NM 41
Clark Hill to US 285 (MP 46.1 to MP 62.1)

Phase 1-B: Detailed Evaluation of Alternatives Report – Volume 1

Santa Fe County, New Mexico
Project No. TPA-1502(20)46, CN U500010

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March 2011
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**APPENDIX A**

Agency Coordination

**APPENDIX B**

Bridge Lab Test Report

**APPENDIX C**

Preliminary Initial Site Assessment
1.0 INTRODUCTION AND BACKGROUND

This report summarizes and documents the investigations, analyses, and findings for the second phase (Phase B) of the NM 41 Alignment Study between Clark Hill (milepost [MP] 46) and the US 285 Junction (MP 62.1). The study is being conducted by the New Mexico Department of Transportation (NMDOT) in cooperation with the Federal Highway Administration (FHWA). The purpose of the NM 41 Alignment Study is: (1) to evaluate the conditions that may require improvements to the existing highway; (2) to identify and evaluate improvement options; and (3) to identify the preferred alternative. The study area covers a distance of approximately 16.1 miles. The general project location and termini are illustrated in Figure 1-1 on the following page.

The preparation of the alignment study has followed the NMDOT Location Study Procedures, as revised, to incorporate the linkage of planning and environmental phases. The Location Study Procedures include a comprehensive identification and evaluation process to determine transportation problems and to identify and evaluate potential improvement alternatives. The Location Study Procedures process is consistent with the environmental regulations of the FHWA as mandated by the National Environmental Policy Act (NEPA) of 1966, as amended. Coordination and consultation with federal, state, and local agencies; highway users; study area residents; and others having an interest in the highway and/or resources within the proposed project area are key components of the study process.

This report builds on the analyses conducted in the Initial Alignment Study (Phase A) completed in June 2010. The findings of the Initial Alignment Study established the need to correct design, structural, and pavement problems, and to improve safety within the project limits. The Initial Alignment Study also identified and evaluated improvement alternatives and concluded with findings and recommendations regarding the feasibility of each alternative. The findings of the initial alignment study identified the alternatives that best address the need for improving the existing highway while avoiding and/or minimizing impacts to important environmental and community resources. Alternatives that did not meet the need of the project and/or had significant impacts with little corresponding benefit were eliminated from further consideration. Phase B of the alignment study involves a more detailed engineering and environmental impact assessment of the alternatives advanced for continued consideration. This report includes the findings of the Phase B (Detailed Evaluation of Alternatives) analysis. The final phase of the project (Phase C) will consist of a formal environmental document in compliance with NEPA.

A primary consideration of this alignment study is to evaluate geometric improvements to the highway and the two historic bridge structures located within the southern portion of Galisteo. Deficiencies with the highway and bridges are of concern to the safety of highway users, including drivers, bicyclists, and pedestrians. Public input obtained during the course of this study and comments received during a previous NMDOT study of the two bridges within Galisteo indicate concerns by some residents of Galisteo that improvements to the highway and bridges could have adverse impacts to the community, the historic character of Galisteo, and environmental resources. This concern extends to the physical destruction of the historic structures as well as the secondary impacts from increased traffic including commercial truck use and higher travel speeds. Based on the feedback from these and other stakeholders, the approach used for this alignment study has emphasized the need to achieve a safe highway for users while minimizing impacts to the community and environmental and cultural resources.
Figure 1-1: Project Vicinity and Location
1.1 Project Setting

NM 41 is classified as a rural major collector highway on the New Mexico State Highway System. A rural collector is a highway that serves smaller communities and connects to larger arterial routes. It begins at US 60 south of Estancia and extends north for 62 miles through the Estancia and Galisteo Basins. The highway ends at its junction with US 285, about 15 miles southeast of Santa Fe.

Between I-40 and MP 46 (the beginning of the proposed improvements), the highway section has been improved and includes two 12-foot travel lanes with 8- to 10-foot shoulders. From MP 46 to MP 62.1 (the junction of NM 41 and US 285 and the end of the project), the highway section consists of two 12-foot travel lanes without shoulders, except in a few isolated locations that include Clark Hill and the approach to the US 285 junction where auxiliary lanes for climbing and turning exist. The project limits do not include any locations where traffic on NM 41 stops for intersecting roadways, with the exception of the termini of NM 41 at US 285.

Two other north-south highways traverse the Galisteo Basin between I-40 and I-25: NM 14 to the west of NM 41 and US 285 to the east. NM 14 is approximately 20 miles west of NM 41 at I-40 and about eight miles west of Galisteo. This highway follows the east slopes of the Sandia Mountains and passes through the Ortiz Mountains. While NM 14 is parallel to NM 41, it serves a different area, including the communities of Cedar Crest, San Antonito, Golden, Madrid, and Los Cerrillos and is used by commuters traveling between the Albuquerque East Mountain area and Santa Fe. County Road 42 (about nine miles long and paved from its crossing of Arroyo de los Angeles to the west) connects NM 14 to NM 41.

US 285 is approximately 22 miles east of NM 41 at I-40 and converges with NM 41 approximately six miles northeast of Galisteo. This highway is the principal north-south arterial highway serving southeast and north-central New Mexico and connects the communities within southeast New Mexico to Santa Fe. US 285 is the designated route for low-level radioactive waste shipments between I-25 and the Waste Isolation Pilot Project (WIPP) near Carlsbad in southeast New Mexico.

Primary users of NM 41 include the residents and ranchers living within the NM 41 corridor, commuters traveling between Santa Fe and the Moriarty area, trucks and other commercial traffic that originate at Moriarty and are destined to locations within and north of the project area, and tourist traffic. An outdoor movie studio, located approximately 1.5 miles south of Galisteo, is also served by NM 41. Observations made during the collection of traffic counts also indicate use by school buses and governmental entities from communities in northeast and south-central New Mexico, suggesting that this route is used to travel between these areas of the state.

Traffic volumes are consistent with a rural collector highway. Traffic counts collected in October of 2009 show average daily traffic volumes of approximately 1,200 vehicles south of Galisteo and 1,400 north of Galisteo. Large trucks account for approximately 9% of the total traffic volume. Traffic projections do not show that volumes are expected to rise significantly; thus, additional capacity is not a primary consideration for this project.

With the exception of the two small urbanized areas of Estancia and Moriarty, the lands along NM 41 are primarily agricultural farm lands and ranch lands. Farmlands are generally located near Estancia, Moriarty, and Stanley; however, these areas are outside of the project area. There are no farmlands within the project area. Cattle and horse ranches occur throughout the highway corridor.
Several small communities exist along NM 41 including Estancia, Moriarty, Stanley, and Galisteo. Only one community is located within the project limits. Galisteo is a small, unincorporated village consisting of approximately 265 residents. The village is located at the junction of NM 41 and County Road 42. The village of Galisteo was founded in 1816 and, like many of the small rural communities near Santa Fe, includes families who have resided in the area for generations and others who have relocated there within recent years. Most of the buildings adjacent to the highway have existed for many years. While many of the buildings may have historic significance, two prominent historic buildings are located adjacent to the highway: the Iglesia Nuestra Senora de Los Remedios church, established in 1884, and La Tienda de Anaya, a store that currently does not operate but is being renovated for potential reopening in the near future. In addition, several older adobe and rock residences are located along the highway. The buildings away from the highway include a mixture of older and newer structures and homes. The residents of Galisteo generally identify the boundaries of the community from the bridges and rodeo grounds south of town to the highway curve north of town and north of the prominent ridgeline at milepost 57.25.

Galisteo is considered a Traditional Community by Santa Fe County. The County defines traditional communities as small settlements that have been continuously settled since at least 1925 and that have been shaped by their cultural and historic origins. These communities include historic structures and village centers and exhibit a historic pattern of diverse and mixed community land uses which have carried through to the present.

The majority of the project area is rural and is within the Galisteo watershed basin. The habitat varies from lower coniferous woodlands at the higher elevations to juniper savanna in the lower lying areas. The existing highway crosses several waterways including one perennial stream (Galisteo Creek), one intermittent stream (San Cristobal Arroyo), and several ephemeral arroyos. Riparian habitat is found within the perennial and intermittent waterways. Additional information about the environmental setting and major drainages within the project limits is provided in Section 5.

1.2 Report Organization
This report is a supplement to the Initial Alignment Study (Phase A) report completed in June 2010. Some information in the Phase A report has been updated, and new information has been added. The report is organized as follows:

- Section 2 summarizes input received from stakeholder agencies, user groups, and the public.
- Section 3 discusses the project purpose and need. This section has been updated to include additional discussion of the bridge condition assessment. The discussion of roadway conditions is the same as presented in Phase A.
- Section 4 discusses project alternatives including those that were not advanced from Phase A and those that have been developed in greater detail during Phase B.
- Section 5 summarizes the assessment of engineering, community, cultural, and environmental factors.
- Section 6 provides a summary of findings and recommendations and identifies the alternatives to be carried forward in an environmental document.
2.0 AGENCY COORDINATION AND PUBLIC INVOLVEMENT

Input and feedback from agency and public stakeholders has been a significant part of the NM 41 Alignment Study through both Phase A and Phase B. Stakeholders include federal and state agencies, city and county governments (City of Moriarty and Santa Fe County), highway users, community residents, bicycle advocacy groups, and others having an interest in the highway and project area. Input from these groups has been used to identify issues of interest and concern to stakeholders and to develop, evaluate, and refine project alternatives. Agency and public outreach and involvement activities have generally followed the approach described in the Public Involvement Plan (PIP) and Context Sensitive Solutions (CSS) Plan prepared at the study onset. Both the PIP and CSS emphasize consideration of the historic context of the Village of Galisteo, the Galisteo Basin, and the natural environment, in balance with the safety of highway users.

In addition to agency and public outreach, the team involved with the NM 41 Alignment Study includes a diverse group of professionals. These include highway and structural engineers, environmental and cultural resource specialists, and community planners. The methods and timing of major public outreach activities and the input received from these activities are summarized in the remainder of this section.

2.1 Public Outreach and Feedback

Public outreach activities conducted to date have included three general public meetings, several meetings with community groups, and numerous meetings with individuals (see Table 2-1). All of the public meetings held to date have been at the community center in Galisteo. Public notice of these meetings included announcements placed in *The Santa Fe New Mexican* and *The Independent* — a local newspaper distributed throughout the communities of Edgewood, Moriarty, Stanley, and others. The distribution areas of both *The New Mexican* and *The Independent* include the areas where commuters and businesses who rely on NM 41 reside. Roadside portable message boards were also placed along NM 41 at the north and south ends of Galisteo. These displays were set up several days in advance of each meeting. In addition, meeting announcements were emailed and mailed to about 300 residents, businesses, governmental agencies, elected officials, and special interest groups with a potential interest in the proposed project and/or project area.

<table>
<thead>
<tr>
<th>Meeting Date</th>
<th>Meeting Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 17, 2009</td>
<td>General public information meeting</td>
</tr>
<tr>
<td>April 7, 2010</td>
<td>General public involvement meeting</td>
</tr>
<tr>
<td>April 19, 2010</td>
<td>Neighborhood meeting (north Galisteo neighborhood)</td>
</tr>
<tr>
<td>May 12, 2010</td>
<td>Land owner meeting (San Cristobal Ranch)</td>
</tr>
<tr>
<td>September 14, 2010</td>
<td>General public involvement meeting</td>
</tr>
<tr>
<td>Various dates</td>
<td>Telephone discussions with various community members and bicycle advocacy group</td>
</tr>
<tr>
<td>Various dates</td>
<td>E-mail correspondence with various public stakeholders</td>
</tr>
</tbody>
</table>

The timing of the three public meetings included: (1) a meeting on November 17, 2009 at the study onset to inform the public that the NM 41 Alignment Study was underway; (2) a second meeting on April 7, 2010
to present the initial set of project alternatives prior to the completion of the Initial Alignment Study; and (3) a third meeting on September 14, 2010 during Phase B to present refinements (made in response to public feedback) to the initial set of alternatives and the findings of the evaluation of these alternatives. Questions, comments, and other feedback from the two meetings held during Phase A were summarized in the Initial Alignment Study report. The primary points raised by meeting participants during the first two meetings are summarized below.

- Comments that NM 41 is used by bicyclists including sanctioned recreational rides. Request to include bike lanes or shoulders of adequate usable width on NM 41.
- Comments that large trucks are causing safety concerns to the residents of Galisteo and that speeding and careless driving by commercial truck operators have been observed. Comment that truck traffic is damaging the historic buildings and two historic bridges within Galisteo. Requests to restrict truck traffic by weight and size or re-route to US 285.
- Comments to leave the vertical alignment of the roadway as is.
- Comments that improvements to bridges be limited to designs that preserve the historic integrity of the bridges.
- Request to include traffic calming and other measures to improve safety within Galisteo. Suggested measures included pedestrian crossings, speed limit reductions, police enforcement, addition of rumble strips, and advisory signing that motorists are traveling through a neighborhood.
- Comment that driving lanes and shoulders should be narrow.
- Comment that 8-foot shoulders for the rural segments of NM 41 are excessively wide.
- General questions related to impacts to cultural and environmental resources.
- Comments supporting roundabouts as a viable traffic calming measure and request to consider this treatment further.
- Comments opposing roundabouts on the basis that they are inconsistent with the rural character of the Galisteo area.
- Comment to emphasize community preservation in the roadway and bridge designs.
- Comments opposed to consideration of a bridge bypass.
- Comment supporting the Community Bypass Alternative on the basis that nothing will effectively slow traffic through the village.

Summaries of the Phase A public meetings are on file at the NMDOT District Offices in Santa Fe and on the NMDOT website.

The third public meeting occurred during the Phase B process (September 14, 2010). The primary topics presented and discussed at this meeting included:

- The major design features of the proposed roadway alternatives. This discussion was separated into the alternatives for the rural highway segments and the community segments.
- The types of traffic calming strategies proposed and their anticipated benefits for reducing travel speeds.
Bridge alternatives for Galisteo Creek Bridge and San Cristobal Arroyo Bridge. The discussion of these bridges included the findings of a supplemental structural conditions assessment and feedback received from outside historic bridge experts.

The comments received from meeting participants at the third meeting and in writing during the subsequent 3-week comment period are summarized below by topic/issue. Seventeen written comments were received.

1. Project Need
   - Request for crash statistics that support the need to flatten the roadway and comment that if crash data and statistics are not available that support the need to flatten the roadway, then it should not be done.
   - Comment that improving the highway will encourage higher/unsafe travel speeds and that speeding through the village will be worse.

2. Alternatives
   - Comment that 6-foot shoulders on the rural highway segments are needed.
   - Comment opposing the proposal to flatten the vertical curves along the roadway.
   - Comment agreeing with the proposal to maintain 12-foot driving lanes and a 55-mph posted speed.
   - Comment to use 12-foot lanes with no more than 4-foot shoulders that serve both bikeways and walkways. This comment included a question about whether the shoulders need to be paved or could be dirt and/or gravel.
   - Comment that the unlabeled and paved area of 6 feet on the sides of the road would result in a total paved width of 48 feet. Question about why NM 41 needs to be nearly 14 feet wider than comparable roads in the area. (Note: A project team member provided a response to this comment to clarify that the area beyond the shoulders is not paved; the proposed width is actually 36 feet).
   - Request to further evaluate the vertical curve reduction and keep it to a minimum to preserve the rural character of the road and to protect wildlife.
   - Comment that NM 41 is in great need of repair and that construction should move forward as soon as possible.
   - Comment agreeing with the proposed design for the rural segments and the community transition segment.
   - Comment to use guardrails with an “aged” look to fit the historic and scenic nature of the route.

3. Community Core and Transition Segment Issues
   - Request to extend the south boundary of the core area to Avenida Vieja.

4. Bicycle and Pedestrian Issues
   - Comment/question that bicyclists and pedestrians do not need to be accommodated by the roadway design.
• Suggestion that bicyclists and pedestrians share the same path.
• Question about the laws regarding pedestrian use of shoulders.
• Comment opposing the use of crusher fines on roadway edge to provide an area for pedestrian use.
• Comments that crusher fines are carcinogenic.

5. Parking
• Concern that the roadway through the community would eliminate parking for those who park alongside the roadway.

6. Construction Timing and Funding
• Question about the source and availability of construction funds.
• Question about when construction would occur.

7. Miscellaneous
• Comment that all wildlife concerns should be considered in the assessment, not just threatened and endangered species.
• Questions about whether San Cristobal Arroyo Bridge is safe to use in the interim period before reconstruction occurs and if trucks should be prohibited during this interim period.
• Comment that the improvements made to NM 14 between Madrid and Lone Butte by the NMDOT were well done.

Most of the written comments submitted after the public meeting included explicit statements regarding the commenter’s preference of alternatives, particularly for the bridges and the community core segment. For the community core, the alternative preference mentioned most often was for 11-foot lanes with a 4-foot paved shoulder. For the bridges, strong support was received for Galisteo Alternative 1 (Rehabilitation Alternative with 11-foot lanes, 3- to 4-foot shoulders, and a 4-foot walkway on one side only). No comments explicitly supported the other alternatives for Galisteo Creek Bridge. Likewise, almost all of the comments stating a preference for the San Cristobal Arroyo Bridge favored Alternative 2 (new bridge on the existing alignment).

2.2 Agency Coordination
Coordination with stakeholder agencies conducted to date has consisted of letter and email notification, scoping letters, telephone discussions, and one-on-one meetings. Agencies with a potential interest in the project were notified of the project by letter during the first study phase. These included:
• US Army Corps of Engineers (USACE)
• US Fish & Wildlife Service (USFWS)
• National Park Service Rivers, Trails, and Conservation Assistance (NPS)
• New Mexico State Land Office (SLO)
• New Mexico Environment Department (NMED)
• New Mexico Department of Game & Fish (NMDGF)
• New Mexico Historic Preservation Division (HPD)
New Mexico Department of Energy, Minerals, and Natural Resources (EMNR)
New Mexico State Police (State Police)
Santa Fe County Sheriff's Department (Sheriff's Department)
Santa Fe County Planning and Development (County Planning and Development Department)
Santa Fe County Public Works Division (County PWD)
Santa Fe Public Schools
Moriarty-Edgewood School District
Santa Fe County Commission

A meeting was held with the New Mexico HPD during the initial study. The purpose of the meeting was to inform and discuss the proposed project with HPD staff and to begin the pre-consultation process for Section 106. The issues discussed with HPD include the need for the proposed project, the initial alternatives under consideration, and future coordination and consultation needs to meet the requirements of Section 106 of the National Historic Preservation Act (NHPA) and Section 4(f) of the Department of Transportation Act of 1966. Formal consultation with HPD will commence in early 2011 after the second phase of the study is completed.

Coordination consisting of telephone discussions or meetings was held with representatives of the USACE and the NMDGF. Formal consultation and coordination with primary agency stakeholders was initiated in November of 2010. Correspondence to request scoping input and to participate in the environmental documentation phase of the project, as either a cooperating agency or a participating agency, was sent to the USFWS, USACE, NMDGF, and the NMED. Copies of the scoping letters are included in Appendix A.
3.0 PURPOSE AND NEED

The purpose of the NM 41 Alignment Study is to evaluate the condition of NM 41 between MP 46 and MP 62.1 and to identify improvements to provide a safe facility for highway users and area residents. An evaluation of the physical condition of the roadway and bridges and a review of the design features of the existing facility identified various problems including, but not limited to:

- Segments of the highway where safe stopping sight distance is substantially limited by vertical curves;
- An absence of safe shoulders for use by both motorists and bicyclists;
- Poor pavement condition;
- Structural and geometric deficiencies with the Galisteo Creek Bridge and San Cristobal Arroyo Bridge; and,
- Various other roadway conditions that affect safety or that do not meet modern design standards.

Data and a discussion of key issues pertinent to the need for improvements to NM 41 are provided in this section.

3.1 Roadways

The existing roadway was reviewed to assess its design features and condition. The assessment included the typical section and alignment.

Roadway Typical Section

The existing configuration of NM 41 generally consists of two undivided travel lanes without shoulders or with shoulder widths of 1 foot or less. Wider shoulders are present in two locations: at the northern end of the project area from US 285 south for 0.3 miles where 8-foot shoulders exist and at the Arroyo de la Jara Bridge at MP 53.5 where the shoulder width across the bridge is 6 feet.

At Clark Hill, the 2-lane section transitions to a 3-lane section that includes a southbound climbing lane as the highway ascends Clark Hill. The climbing lane begins at MP 46.6 and ends at the top of Clark Hill at MP 46.5. The existing typical section by milepost is summarized in Table 3-1. The highway typical section at several locations within the project area is illustrated in the photos in Figure 3-1.

According to A Policy on Geometric Design of Highways and Streets, 2004 Edition, published by the American Association of State Highway and Transportation Officials (AASHTO), shoulder widths for rural major collector highways with traffic volumes over 2,000 vehicles per day should be 8 feet, although narrower widths can be considered when conditions warrant. Wider shoulders provide a safe area for stopped vehicles and emergency use and minimize encroachment into the adjacent traveled way. Shoulders also improve maneuverability for drivers who encounter other vehicles, animals, or other objects in the roadway. In addition, the absence of shoulders prevents the use of rumble strips that can be used to alert drivers that they have left the driving lane.

Roadway Alignment

The alignment of NM 41 includes several locations with short vertical and sharp horizontal curves, several of which are less than desirable for the posted speed of 55 mph. The presence of these curves limits the distance at which motorists can spot animals, other motor vehicles, or objects that may be on the highway.
Table 3-1: Existing Roadway Features

<table>
<thead>
<tr>
<th>Milepost</th>
<th>Posted Speed</th>
<th>Typical Section</th>
<th>Right-of-Way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lanes / Shoulders</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>100 - 174 ft.</td>
</tr>
<tr>
<td>47</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>110 - 120 ft.</td>
</tr>
<tr>
<td>48</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>115 – 120 ft.</td>
</tr>
<tr>
<td>49</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>120 ft.</td>
</tr>
<tr>
<td>50</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>120 ft.</td>
</tr>
<tr>
<td>51</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>115 - 120 ft.</td>
</tr>
<tr>
<td>52</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>115 – 125 ft.</td>
</tr>
<tr>
<td>53</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>105 - 120 ft.</td>
</tr>
<tr>
<td>54</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>115 – 120 ft.</td>
</tr>
<tr>
<td>55</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>100 - 120 ft.</td>
</tr>
<tr>
<td>56</td>
<td>35 – 45 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>70 – 200 ft.</td>
</tr>
<tr>
<td>57</td>
<td>35 – 45 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>145 – 200 ft.</td>
</tr>
<tr>
<td>58</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>200 ft.</td>
</tr>
<tr>
<td>59</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>200 ft.</td>
</tr>
<tr>
<td>60</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>200 ft.</td>
</tr>
<tr>
<td>61</td>
<td>55 mph</td>
<td>2 12-ft. 0 ft.</td>
<td>200 ft.</td>
</tr>
</tbody>
</table>

Good visibility is critical for safe stopping or the ability to maneuver. The vertical alignment of the highway was evaluated against the existing posted speed of 55 mph, and a design speed of 60 mph was assumed. The criteria are from the design guidelines specified in the document *A Policy on Geometric Design of Highways and Streets, 5th Edition*, AASHTO, 2006, referred to as the Green Book. Exhibit 3-72 of the Green Book lists a stopping sight distance of 570 feet for a 60-mph design speed for both crest and sag curves. The rate of vertical curve (K-value) listed in Exhibit 3-72 of the Green Book is 151 for crest curves and 136 for sag (dip) curves.

The vertical curve analysis identified nine vertical curves with an existing K-value less than that specified by AASHTO. These nine curves include six crest curves and three sag curves. Table 3-2 lists the location, length, and existing K-value for each of these curves. As shown in this table, all of the problem curves have a design speed that is significantly less than that recommended for a posted speed of 55 mph. A photo that illustrates an area with vertical curve problems is shown in Figure 3-1.

In contrast, most of the existing alignment of NM 41 meets AASHTO design criteria for horizontal curvature. Analysis of the horizontal alignment identified two locations where the design speed does not meet criteria for the posted speed. These two curves are located near MP 46 where the highway ascends/descends Clark Hill. AASHTO specifies a minimum curve radius of 1,330 feet for a 60-mph design speed and an $e_{\text{max}}$ (super-elevation or “banking”) of 6%, although a larger radius is needed if the super-elevation is 4% or less. The radius of both of these existing curves is 860 feet.

The alignment and geometric problems summarized above contribute to crashes. Crash data for the years 2002 through 2007 show 28 reported accidents on NM 41 within the proposed project limits.
Figure 3-1: Photos Illustrating Various Roadway Conditions within the Project Limits

Roadway typical section at Clark Hill near MP 46

Example of sharp vertical curves north of Clark Hill (near MP 48)

Roadway typical section near MP 52

Roadway typical section near MP 58

Roadway typical section at US 285 Junction

Example of pavement cracking and general poor pavement condition
Almost one-half (46%) of all reported crashes resulted in vehicles over-turning — an indication that roadway geometry and roadside clear zones are a significant contributor. Measures to reduce vehicle over-turning when vehicles leave the roadway should be considered as part of the project alternatives development process.

For comparison purposes, crashes on the segment of NM 41 south of the project area (I-40 to MP 46) were reviewed for the same 6-year period. Even though the traffic volumes are essentially equal and the posted speed is 10-mph higher, fewer crashes occurred south of Clark Hill, and only 19% resulted in a vehicle over-turning (19 crashes during the 6-year period with three resulting in a vehicle over-turning). This section of road has 8-foot paved shoulders with rumble strips and wide roadside clear zones. It is assumed that the safer roadside environment has contributed to the much lower over-turning crash rate on NM 41 south of the study area.

In addition to the geometric conditions of the highway, the general condition of other roadway features is poor and is inconsistent with current design guidelines for collector highways. Notable problem areas include:

- **Poor Pavement Condition** – In general, the existing pavement throughout the project area is in poor condition. Longitudinal and transverse cracking occurs throughout. In addition, pavement rutting and settling is evident in several locations, indicating subgrade failures. Maintenance efforts by the NMDOT have been made with skin patches placed in several locations. Overall, the need for major rehabilitation or reconstruction of the pavement sections is indicated.

- **Guardrail** – Guardrail is installed at 36 locations within the 16-mile length from Clark Hill to US 285. Of the 72 end treatments, 64 of them do not meet current design criteria and should be replaced. Depending on modifications to the roadway geometry and roadside clear zone, the number of sub-par end treatments could change.

- **Drainage** – Forty-two drainage structures cross NM 41 within the project limits. Of these, seven are large concrete box culverts (CBCs) or large oval pipes. The remaining are corrugated metal pipes (CMPs) ranging from 24 inches in diameter to 84 inches in diameter. Of these, about 25% have ends that are in poor condition and would need replacement if the roadway is reconstructed. Thirteen of the CBCs and CMPs indicate insufficient grade for proper drainage.
3.2 Bridges

Three bridges exist within the project limits. These include bridge structures over the Arroyo de la Jara (Bridge #8368 at MP 53.5), San Cristobal Arroyo (Bridge #1814 at MP 55.6), and Galisteo Creek (Bridge #1782 at MP 56.1). The structure over Arroyo de la Jara was constructed in 1981 and is in good condition both structurally and geometrically. In contrast, Galisteo Creek Bridge and San Cristobal Arroyo Bridge were constructed in 1936 and 1939, respectively, and both are in poor condition and have geometric deficiencies.

Galisteo Creek is a perennial stream (year-round flows) with a low-flow channel approximately 10 feet in width. San Cristobal Arroyo is an intermittent waterway (seasonal flows with no flows during dry periods). The typical channel flow for this stream is also about 10-feet wide. However, both of these waterways drain large areas (174 square miles for San Cristobal Arroyo and 57 square miles for Galisteo Creek) and they carry significant flows during major storm events. The drainage analysis for the project area shows the following discharge flows for various storm events:

<table>
<thead>
<tr>
<th>Drainage</th>
<th>2-Year Event</th>
<th>50-Year Event</th>
<th>100-Year Event</th>
<th>500-Year Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Cristobal Arroyo</td>
<td>1,481.5 cfs</td>
<td>6,881 cfs</td>
<td>9,029 cfs</td>
<td>15,242 cfs</td>
</tr>
<tr>
<td>Galisteo Creek</td>
<td>748 cfs</td>
<td>3,604 cfs</td>
<td>4,851 cfs</td>
<td>8,638 cfs</td>
</tr>
</tbody>
</table>

cfs - cubic feet per second

While the low-flow channels are narrow, the bank-to-bank widths are over 200 feet for both drainages. Flow depths for San Cristobal Arroyo are 11.5 feet, 12.8 feet, and 15.3 feet for the 50-year, 100-year, and 500-year storm events, respectively. Flow depths for Galisteo Creek are 6.4 feet, 7.4 feet, and 9.3 feet for the same events.

The condition of these two bridges was assessed using bridge inspection reports prepared by the NMDOT Bridge Management Section in October 2007 and April 2008, a field inspection conducted in July 2010 by an independent licensed structural engineer, and analysis of concrete cores collected from the Galisteo Creek Bridge in November 2010. Key findings of the assessment are as follows:

**Galisteo Creek Bridge Condition**

The Galisteo Creek Bridge is a 4-span rolled steel girder bridge, with concrete abutments and solid-wall piers on concrete footings. It was constructed in 1936. No major changes to the bridge have been made since its construction, although extensive maintenance activities have occurred on the bridge deck. The total bridge length is 240 feet 10 inches, consisting of four 59-foot spans. Total bridge width is 33 feet 3 inches, which provides two 12-foot-wide driving lanes, two 7.5-inch-wide curbs, two 3-foot-wide sidewalks, and two 1-foot concrete post and pedestrian rails. The deck is supported by five W36x170 steel girder lines spaced at 6 feet 4 inches on center. The deck was not placed composite with the girders. The girders are supported by steel rocker bearings which rest on the substructure elements. Figures 3-2.A through 3-2.C illustrate the bridge typical section and general configuration.

**Structural Condition:** Most of the bridge elements are in poor condition in and around the deck joints due to the effects of long-term water leakage and corrosion from salts used for roadway de-icing. The
bridge is classified as “structurally deficient” (according to FHWA criteria) due to the condition of major bridge elements.

- **Deck** – The deck has evidence of extensive prior repair in many areas. Deck cracking is mainly evident near deck joints. The deck underside has advanced deterioration, cracking, discoloration and staining near deck joints; cracking and discoloration is also observed away from joints. The damage is less severe away from joints; however, there are large areas of efflorescence on the underside of the bridge deck. This indicates that the deck is likely saturated with chlorides from the many years of exposure to de-icing salts. Soundings on the underside of the deck show there are large areas where concrete is deteriorated and delamination is likely to occur in the near future. Figures 3-2.D and 3-2.E show the condition of the existing deck surface and underside.

- **Safety Railing** – The railing is in poor condition throughout with major concrete deterioration, extensive concrete loss, and heavy reinforcing steel corrosion. See Figure 3-2.F.

- **Beams (including bearing devices)** – Moderate to heavy rusting is near joints. Condition is fair away from the joints with light to moderate rusting.

- **Abutments and Piers** – The abutment and pier cap beams have extensive cracking, concrete separation, and exposed reinforcement and reinforcement corrosion. Pier walls have extensive map cracking in areas, vertical longitudinal cracks and some areas of section loss. See Figures 3-2.G and 3-2.H.

- **Waterway** – There is no visible evidence of major scour. A low-flow stream channel cuts transverse to the upstream face of Pier No. 3. The waterway is well vegetated.

**Load and Structural Capacity:** The existing bridge was designed for a 15-ton vehicle load. Deterioration of bridge elements has likely reduced the load carrying capacity below the original design load. AASHTO Geometric Design of Streets and Highways, or Green Book, criteria for rural major collectors with a design volume of 1,500 to 2,000 vehicles per day and a design speed of 45 mph require a design loading structural capacity of 20-tons for HS 20-44 (HL-93 LRFD). The existing bridge was designed to carry all the dead-load and live-load utilizing only the strength of the rolled steel girders.

The bridge substructure consists of solid reinforced concrete walls with spread footings founded on solid rock. Since the substructure is founded on rock and the bridge is located in seismic zone I, foundation load capacity and stability is not an issue. However, recent tests of the concrete within the abutments revealed problems (see discussion in Section 3.2.1).

**Geometrics:** AASHTO Green Book criteria for rural major collectors with a design volume of 1,500 to 2,000 vehicles per day and a design speed of 45 mph require a traveled way of at least 22 feet with 6-foot shoulders (AASHTO Green Book, Exhibit 6-5, page 425). For bridges over 100 feet in length, the shoulders may be reduced to three feet (AASHTO Green Book, Exhibit 6-6 footnote “b” page 426). The existing bridge over Galisteo Creek provides a traveled way of 22 feet with 1-foot shoulders. The section also has two 7.5-inch-wide curbs and 3-foot-wide sidewalks for a total out-to-out deck width of 33 feet 3 inches. Thus, the existing typical section does not meet current criteria.

**San Cristobal Arroyo Bridge**
San Cristobal Arroyo Bridge crosses San Cristobal Arroyo at milepost 55.6, just south of the community of Galisteo and the Galisteo Creek Bridge. The existing structure is a 3-span steel beam bridge with concrete
Figure 3-2.A: Galisteo Bridge Typical Section

Figure 3-2.B: Galisteo Bridge Section (2010 photo)

Figure 3-2.C: Galisteo Bridge Section (2010 photo)
Section 3: Purpose and Need

Figure 3-2.D: Galisteo Bridge Deck Surface

Figure 3-2.E: Galisteo Bridge Deck Underside Examples

Figure 3-2.F: Galisteo Bridge Railing Example

Figure 3-2.G: Galisteo Bridge Pier Example

Figure 3-2.H: Galisteo Bridge Pier Cap Example

Note: All photos are 2009 and 2010
concrete abutments, solid-wall piers, and timber pile foundations. It was constructed in 1939. No major changes to the bridge have been made since its construction, although, like the Galisteo Creek Bridge, extensive maintenance activities have occurred on the bridge deck. The total bridge length is 212 feet 8 inches from the back of backwall to back of backwall and includes three simple spans of 69 feet 6 inches. The abutments are u-shaped concrete approximately 36 feet 6 inches in length (parallel to the roadway alignment).

The width of the bridge deck is 28 feet 2 inches with a 24-foot width between the pedestal curbs. The section includes two 12-foot lanes, 6-inch-wide curbs, 7-inch rail mounts, and concrete post and rail railings. No pedestrian facilities are present. Therefore, pedestrians, bicyclists, and equestrians must use the travel lanes. The deck is supported by five W36x170 steel girder lines spaced at 4 feet 10 inches on center. The deck was not placed composite with the girders. The girders are supported by steel rocker bearings which rest on the substructure elements. Figures 3-3.A and 3-3.B illustrate the typical section of the existing San Cristobal Arroyo Bridge.

**Structural Condition:** Most bridge elements have been affected by long-term leaking deck joints. In particular, the abutments and piers have severe damage and are in overall poor condition. The bridge railing is also in poor condition. The bridge is classified as “structurally deficient” (according to FHWA criteria) due to the condition of major bridge elements. While not classified as “scour critical,” its vulnerability to scour is dependent on the condition of the timber piles (see discussion below).

- **Deck** – The deck has been repaired in many areas. Deck deterioration is evident along the deck underside. The most severe damage is located near deck joints, where the concrete has numerous cracks, section loss, and indications of reinforcing steel corrosion. The damage is less severe away from joints; however, there is cracking along with leaching throughout. Soundings on the underside of the deck show there are large areas where concrete is deteriorated and delamination is likely to occur. Figure 3-3.C shows prior repair areas on the existing deck.

- **Safety Railing** – The railing is in poor condition throughout with major concrete deterioration, extensive concrete loss, and heavy reinforcing steel corrosion. See Figure 3-3.D.

- **Beams (including bearing devices)** – There is moderate to heavy rusting near joints with some minor section loss.

- **Abutments and Piers** – The abutment and pier cap beams and bearing areas that support the beams have extensive and severe damage. This is a result of years of water intrusion and leaking deck joints. Extensive concrete and steel degradation is evident by advanced cracking and section loss in most cap areas. Abutment and pier walls have numerous areas of advanced damage such as concrete cracking and section loss and exposed and corroded reinforcing steel. See Figures 3-3.E and 3-3.F.

- **Substructure elements** are founded on “untreated” timber piles approximately 25 feet long. The condition of the timber piles has not been determined, as they are buried and the tops are covered by pier caps. However, due to varying water flows within the arroyo, the piles have had intermittent exposure to moisture and, in combination with being untreated at the time of installation, are highly likely to be in a deteriorated condition. It is reasonable to expect that the structural capacity of the foundations has been significantly reduced, and some of the load carrying capacity has been shifted to the pile caps which are acting as spread footings.
Figure 3-3.A: San Cristobal Arroyo Bridge Typical Section

Figure 3-3.B: San Cristobal Arroyo Bridge Section (2010 photo)

Figure 3-3.C: San Cristobal Arroyo Bridge Deck Surface (2010 photo)
Figure 3-3.D: San Cristobal Arroyo Bridge Curb and Railing Examples

Figure 3-3.E: San Cristobal Arroyo Bridge Abutment Example

Note: All photos are 2009 and 2010

Figure 3-3.F: San Cristobal Arroyo Bridge Pier Condition Example
Waterway – The waterway is vegetated with trees and shrubs. There is no visible evidence of major scour. However, scour analysis indicates that in a major storm event, the maximum scour would extend to 26 feet at the abutments and over 14 feet at the two piers. This depth is below the pile caps. Therefore, scour from a major storm event could undermine the substructure pile caps and result in catastrophic failure of the foundation and collapse of the bridge.

Load and Structural Capacity: The existing bridge is designed for a 15-ton vehicle load. Deterioration of bridge elements has likely reduced the load carrying capacity below the original design load. AASHTO Green Book criteria for rural major collectors with a design volume of 1,500 to 2,000 vehicles per day and a design speed of 45 mph require a design loading structural capacity of 20-tons [HS 20-44 (HL-93 LRFD)].

Geometrics: AASHTO Green Book criteria for rural major collectors require a traveled way of at least 22 feet with 6-foot shoulders (AASHTO Green Book, Exhibit 6-5, page 425). For bridges over 100 feet in length, the shoulders may be reduced to three feet (AASHTO Green Book, Exhibit 6-6 footnote “b” page 426). The existing bridge provides for a traveled way of 22 feet with 1-foot shoulders, two 6-inch-wide curbs, two 7-inch rail pedestals, and two 1-foot concrete rails (out-to-out width = 28 feet 2 inches).

In summary, the critical concern with the San Cristobal Arroyo Bridge is the poor condition of the bridge components and the potential danger for catastrophic failure if scour undermines the bridge foundation. Because the condition of the timber piles cannot be ascertained without extensive excavation within the river channel, there is some uncertainty with this factor. However, it is highly likely that the piles are in poor condition due to their 70 plus-years of exposure to intermittent moisture from water flows. For this reason, it is reasonable to expect that the structural capacity of the foundations has been substantially reduced, and some of the load carrying capacity has been shifted to the pile caps acting as spread footings. This condition exacerbates the potential for bridge collapse after a high-flow event. This safety threat in combination with the very poor condition of the bridge deck, railing, and piers, supports the need to replace this bridge.

3.2.1 Laboratory Analysis of Concrete Cores on the Galisteo Creek Bridge

Findings for the Galisteo Creek Bridge based on the previous NMDOT assessment and the recent field inspections are not as definite as discussed for the San Cristobal Arroyo Bridge. While the condition assessment of the bridge deck and railing clearly warrant their replacement, the condition of the substructure is less clear (based on visual examination). For this reason, additional testing was performed. The additional analysis consisted of collecting concrete cores from the bridge abutments and performing three tests: (1) compressive strength tests to assess the physical strength of the concrete; (2) chemical analysis to evaluate for alkali-silica reactivity that could result in continual degradation of the concrete; and (3) visual examination of the cores to identify other physical flaws in the concrete that would limit the life of the existing substructure.

Eleven cores were collected using a diamond drill. Of these 11 cores, seven were not suitable for compressive strength tests due to the cores shearing during collection, leaving insufficient length for testing. Based on field observation, shearing was due to the large aggregate size and gap-gradation (see discussion in bullet 3, below). Four cores were of adequate length for compression tests. The cores that sheared were saved for chemical analysis and visual examination. The findings of the concrete lab tests are as follows:
1. Four cores were tested for compressive strength in accordance with standards prescribed by ASTM C42 – *Standard Method of Obtaining and Testing Drilled Concrete and Saw Beams of Concrete*. For all four cores tested, the corrected load ranged from 4,430 pounds per square inch (psi) to 5,470 psi.

2. Two additional cores were provided to the H.C. Nutting Petrographic Laboratory in Cincinnati, Ohio. Petrographic analysis is one method to test hardened concrete and concrete aggregate. For this project, the analysis focused on determining the presence of alkali-silica reactivity (ASR). If ASR (or indicators of its past presence) is found, this condition could be a factor in the observed deterioration of the bridge structures. The analysis did not find any observed macrofracturing or microfracturing or any apparent ASR gels. Based on this analysis, it was concluded that ASR was not occurring in the two cores evaluated.

3. The third test was performed by the NMDOT Materials Labs and consisted of a visual examination of the remaining core samples. This observation noted that the magnitude of gapgradation and the top-sized aggregate used in the concrete mix would be conducive to the very high shrinkage observed for the observed concrete cores. The analysis by the Materials Lab also noted that the shrinkage would explain the shearing problems encountered during the coring process. The analysis concluded that even though the compressive strength test results were within criteria, the network of existing cracks through the matrix of this concrete could impair the ability of the concrete to properly handle the stress transfer through the existing concrete structure. Additional consideration was recommended by the NMDOT Materials Labs of the effects of shear loads, bending loads, and lateral loads on the existing structure and its ability to withstand those without failure or shifting.

A copy of the lab test report for compressive strength and ASR is included in Appendix B. Based on the concrete tests, the NMDOT has concluded that the use of the existing substructure at the Galisteo Creek Bridge would not be prudent. This conclusion is based on the factors discussed in bullet 3, above, and the service life differential between the bridge superstructure and the bridge substructure. Additional discussion of bridge service is provided in Section 5.7.

### 3.2.2 Consultation with Independent Structural Engineers

During a previous NMDOT study of the Galisteo Creek Bridge and San Cristobal Arroyo Bridge, the New Mexico Department of Cultural Affairs, Historic Preservation Division (HPD) requested that the NMDOT obtain opinions from independent structural engineers with expertise in historic bridges. HPD provided the NMDOT with a list of structural engineers. The objective of the consultation with other bridge experts was to seek input on the feasibility of and methods available to rehabilitate the two bridge structures. Because the list provided by HPD was extensive, it was narrowed to include engineers within the western United States, particularly in states adjacent to and with similar issues as New Mexico. Contacts in Oregon were also included due to their reputation in historic bridge structures and bridge rehabilitation. A structural engineer from New Hampshire was also contacted because of his prior work in New Mexico and specific knowledge of the two bridges under evaluation. Contact was made with the following individuals:

- Charles Walker, Texas Department of Transportation, Bridge Division, Austin, Texas
- Christopher Leedham, Oregon DOT Bridge Preservation Unit, Oregon
- Mark Taylor, Design Discipline Leader, Federal Lands Division, FHWA Colorado
Patrick Sparks, Sparks Engineering, Inc., Austin, Texas
Tom Densford, The Louis Berger Group, Inc., Manchester, New Hampshire
Fred Rutz, J.R. Harris & Co., Colorado
Kitty Henderson, Executive Director, Historic Bridge Foundation, Austin, Texas

In addition to the above persons, contact was also made with Dr. Sonya Cooper. Dr. Cooper is a professor and the academic head of the Engineering Technology and Surveying Department at New Mexico State University. Dr. Cooper prepared an independent bridge condition assessment for the Galisteo Creek and San Cristobal Arroyo Bridges in June 2009 on behalf of the New Mexico HPD. Feedback from all of the individuals contacted is summarized below.

Initial contact with each of the above was made via an email message sent by David Pennington, D. Pennington & Associates, on August 16, 2010. A draft report summarizing the bridge assessment of the Galisteo Creek and San Cristobal Arroyo Bridges was attached to the email (attached as Appendix B). The email was followed with an attempt to contact each person via telephone. The email message consisted of the following request:

On behalf of the New Mexico Department of Transportation (NMDOT), I am sending this email to request your assistance and opinion on an issue involving historic bridge preservation. Your name was recommended to me by the New Mexico Historic Preservation Division as a structural engineer or group with expertise and/or interest in historic bridges. If you have a few minutes, the NMDOT and I would appreciate your opinion on the following matter.

The NMDOT is investigating the rehabilitation or reconstruction of two small historic bridges in NM. To ensure a thorough analysis and consideration of all feasible options, the NMDOT is seeking input from others who may have experience with WPA-era concrete bridges. Assessments performed by the NMDOT and an independent structural engineer have determined that there are no prudent and feasible measures for the minor rehabilitation of the existing structures that would allow for their safe use by traffic. This determination is primarily based on the condition of the bridge decks. Visual inspection of the decks show large areas of efflorescence on the deck underside indicating likely saturation from chlorides — over sixty years of exposure to de-icing salts. Moreover, soundings on the underside of the deck show areas where concrete is deteriorated and delamination is likely to occur. In addition, one of the bridges is founded on untreated timber piles and is located in a channel with intermittent water saturation.

While the Project Team recommends deck and railing replacement (at a minimum) for one bridge and total reconstruction of the second bridge, the Team recognizes the importance of preserving historic bridges when their continued safe use is feasible. For this reason, we are seeking opinions from other structural engineers on methods you may have used or may be aware of to safely restore concrete bridges that are in advanced conditions of decay. If the bridges cannot be restored for safe use by traffic without destroying their historic integrity, the NMDOT will investigate avoidance options.

Additional discussion and photographs of the two bridges in question are provided in the attached paper. If you have time, we would appreciate your thoughts on this matter. Either I or Chris Baca, P.E., will follow up with a phone call to you in the next few days.

If you have questions about this request, you can contact me at (505) 884-0677, David Quintana, NMDOT, at (505) 827-1653, or Laurel Wallace, NMDOT Cultural Resources Bureau, at (505) 827-1591.
Patrick Sparks, Sparks Engineering, Inc., Austin, Texas (telephone conversation):

- Recommends diagnosis of the concrete elements (deck, abutments, and piers) to help identify the problems that have led to the current condition of the structure. Even if the decks are replaced, a diagnosis would help verify that the substructure elements would have an adequate design life if they are rehabilitated.
- Based on the photos and descriptions provided, concurred that the bridge decks and railings warrant replacement. Also, the photos indicate that the substructure is in relatively good condition for the Galisteo Creek Bridge, pending the outcome of laboratory testing of core samples.
- Based on the information provided, concurs that the wet-dry cycle present at the San Cristobal Arroyo Bridge is likely to have led to deterioration of the timber piles.
- Suggested pursuing a design exception for the railing. Given the 35-mph posted speed and crash history, replacing the railings in-kind would help maintain the historic accuracy of the bridges. This would require an exception by FHWA. The TxDOT C411 standard may be a reasonable alternative, but would not be an accurate railing used for this type of WPA bridge.
- Suggested the use of lighting that highlights the railing to help motorists recognize that they are entering a community area. This would serve as a traffic-calming component.
- In general, concurs that the approach and recommendations discussed in the bridge assessment paper appear to be reasonable.

Kitty Henderson, Executive Director, Historic Bridge Foundation, Austin, Texas (email correspondence):

- Thank you for including the Historic Bridge Foundation in your request. I note in the address line that you have also sent the notification to several well-known bridge engineers. In particular, Pat Sparks, who is a former board president for HBF, should be of help. As he travels often, if you do not hear back from him, recontact him for information or suggestions for other engineers. The Historic Bridge Foundation does not have an engineer on staff and would have forwarded your email to Pat. If we can be of further assistance, please let us know.

Tom Densford, Asst. Director of Structural Engineering, The Louis Berger Group, Inc., Manchester, NH (email correspondence):

- I am familiar with these bridges..., since we proposed on this project...in response to the original NMDOT RFP.
- I have made a field review of the bridges. I have read the attachment included in your email, and agree with the rehabilitation options, and general conclusions and recommendations.
- Regarding “methods...to safely restore concrete bridges....,” the industry standard approach is documented in the NHI Participant Workbook for “Bridge Rehabilitation Evaluation & Design Course.” The methods prescribed therein should lead to a rational decision regarding the structure....

Charles Walker, TxDOT Bridge Division (telephone conversation):

- Mr. Walker stated that he was not a concrete expert, did not feel qualified to comment on this particular project, and would not comment on the need for bridge replacement/rehabilitation in
another state. He stated that the decision to rehabilitate or reconstruct a bridge should be made following the policies and investigations of each State DOT. He also stated that, based on the information in our emails, the NMDOT has followed applicable guidance for bridge preservation.

*Dr. Sonya Cooper, New Mexico State University, Engineering Technology and Surveying (telephone conversations and email correspondence):*

- Dr. Cooper noted that the recommendation for the San Cristobal Arroyo Bridge included in her bridge assessment report prepared for HPD in June 2009 was based on information that the existing timber piles were treated prior to installation. Dr. Cooper obtained this information from a document prepared by the NMDOT on January 2, 2007, that states the bridge substructure is supported by “treated timber piles.” Dr. Cooper was provided a copy of the bridge construction plan. A general note on this plan sheet states “preservative treatment will not be required due to hard driving...” Dr. Cooper concurred with the finding that the timber piles would very likely be in poor condition if they were in fact untreated timbers.
4.0 PROJECT ALTERNATIVES

A full range of potential improvement concepts (alternatives) for the roadway and bridges within the project limits was identified during the first phase of the NM 41 Alignment Study. These alternatives and the findings of a screening analysis for each are described in the Initial Alignment Study Report for NM 41: Clark Hill to US 285, June 2010. The findings and recommendations discussed in that report were presented at a public meeting held in September 2010. Based on the initial analysis and the feedback received from the public, several of the initial alternatives were dropped from further consideration, and refinements were made to the remaining alternatives that met the project purpose and need and that had general public support. The next step of the process is the refinement and further evaluation of the remaining alternatives. This chapter provides: (1) a brief discussion of the alternatives that have been eliminated by the NMDOT from further consideration and the reasons for their elimination and (2) a description of the alternatives that have been advanced for further evaluation. In addition, refinements made to these alternatives in response to public comments and analysis, along with a description of the major design features of each alternative being advanced, are provided. Information about the cost, right-of-way needs, and engineering and environmental impacts of each alternative is provided in Section 5.0.

The development, evaluation, and refinements of project alternatives considers and balances many factors, some of the most critical of which are the safety of users and the adjoining landowners, cost and cost-effectiveness, impacts to affected communities and environmental and cultural resources, and public input. Public interest and participation in the project is high, and a large number of questions and suggestions from the public was received during the first phase. Many refinements have been made in response to this feedback. However, some requests made by the public were not made because of potential conflict with the NMDOT’s mission of providing safe highways for use by the traveling public and for ensuring the judicious expenditure of roadway funds. In all cases, however, the NMDOT Project Team placed high priority on design concepts that avoid or minimize impacts to community residents and historic and environmental resources and maintain the rural setting of the Galisteo Basin.

The approach used for the initial study to divide the project area into distinct subareas was continued into the second phase. This approach separated the study area into three segments, each of which has unique issues. The improvements in the outlying segments of NM 41 north and south of Galisteo are generally tied to minor changes in the vertical alignment of the highway and its cross section to enhance safety for drivers and bicyclists. In contrast, the area within and approaching Galisteo focuses on community and pedestrian safety and the preservation of historic and environmental resources. In addition to the outlying and community highway segments, the two historic bridges at the southern edge of Galisteo involve a different set of issues.

Public comments and requests resulted in revisions to the boundaries of the three subareas established during Phase A. Requests were made to extend the “community core” area south approximately 0.3 miles to the intersection of NM 41 and Avenida Vieja. In addition, a request was made to extend the northern terminus of the “community transition” segment approximately 0.5 miles north to include the driveways for Goose Down Farms and Vista Clara Ranch. Because the roadway typical section and planned posted speeds are based on the limits of the community transition and core areas, changes to their termini will change the roadway design and speed. The requested changes were considered and have been integrated into the evaluation process. The boundaries for the three subareas are shown in Figure 4-1 and Figure 4-2.
Figure 4-1: Project Subareas
Figure 4-2: Community Subareas
4.1 Alternatives Considered and Eliminated

The initial alignment study for the NM 41 corridor concluded with specific recommendations for each of the alternatives considered. The recommendations were developed in consideration of: (1) the project purpose and need; (2) the data collection, initial investigations, and screening analysis; and, (3) input received from community stakeholders, highway users, and agency stakeholders. The findings of the initial study were presented to stakeholder agencies and the public. Based on the findings of the initial study and feedback from agencies and the public, several alternatives have been eliminated from further consideration. These alternatives and the primary reason for their elimination are discussed below. Additional details specific to the alternatives considered in the initial study are available in the document NM 41 Initial Alignment Study Report, June 2010. This document is on file with the NMDOT Main Office in Santa Fe.

- **Rural Alternative 1 (12-foot lanes with 8-foot shoulders)** – The evaluation of this alternative found that it was a viable solution to the safety problems found in the outlying areas of the project area. However, it was eliminated from further consideration due to community concerns with the potential for this alternative to cause excessive disturbance to the roadside and detract from the historic character of the Galisteo Basin. Public comments also expressed concerns that an increase in travel speeds would occur with wider lanes and shoulders.

- **Community Bypass (Community Alternative 4)** – This alternative assumed a 2-lane bypass of the community subarea would be constructed. The bypass would leave the existing NM 41 alignment south of the rodeo grounds near MP 55.5 and extend to the north and east of the existing highway. The bypass alignment would be approximately 0.5 miles east of the community center and would connect to NM 41 north of the hogback ridge on the north edge of town near MP 57.25. The bypass would be about 2.4 to 3.1 miles in length, depending on the location of its tie back to NM 41. The bypass would include the construction of new bridges over Galisteo Creek and San Cristobal Arroyo. This alternative was eliminated due to its potential to adversely impact the residents on the east side of the community, the adjoining ranch, cultural resources, and natural resources. It would also have disproportionately higher costs than other alternatives.

- **Traffic Calming Strategies** – Several roadway design and signing strategies to discourage speeding within the community transition and core areas were evaluated during the initial study. These included additional radar-reader boards, roundabouts and/or medians placed at strategic intervals through the community, traffic chokers, and transverse rumble strips. Of these, traffic chokers and transverse rumble strips have been eliminated from further evaluation. While they can be an effective traffic calming strategy, traffic chokers were eliminated because of road maintenance and snow removal problems. Transverse rumble strips were not recommended due to their potential for noise impact at nearby residences.

Numerous bridge alternatives were identified and evaluated by the Initial Alignment Study. The concepts considered during the initial study were limited to general improvements consisting of minor rehabilitation, major rehabilitation, and replacement of the bridges. The **minor rehabilitation** alternative consisted of repair and restoration of the existing bridge decks, railing, and girders, piers, and abutments. The **major rehabilitation** alternative included the same elements as the minor rehabilitation alternative except that the bridge decks and railings would be replaced instead of repaired. The bridge **replacement alternative** assumes full replacement of the existing structures, either on their current alignments or a new offset alignment.
Of the above bridge improvement concepts, concepts based on the minor rehabilitation of the bridges were discarded. This approach was eliminated due to the poor condition of the bridge decks and railings. The advanced deterioration of these bridge elements makes minor rehabilitation unfeasible. All of the remaining bridge improvement concepts identified during the initial study have been further developed and evaluated during the second phase of the alignment study.

In addition to these three approaches, the construction of a bridge bypass on a new alignment to the west of the existing bridges was considered. This approach would leave the existing bridges in place but would construct two new bridges and a new roadway segment approximately 150 feet to the west of the existing alignment. This specific strategy was eliminated due to the acquisition of private property (approximately 9 acres), potential impacts to the Galisteo Historic District, and public opposition.

4.2 Alternatives Retained for Analysis

Roadway alternatives advanced for further consideration include a single build alternative for the rural subareas of the project, a single build alternative for the community transition segments, and two alternatives for the community core segment. The traffic calming strategies recommended for further consideration have been integrated into the community transition and community core alternatives. For this reason, they are described and evaluated as elements of the roadway alternatives.

The development of bridge improvement alternatives considered changes to the bridge geometric configuration and different approaches to correcting the identified structural deficiencies. The major design features of the roadway and bridge alternatives are described below.

4.2.1 No Build Alternative

The No Build Alternative will be considered throughout the alignment study and subsequent environmental documentation phase. This alternative assumes that NM 41, including the roadway and bridges, would remain in its existing configuration. Improvements would be limited to routine maintenance.

4.2.2 Roadway Build Alternative – Rural Segments

The Build Alternative for the rural segments of the project area applies to the roadway from the southern terminus of the project at milepost 46.0 to milepost 55.4 (at the Galisteo Rodeo Grounds) and from milepost 57.8 to the northern terminus at milepost 62.1. This alternative is generally consistent with the existing alignment and right-of-way. Changes to the typical section and alignment are made to provide a safe highway design that meets current criteria for a rural collector highway (in accordance with AASHTO) with a posted speed of 55 mph. The major design features of this alternative include:

- **Typical Sections** – The roadway typical section would consist of two 12-foot travel lanes with 6-foot shoulders (see Figure 4-3) throughout most areas except where the highway ascends Clark Hill. This section would be provided from milepost 46.0 to milepost 46.3, milepost 46.7 to milepost 55.5, and milepost 57.8 to milepost 62.1.

  At Clark Hill, the roadway typical section would include a single 12-foot lane in the northbound travel direction and two 12-foot lanes in the southbound direction. The southbound outside lane would serve as a truck climbing lane. Shoulders would be 6-feet wide. This section would extend from milepost 46.3 to milepost 46.7. Figure 4-4 illustrates this typical section.
- **Alignment** – In general, the horizontal and vertical alignment of this alternative closely follows that of the existing roadway. Changes to the roadway profile are mostly minor with the exception of the highway segment between milepost 47 and milepost 48 where the highway passes through several successive and sharp crest and sag sections. The roadway profile will be modified in this area by reducing the height of the crest curves and filling the sag sections to achieve a profile that meets the design criteria for 55 mph. The profile will be changed in several other locations as well; however, these are generally very short and isolated segments.

- **Other Improvements** – Several other improvements associated with the roadway are included with this alternative. These include the extension and/or replacement of drainage pipes, culverts, and boxes (as needed), the construction of an 84-inch corrugated metal pipe (CMP) at milepost 47.7 (station 140+00) to allow livestock movement across the highway right-of-way, and the use of weathered steel guardrail within and close to the community of Galisteo.

### 4.2.3 Community Transition Alternative
This alternative is specific to the two transition areas within Galisteo which extend from milepost 55.5 to 55.8 (station 550+00 to 570+00) and from milepost 56.8 to milepost 57.8 (station 630+00 to 676+00). The purpose of this subarea is to provide a transition between the higher speed rural segments and the lower speed community area. This is achieved by using a narrower pavement section and lower speeds.

The transition alternative consists of a roadway typical section with two 11- to 12-foot lanes plus 4-foot paved shoulders. Immediately south of the San Cristobal Arroyo Bridge, 12-foot lanes would be used for the transition segment so that the roadway lane and shoulder widths would match the proposed width of the bridge. In all remaining portions of the transition segments, 11-foot lanes would be used. The typical sections for this alternative are shown in Figures 4-5, 4-6, and 4-9 (see pages 33 and 35).

The south transition segment would include a multi-use path on the right (east) side of the roadway. This path would begin at the northernmost entrance to the rodeo grounds and would connect to the path proposed within Galisteo as part of the Community Core Alternatives (see below). The path would be 6- to 10-feet wide; the exact dimensions would be determined after additional community input is obtained. The path surface would consist of a material that meets Americans with Disabilities Act (ADA) criteria and blends with the historic surroundings of the area. A surface consisting of crusher fine gravel bound with a polymer has been used in similar settings.

Traffic calming measures are incorporated in these segments, including radar-reader boards and either roundabouts or medians. The proposed locations of these measures are described below.

- **Radar-Reader Boards** – These devices consist of radar speed detectors combined with message boards that display the speed of vehicles. Two new detectors would be installed within the community transition sections: one in the northbound direction near milepost 55.6 and one in the southbound direction near milepost 57.7.

![Example of Radar-Reader Board in Galisteo](image)
• **Medians** – Medians would be constructed to provide a visual cue to motorists entering the community transition segments. These would consist of raised areas within the roadway median approximately 20-feet wide by 125-feet long. The medians may include small shrubs and plantings and signage specific to the community (e.g., “Entering Galisteo Village”). Medians are proposed in the vicinity of the NM 41/Avenida Vieja intersection and in the vicinity of the Vista Clara Ranch driveway near milepost 57.8.

• **Roundabouts** – Roundabouts are an alternative to medians. For this alternative, small diameter roundabouts (design speed of 25 mph) would be placed at the same general locations as the median option.

Typical section and plan view drawings of the traffic calming elements are shown in Figures 4-12 and 4-13.

### 4.2.4 Community Core Alternatives

The community core segment includes the portion of NM 41 through the community of Galisteo from milepost 55.8 (intersection of NM 41 and Avenida Vieja) to milepost 56.8 (approximately ¼-mile north of NM 41/La Vega Road intersection). The general location of this segment is illustrated in Figure 4-2. Two alternatives have been identified for this segment, both of which use 11-foot driving lanes — only the shoulder width is different. The alternatives for this segment of NM 41 are intentionally narrower than the adjoining segments of highway. The narrow pavement sections are intended to encourage lower travel speeds compatible with a village center.

**Community Core Alternative 1**

This alternative consists of two 11-foot travel lanes with 4-foot paved shoulders. No changes would be made to the roadway centerline or profile. A multi-purpose path, 6 to 10 feet in width, would be constructed on the right (east) side of the highway. The path width will be determined after additional community input is obtained. It would connect to the path proposed for the Community Transition segment and would end at the intersection of La Vega Road in Galisteo. The path surface would be the same as described for the Community Transition Alternative. Two pedestrian crossings would be constructed in the historic plaza area (the area immediately north and south of the Nuestra Señora de los Remedios Church – see Figure 4-11). These crossings would be 10-feet wide and constructed with brick pavers or stamped and colored concrete to simulate brick pavers. The typical section for the Community Core Alternative 1 is shown in Figure 4-7.

If public input finds that the multi-use path within the Community Core area is not desired or is in conflict with the historic character of the Galisteo, it will be eliminated from consideration, and other methods to accommodate pedestrians will be developed. One potential method could be the placement of crusher fine gravel along the edge of the roadway shoulders. This type of material would blend with the earth edges of the roadway to maintain a narrow appearance but would provide the benefit of a graded and hard-packed surface usable by pedestrians on both sides of the highway.

Traffic calming measures specific to the Community Core area are included at the terminal ends of this segment. The strategies proposed include the two existing radar-reader boards and roadway medians located between the Community Transition and Community Core segments. Typical section and plan view drawings of the Community Core and associated traffic calming elements are shown in Figure 4-12 and Figure 4-13.
Figure 4-3: Rural Subarea Typical Section

Figure 4-4: Rural Subarea Typical Section with Climbing Lane at Clark Hill

Figure 4-5: Community Transition Typical Section (South of San Cristobal Arroyo Bridge)

Figure 4-6: Community Transition Typical Section (North of Galisteo)
Community Core Alternative 2
This alternative has the same features as Community Core Alternative 1 except that the shoulders would be 2-foot-wide flush concrete. As an option, rolled concrete curbs could be used in lieu of the flush concrete. In either case, the concrete could be colored to blend with the roadside to enhance the visual perception of a narrow roadway. The multi-use path and pedestrian crossings in the historic plaza area are the same as for Community Core Alternative 1. Figure 4-8 illustrates the typical section for this alternative.

4.2.5 Bridge Alternatives
Several potential bridge concepts for the Galisteo Creek Bridge and San Cristobal Arroyo Bridge were identified and evaluated during the Initial Alignment Study. The bridge improvement concepts considered during the initial study were limited to general improvement concepts consisting of minor rehabilitation, major rehabilitation, and replacement of the bridges. For this second phase of the evaluation process, bridge alternatives were developed in greater detail and were specific to each bridge. Both rehabilitation and full replacement alternatives were considered. The minor rehabilitation alternative was eliminated in the initial study as discussed in Section 4.1.

As discussed in Section 3, neither the Galisteo Creek Bridge nor the San Cristobal Arroyo Bridge meet current criteria for loading or geometry. According to the AASHTO Green Book, a design loading capacity of HS 20-44 (HL-93 LRFD) is recommended for rural major collector highways with a traffic volume of 1,500 to 2,000 vehicles per day and a design speed of 45 mph (HS 20-44 represents a semi-trailer truck combination weighing 40,000 pounds over the steering and drive axles). A traveled way of at least 22 feet with 6-foot shoulders (AASHTO Green Book, Exhibit 6-5, page 425) is also recommended, except that for bridges over 100 feet in length, the shoulders can be narrowed to 3 feet (AASHTO Green Book, Exhibit 6-6 footnote “b” page 426). Bridge alternatives were developed considering the Green Book loading and geometric guidelines along with other factors, including historic preservation, aesthetic design, and impacts to nearby natural...
Figure 4-9: Photo Rendering of Community Transition Typical Section (11-foot lanes and 4-foot shoulders)

Figure 4-10: Photo Rendering of Community Core with Estate Curb Option (11-foot lanes and 2-foot concrete shoulders)

Figure 4-11: Community Core Pedestrian Crossings (10-foot-wide crossing with brick paver or stamped concrete surface)
Figure 4-12: Median in Cross Section and Plan View

![Median Diagram]

Figure 4-13: Roundabout in Cross Section and Plan View

![Roundabout Diagram]
resources. Because the specific conditions of each bridge are different, the alternatives developed are slightly
different for each bridge. In every case, the bridge geometric design meets the criteria of AASHTO design
guidelines. Bridge alternatives are described below.

Galisteo Creek Bridge
Multiple alternatives were identified and evaluated for the Galisteo Creek Bridge. The alternatives
considered consisted of various combinations of alignment and geometric configurations. After initial
analysis of the potential configurations, the options were consolidated into three alternatives. The
alternatives considered and the major design features of each are as follows. As discussed in Section
3.2.1 and Section 5.7, the NMDOT has concluded that Galisteo Creek Bridge Alternative 1 (rehabilitation)
is not prudent and is therefore, not recommended. However, this alternative was fully evaluated and the
findings are discussed in this document.

Galisteo Creek Bridge Alternative 1 (Rehabilitation Alternative)
This alternative would remove and replace the bridge deck and railings. The existing girders, abutments,
piers, and foundation would be repaired and reused. The new deck would include two 11-foot driving
lanes, 4-foot shoulders, and a 4-foot walkway on the east side of the bridge for a total width of 37 feet 4
inches. Figure 4-14 illustrates the typical section for this alternative.

Preserving the aesthetic appearance of the bridge was an important consideration. However, the historic
railings cannot be replicated due to their inability to withstand crash impact criteria. For this reason, a
railing design would be used that is historically consistent with bridges of this era and that has been
designed to meet crash worthiness. The feasibility of this alternative depends on the condition of the
existing concrete in the bridge piers and abutments. Further discussion of this issue is provided in
Section 5.

Galisteo Creek Bridge Alternative 2 (Replacement Alternative)
This alternative would construct a new bridge on the alignment of the existing bridge. The bridge deck
would include two 11-foot driving lanes, 4-foot shoulders, and a 4-foot walkway on the east side of the
bridge for a total width of 37 feet 4 inches (see Figure 4-14). If the existing bridge is used as a one-lane
traffic detour during construction, the bridge centerline would be offset several feet from the centerline of
the existing bridge. Additional discussion of potential traffic detouring methods is provided in Section 5.5.

The new bridge deck and railing would be constructed using an aesthetic design similar to the existing
bridge, as described for the Galisteo Creek Bridge Alternative 1. However, the number of spans and pier
placement may not be identical to the existing substructure, depending on how much of the existing
bridge is removed. The existing piers and abutments are founded on bedrock at a depth of 16 to 22 feet
below grade. Removal of the pier and abutment foundations would enable the pier spacing to match that
of the existing bridge. However, if removal of the existing pier foundations is limited to the first several
feet below grade, the new pier foundations would be offset. Under this approach, a 3-span bridge would
be constructed. If the Replacement Alternative is advanced, the extent of foundation removal will be
determined based on cost and environmental impact and in consultation with stakeholder agencies.

Galisteo Creek Bridge Alternative 3 (Parallel Bridge Alternative)
This alternative would construct a new bridge parallel to the existing bridge. The new bridge would be
constructed approximately 10 to 16 feet from the downstream side (west) of the existing bridge.
Figure 4-14: Galisteo Creek Bridge Alternative 1 and 2 Typical Section

Figure 4-15: Galisteo Creek Bridge Alternative 3 Typical w/o Sidewalks

Figure 4-16: Galisteo Creek Bridge Alternative 3 Typical with Sidewalks

Figure 4-17: Illustration of Bridge Offset from Existing Bridge
Figure 4-15 illustrates the typical section for this alternative. The pier spacing and aesthetic design of the new bridge would be similar to the existing bridge.

With this alternative, the existing bridge would be left in place and used by pedestrians, bicyclists, and equestrians. If this were to occur, the configuration of the bridge deck would include two 11-foot driving lanes and 4-foot shoulders resulting in an overall deck width of 33 feet. Sidewalks would not be provided. The existing bridge would be repaired and sealed for use as a pedestrian walkway (Figure 4-17).

As an option to using the existing bridge for pedestrian and bicycle travel, the existing Galisteo Bridge could be fenced off or removed. Under this optional approach, the new bridge deck would be constructed with two 11-foot driving lanes, 4-foot shoulders, and 4-foot walkways on one, or possibly, both sides of the bridge. This configuration would result in a total deck width of 38 feet 4 inches to 42 feet 4 inches, depending on whether one or two sidewalks are included (see Figure 4-18).

Regardless of the deck configuration selected, the Galisteo Creek Bridge Alternative 3 would include the realignment of NM 41 several hundred feet north and south of the new bridge.

San Cristobal Arroyo Bridge

Like the Galisteo Creek Bridge, several alternatives were identified and evaluated for the San Cristobal Arroyo Bridge, including various combinations of alignment and geometric configurations. As a starting point, a rehabilitation alternative was considered. After further examination of the structural elements of the existing bridge, rehabilitation was determined unfeasible due to the poor condition of the timber piles and resulting potential for catastrophic bridge failure. It is not considered a safe and feasible alternative. However, this alternative was fully evaluated and the findings are discussed in this document.

After initial analysis of the potential alignment and deck configurations, the options were consolidated into three alternatives. The major design features of each of these alternatives are described below.

San Cristobal Arroyo Bridge Alternative 1 (Rehabilitation Alternative)

This alternative would remove and replace the bridge deck and railings. The existing girders, abutments, piers, and foundation would be repaired and reused. Because the existing bridge does not have shoulders, the bridge piers would be extended to accommodate a wider deck. In addition, a new foundation would be under-pinned to the existing foundation and gabions would be installed to protect the foundation from scour. The new deck would include two 12-foot driving lanes and 4-foot shoulders. As noted above, this alternative has been determined unfeasible due to the poor condition of the timber piles and resulting potential for catastrophic bridge failure. Figure 4-18 illustrates the typical section for this alternative.

San Cristobal Arroyo Bridge Alternative 2 (Replacement Alternative)

This alternative would construct a new bridge on the alignment of the existing bridge. The bridge deck would include two 12-foot driving lanes and 4-foot shoulders. A 4-foot walkway for pedestrians would be provided on the right (east) side of the bridge deck. This configuration would result in an overall deck width of 39 feet 6 inches. If necessary for maintenance of traffic during construction, the bridge centerline may be offset by several feet from the centerline of the existing bridge. Additional discussion of potential traffic detouring methods is provided in Section 5.5. Figure 4-19 illustrates the typical section for this alternative.
The new bridge deck and railing would be constructed using an aesthetic design similar to the existing bridge. As discussed for the Galisteo Creek Bridge alternatives, a railing design similar to the existing railings and that meets crash worthiness requirements would be used.

**San Cristobal Arroyo Bridge Alternative 3 (Parallel Bridge Alternative)**

This alternative would construct a new bridge parallel to the existing bridge. The new bridge would be offset approximately 10 to 15 feet from the downstream side (west) of the existing bridge. The deck would include two 12-foot driving lanes, 4-foot shoulders, and a 4-foot walkway resulting in an overall deck width of 39 feet 6 inches. The existing bridge would be removed. Figures 4-19 and 4-20 illustrate the typical section for this alternative.
Figure 4-18: San Cristobal Arroyo Bridge Alternative 1 Typical Section

Figure 4-19: San Cristobal Arroyo Bridge Alternative 2 and Alternative 3 Typical Section

Figure 4-20: Illustration of Bridge Offset from Existing Bridge
5.0 ALTERNATIVES ANALYSIS

Each of the alternatives described in Section 4 was evaluated for its feasibility considering engineering, environmental, cultural, and community issues. The primary objective of the analysis during this phase of project development is to determine and compare the substantive consequences of each alternative. The discussion in this section is divided into two subsections: Engineering and Environmental. The first section discusses the engineering aspects of the project. The second section discusses environmental, cultural, and community issues.

ENGINEERING ISSUES

5.1 Traffic Operations and Safety

As a rural major collector highway, NM 41 primarily serves traffic originating from or destined to locations within a relatively large area, including the Galisteo Basin and Estancia Valley. Because the population of the communities within this area is generally low, traffic volumes are also relatively low and are consistent with the volumes typically found on rural collector highways. The assessment of traffic conditions and traffic-related factors on NM 41 was based on traffic count data including daily counts and peak-hour counts at intersections. A technical report — NM 41 Traffic Report, May 2009, Harwick Transportation Group — with the complete traffic data has been prepared and is on file with the NMDOT. Additional information is also available in the NM 41 Initial Alignment Study Report, June 2010.

Traffic Volumes

Existing traffic flows on NM 41 at several locations within and outside of the project limits are shown in Table 5-1. The count data shown represent average annual weekday traffic (AAWDT) and average annual daily traffic (AADT) volumes.

<table>
<thead>
<tr>
<th>Location</th>
<th>AAWDT</th>
<th>AADT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM 41 @ MP 39 (Stanley just south of NM 472)</td>
<td>1299</td>
<td>1323</td>
</tr>
<tr>
<td>NM 41 S of San Cristobal Arroyo Bridge</td>
<td>1213</td>
<td>1259</td>
</tr>
<tr>
<td>NM 41 S of Galisteo Creek Bridge</td>
<td>1200</td>
<td>1278</td>
</tr>
<tr>
<td>NM 41 S of La Vega</td>
<td>1348</td>
<td>1548</td>
</tr>
<tr>
<td>NM 41 @ MP 57</td>
<td>1399</td>
<td>1595</td>
</tr>
</tbody>
</table>

1. AAWDT is average annual weekday traffic. AAWDT uses a seasonal adjustment factor to adjust count data to represent seasonal variations in traffic flow.
2. AADT is annual average daily traffic and represents average traffic volumes over the weekdays and weekend.

The count data show that volumes are relatively uniform throughout the NM 41 corridor with slightly higher volumes north of Galisteo in comparison to south of the community. This suggests that traffic originating within the Galisteo area accounts for about 17% of the total daily traffic volumes. The capacity of a 2-lane collector highway is typically about 7,800 vehicles per day before congestion occurs. With a daily volume of less than 1,500 vehicles, the traffic volume on NM 41 is well within the capacity of the existing 2-lane highway.
Because of the concern of some Galisteo residents with large truck traffic, especially petroleum tanker trucks, the volume of heavy vehicles using NM 41 was also counted. Heavy vehicles were defined as all vehicles that are not passenger sedans, pickup trucks, or motorcycles. They included passenger vehicles towing trailers, recreational vehicles, buses, and both light and heavy duty trucks. Most of the vehicles counted had three or more axles. A total of 289 heavy vehicles was counted during the 3-day count period from Monday through Wednesday, which is 13.3% of the average weekday traffic. Of these heavy vehicles, 14 per day (average) were tanker trucks.

Data over a 7-day period were also collected. An anomaly was noted in the 7-day heavy vehicle count data — the number of large trucks mid-day on Thursday and Friday of the count period was two to four times higher than Monday through Wednesday. County Road (CR) 42 was being reconstructed during the count period, and paving operations were being conducted those two days, leading to the unusually high number of trucks (asphalt trucks observed on NM 41 during these two days arrived from and departed to the south). When these two days of data are removed, the weekday truck percentage is 8.7%, and the 7-day percentage is 5.7%.

Turning movement counts were collected at three NM 41 intersections in Galisteo including Avenida Vieja, Via la Puente, and La Vega. Turning movement volumes are shown in Table 5-2.

<table>
<thead>
<tr>
<th>Table 5-2: NM 41 Intersection Volumes</th>
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<tbody>
<tr>
<td>Intersection</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Morning Peak Hour</td>
</tr>
<tr>
<td>NM 41 @ Avenida Vieja</td>
</tr>
<tr>
<td>NM 41 @ CR 42</td>
</tr>
<tr>
<td>NM 41 @ La Vega</td>
</tr>
<tr>
<td>Evening Peak Hour</td>
</tr>
<tr>
<td>NM 41 @ Avenida Vieja</td>
</tr>
<tr>
<td>NM 41 @ CR 42</td>
</tr>
<tr>
<td>NM 41 @ La Vega</td>
</tr>
</tbody>
</table>

The turning movement counts reflect low volumes at each intersection during each period. Observation of intersection operations during the count periods indicated that vehicle delays were minimal, and intersections operate at high levels of service.

Traffic volumes for the design year were estimated from historic traffic volumes for the years 1988 through 2009. Based on the data, a growth rate of 1.7% annually was used. A 1.7% annual growth rate results in a growth factor of 1.425 for 21 years of growth between 2009 and 2030. Based upon the most recent growth trend, this rate is likely conservative for the 20-year design period. Table 5-3 lists the design-year traffic projections for NM 41 within the project area.

<table>
<thead>
<tr>
<th>Table 5-3: Traffic Forecasts for Year 2030</th>
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<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>2010</td>
</tr>
<tr>
<td>2030</td>
</tr>
</tbody>
</table>
Travel Speeds
Speed data were evaluated for the count location near the radar-reader board south of Galisteo Creek. Speed data were collected for a 7-day period and include all vehicle types. The results of the speed study indicate that average travel speeds along NM 41 are above the posted speed limit of 35 mph northbound and 45 mph southbound. The average observed speed was 40.4 mph northbound and 47.5 mph southbound. The observed 85th percentile speeds were 48.4 mph northbound and 57.1 mph southbound. The percentage of vehicles exceeding the posted speeds was 80% in the northbound direction and 60% southbound.

Speed data collected by the NMDOT in 2007 before the radar-reader boards were installed indicate that there has been a significant reduction in speed entering Galisteo from the south during the past two years. Average speeds are approximately 10 mph lower today than in 2007. The data indicate that the radar-reader boards are an effective traffic calming measure entering Galisteo.

Crash Data
Traffic crashes were reviewed within the NM 41 corridor between mileposts 46 and 62 for the years 2002 through 2007 to determine if specific safety issues are present within the study area. The crash data reviewed were those maintained by the NMDOT for the years 2003 through 2007 and data from the University of New Mexico Division of Government Research (UNM-DGR) for 2002 through 2007. The two data sources were correlated to ensure all crashes were evaluated. Table 5-4 summarizes the crash data for these years. Figure 5-1 illustrates the approximate location of each crash.

<table>
<thead>
<tr>
<th>Year</th>
<th>PDO</th>
<th>Injury</th>
<th>Fatal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2003</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>2004</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2005</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>2006</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2007</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>14</td>
<td>1</td>
<td>28</td>
</tr>
</tbody>
</table>

PDO is Property Damage Only

Only two of the 28 reported crashes during the study period involved two or more vehicles. The remaining 26 crashes were single vehicle crashes. Four of the 28 crashes (14%) involved large trucks. The 2002 through 2007 data yielded 15 injury and fatal crashes out of 28 reported crashes, resulting in a severity index (SI) of 54. Severity index is a measure of the percentage of all crashes that result in personal injury or death and is the sum of the injury and fatal crashes divided by the total number of crashes multiplied times 100, i.e., (injuries + fatalities)/total crashes (100).

The crash severity index for NM 41 is much higher than the overall SI for both Santa Fe County (SI of 37) and the State of New Mexico (SI of 34). Data for Santa Fe County were only available for rural road crashes, and the resultant severity index was 40, substantially below the SI of 54 for the project segment of NM 41. This finding suggests that measures to improve safety should be investigated to lower the NM 41 corridor’s severity index.
Figure 5-1: Location of Crashes within the Project Limits

Vehicle Crash Locations by Type 2002-2007
- Bicyclist
- Overturn Vehicle
- Rear End
- Struck Animal
- Struck Fixed Object
The crash rate for the study segment of NM 41 is 0.60 crashes per million vehicle miles (C/MVM) traveled. Santa Fe County had an average rate of 2.83 C/MVM and New Mexico had an average rate of 2.09 C/MVM during the same 6-year period. This indicates that the NM 41 crash rate is much lower than the County and State averages, and somewhat offsets concerns indicated by the higher than anticipated severity index.

Crash types throughout the corridor were identified and are summarized in Table 5-5. As shown in this table, 46% of all crashes resulted in a vehicle overturning. A high incidence of run-off-the-road crashes is typical for a rural roadway section, though the high percentage of overturning crashes is a concern. The incidence of vehicle overturning is reflected in the higher than average severity index for the corridor. The overturn crash locations are shown in Figure 5-1.

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>SUM</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear End</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>4%</td>
</tr>
<tr>
<td>Overturn</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>13</td>
<td>46%</td>
</tr>
<tr>
<td>Cyclist</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>4%</td>
</tr>
<tr>
<td>Fixed Object – Guardrail</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>Fixed Object – Other</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>Animal – Cow</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>Animal – Deer</td>
<td>1</td>
<td>2</td>
<td></td>
<td>1</td>
<td>4</td>
<td></td>
<td>11</td>
<td>14%</td>
</tr>
</tbody>
</table>

For comparison purposes, NM 41 crashes for the segment of highway south of Clark Hill to Interstate 40 (milepost 28 to milepost 46) were reviewed for the same 6-year period. The database for that segment showed 19 crashes during the same 6-year period, three of which (16%) resulted in a vehicle overturning. This section of road has a 10-mph higher posted speed limit (65 mph) than the project study area, and it has 8-foot or wider shoulders with wide roadside clear zones. It is assumed that the safer roadside environment (8-foot shoulders and flatter recovery area adjacent to the shoulders) has contributed to the much lower overturning crash rate on NM 41 south of the study area.

Excessive speed was the primary contributing factor for 35% of all crashes. Driver inattention and avoiding an object in the road were contributing factors at 11% each. All other contributing factors including alcohol were 4% or less.

As previously noted, four of the 28 reported crashes involved large trucks. Of these, three involved northbound trucks cresting Clark Hill (crashes referenced from MP 46.7 to MP 47.0). Each of these three involved an overturned vehicle, one resulting in a fatality, one with minor injuries, and one with property damage only. The NM 41 alignment at Clark Hill has both horizontal and vertical curvature problems. The remaining truck crash occurred approximately 2½ miles north of Galisteo near MP 58.9, where a truck ran off the road and struck a fence.

### 5.1.1 Consequences of Project Alternatives on Traffic and Safety

The effects of the various project alternatives on traffic volumes, operations, and safety are generally the same. The capacity of the existing highway is adequate to accommodate the projected design-year traffic flows at a high level of service. Because the number of travel lanes remains the same as the existing condition, and the proposed posted speeds are the same or lower than existing, none of the alternatives
would change the capacity of the roadway, and all of the alternatives would be able to meet the projected demand.

A concern expressed by some participants at the public meetings was that improvements to NM 41 would attract more traffic to this highway. This concern is not anticipated as a consequence of any of the project alternatives for several reasons:

- The addition of shoulders and changes to the roadway profile to reduce the curves where sight-distance is deficient would make the study portion of NM 41 safer to drive. However, the change in travel time through the project limits that would result from these improvements would be negligible.
- All of the existing bridges within the project area are currently usable by large trucks. Much of the existing truck traffic (see discussion on page 42) are trucks that either originate within the NM 41 corridor in Moriarty or that are delivering goods and services to the communities along NM 41. Improvements to the bridges would not change this condition nor would it affect the number or type of trucks that could use this highway.
- NM 41 does not currently provide travel time savings or travel efficiency for through truck traffic that originate outside of the project area, as compared to the parallel routes available to trucks (I-25 to the west and US 285 to the east). The improvements included in the roadway and bridge alternatives would not change this condition.
- The different shoulder widths assumed for Community Core Alternatives 1 and 2 (i.e. 4-feet vs. 2-feet) would not be expected to encourage or discourage traffic on NM 41. However, as discussed below, the width of shoulders would have safety implications.

Driver safety would be improved with all of the bridge and the roadway alternatives under consideration. Safety would be enhanced by the addition of shoulders, improved tapers, the reduction in vertical curves where sight distance is less than needed for a 55-mph posted speed, lengthening of the climbing lane at Clark Hill, and the additional traffic calming measures. Specific safety improvements of the roadway alternatives are as follows.

- For the Rural alternative, safety would be improved by the addition of 6-foot shoulders and the improvements to sight distance in the vertical curves north of Clark Hill. Shoulders would provide a safe place for motorists to stop if mechanical breakdowns were to occur. The shoulders and reduction of vertical curves would also improve maneuverability and stopping sight distance for motorists to avoid oncoming vehicles and/or objects/animals in the roadway.
- Shoulders would also provide a safe place for bicycles to travel out of the driving lane. With the exception of the 2-foot flush curbs used in Community Core Alternative 2, all of the build alternatives would improve the safety of bicyclists traveling on NM 41. With the 2-foot flush curb option in Community Core Alternative 2, bicyclists would use the driving lanes. Even though the posted speeds will be 25 to 30 mph in the Community Core segment, a significant speed differential would exist between motor vehicles and bicycles, especially in the northbound direction where a slight grade is present.

A concern expressed by bicyclists is the location and width of rumble strips within the shoulder area. Rumble strips would be limited to the Rural typical sections only. Because the shoulders are 6-feet wide in these areas, adequate width would remain for bicycles.
The replacement of the San Cristobal Arroyo Bridge (San Cristobal Bridge Alternative 2) would eliminate the potential for collapse of this bridge. As discussed in Section 2, the poor condition of the timber piles combined with a high scour event from high water flows creates the potential for bridge failure/collapse. If this were to occur, a significant safety threat would result.

The provision of sidewalks and shoulders on the San Cristobal and Galisteo bridges under all of the bridge alternatives would improve safety for bicyclists and pedestrians on these structures.

The proposed traffic calming strategies are intended to cause a reduction in travel speed, which, in turn, would improve safety for motorists, pedestrians, bicyclists, and the residents adjacent to the highway. As noted previously, a reduction of about 10 mph was observed for vehicles entering Galisteo after the two existing radar-reader boards were installed. The two additional units proposed within the Community Transition Alternative would be expected to have a similar effect and would extend the area of reduced travel speeds.

In addition, the medians proposed as part of the Community Transition Alternative would be expected to increase motorist awareness that they are entering a developed neighborhood with pedestrian activity. This reinforcement would contribute to the safety achieved by the narrow shoulders and lanes.

The roundabout option would have the same effect as medians. However, because the design of roundabouts includes short radius curvature, this strategy could have a detrimental effect at the interface between the Community Transition and Rural segments. Even though advisory and other signing would precede the roundabouts, motorists who enter the intersection at excessive speed could overreact to the roundabout median and swerve abruptly. This could result in crashes and property damage at the roundabouts.

5.2 Drainage and Structures

The project area is located in the Galisteo Basin watershed (see Figure 5-2) — a sub-basin within the Rio Grande Basin that covers an area of about 730 square miles. Galisteo Creek is the primary surface water feature in the basin and joins the Rio Grande approximately 36 miles northwest of the community of Galisteo. Galisteo Creek is perennial and occasionally carries high flows. About 70% of the annual flows occur during the spring runoff period. Galisteo Creek gains inflow as ground water levels rise to the land surface in the alluvial sediments; thus, ground water levels are directly related to precipitation.

Galisteo Creek crosses NM 41 near MP 56 and flows parallel to the highway north of the community of Galisteo and encroaches into the highway right-of-way near MP 57. Bank stabilization and reinforcement has been constructed at this location.

San Cristobal Arroyo flows into Galisteo Creek just south of the community of Galisteo near MP 55.6. It is an intermittent waterway, but has considerable riparian habitat along its banks where it passes through the project area. Other surface waters within the project area, all of which are ephemeral, include:

- Arroyo de la Jara, which crosses NM 41 near MP 53.6 (bridge)
- Gaviso Arroyo, which crosses NM 41 near MP 50.7 (16.5-foot x 26-foot CMP)
- Arroyo Puertacito de los Salado begins west of the highway at Clark Hill and is fed by many small arroyos that cross NM 41 between MPs 46.5 – 49.5

Figure 5.10 on page 78 displays the surface waters in the project area.
In addition to the three bridges, the inventory of NM 41 identified 42 drainage structures crossing the highway. Of these, seven are concrete box culverts (CBC) with the remainder being corrugated metal pipe (CMP). Most of the CMPs range in size from 24 inches to 54 inches, although one large oval pipe (16.5 feet x 26 feet) exists at Gaviso Arroyo near MP 50.7. Table 5-6 lists information about the drainage structures within the project limits. Bridges are discussed in the following section.

As shown in Table 5-6, many of the existing drainage structure ends are in poor condition and/or do not function properly. Of the 42 structures identified, 17 may warrant end replacement due to their condition.

Several of the concrete box culverts also function as livestock crossings. However, sediment buildup in some of these boxes has reduced their vertical clearance and has limited their use by livestock. The ranch manager for San Cristobal Ranch has requested that additional livestock crossings be considered if the highway is improved. Project area residents, as well as NMDOT field maintenance personnel, have observed that ponding after major storms occurs between the roadway and the church in Galisteo. The water collection at this location is from parking area and roadway runoff.

5.2.1 Consequences of Project Alternatives on Drainage

The effects on drainage and drainage structures are the same for all alternatives, except for the No Build alternative. The No Build alternative would leave drainage structures in their existing condition with maintenance provided on an as-needed basis. The build alternatives would improve or replace the existing boxes and culvert pipes, as needed. Neither the rehabilitation nor replacement of the Galisteo Creek and San Cristobal Arroyo bridges would affect drainage flows or patterns. The drainage issue near the church would be corrected by either of the build alternatives within the Community Core.
5.3 Access

Access to and from NM 41 is currently uncontrolled with access provided at several County Roads and approximately 17 other major access points. In addition, there are numerous driveways serving individual homes within Galisteo and between Galisteo and US 285. Major access points are listed in Table 5-7.

5.3.1 Access Impacts

With the exception of one location, existing access is not affected by any of the project alternatives. The exception is the realignment of Goose Downs Road which would be moved approximately 950 feet south to align with the primary access route into Vista Clara Ranch (see drawing on the following page). This driveway realignment is proposed to consolidate access points and improve the safety of left turns at this location. The owners of Goose Downs Road and Vista Clara Ranch supported this change as a safety measure. The median (or roundabout) proposed at this location would also serve as a visual cue to designate the start/end of the Community Transition segment.

Minor changes would be made at other driveways and access roads where the roadway profile changes. These changes would be limited to slight changes in the profile to provide an acceptable grade between NM 41 and the intersecting roadway. Because the profile change of NM 41 is generally minor, it is anticipated that the needed changes could be accomplished with temporary construction permits; right-of-way would not be needed.

---

Table 5-6: Existing Drainage Structures

<table>
<thead>
<tr>
<th>Milepost</th>
<th>Type</th>
<th>Condition</th>
<th>Milepost</th>
<th>Type</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>46.4</td>
<td>24&quot; CMP</td>
<td>Poor</td>
<td>55.0</td>
<td>3 - 24&quot; CMP</td>
<td>Good</td>
</tr>
<tr>
<td>46.7</td>
<td>2 - 7'x5' CBC</td>
<td>Fair</td>
<td>55.7</td>
<td>36&quot; CMP</td>
<td>Good</td>
</tr>
<tr>
<td>46.9</td>
<td>48&quot; CMP</td>
<td>Good</td>
<td>56.1</td>
<td>24&quot; CMP</td>
<td>Good</td>
</tr>
<tr>
<td>47.2</td>
<td>2 - 7'x5' CBC</td>
<td>Fair</td>
<td>56.6</td>
<td>24&quot; CMP</td>
<td>Fair</td>
</tr>
<tr>
<td>47.4</td>
<td>54&quot; CMP</td>
<td>Fair</td>
<td>56.7</td>
<td>24&quot; CMP</td>
<td>Fair</td>
</tr>
<tr>
<td>47.6</td>
<td>84&quot; CMP</td>
<td>Good</td>
<td>57.0</td>
<td>6' X 4' CBC.</td>
<td>Good</td>
</tr>
<tr>
<td>48.0</td>
<td>2 - 48&quot; CMP</td>
<td>Good</td>
<td>57.3</td>
<td>6' X 7' CBC</td>
<td>Good</td>
</tr>
<tr>
<td>48.2</td>
<td>24&quot; CMP</td>
<td>Fair</td>
<td>57.4</td>
<td>3 - Triple 6' X 7' CBC</td>
<td>Good</td>
</tr>
<tr>
<td>48.4</td>
<td>54&quot; CMP</td>
<td>Good</td>
<td>57.7</td>
<td>24&quot; CMP</td>
<td>Fair</td>
</tr>
<tr>
<td>48.7</td>
<td>48&quot; CMP</td>
<td>Good</td>
<td>57.9</td>
<td>32&quot; CMP</td>
<td>Poor</td>
</tr>
<tr>
<td>49.1</td>
<td>54&quot; CMP</td>
<td>Good</td>
<td>52.4</td>
<td>24&quot; CMP</td>
<td>Fair</td>
</tr>
<tr>
<td>49.8</td>
<td>24&quot; CMP</td>
<td>Fair</td>
<td>58.6</td>
<td>24&quot; CMP</td>
<td>Poor</td>
</tr>
<tr>
<td>50.7</td>
<td>16.5&quot;X26' Oval CMP</td>
<td>Good</td>
<td>58.8</td>
<td>24&quot; CMP</td>
<td>Poor</td>
</tr>
<tr>
<td>50.8</td>
<td>24&quot; CMP</td>
<td>Poor</td>
<td>59.2</td>
<td>36&quot; CMP</td>
<td>Fair</td>
</tr>
<tr>
<td>51.0</td>
<td>2 - 32&quot; CMP</td>
<td>Poor</td>
<td>59.4</td>
<td>32&quot; CMP</td>
<td>Poor</td>
</tr>
<tr>
<td>52.1</td>
<td>24&quot; CMP</td>
<td>Poor</td>
<td>59.6</td>
<td>3 - 6' X 7' CBC</td>
<td>Good</td>
</tr>
<tr>
<td>52.2</td>
<td>24&quot; CMP</td>
<td>Good</td>
<td>60.1</td>
<td>24&quot; CMP</td>
<td>Poor</td>
</tr>
<tr>
<td>52.4</td>
<td>24&quot; CMP</td>
<td>Good</td>
<td>60.5</td>
<td>24&quot; CMP</td>
<td>Fair</td>
</tr>
<tr>
<td>53.3</td>
<td>24&quot; CMP</td>
<td>Poor</td>
<td>61.1</td>
<td>2 - 3' X 6' CBC</td>
<td>Good</td>
</tr>
<tr>
<td>54.2</td>
<td>24&quot; CMP</td>
<td>Fair</td>
<td>61.4</td>
<td>24&quot; CMP</td>
<td>Poor</td>
</tr>
<tr>
<td>54.4</td>
<td>3 - 24&quot; CMP</td>
<td>Good</td>
<td>61.8</td>
<td>32&quot; CMP</td>
<td>Good</td>
</tr>
</tbody>
</table>
### Table 5-7: Roads Intersecting NM 41

<table>
<thead>
<tr>
<th>Milepost</th>
<th>Side</th>
<th>Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>47.5</td>
<td>Right</td>
<td>San Cristobal Ranch Access Road</td>
</tr>
<tr>
<td>48.3</td>
<td>Left</td>
<td>San Cristobal Ranch Access Road</td>
</tr>
<tr>
<td>50.2</td>
<td>Left</td>
<td>County Road 38B/Rough Road</td>
</tr>
<tr>
<td>50.2</td>
<td>Right</td>
<td>Rough Road</td>
</tr>
<tr>
<td>51.4</td>
<td>Left/Right</td>
<td>San Cristobal Ranch Access Road</td>
</tr>
<tr>
<td>53.9</td>
<td>Right</td>
<td>San Cristobal Ranch Access Road</td>
</tr>
<tr>
<td>55.2</td>
<td>Left</td>
<td>County Road 40</td>
</tr>
<tr>
<td>55.3</td>
<td>Right</td>
<td>Rodeo Grounds Access</td>
</tr>
<tr>
<td>55.4</td>
<td>Right</td>
<td>Rodeo Grounds Access</td>
</tr>
<tr>
<td>55.8</td>
<td>Right</td>
<td>County Road 33A (Avenida Vieja)</td>
</tr>
<tr>
<td>56.3</td>
<td>Left</td>
<td>The Hill Road</td>
</tr>
<tr>
<td>56.3</td>
<td>Right</td>
<td>Via la Puente</td>
</tr>
<tr>
<td>56.3</td>
<td>Left</td>
<td>County Road 42 (Camino Los Abuelos)</td>
</tr>
<tr>
<td>56.5</td>
<td>Right</td>
<td>La Vega Road</td>
</tr>
<tr>
<td>57.0</td>
<td>Left</td>
<td>Local access road</td>
</tr>
<tr>
<td>57.5</td>
<td>Left</td>
<td>Local access road (Light Institute)</td>
</tr>
<tr>
<td>57.8</td>
<td>Right</td>
<td>Vista Clara Ranch</td>
</tr>
<tr>
<td>58.0</td>
<td>Left</td>
<td>Goose Downs Road</td>
</tr>
<tr>
<td>58.5</td>
<td>Left</td>
<td>Entrada Tranquillas</td>
</tr>
<tr>
<td>60.6</td>
<td>Right</td>
<td>Saddleback Ranch</td>
</tr>
</tbody>
</table>

*Realignement of Driveway at Goose Downs Road and Vista Clara Ranch Entrance at MP 57.9*
5.4 Utilities and Other Roadside Features

Few utilities occur within or immediately adjacent to the NM 41 highway right-of-way. Those present include overhead power and telephone, buried telephone cable, and a fiber optic line. Overhead electric and phone utilities are inside the highway right-of-way and immediately outside of the right-of-way in the corridor from Galisteo north to US 285. Extensions from the main lines cross the highway at four locations to provide service to development along both sides of the highway. Buried phone and fiber optic lines are also present from Galisteo north. Both the overhead electric and buried phone/fiber optic cable appear to stop at the south end of Galisteo.

Several telephone boxes, an electric transformer box, and electric utility boxes are present along the east right-of-way (inside) near MP 56.55. These units are approximately 20 feet from the edge of the existing pavement. In addition to the above, domestic utilities such as water, gas lines, and septic systems occur within the Galisteo area but no evidence exists that suggests these utilities extend into the right-of-way.

Utility boxes adjacent to NM 41 in Galisteo

Overhead utility lines adjacent to NM 41 in Galisteo

Historic marker adjacent to NM 41 in Galisteo

Mail boxes in right-of-way in Galisteo
Several other objects exist within the roadway right-of-way that could be affected by highway improvements. These include a scenic historic marker just north of the NM 41/County Road 42 intersection, newspaper vending boxes just south of the church, and mailboxes. The mailboxes include several isolated mailboxes and two clusters of mailboxes: one at the intersection of The Hill Road and NM 41 (south of the church), and a second cluster along the east side of NM 41 just north of the NM 41/Via la Puente intersection. In some instances, the mailboxes are within 10 feet of the existing pavement.

5.4.1 Impacts to Utilities and Roadside Features

Major impacts to underground and overhead utilities are not anticipated with any of the build alternatives. While some utility relocation may be necessary, impacts are expected to be minor and would be the same regardless of the alternative selected. The No Build Alternative would not impact any utilities or roadside features.

The individual mailboxes and mailbox cluster north of Via la Puente would likely require removal during construction. These mailboxes appear to be encroachments within the highway right-of-way. These boxes are not used for US Postal Service deliveries; community mail boxes for this purpose are located south of the church between The Hill Road and County Road 42. However, they may be used by area residents to distribute community information. Their removal and storage during construction would not affect US Postal mail delivery. After construction is complete, the boxes would be replaced at the outside edge of the highway right-of-way. The historic marker is approximately 15 feet from the edge of the existing pavement. It is beyond the anticipated construction area and will likely not be affected.

5.5 Constructability Considerations

Because the reconstruction of NM 41 is relatively minor for most elements of the project, constructability is not a major issue. The two exceptions to this are the improvements to the San Cristobal Arroyo Bridge and Galisteo Creek Bridge, both of which could have substantial constructability challenges. Notable constructability issues and considerations for each alternative are summarized below.

Rural Alternative

The improvements to the rural portions of the NM 41 project are generally limited to pavement reconstruction and the addition of shoulders. In most locations the roadway profile remains the same as the existing alignment or requires changes of less than 2 feet. However, several locations will have more pronounced changes in the roadway profile, as follows:

- The area from the base of Clark Hill at milepost 47.0 north to milepost 48.1 includes several back-to-back sag and crest curves with substandard stopping sight distance. The roadway profile would be changed 5 to 6 feet in two dip sections and one crest curve. In addition, the profile of the dip section at milepost 47.7 would be raised by 12 feet to accommodate an 8-foot diameter CMP to allow livestock and wildlife to cross under the highway. The crest curve at milepost 47.8 following this dip section would be reduced by approximately 8 feet.
- Five consecutive vertical curves beginning at milepost 48.0 and ending near 48.7 would be changed by as much as 5 feet to achieve adequate visibility for stopping sight distance.
- A crest curve followed by a dip section between milepost 52.85 and 53.0 would be modified by lowering the crest curve by approximately 4 feet and filling the dip section by approximately 7 feet.
With the exception of the change at milepost 47.7, all of the improvements would be constructed within the existing right-of-way, although 2:1 side slopes may be needed in some of these locations. The exception is the CMP at MP 47.7 where the adjoining landowner requested consideration of a livestock undercrossing. While the CMP and side slopes would be constructed within the existing highway right-of-way, construction of this structure would require a construction maintenance easement.

Temporary detours would be needed to reconstruct the roadway. Due to the narrow existing roadway, it is likely that one-lane detours may be needed. In general, construction activities will result in temporary delays to commuters and other traffic. The need for and type of detours will be determined during final design.

**Community Transition and Community Core Alternatives**

The Community Transition and Community Core alternatives would remain on the existing profile or within 1 foot of existing. In addition, because shoulders are limited to no more than 4 feet, no significant constructability issues have been identified. One minor issue exists at milepost 56.6 across from La Vega Road where the roadway would be cut into the slope on the west side of the highway. This location would require a short length of barrier (guardrail or thrie-beam) to avoid cutting into this slope and to eliminate the need for right-of-way acquisition.

**Bridge Alternatives**

The Galisteo Creek Bridge and San Cristobal Arroyo Bridge present the most substantial constructability challenges to the NM 41 project. Of greatest importance is the need for detours during bridge construction and the temporary impacts to the habitat within the waterways. Habitat impacts are discussed in Section 5-14 and are not discussed in this section.

NM 41 is used by commuters traveling between Santa Fe and the Moriarty/Edgewood/Estancia area. While routes other than NM 41 are available, they require out-of-direction travel and longer travel times. Traffic count data collected in 2009 at the intersection of NM 41 and Avenida Vieja in Galisteo showed 51 northbound vehicles approaching this intersection in the morning peak hour and 94 southbound vehicles in the evening peak. Daily traffic volumes at this location show a total of 1,280 vehicles using NM 41 south of County Road 42. These data illustrate the importance of NM 41 for commuter travel. Because commuter use of NM 41 is significant, closing the highway during bridge construction would have considerable impacts on travel times for the users of this highway. It would also affect emergency response time for the fire station located in Galisteo. Figure 5-3 illustrates the alternative routes available to NM 41 commuters. Table 5-8 summarizes travel distances and travel times, assuming uncongested conditions. Note that NM 344 through Cedar Grove and Golden is not included as a viable alternative detour route due to the poor condition of this roadway.

The first three travel times shown in Table 5-8 are for the existing conditions, i.e., the no detour condition. As shown in this table, the non-detoured travel time between I-40 and NM 41 in Moriarty and I-25 and St. Francis Drive in Santa Fe is approximately 48 minutes. The added time and distance for these same origin-destination points would be approximately 19 minutes and 23 miles if US 285 is used (see Figure 5-3) or 27 minutes and 21 miles if I-40 to NM 344 and NM 14 are used. Travel times for other trip origination points and routes are provided in the table. The additional travel time and route mileage would be substantial for all potential detour routes.
Figure 5-3: Alternative Detour Routes for NM 41
An additional consideration is emergency medical and fire response service provided by the Santa Fe County Fire Station in Galisteo. This station is located east of NM 41 on Avenida Vieja and serves the Galisteo area south to Clark Hill. Fire trucks exiting this station use Avenida Vieja to access NM 41, even for emergency calls north of Galisteo. Via la Puente is not used because fire trucks exceed the load limits of the timber bridge across Galisteo Creek. For this reason, the Galisteo Creek and San Cristobal Arroyo Bridge Alternatives must consider the impacts of detours on both commuters and emergency response providers.

<table>
<thead>
<tr>
<th>Table 5-8: Travel Times and Miles of Commuter Routes and Potential Detour Routes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route</strong></td>
</tr>
<tr>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Current Routes</td>
</tr>
<tr>
<td>NM 41 via US 285(1)</td>
</tr>
<tr>
<td>NM 41 via CR 42(1)</td>
</tr>
<tr>
<td>NM 41 from Edgewood via NM 344(2)</td>
</tr>
<tr>
<td>Detour Routes</td>
</tr>
<tr>
<td>I-40 to US 285(1)</td>
</tr>
<tr>
<td>I-40 to NM 344 to NM 14(1)</td>
</tr>
<tr>
<td>I-40 to NM 14(1)</td>
</tr>
<tr>
<td>I-40 to NM 14(2)</td>
</tr>
<tr>
<td>NM 344 to NM 14(2)</td>
</tr>
</tbody>
</table>

1. Assumes trip start at I-40 and NM 41.
2. Assumes trip start at I-40 and NM 344 in Edgewood.
3. Assumes posted travel speeds for each respective segment.

One potential solution for fire truck access would be to park a second response vehicle within Galisteo along NM 41 so that the crossing of the timber bridge is unnecessary. The viability of this approach would depend on the availability of a second truck for the Galisteo Fire District from other locations within the Santa Fe County Fire Department. The need for and feasibility of this approach would be determined during final design of the bridges.

**Galisteo Creek Bridge Alternative 1 (Rehabilitation)**

The Galisteo Creek Bridge Alternative 1 assumes the use of the existing bridge foundations, abutments, and piers. Construction of this alternative would occur in three phases with traffic limited to a single lane during each phase of construction. This approach would allow a **single lane of traffic to remain open** at all times. The phasing plan is illustrated in Figure 5-4 and would include the following elements:

1. Phase 1 construction would include placing a temporary wall barrier on the northbound half of the existing bridge to create an 11-foot one-lane detour. The use of a one-lane detour would require that the detour lane be signalized, although a flagman could be used during the times of day when construction is active.

   After the detour has been established, the western (southbound) half of the bridge superstructure would be removed and the new girders, deck, and railing would be constructed to the new dimensions.

2. Phase 2 construction would shift the detour to the newly constructed southbound lane. This detour would be restricted to an 11-foot width and would be protected by wall barrier on both sides. After traffic is shifted, the existing northbound lanes would be removed and the new bridge deck, sidewalk, and railing would be constructed on the eastern half of the bridge.
Figure 5-4: Galisteo Creek Bridge Rehabilitation Alternative Phasing
3. The third and final construction phase would include the placement of wall barrier on the western half of the bridge deck while the walkway and railing are constructed. Two-way traffic could be accommodated during the third phase.

As an alternative to the phased construction approach, a temporary bridge could be used while the existing bridge superstructure is removed and reconstructed. The temporary bridge would be placed approximately 20 to 30 feet to the left (west) of the existing bridge and could accommodate two lanes of traffic. The temporary bridge would require the removal of large trees and shrubs within the Galisteo Creek channel, although it may be possible to cut the existing trees and shrubs above ground level to preserve their root structure and allow re-growth after construction is complete. Some temporary fill and pier foundations would be placed within the channel. Temporary abutments and pavement connecting to the existing roadway would also be constructed to accommodate the detoured traffic. Because access connections to the temporary bridge would be partially or wholly on private property, a temporary work permit would be needed.

**Galisteo Creek Bridge Alternative 2 (Replacement)**

The Galisteo Creek Bridge Alternative 2 includes two options. The first option would reconstruct the bridge using four spans with the bridge piers and abutments located in the same general location as the existing bridge. The second option would use a 3-span design allowing the piers to be offset. The construction impacts for each option are as follows.

The first option would require the removal of the existing piers, pier foundations, and abutments. As discussed in Section 4, the existing piers are founded on bedrock ranging from 16 to 24 feet below ground level. The demolition of these structures would require excavation to their base. Assuming a bridge length of 240 feet, an average excavation depth of 20 feet, and 2:1 side slopes, the excavation would impact an area approximately 240 feet long by 115 feet wide (approximately 0.63 acres). The extent of excavation would add considerable cost, complexity, and environmental impacts to the bridge replacement. This option would also require the use of a temporary bridge during construction. The location and impacts of the temporary bridge would be the same as described for the Galisteo Creek Bridge Alternative 1.

The second option for the Galisteo Creek Bridge Alternative 2 would involve the use of a 3-span bridge offset from the existing piers (see Figure 5-5). The existing piers would be cut several feet below grade and covered. Because the existing piers would not have to be removed, this approach would have substantially less disturbance within the Galisteo Creek channel during construction than the first option. If a two-column pier design is used, it may be possible to construct the new piers and the piling for the abutments with the existing bridge in place. This would require one-lane closures and the use of steel plates over the pier access holes in the existing deck. If this approach is used, construction phasing would be similar to that described for Galisteo Creek Bridge Alternative 1, the Rehabilitation alternative.

**Galisteo Creek Bridge Alternative 3 (Parallel Bridge)**

This alternative would construct a new bridge parallel to the existing bridge and offset approximately 10 to 16 feet from the downstream side (west) of the existing bridge. This alternative does not present any unusual constructability or detouring issues, as the new bridge would be constructed off-line while traffic is maintained on the existing bridge. Only minor detouring would be necessary while the roadway is realigned to match the new bridge centerline.
San Cristobal Arroyo Bridge Alternative 1 (Rehabilitation)
This alternative would remove and replace the bridge deck and railings. The existing girders, abutments, piers, and foundation would be repaired and reused and two new girder lines and piers would be constructed. A new foundation would be under-pinned to the existing foundation, and gabions would be installed to protect the foundation from scour.

Because of the extent of foundation work needed and the narrow width of the existing bridge deck, this alternative would require use of a temporary bridge to the west of the existing bridge. A temporary 2-lane bridge would be placed approximately 30 feet to the left (west) of the existing bridge. The temporary bridge would require the removal of large trees and shrubs within the San Cristobal Arroyo channel. Temporary fill and pier foundations would be placed within the channel. Temporary abutments and pavement connecting to the existing roadway would also be constructed to accommodate the detoured traffic.

San Cristobal Arroyo Bridge Alternative 2 (Replacement)
This alternative would construct a new bridge on the alignment of the existing bridge. An offset of several feet would be required if construction of the new bridge is phased to allow a one-lane detour using the existing bridge. Preliminary analysis indicates reconstruction could occur in two phases with a single lane detour during each phase of construction. The phasing approach is illustrated in Figure 5-6 and would be as described below:

1. Phase 1 construction would include placing a temporary wall barrier on the northbound half of the existing bridge to create an 11-foot one-lane detour. The use of a one-lane detour would require that the detour lane be signalized, although a flagman could be used during the times of day when construction is active. After the detour is established, the opposite half of the bridge would be removed and the left half of the new bridge constructed.

2. Phase 2 construction would shift the detour to the newly constructed southbound lane. After traffic is shifted, the existing northbound lane would be removed and the new bridge deck and railing would be constructed on the eastern half of the bridge.

As an alternative to the phased approach, a temporary bridge could be used while the existing bridge superstructure is removed and reconstructed. The temporary bridge would be as described for San Cristobal Arroyo Bridge Alternative 1, the Rehabilitation alternative.

San Cristobal Arroyo Bridge Alternative 3 (Parallel)
This alternative would construct a new bridge parallel to and offset approximately 10 to 15 feet from the existing bridge on the downstream side (west). This alternative does not present any unusual
Figure 5-6: San Cristobal Arroyo Alternative 2 Phasing
constructability or detouring issues, as the new bridge would be constructed off-line while traffic is maintained on the existing bridge. Only minor detouring would be necessary while the roadway is realigned to match the new bridge centerline.

5.6 Right-of-Way

Only a minor amount of new right-of-way would be required for the proposed project. The Rural alternative would be constructed entirely within the existing right-of-way, although construction maintenance easements (CME) may be needed at several locations where drainage boxes and culverts are extended. In addition, a CME would be necessary at the proposed livestock crossing at MP 47.7.

The roundabout option within the Community Transition alternative would require some right-of-way acquisition. The acquisition would be as follows:

- Milepost 55.5 – 0.23 acres left and 0.36 acres right
- Milepost 56.7 – 0.04 acres left

Construction of the Parallel Bridge alternative (Alternative 3 for both bridges) at Galisteo Creek and San Cristobal Arroyo would require the acquisition of right-of-way along the left side of the highway at both of these bridges. The bridge offset and roadway realignment at both bridges would affect an area approximately 800 feet north and south of the drainages for a total length of approximately 1,600 feet at each bridge. This offset would result in the acquisition of approximately 2.0 acres of right-of-way for each bridge.

5.7 Cost

Table 5-9 summarizes the estimated costs for the two major roadway subareas within the project area: the Rural segments and the Community segments (including the Transition and Core alternatives). The costs shown do not include the replacement bridges (see discussion below). The costs for the Community segments are based on the Community Transition alternative and Community Core Alternative 1 - 4-foot shoulders and medians. If roundabouts are used instead of medians, the total cost would increase by approximately $123,400. If Community Core Alternative 2 (2-foot flush concrete curb section) is used, the roadway construction cost would decrease by approximately $99,250.

Table 5-10 summarizes the construction and life cycle costs for the Galisteo Creek Bridge. Life cycle costs include the total costs of a structure when maintenance and the structure life span are considered. Because design and the type of materials used affect the usable life of bridge structures, the life cycle costs are considered a better estimate than the costs of initial construction alone. The costs in Table 5-10 include initial construction, demolition, and future maintenance for the piers and abutments, and an adjustment factor to compare cost over the bridge service life. Because Galisteo Creek Bridge Alternative 1 (the Rehabilitation alternative) uses the existing abutments and piers, the service life for this alternative is expected to be less than a newly constructed bridge (i.e., Alternatives 2 and 3). While it is difficult to estimate a service life for rehabilitated structures with any degree of certainty, the condition of concrete cores collected in late 2010 revealed gap-gradation and large aggregate in the concrete. Because of this finding, it is probable that cracks may exist through the matrix of this concrete. For this
reason and because the concrete is over 70 years old, the service life for the rehabilitated substructure elements for the Galisteo Creek Bridge was assumed to be no more than 50 years. In comparison, the design service life of Galisteo Creek Bridge Alternatives 2 and 3 was assumed to be the industry standard of 75 years.

### Table 5-9: Estimated Costs of Roadway Segments

<table>
<thead>
<tr>
<th>Item</th>
<th>South Rural Segment</th>
<th>North Rural Segment</th>
<th>Community Segments(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roadway</td>
<td>$5,086,498</td>
<td>$2,186,617</td>
<td>$1,166,424</td>
</tr>
<tr>
<td>Drainage Improvements</td>
<td>$819,366</td>
<td>$42,746</td>
<td>N.A.</td>
</tr>
<tr>
<td>Metal Barrier</td>
<td>$253,827</td>
<td>$107,670</td>
<td>N.A.</td>
</tr>
<tr>
<td>Fencing and Gates</td>
<td>$310,400</td>
<td>$133,029</td>
<td>$61,500</td>
</tr>
<tr>
<td>Medians</td>
<td>N.A.</td>
<td>N.A.</td>
<td>$148,567</td>
</tr>
<tr>
<td>Miscellaneous Construction Items</td>
<td>$1,092,484</td>
<td>$470,634</td>
<td>$100,468</td>
</tr>
<tr>
<td>Construction Subtotal</td>
<td>$7,562,575</td>
<td>$2,940,696</td>
<td>$1,476,959</td>
</tr>
<tr>
<td>Design/CM/Contingencies (30%)</td>
<td>$2,268,772</td>
<td>$882,209</td>
<td>$443,087</td>
</tr>
<tr>
<td>Estimate Total</td>
<td>$9,831,347</td>
<td>$3,822,905</td>
<td>$1,920,047</td>
</tr>
</tbody>
</table>

1. Construction costs are based on 4-foot shoulders and medians. The 2-foot concrete flush curb would reduce the construction cost by approximately $99,250. The use of roundabouts in lieu of the medians would increase the costs by approximately $123,400.

### Table 5-10: Comparison of Life Cycle Costs for Galisteo Creek Bridge

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>Alternative 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Item</td>
<td>RehabilitationAlternative</td>
<td>Replace. Alt. (4-Span)</td>
<td>Replace Alt (3-Span)</td>
</tr>
<tr>
<td>Design, R/W, and Contingency</td>
<td>$284,215.00</td>
<td>$176,395.00</td>
<td>$438,535.00</td>
</tr>
<tr>
<td>Construction</td>
<td>$839,186.00</td>
<td>$1,938,936.00</td>
<td>$1,310,536.00</td>
</tr>
<tr>
<td>Demolition</td>
<td>$121,000.00</td>
<td>$266,000.00</td>
<td>$171,000.00</td>
</tr>
<tr>
<td>Roadway Realignment</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Construction Cost Subtotal</td>
<td>$1,244,401.00</td>
<td>$2,381,331.00</td>
<td>$1,920,071.00</td>
</tr>
<tr>
<td>Routine Maintenance (1)</td>
<td>$389,550.00</td>
<td>$389,550.00</td>
<td>$278,250.00</td>
</tr>
<tr>
<td>Assumed Service Life</td>
<td>50 years</td>
<td>75 years</td>
<td>75 years</td>
</tr>
<tr>
<td>Service life ratio</td>
<td>0.67</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Life Cycle Cost Estimate</td>
<td>$2,438,732.50</td>
<td>$2,770,881.00</td>
<td>$2,198,321.00</td>
</tr>
</tbody>
</table>

1. Assumes major repair and resealing of abutments and piers.
2. Includes the cost of right-of-way and earthwork but no pavement for the realigned sections. The cost of pavement is included in the cost of roadway segments shown in Table 5-9.

Maintenance costs included in the life cycle cost analysis are limited to major repairs and resealing of the piers and abutments. The deck and railings will also require periodic maintenance; however, these would be the same for all alternatives and, therefore, are part of the baseline cost assumptions. According to NMDOT District 5 maintenance personnel, new construction bridges typically require major maintenance
of the piers and abutments 35 to 40 years after initial construction. For existing bridges, this time is reduced to approximately 20 to 25 years. Thus, the life cycle cost assessment for both a new bridge and a rehabilitated bridge should include costs for one to two major maintenance efforts. For this analysis, the costs were limited to a single maintenance effort.

As shown in Table 5-10, the construction of a 4-span bridge on the existing alignment would have the highest cost. The higher cost for this alternative is due to the complete removal of the existing pier and abutment foundations. The cost of the Alternative 1 is also substantially higher than the other alternatives. While the cost to construct the Alternative 1 is substantially lower than Alternative 2, the assumed service life is also considerably less, resulting in a higher cost when the structure service life is considered. The initial construction and life cycle costs are similar for Alternative 2 using a 3-span design and Alternative 3. It is noted that the cost for all of the alternatives would be higher if phased construction is not possible and a temporary bridge is needed to detour traffic.

Table 5-11 summarizes the cost for the San Cristobal Arroyo Bridge alternatives. The cost for this bridge is limited to implementation costs only. A life cycle cost comparison was not estimated, as Alternative 1 is not prudent or reasonable due to the condition of the existing bridge foundations. The difference in costs for this bridge is due to the cost for two-phased construction if the existing alignment is used. Using two-phased construction would add approximately 20% to the total construction cost. In comparison, Alternative 3 does not have this cost, as it can be constructed off-line while traffic is maintained on the existing bridge.

<table>
<thead>
<tr>
<th>Table 5-11: Estimated Cost for San Cristobal Arroyo Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 2</td>
</tr>
<tr>
<td>Cost Item</td>
</tr>
<tr>
<td>Design, R/W, and Contingency</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Demolition</td>
</tr>
<tr>
<td>Roadway Realignment</td>
</tr>
<tr>
<td><strong>Construction Cost Subtotal</strong></td>
</tr>
</tbody>
</table>

**ENVIRONMENTAL ISSUES**

This section presents the detailed environmental analysis of the Build and No Build alternatives for the NM 41 project. Impacts from each alternative to relevant environmental, cultural, and community issues are discussed below.

5.8 Land Use

Land use within the study area varies from large cattle ranches with associated residences to residential properties within the community of Galisteo. Various community facilities exist within Galisteo including a Catholic church (Iglesia Nuestra Senora de Los Remedios), fire station, community center, museum, and rodeo grounds.

Parcel data from Santa Fe County show that most of the property in the project area is either coded as SRES (Single Family residential) or VAC (vacant). Other types of land use in the project area include:
LOT R (residential) – two lots with manufactured homes

COMM (commercial) – two parcels total, both in Galisteo; one large parcel between mileposts 57-58 on the east side of the highway

SFCO (Santa Fe County) – one parcel, the Community Center and Fire Station, owned by the County

NM (New Mexico) – two parcels owned by the State

Unclassified lands – some of which are owned by the BLM but are away from the highway

Several large developments exist in the northern portion of the corridor, including resorts, retreats, and equestrian stables. Hacienda Tranquillas to the northwest of NM 41 contains a few scattered single family homes. Saddleback Ranch, a large residential subdivision, was recently approved by Santa Fe County near the intersection of NM 41 and US 285. Pine Canyon, a large residential subdivision, is also present at the southern terminus of the NM 41 project. In general, the major land uses within the project area are low-density developments (Figure 5-7).

The Sustainable Land Development Plan (SLDP) is a revision and update of the Santa Fe County General Plan. The SLDP is a statement of the County’s vision for its own future and a guide to achieving that vision. Galisteo is one of four Growth Management Areas (GMAs), which were areas delineated for growth management purposes based on criteria such as topography and hydrography, existing community planning areas, political and parcel boundaries, and cultural and open space boundaries. One of the primary themes of the SLDP is a focus on preservation of the historic, cultural, and natural environment in the face of increasing population growth.

Several of the goals listed in the SLDP that relate to the NM 41 project include:

- Establishing a Community Action Group for each GMA to address non-land use planning issues and providing County staff support for the community action groups.
- Working with state departments and non-governmental organizations about limiting pollution (air, noise, water, light), preserving cultural/archaeological sites, establishing a wildlife corridor from the Ortiz to the Sangre de Cristo Mountains, and placing emphasis on the welfare of the entire Galisteo Basin.
- Supporting improved road and bridge infrastructure that maintains rural character.
- Maintaining historic bridges.
- Implementing context sensitive designs to preserve the rural character.
- Cooperating with NMDOT to explore the possibility of downgrading Level of Service along some state routes and/or changing the functional classification of state routes as they pass through communities.
- Ensuring adequate roadway design that includes shoulders, grading, and sidewalks wherever possible.

Coordination with the Santa Fe County Planning Department will be undertaken during subsequent environmental investigations to determine whether the proposed improvements are consistent with the SLDP. Other applicable land use planning documents will be reviewed and summarized in subsequent environmental investigations.
Figure 5-7: Land Use
5.8.1 Land Use Impacts

The No Build Alternative will not impact land use, access, or development within the project area. However, the No Build Alternative will not provide adequate shoulders or sidewalks to enhance pedestrian and bicycle safety, one of the goals of the Santa Fe County SLDP.

None of the build alternatives would change land use, access, or development conditions. The project is not anticipated to change area traffic patterns or land use. Right-of-way acquisition would be minimal (up to 5 acres total along the 16-mile project area) and would not affect any developed areas. Access to adjacent parcels will not be affected.

The Galisteo Creek and San Cristobal Arroyo Bridge Alternatives 2 and 3 (Rehabilitation and Replacement) propose replacement of either major bridge elements or the entire structure in both cases. This is inconsistent with the goal of the SLDP to maintain historic bridges. However, safety issues demand that at least major elements be replaced. The reconstructed bridges could incorporate a historic design aesthetic. The Galisteo Creek Bridge Alternative 3 could keep the existing bridge in place, potentially as a pedestrian/bicycle facility. Alternative 3 for both bridges would construct a new roadway alignment and would require use of currently vacant land; however, the new alignment would be in close proximity to the existing roadway and land use impacts would be minimal.

5.9 Community and Economic Resources

The project area is decidedly rural, even though the metropolitan areas of Santa Fe and Albuquerque are about 20 and 40 miles away, respectively. The project area is within the Galisteo Basin, which has been continuously occupied by diverse groups of people since prehistoric times. The village of Galisteo was founded in 1816 and is the only community located within the project area. NM 41 passes through the community, which lies at the junction of County Road 42 and NM 41. Galisteo, like many of the small rural communities near Santa Fe, includes families who have resided in the area for many decades and others who have relocated there in recent years. Many of the structures adjacent to the highway have been in place for many decades, including the Iglesia Nuestra Señora de Los Remedios (church) which was established in 1884, La Tienda de Anaya (an historic store that currently does not operate, but is planned for reopening), and several older adobe and rock residences. In contrast, a mixture of older and newer structures and homes are found away from the highway. The community of Galisteo considers its boundaries to include the bridges south of town and the hogback ridge north of town.
There are no schools within the study area — the project area is served by the Santa Fe and Moriarty school districts. The Galisteo Community Center is located east of NM 41 and the Galisteo Volunteer Fire Department/EMS is located beside the community center. The (privately-owned) rodeo grounds are located just south of the village. These facilities, along with the church, are the only community facilities within the project area (Figure 5-8).

Demographics and Environmental Justice

The demographic characteristics of the project area population were reviewed to identify the presence of groups that may require special consideration (consistent with Title VI and EO 12898) for public notification and involvement and in the assessment of project impacts. Data from the US Census Bureau’s 2000 Decennial Census were analyzed to determine the demographic characteristics of the project area. While the Census data are over 10 years old, they are likely still representative of the project area as it has undergone little substantive change since 2000. Population characteristics for the stakeholder communities are summarized in Table 5-12.

<table>
<thead>
<tr>
<th>Geography</th>
<th>New Mexico</th>
<th>Santa Fe County</th>
<th>Tract 103.06 BG1</th>
<th>Tract 103.06 BG2</th>
<th>Tract 106 BG4</th>
<th>Tract 107 BG3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population</td>
<td>1,819,046</td>
<td>129,292</td>
<td>1,062</td>
<td>2,689</td>
<td>1,943</td>
<td>1,931</td>
</tr>
<tr>
<td>Black or African American</td>
<td>1.9%</td>
<td>0.6%</td>
<td>0.1%</td>
<td>0.4%</td>
<td>0.8%</td>
<td>0.5%</td>
</tr>
<tr>
<td>American Indian and Alaska Native</td>
<td>9.5%</td>
<td>3.1%</td>
<td>1.8%</td>
<td>1.2%</td>
<td>1.1%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Asian/Pacific</td>
<td>1.1%</td>
<td>0.9%</td>
<td>0.6%</td>
<td>0.7%</td>
<td>0.6%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Some other race</td>
<td>17.0%</td>
<td>17.7%</td>
<td>14.3%</td>
<td>6.9%</td>
<td>17.0%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Two or more races</td>
<td>3.6%</td>
<td>4.1%</td>
<td>4.7%</td>
<td>3.9%</td>
<td>3.6%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>42.1%</td>
<td>49.0%</td>
<td>34.3%</td>
<td>19.8%</td>
<td>45.7%</td>
<td>16.9%</td>
</tr>
<tr>
<td>under 5</td>
<td>7.2%</td>
<td>6.2%</td>
<td>5.1%</td>
<td>4.4%</td>
<td>6.5%</td>
<td>5.8%</td>
</tr>
<tr>
<td>5-17</td>
<td>20.8%</td>
<td>17.9%</td>
<td>17.7%</td>
<td>21.5%</td>
<td>22.0%</td>
<td>18.7%</td>
</tr>
<tr>
<td>18-24</td>
<td>9.8%</td>
<td>8.1%</td>
<td>5.9%</td>
<td>4.4%</td>
<td>6.3%</td>
<td>3.4%</td>
</tr>
<tr>
<td>25-39</td>
<td>20.6%</td>
<td>21.3%</td>
<td>20.0%</td>
<td>18.4%</td>
<td>19.5%</td>
<td>16.5%</td>
</tr>
<tr>
<td>40-64</td>
<td>30.0%</td>
<td>35.7%</td>
<td>42.7%</td>
<td>42.6%</td>
<td>40.7%</td>
<td>47.8%</td>
</tr>
<tr>
<td>65 and over</td>
<td>11.7%</td>
<td>10.8%</td>
<td>8.6%</td>
<td>8.6%</td>
<td>5.0%</td>
<td>7.8%</td>
</tr>
<tr>
<td>Median household income in 1999</td>
<td>$34,133</td>
<td>$42,207</td>
<td>$41,328</td>
<td>$46,302</td>
<td>$46,991</td>
<td>$73,250</td>
</tr>
<tr>
<td>Per capita income in 1999</td>
<td>$17,261</td>
<td>$23,594</td>
<td>$22,731</td>
<td>$19,088</td>
<td>$18,088</td>
<td>$38,146</td>
</tr>
<tr>
<td>Unemployed</td>
<td>4.4%</td>
<td>3.1%</td>
<td>1.4%</td>
<td>3.8%</td>
<td>1.7%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Income in 1999 below poverty level</td>
<td>18.4%</td>
<td>12.0%</td>
<td>10.6%</td>
<td>10.4%</td>
<td>17.4%</td>
<td>9.1%</td>
</tr>
</tbody>
</table>
Figure 5-8: Community Facilities and Businesses

- Goose Downs Farm
- The Light Institute
- Iglesia Nuestra Señora de los Remedios
- La Tienda de Anaya
- Movie Set (approximately)
- Tules Wind Ranch
- Vista Clara Ranch
- Linda Vista Stables and Healing Crosses Gallery
- Galisteo Inn
- Galisteo Historical Museum
- Galisteo Volunteer Fire and Rescue
- Galisteo Community Center
- Rodeo de Galisteo

Legend:
- Blue Circle: Business
- Green Circle: Community Facility

Scale: 0 0.5 1 2 Miles
Galisteo is a Census Designated Place for which the US Census Bureau produces demographic data specific to the place boundary (this boundary is not the same as the Galisteo Historic District). The demographic profile of Galisteo shows that the total population of the village area is 265 persons. According to Census Bureau data, 80.4% of the population of Galisteo is classified as white; 35.5% of the population is of Hispanic origin. The median age is 46.6 years. Only five persons are listed as under the age of 5 years, which reflects the low number of young children residing within the village.

Demographic data for the Census Block Groups that surround the area are generally similar to those for Galisteo. One block group (Tract 106 BG4), which is located north of the project area (and north of the railroad tracks) and closer to Santa Fe, has higher percentages of persons of Hispanic origin and persons living below poverty level. Other than this block group, which is separated from the NM 41 corridor by the railroad tracks, there are no identifiable environmental justice populations within the project area. Census block group boundaries are shown in Figure 5-9.

In the community of Galisteo, approximately 81% of the population is in the workforce, and unemployment is lower than state or county averages. The mean travel time to work is 31.7 minutes, which indicates most residents commute to Santa Fe or Moriarty/Edgewood for work. Median and per capita incomes are higher than or are equal to those of the United States, which are generally much higher than the same statistics for the state. Only 3.6% of the population is living below poverty level.

**Businesses**
There is very little commercial activity and no industrial activity within the project area. The few businesses in operation in and near Galisteo include Linda Vista Stables, Vista Clara Ranch spa and resort, and the Galisteo Historical Museum. Many artists live and work out of their homes in the village. The Light Institute, a spiritual and meditational center, is located approximately one mile north of

![Figure 5-9: Census Block Groups](image-url)
town. A large movie set is present south of Galisteo — accessed by County Road 40 — and, during production, generates considerable traffic from large trucks delivering props, trailers, and other equipment.

The business community outside of Galisteo includes large ranches primarily engaged in cattle and horse operations. Goods and services used by project area residents are generally found in Santa Fe and Moriarty. Santa Fe is less than 18 miles north of the intersection of NM 41 and US 285, and Moriarty is about 20 miles south of Clark Hill. No motels, gas stations, stores, or restaurants exist within the project area. Project area businesses are shown on Figure 5-8.

**Ranching Activities**
Several large ranches exist along the study corridor (see Figure 5-7). San Cristobal Ranch owns the land along both sides of NM 41 between mileposts 47-55. At least two other large ranches including Zorro Ranch exist on the west side of NM 41 south of Galisteo. Goose Downs Farms operates a horse training facility north of Galisteo. Other smaller ranching operations also operate in the project vicinity.

**5.9.1 Community and Economic Resource Impacts**
The No Build alternative will not impact community or economic resources.

The Rural, Community Transition, and Community Core alternatives will have no effect on project area community resources, demographics, businesses, or ranching activities. While access to the ranches, movie set, and businesses may be temporarily altered during construction, no permanent impacts would occur. Portions of driveways within the NMDOT right-of-way affected by construction would be reconstructed. Temporary Construction Permits may be required to tie the reconstructed driveways to private property.

The project proposes to realign the Goose Downs Farm driveway on the west side of NM 41 in the Community Transition subarea to align with the primary access to the Vista Clara Ranch on the east side of NM 41. This realignment is proposed so that left-turn lanes can be provided to serve both businesses, which will improve safety and access. The realignment is illustrated in Section 5.3.1.

The Community Core area includes the businesses and community facilities within the village of Galisteo itself. These include the Galisteo Museum, the Nuestra Señora de los Remedios church, and the rodeo grounds located just south of town. The fire station and community center are located well east of NM 41 and will not be affected by the proposed project. The Community Core alternatives will stay entirely within NMDOT right-of-way; however, the right-of-way currently contains some landscaping that may be removed. The right-of-way is also used for parking by some village residents; this unauthorized use of the right-of-way would be unavailable during construction and may be permanently lost if the optional pedestrian trail is included in the project. The Community Core alternatives may also affect the row of mailboxes on the east side of NM 41, north of the CR 42 intersection, as well as the Galisteo Pueblo Official Scenic Historic Marker on the west side of the roadway. While these may need to be removed during construction, they would be replaced after construction is complete. Access to the church, rodeo grounds, and Galisteo Museum may be temporarily altered during construction; however, access will be maintained to all adjacent parcels at all times and will be restored after construction is complete.
The Galisteo Creek Bridge Alternatives 1 and 2 would have impacts to the community of Galisteo during construction. Assuming a two-phased construction approach is used that would limit traffic on the bridges to one lane, southbound traffic waiting to cross the bridge could back up into the community core. This would cause increased noise as traffic idles and then restarts. These impacts would be temporary and would not occur after the construction of the bridge is complete.

5.10 Cultural Resources

Cultural resources within the project area are protected under the National Historic Preservation Act (NHPA) as well as several state statutes. Only those resources determined to be listed in or eligible for listing in the National Register of Historic Places (NRHP) or New Mexico State Register of Cultural Properties (SRCP) are afforded protection under federal and state law. To qualify for listing in the NRHP, a property must have historic significance and integrity and generally be at least 50 years old. Sites, buildings, districts, structures, and objects may have historic significance in American history, architecture, archaeology, engineering, and culture. A property must demonstrate significance in at least one of the following areas:

A. Association with events that have made a significant contribution to the broad patterns of our history; or

B. Association with the lives of persons significant in our past; or

C. Embodiment of the distinctive characteristics of a type, period, or method of construction or representative of the work of a master, or possessing high artistic value, or representative of a significant and distinguishable entity whose components may lack individual distinction; or

D. Yielding, or likely to yield, information important in prehistory or history.

Historic properties must also possess integrity of location, design, setting, material, workmanship, feeling, and association in order to convey that significance. In addition to the above criteria, significance is defined by the area of history in which the property made important contributions and by the period of time when these contributions were made (National Register Bulletin 16).
Intensive pedestrian survey of the NM 41 project area was conducted in the spring of 2010. This survey identified 14 archaeological sites (Table 5-13), eight historic buildings (Table 5-14), two historic bridges, the historic NM 41 roadway, an Official Scenic Historic Marker, and the SRCP-listed Galisteo Historic District (HPD) in the project area. For the purposes of survey, the project area (or Area of Potential Effect [APE]) was defined as the NM 41 right-of-way for identification of archaeological sites and the NM 41 right-of-way plus a buffer of 100 feet for the identification of the built historic environment. The Bridge Bypass Alternative, which was considered in Phase A, but has since been eliminated, was also surveyed. Detailed results of the survey are presented in Cultural Resources Survey, NM 41 Clark Hill to US 285, MP 46.1 to 62.1, Santa Fe, County, New Mexico, prepared by D. Pennington & Associates, January 2011.

Eligibility recommendations for the archaeological sites and historic buildings are included in Tables 5-13 and 5-14 on the following pages. Formal determinations of eligibility and project effect are pending consultation with the New Mexico SHPO. All of the historic buildings are within the Galisteo Historic District. The Galisteo Creek Bridge (#1782) was built in 1936 as part of a Works Progress Administration (WPA) project to realign NM 41 through Galisteo. The WPA was a New Deal-era government program that built numerous roads, bridges, and buildings in New Mexico in the 1930s and early 1940s. The bridge is a contributing element to the Galisteo Historic District and is recommended individually eligible under Criterion A for its association with the WPA and New Deal. The NMDOT Bridge Survey (Van Citters 2003) also indicates the structure is eligible under Criterion C, presumably for its standard design and perhaps its relatively long spans (as described under Bridge 1814, below). However, Criterion C is not specifically discussed in Van Citters’ recommendation for the bridge (2003:73).

The San Cristobal Arroyo Bridge (#1814) was also constructed with New Deal funds in 1939. The San Cristobal Arroyo Bridge is not within the Galisteo Historic District, but has been determined eligible for inclusion in the NRHP under Criteria A and C for its association with the New Deal and for its exemplary steel-stringer design and unusually long 70-foot spans (HPD Log # 69394).

NM 41 has connected Willard and Lamy since 1912 (Wallace 2004). The geometry and alignment have changed since its original construction, although some historic features (bridges) are still present. NM 41 is associated with the Early Statehood (1912-1926) and the New Deal (1931-1940) periods of significance in New Mexico highway history (Wallace 2004) and is considered to have undetermined eligibility to the NRHP without more extensive research that is beyond the scope of this undertaking.

5.10.1 Cultural Resource Impacts

The No Build alternative will not impact cultural resources.

Rural Alternative

The Rural alternative has the potential to impact six archaeological sites (LA 167739, 168909, 168910, 168912, 168913, and 168914). These six sites extend into the existing NM 41 right-of-way within the Rural Subarea. LA 168912 is not eligible for inclusion in the NRHP and no further assessment is required. LA 168909, LA 168913, and LA 168914 have undetermined eligibility for inclusion in the NRHP. However, none of these sites has intact subsurface deposits within the construction area of the project. LA 167739 is eligible for inclusion in the NRHP under Criterion D. Similarly, this site has no intact subsurface deposits within the construction area, LA 168910 is also eligible for inclusion in the NRHP.
under Criterion D. This site does have the potential for intact subsurface deposits within the construction area.

The Rural alternative will not affect any historic buildings, bridges, or districts. Given that the typical section and alignment of the historic NM 41 roadway has undergone numerous changes since its original construction, the addition of shoulders and the minor curve realignments proposed as part of the Rural alternative are not anticipated to have an adverse effect on the historic roadway.

### Table 5-13: Archaeological Sites in the NM 41 Project Area

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Description</th>
<th>Subarea</th>
<th>Eligibility Recommendation (criteria)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA 149345</td>
<td>Historic NM 41 road bed (within ROW) and artifact concentration (outside ROW)</td>
<td>Community</td>
<td>Determined not eligible</td>
</tr>
<tr>
<td>LA 150613</td>
<td>Large prehistoric petroglyph site with numerous panels and small artifact scatter within the ROW</td>
<td>Community</td>
<td>Determined eligible (D)</td>
</tr>
<tr>
<td>LA 167739</td>
<td>Large lithic scatter/procurement site (300+ artifacts) extending along both sides of road; two artifact concentrations present</td>
<td>Rural</td>
<td>Eligible (D)</td>
</tr>
<tr>
<td>LA 168909</td>
<td>Low-density lithic scatter along edge of ROW; artifacts may be eroding out of slope, and site clearly extends beyond existing ROW</td>
<td>Rural</td>
<td>Undetermined</td>
</tr>
<tr>
<td>LA 168910</td>
<td>Pueblo IV habitation site with intact features and midden area</td>
<td>Rural</td>
<td>Eligible (D)</td>
</tr>
<tr>
<td>LA 168912</td>
<td>Small lithic and ceramic scatter (10-15 artifacts in ROW); site may extend beyond ROW to the west (not inspected); portion of site in ROW is badly disturbed, has no potential for subsurface deposits, and does not contribute to its eligibility potential</td>
<td>Rural</td>
<td>Not Eligible</td>
</tr>
<tr>
<td>LA 168913</td>
<td>Low density, medium-sized artifact scatter (ceramics/lithics); site extends beyond ROW to the west (not inspected)</td>
<td>Rural</td>
<td>Undetermined</td>
</tr>
<tr>
<td>LA 168914</td>
<td>Low density artifact scatter (16 items) in badly deflated/disturbed setting; site may continue to the west, although no artifacts observed; portion of site in ROW does not retain integrity</td>
<td>Rural</td>
<td>Undetermined</td>
</tr>
<tr>
<td>LA 168915</td>
<td>Lithic and ceramic (Pueblo IV) artifact scatter along edge of arroyo; artifacts may be eroding out of arroyo cut; site may continue west</td>
<td>Community</td>
<td>Undetermined</td>
</tr>
<tr>
<td>LA 168916</td>
<td>Very small ceramic scatter (8 items) along bank of arroyo; ceramics and charcoal are eroding out of arroyo cut (1 m below ground surface)</td>
<td>Community</td>
<td>Eligible (D)</td>
</tr>
<tr>
<td>LA 168917</td>
<td>Small historic artifact scatter, corral/enclosure, and posts</td>
<td>Community</td>
<td>Not Eligible</td>
</tr>
<tr>
<td>LA 168918</td>
<td>Large multi-component (Archaic/Pueblo IV) artifact scatter (200-300 artifacts); no features; site continues west</td>
<td>Community</td>
<td>Eligible (D)</td>
</tr>
<tr>
<td>LA 168919</td>
<td>Moderate density multi-component (Pueblo IV-Historic) artifact scatter; site may continue west</td>
<td>Community</td>
<td>Undetermined</td>
</tr>
<tr>
<td>LA 168920</td>
<td>Small lithic scatter; possible features located to the east (not inspected)</td>
<td>Community</td>
<td>Undetermined</td>
</tr>
</tbody>
</table>

Section 5: Alternatives Analysis
Table 5-14: Historic Buildings within the NM 41 Project Area

<table>
<thead>
<tr>
<th>Historic Building No.</th>
<th>Description</th>
<th>Eligibility Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>30055 (Galisteo 031)</td>
<td>Gabled stucco pump house/storage building, ca. early 1900s</td>
<td>Non-contributing to Galisteo Historic District, not eligible</td>
</tr>
<tr>
<td>30056 (Galisteo 034)</td>
<td>Iglesia de Nuestra Senora de los Remedios, gabled stucco church with stone buttresses and copula, 1882-1884</td>
<td>Contributing to Galisteo Historic District, eligible (A)</td>
</tr>
<tr>
<td>30057 (Galisteo 071)</td>
<td>San Jose Dance Hall, stucco Folk Territorial building with brick coping, ca. 1890s</td>
<td>Contributing to Galisteo Historic District, eligible (A)</td>
</tr>
<tr>
<td>30058 (Galisteo 072)</td>
<td>Epifanio Mora House, stucco-covered courtyard home, ca. 1880</td>
<td>Contributing to Galisteo Historic District, individual eligibility undetermined</td>
</tr>
<tr>
<td>30059 (Galisteo 074)</td>
<td>Jose Remedios y Yerbas, adobe and stucco residence/store, ca. 1850</td>
<td>Contributing to Galisteo Historic District, eligible (A)</td>
</tr>
<tr>
<td>30060 (Galisteo 075)</td>
<td>La Tienda de Anaya, stucco-covered Territorial building, ca. 1900.</td>
<td>Contributing to Galisteo Historic District, eligible (A)</td>
</tr>
<tr>
<td>30061 (Galisteo 077)</td>
<td>Davis y Ortiz House, L-shaped stucco-covered Spanish-Pueblo house, ca. 1860-1910.</td>
<td>Contributing to Galisteo Historic District, eligible (A and C)</td>
</tr>
<tr>
<td>30062 (Galisteo 085)</td>
<td>Spanish-Pueblo stucco-covered house, ca. 1890-1910.</td>
<td>Non-contributing to Galisteo Historic District, individual eligibility undetermined</td>
</tr>
</tbody>
</table>

Community Alternatives

The Community Transition alternative has the potential to impact two archaeological sites (LA 149345 and LA 150613). LA 149345 has been determined not eligible for inclusion in the NRHP and no further assessment is required. LA 150613 has been determined eligible for inclusion in the NRHP under Criterion D. The Community Transition alternative will avoid the petroglyph panels and the other portions of this site that contribute to its historical importance. Traffic calming strategies such as roundabouts and medians, if used, would alter the visual appearance of the roadway. However, these minor visual changes to a small segment of the roadway would not affect its overall historical associations.

Bridge Alternatives

All of the Bridge alternatives will affect the two historic bridge structures, the Galisteo Creek Bridge (#1782) and the San Cristobal Arroyo Bridge (#1814). The two bridges are discussed separately.

Galisteo Creek Bridge

The Galisteo Creek Bridge is a contributing element to the listed Galisteo Historic District and has been determined individually eligible for inclusion in the NRHP under Criteria A and C. Galisteo Creek Bridge Alternatives 1 and 2 (the Rehabilitation and Replacement alternatives) will remove and replace the existing deck and railings, and Alternative 2 will also remove deck, girders, abutments, and piers.
Galisteo Creek Bridge Alternative 3 will leave the existing historic bridge in place. A new bridge would be constructed approximately 10-16 feet to the west. Because the NM 41 roadway would be realigned to the west, Alternative 3 has the potential to affect two archaeological sites: LA 168918, recommended eligible for inclusion in the NRHP under Criterion D, and LA 168919, recommended as having undetermined eligibility. While preliminary design plans show the alignment of the new parallel bridge as just outside the site boundaries of both sites, the sites are in such close proximity that the potential for impacts cannot be eliminated.

All of the Galisteo Creek Bridge alternatives will also have a potential effect on the Galisteo Historic District. The Galisteo Creek Bridge (#1782) is a contributing element of the District. Both Alternatives 1 and 2 would alter the characteristics of the bridge that convey its significance as a WPA resource. Alternative 3 would add a new visual element to the district and would realign a small segment of NM 41 within the district. However, these changes would not significantly change the visual appearance of the district as a whole, nor would they affect the viewshed of any specific district resource.

San Cristobal Arroyo Bridge

The San Cristobal Arroyo Bridge has been determined individually eligible for inclusion in the NRHP under Criteria A and C. Similar to the Galisteo Creek Bridge, San Cristobal Arroyo Bridge Alternatives 1 and 2 will remove and replace the existing deck and railings, and Alternative 2 will also remove the substructure of the bridge (girders, abutments, and piers).

San Cristobal Arroyo Bridge Alternative 3 has the potential to affect two archaeological sites: LA 168915, eligibility undetermined, and LA 168917, recommended not eligible, due to the realignment of NM 41. While preliminary design plans show the alignment of the new parallel bridge as just outside the site boundaries of both sites, the sites are in such close proximity that the potential for impacts cannot be eliminated. The San Cristobal Arroyo Bridge is outside of the Galisteo Historic District, so there would be no effect to the district.

It should be noted that there is a cumulative effect if Alternative 3 is selected for both bridges. Because NM 41 would remain offset for a longer distance between the bridges, a larger portion of LA 168918 would be impacted, in addition to the sites affected by the individual bridge alternatives.

Both the Galisteo Creek and San Cristobal Arroyo bridges were constructed in the mid to late-1930s with New Deal funding. These historic structures contribute to the historic association of NM 41 with the New Deal era. However, while the bridges may be rehabilitated or replaced and a short segment of NM 41 may be realigned, these changes will not alter the essential physical features of this segment of NM 41 that may make it eligible for nomination to the NRHP.

5.11 Section 4(f) Resources

Section 4(f) of the Department of Transportation Act of 1966, as amended (49 USC 303), states that the US Department of Transportation may not approve the use of land from a significant publicly-owned public park, recreation area, wildlife or wildfowl refuge, or a significant historic site unless a determination is made that:

- There is no feasible and prudent alternative to the use of land from the property; and
- The action includes all possible planning to minimize harm to the property resulting from such use.
Impacts on Section 4(f) resources are categorized as impacts involving a “use” or “constructive use” of such resources. A Section 4(f) use, as defined in 23 CFR 774.17, occurs when land is permanently incorporated into a transportation facility, or there is temporary occupancy of land that is adverse in terms of the statute’s preservationist purposes. Adverse “temporary occupancy” could occur when the capability to perform any of the site’s substantial functions is substantially impaired. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) states that the requirements of Section 4(f) will be considered satisfied if it is determined that a transportation project will have only a "de minimis impact" on the Section 4(f) resource. The provision allows avoidance, minimization, mitigation, and enhancement measures to be considered in making the de minimis determination. The agencies with jurisdiction must concur in writing with the determination. For historic properties, the de minimis criteria are defined as "no adverse affect" or "no historic properties affected" under Section 106 of the National Historic Preservation Act.

A Section 4(f) “constructive use” occurs when the transportation project does not incorporate land from the resource, but the project’s proximity impacts are so severe that the protected activities, features, or attributes that qualify a resource for protection under Section 4(f) are substantially impaired. For example, a constructive use can occur when one or more of the following conditions apply:

- The projected noise level increase attributable to the project substantially interferes with the use and enjoyment of a noise-sensitive resource protected by Section 4(f).

- The proximity of the proposed project substantially impairs aesthetic features or attributes of a resource protected by Section 4(f) where such features or attributes are considered important contributing elements to the value of the resource. An example of such an effect would be the location of a proposed transportation facility in such proximity that it obstructs or eliminates the primary views of an architecturally significant historic building, or substantially detracts from the setting of a park or historic site which derives its value in substantial part from its setting.

- The project results in a restriction on access that substantially diminishes the utility of a significant publicly owned park, recreation area, or historic site.

Section 4(f) resources in the NM 41 project area include the two historic bridges – the Galisteo Creek Bridge (#1782) and the San Cristobal Arroyo Bridge (#1814) – the listed Galisteo Historic District, and the seven individually eligible or contributing buildings within the Galisteo Historic District. Significant archaeological sites are present within the project area. However, under Section 4(f), archaeological sites important chiefly for information that can be gained through data recovery and have minimal value for preservation in place are excepted from the rule [23 CFR 774.13(b)]. This is typically equated to sites eligible solely under Criterion D, which is the case for all eligible archaeological sites within the project area.

5.11.1 Section 4(f) Impacts

The No Build Alternative will not impact any Section 4(f) resources. A Section 4(f) evaluation will be prepared as part of the environmental documentation for the project to determine the impacts of the build alternatives.

5.12 Surface Water, Wetlands, and Riparian Habitat

NM 41 crosses numerous ephemeral drainages within the project limits (see Figure 5-10). Primary arroyos include:
Galisteo Creek, which is a perennial waterway that crosses the highway near MP 56.
San Cristobal Arroyo flows into Galisteo Creek just south of the community of Galisteo near MP 55.6. San Cristobal Arroyo is an intermittent waterway that includes riparian habitat within the project area.
Arroyo de la Jara, which is an ephemeral waterway that crosses NM 41 near MP 53.6.
Gaviso Arroyo, which is an ephemeral waterway that crosses NM 41 near MP 50.7.
Arroyo Puertacito de los Salado, an ephemeral waterway, begins west of the highway at Clark Hill and is fed by many small arroyos that cross NM 41 between MPs 46.5 – 49.5.

As all of these surface water features are tributaries to Galisteo Creek and have well defined channels, they are considered waters of the United States and, therefore, are regulated by the US Army Corps of Engineers (USACE). Any construction or disturbance within the Ordinary High Water Mark (OHWM) of these arroyos will require coordination and a permit under the Clean Water Act.

Jurisdictional wetlands exist along Galisteo Creek and San Cristobal Arroyo. Even though the active channel covers most of the channel width of both drainages, the wetland habitat is confined to narrow strips — about 5- to 8-feet wide — along the north and south banks (see photos below and Figure 5-10). Small pockets of jurisdictional wetland also occur along Arroyo de la Jara at MP 53.6, and potential wetland habitat occurs along the bottom of Gaviso Arroyo near MP 50.7. Although several of the other ephemeral waterways in the project area support wetland vegetation, these areas appear to lack the hydrology and soil characteristics to warrant a wetland determination.

5.12.1 Surface Water, Wetlands, and Riparian Habitat Impacts
The No Build alternative will not impact surface waters, wetlands or riparian habitat.

Many of the existing drainage structure ends are in poor condition and/or do not function properly. Of the 42 structures identified, 17 may warrant end replacement due to their condition. In addition to the replacement of structure ends, the addition of shoulders and surface tapers will require that these structures are lengthened. In many instances, the work on these structures will result in fill placed in
Figure 5-10: Surface Water and Wetlands
Waters of the US and the need for a 404 permit from the USACE. Coordination with the USACE to determine the appropriate permitting method and the total area and volume of impacts will occur prior to final design. No impacts are anticipated to potential wetland habitat at Arroyo de la Jara or Gaviso Arroyo, as neither of these structures warrant replacement or rehabilitation.

**Bridge Alternatives**

All of the Bridge alternatives would involve dredge, fill, and the use of construction equipment within the active channels of Galisteo Creek and San Cristobal Arroyo. The extent of temporary and permanent impact would vary depending on the design of each alternative and the method used to detour traffic.

**Galisteo Creek Bridge Alternatives**

Permanent impacts to wetland and riparian habitat within this waterway would result from the placement of bridge piers and abutments and, for Galisteo Creek Bridge Alternative 3, from vegetation (including wetland species) removal and loss of direct sunlight under the new deck. In addition, temporary impacts would result from the removal of pier foundations and general construction activities within the channel area. Temporary impacts would also result from the installation of temporary bridges if this option is selected for traffic detours instead of two-phased construction using the existing bridges. Impacts may also result if temporary diversions are required for Galisteo Creek flows.

- **Galisteo Creek Bridge Alternative 1 (Rehabilitation)** would have the least amount of impact to wetlands and riparian habitat. Because this alternative uses the existing piers and abutments, impacts would be limited to temporary loss of vegetation and wetland disturbance from construction activities, assuming a phased construction approach that uses a one-lane traffic detour (see discussion in Section 5.5).

  If a temporary bridge is used to detour traffic while the bridge is rehabilitated, the impacts would be much greater. It is likely that some wetland habitat would be disturbed if the temporary bridge piers cannot be set outside of the wetland boundaries. Considerable vegetation would be also disturbed or lost with the temporary bridges. The Galisteo Creek channel has large cottonwoods, willows, and Russian olive trees that would have to be removed to construct the temporary bridge. Methods to minimize impact may be possible, including trimming the existing trees and shrubs near ground level to leave their root structure intact. Assuming a temporary bridge width of 30 feet plus an additional 10 feet on each side to allow for its construction, approximately 0.26 acres of vegetation would be removed. Impacts to riparian habitat are also discussed in Section 5.14.

- **Galisteo Creek Bridge Alternative 2 (Replacement)** would impact wetland and riparian habitat from the demolition of the existing piers and abutments and the placement of new piers and abutments. As discussed in Section 4.2.5, two options are under consideration for this alternative: reconstruction using a 4-span design similar to the existing bridge and a 3-span design. Because the wetland habitat is limited to narrows strips along the active river channel, only a small amount of wetland habitat would be lost during construction — approximately 0.02 acres total. In addition, some riparian vegetation, including trees and shrubs, would be lost; however, because this alternative is built on the existing alignment, the vegetation under the bridge is limited to a few small willows, grasses, and some small shrubs.

  The greatest impact would result from pier and abutment demolition. As discussed in Section 4.2.5, the existing piers and abutments are founded on bedrock at a depth of 16- to 22-feet below
grade. These foundations would have to be excavated and removed to allow for the construction of the new structures (with the 4-span bridge option). Because of their depth, the removal of these structures would excavate the entire channel at a width of approximately 115 feet. This would remove approximately 0.5 acres of vegetation plus approximately 0.05 acre of wetland habitat. These impacts would require revegetation and wetland mitigation and/or restoration.

The loss of vegetation would be substantially less with the 3-span bridge option, as the existing pier and abutment foundations could remain in place. Only the above ground portions and the area several feet below the surface would have to be removed. The surface area of excavation would disturb a much smaller area for placement of the 3-span design.

- **Galisteo Creek Bridge Alternative 3 (Parallel Bridge)** would impact wetland and riparian habitat from the construction of the new piers and abutments. Assuming a 4-span bridge is used, the three piers would occupy an area of about 500 square feet (0.01 acres). Depending on the exact alignment selected, it is likely that one or more piers would be constructed within wetland habitat. However, the loss of habitat would be small.

Alternative 3 would also remove vegetation across the entire channel and in the area immediately adjacent to and west of the existing bridge. Assuming an approximate bridge width of 38 feet plus 10 to 15 feet on each side for construction, this alternative would remove about 0.32 acres of vegetation. The trees west of the existing bridge are predominantly Russian olive and some willow. Several mature cottonwoods are adjacent to the west side of the existing bridge. These trees may be impacted by construction, although efforts to avoid them will be considered during final design.

**San Cristobal Bridge Alternatives**

Permanent impacts to wetland and riparian habitat within this waterway would result from the placement of bridge piers and abutments and, for San Cristobal Arroyo Bridge Alternative 3, from vegetation (including wetland) removal and loss of direct sunlight under the new deck. In addition, temporary impacts would result from the removal of pier foundations and general construction activities within the channel area. Temporary impacts would also result from the installation of temporary bridges if this option is selected for traffic detours instead of two-phased construction using the existing bridges.

In general, the habitat quality within the San Cristobal Arroyo channel is of much lower quality than found in Galisteo Creek channel. While cottonwoods and Russian olive are present, they are at a low density. This channel is dominated by salt cedar, which is a weedy species and has low wildlife habitat potential.

- **San Cristobal Arroyo Bridge Alternative 2 (Replacement)** would impact wetland and riparian habitat from the demolition of the existing piers and abutments and the placement of new piers and abutments. Because the wetland habitat is limited to narrow strips along the active river channel, only a small amount of wetland habitat would be lost during construction — approximately 0.02 acres total. In addition, some trees and shrubs would be lost as a result of construction activity within the channel. As mentioned above, these are mostly undesirable weedy species.

- **San Cristobal Arroyo Bridge Alternative 3 (Parallel Bridge)** would impact wetland and riparian habitat from the construction of new piers and abutments. The piers would occupy an area of 300 square feet (0.01 acre) or less. Depending on the exact alignment selected, it is likely that one or more piers would be constructed within wetland habitat. However, the loss of wetland habitat would be small.
Alternative 3 would remove vegetation across the entire channel and in the area immediately adjacent to the bridge. Assuming a bridge width of 34 feet plus 10 to 15 feet on each side, this alternative would remove about 0.31 acres of vegetation. The impacted area consists almost entirely of salt cedar. Thus, the habitat lost would be of low quality.

The loss of wetlands and riparian vegetation with any of the alternatives would require enhancement of existing wetlands and habitat, preferably in proximity to NM 41, or creation of new wetlands within the Galisteo Basin. Coordination with the USACE would be conducted to determine the appropriate replacement ratio and location for compensatory mitigation. Other riparian habitat that is impacted would be replaced. A compensatory mitigation plan would be developed in collaboration with the USACE.

5.13 Floodplains

Floodplains within the project area were determined using the Digital Flood Insurance Rate Map Database (DFIRM) prepared by FEMA. A review of the DFIRM data indicates that there are two floodplain zones within the project vicinity (see Figure 5-11). Zone X includes lands outside the 0.2% annual chance flood (500-year flood). The majority of the NM 41 corridor lies within Zone X, which is not considered to be a Special Flood Hazard Area (SFHA). The other zone – Zone A - is considered a Special Flood Hazard Area (SFHA), which is an area subject to water inundation once every 100 years by the base flood (aka 100-year flood). Zone A includes lands that are subject to flooding during the 100-year flood event, but do not have base flood elevations determined.

Zone A floodplains include:

- Gaviso Arroyo, which crosses NM 41 near MP 50.7.
- Arroyo de la Jara, which crosses NM 41 near MP 53.6.
- San Cristobal Arroyo, which crosses NM 41 near MP 55.6.
- Galisteo Creek, which crosses NM 41 near MP 56.1. Just north of MP 57, which is where the creek encroaches on NM 41 ROW, the Zone A floodplain lies within 75 feet of the highway; the Zone A floodplain also lies within 75 feet of the highway near the intersection of NM 41 and US 285.

5.13.1 Floodplains Impacts

Floodplain impacts occur if a project adversely affects the functional characteristics of an existing floodplain or supports incompatible floodplain development.

The No Build alternative will not impact floodplains.

The Rural alternative does not require that any existing structures be extended within Zone A floodplains. The existing 16.5-foot by 26-foot oval culvert metal pipe (CMP) at Gaviso Arroyo (milepost 50.7) is in good condition and does not require replacement, but the addition of shoulders may require that the concrete end caps be widened. This work will not change the capacity of the culvert, so the floodplain will remain unchanged from its current condition. Therefore, changes to the Zone A floodplain in the vicinity of this CMP are not anticipated.

The Arroyo de la Jara bridge is in good condition and does not require modification; thus, the Zone A floodplain in the vicinity of this location would not be altered. Base flood elevations will not be altered, nor
Figure 5-11: Floodplains
would the functional characteristics of the floodplain be degraded beyond the existing condition. Support of incompatible development would not occur as a consequence of the Rural Build alternative.

The flow depths for storm events Zone A floodplains at San Cristobal Arroyo and Galisteo Creek are shown in Table 5-15 below.

<table>
<thead>
<tr>
<th>Milepost</th>
<th>Ground Elev.</th>
<th>Bridge Pier Elev.</th>
<th>100-yr Flow Depth</th>
<th>500-yr Flow Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Cristobal Arroyo</td>
<td>55.6</td>
<td>6022'</td>
<td>6039'</td>
<td>12.77 feet</td>
</tr>
<tr>
<td>Galisteo Creek</td>
<td>56.1</td>
<td>6008'</td>
<td>6025'</td>
<td>7.43 feet</td>
</tr>
</tbody>
</table>

The depths of flow for the 100-year storm events are several feet below the bottom of the bridge decks, indicating sufficient depth to pass flows from both the 100-year and 500-year flow events. The bridge replacement and parallel structure alternatives would be designed with a similar deck elevation and structure depth as the existing bridges. For this reason, the bridge alternatives would not constrain upstream flows and impacts to floodplains would not occur.

5.14 Wildlife and Wildlife Habitat

The project area has a rural atmosphere, even though it lies less than 18 miles south of Santa Fe. Development extends south from Santa Fe, but the majority of this is residential which ends north of the NM 41/US 285 intersection. With the exception of the village of Galisteo, the project area is characterized by open lands used for ranching and grazing with widely dispersed residential use.

From the southern terminus, the project area descends in elevation from nearly 6,600 feet downward to the village of Galisteo at approximately 6,050 in elevation, and then climbs to nearly 6,400 feet in elevation at the northern terminus. Most of this change in elevation is gradual with the exception of a steep drop in elevation at the southern terminus where higher table lands to the south drop down approximately 200 feet in elevation creating a north-facing slope. Lower Coniferous Woodland dominated by one-seed juniper and scattered piñon pine is spread in a band along this north-facing slope. This woodland habitat transitions into a Juniper Savanna at the base of the slope, and other small patches of Juniper Savanna occur in areas of low topographic relief along NM 41. Nearly all of the flatlands within the project are dominated by elements of Plains-Mesa Grassland. In some of these grassland areas on clay soils, the grassland communities contain substantial numbers of shrubs such as four-wing saltbush.

The smaller ephemeral arroyos within the project area are lined with vegetation such as rabbitbush and scattered salt cedar, as well as grasses such as alkali sacaton, threeawn, and in sandy areas Indian rice grass. The larger ephemeral to intermittent waterways in the project area (such as Arroyo de La Jara and San Cristobal Arroyo) had small pockets of surface water present and supported wetland species such as Baltic Rush and salt cedar. Galisteo Creek is lined with Rio Grande cottonwood, Russian olive and coyote willow, as well as a variety of herbaceous wetland species. Vegetation within the community of Galisteo along NM 41 consists primarily of weedy (which may include Class C noxious weeds such as bindweed or jointed goatgrass) or landscape species.
Fifty-four species of vertebrates were found during surveys of the project area, including 40 species of birds, nine species of mammals, and five species of reptiles. In general, the upland habitats within the project area had low bird species diversity. The most common birds within the grassland and other upland habitats included mourning dove, horned lark, western meadowlark, northern mockingbird, turkey vulture, and western kingbird. The greatest concentration of birds was found around Galisteo Creek, where 32 species were identified, including species such as the hairy woodpecker, ladder-backed woodpecker, black phoebe, orange-crowned warbler, yellow warbler, yellow-rumped warbler, western tanager, black-headed grosbeak, blue grosbeak, and lesser goldfinch.

Migratory birds are protected under the Migratory Bird Treaty Act of 1918 (MBTA), which includes nearly all species of birds as well as their eggs and nests. Although there were shrubs present that provided suitable nesting habitat for smaller birds, there were very few trees within the project limits. There were no stick nests or nests made of herbaceous material within the project area. However, there were many cliff swallow nests on bridges (and to a lesser degree within culverts) within the project area. The most significant concentrations of cliff swallow nests were at the Gaviso Arroyo crossing near MP 50.7 and the Arroyo de la Jara bridge near MP 53.6. Over 400 cliff swallow nests were found at these locations. Scattered cliff swallow nests occur on the structures at San Cristobal Arroyo, Galisteo Creek, and at some of the unnamed ephemeral arroyos at MPs 57.0, 57.4, and 61.1.

Aside from species such as the banner-tailed kangaroo rat, evidence of small mammals was limited within the project area. Pocket gopher mounds were sporadic in the right-of-way, and evidence of other rodents such as Ord’s kanagroo rat and deer mice was scarce. Evidence of large mammals such as mule deer, pronghorn antelope, and even coyote was also limited. While no pronghorn antelope were observed during the survey, they were observed during other field reconnaissance activities within the southern and central portions of the project area.

Scattered mule deer tracks were noted along the wooded slope near the southern terminus of the project area between MPs 46-47 and near a large ridge located west of the highway between MPs 48.5-49. However, substantial numbers of mule deer tracks were noted around Galisteo between MPs 58-60. It appears that these deer may be moving along the drainage of Galisteo Creek and possibly San Cristobal Arroyo and are crossing the roadway at locations between MPs 58-60. A review of the NMDOT crash records found infrequent game animal crashes with vehicles within the project area. In addition, the field survey found only a few animal carcasses adjacent to the highway. However, anecdotal information from residents of Galisteo indicates some vehicle collisions occur with deer and other smaller mammals. In addition, the abundance of tracks between MPs 58-60 suggests a potential for wildlife-vehicle impacts in this area.

Review of crash data does not indicate that animal-vehicle collisions are an immediate concern along NM 41. Public involvement has indicated concern about wildlife crossings. Field reconnaissance conducted to date has not identified locations where large animal carcasses are present, which would provide information about animal movement and specific corridor locations.

No bat day roosts or maternal colonies were found within the project area, although evidence of bat night roosting locations on the bridges and/or culvert structures at Gaviso Arroyo, Arroyo de la Jara, San Cristobal Arroyo, and Galisteo Creek was found. In all cases, there were only scattered bat droppings present on the concrete walls of the culverts and the beams of the bridges.
The most common reptiles noted within the project area were whiptail lizards, including the desert grassland whiptail, plateau striped whiptail, and the little striped whiptail. Common side-blotched lizard was also found sporadically in the project area. A solitary bull snake was also noted near the southern terminus of the project area. Although no amphibians were noted during the surveys, species such as the plains spadefoot and Woodhouse’s toad are expected in the project area.

5.14.1 Wildlife and Wildlife Habitat Impacts

The No Build alternative will not affect wildlife or habitat. The Rural alternative will result in the permanent loss of approximately 23 acres of roadside habitat. All habitat affected is piñon-juniper grassland, with a few small pockets of Arroyo Riparian habitat potentially impacted near drainages. Piñon-juniper grasslands cover many thousands of acres in central New Mexico, and the losses due to the NM 41 project constitute only a very small proportion. The project will not affect the viability of the community as a whole.

Extension of pipes or culverts or construction at the two historic bridges could impact cliff swallow nests if construction occurs during the nesting season. No impacts are anticipated to potential habitat or cliff swallow nests at Arroyo de la Jara or Gaviso Arroyo, as neither of these structures warrant replacement or rehabilitation. Extension or replacement of culverts or pipes is not anticipated to have impacts on other wildlife or habitat, as very small areas would be disturbed at each location. In addition, sediment removal and end segment repairs will improve their usability by small animals.

Wildlife benefits would also result from the construction of the 8-foot diameter CMP at MP 47.7. While this structure is proposed for use as a livestock undercrossing, it would be available for use by deer, antelope, and other smaller mammals. Changes to the bridges at Galisteo Creek and San Cristobal Arroyo would not affect use of the river channels by wildlife to cross the highway. The bridge height, width, and pier spacing would not be altered to an extent that would affect use of the channels by wildlife.

Impacts to vegetation for the bridge alternatives at San Cristobal Arroyo and Galisteo Creek are discussed in Section 5.12. The loss of this vegetation, especially the larger trees, will remove habitat used by migratory birds and possibly, bats that use the bridges for night roosts. Galisteo Bridge Alternatives 1 and 2 would have similar impacts to migratory birds and other wildlife. Galisteo Bridge Alternative 3 would have the greatest impact as it would remove trees and shrubs along the new alignment. The habitat at this location is used for nesting, foraging, and roosting by migratory birds and other wildlife. Overall, the loss of habitat for all of the bridge alternatives is a small part of the riparian habitat along Galisteo Creek and its loss would not be expected to have a significant effect on wildlife populations.

The effects of the San Cristobal Arroyo Bridge alternatives on wildlife would be similar to those identified for Galisteo Creek. However, because the riparian habitat quality is lower along this drainage, the impacts would be less.

5.15 Threatened and Endangered Species

The Endangered Species Act of 1973, as amended (ESA), mandates that federal actions do not jeopardize the continued existence of any threatened or endangered species or adversely modify or destroy critical habitat for these species. In addition to the ESA, the State of New Mexico identifies other plant and animal species protected by state laws.
Eight species protected under ESA or state law are expected to occur in the study area. These species include western burrowing owl, gray vireo, mountain plover, swift fox, southwestern willow flycatcher, yellow-billed cuckoo, New Mexico meadow jumping mouse, and Santa Fe cholla.

Fields surveys conducted in 2008 and 2009 did not find southwestern willow flycatcher or yellow-billed cuckoo within the project area. Additional protocol surveys performed in 2010 did identify the presence of a single southwestern willow flycatcher at Galisteo Creek. This bird was documented during the first of five protocol survey periods performed in 2010. Because no additional sightings occurred in the following four survey periods, the observed bird is believed to be a migrant. None of the other species that are expected to occur in the project area were observed. A Biological Survey Report will be prepared as part of the environmental document to document impacts to wildlife, habitat, and threatened and endangered species in the project area.

5.15.1 Impacts to Threatened and Endangered Species
The No Build and Rural alternatives will have no impacts to threatened or endangered species or their habitat.

Bridge Alternatives
The potential for impacts to habitat for threatened and endangered species — specifically the southwestern willow flycatcher and the yellow-billed cuckoo — are most likely to result from construction within Galisteo Creek, and to a lesser extent, San Cristobal Arroyo. All of the Bridge alternatives would involve dredge, fill, and the use of construction equipment within the active channels of Galisteo Creek and San Cristobal Arroyo. The extent of temporary and permanent impacts would vary depending on the design of each alternative and the method used to detour traffic. These impacts are discussed in detail in Section 5.12. No impacts to other threatened or endangered species are anticipated. The potential for impact at each bridge is summarized below.

Galisteo Creek Bridge Alternatives
The loss of vegetation, as discussed in Section 5.12, would remove potential habitat for southwestern willow flycatcher and yellow-billed cuckoo.

- Galisteo Creek Bridge Alternative 1 (Rehabilitation) would have the least amount of impact to potential habitat for threatened & endangered species if 2-phased bridge construction is used. However, if a temporary bridge is used to detour traffic while the bridge is rehabilitated, the potential for impact would be much greater, as approximately 0.26 acres of vegetation would be removed. This vegetation includes a few scattered cottonwoods, a dense stand of Russian olive trees, and several willows.

- Galisteo Creek Bridge Alternative 2 (Replacement) using a 3-span design would have impacts similar to Alternative 1. In contrast, Alternative 2 using a 4-span design would have the greatest potential impact to habitat for southwestern willow flycatcher and yellow-billed cuckoo. The loss of habitat from the pier and abutment demolition and the temporary bridge required for this alternative would remove a total of approximately 0.75 acres of habitat, including some of the large cottonwood and Russian olive trees upstream of the bridge. While the disturbed areas would be restored, a stratified riparian forest would take many years to reach maturity.
Galisteo Creek Bridge Alternative 3 would remove about 0.32 acres of vegetation, most of which is not stratified forest. Thus, while some potential habitat for southwestern willow flycatcher and yellow-billed cuckoo would be lost, it is lower quality habitat than that found upstream of the existing bridge.

San Cristobal Bridge Alternatives
In general, the habitat quality within the San Cristobal Arroyo channel is of much lower quality than found in Galisteo Creek channel. While cottonwoods and Russian olive trees are present, they are at a low density. This channel is dominated by salt cedar which is a weedy species and has low wildlife habitat potential. Consequently, the potential to impact habitat for southwestern willow flycatcher and yellow-billed cuckoo is low regardless of the alternative selected.

5.16 Visual Resources
Although NM 41 through the Galisteo Basin is recognized as a valuable aesthetic resource, it is not designated as a New Mexico Scenic Byway. While there are no specific laws or regulations protecting visual resources or aesthetic values for highway projects, the visual environment is referenced in NEPA, and FHWA has developed guidance to assist with visual resource impact assessment. Publication No. FHWA-HI-88-054 Visual Impact Assessment for Highway Projects provides a general framework for the identification and assessment of visual resources. According to this document, visual resource assessment involves describing the visual characteristics of the project area, the visual resources and viewers affected, the significance of the main visual issues, and the effects of project alternatives. Project visual impacts are seen both in the view from the road and the view of the road.

Visual Environment and Viewers
Establishing the visual environment of the project involves assessing the visual resources of the project area and identifying viewer response to those resources. In the NM 41 project area, the regional landscape is characterized by the Galisteo Basin, a large area drained by the Galisteo Creek and its tributaries. The Galisteo Basin is surrounded by mountains to the north, east, and west, and these provide dramatic background views. The basin itself is characterized by rocky ridges and mesas and rolling hills, creating visual diversity and interest in the middleground views. Foreground views are primarily of roadside vegetation, which is primarily grassland with scattered juniper, except along watercourses which include more large trees and riparian species and in the community of Galisteo. For the most part, NM 41 maintains landform continuity, following the existing topography.
The project area is primarily undeveloped except for the village of Galisteo, which, as stated previously, is located at the junction of NM 41 and County Road 42, which connects to NM 14 to the west. The NM 41 project area is considered to have high visual quality, as there is substantial evidence of natural processes (mountain formation, watershed drainage), as well as striking and distinctive visual patterns. The viewscape is largely intact as the man-made elements, including NM 41, are consistent with the natural surroundings and do not detract from the natural setting.

The primary viewers of and from NM 41 include the residents and ranchers living within the NM 41 corridor, commuters traveling between Santa Fe and the Moriarty area, trucks and other commercial traffic that originate in Moriarty and are destined to locations within and north of the project area, and tourist traffic. Observations made during the collection of traffic counts also indicate use by school buses and governmental entities from communities in northeast and south-central New Mexico, suggesting that this route is used to travel between these areas of the state. The character of this particular segment of NM 41 is distinctive from areas to the north and south; therefore, visual awareness is heightened as drivers enter the Galisteo Basin. While visual awareness may be lower for residents who are more accustomed to the visual environment, exposure for these viewers is much greater, and smaller-scale changes may be more apparent.

5.16.1 Visual Resource Impacts
The No Build alternative will not alter the existing highway, so no impacts to visual quality would occur.

The Rural alternative will minimally alter the visual appearance of NM 41 as well as some of the views of and from the roadway. The addition of shoulders, the flattening of a number of horizontal and vertical curves, and the addition of a southbound climbing lane on Clark Hill will enlarge the roadway’s apparent scale and will disrupt the visual continuity of the landform to some degree. However, these are relatively minor changes that will not alter the most distinctive and high-quality visual elements in the area, which are the mesas and mountains in the middle and background views. Views of the roadway are not as significant in the Rural subarea as there is very little roadside development in this area. Some additions of guardrail or concrete wall barrier may heighten the visual differences between the roadway and the surrounding natural setting. Guardrail design will be selected to be consistent with the natural landscape (i.e. rusticated or weathered steel). Overall, visual impacts of the Rural alternative are considered to be minor.

The Community Transition alternative has been specifically designed to provide a visual change to drivers to reduce speeds as they enter the community of Galisteo. A narrower roadway section (4-foot shoulders) is proposed for the Community Transition area north and south of the community. Traffic calming strategies such as radar-reader boards, medians, and roundabouts, if implemented, would also be intentional visual changes to the roadway to alert drivers and reduce speeds. Roundabouts would require several advance signs to alert motorists. All of these traffic calming measures would constitute new visual elements and would alter foreground views of motorists. These elements may also be visible to some Galisteo residents on the north and south ends of town.

The multi-use path proposed as part of Community Core alternatives would introduce a new visual element into the Galisteo community. However, the path is proposed to be soft-surface and would be designed to blend into the existing landscape. The shoulders (either 4-foot asphalt or 2-foot flush concrete or estate curbs) proposed in the Community Core alternatives would provide a narrower roadway section and a visual cue to reduce speed. The concrete shoulders could be colored to enhance
the narrow roadway appearance and better blend with roadside vegetation. Overall, the Community Core alternatives are designed to be as visually consistent with the existing roadway as possible while providing needed safety improvements. The roadside path would be a new visual element and would be a change in visual information, particularly for residents of Galisteo. However, the trail would not necessarily change the visual character of the village adjacent to the roadway, which is defined more by the roadside structures and trees. The roadway is part of the historic context of the village and views of the roadway are a historic condition that continues today.

The Galisteo Creek and San Cristobal Arroyo Bridge Alternatives 1 and 2 involve the loss of historic bridges; however, the bridges will be replaced and the overall visual change will be minimal. Some of the specific visual characteristics of the bridges will be lost (i.e. the railings and identification plaques). However, the new bridges could include railings that are historically consistent with the old bridges. More detailed discussion of the visual impacts to the bridges is included in the Cultural Resources discussion.

5.17 Hazardous Materials

A Preliminary Initial Site Assessment (PISA) was prepared by the NMDOT Environmental Geology Bureau. This PISA covered the two historic bridges in the project area (Galisteo Creek and San Cristobal Arroyo) as these are proposed for replacement before improvements to the rest of the corridor. The PISA found no conditions that would prompt precautionary measures during construction to protect worker safety, the environment, or to reduce risk to the NMDOT. The only exception was the presence of lead-based paint on the metal portions of the two historic bridges. The presence of lead-based paint will be specified in the construction notes and the contractor will be instructed to recycle any steel bridge elements removed as part of the project. A copy of the PISA is included in Appendix C of this document.

5.18 Air Quality

Air quality regulations pertinent to transportation projects are found in the Clean Air Act Amendments of 1990 (CAA) and the Final Transportation Conformity Rule (40 CFR Parts 51 and 93). The CAA required the US Environmental Protection Agency (EPA) to develop National Ambient Air Quality Standards (NAAQS) for several major air pollutants. These pollutants, known as criteria pollutants, are carbon monoxide, nitrogen dioxide (usually referenced as oxides of nitrogen (NOx)), ozone, particulate matter (PM_{10} and PM_{2.5}), sulfur dioxide, and lead. The State of New Mexico has also established ambient air quality standards that, in some cases, are more stringent than the corresponding federal standards. The area surrounding the NM 41 corridor is classified by EPA as being in attainment of the NAAQS for all criteria pollutants. It is a rural area without any major point or area sources of air pollutants.

Because of the rural nature of the study area and the lack of major sources of air pollution, the Air Quality Bureau of the New Mexico Environment Department (NMED) does not perform ambient air quality monitoring in the study area. The nearest air quality monitoring stations operated by the NMED are located in Santa Fe, an area with much higher traffic volumes and other sources of air pollutants. Based on the data from these monitor locations, air pollutant concentrations in the study area are likely to be well below the maximum thresholds established by the EPA. None of these monitors have recorded violations of ambient air quality standards in recent years, and the city and surrounding areas (El Dorado and Galisteo) are in attainment of NAAQS. None of the project alternatives will cause an increase in traffic flows or increase congestion. For this reason, none of the project alternatives, including the No Build, is anticipated to have adverse impacts to air quality.
5.19 Noise

Noise levels within the project area are primarily a result of traffic traveling on NM 41, CR 42, and local streets. The predominant traffic noise sources are from a mixture of automobiles and large trucks. Sporadic train noise is also present in the last few miles of the project area where railroad tracks parallel the highway. No industrial noise or other major noise sources occur within the project area.

Existing noise level conditions within the NM 41 corridor were determined from field measurements collected on October 15, 2009 at five locations along NM 41. Four locations were selected to represent houses/buildings that were expected to experience the highest noise levels from existing traffic traveling on NM 41, and the fifth location was selected to measure noise levels at a location with a higher posted speed outside of the Community subarea. The results of the data collection revealed noise levels ranging from 54 dBA to 62 dBA for four locations. Noise data recorded from the northeast corner of the stone wall of the church in Galisteo yielded a noise level of 67 dBA. This noise level is primarily due to the close proximity of the church to the vehicles and trucks traveling on NM 41 and CR 42 (to Madrid). The collected data are shown in Table 5-16. In general, the measured noise levels are low and are consistent with a rural, low-volume highway.

<table>
<thead>
<tr>
<th>Measurement Location</th>
<th>Distance from NM 41</th>
<th>Measured Noise Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1: East of NM 41 and south of Galisteo Bridge</td>
<td>108 feet</td>
<td>53.7 dB(A)</td>
</tr>
<tr>
<td>Site 2: West of NM 41 and south of El Tanque Viejo</td>
<td>151 feet</td>
<td>54.9 dB(A)</td>
</tr>
<tr>
<td>Site 3: SW corner of NM 41 and CR 42</td>
<td>29 feet</td>
<td>67.4 dB(A)</td>
</tr>
<tr>
<td>Site 4: Residence west of NM 41, 275’ north of CR 42</td>
<td>26 feet</td>
<td>62.2 dB(A)</td>
</tr>
<tr>
<td>Site 5: North of Galisteo near NM 41 MP 57.1</td>
<td>24 feet</td>
<td>59.8 dB(A)</td>
</tr>
</tbody>
</table>

FHWA noise impact assessment procedures and policies require the consideration of noise abatement when measured or model-estimated sound levels approach or exceed 67 dBA. NMDOT's noise procedures further define noise impact as when predicted noise levels approach within 1 dBA of the FHWA's noise abatement criteria (i.e., 66 dBA) and when predicted noise levels exceed existing noise levels by 10 dBA or more.

As shown in Table 5-16, only one location has been identified that currently exceeds noise abatement criteria — Site 3, the SW corner of NM 41 and CR 42. Noise is not expected to increase as a consequence of any of the project build alternatives or the No Build alternative. However, traffic noise is likely to increase as a consequence of traffic growth on NM 41. According to traffic projections, traffic volumes on NM 41 are expected to increase approximately 50% by the 2030 design year. Based on this increase, traffic noise will likely increase from 1 to 2 dBA as a result of traffic growth (a general rule is that traffic noise increase 3 dBA for every doubling of traffic volume). Thus, noise levels in the design year will remain below noise abatement thresholds, except for Site 3, which already exceeds the threshold criteria.

Because Site 3 is within the historic district, the construction of a noise barrier is not practical. Moreover, it is unlikely that a barrier would meet FHWA and NMDOT cost-effectiveness criteria. Some noise abatement may be achieved by the proposed traffic calming measures in the Community Transition alternative as noise levels decrease due to slower travel speeds. This reduction would be minor and would not likely be noticeable.
6.0 SUMMARY AND RECOMMENDATIONS

This report summarizes and documents the investigations, analyses, and findings for the second phase (Phase B) of the NM 41 Alignment Study between Clark Hill (milepost [MP] 46.1) and the US 285 Junction (MP 62.1). The purpose of the alignment study is to: (1) evaluate the conditions that may require improvements to the existing highway; (2) identify and evaluate improvement options; and (3) identify the preferred alternative. This section provides a summary of the Phase B document, the recommendations for alternatives, and the class of environmental action proposed for Phase C.

6.1 Phase B Summary

Analysis of the condition of the existing highway and bridges indicates modifications to the highway are needed. These needs include:

- To correct two structurally and geometrically deficient bridges;
- To provide shoulders for improved driver safety and for the safety of bicyclists;
- To achieve a safe and consistent design speed by reducing the curvature and improving sight distance in several vertical and horizontal curves; and,
- To correct poor pavement.

Potential improvement alternatives for the roadway and bridges within the project limits were identified during the first phase of the NM 41 Alignment Study. Based on the initial analysis and the feedback received from the public, several of the initial alternatives were eliminated from further consideration, and refinements were made to the remaining alternatives that met the project purpose and need and that had general public support. Alternatives were developed specific to three subareas within the project area including: (1) the rural highway segments outside of the Galisteo area; (2) the community segments that include the transition areas leading into Galisteo and the segment of highway within the community; and (3) the two historic bridges at the south end of Galisteo. The alternatives evaluated in this report include:

Rural Area

The rural subarea includes NM 41 from MP 46.1 to 55.4 and from MP 57.8 to 62.1. Two alternatives have been considered for this segment including the No Build Alternative and the Rural Build Alternative. The Rural Alternative consists of two 12-foot driving lanes and 6-foot shoulders. In addition, a southbound climbing lane is provided at Clark Hill. This alternative also includes several profile changes to the existing highway to reduce vertical curves for the first two to three miles north of Clark Hill. Other improvements include upgrades to drainage boxes and culverts, guardrail improvements, and an added CMP livestock crossing at MP 47.7.

Community Transition Area

This subarea includes NM 41 from MP 55.5 to 55.8 south of Galisteo and from MP 56.8 to 57.8 north of Galisteo. The alternatives for this area include the No Build and the Community Transition Alternative. The Community Transition Alternative consists of two 11-foot lanes with 4-foot shoulders, except for the short transition between MP 55.5 and the San Cristobal Arroyo Bridge at MP 55.6 where 12-foot lanes are proposed. A multi-use path would be included in this alternative between the rodeo grounds into the Village of Galisteo. Radar-reader boards, medians, or roundabouts were also evaluated in the transition zones.
Community Core Area

The Community Core area includes the highway through the Village of Galisteo. The core segment begins at MP 55.8 and ends at 56.8. Three alternatives were evaluated: the No-Build and two build alternatives. The build alternatives are:

- **Community CoreAlternative 1** – This alternative includes two 11-foot lanes and 4-foot shoulders and an option for a multi-use path on the east side of the highway. At-grade pedestrian crossings of NM 41 are proposed on the north and south sides of the church.

- **Community CoreAlternative 2** – This alternative includes the same lane widths and pedestrian options as Alternative 1. The only difference is that 2-foot concrete flush curbs would be used in lieu of the 4-foot paved shoulders.

Galisteo Creek and San Cristobal Arroyo Bridges

Several alternatives were identified and evaluated for the Galisteo Creek Bridge and the San Cristobal Arroyo Bridge. These are:

- **Galisteo Creek Bridge Alternative 1 (bridge rehabilitation)** – This alternative would replace the bridge deck, railings, and girders and would repair and reseal the bridge substructure. Laboratory and visual examination of concrete cores collected from the abutments of this bridge identified problems with the structural condition of the existing substructure. For this reason, the NMDOT has concluded that the rehabilitation of the existing substructure is not prudent and is therefore, not recommended. However, this alternative was fully evaluated and is discussed in the document.

- **Galisteo Creek Bridge Alternative 2 (bridge replacement)** – This alternative would remove the existing bridge and construct a new bridge on the same alignment. Two options for this alternative were evaluated including the use of a 4-span bridge to closely match the appearance of the existing bridge and a 3-span bridge to reduce the amount of subsurface demolition and disturbance needed.

- **Galisteo Creek Bridge Alternative 3 (parallel bridge)** – This alternative would construct a new bridge approximately 10- to 16-feet downstream of the existing bridge. The existing Galisteo Creek Bridge could be preserved in place and used as a pedestrian and bicycle facility.

- **San Cristobal Arroyo Alternative 1 (bridge rehabilitation)** – This alternative would replace the bridge deck, railings, and girders and would repair and reseal the bridge substructure. The foundation would also be upgraded and scour protection added. Examination of the structural elements of the existing bridge determined that rehabilitation of this bridge is not feasible due to the poor condition of the timber piles and resulting potential for catastrophic bridge failure. It is not considered a safe and feasible alternative. However, this alternative was fully evaluated and the findings were discussed in the document.

- **San Cristobal Arroyo Alternative 2 (bridge replacement)** – This alternative includes removal of the existing bridge and construction of a new bridge on the same general alignment.

- **San Cristobal Arroyo Bridge Alternative 3 (parallel bridge)** – This alternative would construct a new bridge approximately 10- to 15-feet downstream of the existing bridge. The existing bridge would be removed for safety reasons.
A detailed engineering and environmental evaluation of each of the alternatives was completed. Tables 6-1 through 6-3 summarize the findings for critical issues. The No Build Alternative is included as a baseline for comparison and will be carried forward through the entire study process. Impacts and notable issues of the project alternatives are primarily related to:

- **Safety** – Safety concerns exist for three issues. First, several vertical curves have stopping sight distances substantially below the posted and prevailing speeds within the project limits. Several of these curves do not meet stopping sight distance criteria for speeds over 35 mph. Second, bicycle use of NM 41 creates an unsafe condition for bicyclists as the lack of shoulders on the roadway and the two historic bridges force bicyclists to ride in the driving lanes. The posted speed of 55 mph through most of the corridor results in a high speed differential between bicyclists and motorists. The third safety concern is the condition of the pier foundations at San Cristobal Arroyo Bridge. The timber piles are very likely to be in poor condition. Their condition, in combination with the potential for scour during major storms, creates the potential for catastrophic bridge failure.

- **Constructability Issues** – No major constructability issues were identified for the roadway elements of the project. For the bridges, constructability issues are associated with traffic detouring and delays to emergency response needs. An evaluation of detour route options found that the added distance and time for the users of NM 41 would be substantial. As an alternative to the use of detour routes, traffic could be maintained using 2-phased construction of the bridges or the use of temporary bridges. Two-phased construction may be feasible for the rehabilitation alternatives and the replacement alternatives, except for the 4-span replacement option at Galisteo Creek. The demolition of pier foundations at this bridge is incompatible with 2-phased construction. Detouring is not an issue with the parallel bridge alternatives.

- **Bridge Structural Life and Life Cycle Costs** – Concrete core samples were collected at the abutments of the Galisteo Creek Bridge. The cores were collected to allow for visual examination of the concrete, compressive strength analysis, and chemical analysis for alkali-silica reactivity. The visual examination identified gap-gradation and large aggregate in the concrete leading to cracks throughout the matrix of the concrete. For this reason, and because the concrete is over 70 years old, the service life for the rehabilitated substructure elements of the Galisteo Creek Bridge would be substantially less than the service life of the new deck and railing. While the initial construction costs of this alternative are lower than the other alternatives, the life cycle cost would be among the highest of all alternatives considered. Life-cycle costs were not prepared for San Cristobal Arroyo Bridge as the condition of this bridge makes rehabilitation unfeasible.

- **Vegetation and Wetlands** – The Bridge alternatives would require removal of riparian vegetation and wetlands in the Galisteo Creek and San Cristobal Arroyo channels. The Rehabilitation alternatives would have the least impact; the Parallel Bridge alternative would have the most impact. Temporary, impacts to riparian vegetation would also occur if temporary bridges are used to detour traffic during construction.

- **Cultural Resources** – All of the bridge alternatives would affect the historic-defining characteristics of the Galisteo Creek and San Cristobal Arroyo Bridges. Only the parallel bridge alternative at Galisteo Creek would preserve the existing bridge. Removal of the Galisteo Creek Bridge would also potentially adversely affect the Galisteo Historic District. The Rural alternative would affect one archeological site. San Cristobal Arroyo Bridge Alternative 3 has the potential to affect two archaeological sites.
6.2 Recommendations

Based on the detailed engineering and environmental evaluation of the Phase B alternatives, some alternatives are recommended for elimination and others are recommended to be carried forward for further evaluation in an environmental document (Phase 1-C). The following alternatives are recommended for advancement to Phase C:

- **No Build Alternative** – The No Build Alternative for the highway and bridges is a viable alternative if funds are not available for the proposed improvements. However, the condition of San Cristobal Arroyo Bridge is poor and necessitates the replacement of this bridge in the near future.

- **Rural Alternative** – The Rural alternative is recommended to be advanced as the preferred alternative for evaluation in an environmental document.

- **Community Transition Alternative** – The Community Transition alternative is recommended to be advanced as the preferred alternative for evaluation in an environmental document. In addition, radar-reader boards are proposed for inclusion with the base roadway improvements. Medians are recommended for further consideration as an optional element of this alternative.

- **Community Core Alternative 1** – Community Core Alternative 1 (11-foot lanes with 4-foot shoulders) is recommended for the community core area. The shoulders would provide an area for use by bicyclists outside of the driving lanes. This typical section would also be more consistent with the transitions with the bridges.

- **Galisteo Creek Bridge Alternative 2** – This alternative using a 3-span design is recommended for continued consideration. The use of a 4-span bridge is not recommended because of its high cost and impact to wetlands and riparian habitat. The bridge replacement alternative is feasible, has a relatively low life cycle cost, would have low impacts to wetlands and habitat, and would be consistent with the historic context of Galisteo. A typical section of 11-foot lanes, 4-foot shoulders, and a single sidewalk on the right side is recommended. This section will maintain a relatively narrow bridge width consistent with the Historic District.

- **Galisteo Creek Bridge Alternative 3** – The Parallel Bridge alternative would have greater impacts to the historic context, wetlands, and habitat. However, it has low life cycle costs and would have minimal disruption to traffic during the construction period. If this alternative is advanced to the environmental documentation phase, the typical section with 11-foot lanes, 4-foot shoulders, and walkways on both sides is recommended.

- **San Cristobal Arroyo Bridge Alternative 2** – The bridge replacement alternative is recommended for further consideration for the San Cristobal Arroyo Bridge. This alternative has relatively low cost and would have low impacts to wetlands and habitat. The recommended typical section for this bridge includes 12-foot lanes with 4-foot shoulders and a 4-foot walkway on the right side (east) of the bridge deck.

- **San Cristobal Arroyo Bridge Alternative 3** – The parallel bridge alternative has low cost and would be easier to construct without the need for detours. It would have greater impacts to wetlands and habitat, as compared to the replacement bridge alternative. The recommended typical section is the same as San Cristobal Arroyo Bridge Alternative 2.

Based on the detailed engineering and environmental evaluation of the Phase B alternatives, the following alternatives are recommended to be eliminated from further consideration.
• **Community Core Alternative 2** – This alternative is recommended for elimination because it would not provide for the safety of bicyclists.

• **Galisteo Creek Bridge Alternative 1** – The rehabilitation alternative for Galisteo Creek Bridge is not recommended because of its relatively high life cycle costs and the inconsistency between the service life of the substructure and new bridge deck and railing. The service life of the substructure is likely to be substantially less than the superstructure, resulting in the replacement of the substructure before the end of the service life for the deck and railing.

• **San Cristobal Arroyo Bridge Alternative 1** – The rehabilitation alternative for San Cristobal Arroyo Bridge is not recommended due to the complexity of improving the bridge foundation, the need for scour protection, and the higher cost.

• **Roundabouts** within the community transition and community core alternatives are not recommended due to their potential inconsistency with the historic character of Galisteo, potential safety concerns, and low acceptance from the public.

**Environmental Class of Action**
The preliminary evaluation of environmental and cultural issues and impacts did not identify issues where significant impacts are likely to occur. It is recommended that the project be evaluated using an environmental assessment.

If the recommendations for the alternatives, as discussed above are advanced, it is also recommended the alternatives be aggregated and identified as follows:

• **No Build Alternative** – This alternative would be applicable to all elements of the corridor including the rural segments, the community transition and core areas, and the two bridges.

• **Build Alternative** – This alternative would be defined to include the Rural Build Alternative, Community Transition Alternative, Community Core Alternative 1, Galisteo Creek Bridge Alternative 2, and San Cristobal Arroyo Bridge Alternative 2. Galisteo Creek Bridge Alternative 3, San Cristobal Arroyo Bridge Alternative 3, and the use of medians in the Community Core and Community Transition areas would be defined as independent options under the build alternative.
Table 6-1: Engineering

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Safety</th>
<th>Right-of-Way Acquisition</th>
<th>Cost</th>
<th>Constructability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rural Segments: MP 46.2 to MP 55.5 and MP 57.5 to 62.1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No-Action</td>
<td>9 vertical curves with inadequate sight distance for 55 mph or &gt;; Bicycles must travel in driving lane; Climbing lane at Clark Hill is deficient.</td>
<td>None</td>
<td>Cost for on-going maintenance only. This cost will increase as the pavement and subgrade worsen.</td>
<td>Temporary lane closures and/or detouring required during maintenance activities.</td>
</tr>
<tr>
<td>Rural Roadway Alternative (two 12' lanes with 6' shoulders)</td>
<td>All curves meet sight distance criteria for 55-mph posted speed; roadside meets criteria for driver recovery; shoulders available for bicyclists.</td>
<td>Limited to small CMEs at milepost 47.7 where a livestock crossing is proposed.</td>
<td>$13,643,403</td>
<td>No substantive constructability issues identified.</td>
</tr>
<tr>
<td><strong>Community Transition and Core Segments: MP 55.5 to MP 57.5 (bridges are discussed in Table 6-2)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No-Action</td>
<td>No safety improvements.</td>
<td>None</td>
<td>Cost for on-going maintenance only. This cost will increase as the pavement and subgrade worsen.</td>
<td>Temporary lane closures and/or detouring required during maintenance activities.</td>
</tr>
<tr>
<td>Community Transition</td>
<td>Provides slower travel through developed areas; provides 4' shoulders for use by bicycles.</td>
<td>Approximately 0.1 acres for realignment of Goose Farm Road.</td>
<td>$1,920,047 (includes the Community Core and Transition Segments)</td>
<td>Temporary lane closures and/or detouring required during maintenance activities.</td>
</tr>
<tr>
<td>Community Core Alternative 1</td>
<td>Provides slower travel through developed areas; provides 4' shoulders for use by bicycles.</td>
<td>None with median treatments. Approximately 0.63 acres if roundabouts are used.</td>
<td>$1,920,047 (includes the Community Core and Transition Segments)</td>
<td>Temporary lane closures and/or detouring required during maintenance activities.</td>
</tr>
<tr>
<td>Community Core Alternative 2</td>
<td>Provides slower travel through developed areas; does not provide shoulder area for bicycle use.</td>
<td>Same as above</td>
<td>$1,820,797 (decrease of $99,250 for 2' flush concrete edge; includes the Community Core and Transition Segments)</td>
<td>Temporary lane closures and/or detouring required during maintenance activities.</td>
</tr>
<tr>
<td>Alternative</td>
<td>Safety</td>
<td>Right-of-Way Acquisition</td>
<td>Cost</td>
<td>Constructability</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>--------------------------</td>
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<td>------------------</td>
</tr>
</tbody>
</table>
| No-Action | Numerous safety concerns including:  
- potential for bridge failure at San Cristobal due to condition of timber piles.  
- lack of pedestrian facilities or shoulders at San Cristobal forcing pedestrians to walk in driving lanes  
- inaccessible sidewalks and lack of shoulders at Galisteo Creek Bridge. | None | Cost for major repairs will be significant due to the need for major repairs at both bridges and scour protection at San Cristobal. | Temporary closures required for bridge deck and railing maintenance. |
| Galisteo Bridge Alternative 1 | Provides shoulders and a 4’ walkway on at least one side of the bridge. | None required. Temporary work permit needed if temporary bridge is used for traffic detour. | Construction cost of $1,244,401  
Life-cycle cost of $2,438,733 | Condition of concrete in substructures would result in a substantially shorter service life. This would result in a bridge deck with a much longer service life than the bridge substructure. 2-phase construction may be possible to accommodate a 1-lane detour. |
| Galisteo Bridge Alternative 2 (with 3-Span) | Provides shoulders and a 4’ walkway on at least one side of the bridge. | None required. Temporary work permit needed if temporary bridge is used for traffic detour. | Construction cost of $1,920,071  
Life-cycle cost of $2,198,321 | Full service life. While 2-phase construction may be possible, pier and abutment construction would be difficult. Probability of the need for a temporary bridge. |
| Galisteo Bridge Alternative 2 (with 4-Span) | Provides shoulders and a 4’ walkway on at least one side of the bridge. | None required. Temporary work permit needed if temporary bridge is used for traffic detour. | Construction cost of $2,381,331  
Life-cycle cost of $2,770,881 Plus significant costs for temporary bridge | Full service life. Temporary bridge needed for detour during demolition and construction. |
| Galisteo Bridge Alternative 3 | Provides shoulders. Option to maintain existing bridge for pedestrian use, or to include sidewalks on new bridge. | 2 acres | Construction cost of $1,498,811  
Life-cycle cost of $1,888,361 | Full service life. Traffic detour can be handled on existing bridge while new bridge is constructed. |
| San Cristobal Bridge Alternative 2 | Provides shoulders that can be used by bicyclists. Shoulders can be used by pedestrians if bridge crossing is necessary. | None required. Temporary work permit needed if temporary bridge is used for traffic detour. | Construction cost of $1,539,941 | Full service life. 2-phase construction can be used to provide a one-lane detour during construction. |
| San Cristobal Bridge Alternative 3 | Provides shoulders that can be used by bicyclists. Shoulders can be used by pedestrians if bridge crossing is necessary. | 2 acres | Construction cost of $1,283,284 | Full service life. Traffic detour can be handled on existing bridge while new bridge is constructed. |
### Table 6-3: Substantive Environmental Aspects

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Cultural Resources</th>
<th>4(f) Impacts</th>
<th>Wetlands and Riparian</th>
<th>Wildlife Habitat and T&amp;E</th>
<th>Other Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No-Action</strong></td>
<td>Does not affect cultural resource sites.</td>
<td>No effect</td>
<td>None anticipated</td>
<td>No effect</td>
<td>None anticipated</td>
</tr>
<tr>
<td><strong>Rural Roadway Alternative</strong></td>
<td>Archaeological sites within r/w, but are likely to be avoided. One site is located within construction area - LA 168910 = adverse effect.</td>
<td>No 4(f) resources within project segment.</td>
<td>None anticipated</td>
<td>Loss of up to 23 acres of roadside habitat. Loss of habitat would not impact wildlife or affect T&amp;E Species.</td>
<td>None anticipated</td>
</tr>
<tr>
<td><strong>Community Transition Alternative and Community Core Alternatives combined</strong></td>
<td>Archaeological sites within r/w, but are likely to be avoided.</td>
<td>No 4(f) resources within project segment.</td>
<td>None anticipated</td>
<td>Loss of up to 14.5 acres of roadside habitat. Loss of habitat would not impact wildlife or affect T&amp;E Species.</td>
<td>Minor changes to visual character due to addition of shoulders, pedestrian paths, and possibly roundabouts.</td>
</tr>
<tr>
<td><strong>Galisteo Bridge Alternative 1</strong></td>
<td>Adverse effect to the Galisteo Creek Bridge.</td>
<td>To be determined in Phase 1-C</td>
<td>Temporary disturbance from construction equipment. Loss of ~ 0.26 acres of riparian habitat.</td>
<td>Minor impacts to habitat from construction activity and disturbance to wildlife from construction activity. Impacts are temporary.</td>
<td>None anticipated</td>
</tr>
<tr>
<td><strong>Galisteo Bridge Alternative 2 (with 3- Span)</strong></td>
<td>Adverse effect to the Galisteo Creek Bridge.</td>
<td>To be determined in Phase 1-C</td>
<td>Temporary disturbance from construction equipment. Loss of ~ 0.02 acres of wetland habitat and minor impacts to riparian habitat.</td>
<td>Minor amount of habitat lost and disturbance to wildlife from construction activity. Impacts are temporary.</td>
<td>None anticipated</td>
</tr>
<tr>
<td><strong>Galisteo Bridge Alternative 2 (with 4- Span)</strong></td>
<td>Adverse effect to the Galisteo Creek Bridge and the Galisteo Historic District.</td>
<td>To be determined in Phase 1-C</td>
<td>Temporary disturbance from construction equipment. Loss of ~ 0.05 acres of wetland habitat and ~ 0.5 acres of riparian habitat.</td>
<td>temporary loss of 0.5 acres of riparian habitat. Habitat is low quality</td>
<td>None anticipated</td>
</tr>
<tr>
<td><strong>Galisteo Bridge Alternative 3</strong></td>
<td>Potential to affect two archaeological sites.</td>
<td>To be determined in Phase 1-C</td>
<td>Temporary disturbance from construction equipment. Permanent loss of ~ 0.01 acres of wetland habitat and ~ 0.3 acres of riparian habitat.</td>
<td>Loss of up to 0.5 acres of potential habitat for southwestern willow flycatcher and yellow billed cuckoo, plus loss of up to 0.3 acres of vegetation/previously open habitat.</td>
<td>None anticipated</td>
</tr>
<tr>
<td><strong>San Cristobal Bridge Alternative 2</strong></td>
<td>Adverse effect to the San Cristobal Bridge; Likely to result in impacts to archaeological sites.</td>
<td>To be determined in Phase 1-C</td>
<td>Temporary disturbance from construction equipment. Loss of ~ 0.02 acres of wetland habitat and minor impacts to riparian habitat.</td>
<td>Temporary loss of 0.5 acres of riparian habitat. Habitat is low quality.</td>
<td>None anticipated</td>
</tr>
<tr>
<td><strong>San Cristobal Bridge Alternative 3</strong></td>
<td>Adverse effect to the San Cristobal Bridge; Potential to affect two archaeological sites.</td>
<td>To be determined in Phase 1-C</td>
<td>Temporary disturbance from construction equipment. Permanent loss of ~ 0.01 acres of wetland habitat and ~ 0.3 acres of riparian (salt cedar) habitat.</td>
<td>Will result in the loss of up to 0.3 acres of vegetation/previously open habitat.</td>
<td>None anticipated</td>
</tr>
</tbody>
</table>
APPENDICES

APPENDIX A
Agency Coordination

APPENDIX B
Bridge Test Results

APPENDIX C
Preliminary Initial Site Assessment
APPENDIX A
Agency Coordination
November 9, 2010

Ms. Lesley McWhirter
US Army Corps of Engineers
Albuquerque District, Regulatory Division
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

RE: NM 41 Alignment Study (Clark Hill to US 285) – Scoping Request and Invitation to Become a Cooperating Agency

Dear Ms. McWhirter:

The New Mexico Department of Transportation (NMDOT), in cooperation with the Federal Highway Administration (FHWA), is initiating an environmental assessment (EA) for proposed improvements to NM 41 in Santa Fe County, New Mexico. The proposed project begins at milepost 46 and extends north to the junction of NM 41 with US Highway 285 near Lamy (see attached exhibit). The proposed project includes reducing several sharp vertical curves, adding shoulders, replacing or rehabilitating the bridge over Galisteo Creek, and replacing the bridge over San Cristobal Arroyo. The project will also include traffic calming measures through the community of Galisteo and other ancillary improvements. The purpose of the project is to improve safety and to replace aging infrastructure.

The US Army Corps of Engineers has been identified as an agency that may have an interest in and jurisdictional responsibility over some aspects of the project. All of the alternatives under consideration would cross the Galisteo Creek and San Cristobal Arroyo. The improvements under consideration at these locations could impact wetlands, riparian habitat, and water quality. Other minor drainage may be affected as well, although the impacts at these locations are likely to be minor. As a starting point, we would appreciate your input on issues of concern as they pertain to this project.

In addition, we are requesting that the Army Corps of Engineers serve as a cooperating agency with FHWA and the NMDOT in the development of the EA. This request is made because the proposed project will require application for a Section 404 permit before construction can begin. We understand that your agreement to serve as a cooperating agency does not imply that your agency supports the proposal.

In accordance with Section 6002 of SAFETEA-LU, cooperating and participating agencies are responsible for identifying, as early as practicable, any issues of concern regarding the project's potential environmental or socioeconomic impacts that could substantially delay or prevent an agency from granting a permit or other approval that is needed for the project. We suggest that your agency's role in the development of the NM 41 project should include the following as they relate to your area of expertise:
Your agency’s involvement should entail those areas under its expertise and no direct writing or analysis will be necessary for the document’s preparation. The following are activities we will take to maximize interagency cooperation:

1. Invite you to coordination meetings;
2. Consult with you on any relevant technical studies that will be required;
3. Organize joint field reviews with you;
4. Provide you with project information, including study results;
5. Encourage your agency to use the above documents to express your views on subjects within your jurisdiction or expertise; and
6. Include information in the project environmental documents that cooperating agencies need to discharge their NEPA responsibilities and any other requirements regarding jurisdictional approvals, permits, licenses, and/or clearances.

You have the right to expect that the EA will enable you to discharge your jurisdictional responsibilities. Likewise you have the obligation to tell us if, at any point in the process, your needs are not being met. We expect that at the end of the process the EA will satisfy your NEPA requirements including those related to project alternatives, environmental consequences and mitigation. Further, we intend to utilize the EA as our decision-making document. As the process dictates, this environmental documentation will contribute to the eventual goal of Federal-aid project authorization.

Please let us know as soon as possible if the Army Corps of Engineers agrees to serve as a cooperating agency. Your written response by November 19, 2010 would be appreciated. If your agency declines this invitation, we would appreciate the reason for your decision.

A representative of the NMDOT Project Team will contact you in the next week to answer any questions you may have about the proposed project. In the interim, if you have questions about the project, please contact me at (505) 820-2027 or anyone of the following project representatives:

- Jeff Fredine, Acting Manager, Human and Natural Resources Bureau, (505) 827-5681 or jeffrey.fredine@state.nm.us;
- Christina Kelso, Environmental Scientist, (505) 827-1873 or Christina.kelso@state.nm.us;
- David Pennington, D. Pennington & Associates, (505) 884-0667, dave@dpenningtonassociates.com

Sincerely,

[Signature]

Gregory L. Heitmann
Environmental Specialist

For: J. Don Martinez
Division Administrator

Enclosure

cc: Mr. Jeff Fredine, NMDOT Environmental Services Division
Ms. Christina Kelso, NMDOT Environmental Services Division
Mr. David Quintana, P.E., NMDOT Project Manager
Mr. David Pennington, D. Pennington & Associates
DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435
505-342-3284
FAX 505-342-3498

November 17, 2010

REPLY TO
ATTENTION OF:

Regulatory Division
New Mexico/Texas Branch

SUBJECT: Action No. SPA-2010-00480-ABQ; FHWA/NMDOT, NM 41 Alignment Study,
Santa Fe County, NM

Mr. Gregory Heitmann
Federal Highway Administration
New Mexico Division
4001 Office Court St., Ste 801
Santa Fe, New Mexico 87507-4902

Dear Mr. Heitmann:

This is in response to your letter dated November 9, 2010, requesting the U.S. Army Corps of Engineers’ (Corps) participation as a cooperating agency in the preparation of an Environmental Assessment (EA) for the Federal Highway Administration (FHWA) and New Mexico Dept. of Transportation’s (NMDOT) proposed NM 41 Alignment Study from Mile Post 46 to US Highway 285, near Galisteo, Santa Fe County, New Mexico. Potential waters of the United States that may be affected by the project include Galisteo Creek, its tributaries and adjacent wetlands. We have assigned Action No. SPA-2010-00480-ABQ to this activity. Please include this number in all future correspondence concerning this project.

In response to your request, the Corps agrees to be a cooperating agency in the preparation of this EA. Our participation will satisfy the procedural and statutory requirements of the Corps (33 CFR 325, App. B and Sec. 230.16) and allow our review for adoption of the document in accordance with 40 CFR 1506.3 for a permit decision under Section 404 of the Clean Water Act. Our participation will include providing available information, coordination, review, and meeting attendance as scheduling allows. The Corps will not contribute funds to the EA preparation other than our participation.
The Corps' area of expertise or jurisdiction by law is generally flood control, navigation, hydropower, and regulatory responsibilities under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. We will provide comments on the draft EA within our areas of expertise or jurisdiction.

As a cooperating agency, we expect to receive invitations to meetings and field reviews, to be consulted on technical studies, to be provided study results and draft documents, and to have our comments appropriately included in the EA. When design specifics are available and upon request, we will review the project for Section 404 permit requirements. The FHWA and NMDOT must also obtain certification that the project complies with the State of New Mexico and/or tribal water quality standards prior to our permit issuance.

We encourage the FHWA and NMDOT to coordinate with the Corps during production of the EA regarding preliminary investigations pertinent to jurisdictional waters potentially impacted by the NM 41 Alignment Study project. Concurrent with preparation of the EA, an alternatives analysis should be conducted in accordance with the 404(b)(1) Guidelines (40 CFR Part 230), which are the substantive criteria for discharges of dredged or fill material into waters of the United States. The (b)(1) Guidelines state that “... no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. ... An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. ...”

Our contact for this action is Mr. William Oberle at the Albuquerque District Office, 505-342-3284, e-mail: william.m.oberle@usace.army.mil.

Sincerely,

Lesley McWhirter
Chief, NM/TX Branch
Copies furnished:

Mr. Jeffrey Fredine
Human and Natural Resources Bureau
NM Dept. of Transportation
PO Box 1149
Santa Fe, NM 87504-1149

Ms. Christina Kelso
Human and Natural Resources Bureau
NM Dept. of Transportation
PO Box 1149
Santa Fe, NM 87504-1149

Mr. Neal Schaeffer
New Mexico Environment Department
Surface Water Quality Bureau
PO Box 5469
Santa Fe, NM 87502-5469
November 9, 2010

Mr. Matt Wunder
New Mexico Department of Game and Fish
Conservation Services Division
PO Box 25112
Santa Fe, New Mexico 87504

RE: NM 41 Alignment Study (Clark Hill to US 285) – Scoping Request and Invitation to Become a Participating Agency

Dear Mr. Wunder:

The New Mexico Department of Transportation (NMDOT), in cooperation with the Federal Highway Administration (FHWA), is initiating an environmental assessment (EA) for proposed improvements to NM 41 in Santa Fe County, New Mexico. The proposed project begins at milepost 46 and extends north to the junction of NM 41 with US Highway 285 near Lamy (see attached exhibit). The proposed project includes reducing several sharp vertical curves, adding shoulders, replacing or rehabilitating the bridge over Galisteo Creek, and replacing the bridge over San Cristobal Arroyo. The project will also include traffic calming measures through the community of Galisteo and other ancillary improvements. The purpose of the project is to improve safety and to replace aging infrastructure.

The New Mexico Game and Fish Department has been identified as an agency that may have an interest in and jurisdictional responsibility over some aspects of the project. All of the alternatives under consideration would cross the Galisteo Creek and San Cristobal Arroyo. The improvements under consideration at these locations could impact habitat used by federal and state threatened and endangered species. Habitat used by wildlife may also be affected in other parts of the project corridor. As a starting point, we would appreciate your input on issues of concern to your agency as they pertain to this project.

In addition, we are requesting that the Game and Fish Department serve as a participating agency with FHWA and the NMDOT in the development of the EA. This request is made because of the potential impacts the proposed project could have on threatened and endangered species and any consultation that may be needed for compliance with the Endangered Species Act. We understand that your agreement to serve as a participating agency does not imply that your agency supports the proposal.

In accordance with Section 6002 of SAFETEA-LU, cooperating and participating agencies are responsible for identifying, as early as practicable, any issues of concern regarding the project's potential environmental or socioeconomic impacts that could substantially delay or prevent an agency from granting a permit or other approval that is needed for the project.
We suggest that your agency's role in the development of the NM 41 project should include the following as they relate to your area of expertise:

1. Provide input on the project purpose and need, the range of alternatives to be considered, and the methodologies and level of detail required in the alternatives analysis.
2. Participate in coordination meetings and field reviews, as appropriate.
3. Provide timely review and comment on the pre-draft environmental document to reflect the views and concerns of your agency regarding the adequacy of the document, alternatives considered, and the anticipated impacts and mitigation.

Please let us know as soon as possible if the Game and Fish Department agrees to serve as a participating agency. Your written response by November 19, 2010, would be appreciated. If your agency declines this invitation, we would appreciate the reason for your decision.

A representative of the NMDOT Project Team will contact you in the next week to answer any questions you may have about the proposed project. In the interim, if you have questions about the project, please contact me at (505) 820-2027 or anyone of the following project representatives:

- Jeff Fredine, Acting Manager, Human and Natural Resources Bureau, (505) 827-5681 or Jeffrey.Fredine@state.nm.us;
- Christina Kelso, Environmental Scientist, (505) 827-1873 or Christina.kelso@state.nm.us;
- David Pennington, D. Pennington & Associates, (505) 884-0667, dave@dpenningtonassociates.com

Sincerely,

[Signature]
Gregory L. Heitmann
Environmental Specialist

For: J. Don Martinez
Division Administrator

Enclosure

cc: Mr. Jeff Fredine, NMDOT Environmental Services Division
Ms. Christina Kelso, NMDOT Environmental Services Division
Mr. David Quintana, P.E., NMDOT Project Manager
Mr. David Pennington, D. Pennington & Associates
29 November 2010

US Department of Transportation New Mexico Division
Gregory Heitmann
4001 Office Court Dr., Ste 801
Santa Fe NM 87507

Re: NM 41 Alignment Study; NMDGF No. 13862

Dear Mr. Heitmann;

The New Mexico Department of Game and Fish (Department) has reviewed your letter of November 9, 2010, for the above-referenced project. Since the bridge planned for reconstruction spans the Galisteo Creek, we provide you with the Department's *Bridge and Road Reconstruction Guidelines for Wetland and Riparian Areas*. These guidelines should assist in minimizing impacts to Galisteo Creek, and are likely similar to standard best management practices for these types of construction activities.

The Department also recommends that occurrence of bats under the bridge be assessed and work be scheduled to avoid impacting bats that may roost there (i.e., conduct work in winter months). If feasible, we recommend bat boxes be constructed beneath the bridge to increase bat populations. These animals provide an important ecological benefit to humans in relation to insect control.

For your additional information, we have enclosed a copy of New Mexican Wildlife of Concern for Santa Fe County (Biota Information System of New Mexico, BISON-M, New Mexico Dept. of Game and Fish electronic database). Species accounts and habitat associations can be accessed from the BISON-M database via the World-wide Web at [http://www.bison-m.org](http://www.bison-m.org).
Thank you for the opportunity to review and comment on your project. If you have any questions, please contact Brandon Griffith, Northwest Area Office Depredation Specialist at (505) 22-4721 or brandon.griffith@state.nm.us.

Sincerely,

Matt Wunder, PhD
Chief, Conservation Services Division

MW/bwg

xc: Wally Murphy, Ecological Services Field Supervisor, USFWS
    Brian Gleadle, NW Area Operations Chief, NMDGF
NEW MEXICO WILDLIFE OF CONCERN  
SANTA FE COUNTY

For complete up-dated information on federal-listed species, including plants, see the US Fish & Wildlife Service NM Ecological Services Field Office website at http://www.fws.gov/ftw2es/NewMexico/SBC.cfm. For Information on state-listed plants, contact the NM Energy, Minerals and Natural Resources Department, Division of Forestry, or go to http://nmrareplants.unm.edu/. If your project is on Bureau of Land Management, contact the local BLM Field Office for Information on species of particular concern. If your project is on a National Forest, contact the Forest Supervisor’s office for species information.

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<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>NMGF</th>
<th>US FWS</th>
<th>critical habitat</th>
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<td>Bald Eagle</td>
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<td>Northern Goshawk</td>
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<td>Peregrine Falcon</td>
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<tr>
<td>White-tailed Ptarmigan</td>
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<td>Mountain Plover</td>
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<td>Oreohelix neomexicana</td>
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</tbody>
</table>
November 9, 2010

Ms. Georgia Cleverley
New Mexico Environment Department
Office of the Secretary
Harold Runnels Building
1190 St. Francis Drive
Santa Fe, New Mexico 87505

RE: NM 41 Alignment Study (Clark Hill to US 285) – Scoping Request and Invitation to Become a Participating Agency

Dear Ms. Cleverley:

The New Mexico Department of Transportation (NMDOT), in cooperation with the Federal Highway Administration (FHWA), is initiating an environmental assessment (EA) for proposed improvements to NM 41 in Santa Fe County, New Mexico. The proposed project begins at milepost 46 and extends north to the junction of NM 41 with US Highway 285 near Lamy (see attached exhibit). The proposed project includes reducing several sharp vertical curves, adding shoulders, replacing or rehabilitating the bridge over Galisteo Creek, and replacing the bridge over San Cristobal Arroyo. The project will also include traffic calming measures through the community of Galisteo and other ancillary improvements. The purpose of the project is to improve safety and to replace aging infrastructure.

The New Mexico Environment Department has been identified as an agency that may have an interest in and jurisdictional responsibility over some aspects of the project. All of the alternatives under consideration would cross the Galisteo Creek and San Cristobal Arroyo. The improvements under consideration at these locations could impact wetlands, riparian habitat, and water quality. Other minor drainage may be affected as well, although the impacts at these locations are likely to be minor. As a starting point, we would appreciate your input on issues of concern as they pertain to this project.

In addition, we are requesting that the NMED serve as a participating agency with FHWA and the NMDOT in the development of the EA. This request is made because the proposed project will require Section 401 Water Quality Certification. As a related matter, the application for a Section 404 permit through the US Army Corps of Engineers will occur before construction can begin. We understand that your agreement to serve as a participating agency does not imply that your agency supports the proposal.

In accordance with Section 6002 of SAFETEA-LU, cooperating and participating agencies are responsible for identifying, as early as practicable, any issues of concern regarding the project's potential environmental or socioeconomic impacts that could substantially delay or prevent an agency from granting a permit or other
approval that is needed for the project. We suggest that your agency's role in the development of the NM 41 project should include the following as they relate to your area of expertise:

1. Provide input on the project purpose and need, the range of alternatives to be considered, and the methodologies and level of detail required in the alternatives analysis.
2. Participate in coordination meetings and field reviews, as appropriate.
3. Provide timely review and comment on the pre-draft environmental document to reflect the views and concerns of your agency regarding the adequacy of the document, alternatives considered, and the anticipated impacts and mitigation.

Please let us know as soon as possible if the NMED agrees to serve as a participating agency. Your written response by November 19, 2010 would be appreciated. If your agency declines this invitation, we would appreciate the reason for your decision.

A representative of the NMDOT Project Team will contact you in the next week to answer any questions you may have about the proposed project. In the interim, if you have questions about the project, please contact me at (505) 820-2027 or anyone of the following project representatives:

- Jeff Fredine, Acting Manager, Human and Natural Resources Bureau, (505) 827-5681 or Jeffrey.Fredine@state.nm.us;
- Christina Kelso, Environmental Scientist, (505) 827-1873 or Christina.kelso@state.nm.us;
- David Pennington, D. Pennington & Associates, (505) 884-0667, dave@dpenningtonassociates.com

Sincerely,

[Signature]

Gregory L. Heitmann
Environmental Specialist

For: J. Don Martinez
Division Administrator

Enclosure

cc:
Mr. Jeff Fredine, NMDOT Environmental Services Division
Ms. Christina Kelso, NMDOT Environmental Services Division
Mr. David Quintana, P.E., NMDOT Project Manager
Mr. David Pennington, D. Pennington & Associates
December 20, 2010

Gregory L. Heitmann
4001 Office Court Dr., Ste 801
Santa Fe, NM 87507

RE: NM 41 Alignment Study (Clark Hill to US 285) - Scoping Request and Invitation to become a Participating Agency. (NMED File Number: 3346 ER)

Dear Mr. Heitmann:

Your letter regarding the above named project was received in the New Mexico Environment Department (NMED) and was sent to various Bureaus for review and comment. Comments were provided by the Surface Water Quality Bureau and Air Quality Bureau and are as follows.

Surface Water Quality Bureau
Surface Water Quality Bureau (SWQB) has reviewed the above referenced document. SWQB has no comments to make at this time.

Air Quality Bureau
The New Mexico Environment Department-Air Quality Bureau has evaluated the scoping document you have submitted with respect to the proposed road construction along NM 41 from US 285 to Clark Hill, Santa Fe County. The Air Quality Bureau would like to be a participating agency as you proceed with the planning for this project.

I apologize for the delay in responding to you and hope this information is helpful.

Sincerely,

Julie Roybal for
Georgia Cleverley
NMED File #3346
November 9, 2010

Mr. Wally Murphy
U.S. Fish & Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuna Road
Albuquerque, New Mexico 87113

RE: NM 41 Alignment Study (Clark Hill to US 285) – Scoping Request and Invitation to Become a Participating Agency

Dear Mr. Murphy:

The New Mexico Department of Transportation (NMDOT), in cooperation with the Federal Highway Administration (FHWA), is initiating an environmental assessment (EA) for proposed improvements to NM 41 in Santa Fe County, New Mexico. The proposed project begins at milepost 46 and extends north to the junction of NM 41 with US Highway 285 near Lamy (see attached exhibit). The proposed project includes reducing several sharp vertical curves, adding shoulders, replacing or rehabilitating the bridge over Galisteo Creek, and replacing the bridge over San Cristobal Arroyo. The project will also include traffic calming measures through the community of Galisteo and other ancillary improvements. The purpose of the project is to improve safety and to replace aging infrastructure.

The U.S. Fish & Wildlife Service has been identified as an agency that may have an interest in and jurisdictional responsibility over some aspects of the project. All of the alternatives under consideration would cross the Galisteo Creek and San Cristobal Arroyo. The improvements under consideration at these locations could impact habitat used by threatened or endangered species. As a starting point, we would appreciate your input on issues of concern to the FWS as they pertain to this project.

In addition, we are requesting that the Fish & Wildlife Service serve as a participating agency with FHWA and the NMDOT in the development of the EA. This request is made because of the potential impacts the proposed project could have on threatened and endangered species and any consultation that may be needed for compliance with the Endangered Species Act. We understand that your agreement to serve as a participating agency does not imply that your agency supports the proposal.

In accordance with Section 6002 of SAFETEA-LU, cooperating and participating agencies are responsible for identifying, as early as practicable, any issues of concern regarding the project’s potential environmental or socioeconomic impacts that could substantially delay or prevent an agency from granting a permit or other approval that is needed for the project. We suggest that your agency’s role in the development of the NM 41 project should include the following as they relate to your area of expertise:
1. Provide input on the project purpose and need, the range of alternatives to be considered, and the methodologies and level of detail required in the alternatives analysis.

2. Participate in coordination meetings and field reviews, as appropriate.

3. Provide timely review and comment on the pre-draft environmental document to reflect the views and concerns of your agency regarding the adequacy of the document, alternatives considered, and the anticipated impacts and mitigation.

Please let us know as soon as possible if the Fish & Wildlife Service agrees to serve as a participating agency. Your written response by November 19, 2010 would be appreciated. If your agency declines this invitation, we would appreciate the reason for your decision.

A representative of the NMDOT Project Team will contact you in the next week to answer any questions you may have about the proposed project. In the interim, if you have questions about the project, please contact me at (505) 820-2027 or anyone of the following project representatives:

- Jeff Fredine, Acting Manager, Human and Natural Resources Bureau, (505) 827-5681 or Jeffrey.Fredine@state.nm.us;
- Christina Kelso, Environmental Scientist, (505) 827-1873 or Christina.kelso@state.nm.us;
- David Pennington, D. Pennington & Associates, (505) 884-0667, dave@dpenningtonassociates.com

Sincerely,

[Signature]

Gregory L. Heitmann
Environmental Specialist

For: J. Don Martinez
Division Administrator

Enclosure

cc:
Mr. Jeff Fredine, NMDOT Environmental Services Division
Mr. Christina Kelso, NMDOT Environmental Services Division
Mr. David Quintana, P.E., NMDOT Project Manager
Mr. David Pennington, D. Pennington & Associates
APPENDIX B

Bridge Test Results
Results of Limited Petrographic Examination
Of Concrete Cores

Galisteo Creek Bridge
Galisteo, New Mexico
Lab Nos. 13016 and 13017
Terracon Project No. 66101064
November 22, 2010

Prepared for
D. Pennington & Associates
6605 Uptown Blvd., Suite 240
Albuquerque, New Mexico

Prepared by

Cincinnati, Ohio
Results of Limited Petrographic Examination Of Concrete Cores

INTRODUCTION

Two nominal 4" diameter concrete cores from the referenced project were obtained by Terracon, Albuquerque, New Mexico personnel and delivered to the H. C. Nutting, a Terracon Company, Cincinnati, Ohio laboratory on November 17, 2010 for limited petrographic examinations to assist in determining the cause(s) of reported concrete deterioration at the subject site. The examination was limited solely to determining if alkali-silica reactivity was contributing to, or was the cause of, the reported deterioration. Cores were identified as Core 4 (66-2990) and Core 11 (66-2994) and were assigned HCN lab #’s 13016 and 13017, respectively.

No information on the concrete itself (age, mix design, photographs of deterioration, exposure scenarios etc.) was provided to the writer. Consequently, all findings/conclusions are based solely on examinations of the submitted cores.

Core #4 is a vertical core obtained 9’ east of the western-most I-beam. Core #11 is a horizontal core obtained 2’3” east of the western-most I-beam

METHODOLOGY

Both cores were visually (megascopically) photographed and sawn vertically in half (i.e. along the core axis). These sawn halves were ground, using a series of progressively finer grits, to a surface suitable for examination by stereomicroscope.
GROSS CHARACTERISTICS

Neither of the cores exhibited any visual deterioration. No fracturing of either core was visually observed. Core #4 was 5\" to 5 ½\" long; core #11 was 6\" to 6 ½\" long. Both cores were nominal 4\" diameter.

Both cores contained 2\" maximum size subrounded to subangular, natural gravel which consisted predominantly of granitic to intermediate (rarely basic) siliceous/igneous rocks. Some of the coarse aggregate particles appeared to exhibit more porous "rinds" on exterior surfaces. Fine aggregate consisted essentially of similar materials plus quartz (silicon dioxide).

STEREOMICROSCOPIC EXAMINATION

The sawn portions of both cores were examined using a stereomicroscope at 70x magnification. Microfractures were not apparent in the paste of either core. The concrete did not appear to be air entrained. Rinds on certain coarse aggregate particles appeared to be weathering rinds. No ASR related gels were observed in the cement paste.

CONCLUSIONS

Based on and limited to the scope of work performed there was no observed macrofracturing or microfracturing observed and no apparent ASR gels. Based on this, we conclude that alkali-silica reactivity is not occurring in these 2 cores. None of the reported deterioration was present in these 2 cores.

Respectfully submitted,

H. C. NUTTING / A Terracon COMPANY

Terry E. Strantsky, P.G.
Principal / Petrographic Services Manager

Tim Goodall.
Laboratory Manager
APPENDIX I

PHOTOGRAPHS
Photo 1
Core #11, as received. Note lack of fracturing

Photo 2
Exterior surface of Core #11
Photo 3
Core #4 as received. Note lack of fracturing.

Photo 4
Exterior surface of Core #4
Photo 5
Sawn surface of Core #11. Note lack of fracturing.

Photo 6
Sawn surface of Core #4. Note lack of fracturing.
## TEST RESULTS

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<th>Core No.</th>
<th>Date Drilled</th>
<th>Steel Depth Encountered (inches)</th>
<th>Recovered Core (inches)</th>
<th>Prepared Core (inches)</th>
<th>Maximum Aggregate Size (inches)</th>
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<td>N/A</td>
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### Compressive Strength Results

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</tbody>
</table>

Test specimens were removed with a diamond drill. Ends of the specimens were sawed to obtain smooth surfaces perpendicular to the axis and of the same diameter as the body of the specimen. Specimens were tested in the moisture noted above. They were capped with an approved compound and tested in accordance with ASTM C42, Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

### Location Details

- **Location #1**: South abutment 9'E, of western most I-beam
- **Location #2**
- **Location #3**
- **Location #**
- **Location #**
- **Location #**

**Comments**: A total of four cores were collected with this group. Cores were shearing (3) so an additional core (1) was taken in order to obtain a core for compressive strength. Sheared cores will be retained for additional testing if needed.

**Reviewed by**: [signature]
# Core Drilling Test Report

**Client Name:** D. Pennington & Associates  
**Client Address:** 6605 Uptown Blvd. N.E., Suite 240  
Albuquerque, NM 87110  
**Project Name:** Galisteo Bridge Coring  
**Project Location:** Galisteo Creek Bridge  
**Date:** 11/10/2010  
**Job No.:** 66101064  
**Authorized by:** David Pennington  
**Cored by:** Marcus De La Rosa  
**Tested by:** Marcus De La Rosa

## TEST RESULTS

<table>
<thead>
<tr>
<th>Core No.</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Drilled</td>
<td>11/3/2010</td>
</tr>
<tr>
<td>Steel Depth Encountered (inches)</td>
<td>N/A</td>
</tr>
<tr>
<td>Recovered Core (inches)</td>
<td>7.89</td>
</tr>
<tr>
<td>Prepared Core (inches)</td>
<td>4.86</td>
</tr>
<tr>
<td>Maximum Aggregate Size (inches)</td>
<td>2&quot;</td>
</tr>
</tbody>
</table>

### Compressive Strength Results

| Capped Height (inches) | 5.06 |
| Diameter (inches) | 3.99 |
| Area (sq. in.) | 12.50 |
| L/D Ratio | 1.27 |
| Correction Factor | 0.93 |
| Total Load (lbs.) | 59,870 |
| Unit Load (psi) | 4,790 |
| Corrected Load (psi) | 4,450 |
| Curing Method | Air |
| Type Fracture | 3 |
| Date Tested | 11/09/10 |
| Density (pcf) | 147.2 |

Test specimens were removed with a diamond drill. Ends of the specimens were sawed to obtain smooth surfaces perpendicular to the axis and of the same diameter as the body of the specimen. Specimens were tested in the moisture noted above. They were capped with an approved compound and tested in accordance with ASTM C42, Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

**Location #1**  
South abutment 9' 6" W. of eastern most I-beam

**Location #2**  

**Location #3**  

**Location #**  

**Location #**  

**Location #**  

**Comments:** A total of two cores were collected with this group. Core (1) sheared off so an additional core (1) was taken in order to obtain a core for compressive strength. Sheared cores will be retained for additional testing if needed.

**Copies To:**  

**Reviewed by:** [Signature]
# Core Drilling Test Report

**Client Name:** D. Pennington & Associates  
**Client Address:** 6605 Uptown Blvd. N.E., Suite 240  
Albuquerque, NM 87110  
**Project Name:** Galisteo Bridge Coring  
**Project Location:** Galisteo Creek Bridge  

**Date:** 11/10/2010  
**Job No.:** 66101064  
**Authorized by:** David Pennington  
**Cored by:** Marcus De La Rosa  
**Tested by:** Marcus De La Rosa

## TEST RESULTS

<table>
<thead>
<tr>
<th>Core No.</th>
<th>9</th>
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</thead>
<tbody>
<tr>
<td>Date Drilled</td>
<td>11/3/2010</td>
</tr>
<tr>
<td>Steel Depth Encountered (inches)</td>
<td>N/A</td>
</tr>
<tr>
<td>Recovered Core (inches)</td>
<td>7.82</td>
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<td>Prepared Core (inches)</td>
<td>4.81</td>
</tr>
<tr>
<td>Maximum Aggregate Size (inches)</td>
<td>2&quot;</td>
</tr>
</tbody>
</table>

## Compressive Strength Results

<table>
<thead>
<tr>
<th>Capped Height (inches)</th>
<th>4.87</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (inches)</td>
<td>3.99</td>
</tr>
<tr>
<td>Area (sq. in.)</td>
<td>12.50</td>
</tr>
<tr>
<td>L/D Ratio</td>
<td>1.22</td>
</tr>
<tr>
<td>Correction Factor</td>
<td>0.92</td>
</tr>
<tr>
<td>Total Load (lbs.)</td>
<td>51,645</td>
</tr>
<tr>
<td>Unit Load (psi)</td>
<td>4,930</td>
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<tr>
<td>Corrected Load (psi)</td>
<td>4,540</td>
</tr>
<tr>
<td>Curing Method</td>
<td>Air</td>
</tr>
<tr>
<td>Type Fracture</td>
<td>3</td>
</tr>
<tr>
<td>Date Tested</td>
<td>11/09/10</td>
</tr>
<tr>
<td>Density (pcf)</td>
<td>143.3</td>
</tr>
</tbody>
</table>

Test specimens were removed with a diamond drill. Ends of the specimens were sawed to obtain smooth surfaces perpendicular to the axis and of the same diameter as the body of the specimen. Specimens were tested in the moisture noted above. They were cored with an approved compound and tested in accordance with ASTM C42, Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

- **Location #1:** North abutment 4" 4" W. of eastern most I-beam
- **Location #2:**
- **Location #3:**
- **Location #:**
- **Location #:**

**Comments:** One core was collected and split into two cores if additional testing is needed.

**Copies To:**  
**Reviewed by:**
Core Drilling Test Report

Client Name: D. Pennington & Associates
Client Address: 8605 Uptown Blvd. N.E., Suite 240
Albuquerque, NM 87110
Project Name: Galisteo Bridge Coring
Project Location: Galisteo Creek Bridge

Date: 11/10/2010
Job No.: 66101064
Authorized by: David Pennington
Cored by: Marcus De La Rosa
Tested by: Marcus De La Rosa

TEST RESULTS

<table>
<thead>
<tr>
<th>Core No.</th>
<th>Date Drilled</th>
<th>Steel Depth Encountered (inches)</th>
<th>Recovered Core (inches)</th>
<th>Prepared Core (inches)</th>
<th>Maximum Aggregate Size (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>11/3/2010</td>
<td>N/A</td>
<td>6.82</td>
<td>5.26</td>
<td>2&quot;</td>
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</tbody>
</table>

Compressive Strength Results

<table>
<thead>
<tr>
<th>Capped Height (inches)</th>
<th>Diameter (inches)</th>
<th>Area (sq. in.)</th>
<th>L/D Ratio</th>
<th>Correction Factor</th>
<th>Total Load (lbs.)</th>
<th>Unit Load (psi)</th>
<th>Corrected Load (psi)</th>
<th>Curing Method</th>
<th>Type Fracture</th>
<th>Date Tested</th>
<th>Density (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.46</td>
<td>3.99</td>
<td>12.50</td>
<td>1.37</td>
<td>0.95</td>
<td>72,050</td>
<td>5,760</td>
<td>5,470</td>
<td>Air</td>
<td>3</td>
<td>11/09/10</td>
<td>144.2</td>
</tr>
</tbody>
</table>

Test specimens were removed with a diamond drill. Ends of the specimens were sawed to obtain smooth surfaces perpendicular to the axis and of the same diameter as the body of the specimen. Specimens were tested in the moisture noted above. They were cored with an approved compound and tested in accordance with ASTM C42, Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

Location #1: North abutment 2’3” E. of western most I-beam
Location #2: 
Location #3: 
Location #4: 
Location #5: 
Location #6: 

Comments: Two cores were collected, one core will be held if additional testing is needed.

Copies To: 
Reviewed by: "Signature"
February 4, 2011

David Pennington
D. Pennington & Associates, Inc.
Suite 240 Uptown Boulevard N.E.
Albuquerque, NM 87110

Re: NM 41, Galisteo Bridge Substructure

Mr. Pennington:

NMDOT in conjunction with FHWA have had the opportunity to look at the cores that were extracted from the substructure of the Galisteo Bridge over NM 41. The following are the observations made by our in-house technical experts and FHWA.

From Bryce Simons, Materials Testing Engineer, NMDOT; -“Terracon got the cores delivered up here and I have had a chance to do a fairly comprehensive review of them. The conclusions that I was able to reach are as follows:

- Although there is some evidence of minor ASR and ASR gel, it does not appear to be prevalent or common. It is very probably that the cement used predated our modern Low-Alkali cements and that the alkali loading from the cement was significantly higher than that used today. This is relevant because it probably explains why the level of reaction exists. However it is also probable that all of the available alkalies have been consumed and the risk of further formation of ASR gel is unlikely. Consequently, I am now much more comfortable with the conclusions expressed in the report issued by Terracon on the cores that they did examine:

- The magnitude of the gap-gradation and the top-sized aggregate used in the mix virtually guarantees a very high shrinkage for this concrete. That would explain why Terracon had so much difficulty obtaining samples large enough to perform compressive tests. Even though the compressive strengths obtained appear to be relatively good, I would be concerned that there is a network of existing cracks through the matrix of this concrete that may impair the ability of this concrete to properly handle the stress transfer through this existing concrete. I do not know what the loading characteristics are that this concrete will have to support: however, it may be appropriate to provide additional consideration of the effects of shear loads, bending loads or lateral loads on this structure and its ability to withstand those without failure or shifting.”

From Jimmy D. Camp, P.E. NMDOT Engineering Support Division Manager; -“I had the opportunity to look at the concrete core samples taken from the NM 41 Galisteo Bridge. On the conference call we had on Dec 17th, I had expressed my suggestion of not using the existing substructure abutments and piers for these bridges. After seeing these core samples, my recommendation is not to use these abutments and piers to support a new substructure and deck. I am now changing my suggestion to a recommendation. I do not have confidence that this concrete will have the durability to provide long-term support for this bridge.

From what I saw in these cores, I am quite certain that the substructure would begin to have some major cracking and/or major concrete deterioration issues long before a new deck and superstructure would experience any deterioration or decay. It would not be good use of public funds to have a major expenditure supported by old abutments and piers of the poor quality of...
concrete that these cores indicate. Problems of the substructure units at a later date would create very big issues with the function of this bridge. Substructure problems that would cause repair/replacement issues with portions of this bridge at a later time would be cost prohibitive.

Both Thiet Nguyen and I looked at the samples yesterday. Bryce Simons and I had looked at the samples the day before.

I would hope that my recommendation be strongly considered in determining what decisions are finally made with this bridge.

From Thiet Nguyen, Ph.D. Division Bridge Engineer, FHWA; - "Jimmy and I had reviewed the sample yesterday. I concur with his recommendation; advancing the vision of FHWA’s Bridge Program to produce low-to-zero maintenance 75 to 100-year design life bridges. Please refer to the AASHTO standards.”

From Bob Meyers, P.E. NMDOT Geotechnical Section Manager; - "As a matter of practice; the NMDOT Geotechnical Design Section does not recommend spread footings to be considered in waterways for the substructure foundations of new bridges. This practice is independent of the depth of total and contraction scour that is provided the Drainage Report. This policy is based on the comments below from:

AASHTO LRFD Bridge Design Specifications, 5th edition – 2010; Section 2.6.4 Hydraulic Analysis

“A majority of bridge failures in the United States and elsewhere are the result of scour. The added cost of making a bridge less vulnerable to damage from scour is small in comparison to the total cost of a bridge failure.”

“Foundations should be designed to withstand the conditions of scour for the design flood and the check flood. In general, this will result in deep foundations.”

Should an existing structure be considered for rehabilitation for an additional 50 year service life, the NMDOT Geotechnical Design Section recommendations follow along the same line; that is not to retain the existing bridge on structure foundations consisting of spread footings; unless there are other compelling reasons for the existing substructure to remain in service.”

From Shane Kuhlman, P.E. NMDOT Bridge Engineer; - "I agree with Jimmy Camp’s recommendation and would like to provide a few comments as well. I was onsite during the coring of the existing substructure and the technicians had a hard time even getting samples that could be tested. Most of the cores that were taken fractured through weak planes in the fine aggregate during coring. The coarse aggregate used in the concrete was large rounded aggregate and provides poor interlock between the coarse aggregate. The cores also showed signs of weak cement paste bond to the coarse aggregate. On one core the technicians hit a reinforcing steel bar and when the core was removed the surface of the reinforcing steel was clean which indicates poor bonding between the concrete and reinforcing steel. All of these items would lead me to conclude that the existing substructures would not provide the desired service life required for supporting a new superstructure.”

As stated by Jimmy in his recommendation reusing the existing substructure would eventually lead to major concrete cracking and/or major concrete deterioration. Therefore placing a new superstructure on an old substructure is not the best option. This would make future
substructure repairs very difficult and expensive and could require the demolition and replacement of the new superstructure, which as stated is not a good use of public funds."

As a result of the concerns expressed by NMDOT and FHWA; I would like you to include this letter in the Final Phase B report so we can effectively document the elimination of the Galisteo Bridge Rehabilitation option for further consideration and move into Phase C; Environmental Documentation.

The following page includes concurrence signature lines from those whose testimony was used to make this decision.

Miguel Gabaldon, P.E., District Engineer, D5.

Ray Trujillo, P.E., NMDOT Bridge Engineer

Jimmy D. Camp, P.E.

Robert Meyers, P.E.

Bryce Simons, Materials Engineer

Shane Kuhlman, P.E.

Should you have any questions with regard to this issue, please do not hesitate to contact me at 505-827-1635.

Thank you,

David D. Quintana, P.E.
NMDOT Acting North Region Manager
Infrastructure Division
March 31, 2011

David Quintana, P.E.
Acting North Region Manager
NMDOT
General Office
1120 Cerrillos Rd. Rm 203
Santa Fe, NM 87504

Dear Mr. Quintana,

Please find the attached report on the field observation of the existing bridge substructure concrete coring of Bridge No. 1782. If you have any questions or need any additional information please contact me by phone at 505-827-5584 or by email at shane.kuhlman@state.nm.us.

Thanks,

Shane R. Kuhlman, P.E.
NMDOT Bridge Engineer
Bridge No. 1782 Foundation Coring Observation

Concrete cores samples were taken from the substructure of Bridge No. 1782 on Monday November 15, 2010. The bridge structure is located on NM 41 in Galisteo, NM. The bridge structure was built in 1936. The technicians taking the samples were Marcus De La Rosa and Chris Kozloski from Terracon Consultants, Inc. Coring at the abutment was observed between 8:00 am and 12:45 pm. By Shane Kuhlman from the NMDOT Bridge Design Bureau.

Figure 1: Bridge No. 1782

Figure 2: Concrete coring drill.
The coring of eight concrete core holes was observed. Out of the eight attempted core samples only three complete usable cores that were removed from the concrete remained in tact. The intact samples are shown in figures three thru six. These figures give a good visual representation of the grading of the concrete aggregates. As well as the distribution of fine aggregate and coarse aggregate present in the concrete.

Figure 3: Intact concrete core sample.

Figure 4: Intact concrete core sample example of aggregate distribution and grading.
The other five core samples taken during observation failed during coring. The coarse aggregate in the samples ranged in size with maximum observed sizes greater than four inches. Also observed during coring was the distribution of coarse aggregate in the core samples. The samples appeared to be gap graded with large size coarse aggregate and large areas of fine aggregate between the coarse aggregate. Figure seven shows two large pieces of coarse aggregate next to each other with a band of mostly fine aggregate between them.
Figure 7: Example of two pieces of large sized coarse aggregate.

Figure 8: Example of large sized rounded coarse aggregate.
The core samples appeared to fail along the interface between the fine aggregate and the coarse aggregate. The bond between the coarse aggregate and the fine aggregate appeared weak. The coarse aggregate surface on the broken samples was relatively clean and did not show signs of a strong bond between the cement paste and coarse aggregate. Visual observation of figures nine thru eleven, show diagonal failure surfaces through the fine aggregate in the cores. There does not appear to be any intersection of coarse aggregate along the failure planes. In figures ten and eleven it can be observed where the coarse aggregate separated from the fine aggregate and left clean outlines where the coarse aggregate was located. This shows the type of bonding between the cement paste and the coarse aggregate.
Figure 10: Example of failure during coring of concrete.

Figure 11: Example of failure during coring of concrete.
Also during the coring of one core sample a steel reinforcing bar was encountered and visual observation of the reinforcing bar show a relatively clean surface. The concrete did not appear to have a strong bond between the paste and reinforcing steel similar to the coarse aggregate. In figures twelve thru thirteen the reinforcing steel can be seen and there is only a small amount of residual paste on the reinforcing steel bar.

![Figure 12: Reinforcing steel bar encountered during coring.](image)

![Figure 13: Reinforcing steel bar encountered during coring and example of bond between reinforcement and concrete.](image)

![Figure 14: Example of concrete grading in the existing substructure and location of reinforcing steel.](image)
Observation of figures fifteen thru seventeen show the outline of where the reinforcing steel was located in the concrete. Based on the figures and the outline of the bar in the sample the bond between the concrete and reinforcing steel appears relatively weak.

Figure 15: Outline of reinforcing steel bar in concrete sample and visual representation of bond between concrete and reinforcing steel.

Figure 16: Example of large sized rounded coarse aggregate.
After observing the coring of the existing substructure and looking at the difficulty in obtaining intact core samples it appears that the concrete has reached the end of its service life. Typically to get a good representation of in place concrete multiple cores would need to be tested and compared to determine the concrete characteristics. When looking at the concrete in this substructure only three of eight testable cores were obtained. Therefore 66.25% of the concrete cores failed before they could be tested to determine the structural integrity of the concrete. The technicians coring the concrete also commented that they had not encountered concrete that failed like this concrete during core drilling.

Therefore based on the failure of the concrete during coring, and the age of the structure, which is approximately seventy five years old, it would appear that reusing the existing substructure to support a rehabilitated or new bridge superstructure will not provide another seventy five years of service life. Rehabilitating the existing substructure after a new, or rehabilitated superstructure are in place would be very costly and difficult. Therefore the utilization of the existing substructure would not be a prudent use of public resources for supporting a new or rehabilitated bridge superstructure.

Concur:

Shane R. Kuhlman, P.E.
NMDOT Bridge Engineer

Ray M. Trujillo, P.E.
NMDOT State Bridge Engineer
CN U500010 covers the NM 41 corridor from MP 46 at Clark Hill to MP 62.1 at the junction of US 285 in Santa Fe County (see Figure 1). Ordinarily any hazardous material assessment would cover the entire corridor but in this instance, improvements to two bridges located south of the Village of Galisteo (BR 1782 and BR 1814) will be completed first. An ISA for the entire corridor will be produced upon receipt of the final scoping report.

Recommended improvements to each bridge are presented in Pennington & Associates’ August 2010 *Condition Assessment for the Galisteo Creek and San Cristobal Arroyo Bridges* and generally include deck replacement and repairs and modifications to the super- and substructure of BR 1782 and total reconstruction of BR 1814. Significant soil disturbance is not likely to occur and no right of way acquisition or utility relocations are anticipated. The likelihood of a temporary detour route to accommodate traffic during construction of either bridge has not been reported to the EGB.

Data evaluated for this preISA include historical bridge plans, aerial photographs, the records of the National Response Center for reports of hazardous material spills or incidents along the NM 41 corridor, and local and professional familiarity with the project area. The data was reviewed in order to identify conditions that would prompt precautionary measures during construction to protect worker safety, the environment, and reduce risk to the NMDOT. With the exception of lead-based prime coat on the painted metal members, there is no obvious evidence of such conditions.

In their September 2005 *Bridge Procedures & Design Guide*, the NMDOT’s Bridge Design Bureau recommends that specific general notes and other information be included in the final plan set to alert the contractor to the presence of lead-based paint.
An excerpt from Section 6 of the Guide is attached to this memorandum as are sample general notes that could be modified for CN U500010.

Note that specification 541.3.7.6 (NMDOT, 2007) does not permit reuse of salvaged steel members coated with lead-based paint. The EGB recommends that if steel members will be removed, that the construction contractor transports them immediately to a recycling facility. The contractor should notify the recycling facility of the presence of lead-based paint.

The EGB offers these recommendations for CN U500010 within the framework of the scope described in this memorandum. If the scope of work is modified from that described, it may become prudent to update the findings and reevaluate the conclusions and recommendations.

Attachments: References, Project Vicinity Map, Excerpt from Bridge Procedures & Design Guide, Sample General Notes

CC (via e-mail): Dave Pennington, D. Pennington & Associates, Inc.
Christina Kelso, NMDOT Human & Natural Resources
Blake Roxlau, Cultural Resources Bureau
REFERENCES


NMDOT, 2005b, December 22, Environmental Geology Bureau: *ISA Summary - Bridge Number 1782, NM 41, Galisteo, Santa Fe County, New Mexico PN: BR-0041(11)56, CN: D5016*

NMDOT, 2007, State Construction Bureau: *Standard Specifications for Highway and Bridge Construction*

Pennington & Associates, 2010, August, *Condition Assessment for the Galisteo Creek and San Cristobal Arroyo Bridges NM 41 Clark Hill to US 285 (MP 46.1 to MP 62.1) Santa Fe County, New Mexico Project No. TPA-1502(20)46, CN U500010*

USEPA, 2005, November 1, *40 CFR Part 312 Standards and Practices for All Appropriate Inquiries; Final Rule*

USGS, 1966, *7 ½ minute Quadrangle Map for Galisteo, NM*
6.3 DESIGN ECONOMY
Recent experience has shown that, for steel design, economy is achieved not necessarily through conserving material but by designing to limit the fabrication effort that is needed as well. For this reason, plate girder designs that eliminate both longitudinal and intermediate stiffeners and limit the number of welded flange splices to an absolute minimum are preferred.

6.4 RECOATING STEEL ELEMENTS ON EXISTING BRIDGES
Prior to 1986 structural steel elements on NMDOT bridges were painted with a system which included a lead based primer. If adequate precautions are not observed, removal of this paint can cause severe health problems for workers. Additionally, the paint residue is harmful to most organisms if introduced into the environment. It must therefore be collected and disposed of in a safe manner. This is both problematic and expensive.

For these reasons, NMDOT recoating specifications (Section 546 of The Standard Specifications For Highway And Bridge Construction) utilizes a procedure where by only non-adherent paint is removed. Adherent paint is left in place and encapsulated by the new coating system. Proper application of this system requires that certain items be included in the plans for bridges that are to be recoated. These items are outlined in the following section.

6.4.1 Plan Requirements for Bridges To Be Recoated
For bridges that are to be recoated the following items need to be included in the plans:

1. In the general Notes, include a note stating that the work of recoating is to be done and identifying the elements that are to be recoated. The areas, if any, which are to be cleaned to SSPC-SP3 and SSPC-SP11 requirements and for which payment is to be included in the lump sum price for “Recoating Bridges” need to be identified in the note.

2. Include the lump sum pay item “Recoating Bridges” in the listing of estimated Quantities.

3. Include pay items and quantity estimates for areas to be cleaned to SSPC-SP3 and SSPC-SP11 requirements. These are areas additional to those identified in item 1.

4. Include the lump sum pay item “Safety and Environmental Requirements” in the listing of estimated quantities.

5. If the existing paint system is lead based, include a general note informing the contractor that this is the case.

Automatically include the note discussed in Item 5 above for all bridges built prior to 1986. For bridges built between 1986 and 1990 the designer will have to ascertain whether or not the paint contains lead by researching as-built plans, or if this fails, arranging to have the paint analyzed in a laboratory. Lead based paint was definitely not used on bridges built after 1990.
Sample General Notes pertaining to lead-based paint.

LEAD BASED PAINT ABATEMENT PRIOR TO BRIDGE DEMOLITION

THE CONTRACTOR SHALL EMPLOY THE SERVICES OF A QUALIFIED LEAD BASED PAINT ABATEMENT FIRM. WORKING IN COORDINATION WITH THE BRIDGE DEMOLITION TEAM, THE ABATEMENT CONTRACTOR SHOULD REMOVE ONLY THAT PAINT AND PRIME COAT REQUIRED TO SAFELY DISMANTLE THE STRUCTURE IN ACCORDANCE WITH SPECIFICATION 547.3. THE BRIDGE MEMBERS SHALL BE DISPOSED OF IN ACCORDANCE WITH SPECIFICATION 541.3.7.6. THE CONTRACTOR MUST COMPLY WITH ALL TRIBAL, STATE, LOCAL, AND FEDERAL ENVIRONMENTAL REGULATIONS AT ALL TIMES.

REPAINTING BRIDGES WITH LEAD BASED PAINT

THE CONTRACTOR SHALL FOLLOW ALL CONSTRUCTION REQUIREMENTS DETAILED IN SPECIFICATION 547.3.2 (ENVIRONMENTAL REQUIREMENTS) TO INCLUDE WASTE CONTAINMENT, COLLECTION, DISPOSAL, AIR QUALITY & SOIL CONTAMINATION, AND SUBMITTALS & CERTIFICATIONS. THE CONTRACTOR MUST COMPLY WITH ALL TRIBAL, STATE, LOCAL, AND FEDERAL ENVIRONMENTAL REGULATIONS AT ALL TIMES.