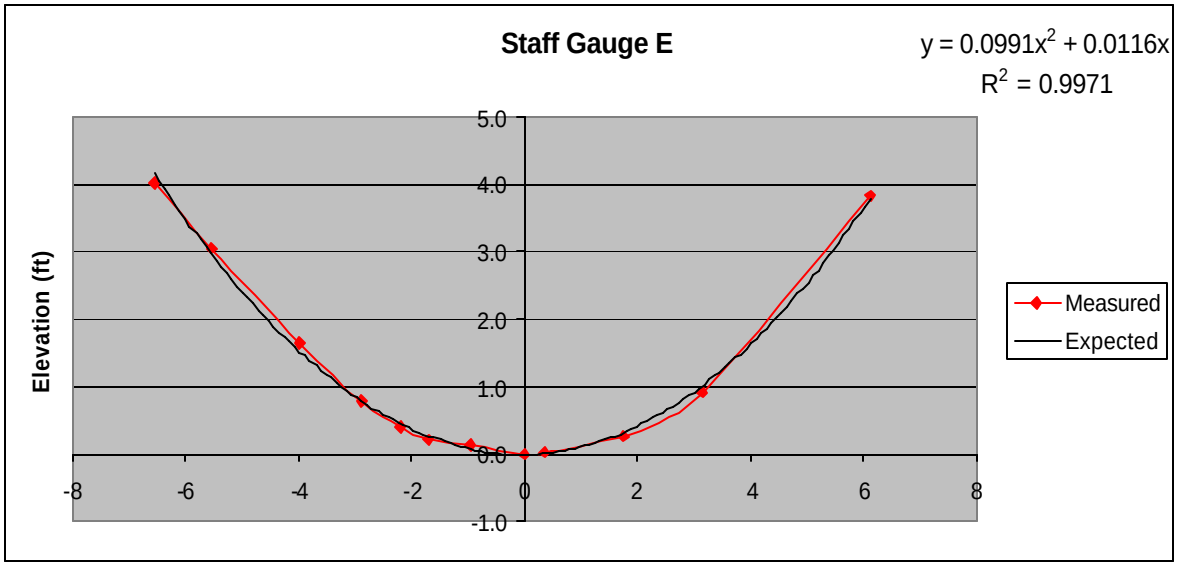

Figure 13. Cross-section at Staff Gauge E, 16HC1.

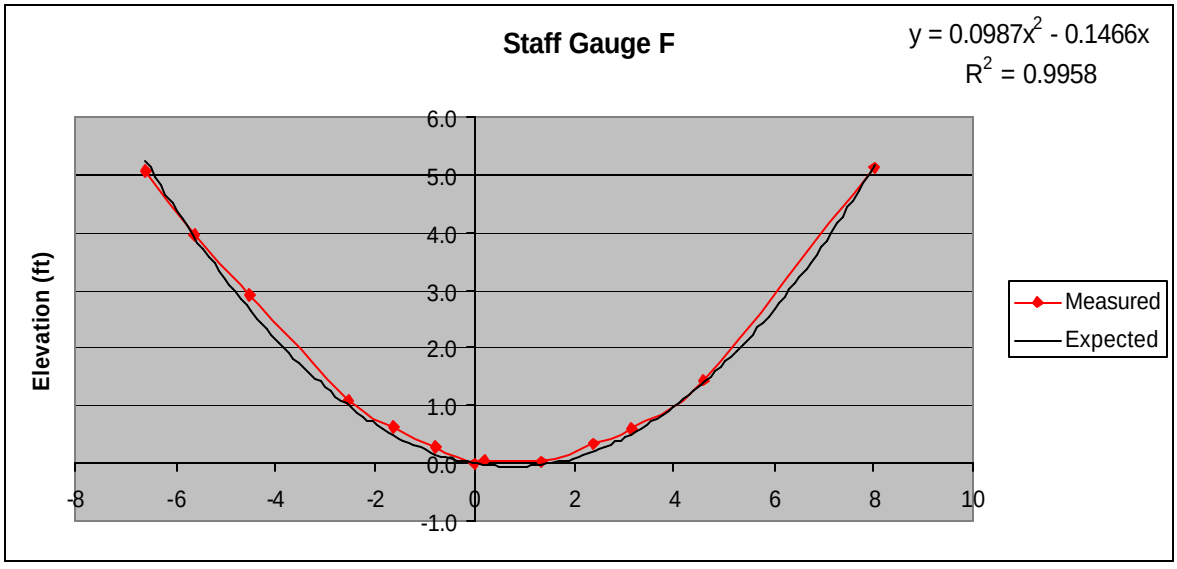

Figure 14. Cross-section at Staff Gauge F, 16HC1.

Table 5. Data for Test 16HC2: Main Canal B.

District: Hidalgo County Irrigation District No. 16	**Test ID:** 16HC2
Canal: Main Canal B	**Lining Type:** Lined
Starting Water Span Widths: **A:** 11.66 feet, **B:** 11.78 feet, **C:** 12.36 feet	**Date:** Oct 22-24, 2003
Test Segment Length: 1000 feet	**Start Time:** 12:17 pm **Finish Time:** 1:49 pm
Test Starting Depths: A: 3.31 feet, **B:** 3.39 feet, **C:** 3.54 feet	
Location: South of FM 2221 and west of Iowa Rd. and just northwest of Mile 6	

Staff Gage Readings

Date	**A**		**B**		**C**	
	Time	**Feet**	**Time**	**Feet**	**Time**	**Feet**
Oct 22	**12:17**	**1.89**	**12:19**	**5.18**	**12:20**	**5.32**
	13:38	**1.87**	**13:32**	**5.17**	**13:31**	**5.31**
	14:31	**1.86**	**14:28**	**5.15**	**14:26**	**5.28**
	15:36	**1.84**	**15:35**	**5.13**	**15:34**	**5.27**
Nov 21	**10:11**	**1.62**	**10:09**	**4.92**	**10:07**	**5.05**
	14:04	**1.56**	**14:42**	**4.86**	**14:40**	**5.02**
Nov 22	**10:08**	**1.44**	**10:07**	**4.72**	**10:05**	**4.86**
	11:45	**1.42**	**11:44**	**4.70**	**11:43**	**4.84**
	13:47	**1.40**	**13:46**	**4.68**	**13:49**	**4.82**
True depth adjustment factor (ft)		**1.423**		**-1.788**		**-1.785**

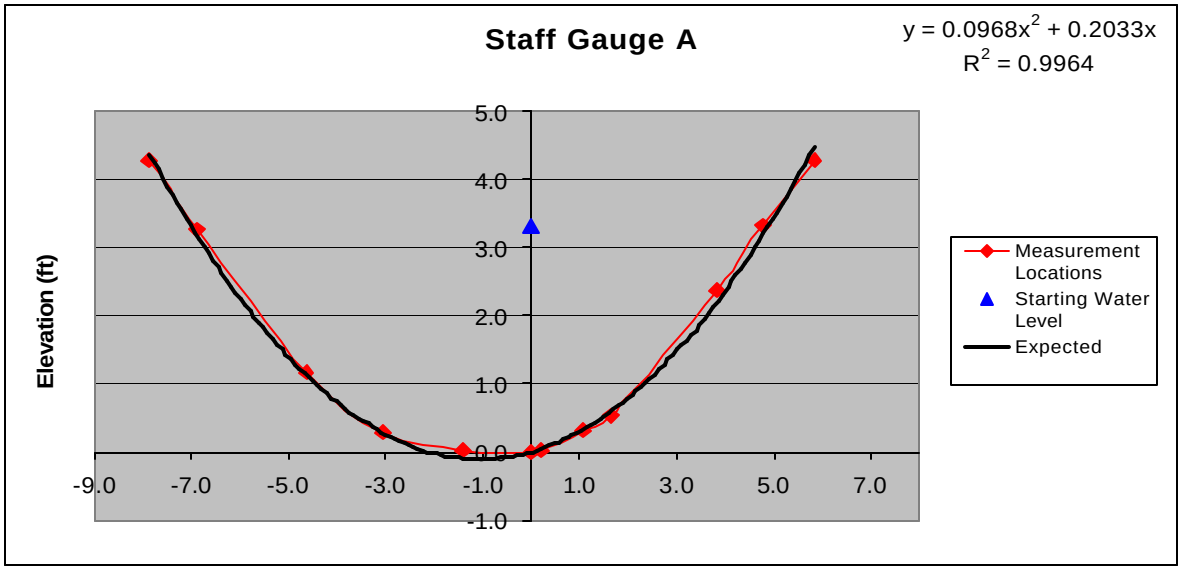

Figure 15. Cross-section of Staff Gauge A, 16 HC2.

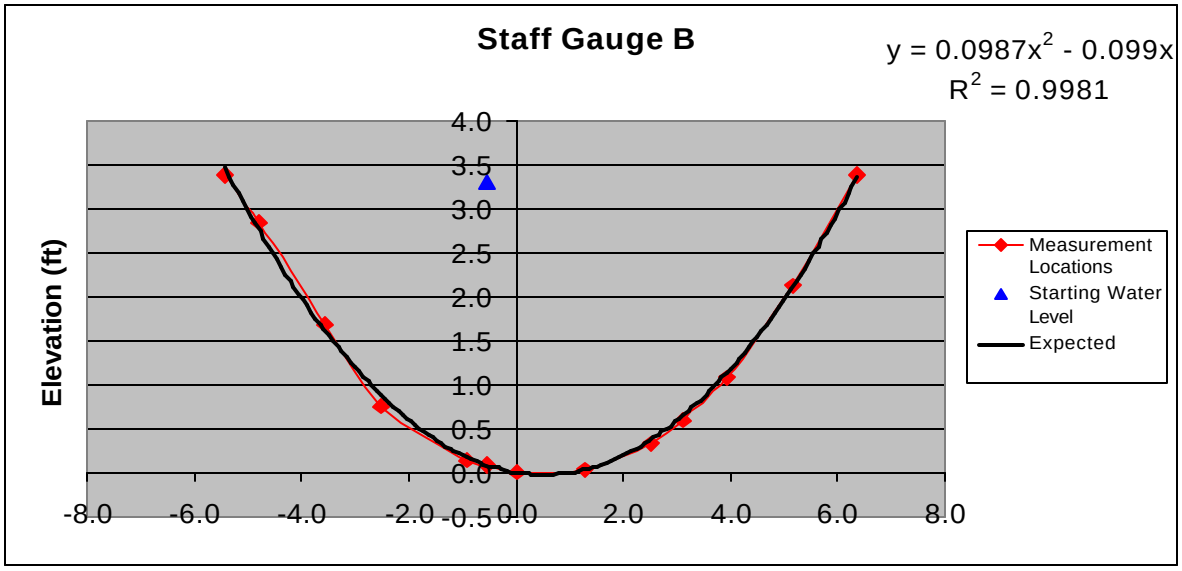

Figure 16. Cross-section of Staff Gauge B, 16HC2.

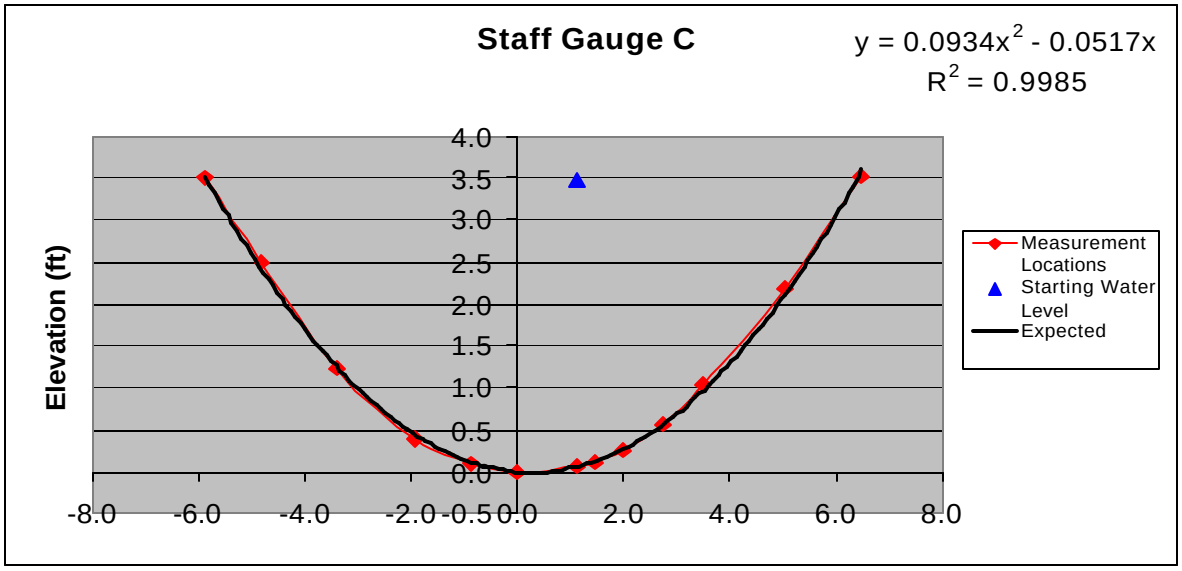

Figure17. Cross-section for Staff Gauge C, 16HC2.

SOIL DESCRIPTIONS

General Soil Series

2 – McAllen-Brennan: Deep, moderately permeable soils that typically have a light brownish gray or dark brown fine sandy loam surface layer (source: Soil Survey of Hidalgo County, Texas USDA, 1978).
3 – Brennan-Hidalgo: Deep, moderately permeable soils that typically have a dark brown or dark grayish brown fine sandy loam surface layer (source: Soil Survey of Hidalgo County, Texas USDA, 1978).

Detailed Soil Units

Table 6. Soil Series Key Codes and Permeability Ranges.

Soil Unit	Permeability (in/hr)
3 – Brennan fine sandy loam	0.6 – 6.0
25 – Hidalgo fine sandy loam	0.6 – 2.0
35 – McAllen fine sandy loam	0.6 – 2.0

Other Test Results

Texas Cooperative Extension has conducted approximately 50 total loss tests and seepage loss tests in the Lower Rio Grande River Basin since 1998. The results are summarized in Tables 7 – 9. Table 10 gives seepage rates versus lining type as reported in the scientific literature.

Table 7. Results of seepage loss tests conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
Lined						
16HC2	03			M		
LF1	03	12	5	M	1.77	152.9
LF2	03	10	6	M	4.61	369.1
MA4	03	12	5	S	8.85	529.7
SJ4	00	15	4	M	1.17	111.2
SJ5	02	14	5	M	1.38	145.5
UN1	01	12	6	M	2.32	217.7
UN2	01	8	3	M	2.09	121.2
Unlined						
BR1	03	60	11	M	3.14	794.6
MA3	03	19	5	S	13.9	1690.1
RV1	03	38	4	M	0.15	23.0
SB4	02	16	4	S	0.64	68.3
SB5	02	18	3	S	1.67	188.3
SB6	02	20	5	S	1.44	189.0
SB7	02	16	4	S	0.42	47.4
SB8	02	20	5	S	0.83	104.0

Classification of canal: M = main, S = secondary

Table 8. Results of total loss tests in lined canals (leaking gates and valves may have contributed to measured loss rates) conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
Lined						
16HC1	03	14	5	M	1.89	192.4
BV1	99	10	5	M	7.97	510.5
BV2	99	9	4	M	8.53	451.5
DL1	00	20	6	M	0.16	18.8
DL2	00	7	4	S	4.12	236.2
DO1	03	5	3	S	1.68	65.2
DO2	03	6	4	S	2.18	121.5
DO3	03	6	3	S	2.71	107.2
ED1	00	6	4	S	34.32	1519.6
ED2	00	6	4	S	21.5	858.2
ED3	00	3	2	T	10.22	308.2
ED4	00	4	3	S	18.72	567.7
ED6	99	9	4	M	8.53	451.5
HA2	00	10	4	M	2.26	135.2
HA3	98	15	2	S	0.64	45.5
ME1	98	38	7	M	1.26	281.9
ME2	98		4	M	1.88	163.5
SJ1	99	12	5	M	2.58	126.8
SJ6	03	12	3	M	1.88	1.63
SJ7	03	19	4	M	1.98	227.1
UN3	02	12	6	M	2.02	154.3

Classification of canal: M = main, S = secondary, T = tertiary

Table 9. Results of total loss tests in unlined canals (leaking gates and valves may have contributed to measured loss rates) conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
BV3	99	55	8	M	0.15	53.4
ED5	02	105	7	M	2.39	1213.2
MA1	99	50	10	M	1.98	227.1
MA2	99	20	5	S	4.32	371.4
SB1	00	29	7	S	1.27	215.5
SJ2	00	23	6	M	2.74	293.2
SJ3	00	30	5	S	0.95	132.6

Classification of canal: M = main, S = secondary

Table 10. 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). Technical Memorandum: San Luis unit drainage program project files. US Bureau of Reclamation, Sacramento. [2] U.S. Bureau of Reclamation (1963). Lining for Irrigation Canals. [3] Nayak, et al. (1996). The influence of canal seepage on groundwater in Lugert Lake irrigation area. Oklahoma Water Resources Research Institute. [4] Nofziger (1979). Profit potential of lining watercourses in coastal commands of Orissa. Environment and Ecology 14(2):343-345.

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