

Estimate of Franklin Canal Seepage Losses Using Ponding Tests

Prepared by

Zhuping Sheng, Ph.D., P.E.

TAMU, Agricultural Research and Extension Center, El Paso
Texas Agricultural Experiment Station



Submitted to

Texas Water Resources Institute

Sponsored by

Texas Water Resources Institute

U.S. Bureau of Reclamation

June 2002

Estimate of Franklin Canal Seepage Losses Using Ponding Tests

Executive Summary

This report summarizes the findings on seepage losses from the Franklin Canal using three ponding tests. This project was conducted under sponsorship of Texas Water Resources Institute and U.S. Bureau of Reclamation. Three ponding tests show that water losses range from 0.114 to 0.403 cubic ft per day per square feet of the wetted area. The total seepage loss for the first 3.26 miles of the Franklin Canal was estimated up to 1,160 ac-ft (or 355.73 ac-ft per mile) for the irrigation season. Field observations derived from three ponding tests indicated that water seeps from the canal into the underground through the canal beds and partially through both sides of the canal. Seepage rates vary from one location to another, depending on the hydraulic condition of the canal beds.

Ponding Test Procedures

Three berms were built with compact soil at three preselected sites to form ponding test sites near the Estrella Street Bridge, the Paisano and Alameda intersection, and the Pendell Street Bridge (Map1). Two twenty-four inch pipes were placed at approximately three feet above the canal floor on each berm to allow downstream flow to the other ponding sites, and prevent flooding that could have been caused by an excessive amount of water. Staff gauges (Picture 1) were installed under the bridges upstream from the berms to measure water level. After the berms were in place, water was fed into the first ponding site at a rate of 5 to 10 cfs. Water for the second and third ponding sites was fed through the installed, 24 inch pipes on each berm. The canal beds and side berms were saturated for over 48 hours before ponding tests took place. Once water inflow and outflow ceased at each site, measurement of water level readings, water temperature, air temperature, and



Picture 1: Staff gage measuring water level

relative humidity began. Air temperature and relative humidity were measured with a digital hand-held meter and cross-referenced and checked with the national weather station at the El Paso International Airport. Water temperature was measured with a standard thermometer attached to a nylon string and a yardstick. Water level, water temperature, air temperature and relative humidity were measured and logged every two to four hours at each ponding site during each day. It was noted that washout of two berms could have been caused by a poor compaction and a high water flow rate.

Field Measurement

Ponding test for site one (near the La Estrella Street Bridge) was started on January 25, 2002. At this site, water level recorded on the staff gage readings ranged from 0.915ft on the first day to 0.19ft on the fourth day. There was a total water level change of 0.825ft due to seepage and evaporation at this observation site. The seepage rate was fairly constant throughout the testing period except for the last two days in which the seepage rate dropped slightly (Figure 1), possibly due to lower head driving force. Water temperature was also fairly constant. It ranged from 5°C to 10°C, but air temperature varied considerably from 13°C to 30°C. Relative humidity also varied from 17% to 35%.



Picture 2: Ponding Site Two

Ponding test for site two (located on Concepcion Street near the Paisano and Alameda intersection, Picture 2) was started on January 25, 2002. The water level at this site dropped 1.095ft, from 1.19ft to 0.095ft during the four-day period. Seepage rate was constant throughout the day (Figure 2). For this pond site, water temperature did not change considerably. The temperature low was 7°C and the high was 12°C.

On the other hand, the air temperature varied somewhat from 12°C to 27°C. Relative humidity ranged from 18% to 43% during the four-day test period.

Ponding test for site three (located near Pendell Street, Picture 3) was started on January 26. The water level dropped 0.365ft in the third day at a constant rate (Figure 3).

Measurements were only taken during the day. This pond site had the smallest variance in rate but also the smallest water level drop. Water and air temperature ranged from 6°C to 10°C and 7°C to 27°C respectively. Relative humidity at this site also ranged from 17% to 37%.



Picture 3: Ponding test site 3.

The evaporation rate during the four-day test period was estimated at 0.006 ft per day based on pan evaporation measurement obtained at the Ysleta station and provided by EPCWID No. 1. Wind speeds range from 4 to 16 miles per hour.

Analysis of Test Results

Table 1 shows analytic results of the seepage loss for each site based on the ponding test measurements (Figures 1 through 3) and geometry of the canal. It also includes estimates of seepage losses for the first 3.26 miles of the upstream Franklin Canal.

1. Seepage loss for each site

Based on water level measurement and geometry of the canal, seepage losses per unit wetted area were calculated (Table 1). For ponding site one, seepage losses ranged from 0.12997 to 0.25379 cub ft/sq ft/day. The second ponding site's seepage losses ranged from 0.31409 to 0.40261 cub ft/sq ft/day. Variations in seepage losses for these two sites may have possibly been resulted from lower head differences at the end of seepage testing. For the third ponding site, the seepage losses ranged from 0.11385 to 0.13173 cub ft/sq ft/day. Ponding site three had the least variation in seepage loss in comparison with the other two sites, which may be attributable to the lining of approximately 1/3 of the canal beds within the third ponding site. The results also indicate that seepage rates change from one location to another, and seepage rates are also reduced with the drop in water level.

2. Total seepage loss for the irrigation season

Maximum and minimum seepage rates at each ponding site, daily seepage losses and total losses for the irrigation season (Table 1) were estimated. In the estimate, the following parameters were used: water top width was 30 ft; bottom width of the canal was 26 ft; the wetted perimeter was 32 ft, and slope was 1:1. The calculated seepage losses range from 0.414 to 1.4639 ac-ft/mile/day, or 100.59 to 355.73 ac-ft/mile for the primary irrigation season. Table 1 also includes the estimate of total seepage losses during the 243-day primary irrigation season for the 3.26 miles of the upstream canal. In consideration of the similarity of the hydraulic conditions between the high water level ponding and irrigation flow, early stage seepage loss rates were used to estimate the total seepage losses for the irrigation season. Using seepage rates from sites 1 and 2, it was estimated that total seepage losses were 731.02 ac-ft and 1,159.69 ac-ft respectively. Although the Canal was saturated for over 48 hours before ponding tests were conducted, the hydraulic condition will still differ from that of the irrigation season. The preliminary data reported in this report will be further evaluated with current meter measurement during the irrigation season. Other losses may also be identified at that time. In summary, total seepage loss was calculated at a range between 731 and 1,160 ac-ft for the 3.26 miles of the upstream Franklin Canal during the primary irrigation season, or 220 to 360 ac-ft/mile for the primary irrigation season.

The estimated seepage losses for the primary irrigation season derived from the results of these three tests are very close to the 2001 Dr. Al Blair's results (200 to 400 ac-ft/mile) and to the USBR's measurement (370 ac-ft/mile) in 1984. However, the estimated seepage losses are only about 1/4 to 1/2 of those of the USBR's estimates (800 to 1,000 ac-ft/mile) conducted in 1991 and 1993 respectively, and are approximately 1/8 to 1/4 of the USGS estimate (1,700 ac-ft/mile).



