



San Juan County Four Corners Freight Rail Project

Feasibility Study

Task 3.1 Route Options Analysis Final Subtask
Work Product

San Juan County, New Mexico
November 15, 2023



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I. SUBTASK 3.1: ROUTE OPTIONS SCREENING AND EVALUATION MEMORANDUM

OVERVIEW

This Route Options Screening and Design Memorandum is an overview of the process that was used to develop the initial route options.

This subtask builds off the Task 2 Freight Demand Forecast to identify Route Options that are conducive to carrying the anticipated freight traffic. Based on the Freight Demand Forecast, most traffic is anticipated to primarily consist of bulk commodities, such as grains, fertilizers, and energy products, with smaller quantities of manifest traffic.

The conceptual geometry for Route Options developed during previous studies has been re-created and assessed based on consistency with anticipated operational requirements as determined in the Freight Demand Forecast Report and consistent with the Preliminary Purpose and Need. Similarly, new Route Options have been developed based on desktop analysis, input from the County and Stakeholders, and assessed for consistency with the anticipated operational requirements.

This process resulted in six route options to be considered either for further study or elimination from further consideration. The six route options are named as follows:

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

These six route options will be described in more detail in the sections below. At this initial stage, all six Route Options evaluated are consistent with the anticipated operational requirements that will be carried forward for further analysis and refinement in subsequent subtasks 3.2 Investment Options Analysis (which will refine specific portions of the options, such as terminal facilities, grade separations, and major spur tracks) and 3.3 Design Options Analysis (which will further refine the Route Options). Work developed in Task 3 will be the basis for subsequent analysis in Task 4, including operations analysis, preliminary engineering, and cost estimates for the selected routes, as well as subsequent environmental review as part of Task 5 and an Economic Feasibility Analysis in Task 6.

DATA GATHERING

The team reviewed several prior studies (listed below) for information regarding the various routes that have been previously considered. The following studies were considered as part of the Route Options screening and evaluation:

- “Economic Review for a Railroad Serving San Juan County New Mexico”, JL Industries (1983). The route illustrated in this study was a hand-drawn line on a photocopy of a road map of the area, which appeared to mimic the Star Lake Route. However, the graphic was so devoid of detail that the Project Team deemed it not useful other than to identify approximate endpoints.
- “Economic Feasibility Study for Construction of the Proposed San Juan Railroad – Market Analysis”, Freight Services Incorporated and Resource Data International (1991). The route shown in this 1991 market study appears to be somewhat similar to the Defiance Route contemplated in the current study, leaving the BNSF Railway (BNSF) Defiance Spur and proceeding northward towards Farmington, New Mexico. However, it is difficult to determine from the graphics in the 1991 study whether this route follows the U.S. Highway 491 (US-491) Corridor and, if so, how close the 1991 route might be to US-491 Corridor.
- “Feasibility and Alignment Study for the Northern Extension to the Star Lake Railroad”, Freight Services Incorporated (1998). As with the other prior studies, existing mapping for this route was vague, consisting of a line printed on a road map at roughly 1” = 50,000’ scale. This route started on the existing El Segundo Mine Spur and extended northeast along New Mexico State Highway 509 towards U.S. Highway 550 and then north toward Bloomfield (just east of Farmington).
- “Farmington-Thoreau Railroad Study, August 21, 2015, Final Report”, New Mexico Institute of Mining & Technology and Navajo Nation Bureau of Economic Development (2015). This study included an overall map, contour maps of key segments, and an alignment and profile that, unlike the prior studies, accounted for existing ground contours. The Thoreau Route contemplated in the current study is based on this 2015 report.

Maps of the routes considered by each of these previous studies are attached, as Appendix 1. Note that two of the studies focused on the Star Lake Route. As a result, these four studies (noted above) only evaluated three routes (Defiance, Star Lake, and Thoreau) of the six routes considered in this Subtask 3.1, the Defiance route, the El Segundo route, and the Star Lake route.

Data gathering included collecting aerial imagery and digital terrain model (DTM) from the United States Geological Service (USGS) and preliminary land ownership data and environmental resource data from publicly available Geographic Information System (GIS) data sets. This data provided the baseline for developing proposed alignments and profiles for the six route options, described below.

HIGH-LEVEL SCREENING PROCESS

The high-level screening process began by reviewing the freight demand forecast, establishing basic railway geometric criteria, evaluating the three routes previously studied using current aerial imagery and DTMs, developing conceptual designs based on those three previously studied routes, and developing conceptual designs based on three additional routes.

General Operational Requirements from Freight Demand Forecast

The freight demand forecast (Subtask 2.3) indicates that the majority of the freight traffic is classified as bulk or manifest, and are chiefly lower-value commodities (such as agricultural and energy products). Such traffic often operates in unit trains and, due to its lower value, is generally only modestly time sensitive. Intermodal traffic, such as shipping containers filled with relatively higher value goods (e.g., consumer goods), is not anticipated on

the proposed rail line. Since the proposed rail line is approximately 100 miles in length (depending upon route option considered), there would be little benefit to designing a “high speed” railroad with shallow grades and broad curves. For example, the rail travel time over 100 miles at 40 miles per hour (MPH) would be 2.5 hours, while the travel time over the same 100 miles at 60 MPH would be 1.67 hours. The 50 minute difference in travel time would not be significant in the context of an overall rail trip that lasts several days between origin and destination (for example, between an origin in California and the Farmington area, or between an origin along the Gulf Coast and the Farmington area).

Railroad Geometrics

The railroad geometry was based on recommended practices contained in the American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering (MRE). Curvature is limited to approximately 5 degrees and grades limited to approximately 1.8 percent on most of the route options. This provides for 35 miles per hour (MPH) operation at the sharpest curves with 4.5 inches of total elevation (e.g., 2.5 inches of superelevation and 2 inches of underbalance), which is typical of mountainous freight railroads and is also similar to the mountainous sections along the BNSF Lee Ranch Subdivision (the connection to the existing El Segundo Mine Spur) to which many of the options would connect. These curves and grades are also similar to those found along the BNSF main line west of Gallup, New Mexico based on a review of Google imagery and topography. However, a major exception is a somewhat steeper grade, nearly 2.2 percent, which appears to be necessary on the Defiance Route option due to existing topography and residential development which constrain the possible alignment locations near Gallup, as well as a 2.0 percent grade ascending towards Navajo Agricultural Products Industry (NAPI), also constrained by topography. By constraining the alignment, the circuitry of the route is limited, thereby limiting ability to increase the length of the alignment (e.g., by looping back upon itself to gain elevation) in order to reduce the grade. Grades of up to 2.0 percent appear necessary on the Star Lake and Thoreau Route options. Note that the El Segundo, Gallup, and East-West Connector Routes maintain grades of 1.8 percent or less. As part of Subtask 3.3, it may be possible to further refine the alignments and profiles in order to further reduce the grades. And, as part of the Task 4 operating analysis and conceptual and preliminary engineering, further refinements may be possible.

As noted, the existing El Segundo Mine Spur on BNSF’s Lee Ranch Subdivision has ruling grades of approximately 1.9 percent northbound and 1.5 percent southbound. Since both the El Segundo and Star Lake routes rely on this existing mine spur as a connection to the BNSF main line, any train capable of climbing the grades (i.e., with similar horsepower to ton ratio or power make-up) on the existing mine spur would also be capable of climbing the grades on the proposed railroad. Similarly, any train with sufficient power to maintain the 60 MPH track speed (typical of bulk and manifest trains) on the BNSF’s main line ruling grades (approximately 1.5 percent against westbound trains leaving Gallup and approximately 1.2 percent against eastbound trains leaving Gallup) would also likely have sufficient power to climb a 1.8 to 2.0 percent grade on the proposed Route Options, albeit at a slower speed. The steepest grade on the Defiance Route option, 2.2 percent, may deserve further scrutiny as part of Subtask 3.3. However, even if trains are forced to reduce speed in order to ascend the grades on the proposed railroad, the shortened length of the proposed railroad and relatively low anticipated traffic density means that a section of slow operations (say, 15-20 MPH while climbing a steep grade) would not likely be an operational hinderance or adversely affect the practical capacity of the line.

At this time, the focus has been on identifying feasible route options and no attempt has been made to balance or optimize earthwork. As a result, at this early stage, there are significant cuts and fills on various route options. The maximum cut depth for a long cut has been assumed to be approximately 100 feet before a tunnel would be

necessary although short sections of deeper cuts are assumed to be acceptable (in order to avoid the relatively high cost of a short tunnel).

Since two of the previously studied route options consisted of only lines drawn on maps, effectively “sketches,” those two route options, the Star Lake Route and Defiance Route, required substantial modification in order to develop actual alignments and profiles for the current study. The 2015 Thoreau Route was relatively well developed and so parts of the Thoreau Route were recreated, while other parts of the Thoreau Route were adjusted (such as the portion in the tunnel). The remaining three routes, the Gallup, El Segundo, and East-West Connector Routes, were created specifically for this study with the intention that they would avoid corridors that had previously been studied. In so doing, even more new options became available for consideration.

Endpoints and Connection to the National Freight Rail Network

The northern endpoint of the proposed railroad near Farmington, and near the NAPI headquarters, was selected since NAPI would be a major shipper, and there appears to be the possibility of transload traffic in the Farmington area. Additionally, the subsequent analyses in Task 3 – the investment options analysis (in Subtask 3.2) and design options analysis (in Subtask 3.3) – will evaluate connections to other potential traffic sources, including both the Navajo Mine Railroad and into the Farmington valley.

At the southern endpoint, the portion of the BNSF main line extending between Gallup and Prewitt, New Mexico, is the nearest common carrier railway to the Four Corners/Farmington region. The BNSF main line is approximately 90 miles away (measured as straight-line distance) and is separated from the Four Corners/Farmington region by an east-west trending, low mountain range that is just north of both Interstate 40 and the existing BNSF main line (the BNSF main line effectively parallels the southern base of this mountain range). As such, this section of the BNSF Railway has been selected as the connection to the national freight rail network.

The next closest possible connection to the national freight rail network, the Colorado Pacific Rio Grande Railroad in Antonito, Colorado, is separated from the Four Corners region by over 120 straight-line miles and several mountain ranges, the passes through which exceed 10,000 feet in elevation. The Union Pacific Railroad (UP), at Montrose, Colorado, is also approximately 120 straight-line miles away, but is separated from the Four Corners region by mountain passes exceeding 8,000 feet in elevation and national forest lands. Similarly, the existing railway line at Albuquerque is over 130 straight-line miles away from the Four Corners region and is also separated from the Four Corners area by mountain passes. Any of these connection points would require substantial circuitry to either avoid the mountain ranges or gain sufficient elevation to cross the mountain ranges, thereby adding many additional route miles to the straight-line distances. By simple inspection, it would be impractical to construct a new railway over any of this rugged terrain when other options (specifically, the BNSF in the vicinity of Gallup and Prewitt) are available immediately south of the Four Corners region, over much gentler terrain.

At the southern end of the proposed railroad, there are relatively few locations where the proposed rail line could connect with BNSF. These potential connection locations are constrained by the aforementioned east-west trending low mountain range that is just north of the existing BNSF main line (the BNSF main line effectively parallels the southern base of this mountain range), with a limited number of passes through that mountain range suitable for a railroad:

- One pass is located in the western part of the study area used for the Defiance Route option;
- Another pass is located east of Gallup, used by the Gallup Route option;
- Another pass is located near the center of the study area near Thoreau, used by the Thoreau Route option; and,

- Another pass is located near Prewitt (used by the existing BNSF Lee Ranch Subdivision and El Segundo Mine Spur), used by the El Segundo and Star Lake route options.

These are the four mountain passes that were used for the route options.

General Description of Route Options

As noted above, the existing BNSF main line was constructed along the southern edge of a low mountain range that trends east-to-west. Each of the six route options for the proposed railroad i.e., Defiance, Gallup, Thoreau, El Segundo, Star Lake, and East-West Connector) must cross that mountain range to link the national rail network to the Four Corners Region via one of the aforementioned passes. Each route option satisfies the preliminary purpose and need though, as described below, the East-West Connector Route option only does so in combination with other routes.

Defiance: The Defiance Route option begins on the BNSF Defiance Subdivision, an existing spur extending northward from the BNSF main line near Gallup, which allows this option to use the existing railroad to gain elevation. Leaving the BNSF Defiance Subdivision, the grade steepens to climb over a ridge line and proceeds northward, generally following within a few miles of US-491 towards the town of Newcomb where it turns northeast, following Indian Service Route 5 towards NAPI headquarters. Recently, portions of the route near US-491 were environmentally cleared for the development of the Gallup-Navajo Water Line project. Based on conversations with community members at public meetings, there are lands covered by grazing permits along this route that may need to be avoided or minimally impacted. As noted previously, at this early stage of development, the Defiance Route option has grades of up to 2.2 percent; it is possible that these steep grades can be reduced as part of the design options analysis in Subtask 3.3.

Gallup: The Gallup Route option leaves the BNSF main line just east of the town of Gallup, following County Road 77 through a shallow canyon (also occupied by and apparently formed by a seasonal wash) to cross the ridge line north of Gallup. After crossing the ridge line, the Gallup Route option continues generally northward through mostly open territory (with few roads, mostly unimproved) until it intersects State Highway 371, which it follows northward towards NAPI Headquarters.

Thoreau: The Thoreau Route option leaves the BNSF main line at Thoreau and generally follows State Highway 371 all the way north to NAPI, passing near the town of Crownpoint *en route*. This is the route that the New Mexico Institute of Mining & Technology and Navajo Nation Bureau of Economic Development considered. The crossing of the mountain range north of Thoreau appears to require an approximately 12,000 foot long tunnel. This route option has grades of up to 2.0 percent near Thoreau (mimicking those in the 2015 Study), though it may be possible to reduce these grades with additional heavy earthwork or even the addition of another short tunnel.

El Segundo: The El Segundo Route option employs the existing BNSF Lee Ranch Subdivision (which accesses the El Segundo Mine spur) to cross the mountains north of Prewitt. From the El Segundo Mine, the El Segundo Route option proceeds northwesterly to intersect the State Highway 371 corridor north of the town of Crownpoint, New Mexico. It then proceeds northward towards NAPI, staying somewhat west of State Highway 371 and also west of the Defiance Route option, which also parallels State Highway 371.

Star Lake: The Star Lake Route option, like the El Segundo Route option, also uses the BNSF Lee Ranch Subdivision to cross the mountains north of Prewitt. It generally follows the State Highway 509 Corridor northward until it meets U.S. Highway 550 (US-550), then turns northwest, generally following US- 550 towards NAPI. The profile does include several sections of 2.0 percent grade, though it may be possible to add circuitry to further reduce the

grades in this area. Note that the 2.0 percent grade is not substantially steeper than the existing 1.9 percent grade on the BNSF El Segundo Mine Spur, to which the Star Lake Route connects.

East – West Connector: The East-West Connector Route option does not cross the east-west trending mountain range just north of the BNSF main line, nor does it connect to the Farmington area. However, it does link the Defiance Route (on the west) with the existing El Segundo Mine Spur (on the east), crossing the other five alignments, thereby allowing any of the route options crossing the mountain range to connect with any other route option extending northward. For example, it would allow the Defiance Route to connect to the El Segundo Route. This might be helpful if, for example, it becomes desirable to connect the Defiance route along US- 491 with the El Segundo Route, which could be used to cross the mountain range. Note that the East-West Connector by itself would not serve the preliminary purpose and need but would need to be constructed in conjunction with one or more other route options. The East-West Connector Route option traverses relatively flat land along the north side of the east-west trending mountain range and thus features relatively shallow grades along its entire route.

Combinations of Options: In addition to the East-West Connector, several of the options are close to each other, for example, in the area north of Crownpoint, New Mexico, the Gallup, Thoreau, and El Segundo route options are all within a few miles of each other. It would be possible to consider different combinations of route options, depending upon the construction costs, land tenure, and environmental impacts found along a given route.

Right of Way Considerations: As a “greenfield” or entirely new railway, the entire length of each route option would require obtaining new right-of-way. There are different types of land tenure along each route, including a mix of Tribal land, federal land (such as Bureau of Land Management holdings), private land, land “allotted to” tribal members, and other types of public ownership (such as public roadway crossings). At this early stage, land ownership by parcel has not been identified, though the overall boundaries of the Navajo Nation Reservation lands have been identified.

A significant portion of each route option traverses the Navajo Nation Reservation land. The boundary of the Navajo Reservation is identified on the plan and profile exhibits for each route option.

All routes traverse portions of land known as the “Checkerboard area” or “Allotment area” of landholdings, which exist around the perimeter of the Navajo Nation Reservation land. This land is shown in the plan and profile exhibits as “Tribal Land – Off Reservation”. In these Allotment areas, many sections of land (approximating a “checkerboard”) are held in trust for the Navajo Nation while other sections in the checkerboard pattern are “allotted to” Navajo tribal members. Georeferenced data that would identify the Allotment areas has been requested to better define the ownership of the various sections of the checkerboard. As this georeferenced information on the Allotment areas becomes available, the route options will be updated and refined as part of Subtask 3.3 (Design Options) and Subtask 4.4 (Conceptual and Early Preliminary Engineering) in order to account for land tenure. Based on conversations with Tribal members, right of way acquisition appears to be less complicated on Navajo Nation Reservation land.

EVALUATION PROCESS

The Route Options will be assessed at an initial, qualitative level based on the following high-level screening criteria, listed below:

- Curvature (less than 10 degrees strongly preferred, and preferably wider, with curvature of 0 to 6 degrees desired)
- Grade (less than 2 percent preferred)
- Undulation (i.e., adjacent reverse vertical curves in the railroad profile forming multiple sags and crests. Less undulation is preferred.)
- Potential to avoid topographic obstacles (e.g., large escarpments, deep valleys, etc.)
- Potential for connection to the national freight rail network
- Meets Preliminary Purpose and Need
- Land ownership information (if available from GIS sources or from stakeholders)
- Environmental constraints, such as:
 - Communities
 - Habitat
 - Waterways
 - Archeological resources
 - Cultural resources

The following table identifies whether each option meets the railroad geometric criteria established above (indicated by “Yes” or “No”), whether a given option is an outlier with respect to certain railway geometric criteria, a binary evaluation of whether the route option meets the preliminary purpose and need, and a subjective, preliminary evaluation of the land ownership and environmental constraints along each route. Where additional study is needed (e.g., as part of Task 3.3, Task 4, or Task 5), the notation “TBD” (to be determined) has been included.

Table 1: Screening of Route Options (“Yes” or “No” indicates whether a route meets geometric criteria identified above, “TBD” indicates “To Be Determined” as part of subsequent sub tasks)

Route	Defiance	Gallup	Thoreau	El Segundo	Star Lake	East-West Connector
Grade	Outlier – 2.2%	Yes	Outlier – 2.0%	Yes	Outlier – 2.0%	Yes
Curvature	Yes	Yes	Yes	Yes	Yes	Yes
Undulation	TBD in Task 4 – appears acceptable	TBD in Task 4 – appears acceptable	TBD in Task 4 – appears acceptable	TBD in Task 4 – appears acceptable	Relatively significant undulation	TBD in Task 4 – appears acceptable
Topography	Yes	Yes	Requires tunnel to avoid mountain peak	Yes	Yes	Yes
Meets Preliminary Purpose and Need	Yes	Yes	Yes	Yes	Yes	Only in conjunction with other options
Land Ownership	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Environmental Constraints	TBD in Task 5 (Follows existing US-	TBD in Task 5	TBD in Task 5 (avoids Chaco Canyon)	TBD in Task 5 (avoids Chaco Canyon)	TBD in Task 5	TBD in Task 5

Route	Defiance	Gallup	Thoreau	El Segundo	Star Lake	East-West Connector
	491 and water line corridor)					

While all routes involve highway-rail grade crossings, it would be possible to grade separate all major crossings. As a result, the number of highway-rail grade crossings would not be a defining characteristic at this stage.

- Grade, curvature, and undulation** for most route options appears to be reasonable, based upon an inspection of the proposed profiles. However, the topography along the Star Lake Route forces significant undulation in the profile. This will be further considered in Task 4, when Train Performance Calculations are performed. However, with the exception of the Star Lake Route, based on the topography of the remaining route options, areas where undulation might be a concern on the other Routes could likely be addressed during early preliminary engineering or subsequent stages of design by adjusting cut depths and fill heights in order to minimize the vertical curves.
- The Preliminary Purpose and Need** are detailed in the Subtask 2.1 Memo. A brief summary of the Purpose and Need follows:
 - Purpose:** The purpose of the Project is to construct a standard gauge freight rail line connecting the historically underserved Four Corners Region, generally located at the convergence of Colorado, New Mexico, Utah, and Arizona (and specifically San Juan County, New Mexico) to the national freight rail network via a connection to the existing BNSF Gallup Subdivision at a location in or near Gallup, New Mexico, through San Juan and McKinley County, New Mexico. The Project is partially located within the Tribal lands of the Navajo Nation. The Project will enhance the economic well-being of the Four Corners Region for future generations by enabling rail-dependent economic development opportunities for the Navajo Nation and surrounding communities, and by providing a viable freight transportation modal alternative to highway trucking for existing and future freight flows. The creation of a viable freight rail connection will also contribute to an anticipated reduction of truck miles on highways in the Four Corners Region, enhancing highway safety for underserved populations and reducing highway maintenance needs due to wear and tear caused by the trucking of heavy freight over regional highways.
 - Need:** The Four Corners Region is an historically disadvantaged and underserved area of the United States that has not been connected to the national freight railroad network for over fifty years. Freight access to the region exists via the National Highway System (US-550, US-491, and US-64), State highways (SH-371) and via privately-owned pipelines. Previous studies, including the Farmington-Thoreau Railroad Study (2015) have identified access to rail transportation as a significant requirement and a local priority for expanding and diversifying economic development in the region. Access to rail transportation would also simplify the existing multimodal supply chain and reduce highway impacts, providing additional public benefit.
 - Five options considered connect the Four Corners Region to the national freight rail network, while the sixth option, the East-West Connector Route option, is intended to meet the Preliminary Purpose and Need by allowing combinations of any route option’s proposed rail crossing of the southern mountain range (along Interstate 40) to connect with any other rail option extending northward (the East-West Connector does not, by itself, fulfil the Preliminary Purpose and Need). Note that this does not imply that, in addition to the East-West Connector, *two* route options would both be constructed the entire distance between the BNSF main line and the Four Corners Region. Rather, only the

portion of a single option would be constructed *south* of the East-West Connector and the portion of another option *north* of the East-West Connector would be constructed, the two portions being joined together by the East-West Connector.

- **Land Ownership** within the Gallup and Four Corners area is complex, with some private, fee ownership land existing in the Gallup and Farmington areas, while the entirety of the area between Gallup and Farmington comprising either the Navajo Nation Reservation, Tribal Trust land, Tribal Allotment land, state lands, or federal land. At this early stage, the only GIS information available distinguishes between Reservation Trust, State, and federal land. The boundaries and locations of Allotment lands, which are controlled by multi-generational families, are not yet available. Initial discussions between the County and the Navajo Nation indicate that the Nation is willing to consider allowing a right of way across Reservation and Trust lands. It is assumed that state and federal entities would allow construction of a railroad across lands that they control. Additional information on land ownership has been requested and will be included as part of the Early Preliminary Engineering in Task 4.
- **Environmental Constraints** will be addressed in Task 5. However, at this early stage, one major constraint is known, the Chaco Culture National Historic Park (Chaco Canyon). The alignment for each route was developed in order to avoid the Chaco Canyon. Additional environmental constraints, such as recreational resources or cultural resources, may become evident as Task 5 progresses.

EVALUATION RESULTS

Route options were evaluated against the criteria above: geometry (grade, curvature, and undulation), topography, whether they meet the Preliminary Purpose and Need, land ownership considerations, and environmental constraints. At this time, all Routes appear feasible from a geometric perspective and the geometric characteristics do not exceed those for other freight railroads. Similarly, the topography for all routes is similar to that of other freight railroads and presents no unusual obstacles, such as inordinately deep valleys, wide river crossings, or steep hillsides that would be likely to cause unusually high construction costs. All route options meet the Preliminary Purpose and Need (as noted, with the exception of the East-West Connector which would need to be constructed in conjunction with portions of two other options). The land ownership for all route options is primarily government-owned or controlled (including both tribal and federal governments) and is assumed to be available for a rail right-of-way. And, all route options avoid currently known environmental constraints.

Thus, at this stage, all six options are recommended for further study as part of Tasks 3.2 and 3.3.

APPENDICES

Appendix 1: Previous Study Maps: Maps illustrating alignments considered as part of previous studies.

Appendix 2: Plan and Profile Drawings: illustrating the following six Route Options, plus a Key Map and the BNSF Lee Ranch Subdivision:

- **Key Map** This shows the relative relationship of the various route options considered; this Key Map shows broad corridors emphasizing that the exact alignments are not yet final – additional refinement will be performed in Task 3.3-Design Options and Task 4-Project Development
- **Defiance Route Option** Plan and profile drawings of the Defiance Route Option
- **Gallup Route Option** Plan and profile drawings of the Gallup Route Option
- **Thoreau Route Option** Plan and profile drawings of the Thoreau Route Option
- **El Segundo Route Option** Plan and profile drawings of the El Segundo Route Option
- **Star Lake Route Option** Plan and profile drawings of the Star Lake Route Option
- **East-West Connector Route Option** Plan and profile drawings of the East-West Connector Route Option
- **BNSF Lee Ranch Subdivision** Plan and profile drawing of the existing BNSF mine spur (the “Lee Ranch Subdivision”) connecting the BNSF main line to the Lee Ranch and El Segundo mines. This mine spur is used as the southern terminus for the El Segundo Route Option and Star Lake Route Option.