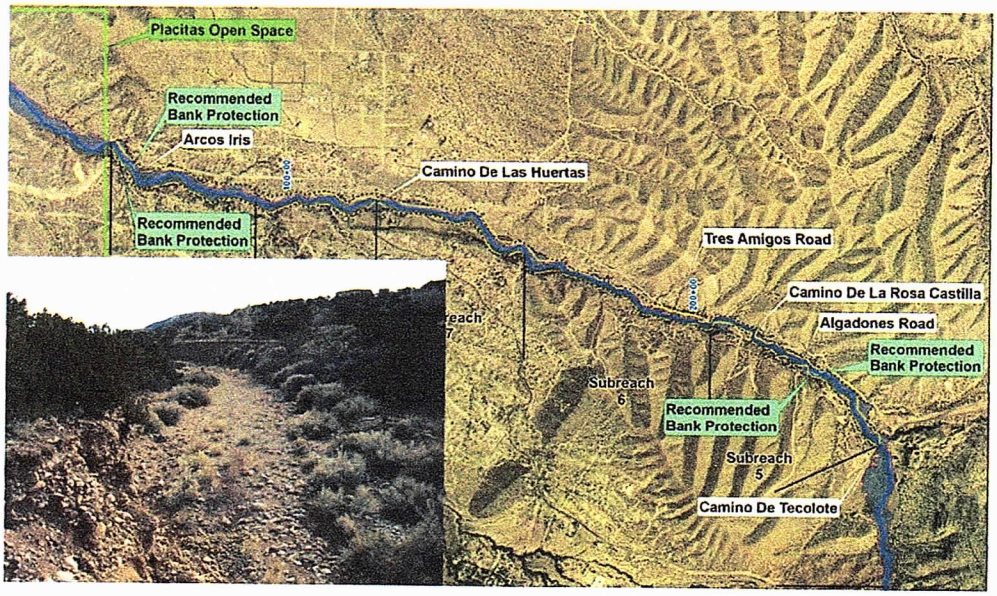
2010 ENGINEERING REPORT ON LAS HUERTAS CREEK

Channel Stability Analysis and Prudent Line Assessment for Las Huertas Creek, Sandoval County, New Mexico



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1. INTRODUCTION AND BACKGROUND

Tetra Tech, Inc. (Tetra Tech), under a subcontract agreement with Wilson and Company, Inc., Engineers and Architects (hereinafter referred to as Wilson & Co.), conducted a study to evaluate the hydraulic and sediment-transport characteristics of the approximately 6.6-mile reach of Las Huertas Creek between the upstream boundary of the Placitas Open Space and the National Forest Boundary (**Figure 1.1**). The purpose of this study was to assess potential flood conditions and the vertical and lateral stability of the channel, and based that information, identify an appropriate lateral erosion corridor that can be used by the Eastern Sandoval County Arroyo and Flood Control Authority (ESCAFCA) to assist the community in guiding future development along the creek. The need for grade control structures to prevent excessive channel degradation and other naturalistic channel stabilization measures to limit lateral erosion in key areas was also assessed.

Specific work for this project included development and application of a 1-dimensional (1-D) HEC-RAS hydraulic model of the reach that was used to estimate preliminary limits of the 100-year flood inundation mapping under existing and future development conditions hydrology and an assessment of the lateral and vertical stability of the creek under existing conditions. This information was then used to identify existing erosion problem areas and potential changes in the lateral and vertical stability under future development conditions, prepare recommendations for the location and size of grade-control structures, and develop an erosion limit line. The erosion limit line is consistent with the Lateral Erosion Envelope (LEE) line, as defined by the Southern Sandoval County Arroyo and Flood Control Authority (SSCAFCA) (Mussetter Engineering, Inc., 2008)]. The *Prudent Line*. as defined by the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) (Mussetter et al., 1994), is then developed by defining the corridor that encompasses both the potential flooding limits for the 100-year event under future development conditions and the erosion limit line. Along the 2.8-mile reach upstream from Camino del Tecolote, where the potential for lateral migration is relatively small, a qualitative assessment of the lateral and vertical stability was performed, and the 100-year flood inundation boundaries were delineated under both existing and future development conditions hydrology. For the 3.8-mile reach below Camino del Tecolote, a quantitative analysis of the lateral and vertical stability was performed and used in conjunction with the 100-year flood inundation limits to develop the Prudent Line.

The conclusions and recommendations resulting from this study are summarized in Chapter 7. The technical basis for these conclusions and recommendations are described in detail in Chapters 2 through 6.

In reviewing the information in this report. it is important to note that all reference to the left and right banks is with respect to a downstream-oriented view. As a result, the left bank is generally on the south and west side of the channel and the right bank is generally on the north and east side. It should also be noted that the channel stationline used for the analysis begins approximately 1 mile downstream from the Placitas Open Space Boundary and increases in the upstream direction to the upstream study boundary. The subreaches are, however, numbered from upstream to downstream to facilitate the sediment-transport and channel-stability analyses.

This work was performed under Subcontract No. 01 of Wilson & Co. Job No. 09600070-11. Mr. Steve Salazar was the Project Manager for Wilson & Co., and Dr. Robert Mussetter (PE, NM) was Tetra Tech's Project Manager. Most of the analysis was performed by Mr. Stuart Trabant (PE, CO) with assistance from Mr. Michael Pierce (EIT, CO) and Ms. Susan Novak.

7. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1. Summary

This study was prepared to assist ESCAFCA in assessing the hydraulic and channel-stability characteristics of Las Huertas Creek between the National Forest Boundary and the upstream (eastern) boundary of the Placitas Open Space and to recommend a Prudent Line boundary within which there is significant risk of damage to property improvements due to flooding or erosion associated with flows up to the 100-year flood peak. In the portion of the reach upstream from Camino del Tecolote, channel stability and lateral erosion potential were assessed qualitatively based on primarily field observations and the overall channel characteristics. Downstream from Camino del Tecolote, a quantitative assessment of the vertical and lateral stability of the channel was carried out to aid in developing the LEE lines. In both portions of the reach, the potential flood hazard was assessed by delineating the flood inundation limits associated with the 100-year peak flow for both the existing and future development conditions hydrology. As noted in the footnote on Page 4.7, neither the model nor the flood inundation mapping have been subjected to the level of quality assurance and the FEMA review process that is typically performed for a detailed and approved FIS. As a result, it is possible the FEMA-approved flooding limits in some areas would be different from those shown on the mapping presented here. The Prudent Line was developed based on the maximum extent of the LEE lines and 100-year flood inundation boundaries.

7.2. Conclusions

The following specific conclusions were drawn from the analysis:

1. The reach between the National Forest boundary and Camino del Tecolote is very coarse grained with large boulders along the channel bed and banks, and is relatively stable, both vertically and laterally.
2. Hydraulic conditions (e.g., depth, velocity, and topwidth) vary significantly along the project reach.
3. The longitudinal extent of backwater caused by the numerous road and culvert crossings along the reach is generally limited due to the steep channel gradient. The most significant backwater effects occur upstream from the Camino del Tecolote and Camino de Las Huertas culvert crossings.
4. Anticipated future development in the watershed will be relatively limited; thus, peak flows will increase only modestly under future development conditions. For example, at the downstream end of the project reach, the 2-year peak flow will increase from about 360 cfs under existing conditions to about 380 cfs under future development conditions, and the 100-year peak flow will increase from 13,620 to 13,780 cfs.
5. Several tributaries deliver sediment to the mainstem along the reach; however, only Arroyo del Ojo appears to deliver a sufficient coarse-grained (gravel- and cobble-sized) material to significantly affect the overall sediment balance in the reach. An equally significant supply is derived through bank erosion that, in some cases, delivers very coarse bed material to the mainstem.
6. A sediment continuity analysis that was performed to assess the relative balance between the sediment supply and transport capacity indicates that Subreach 6 (Camino de la Rosa Castilla to Senda Osa Vieja) and Subreach 8 (Camino de Las Huertas to Arroyo del Ojo) are degradational, while Subreach 7 (Senda Osa Vieja to Camino de Las Huertas) is

aggradational, and the other subreaches downstream from Camino del Tecolote are in approximate balance.

7. Based on estimates of the ultimate equilibrium slope, degradation potential will be most significant in Subreach 6, where up to 9 feet of additional downcutting could occur. The downcutting in this reach will, however, be limited to some degree by the existing grade control structures, if they remain stable. Additional downcutting of up to 9 feet could occur in Subreach 8, the portion of the study reach where there are several pipeline crossings of the creek. Recommendations for grade control in this area are discussed below.

8. Lateral migration potential along the project reach is limited to varying degrees by several factors, including erosion-resistant, bounding terraces, existing bank protection, and lateral control provided by road crossings.

The Prudent Lines developed for this study provide a framework that can be used by ESCAFCA to assist landowners and developers in identifying locations for future residences and other structures that are reasonably safe from flooding and erosion impacts associated with flows up to the peak of the 100-year flood. The study result may also be used to evaluate and prioritize channel-stability measures where existing structure may be at risk.

7.3. Recommendations

The Prudent Line boundaries shown in Appendix A delineate the area within which there is significant risk of damage to property improvements due to either flooding or erosion during flood flows up the peak of the 100-year storm. It is recommended that the community adopt a policy that would discourage or prohibit future construction of structures, and actions should be taken to protect existing structures, within this corridor. The vertical and lateral stability of the project reach may be enhanced and existing structures may be protected by installing grade control structures at some locations, monitoring the vertical stability in other areas, and installing bank protection at specific locations, as described below. Guidelines for designing the channel stability measures are presented in the Design Guide.

7.3.1. Recommendations for Vertical Stability

Pipeline crossings were identified during the field reconnaissance at a number of locations based on the presence of articulated concrete aprons or pipeline markers, including:

1. Two crossings located upstream from each of the Camino De La Rosa Castilla culvert crossings near the downstream limit of Subreach 5,

2. Upstream from the Camino de Las Huertas culvert crossing near the downstream limit of Subreach 7, and

3. Numerous crossings (including longitudinal reaches of pipeline) in Subreach 8.

Grade control is provided by the Camino De La Rosa Castilla culvert crossings, so it will not be necessary to provide additional protection for the pipeline crossings upstream from these culverts at the current time. Similarly, no protection is necessary for the pipeline crossings in the downstream portion of Subreach 7 since the Camino de Las Huertas culverts provide grade control at the downstream limit of this subreach. Each of these culvert crossings (Camino De La Rosa Castilla and Camino De Las Huertas) should be monitored after flood events to ensure the culverts are stable and are still providing the necessary grade control to protect the upstream crossings.

Based on the equilibrium slope analysis, it appears grade control may be necessary to protect the pipeline crossings in Subreach 8 (**Figure 7.1**). Preliminary recommendations for these grade-control structures were developed based on the anticipated degradation depths and located either downstream from the pipeline crossings to prevent undermining of the pipelines or located between the crossings to reduce the drop height across the structures (**Figure 7.2**). The estimated drop heights for the structures, which do not include any estimates for local scour, range from about 3 feet at the downstream structure to about 7.5 feet at the upstream structure. It should be noted that additional information regarding the location or depth of the pipelines (discussed below) will likely result in some refinement of these preliminary recommendations for grade control. Prior to construction of the grade-control structures, the articulated concrete mat that is currently providing at least some protection for the pipeline crossings should be inspected periodically to insure that it is structurally sound. It is also recommended that the existing grade- control structures in Subreach 6 be inspected periodically to insure that they remain stable, especially after flood events. Similarly, the existing culvert and grouted rock/concrete sill crossings in this subreach should also be inspected on a regular basis to evaluate downstream scour conditions that could undermine the foundations. In any of these cases, properly toed-down protection measures can be added in the scour area immediately downstream from the structures if undercutting becomes evident.

7.3.2. Recommended Bank Protection

A number of existing residences are located within the LEE line corridor. To insure that these structures are not threatened by potential lateral migration, bank protection is recommended at several locations (**Table 7.1**, Appendix A). Bank protection was not recommended at smaller, non-residential structures such as storage facilities, livestock shelters or barns (Table 6.3) based on a qualitative judgment that such protection measures would probably not be cost effective. These locations should be carefully reviewed on a case-by-case basis to insure that the above conclusion is correct. The recommended bank protection at the sites listed in Table 7.1 varies in length from about 190 to 230 feet. The highest priority sites are located along both banks in the actively eroding reach between Sta 58+80 and Sta 63+20 in Subreach 9. Lower priority bank protection is recommended along both banks upstream from the Algodones Road crossing between Sta 232+30 and Sta 234+50 in Subreach 5, where the existing bank protection may not be sufficient to prevent lateral migration or channel widening. Residential structures that are not within the LEE line corridor but are sufficiently close to warrant periodic monitoring of lateral erosion are located at Sta 98+00 (structure on left bank terrace) and Sta 169+50 (structure on right bank near apex of very sharp bend). It should be noted that the aerial photography used to develop the above recommendations for bank protection was collected in September 2009; thus, a similar evaluation should be made if any structures have been constructed within the LEE since this time.

7.3.3. Recommendations for Future Work

A number of future tasks should be carried out to better evaluate the potential threats to the pipelines. This work should include the following:

1. Collect additional site-specific information to identify the location and nature of the pipeline crossings, if available (i.e., contact the utility and pipeline companies for this information).

2. Perform field investigations to verify the pipeline locations and determine burial depths and the nature of protection measures, if present.

a. Conduct a field reconnaissance and survey of the study reach to identify crossing marker locations,

Table 7.1. Summary of recommended bank protection along the project reach of Las Huertas Creek.

Upstream Station	Downstream Station	Length of Bank Protection (ft)*	Bank	Remarks
236+00	234+00	220	Right	Existing bank protection may be insufficient at this location.
234+00	232+30	190	Left	Existing bank protection may be insufficient at this location.
63+20	61+00	230	Right	No significant existing bank protection.
60+50	58+80	220	Left	No existing bank protection.

*Length of bank protection not linked to station line.

b. If permissible by utility/pipeline companies, use a backhoe to pothole pipeline crossings to determine burial depth and presence of protection measures, and

c. During field reconnaissance, verify local sediment supply conditions, including tributaries and bank erosion, and obtain additional bed- and bank-material samples near the pipeline crossings (i.e., Subreach 8). Because the field reconnaissance for this study was conducted during a snowy period and at a time when the exact location of the pipelines was not known, this additional field reconnaissance may provide valuable information for specifically evaluating the threats to the pipelines.

3. Based on the information in Tasks 1 and 2, above, update the equilibrium slope analysis to refine the estimated potential for degradation, and revise the recommendations for the number, size, and location of grade-control structures that would be necessary to protect the pipeline crossings.

4. Prepare preliminary designs for the grade-control structures, bank protection and other measures that may be necessary to prevent pipeline failure.