RECLAMATION
Managing Water in the West

Bernalillo River Maintenance Priority Site

Bend Migration Monitoring
Spring 2005

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MISSION STATEMENTS

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

BERNALILLO PRIORITY SITE

Spring 2005 Monitoring Report

The Bernalillo Priority Site is located on the Rio Grande, approximately a half mile downstream of the U.S. Highway 550 bridge crossing; the site is located immediately upstream from the Pueblo of Sandia. The concern for this site is that the river is eroding the eastern bankline, and that the distance between the bankline and the toe of the levee is small. A levee breach at this location could cause flooding in the town of Bernalillo, NM.

This Rio Grande bend formed in the 1990s and slowly migrated towards the levee toe. As the bankline moved closer to the levee (Figure 1), a short-term 'fix' of riprap was emplaced along the edge of the bankline in 2003 (Figure 2). The bankline armouring is a short-term solution until a long-term solution is constructed. At present, a long-term solution is in the planning phase which may include both reinforcing the eastern bank line with a series of 'bendway' weirs and splitting the low-moderate flows by partially re-activating the western side channel (Figure 1). This project is estimated to begin construction next year (Fiscal Year 2006).

Figure 1: Aerial view of the Priority Site, May 2004, looking downstream at the east bank with the town of Bernalillo in the distance.

While waiting for the long-term 'fix' to be implemented, Reclamation is monitoring bend migration and bank erosion in the vicinity. Until 2005, bank erosion was slow, however, in the 2005 runoff, the bend apex at the Priority Site 'slid' down the riprap lined bankline and rapidly eroded the unprotected bankline downstream. This report documents the magnitude of bankline erosion in the priority site area.

Figure 2: Bernalillo Priority Site; photo taken in July 2004, looking downstream towards the rip-rap lined east bank.

Priority Site Migration

Bank erosion was first noticed on March 14, 2005 (Figure 3), however the initiation of a migrating bend was not observed until late in April 2005 as spring runoff flows began; erosion continued until the end of May. Although the priority site bend is located upstream of the boundaries of the Pueblo of Sandia, once bend migration initiated, the bend rapidly shifted downstream onto the Pueblo's land. At this point, the Pueblo was contacted and arrangements were made to visit and map the bankline weekly.

Bend migration was first observed on April 21st, with additional observations, photographs and notes on April 22nd (Figure 4) at which time, approximately 200 feet of bankline had already eroded. Runoff was just ramping up with river flows about 4,700 cfs on April 22nd, a moderately high flow. Prior to runoff, a row of Kellner jetty jacks lined the bank (some visible on right of Figure 4 photo), with vegetation growing through them; these jacks were easily eroded and transported downstream. Also, based on observations of several trees in the river downstream of the Priority Site, bank erosion was not significantly hindered by the presence of mature trees or other vegetation on the terrace. At a distance of about 60 feet perpendicular to the old bankline, the migrating bend hit two rows of jacks that hindered the bank erosion. These jacks were partially buried and remained connected to the bank throughout most of runoff (line of jacks visible in center of Figure 4 near leaning tree).

Figure 3: Bank erosion just downstream from the rip-rap armoured bankline at the Bernalillo Priority Site.

Bank erosion continued throughout the spring runoff with significant erosion into late May. The length of re-worked bankline increased up to 300 feet where the bend encountered a small group of healthy Russian

Figure 4: Bank erosion/bend migration at the Bernalillo Priority Site on April 22, 2005.

Olive/Tamerisk trees. After 'hitting' this erosion resistant location, the bend apex began to erode eastward, into the bank material which sculpted a bend with a larger curvature/radius (Figure 5); about 50 feet of bank material was eroded during the increased curvature event.

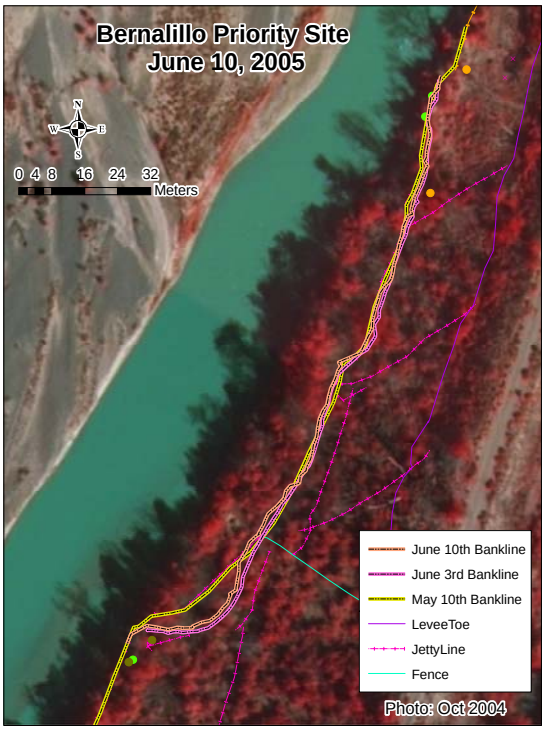

Figure 5: Bernalillo Priority Site map with bank line locations mapped periodically in Spring 2005.

In early June, bend migration essentially stopped (Figure 5). The two jetty jack lines that had prevented southeast erosion had become undermined and sections of the jack line began falling into the river channel (Figure 6). Although the sediment underneath the jetty jacks has been continuously eroded since the bend apex passed this location, the magnitude of the undermining appears to be decreasing, but may continue, even during low-flow periods.

Figure 6: Bank erosion at the Priority Site on May 27th, showing the erosion of sediments underneath the jetty jacks.

By late June, large blocks of bank material were un-transported by the Rio Grande, and began lining the eroding bankline (Figure 7) thus indicating that the bend location was stabilizing. Since that time, the bankline along the entire bend apex has

Figure 7: Small slump blocks fallen from the bank line at the bend apex on June 3rd.

slumped (Figure 8). The result of the bank slumping is to form a toe at the river's edge that 'protects' the remaining undisturbed bank sediments from lower riverine flows.

Figure 8: Extensive bank slumping/collapses at the bend apex; photo taken on June 24th.

The cause of the reduced bank erosion was not a reduction in discharge or the end of runoff, in fact, the flow increased from about 5,000 cfs to 6,500 cfs at the USGS Rio Grande gage at Albuquerque, NM on June 1st. Field observations from a site visit on June 3rd indicate that the thalweg shifted towards the middle of the main channel, away from the east bank. Also noted at this time was that the water surface level on medial bars visible from the Priority Site decreased in elevation, such that more of the bars became exposed and other smaller bars emerged from being flooded. The decrease in water surface elevation was estimated at ½ - 1 foot.

A site visit on July 22, 2005, shows that the major change after runoff, is the continuation of bank slumping along the new bank line, including under the jetty jacks (Figure 9). Bank slumping around jetty jacks has allowed them to completely fall into the river channel. The current water surface extends to the toe of the new bankline.

Two important features that are now visible are the main channel thalweg location and the bar development on the opposite side of the main channel from the bend. The low flow thalweg is in a similar position to that prior to spring runoff, such that it intersects the east bank at the upstream end of the bend, where the bank is armoured with rip-rap. It then follows the bankline downstream, flowing at about ⅓ the distance across the main channel.

The other important feature, opposing bar (point bar), is also obvious at the site (Figure 10). Prior to the 2005 runoff, this bar existed; however it was connected to a small, sparsely vegetated island to the west of the priority site. After the 2005 runoff, this bar was reshaped such that the top of the bar appears to have been partially eroded, but it also slopes gently to the current rivers edge (pro-grades), and extends some distance into the main channel. The most important aspect of this bar is that it appears to have grown in

Figure 9: Site photo from July 22, 2005 that shows bank slumping along the bend apex, and a portion of the jetty jack line that has fallen into the river.

size and is now narrowing the main channel at the upstream end of the bend.

Figure 10: Looking upstream from the Bernalillo Priority Site; photo shows a large point bar on the west bank of the main channel, opposite the priority site (photo date 7/22/05).

In summary, approximately 350 feet of bank line downstream from the riprap lined bank was eroded during spring runoff 2005 (Figure 5). At the apex of the bend, the width of erosion is about 50 feet. Two lines of jetty jacks that were well anchored in the bank material appear to have initially hindered lateral migration of the bend apex towards the levee, while the already compromised jetties that had fallen into the river channel prior to runoff were easily transported downstream from the site during the early stages of bend migration. Since the migration rate decreased, the edges of the banks have begun to collapse. This additional bank sediment did not fill-in the river channel at the bend apex; rather this section of the channel is an eddy or backwater. The thalweg does not hug the eastern bankline at either very high flows or low summer flows. Under the line of jetty jacks, the bank sediments have also collapsed and have been eroded by the river. As a result, part of the jetty jack line has fallen into the river. A pro-grading point bar grew from an old medial bar/riverine deposit across the main channel from the priority site. The new bar is larger than the pre-2005 runoff bar and narrows the main channel along the rip-rap armoured bankline. Additional bank erosion is expected at this site when river flow returns to a moderate level, 2,000 – 4,000 cfs.

Upstream Bank Erosion

Although minor amounts of the western river bank has been eroded in the past few years (Figure 11), a large section of bankline began eroding during the 2005 spring runoff event. The west river bank, upstream from the Bernalillo Priority Site began rapidly eroding in May 2005; at present, the bank appears to be retreating in a predominantly western direction (Figure 12). Prior to runoff, the bank line was steep (Figure 13) vegetated with a mature cottonwood forest; the rate of bank erosion prior to May 2005 is not known, but the steep banks indicate that some erosion was ongoing.

Figure 11: Aerial photograph during 2005 spring runoff looking upstream at the NM HWY 550 bridge crossing.

During runoff, as seen at the priority site, the thalweg in the Rio Grande shifted, such that new bank erosion occurred; however, this site erosion began in ernest when the spring runoff peaked in June. At this site, photography during the runoff shows that the thalweg shifted closer to the bank line in June, and consequently, the bankline gained curvature (began eroding). At approximately the bend apex, a local land owner placed large pieces of concrete along the eroding bankline in mid-June (Figure 13).

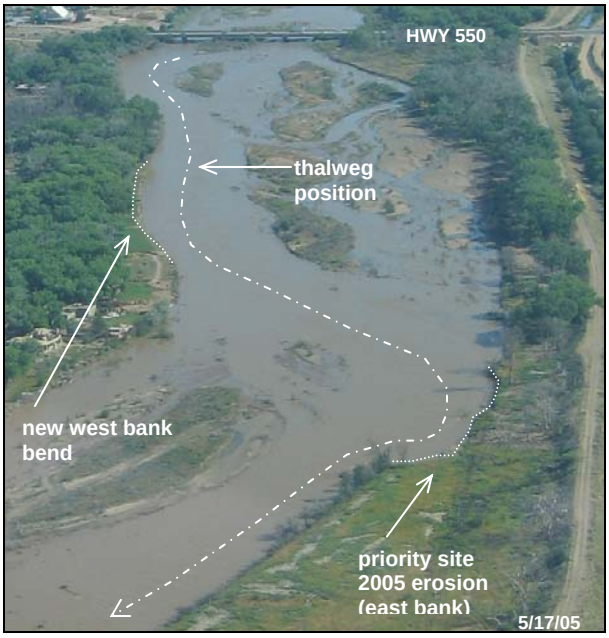

Figure 12: Aerial photograph during 2005 spring runoff looking upstream at the NM HWY 550 bridge crossing.

As found at the Priority Site located immediately downstream, a point bar has developed opposite the bank erosion of the main channel. This point bar is connected to a partially vegetated island and pro-grades into the main Rio Grande channel. The point bar effectively reduces the wetted width, especially during low flows and concentrates the thalweg against the west bank. The point bar was examined on July 22, 2005; it is composed of loosely consolidated cobble, gravel and sand sized sediments.

In summary, the western bankline is eroding upstream of the Bernalillo Priority Site. The shifting thalweg from the west bank to the east bank is consistent with a migrating river system; this channel pattern is expected to not only continue as these bend mature (grow) but other meander bends will likely form in the vicinity.

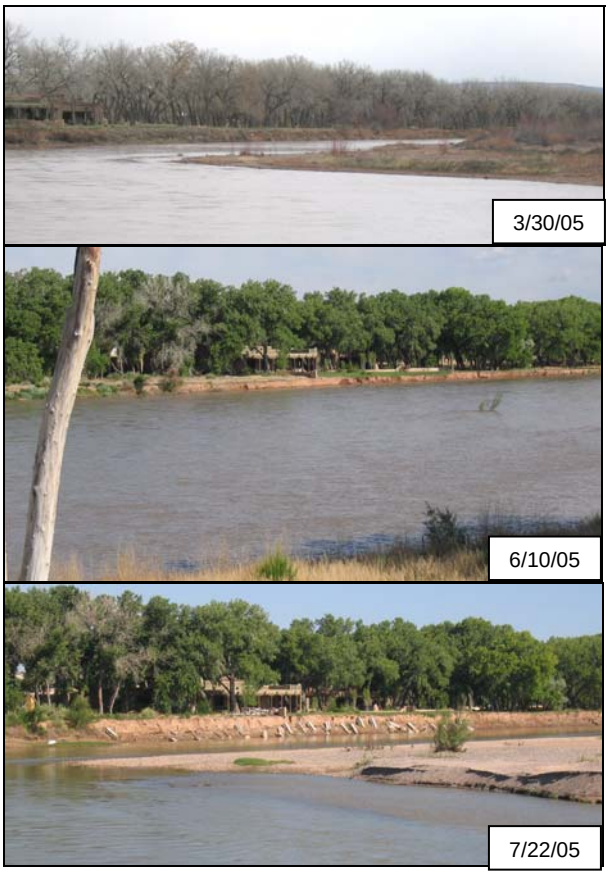

Figure 13: West bank bend: March to the end of July 2005, showing progression of bank erosion.

Additional monitoring of these sites is recommended, as the reach scale meander pattern is just setting up. The proposed long-term 'fix' at the Bernalillo Priority Site still appears feasible based on the current conditions, however additional erosion protection may be warranted if erosion continues after construction. The bank erosion upstream of the Priority Site is ongoing, but is not expected to significantly influence the priority site project.