



San Juan County Four Corners Freight Rail Project

Preliminary Alternatives Analysis Report

Feasibility Study

Revision 1

San Juan County, New Mexico

March 10, 2025

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I. OVERVIEW

This Preliminary Alternatives Analysis Report summarizes the results of Task 3 and the three subtasks, Subtask 3.1, Route Options Analysis; Subtask 3.2 Investment Options Analysis; and Subtask 3.3 Design Options Analysis. The key findings of Task 3 were outlined in Subtask 3.3. To avoid repetition in this memorandum, key elements of Subtask 3.3 (the Design Options Analysis memorandum and strip maps illustrating the five options that emerged from Task 3, as well as sub-options considered during that process) are included as Appendices to this memorandum. Similarly, key exhibits from Subtask 3.2, Investment Options Analysis, are included as Appendices to this memorandum.

The following sections and appendices summarize the six initial conceptual route options, the characteristics of the five route options that progressed for further analysis in Task 4, the major constraints for each option, and the Investment Options (yards and terminals and typical sections).

II. SUBTASK 3.1: ROUTE OPTIONS ANALYSIS SUMMARY

SUBTASK RESULTS

Subtask 3.1 evaluated six route options as to whether they met the following criteria for route selection:

- Grade, Curvature, Undulation, and Topography
 - Route should provide suitable grades and curves as well as profiles that are not undulating based on topography, allowing safe and economical operation of heavy haul freight trains without undue quantities of earthwork and while endeavoring to avoid communities.
- Preliminary Purpose And Need (brief summary)
 - 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 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: Previous studies have identified access to rail transportation is a significant requirement and a local priority for expanding and diversifying economic development in the Four Corners region, and would provide public benefit by simplifying the existing multimodal supply chain and reducing highway impacts. The lack of a direct rail connection to the national freight rail network limits the economic development potential of the Four Corners region.
- Land Ownership

- The lands within the Four Corners region is a complex mix of Private, Federal, Fee, and Tribal lands. The Tribal lands consist of Reservation, Trust, and Allotment lands.
- Outreach to members of the Navajo Nation and residents of the area traversed by the routes was conducted as part of Task 2, including several town hall meetings.
- Because there are no electronic land records for tribal lands, avoidance of communities, leaseholds, grazing permits, etc., has been based on visual observation of aerial imagery.
- Environmental Constraints
 - At the time Subtask 3.1 was developed, environmental constraints were to be addressed in Task 5, however the Chaco Culture National Historic Park (Chaco Canyon) was a known major constraint. (As part of Task 5, performed subsequent to Subtask 3.1, no major, known environmental constraints were identified along the proposed routes.)

The results of the six routes from Subtask 3.1 are summarized in Table 1. All were determined to meet the screening criteria and would continue to be studied. The East-West Connector route was developed with the intent that it could be subsequently used to connect portions of multiple routes, and was not a stand-alone route. Thus, there were 5 stand-alone routes.

A key map of the route options initially considered in Subtask 3.1 is included in the Appendices.

Table 1: Screening of Route Options From Subtask 3.1 (“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-491 and water line corridor)	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 options were evaluated against the criteria above: geometry (grade, curvature, and undulation), topography, whether then 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.

At the close of Subtask 3.1, all six route options were considered for further evaluation. Subtask 3.1 received FRA approval on January 18, 2024.

III. SUBTASK 3.2: INVESTMENT OPTIONS ANALYSIS SUMMARY

SUBTASK RESULTS

Subtask 3.2 developed the physical characteristics of the conceptual routes, such as a typical section and cross sections of the track grading, a concept for a grade separation to be used at major road crossings, and cattle underpasses for use in grazing areas. Concepts for the end of line terminal at the Navajo Agricultural Products Industry (NAPI), and optional route extensions to the Navajo Mine Railroad and into the San Juan River valley near Farmington were also developed. These extensions would allow access to areas that could be origination or termination points for the cargo the railroad would haul. Additionally, updates were made to the six route options to improve their viability and ability to meet the purpose and need of the project.

The major update to the route screening from Subtask 3.2 was the obtaining of the allotment land boundaries. Allotment lands have the potential to be controlled by multi-generational groups; obtaining a right-of-way across such properties could be challenging. Two routes, El Segundo and Defiance, had minor modifications in Subtask 3.2 to reduce allotment land impacts. The other three routes, Star Lake, Gallup, and Thoreau, were identified as having numerous allotment land impacts, and thus would require more significant modifications which were performed as part of Subtask 3.3.

The location of the northern terminus was preliminarily set to be just east of the existing NAPI headquarters in an area that has open lands, does not notably impact existing agricultural operations, and is local to a major expected shipper. The investment option of a route to Farmington extends north from the NAPI terminus, descending into the San Juan River valley west of Farmington, while the investment option of a route to connect to the Navajo Mine Railroad diverged from the route alternates approximately 14 miles south of NAPI and runs northwestward to the Navajo Coal Mine.

Subtask 3.2 received FRA approval on March 13, 2024.

IV. SUBTASK 3.3: DESIGN OPTIONS ANALYSIS SUMMARY

SUBTASK RESULTS

Subtask 3.3 was the culmination of the Task 3 tasks to prepare the initial route alternatives which addressed:

- The physical feasibility of the design
 - The routes do not encounter any unsurmountable obstacles such as wide canyons or impenetrable mountain ranges.
 - The basic design criteria for the routes allowed for “heavy haul” trains typical of North American practice, with cars weighing up to 286,000 pounds
 - The routes had a maximum curvature of 7.5 degrees, but the majority of the curves are 5 degrees or flatter
 - The routes preliminarily allowed speeds of up to 45 mph, with lower speeds required at some curves as a trade-off for economies of construction.
 - The routes included grades up to 2.0% compensated.
- The ability of the proposed design to fulfill the operational objectives and functional requirements of the specific component investment (as established in the Investment Options Analysis)
- The general constructability of the design, including consideration of potential construction phasing to allow for the continuation of operations during the construction period
- The adequacy of the design to support a future detailed site-specific environmental analysis of the component investment

This Task revised several routes to avoid allotment lands identified in Subtask 3.2. Revisions were illustrated on the plan and profile drawings as “sub-options”. The former Gallup and Thoreau routes were updated to utilize portions of the former East West Connector and thus reduce potential difficulties in obtaining rights of way across allotment lands. Reflecting the desire for route names to reflect their connection point with the BNSF, the former Gallup and Thoreau routes were renamed to “Defiance via Indian Creek” and “Defiance Via Highway 371”, respectively. The former Defiance route was renamed to “Defiance via Highway 491” for clarity. Portions of the East West Connector route were incorporated into the Defiance via Indian Creek and Defiance via Highway 371

routes, and thus the East West Connector was no longer needed as a route option. Table 2 includes a comparison of the options, their feasibility, and major constraints.

Strip maps showing track plans and profiles for each of the Design Options (and sub-options) from Subtask 3.3 are included in Appendix C. Preliminary operating speeds for each of the routes are shown on the strip maps.

A key map from Subtask 3.3 is included in the Appendices. This provides an illustration of how the route options have evolved from Subtask 3.1 to Subtask 3.3.

Table 2: Comparison of Design Options

Route	Defiance via Hwy 491	Defiance via Indian Creek	Defiance via Hwy 371	El Segundo	Star Lake
Geometry & Operations: Grade (uncompensated)	2.0% NB 1.8% SB	1.8% NB 1.8% SB	1.9% NB 1.8% SB	1.8% NB 1.5% SB	2.0% NB 1.9% SB
Geometry & Operations: Max. Curvature	5.0° (typical) 7.5° (max, 1)	5.0° (typical) 7.5° (max, 1)	5.0° (typical) 7.5° (max, 1)	4.0°	5.0° (typical) 7.5° (max, 2)
Geometry & Operations: Undulation	Minimal undulation	Minimal undulation	Some undulation near MP 87	Minimal undulation	Relatively significant undulation
Geometry and Operations: Advance Option to Task 4?	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development
Feasibility and Constructability: Potentially High Cost Constraints	~1 mile private R/W	~1 mile private R/W	~1 mile private R/W	16 miles private R/W	18 miles private R/W, ~1 mile tunnel, undulation
Feasibility and Constructability: Constraints from Existing Infrastructure	Parallels water line & power line; Hwy 264, 491, 371 crossings	Hwy 264, 491, 371 crossings	Hwy 264, 491, 371 crossings	Hwy 57, 371 (2) crossings	No identified conflicts with major infrastructure
Feasibility and Constructability: Allotments Traversed	1	1	1	5	None
Feasibility and Constructability: Advance Option to Task 4?	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development

Route	Defiance via Hwy 491	Defiance via Indian Creek	Defiance via Hwy 371	El Segundo	Star Lake
Environmental Constraints More Information on Each Route Option to Be Developed in Task 5	~1 mile or less from Twin Lakes, Naschitti, and Sheep Springs, and homesites near Hwy 264; near grazing permit areas	~1 miles to Twin Lakes and homesites near Hwy 264; near grazing permit areas	Close to homesites near Hwy 264 and ~1 mile from Twin Lakes, Standing Rock and White Rock; avoids Chaco Canyon by ~3.5 miles; near grazing permit areas	Avoids Chaco Canyon by ~3 miles; near grazing permit areas	Near grazing permit areas
Environmental Constraints: Advance Option to Task 4?	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development	Advance to Task 4, Project Development,

Subtask 3.3 concluded that the routes are constructible and that the footprints established as part of Task 3 were adequate to allow, as part of Task 5, initial environmental analysis of the design and investment options. All five options analyzed in Subtask 3.3 were advanced to subsequent analysis in Task 4.

Subtask 3.3 received FRA approval on May 15, 2024.

V. TASK 3 FINAL CONDITIONS

At the conclusion of Task 3, five preliminary route alternatives had been established. These routes all met the conditions set forth in the prior 3 subtasks. All preliminary route alternatives:

- Met the purpose and need
- Were physically feasible and suitable for operation of the intended trains
- Constructable using conventional methods
- Suitable for performing detailed, site-specific environmental analysis
- Feasible to obtain a right of way

Further, the physical nature of the routes was established with the development of the Typical Section, Highway Grade Separation, and Cattle Crossings. Investment options in the form of rail spurs to Farmington and the Navajo Mine Railroad were also developed.

As noted previously, strip maps showing the horizontal and vertical geometry of each of the five route options as well as sub-options) from Subtask 3.3 are included in the Appendices. The descriptions that follow are based on the Subtask 3.3 Design Options.

Basic Design Criteria

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) and is consistent with the route design recommendations of the International Heavy Haul Association. Curvature was limited to approximately 5 degrees or less in most areas (with most curves on each option in the range of 2 to 4 degrees). On the sharper, 5 degree curves, this provided for 35 mile per hour (MPH) operation with 4.5 inches of total elevation (e.g., 2.5 inches of superelevation and 2 inches of underbalance), while on the shallower, 2 degree curves, a combined elevation of less than 3 inches was required to obtain 45 MPH. In a few limited cases, curvature was increased up to 7.5 degrees in highly restricted areas. The maximum operating speed on tangent track and broad curves was preliminarily set at 45 MPH.

The maximum grades for the railroad were preliminarily set at a 2.0% maximum compensated grade, which allowed trains to traverse any of the route alternatives as well as maintain 50 MPH operations when traversing the BNSF routes beyond the connection of this project. However, most grades were shallower than 2.0%.

Typical sections that meet Class 1 rail standards for heavy haul railways were developed and used to establish the grading footprint of the routes. The typical section can be found in the Appendices of this document.

Route Descriptions

Defiance Routes – Common Segment

Three routes start from the Defiance, New Mexico, area, and share a common route from their start at milepost 0.0 to approximately milepost 28. The three Defiance routes originate from the BNSF at approximately BNSF milepost 7.8 of the Defiance Subdivision. The common segment turns north to parallel the east side of Defiance Draw Road. The common segment crosses NM Highway 264 with a grade separation taking the highway over the railroad. The route continues north, ascending onto the plateau and crossing into the Navajo Reservation Lands. The routes turn east, following the summit of the plateau, to milepost 12 where the route descends the face of the plateau. The plateau, which in places stands up to 300 feet higher than the valley below, is most favorable to descend in this location due to a smaller elevation differential between the plateau and valley and availability of rolling foothills to work the routes into the terrain more easily. The routes descend the face of the plateau with numerous large cuts and fills, a 2.0% compensated grade, and curves up to 7.5 degrees dictated by the contours of the land. By milepost 15, the most difficult terrain has been negotiated and the routes head generally eastward, passing north of the community of Twin Lakes until the Navajo-Gallup waterline is met near MP21.8, at which point the common segment turns to parallel the west side of this utility to approximately milepost 26.

This Common Segment of three routes was developed in Subtask 3.3 as a response to the large number of allotment land parcels that were impacted by the former Defiance, Gallup, and Thoreau routes. This revised location, near milepost 7.8, was chosen due to the fact that routes from this location are only required to traverse a single parcel of allotment land to attain the Navajo Reservation Boundary. For the Defiance Via HWY 371 and Defiance Via Indian Creek options, portions of the former East West Connector were utilized to avoid further allotment land impacts, and rejoin their former routes where they intersected the East West Connector.

A sub-option was considered starting near milepost 19 and following the west side of US HWY 491 for approximately 4 miles before crossing it and heading east to join the waterline. However, the waterline corridor was deemed desirable due to prior environmental clearance and fewer expected impacts.

Defiance Via Highway 491

Continuing from milepost 26, the Defiance Via Highway 491 route diverges from the Defiance Via Highway 371 and Defiance Via Indian Creek routes to follow the Navajo-Gallup waterline corridor. At milepost 42, the route deviates to the east approximately 1 mile due to significant residential developments near the waterline at Naschitti and Sheep Springs. The route runs approximately 1 mile to the east of HWY 491 to milepost 57, where it turns northeast to follow drainages toward Chaco Wash

Near milepost 69, the route passes under Indian Service Rte 5 via an underpass beneath the roadway, and then turns east to generally follow this road to the north until milepost 87. A major bridge will need to be constructed for the crossing of Chaco Wash at milepost 70.5. Beyond milepost 87, the route travels generally northeasterly to a grade separated crossing of NM Highway 371 near milepost 92, from which the route continues northeasterly until encountering County Road 7100, which it follows northward to the terminus point just east of the NAPI headquarters.

Defiance Routes – Defiance Via Highway 371 and Defiance Via Indian Creek Common Segment

From the divergence point with the Defiance via Highway 491 route at milepost 26, the Defiance Via Highway 371 and Defiance Via Indian Creek routes share a common segment up to approximately milepost 41. The route generally runs 2-3 miles north of Indian Service Route 9 through open lands and was originally part of the East-West Connector.

Defiance Via Highway 371

From the divergence point at approximately milepost 41, the Defiance Via Highway 371 route continues east from the Defiance via Indian Creek Route, passing north of the community of Standing Rock. Near milepost 49, the route diverges from the former East West Connector alignment and heads north along the Navajo Reservation Line boundary for 8 miles until the wall of allotment parcels terminates, allowing the route to turn northeast to join HWY 371 and the prior Thoreau alignment near milepost 63.5. HWY 371 is followed until milepost 69. While there are impacts to some allotment parcels in this area, it has been assumed that since the highway was able to be located through those parcels that a railroad could be as well.

At milepost 69, the highway heads into terrain unfavorable for a railroad, and the Defiance Via Highway 371 route diverts onto an independent routing generally following the Chaco Wash valley. Through this valley the route has been refined to skirt the hills as well as avoiding allotment parcels. Near milepost 82 the route crosses Chaco and De-nah-zin Washes and crosses the ridge to the adjacent valley containing Hunter Wash, which is crossed near milepost 86.5. The route ascends the plateau to the north, rejoining Highway 371 at milepost 88.

From this point, the route generally follows to the west side of HWY 371 until milepost 105 where the route crosses over the highway, from which the route continues northeasterly until encountering County Road 7100, which it follows northward to the terminus point just east of the NAPI headquarters.

Defiance Via Indian Creek

From milepost 41, the Defiance Via Indian Creek route turns north through generally open country with few developed areas, following a utility corridor that is observable on aerial photography. A sub-option had been considered between milepost 52 and 64 which would have routed the alignment to the east to join Indian Creek at an earlier milepost, but the current route was deemed preferable, as it is shorter, follows a disturbed corridor, and avoids duplication with other routes. At milepost 63 the route enters the Indian Creek valley. At milepost 69 the route turns east for 3 miles, following Chaco Wash to where it is crossed at milepost 72. The route then crosses the ridge to the north via an alignment that seeks to reduce gradient and earthwork, and crosses Hunter Wash near milepost 72. From Hunter Wash, the route ascends the plateau to the north, joining the west side of Highway 371 at milepost 82. From this point, the route generally follows to the west side of HWY 371 until milepost 98 where the route crosses over the highway, from which the route continues northeasterly until encountering County Road 7100, which it follows northward to the terminus point just east of the NAPI headquarters.

El Segundo and Star Lake Common Segment

The El Segundo and Star Lake routes are in common for the first 9 miles of the routes. The start point for the routes is approximately milepost 32 of BNSF's Lee Ranch Subdivision. From this point, the routes head northeast towards NM Highway 509, crossing a haul road to the El Segundo coal mine near milepost 1.5 via a rail over road grade separation. At milepost 3, the routes turn generally north and west through open country to the end of the common segment. This common segment is a revision for both of the routes that was undertaken in Subtask 3.3 to allow avoidance of allotment parcels further along each route.

El Segundo Route

From milepost 9, the El Segundo Route continues north to milepost 10, then west through open country. At milepost 24 the route begins following the Kim-me-ni-oli wash northwestward. Several Sub-Options were looked at for El Segundo. In Subtask 3.3, the route between milepost 0 and milepost 26.5 was revised due to the impacts to allotment parcels along that Sub-Option. The current route avoids allotment parcels where practical, but it approximately 5 allotment parcels are still impacted, which is fewer than the route from Subtask 3.1. A Sub-Option to reduce the impacted parcels to zero resulted in an alignment running in close proximity to Chaco Culture National Historic Park and was deemed too unfavorable due to that close proximity.

Leaving the remaining impacted allotment lands, the route crosses NM Highway 371 via a road over rail grade separation, before descending into the valley of Indian Creek, which is followed between milepost 38 to milepost 57. Between mileposts 57 and 60, the route follows Chaco Wash, which is crossed at milepost 60. The route then crosses the ridge to the north via an alignment that seeks to reduce gradient and earthwork, and crosses Hunter Wash near milepost 67. From Hunter Wash, the route ascends the plateau to the north, joining the west side of Highway 371 at milepost 71. From this point, the route generally follows to the west side of HWY 371 until milepost 86 where the route crosses over the highway, from which the route continues northeasterly until encountering County Road 7100, which it follows northward to the terminus point just east of the NAPI headquarters.

Star Lake Route

The Star Lake alternate was nearly wholly redefined from milepost 3 of the Common Segment up to milepost 71 in order to provide a route with no allotment land impacts. From milepost 9, the Star Lake route continues northward through open lands. Between mileposts 19 and 23, the route skirts the west side of a large block of allotment lands. From milepost 24 to 27, the route ascends, winding along the face of a large plateau, which is tunneled through with an approximately 3,760' long tunnel. East of the tunnel the route hugs the face of the rugged canyon walls as it descends to a crossing of the Chaco Wash near milepost 32. Past Chaco Wash, the route travels northwestward. A series of drainages which drain the hills to the east into Chaco Wash must be negotiated between mileposts 40 and 49. In order to keep a buffer from Chaco Culture Historic Park, and due to the location of some allotment parcels in this area, the sawtooth nature of the land is encountered head on, resulting in an undulating profile. Significant earthwork is used to keep the profile grades within desired tolerances, as opposed to hugging the hilly terrain and venturing into allotment parcels.

Beyond milepost 49, the terrain is more straightforward, and the route ascends onto a plateau at milepost 53, continuing through open country in a northward direction. Between mileposts 72 and 75, the route travels on the west side of US Highway 550. Turning west, the route skirts agricultural lands as it descends to a crossing of Gallegos Wash near milepost 86.5. From this point, the route heads west to Road 7100, then north to the northern terminal at NAPI, ascending the entire distance.

VI. Appendices

Appendix A –Route Key Maps from Subtask 3.1 and Subtask 3.3

Appendix B –Subtask 3.3 Design Options Memorandum Summarizing Route Characteristics

Appendix C –Route Strip Maps from Subtask 3.3

Appendix D –Typical Sections from Subtask 3.2

Appendix E –Northern Terminal Layout from Subtask 3.2