San Juan County Four Corners Freight Rail Project

Task 3.2 Investment Options

Feasibility Study

San Juan County, New Mexico

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I. SUBTASK 3.1: ROUTE OPTIONS SCREENING AND EVALUATION MEMORANDUM

OVERVIEW

This Investment Options Final Subtask Memorandum is an overview of the process that was used to develop the investment options for each route option.

This subtask builds off the Task 3.1 Route Options Analysis. Task 3.1 developed the following six route options, which were described in the Task 3.1:

- Defiance
- Gallup
- Thoreau
- El Segundo
- Star Lake
- East-West Connector

The investment options included in this submittal are:

1. Updates to the alignments and profiles for the Defiance and El Segundo Route options and revised plan and profile drawings updated with grading footprints for each of the six options.
2. Preliminary typical sections and cross sections based on the alignments and profiles developed as part of Task 3.1
3. Plan and profile drawing for a typical cattle underpass
4. Pan and profile drawing for a typical grade separation
5. Concept layout for the northern terminal near the Navajo Agricultural Products Industry (NAPI) headquarters and Operations and Maintenance (O&M) facility.
6. Plan and profile drawing for the spur connection to the town of Farmington
7. Plan and profile drawing for the spur connection to the Navajo Mine Railroad
8. Key map
9. Schematic drawings for each route option

Each of the above listed investment options is illustrated with drawings in the appendices. The numbering, above, corresponds to the numbering of the appendices.

Alignments and profiles were previously submitted as part of Subtask 3.1. As part of this Subtask 3.2, investment options that would apply to all alignments have been developed to identify key infrastructure elements, such as yards, spur tracks, connection location to existing railroads, and grade separations. It is important to note most of the corridor between Gallup and the Four Corners region is located in relatively flat terrain meaning that differences in earthwork (e.g., cuts and fills) will not be a significant factor in locating many of the investment options. As a result, many of the investment options have been developed as “typical” plans, suitable for nearly any location along any of the routes. These “typical” investment options include a roadway-over-railroad grade separation and cattle underpass.

For example, on relatively flat terrain characteristic of the majority of the route options, there will be an insignificant difference in relative cost and feasibility of locating a cattle underpass in one location compared to a different location a few miles away. Instead, drainage culverts, which are both comparatively inexpensive and can be located nearly anywhere, appear to suffice for conveying water from one side of the embankment to another. For the same reasons of relatively flat terrain and no major perennial streams or rivers, railroad bridges are not included in this Investment Options analysis and, at this stage, it is assumed that fills, possibly with culverts at the bottom, will suffice. Areas of particularly tall fills will be investigated in Subtasks 3.3 and 4.4 to determine whether alignment or profile refinements can reduce the amount of fill.

Conversely, several investment options are site-specific. These include the location and configuration of the northern terminal and yard, near Farmington, New Mexico, the spur track descending the bluff into the valley in which Farmington is located, and the connection to the Navajo Mine Railroad.

Siding locations have not been established since the operational modeling that would support siding locations is included in Task 4 and is itself contingent upon commencement of additional design work in Task 4. As with many of the other investment options, the terrain for each route option would allow sidings to be located nearly anywhere, with relatively similar costs and topographic considerations at all candidate locations. Thus, siding locations are not a dispositive factor in route option selection.

As noted in both the Project Management Plan and Task 3 Methodology, this Task 3.2 is to be supported by work completed in Task 4. Thus, Task 3.2 includes preliminary modifications to alignments and profiles, as well as preliminary cross sections, which will be further refined in Task 4.

DATA GATHERING AND INVESTMENT OPTION DEVELOPMENT

Data Gathering and Right of Way Considerations:

Data for the investment options analysis consisted of the aerial imagery and digital terrain model (DTM) from the United States Geological Service (USGS) employed for Task 3.1. This information was used for development of the spur connections to Farmington and the Navajo Mine Railroad. Additional land ownership data was obtained through San Juan County and McKinley County. This new land ownership data provided additional information on the types of Tribal land ownership, distinguishing Off-Reservation Tribal land from Tribal Allotment land (previously, the only information available identified both of these types of land ownership in the single category, Off-Reservation Tribal land). The allotment lands have been identified on the accompanying plan and profile drawings in a cross-hatched pattern.

Allotment lands are located outside the Navajo Reservation and were historically “allotted” to tribal members, often in a checkerboard pattern of generally square cadastral sections of allotment lands interspersed among sections of other land ownership types (a cadastral section generally being 1 mile on each side). However, ownership of these lands is restricted to tribal members from the same family and is passed down from one generation to the next. As a result, land that was allotted to a single family (say, consisting of parents and their children) has, over successive generations, come to be controlled by many more members of the same family. In general, decisions over land use for allotment lands must be agreed-to by all surviving descendants of the initial allotee(s). As a result, in some extreme cases, a single allotment section may be controlled by over 400 allotees,

though most are controlled by smaller number of allotees. Thus, obtaining a right-of-way for a railroad over allotment lands can be a relatively complex issue, with many individual allotees all needing to agree in order for the railroad to traverse each section. Therefore, reducing the number of individual allotments traversed will also reduce the complexity of eventual right-of-way acquisition for a given route option. The Defiance and El Segundo Route options have been modified to minimize or eliminate the number of allotment areas they traverse (compared to their original configurations in from Task 3.1), described below.

The four other route options, Gallup, Thoreau, Star Lake, and East-West Connector, all traverse large blocks of contiguous allotment areas, with no way to significantly reduce the number of individual allotments traversed. As a result, these four route options have not been modified. While crossing allotment lands does not render these four route options infeasible, it does imply that right-of-way acquisition would be more complex.

Investment Option Development:

Descriptions of each investment option follow; conceptual plan sheets are included in the appendices. (The appendix numbers correspond to the numbers below).

1. *Updates to the alignments and profiles for the Defiance and El Segundo Route options and revised plan and profile drawings updated with grading footprints for each of the six options.* For all six route options, a preliminary grading footprint area has been identified (based on the footprints established in the cross sections, see Appendix 2) and the resulting footprint has been added to the alignment plan drawing for each route option. This footprint can be seen in "gray" outline on either side of the alignment centerline.

   In addition, updates were made to the alignments and profiles of the Defiance and El Segundo Route options. These updates consisted of short realignments to avoid Allotment lands, the location of which only became available during this Task 3.2. These updates also increased the distance between the alignments and existing developments (i.e., residences, schools, etc.). With this new information, the number of allotments traversed by the original alignments were identified and new alignments developed to reduce the number of allotments traversed. These updates will be revisited as part of Task 4, when conceptual and early preliminary engineering will occur.
   a. For the Defiance Route option, the modifications occurred at the south end of the alignment, in the vicinity of engineering stations (sta.). 0+00 to sta. 800+00. The original Defiance Route option from Task 3.1 traversed four different allotments. The revised Defiance Route option traverses only one allotment. Maximum curvature and gradients were maintained so that the revised alignment does not present any new operational challenges. The Defiance Route option was also modified between sta. 200+00 and sta. 1900+00 to more closely follow Indian Service Route 9 (a roadway) increase the distance between the railway and the Tohachi chapter of the Navajo Nation (which includes residences, businesses, and schools) located near U.S. Highway 491 (US-491).
   b. For the El Segundo Route option, modifications occurred near the middle of the alignment, in the vicinity of sta. 0+00 to 1600+00. The original El Segundo Route option from Task 3.1 traversed 18 different allotments. The revised El Segundo Route option traverses five allotments. Maximum curvature and gradients were maintained so that the revised alignment does not present any new operational challenges.

2. *Preliminary typical sections and cross sections based on the alignments and profiles* developed as part of Task 3.1. The typical sections were developed based upon relatively shallow side slopes, 3H:1V (three units horizontal to one vertical). While 2H:1V side slopes are often used for freight railways, some of the

terrain in the Four Corners area is believed to have clay content. Thus, a slightly more conservative side slope has been assumed for this initial effort based on engineering judgment and observation of the slopes used for existing infrastructure. If more detailed geotechnical information becomes available, for example, during Task 4, these side slopes can be further refined. The top of the subgrade is assumed to extend 15' to each side of track centerline, with top of subballast extending 13' to each side of centerline, which is typical of main line practice. Geotechnical analysis at later stages of the project could confirm or modify these assumptions. Where a siding may be added, the siding is assumed to be placed on 15' centers to the main track. Track drainage has been assumed to be contained within eight-feet-wide flat bottom ditches on each side of the rail corridor, which also is assumed to be conservative. At this early stage, no hydrology or hydraulics are available to refine ditch sizes.

Typical sections for yards and tunnels were also developed. The yard typical section is assumed to support a wider (20') track spacing, to allow car inspectors crews access between tracks. Where there are too many parallel tracks to support sheet flow of drainage off the subballast, underdrains may be required to support drainage. The typical section for a yard is suitable for any number of tracks, though, as noted in the typical section drawing, only three tracks have been shown.

Based on the preliminary cross sections, no retaining walls are currently anticipated. At this time, the only major structure is the tunnel on the Thoreau Route option (as noted on the plan and profile).

Only the Thoreau Route option employs a tunnel. The typical section for a tunnel is based on 10' side clearance in order to allow for a sufficient width drainage structure (an underdrain is shown, but an open channel may also be possible). The crown of the tunnel curves inward from the springline (base of the inward curving tunnel roof, at the junction with the vertical tunnel walls) at a constant 10' radius, which results in 24' clearance above top-of-rail, which exceeds the 23'-6" minimum used by BNSF Railway and would provide sufficient clearance for any anticipated traffic. Since geotechnical and hydrogeologic conditions are unknown, tunnel clearances may be adjusted to allow for structural linings, insulation, and revised widths for drainage systems.

The preliminary cross sections for all route options were developed based on these typical sections. However, due to the preliminary nature of this phase of work, earthwork quantities have not been balanced nor has there been troubleshooting of short segments that returned errors in the digital terrain model. These activities will need to be re-done as alignments are refined in Task 3.3 and Task 4 and thus, to avoid unnecessary re-work, they are not part of Task 3.2 (and, as noted in the approved Methodology Work Product covering Task 3.2, these design elements will be further investigated in by Task 4).

3. *Plan and profile drawing for a typical cattle underpass.* Since there are several cattle grazing areas and public outreach has identified the possibility that individual tribal members hold grazing permits, a plan and profile drawing has been developed for a "typical" cattle underpass. This concept assumes level terrain and that a standard precast concrete box, large enough for both cattle and light duty vehicles (e.g., pickup trucks), with the floor of the box level with existing ground, would be used for the cattle underpass itself. The concept identifies the approximate length of railway embankment that would be needed to climb over the underpass at an 0.5 percent grade. Since exact locations of grazing areas are not known, this "typical" design is assumed to be suitable for any area that becomes known and also confirms that such cattle underpasses are both feasible and easily implemented as needed. As a side note, based on current information, grazing permits are not available electronically and are only available in paper form at each Tribal chapter or agency. Because of the significant fieldwork and research effort needed to identify grazing permit areas, this information will not be available as part of this study. Instead, the typical cattle undercrossing is assumed to be sufficient to allow cattle to cross the proposed railway embankment and maintain connections within any affected grazing area. As part of the cost estimating

effort in Task 4, an assumed interval between cattle underpasses will be determined and the number of underpasses identified for each route option.

4. *Plan and profile drawing for a typical grade separation.* A typical grade separation based on precast concrete arch elements has been developed to support roadways over the railroad. Because roadways can accommodate much steeper grades that railways, the typical grade separation assumes the roadway is elevated over the railroad. As with the cattle underpass, given the flat terrain that all the route options traverse, this "typical" design would be suitable for most locations. This typical design provides sufficient information and basis of quantities for the initial cost estimating effort to be conducted in Task 4.

   Because the Four Corners region is rural, most roadways are low volume roads. Similarly, the proposed railroad would also have comparatively few trains -- a maximum of approximately 4-6 trains per day. As a result, relatively few grade separations are expected to be required. The requirement for and final locations of any grade separations will be dependent upon the results of field diagnostic meetings and input from the roadway authorities. The Navajo Division of Transportation, the roadway authority for roadways on the Navajo Nation, would also be involved in the decision process for the need for grade separations. However, for this Subtask, it has been assumed that grade separations would be needed at the crossings of the major highways in the area, State Route 264 (near Gallup), US- 491 which is generally parallel to the Defiance Route option, and State Route 371, which is generally parallel to the Thoreau Route option.

5. *Concept layout for the northern terminal near the Navajo Agricultural Products Industry (NAPI) headquarters and Operations and Maintenance (O&M) facility.* The northern terminus of the railroad is anticipated to be near the NAPI headquarters on property outside the boundaries of the Navajo Reservation, but on land controlled by the Tribe. (Note that NAPI is itself an enterprise developed by and operated for the benefit of Navajo Nation.) The conceptual location and configuration of the facility were reviewed with NAPI; NAPI identified no conflicts between this initial concept and their plans for future expansion.

   The concept for the terminal facility assumes that it will handle unit trains for NAPI (and potentially for other bulk commodities) as well as manifest traffic. The northern terminal is also assumed to be the base of operations and include servicing facilities for locomotives and car repair. Key elements of the terminal facility include (all lengths are clear lengths, and at this early stage of development all tracks reassumed to be on 20' centers to allow for inspection equipment to operate between any tracks):
   a. Storage tracks for up to three unit trains of up to 13,000' length. Note that most trains of agricultural products (e.g., covered hoppers for grains) are 125 cars or less, and are thus less than 9,000' long, including motive power. Approximately 13,000' long tracks are more than adequate length and confirm the feasibility, and also allow for longer trains in the future. Fertilizer is expected to be shipped in trains of similar length, or handled in manifest trains, due to the relatively low volumes. These storage tracks are not expected to stage coal trains, which instead would stage on tracks at the coal mine. Based on the freight demand forecast, if all non-coal traffic were to move in unit trains, the volume would equate to approximately one to two trains per week. Thus, three staging tracks would be sufficient.
   b. Manifest yard storage tracks of 3,000' length each. These provide track capacity for switching cars into blocks as well as storage for manifest cars. The length of these tracks is coordinated with the two transload tracks so that each manifest storage track is capable of chambering at least one full transload track worth of cars (plus additional headroom for spare cars, if needed). These tracks have been located such that there is headroom for switching on either end.
   c. Two transload tracks of at least 2,000' length. These tracks provide a location for development of a paved (with road rock or asphalt) driving and laydown area for truck-to-rail transload of

breakbulk materials (e.g., structural steel, drill string, lumber, etc.) that would typically travel on open-top cars and be handled with forklifts, cranes, or end loaders.

d. A maintenance shop facility for locomotives and cars with two tracks. This facility would include storage for cars and locomotives awaiting repairs or parts, an area for locomotive fueling, and storage for maintenance-of-way equipment, such as tampers, regulators, and ballast hopper cars.
e. A "Runner" track for through movements within the facility and an Arrival and Departure (R&D) track that can be used to receive inbound trains or inspect outbound manifest trains (unit trains would be inspected on the unit train staging tracks). Together, these two tracks also provide an area for run-around movements (i.e., to move locomotives from one end of a train or group of cars to the other).
f. A loop track with loading/unloading facility. As is typical for unit train operations, this loop track would be used for loading or unloading of unit trains (e.g., outbound grain or inbound fertilizer). It could also be used to turn locomotives or cars if the need arises.

The terminal facility is proposed to be located in an area that would allow for relatively easy expansion, if the need arises It has also been configured to maintain a ¼ mile distance from homes in order to reduce noise and vibration, which is the reason for the slight curve in the middle of the unit train staging tracks. The track profile at the terminal provides a "bowl" shape for the storage tracks to minimize the possibility of railcars rolling-out of the yard and also provides for a maximum 0.3 percent grade within the terminal. Since the site is on a plateau, the main line grade entering (or exiting) the facility at the south end of the facility steepens significantly. However, headroom on relatively flat track for switching is available on the north end of the facility at the unit train loop, if needed.

At this stage, although BNSF Railway (BNSF) has indicated that they are amenable to a connection with the proposed railway, no detailed discussions have occurred to determine preferred track configuration at the junction with the BNSF main line. As noted in the approved Methodology Work Product for Task 3.2, the content of this Task will be further supported by the work in Task 4. Since one or more route options may be eliminated in Task 3.3 or Task 4, to avoid unnecessary effort on speculative track configurations at the various possible BNSF connection locations, further development of the BNSF connection will occur in Task 4.

6. *Plan and profile drawing for the spur connection to the town of Farmington.* Although the majority of freight demand is for agricultural and energy products, which would be loaded onto trains at the northern terminal near NAPI or at a mine (via its own spur connection), respectively, a concept for a spur to or near Farmington has been developed. The spur into Farmington is geometrically challenging since Farmington sits in a river valley, while the northern terminal is located on a plateau above that valley. As a result, there is a 2 percent grade descending into the valley, and the railroad curves back on itself with curves as sharp as 6 degrees in order to descend into the valley. There are also a series of relatively deep cuts and fills, with several on the order of 100' deep. The proposed spur ends at a relatively flat agricultural area between Farmington and the adjoining town of Kirtland due to the fact that there is not a substantial amount of undeveloped flat land in Farmington itself. However, even this location between Farmington and Kirtland could impact several homesites or otherwise impede access to the local roadway network.

   Another challenge associated with the spur connection to the Farmington area is that industries are widely dispersed. Rather, some kind of truck-to-rail (or vice versa) transload operations would be necessary at the end of the rail spur near Kirtland. Conversely, re-routing the spur directly into Farmington to provide direct rail access to potential shippers could disrupt existing developed properties; based on initial discussions with San Juan County, this was determined to be undesirable.

7. *Plan and profile drawing for the spur connection to the Navajo Mine Railroad.* This spur track would branch off the proposed railroad main line at a point several miles south of the northern terminal near NAPI and extends approximately 20 miles to a connection with the Navajo Mine Railroad, an existing, isolated railroad that currently transports coal from the Navajo Mine to the Four Corners Generating Station, approximately 14 miles north of the mine.

   The connection of this spur with the proposed main line occurs about 15 miles south of the proposed northern terminal at NAPI and occurs at a similar location on four route options (Defiance, Gallup, Thoreau, and El Segundo options), since all four route options share the same (or similar) alignments as they approach NAPI from the south. The connection to these four route options is configured to allow loaded trains from the mine to proceed southward on the proposed railroad directly to a connection with the BNSF main line. Such trains would never need to enter the northern terminal near NAPI.

   Note that Star Lake Route option approaches the northern terminal at NAPI from the east, and thus the Star Lake Route option is farther from the Navajo Mine Railroad. Thus, the proposed spur connection to the Navajo Mine Railroad would be extended northward, along the alignment of the other route options, toward the northern terminal near NAPI, where the Navajo Mine Railroad would connect to the Star Lake Route option. The Key Map illustrates the relationship of these various route options to the Navajo Mine Railroad; the connection spur is shown in purple on the Key Map.

   Grades and curves on this spur connection to the Navajo Mine Railroad are relatively gentle. Grades are less than 1.5 percent and curves are 3 degrees or wider. This geometry should present no difficulty for unit train operations.

8. *Key Map.* The key map from Task 3.1 has been included to illustrate the overall geographic relationship of the various route options, as well as their relationship to the spur tracks connecting to the Navajo Mine Railroad and Farmington.

9. *Schematic drawings for each route option.* A schematic drawing for each route option is included indicating proposed curvature and proposed speeds. FRA's request for information on signal locations does not pertain to the proposed project, since the total tonnage contemplated by the Freight Demand Forecast (ranging from approximately 2 million to 9 million tons per year) could be handled by fewer than six trains per day (three each direction, assuming an average of 10,000 tons per train). There are many examples of non-signaled single-track railways that handle more than six trains per day (e.g., Spokane International, Oregon Trunk, to name only two in the Western United States), and thus we assume no wayside signal system would be required. Similarly, FRA's request for schematics of the existing designs does not pertain to this project since this is a greenfield railway and there is no existing design for any of the previously proposed route options.

EVALUATION AND RECOMMENDATIONS

Route Options Recommended to Be Removed from Further Consideration

As part of this Task 3.2, the route options were evaluated with respect to the newly obtained land ownership information. Based on the extents of the allotment areas, the southern sections of the Gallup and Thoreau Route options traverse a large number of allotment areas as they cross the southern mountain range that parallels

Interstate 40 (I-40); there appear to be no options to avoid these allotment areas. There is, in effect, a "wall" of allotments that blocks the Gallup and Thoreau Route options.

Conversely, the Defiance Route option has been modified to traverse only one allotment, while the El Segundo Route option has been modified to avoid all allotment areas. The Star Lake Route option traverses many allotments, but, as part Task 3.3 and Task 4 will be further evaluated to determine whether a path avoiding most allotments can be developed.

As such, due to the large number of allotments crossed by the Gallup and Thoreau Route options, unless other route options are subsequently found to be infeasible, it is recommended that the southern portions of the Gallup and Thoreau Route options be omitted from further consideration. Specifically, it is recommended that there be no further consideration of:

- The portion of the Gallup Route option that lie south of the East-West Connector (the East-West Connector Route option crosses the Gallup Route option at approximately sta. 1700+00 on the Gallup option)
- The portion of the Thoreau Route option that lies south of the East-West Connector (the East-West Connector Route option crosses the Thoreau Route option, also at approximately sta. 1700+00 on the Thoreau option). This would also remove from further consideration the portion of the Thoreau Route option that passes through a long tunnel.

The East-West Connector Route option plan and profile shows the approximate junction points of the Gallup and Thoreau Route options with the other route options.

Northern Terminal Near NAPI

Several possible terminal areas were considered for the northern terminal. Locations along the San Juan River Valley (in which Farmington is located) were deemed infeasible for a large rail terminal due to the lack of undeveloped land; any development of a rail terminal large enough to handle unit trains in this area would displace or disrupt many farms, businesses, residences, and other development. In addition, the main source of non-coal rail traffic is anticipated to be NAPI itself; thus, a terminal near NAPI is logical.

Conversations were held with NAPI about the conceptual terminal location identified in the accompanying plan. NAPI's initial response was that this location would be acceptable. Other potential locations would interfere with NAPI agricultural operations. As such, the currently proposed terminal location is recommended for further consideration.

Spur Connections to Farmington and Navajo Mine Railroad

These two spur connections appear to be technically feasible and are recommended for further consideration.

Typical Sections, Typical Cattle Underpass, and Typical Grade Separation

Each of these is technically feasible and has precedent on other main line railroads. These are recommended for inclusion where appropriate as design development progresses further.

APPENDICES

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