San Juan County Four Corners Freight Rail Project

Subtask 4.2 Operations Analysis

Feasibility Study

San Juan County, New Mexico

September 13, 2024

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SUBTASK 4.2: OPERATIONS ANALYSIS

OVERVIEW

Subtask 4.2, the Operations Analysis, will inform the engineering and environmental process through the use of train performance analysis tools, modeling, and operations and capacity simulations. The Operations Analysis is intended to support the identification of operations capabilities and costs in order to inform the Economic Feasibility Analysis in Task 6.

Data from Other Subtasks and Sources

This subtask utilized information from Subtask 4.1 – Conceptual Railway Operating Plan Criteria and its definition of a representative freight train to inform the Operations Analysis for the project. The Operations Analysis identified key operating criteria and parameters for the proposed new rail line in conjunction with conceptual engineering. The Operations Analysis conducted an operations simulation of proposed concepts to identify capacity and infrastructure placement and performance, based on the conceptual alignments and forecasted freight demand over a 40-year planning horizon, from 2031 to 2070.

A preliminary Train Dynamics Analysis was conducted to evaluate the screened alignments and provide potential enhancements that will improve engineering design and operating and maintenance costs in future design revisions.

As part of this Operations Analysis, a Maintenance Plan was developed and identified the potential requirements for motive power maintenance, rolling stock maintenance, maintenance equipment, and infrastructure maintenance. It also discussed the potential maintenance requirements for proposed railroad facilities and utilize other information from Subtask 4.3 – Support Facilities and Access Analysis. A tabulation of conceptual workforce counts was also developed based on the operation and maintenance of the proposed railroad operation.

Lastly, this subtask identified potential Training Programs that would be required, such as training programs for train dispatchers and operations and maintenance personnel.

Operations Analysis

The Operations Analysis is based on the consist of a freight representative train, as identified in Subtask 4.1, for both unit and manifest operations. These train characteristics assume that the proposed railroad will emulate the typical practices used by U.S. common carrier railroads, and will be planned as a common carrier railroad with freight-only operations and will not consider joint operation with passenger rail.

Train Volumes

Subtask 4.1 identified potential train volumes utilizing the Freight Demand Forecast, which was developed in Subtask 2.3. The initial traffic volumes identified in the Freight Demand Forecast (about 10 MGT or less) suggested that only three (3) loaded trains per day and a similar number of empty trains would be needed to handle the traffic on the line.

Below is a summary of the train volumes relative to the freight forecast.

Table 1: Freight Forecast Summary, 2030 through 2070

Forecast Year:	2030	2070
All Commodities, Net Tons		
Total Volume “High” Forecast	9,966,000	6,550,000
Manifest Commodities (Assumed Inbound), Net Tons		
Total Volume “High” Forecast	1,720,000	3,872,000
“High” Forecast Number of Manifest Loaded Trains per Day	**0.50**	**1.13**
Rounded “High” Forecast Number of Manifest Loaded Trains per Day	**1**	**2**
Bulk Commodities (Assumed Outbound), Net Tons		
Total Volume “High” Forecast	8,246,000	2,678,000
“High” Forecast Number of Bulk Loaded Trains per Day	**1.64**	**0.53**
Rounded “High” Forecast Number of Bulk Loaded Trains per Day	**2**	**1**
Rounded “High” Forecast Number Outbound Trains per Day	**3**	**3**
Rounded “High” Forecast Number Inbound Trains per Day	**3**	**3**

Note 1: All volumes in net tons
Note 2: Manifest trains per day assumes 85 cars per train, 115 net tons per car
Note 3: Bulk trains per day assumes 125 cars per train, 115 net tons per car

Per the Freight Forecast Demand Methodology developed in Task 2, it was assumed that outbound bulk commodities move in unit trains of 125 cars, while inbound manifest trains move in trains of 85 cars. It was assumed that each car has 115 net ton carrying capacity, which is typical for bulk traffic moving in gondola, hopper, or covered hopper cars. It is assumed that trains operate 350 days per year.

It is important to note that car types for inbound and outbound commodities may not match, and thus, to be conservative for the operational analysis, it is assumed that each loaded train is matched by an empty train on the same day. The number of trains per day has been rounded-up to the next whole number. This results in a conservative assumption of three (3) inbound and three (3) outbound trains per day.

Train Makeup

The proposed operation is a freight-only railroad and will not consider passenger rail operations. There are two (2) freight train types anticipated to be operated on the proposed railroad. The first train type would be unit (or bulk) trains that haul a single commodity in one uniform car type for a single shipper between one (1) origin-and-destination pair. The second train type would be manifest (or mixed freight) trains that haul many commodities in carload volumes, with each carload or group of carloads typically with its own shipper and its own points of origin and destination may be required as needed.

Road Unit and Manifest trains will be hauled by high-horsepower diesel-electric locomotives, each developing 4,300 to 4,400 horsepower and applying it to six (6) powered axles as is current standard North American railroad practice.

Table 2: Train Makeup

Train Type (Loaded)	Number of Loaded Cars	Minimum Number of Locomotives	Approximate Trailing Tons	Approximate Length (Feet) – including Locomotives	Approximate Minimum Horsepower (HP)
Unit (Road)	125	7	17,875	8,000	30,100
Manifest (Road)	85	5	12,125	5,500	21,500

Train Routings

Subtask 3.3 identified five (5) individual route options, which were:

1. Defiance via Highway 491
2. Defiance via Indian Creek
3. Defiance via Highway 371
4. El Segundo
5. Star Lake

For the purpose of this operations analysis, it is assumed that each of the three (3) “Defiance via…” route options is effectively the same for operational purposes: all three (3) “Defiance via…” route options have similar lengths (105 to 117 main line miles) and similar grades (all approximately 2 percent maximum), all have the same potential for on-line traffic, all have the same northern endpoints, and all connect with BNSF at the southern terminus.

In general, train routings will be from the proposed BNSF Railway (BNSF) connection near either Gallup or Prewitt, New Mexico (depending upon considered route option) to the northern terminal of the proposed railroad in the Four Corners region, near the headquarters of the Navajo Agricultural Products Industry (NAPI). NAPI has land available for a terminal and has informally expressed willingness to consider allowing use of some of this land for a railway terminal. Based on the work of Task 3, possible origins and destinations in the Four Corners region include:

- NAPI, where the operational headquarters, a yard, bulk loading and unloading facilities for agricultural products and crop inputs, and a transload facility for manifest products would be located.
- The Navajo mine, reached via a spur that leaves the proposed railroad’s main line several miles south of NAPI.

It was assumed that traffic moving to or from the Navajo Mine would operate directly to or from the BNSF connection, without entering the yard at NAPI.

It was assumed that intermediate freight origins or destinations, such as possible transload facilities at or near towns such as Crown Point or Newcomb, would offer low volumes of freight, if any, as borne-out by the Freight Demand Forecast. As such, these industries would be switched by manifest trains while enroute to the Four Corners region.

Once on the BNSF network, trains may operate intact to their destination or to yards on the national freight rail network, where they would be reclassified for furtherance to their respective final destinations.

Operating Windows

Subtask 4.1 identified scheduled services or operating windows for unscheduled service. Currently, freight traffic is anticipated to be up to six (6) trains per day each direction. Freight service is anticipated to be unscheduled, operating as needed based on freight demand. Train operations are anticipated to be continuous (i.e., 24 hours per day and 7 days per week). Train schedules would target approximately 350 days of operation per year to allow for holidays, downtime, etc. It is envisioned that NAPI headquarters, mines, and other industries would work with the railroad to develop regular service plans for integration into the Railway's future transportation plan.

Maintenance-of-Way Window Requirements

Assuming that a total of approximately six (6) trains per day operate over the rail line, and with infrastructure designed for heavy haul operation, it should be possible to provide adequate windows for infrastructure maintenance (Maintenance of Way, or "MoW"). Since many similar single-track railways in North America operate with as many as 16 trains per day on a regular basis while still providing sufficient time for maintenance, it is assumed that sufficient work windows can be made available. Larger maintenance windows would have to be planned for through coordination with train management and customer communications.

At six (6) trains per day, relatively large work windows, several hours long, would be available. As an alternative, on some rail lines where train schedules are somewhat flexible (as with the bulk and manifest traffic anticipated on this Railway), it is possible to regularly establish one (1) maintenance window, every week or every month, where trains cease operation over the line for an 8-hour to 12-hour period. This would enable MoW crews/contractors to execute larger projects and maximize productivity on a regular basis. Coordination with train operations staff from BNSF, the proposed railroad train management team, and customers may also allow for larger work windows to complete major maintenance or capital work, as well.

Preliminary Operating Speeds / Timetables

Subtask 4.1 identified conceptual timetables for each of the five (5) identified route options based on inputs from Subtask 3.3 (i.e., alignment, grade, and curve data from the schematics) and the grade and curve adjustments from Subtask 4.1.

A summary of the preliminary timetables follows.

1. **Defiance via Highway 371 Route – Preliminary Operating Speeds**

Milepost - Start (MP)	Milepost - End (MP)	Max. Speed - Freight (mph)	Distance (mi)
(South) 0.00	9.09	30	9.09
9.09	18.94	25	9.85
18.94	27.46	40	8.52
27.46	37.88	45	10.42
37.88	53.03	40	15.15
53.03	69.13	30	16.10
69.13	82.39	35	13.26
82.39	89.96	25	7.58
89.96	115.91	30	25.95
115.91	118.9	20 (Yard Limits)	2.99
(North) 118.90	End		

2. **Defiance via Indian Creek Route – Preliminary Operating Speeds**

Milepost - Start (MP)	Milepost - End (MP)	Max. Speed - Freight (mph)	Distance (mi)
(South) 0.00	9.09	30	9.09
9.09	18.94	25	9.85
18.94	27.46	40	8.52
27.46	37.88	45	10.42
37.88	45.45	40	7.58
45.45	47.35	35	1.89
47.35	55.87	40	8.52
55.87	57.77	35	1.89
57.77	75.76	40	17.99
75.76	79.55	35	3.79
79.55	89.96	30	10.42
89.96	95.64	40	5.68
95.64	108.33	30	12.69
108.33	111.36	20 (Yard Limits)	3.03
(North) 111.36	End		

3. **Defiance via Highway 371 Route – Preliminary Operating Speeds**

Milepost - Start (MP)	Milepost - End (MP)	Max. Speed - Freight (mph)	Distance (mi)
(South) 0.00	9.09	30	9.09
9.09	18.94	25	9.85
18.94	27.46	40	8.52
27.46	37.88	45	10.42
37.88	53.03	40	15.15
53.03	69.13	30	16.10
69.13	82.39	35	13.26
82.39	89.96	25	7.58
89.96	115.91	30	25.95
115.91	118.90	20 (Yard Limits)	2.99
(North) 118.90	End		

4. **El Segundo Route – Preliminary Operating Speeds**

Milepost - Start (MP)	Milepost - End (MP)	Max. Speed - Freight (mph)	Distance (mi)
(South) 0.00	14.20	30	14.20
14.20	26.52	40	12.31
26.52	42.99	45	16.48
42.99	48.30	35	5.30
48.30	55.87	40	7.58
55.87	58.71	35	2.84
58.71	60.61	40	1.89
60.61	68.18	35	7.58
68.18	97.54	30	29.36
97.54	100.00	20 (Yard Limits)	2.46
(North) 100.0	End		

5. **Star Lake Route – Preliminary Operating Speeds**

Milepost - Start (MP)	Milepost - End (MP)	Max. Speed - Freight (mph)	Distance (mi)
(North) 0.00	22.73	30	22.73
22.73	28.41	20	5.58
28.41	33.52	25	5.11
33.52	48.30	30	14.77
48.30	54.92	25	6.63
54.92	74.81	30	19.89
74.81	92.80	25	17.99
92.80	94.89	20 (Yard Limits)	2.08
(South) 94.89	End		

Operating Analysis Inputs

Infrastructure Parameters

In general, the proposed railroad will be constructed and operated commensurate with North American heavy-haul freight railroad practices and standards.

The proposed railroad will follow American Railroad Engineering and Maintenance-of-Way Association (AREMA) recommended practices for design. Where BNSF crews operate (at the interchange point), BNSF engineering standards will be followed.

Owing to the maximum preliminary operating speed for the five routes, it is anticipated that the main track will be maintained to FRA Class 4 track safety standards, which permits a maximum operating speed of 60 miles per hour (mph) for freight trains, though maximum operating speeds are planned to be 45 miles per hour or less, depending upon the route selected. Sidings and other than main tracks will be maintained to the FRA track class commensurate with their maximum allowed speed, but not less than FRA Class 2. Actual main track maximum operating speeds will be governed by operating rules and an employee timetable that establishes the entire main track, sidings, and yard tracks, the maximum operating speed by train type, trailing tonnage, and makeup; locomotive type, placement, horsepower and effective axles of dynamic braking; vertical and horizontal profile of the railway; Method of Operation; and applicable FRA regulations.

Loading Gauge:

Maximum loaded gross weight of four-axle rail cars will be 286,000 pounds (lbs.)

Clearances

As summarized in Subtask 4.2, design clearances for the proposed railroad are intended to accommodate AAR Plates B, C, F, and H recommended clearances (“loading gauge”). This means that vertical and horizontal clearances will be sufficient to enable operation of double-stack, high-cube intermodal containers in well cars, and intermodal, automotive, and other rail car types, if any, that would be handled in existing manifest trains.

Table 3: Maximum Grades and Curvature for Route Options (per Subtask 3.3)

Route	Defiance via Hwy 491	Defiance via Indian Creek	Defiance via Hwy 371	El Segundo	Star Lake
Geometry & Operations: Max. 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)	5.0° (typical) 7.5° (max)	5.0° (typical) 7.5° (max)	4.0°	5.0° (typical) 7.5° (max)

*NB= Northbound, SB= Southbound, ° = Degrees (decimal)

The track center distance between a main track and another main track, a siding, a set-out track, or a yard track will be 15 feet. Yard and storage tracks will be designed with a minimum of 15-foot track centers, except where access roads or inspection roads are required, in which case greater track centers will be provided.

Maximum Train Lengths

- Mentioned in the Train Makeup section of this memorandum, the typical unit train is assumed to be approximately 8,000 feet long and manifest train is assumed to be approximately 5,500 feet long.
- Siding lengths will accommodate the longest train types and include additional distance for acceleration and deceleration. Sidings are proposed to be 2.5 miles in length (~13,000 feet).
- Interchange and staging tracks at the BNSF Connection would accommodate the longest train types and include additional distance for acceleration and deceleration.
- In laying out loading and unloading terminals, such as NAPI, storage length of 13,000 feet was planned for while actual train lengths may ultimately be shorter, as noted above.

Railroad Equipment Requirements – Motive Power and Rolling Stock

Based on the existing topography between the national rail network and the Four Corners Region, it is assumed that many Route Options for the proposed new rail line would have generally similar alignments and profiles, resulting in generally similar train performance and operating characteristics for many of the route options. In recognition of the conceptual nature of the Route Options, as well as the general similarity between many of the six route options, equipment requirements are assumed to be the same for all route options.

Motive Power (Locomotives)

For unit train operations, it is assumed that the proposed railroad would likely utilize run-through motive power for its main line operations, though this would be subject to agreement between the operator and BNSF. As the connecting Class I carrier, BNSF's locomotives inbound trains would remain intact and BNSF locomotives would remain attached to those trains for delivery to customer facilities. After loading or unloading, such trains would be returned to the BNSF, intact with BNSF locomotives and with no intermediate switching, in 24-48 hours. This is a typical arrangement for short line railroads: they often are allowed to use the locomotives from the connecting main line railroad in order to expedite operations. There are many examples around the US of this arrangement. On the west coast alone, California Northern, Puget Sound and Pacific, Central Oregon and Pacific all operate trains using locomotives on trains handled intact delivered from and returning to the connecting main line railroad.

For manifest operations, it is assumed that the proposed railroad would use its own locomotives to take the manifest trains from the BNSF interchange to the corresponding switching yard. Manfest trains are assumed to originate from BNSF's nearby Gallup Yard, where cars from many origins or destinations would be combined into train for delivery to the interchange with the proposed railroad.

Rolling Stock (Freight Rail Car)

It is assumed that the proposed railroad would not own rail cars for revenue service; rather, its customers would make other arrangements for the provision of railcars to accommodate their shipments. This is a typical arrangement for short line railroads across North America.

Listed below are the likely freight rail car types that are associated with the commodities identified in Subtask 2.3 – Freight Demand Forecast. Based on market needs, other rail car types may be used on the proposed railroad in the future. Given the generally open terrain traversed by all the route options, clearances on the proposed railroad are expected to allow for high/wide loads, in the event there is demand for shipments such as wind turbine blades, generators, or transformers.

- Covered hoppers for agricultural use (e.g., corn, wheat, wheat flour, popcorn, beans, fertilizer).
- Boxcars, agriculture (e.g., potatoes).
- Boxcars, freight (e.g., misc. freight).
- Covered hoppers for industrial use (e.g., cement, fly ash, carbon black).
- Open hoppers (e.g., minerals and other bulk commodities).
- Gondolas (e.g., steel beams, steel pipe/tubing, bulk commodities).
- Flat cars (e.g., steel beams, steel pipe/tubing, windmill blades).
- Centerbeam cars (e.g., lumber, other stackables).
- Tank cars for chemical or fuels (e.g., chemicals, fertilizer, fuels).
- Containers (e.g., alfalfa, misc. freight).
- Other specialty cars, as needed.

For this analysis, it is assumed that bulk commodities move in unit trains of 125 cars, while manifest trains move in trains of 85 cars. It is assumed that each car has 115 net ton carrying capacity totaling 143 tons per rail car (assumed average tare weight of 28 tons), and average length of approximately 61 feet, which is within the typical range for bulk traffic moving in gondola, hopper, or covered hopper cars. It is assumed that trains operate 350 days per year. Below is a summary of train makeup (additional information regarding motive power requirements) is provided later in this document).

Revenue rolling stock would come from the national railcar fleet, either owned by major railroads (such as BNSF) or private car owners. In the case of private cars, the shippers or receivers would secure the necessary equipment, either purchasing it themselves or, as is often the case, leasing it on a long-term basis from one of many railcar lessors. In this arrangement, payment for use of the car is typically made by the shipper or receiver to the railcar owner.

In the case of railroad-owned cars (for example, owned by BNSF or another Class 1 railroad), upon request from a shipper, the railroad would order such a car for delivery to the shipper's location (e.g., the transload at NAPI). Payment for use of the car would typically be included in the transportation charges billed to the shipper (or receiver) by the railroad.

As noted above, the proposed railroad is not anticipated to own any railcars for revenue service.

The proposed railroad may own or lease approximately two flat cars to store track panels or transport maintenance equipment. Similarly, it is expected that the proposed railroad may own or lease approximately three ballast hoppers that can deposit ballast for track maintenance activities. The proposed railroad may intermittently lease other rail cars to aid in maintenance operations, such as other flatcars or gondolas for storing or transporting track or structures materials.

Dispatching Method and Guidelines for Distance Between Passing Sidings

The operating practices of the proposed railroad will be consistent with practices of other U.S. railroads. The proposed railroad will adopt the General Code of Operating Rules (GCOR), which is used by nearly all railroads in the Midwestern and Western United States, as its governing system of operating rules.

With only approximately six (6) trains per day forecasted to traverse the line, little or no traffic at intermediate points, and no helper grades anticipated, a full centralized traffic control (CTC) signal system would not be warranted from a capacity perspective. It is assumed that main line track switches (e.g., at sidings between NAPI and the BNSF interchange) would be operated remotely by train crews using dual tone multi frequency (DTMF) radio control. For this reason, a signal system would not be required.

The likely method of operation will be Track Warrant Control (TWC), which authorizes train movements and protects roadway workers or machines on a main track within specified limits in a territory designated by the timetable.

The spacing of passing sidings on a railroad is dependent upon the frequency of train operations and desired flexibility in dispatching trains and the desired ability to recover from unanticipated events and delays. The proposed railroad is assumed to operate an average of six (6) trains per day. Operational simulations (discussed below) identified that three (3) intermediate sidings would be sufficient to handle the proposed traffic, providing an approximate spacing of 25 to 30 miles between sidings. With average operating speeds typically 30 miles per hour or higher, this would allow for a running time of 1 hour or less between sidings. Due to the generally flat nature of the terrain and lack of major obstacles, if at some later time during the project development process additional sidings are desired, these can easily be added with minimal additional cost.

Interoperability and Interchange Requirements

The proposed railroad will conform to AAR and industry rules for interchange requirements. Additionally, it will conform to BNSF's interchange requirements for connecting short line railroads to enable the uninhibited interchange of freight cars and trains between the proposed railroad and the national freight rail network.

Unit trains are assumed to be interchanged intact to/from BNSF. No additional classification or assembly of unit trains will be required for interchange. Manifest traffic is assumed to be interchanged as a solid block of cars at the interchange point, with locomotives from the proposed railroad moving the manifest traffic from the BNSF interchange to the northern terminus at NAPI. Some minor switching of manifest trains may be necessary at the BNSF interchange. For example, the proposed railroad's locomotives would need to be uncoupled from the outbound manifest train delivered to the BNSF interchange and re-coupled to the northbound manifest train prior to the northbound train departing for NAPI.

Operations Analysis and Simulation

An operations analysis has been conducted using the Rail Traffic Controller ® (RTC) simulation software. RTC generates a representation of the running time of a train over a given railroad line which analysts can use to assess the capacity of the railroad line in terms of its ability to handle a number of trains per unit of time. The RTC simulations have been used to assist in developing a proposed operating plan and approximate schedule for trains. Running times are also helpful for planning maintenance over the line.

This operational analysis assessed train performance and operational characteristics and will inform the engineering and environmental process in subsequent Subtasks. It can be used to estimate fuel consumption, highway-rail grade crossing occupancy times, noise impacts, etc.

At the conclusion of Task 3, there were (and are) five (5) candidate routes being considered, designated as follows:

1. Defiance via Highway 491
2. Defiance via Indian Creek
3. Defiance via Highway 371
4. El Segundo
5. Star Lake

Route Options

Of these five (5) routes, the first three (3) routes, designated as "Defiance via…," traverse similar topography, are of similar length, have generally similar alignments and profiles, and are expected to result in generally similar train performance simulations. These three "Defiance via…" routes share identical geometry for over 1/3 of their routes (approximately 39 miles of shared alignment compared to the overall lengths, which range from 105 miles to 117 main line miles, excluding yard tracks). Since all "Defiance via…" routes are generally similar, in a "Route Selection Memo," dated July 4, 2024, it was proposed that only one of the "Defiance via…" routes would need to be the subject of an operational simulation. The longest of the three "Defiance via…" routes, Defiance via Highway 371, which is approximately 117 main line miles from the BNSF connection to NAPI was selected. For the purposes of the operational simulation and operating cost estimates, this route would be representative of the other two "Defiance via…" routes. Defiance via Highway 371 has similar alignment and profile characteristics from an operational perspective and, as the longest of the three routes, would return conservative results for operating costs compared to the other two "Defiance via…" route options.

The Operations Simulation Analysis only considered these routes:

1. Defiance via Highway 371
2. El Segundo
3. Star Lake

Utilizing conceptual engineering profiles and schematics from Subtask 3.3 and timetable from Subtask 4.1, the infrastructure elements for the remaining three (3) proposed Route Options were input into RTC software to determine conceptual track capacity and train performance.

Conceptual Operations Simulation Analysis Results

The conceptual operations simulation analysis considered one scenario per route option, which was three (3) trains per day each way – one (1) manifest train and two (2) unit trains daily – for a total of six (6) train trips per day. This matches the anticipated freight demand forecast for the year 2030. Below are the characteristics of the train types for the 2030 High Volume Scenario. Per Subtask 2.2 for future freight forecasts, gross tonnage hauled is expected to decline by 2070; however, train counts will remain the same except that the number of manifest trains will increase from one (1) to two (2) per day each way and unit trains will decrease from two (2) to one (1) per day each way.

- Manifest – Empty, 85 rail cars.
- Manifest – Loaded, 85 rail cars.
- Unit – Empty, 125 rail cars.
- Unit – Loaded, 125 rail cars.

Respective train types were dispatched against the conceptual engineering profiles and conceptual operating speeds. Train Performance Calculators plotted the results of the RTC run for each route option. The graphical results can be found in **Appendix A**; a tabular summary is as follows.

Table 4: Conceptual Operations Simulations Results

Route Option	Minimum Operating Speed, mph	Fuel Consumption, gallons	Run Time, hh:mm	Length, miles
Defiance via Highway 371				
Manifest – Empty, 85 rail cars	20 mph	505.7 gallons	03:56	116.85 miles
Manifest – Loaded, 85 rail cars	13 mph	2,007.8 gallons	04:24	116.85 miles
Unit – Empty, 125 rail cars	20 mph	615.8 gallons	03:59	116.85 miles
Unit – Loaded, 125 rail cars	11 mph	3,633.9 gallons	04:31	116.85 miles
El Segundo				
Manifest – Empty, 85 rail cars	20 mph	540.4 gallons	03:02	98.04 miles
Manifest – Loaded, 85 rail cars	13 mph	1,350.3 gallons	03:24	98.04 miles
Unit – Empty, 125 rail cars	20 mph	437.9 gallons	03:03	98.04 miles
Unit – Loaded, 125 rail cars	12 mph	3,767.8 gallons	03:41	98.04 miles
Star Lake				
Manifest – Empty, 85 rail cars	20 mph	510.2 gallons	03:55	92.86 miles
Manifest – Loaded, 85 rail cars	10 mph	1,650.1 gallons	04:12	92.86 miles
Unit – Empty, 125 rail cars	20 mph	463.1 gallons	03:55	92.86 miles
Unit – Loaded, 125 rail cars	12 mph	3,864.6 gallons	04:33	92.86 miles

For this conceptual operations simulation analysis, the operations analysis assumed a single end-of-the-line customer facility (NAPI). This allows the model to focus solely on determining if the proposed main line capacity is adequate for the given number of daily train movements.

A stringline diagram was also developed for each route option to graphically plan the flow of traffic on the proposed railroad and depicts running times, work times, and proposed meet times for trains that may conflict with one another – often these proposed meets will occur at a conceptualized siding location. **Appendix B** contains stringline diagrams for each route option analyzed.

An initial assessment of crew on-duty time has been made. Assuming a regular crew starts its tour of duty at NAPI, it could return to NAPI within approximately nine (9) hours, including at least 60 minutes at the BNSF interchange at the south end of the proposed railroad. This would leave three (3) hours “cushion” on the crew’s maximum available 12 hours of service (based on the hours-of-service law that limits operating personnel to a maximum of 12 hours of on-duty time). This three (3)-hour cushion would allow for unanticipated delays. Note that crews change trains at the BNSF interchange.

Note that the crew that delivers the southbound manifest train to BNSF may take a northbound unit train back to NAPI. Conversely, the crew that delivers a southbound unit train to BNSF may take a northbound manifest train back to NAPI. This provides a relatively long “dwell time” for manifest trains at the BNSF interchange: there are several hours between the arrival of the southbound manifest train from NAPI and the departure of its northbound counterpart to NAPI.

This additional time allows for re-positioning the locomotives from the south end of the outbound train to the north end of the inbound train. By spreading this work over a long time period (and potentially over two crews), there is flexibility in the event the locomotive change takes extra time. This long time period also allows flexibility in the event that the BNSF drop-off of manifest cars encounters an unexpected delay.

Defiance via Highway 371 – Stringline Narrative

- An empty, outbound manifest train departs NAPI daily at approximately 0315 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 0715.
- A loaded, outbound unit train (#1) departs NAPI at approximately 0600 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 1045.
- An empty, inbound unit train (#1) arrives at the BNSF interchange at approximately 0830 and proceeds the entire length of the territory to NAPI, arriving at approximately 1230 – it must either meet or pass the loaded unit train headed to the BNSF interchange; this occurs around 0930 near MP 25.90 to MP 28.40.
- Another loaded, outbound unit train (#2) departs NAPI at approximately 1400 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 1830.
- A loaded, inbound manifest train arrives at the BNSF interchange at approximately 1145 and proceeds the entire length of the territory to NAPI, arriving at approximately 1615 – it must either meet or pass the loaded unit train headed to the BNSF interchange; this occurs around 1500 near MP 92.00 to MP 94.50.
- An empty, inbound unit train (#2) arrives at the BNSF interchange at approximately 1930 and proceeds the entire length of the territory to NAPI, arriving at approximately 2330.

El Segundo – Stringline Narrative

- An empty, outbound manifest train departs NAPI daily at approximately 0330 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 0630.
- A loaded, outbound unit train (#1) departs NAPI at approximately 0600 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 1000.
- An empty, inbound unit train (#1) departs from the BNSF interchange at approximately 0800 and proceeds the entire length of the territory to NAPI, arriving at approximately 1115 – it must meet the loaded unit train headed to the BNSF interchange; this occurs around 0845 near a siding located in the vicinity of MP 27.50 to MP 30.00.
- Another loaded, outbound unit train (#2) departs NAPI at approximately 1245 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 1630.
- A loaded, inbound manifest train departs from the BNSF interchange at approximately 1115 and proceeds the entire length of the territory to NAPI, arriving at approximately 1445 – it must either meet or pass the loaded unit train headed to the BNSF interchange; this occurs around 1345 near MP 78.80 to MP 81.30.

- An empty, inbound unit train (#2) departs from the BNSF interchange at approximately 1800 and proceeds the entire length of the territory to NAPI, arriving at approximately 2110 with no meets.

Star Lake – Stringline Narrative

- An empty, outbound manifest train departs NAPI daily at approximately 0330 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 0730.
- A loaded, outbound unit train (#1) departs NAPI at approximately 0600 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 1030.
- An empty, inbound unit train (#1) departs from the BNSF interchange at approximately 0845 and proceeds the entire length of the territory to NAPI, arriving at approximately 1245 – it must meet the loaded unit train headed to the BNSF interchange; this occurs around 0930 near MP 20.50 to MP 23.00.
- Another loaded, outbound unit train (#2) departs NAPI at approximately 1400 and proceeds the entire length of the territory to the BNSF interchange arriving at approximately 1830.
- A loaded, inbound manifest train arrives at the BNSF interchange at approximately 1200 and proceeds the entire length of the territory to NAPI, arriving at approximately 1615 – it must meet the loaded unit train headed to the BNSF interchange; this occurs around 1500 near MP 72.00 to MP 74.50.
- An empty, inbound unit train (#2) departs from the BNSF interchange at approximately 2000 and proceeds the entire length of the territory to NAPI, arriving at approximately 2359.

The proposed siding infrastructure was implemented into the conceptual stringline utilizing three (3) sidings each for each route option as described below.

<u>Proposed Sidings Relative to Route Option</u>

Each route option includes three (3) sidings. As currently contemplated, each siding would be approximately 13,000 feet long. While this length significantly exceeds the current 8,000-foot assumed train length (based on the freight demand forecast), it allows flexibility in the event it becomes desirable to increase train length. Conversely, if it becomes known that train length will not increase, it would be possible to shorten the sidings and realize a cost savings.

Defiance via Highway 371

1. Proposed BNSF Connection from approximately MP 0.8 to MP 3.3.
    a. This will have three (3) sidings to allow for interchanging trains with BNSF.
    b. Refinement of this location would occur in conjunction with interchange partner BNSF during the environmental documentation process.
2. Proposed Siding #1 - approximately from MP 25.9 to MP 28.4.
3. Proposed Siding #2 - approximately from MP 57.80 to MP 60.3.
    a. This siding is not utilized as modeled in the stringline, but provides operational flexibility should a train depart late from NAPI or arrive late from BNSF. It is more than likely other trains will need to make a meet at this siding location instead of Proposed Sidings #1 and #3.
4. Proposed Siding #3 - approximately from MP 92.0 to MP 94.5.

El Segundo

1. Proposed BNSF Connection from approximately MP 3.5 to MP 6.5.
    a. This will have three (3) sidings to allow for interchanging trains with BNSF.
    b. Refinement of this location would occur in conjunction with interchange partner BNSF during the environmental documentation process.
2. Proposed Siding #1 - approximately from MP 27.5 to MP 30.0.

3. Proposed Siding #2 - approximately from MP 51 to MP 53.5.
    a. This siding is not utilized as modeled in the stringline, but provides operational flexibility should a train depart late from NAPI or arrive late from BNSF. It is more than likely other trains will need to make a meet at this siding location instead of Proposed Sidings #1 and #3.
4. Proposed Siding #3 - approximately from MP 78.8 to MP 81.3.

Star Lake

1. Proposed BNSF Connection from approximately MP 3.5 to MP 6.5.
    a. This will have three (3) sidings to allow for interchanging trains with BNSF.
    b. Refinement of this location would occur in conjunction with interchange partner BNSF during the environmental documentation process.
2. Proposed Siding #1 - approximately from MP 20.5 to MP 23.0.
3. Proposed Siding #2 - approximately from MP 49.6 to MP 52.1.
    a. This siding is not utilized as modeled in the stringline, but provides operational flexibility should a train depart late from NAPI or arrive late from BNSF. It is more than likely other trains will need to make a meet at this siding location instead of Proposed Sidings #1 and #3.
4. Proposed Siding #3 - approximately from MP 72.0 to MP 74.5.

Based on the Stringlines, the modeling showed roughly uniform usage of proposed sidings nearest to NAPI and BNSF, with no observed bottlenecks, and traffic tended to fall into a pattern of one-on-one meets. There was a proposed siding in the middle of each of the route options that was not utilized per the operating schedule shown. However, the unused siding offers another location for meet-pass events and provides operational flexibility for variance in train schedules, a location for maintenance equipment staging, and a location for setout of malfunctioning equipment.

Preliminary Train Dynamics Analysis

The Preliminary Train Dynamics analysis examines the dynamic interaction of a sample train consist with track as affected by operating practices, terrain, and climatic conditions. This analysis relies on the same inputs for train consists as the RTC analysis and utilizes the RTC and its Train Performance Calculator (TPC) module analysis to analyze the ruling grade segment of the proposed railway. Due to the similarities in the route options, one (1) analysis was completed, and the unit train consist was examined.

Train Resistance

The Preliminary Train Dynamics Analysis utilized several sources, such as the Canadian National version of the Davis Equation contained within the AREMA Manual for Railway Engineering (MRE), Chapter 16: Economics of Railway Engineering and Operations (version 2024)[1] and the textbook *Railroad Engineering, 2nd Edition* by Dr. William H. Hay[2]. The Preliminary Train Dynamics Analysis was used to check the output of the TPC for southbound loaded unit trains on the controlling curvature and grade.

Inputs for the Preliminary Train Dynamics Analysis based on the Davis Equation are identified in the AREMA MRE and Hay text are summarized here below:

[1] AREMA 2024 Manual for Railway Engineering; Volume 4, Chapter 16: Economics of Railway Engineering and Operations

[2] *Railroad Engineering, 2nd Edition (Hay)*

- Track profile, including horizontal and vertical geometry and ruling grades[3]. For southbound loaded unit trains, this would occur at the "Defiance via" routes near MP, where there is a 1.8 percent grade and 5-degree curve.
- Expected track speeds to be analyzed.
- A typical locomotive type and power configuration that might be used.
- Characteristics for the cars to be used.
- Rail adhesion factor.

Table 5: Conceptual Train Analysis Inputs

Conceptual Train Dynamics Analysis Inputs	Values
Maximum Horizontal Curvature	5 degrees
Ruling Grade	1.8% uncompensated
Track Speed	Max: 50 mph | Min: 10 mph
Locomotive Type	4,400 hp 6-axle AC motor
Locomotive Power Configuration	7 locomotives for unit trains
Locomotive Weight	210 tons
Rail Car Weight	143 tons loaded
Rail Car Weight per Axle	35.75 tons loaded
Rail Car Type	Loaded Gondola (unit train)
Adhesion, Frosty Rail	28%

Outputs from Preliminary Train Dynamics Analysis identified train resistance, required tractive effort, and motive power requirements. This allowed for a preliminary assessment of potential longitudinal forces along the maximum 1.8 percent southbound grade, adverse to the unit train loads. Note that Table 3, on Page 9, indicates a maximum grade of 1.9 percent southbound, which is found on a section of the Star Lake route option. However, at only 6000 feet long, this 1.9 percent grade is significantly shorter than the overall length of a unit train. The next steepest adjoining grade is 0.75 percent, which extends for over 2,000 feet. For the purposes of analyzing the forces involved, it is the average grade experienced over the entire length of a train that is the controlling factor. The effective average grade under the 8,000-foot-long train is thus the weighted average of these two (2) grades, 1.6 percent. The next steepest southbound ascending grade on any route options occurs on the Defiance option; this grade is 1.8 percent, and extends for 8,500 feet, slightly longer than the longest train. Thus, this is the grade that controls the analysis.

A speed of 10 mph was selected for the proposed railroad as a minimum speed for this particular ruling grade as to not stall the train when climbing the grade.

The outputs of the analysis are shown below. Note that a sample section of the BNSF main line, which would also be traversed by the loaded unit trains, has also been analyzed in order to determine the locomotive requirements for the train's entire trip. Additional information is included below.

[3] Ruling Grade: Commonly defined as the steepest section of track, based on the average grade measured over one train length.

Table 6: Car Resistance, Relative to Speed and Grade, 125-Rail Car Consist, All "Defiance Via…" Options

Resistance per Train Consist	10 mph, 1.8% Ruling Grade	50 mph, 1.25% Ruling Grade
Rail Car (143 tons each)	(Proposed Railroad, Defiance Option)	(Assumed BNSF Characteristics)
Curve	5 degrees - 71,500 lbs.	1.5 degrees - 21,450 lbs.
Grade	643,500 lbs.	446,875 lbs.
Rolling – CN Equation	41,726 lbs.	76,406 lbs.
Total	**756,726 lbs.**	**577,031 lbs.**

Table 7: Locomotive Resistance, Relative to Speed and Grade

Resistance	10 mph, 1.8% Ruling Grade	50 mph, 1.25% Ruling Grade
Locomotive (210 tons each)	7 Locomotives	5 Locomotives
Curve	5 degrees – 5,880 lbs.	1.5 degrees – 1260 lbs.
Grade	52,920 lbs.	26,250 lbs.
Rolling – CN Equation	3,464 lbs.	4,790 lbs.
Total	**62,264 lbs.**	**32,300 lbs.**

The total train resistance on the proposed railroad (10 mph, 1.8 percent ruling grade) is the sum of the car resistance (756,726 lbs.) and locomotive resistance (62,264 lbs.), equaling 818,990 lbs.

Tractive Effort

A locomotive's tractive effort is a function of its weight and the adhesion between its wheels and the rail. Adhesion varies under different conditions, as shown in Table 8, below. To be conservative, the worst adhesion conditions (frosty rail) have been assumed.

Table 8: Adhesion per Locomotive for Varying Conditions (For Comparison)

Adhesion per Locomotive	Adhesion Calculation per Locomotive
Frosty or snow-covered rail = 28%	117,600 lbs.
Wet rail = 32%	134,400 lbs.
Dry rail = 38%	159,600 lbs.

Using the worst-case adhesion, a locomotive can produce 117,600 lbs. of tractive effort.

Motive Power Requirements

To determine the motive power requirements, the total resistance of the train plus its locomotives must be offset by the tractive effort provided by the locomotives. This becomes an iterative process because locomotives also have weight, and their rolling resistance is affected by grades and curves themselves. The total rolling resistance of a train is the sum of the rolling resistance of the cars plus the rolling resistance of the locomotives. Thus, as more locomotives are added to pull a train, the total rolling resistance of the train increases.

The number of locomotives required to operate a loaded unit train on the proposed railroad is determined by dividing the total resistance (818,990 lbs.) by the worst-case tractive effort (assuming frosty rail conditions) of one locomotive (117,600 lbs.), which gives 6.96 locomotives. Rounded-up, that would be seven (7) locomotives. Since frosty rail conditions occur infrequently, for the remainder of the year, fewer locomotives, as few as six (6) locomotives, could be required.

Considering the inputs and outputs from the analysis, the following assumptions can be made for the case of a southbound unit train ascending a 1.8 percent grade with 17,875 trailing tons:

1. The tractive effort needed to move a 125-car loaded unit train up a 1.8 percent grade at 10 mph, with 5-degree maximum curvature would require seven (7) locomotives for frosty rail conditions.
2. The calculations did not account for rail lubrication, which could reduce curve resistance by an additional 50 percent[4].
3. It is assumed that locomotive sanding and slip control would help adhesion ratings and tractive effort.
4. This calculation matches the results of the TPC well. The TPC shows that, on the steepest part of the Defiance route, the southbound train is able to maintain a speed slightly higher than 10 mph with seven (7) locomotives as it ascends the hill towards the BNSF interchange.

The loaded unit train resistance on the proposed railroad was also compared to a conceptual estimate of the train resistance on the BNSF.

- Westbound unit trains departing the Gallup area westbound would eventually encounter sustained grades between 1.6 percent and 2.25 percent shortly after entering California (depending upon their route to final destination). By inspection, to maintain an approximate 50 mph speed, these sections of grade would require approximately the same number of locomotives - or more, in the case of the 2.25 percent grade - as the short section of 1.8 percent grades on the proposed railroad.
- Eastbound from Gallup, east of Belen, New Mexico, unit trains would encounter an approximately 1.25 percent grade. Initial calculations (above) indicate that, to maintain a speed of approximately 50 mph on this grade, five (5) locomotives would be required. Ultimately, if loaded unit trains from the proposed railroad proceed eastward on the BNSF, no additional motive power would be needed.
- Exact motive power requirements will not be known until final design, when customer destinations are known, and a route selected for the proposed railroad. At that time, locomotive consists can be refined.
- Information about the BNSF subdivisions was sourced on-line, from a non-official website. Actual grades may vary somewhat.

Manifest trains, which will not use run-through motive power but rather will use motive power from the proposed railroad, were not evaluated for operation on the BNSF, since a motive power change at the BNSF interchange means that any number of locomotives required could be added at the interchange. Locomotive requirements on the proposed railroad for manifest trains were based on the results from the TPC. The TPC identified that five (5) locomotives would be required to operate loaded northbound manifest trains.

As noted, the only motive power that would need to be owned by the proposed railroad would be that to power the manifest trains (with BNSF locomotives powering unit trains). To allow for maintenance and overhaul, in addition to the five (5) locomotives needed to operate trains, at least two (2) additional "spare" locomotives would be needed. This results in a total of:

- Seven (7) – locomotives owned by the proposed railroad.

[4] AREMA MRE Chapter 16 Section 2.1.9: Rail Lubrication

Train Dynamics Operating Considerations

Effects of undulation (resulting from the number and spacing of sags and crests in the track profile) were assessed on a qualitative basis using the TPC. At this conceptual stage, undulation can be assessed from the TPC based on the number of changes from Throttle to Dynamic Brake over a given distance, and the magnitude of those changes. Long intervals between changes from throttle to brake are desirable to reduce in-train forces. At this early stage, undulation does not appear to be a constraint on any of the routes except potentially Star Lake.

The Star Lake Route Option does show many changes from high throttle settings to high brake settings for loaded trains. For empty trains, these changes are of lower magnitude and would be less problematic. If the Star Lake Route Option were selected, during final design additional simulations would be performed to assess whether adjustments to the speed limits, grades, or curves would reduce the number and magnitude of the changes from throttle to brake (e.g., target a lower speed on ascending grades to reduce the speed over the top of a crest and thus reduce the need for brakes on the downhill side). At this early stage, there do appear to be approaches to mitigate the effects of undulation of the Star Lake Route Option during later stages of design.

Additionally, distributed power (DPU) configurations, wherein locomotives are spaced through a train but remotely controlled by the engineer in the leading locomotive, would also reduce in-train forces and help to control slack in undulating territory. Train handling methods in undulating territory can account for changes in operating speed, train characteristics, and train make-up (i.e., placement of empty and loaded rail cars) and skillful handling by locomotive engineers can reduce the effects of undulation. For example, a locomotive engineer may operate below the allowable speed limit in approach of a crest in the profile or in approach of a curve. By decelerating slowly, the in-train forces are reduced, and the effects of undulation also reduced.

The results from this conceptual train dynamics analysis illustrate that the proposed railroad can be operated and provide confirmation of the number of locomotives needed for the controlling scenario: the southbound loaded unit train. As the project progresses towards final design, alignment and profile adjustment will provide more opportunities to refine horizontal and vertical track geometry. As the alignment and profile are revisited, speed limit modifications may also be made to improve results.

Maintenance Plan

The proposed railroad is a relatively low-speed, low-density freight railway, compared to most of the principal main lines of the U.S. railway system. It is proposed to be a heavy haul railroad with car weights up to 286,000 lbs., the common maximum car weight hauled on most of the U.S. railway system. As a common-carrier railway, the proposed railroad would be subject to FRA safety regulation, and its maintenance must comply with applicable FRA regulations.

Several elements must be considered with respect to annual maintenance requirements for the proposed railroad in order to provide freight services described in the previous memorandums. The major elements driving the proposed railroad’s Maintenance Program likely consist of maintenance of motive power and rolling stock and infrastructure maintenance activities. These elements are described in the following sections.

Motive Power and Rolling Stock Maintenance

Maintenance of locomotives and rolling stock would occur at the proposed maintenance facility at the northern terminal near NAPI. As outlined in Task 4.3, this facility would include an enclosed shop building with space for 4 locomotives, an inspection pit, an overhead crane, tools, equipment, and spare parts storage. There would be a separate locomotive fueling area. Although the proposed railroad would require more than four locomotives, the remaining locomotives would be stored outside, as is commonly done on short line railroads and main line railroads in all kinds of weather around North America.

Motive Power

Anticipated maintenance activities for locomotive maintenance facility include inspection (e.g., FRA mandated 31, 92 day and annual inspections) light running repairs (e.g., brake shoe replacement, filter replacement, lubrication, minor repairs, periodic testing, etc.) and medium running repairs (e.g., air reservoir tests, unit exchange of various components such as electrical contacts, power assemblies, brake valves, and wheelset-traction motor combinations). For heavy repairs, such as wheel truing, major overhaul of the diesel engine, or repairs to traction motors, the expectation is that the components would be removed from the locomotive at the maintenance facility and shipped to a contract shop with the capability of performing such repairs. When repaired parts are available, they would be re-installed at the maintenance facility.

Locomotives received in interchange on unit trains are anticipated to be maintained by BNSF and not at the proposed maintenance facility. The only locomotive anticipated to be maintained by the proposed railroad are those needed for manifest service.

Daily servicing, such as fueling, window washing, cab interior cleaning, emptying of restroom retention tanks, and refilling locomotive traction sand would occur outside at the fuel track.

Rolling Stock

For the rolling stock, it is reasonable to assume occasional repairs are required to railcars received in interchange or while operating over the line. Repairs will be conducted in accordance with interchange agreements. Anticipated activities for the rail car maintenance facility would include repairing defects found upon inspections, such as replacing brake shoes, repairing air hoses and steps, wheelset changeouts, unit exchange of brake valves, single-car air brake tests, and allowance for other minor repairs. Heavy repairs would need to be addressed on a case-by-case basis by equipment maintenance forces or third-party contractors.

Infrastructure Maintenance Activities

Track Maintenance

Per the Code of Federal Regulations (CFR) Part 213, track safety standards are associated with track class or the maximum operating speed for freight/passenger train operations. These are the minimum safety standards that are to be met when inspecting and maintaining a railroad. It is reasonable to maintain tracks to at least one class higher than the current track class.

Track maintenance activities will generally consist of track inspection, track maintenance, turnout maintenance, track surfacing, track undercutting, routine rail replacement, routine tie replacement, maintenance of grade crossings, and maintenance of active and passive grade crossing warning systems. General overviews of these activities are listed below:

- Track inspection at regular intervals, to verify that the railway meets the standards of care prescribed by the FRA when operating on railroad tracks.
    - All the routes except for Star Lake have preliminary operating speeds up to 45 mph, or FRA track safety standard Class 4 (60 mph freight). Per CFR Part 213 Subpart F Inspections[5], 45 mph is Class 4 track, which requires visual inspections for main track to be conducted twice weekly with at least one (1) calendar day in between inspections. Should the maximum operating speed be reduced to a lower class of track, the inspection frequency will be reduced accordingly. In the final design phase, as alignments are refined, an investigation could be conducted to assess the value of operating at a maximum speed of 40 mph versus 45 mph. The lower speed increases travel time somewhat, but conversely allows track inspection based on Class 3 track criteria (and thus allows for one (1) inspection per week, rather than two (2)).
    - There are also inspection requirements for switch inspection frequencies[6], rail inspection[7], and inspections specific to continuous welded rail (CWR)[8]. Other track assets with high wear will also need to be inspected frequently.
- Track surfacing and ballasting to maintain the surface and line of the ballasted track, with spot maintenance of isolated, problematic areas. It is assumed that, immediately after construction, some additional surfacing will be required as embankments and track settle slightly. Thereafter, surfacing intervals should increase substantially, and only isolated spot surfacing is anticipated to be necessary for approximately five to ten years, depending upon traffic levels.
- Ultrasonic rail inspection to detect internal flaws within the rail itself, conducted in compliance with 49 CFR Part 213.
- At this stage, no determination has been made with respect to tie type, whether concrete or wood. Tie replacement activities would need to be performed if wood ties are selected. If needed, spot tie replacement (a few ties at a time at specific locations, such as ties in switches) would be performed by the railroad's maintenance forces, while replacement of large quantities of ties would likely be performed by a contractor.
- Clearance inspections, as needed, to maintain appropriate horizontal and vertical clearances from fixed structures.
- Rail maintenance
    - Preventative rail grinding extends the life of the rail and rail replacement interval due to ordinary wear, curve wear and reduces the likelihood of occurrence for internal rail defects and other conditions. It removes fatigued metal from the rail head, improves wheel and rail interaction, and extends the life of the rail asset. This is typically done on a tonnage basis, first after installation and then periodically. Preventative grinding interval depends on curvature, truck type, and tonnage, and should be confirmed with a specific vendor. An example preventative

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[5] https://www.ecfr.gov/current/title-49/part-213/subpart-F
[6] https://www.ecfr.gov/current/title-49/section-213.235
[7] https://www.ecfr.gov/current/title-49/section-213.237
[8] https://www.ecfr.gov/current/title-49/section-213.118 and https://www.ecfr.gov/current/title-49/section-213.343

grinding interval for 136RE rail on wood crossties is an initial grind after 5 million gross tons (MGT) and then follow-up grinding at 15 MGT for curves sharper than three (3) degrees, 30 MGT for curves shallower than three (3) degrees, and 50 MGT for tangent track[9].

    - Rail replacement in sharper curves may be required. Outside contractors would perform rail replacement.

- Grade crossings, including asphalt approaches; crossing panels; signage and marking; and active warning devices (e.g., bells, flashing lights, and gates) will be regular maintenance items at crossings. Annual maintenance is assumed for each roadway crossing by type.

- Trackside ditching will need to be a periodic maintenance item to maintain and promote positive drainage away from the ballast section and embankment. There is a trade-off between the extra earthwork and extra cost associated with oversized ditches at construction versus the ongoing maintenance cost of ditches that are sized to match flow, but have little spare capacity to accommodate debris or sedimentation.

- Other annual track maintenance items include the maintenance of turnouts, rail lubricators, and wayside asset devices (i.e., dragging equipment detectors and hot box detectors, etc.).

- There will often be consumables that will be required to support track maintenance, including but not limited to specialty tools, drill bits, saw blades, fuel, etc.

- Access roads are anticipated at key locations, like structures and the interchange with BNSF. These roads will need occasional maintenance, which is anticipated to be performed by the railroad's maintenance forces with equipment like end loaders or backhoes.

While not directly related to track maintenance, the railroad maintenance department will be expected to maintain right-of-way (ROW) fence for properties adjacent to the railroad. In New Mexico, railroads are statutorily required to construct and maintain ROW fence that are sufficient to prevent livestock from getting onto the railroad, except at highway-rail grade crossings of public roads and highways, and the limits of towns, cities, and villages[10]. For this reason, ROW fencing maintenance must be considered for the proposed railroad.

Structures Maintenance

Track owners, such as the proposed railroad, are responsible for a Bridge Maintenance Program (BMP). This includes keeping an accurate inventory of railroad structures, recording the load capacity of bridges railroad structures, maintaining design records of railroad structures, inspecting structures, and documenting repairs, modifications, and inspections of structures.

The maintenance of newly constructed railroad bridges and drainage structures will be minor early in their lifecycle (e.g., the first 20-years of their life). Routine maintenance will be focused on maintaining safe walking conditions, adequate stream flows under and through drainage structures, removal of brush or obstructions from bridges and culverts, and annual inspections (at a minimum). The BMP will need to distinguish if special inspections are required for some structures, such as bi-annual inspections for critical structures, underwater (scour), seismic, cursory inspections of overhead bridges that are not the responsibility of the railroad, and other specially

[9] https://loram.com/wp-content/uploads/rail-grinding-best-practices-sroba.pdf
[10] https://nationalaglawcenter.org/wp-content/uploads/assets/fencelaw/newmexico.pdf

designated inspection. Inspections may be self-performed by a qualified person or contracted out to designated person.

Non-routine maintenance and repairs of railroad structures or repairs requiring design may require the use of contractors to perform the design and construction activities unless the proposed railroad has qualified personnel to conduct this work. Owing to the specialized nature of structures design and construction, it is assumed that contracted forces will perform this work.

Signal and Communications Maintenance

The only signals on the proposed railroad are expected to be grade crossing signals and wayside detectors (such as hot bearing detectors and dragging equipment detectors. Highway-rail grade crossings equipped with active warning devices such as flashing light signals, automatic gates, and similar devices, will need regular inspections and maintenance in compliance with 49 CFR Part 234 Grade Crossing Safety, by signal forces. Wayside detectors will be inspected in accordance with manufacturer's recommendations and industry practice.

Wayside signals are not anticipated on the proposed railroad. BNSF trackage at the proposed interchange locations is not signalized.

The proposed railroad is anticipated to request a waiver from Positive Train Control requirements based on a lack of Poisonous by Inhalation Hazard traffic and lack of passenger traffic.

Railroad Facilities

There will also be general maintenance requirements for proposed railroad facilities as identified in Subtask 4.3, Support Facilities and Access Analysis. These facilities will themselves require some level of maintenance (e.g., regular cleaning, replacement of consumables such as locomotive sand, etc.).

Several railroad support facilities are likely required to support the operation of the UBRY and its maintenance practices. Some of these facilities include:

1. Locomotive and rail car maintenance facility.
2. Transload facilities.
3. Unit train loop track.
4. Maintenance-of-Way (MoW) facility.

Locomotive and Rail Car Maintenance Facility

This building will facilitate locomotive and MoW equipment repair and house employees and their offices. Typical maintenance items for this facility include maintenance of typical building systems, overhead bridge cranes, maintenance and inspection of an oil/water separator, maintenance and inspection of an on-site wastewater treatment plant, minor maintenance of equipment doors, light bulbs, and regular cleaning of the facility, offices, and restrooms.

Adjacent to the locomotive maintenance facility will be the car repair tracks, consisting of an outdoor work area with designated storage bins. A parallel roadway will need to be maintained to ensure good footing and access to the work area.

Locomotive Servicing Area

A locomotive servicing area (fuel shed) and servicing track is near the locomotive and rail car maintenance facility. Fueling, watering, sanding, and sanitary waste extraction will be performed on this track. Direct-to-Locomotive (DTL) technology will be used and will eliminate the need for fueling racks. Roadway access will need to be maintained on either side of the servicing track to accommodate fuel truck or septic cleaning truck to access the locomotives for servicing and emptying sanitary retention tanks. A drip pan will capture liquids that will then be directed to an on-site industrial wastewater treatment plant and oil/water separator.

Transload Facilities
Roadway access will need to be maintained to the dry transload facilities. Security and lighting are important to maintaining a "24/7" transloading operation. Otherwise, the transload facility is largely a paved, open pad area and, as such, requires little or no maintenance. It is not anticipated that liquid transload will occur at these facilities and no secondary containment system is anticipated.

Unit Train Loop Track
This track facility is used to unload or load bulk dry materials by truck to or from a storage area for loading/unloading from trains. In addition to ordinary track maintenance, the sharp curvature of the loop may require rail lubrication to lessen rail and wheel wear, and reduce friction, wheel slippage, and potential noise from a train advancing through the loop.

Bulk material loading and unloading equipment, such as conveyors, dust collection equipment, and scales, may have specific maintenance requirements, but the equipment maintenance plan will need to be developed in conjunction with the needs of specific users and the manufacturer's recommendations.

Maintenance-of-Way (MoW) Facility
This facility is used to store materials and equipment associated with maintaining the ROW and railroad infrastructure. It would have track assets at the facility that would allow on-track equipment and track cars to be stored within the same area, as well. The site would need to be kept level for driving work equipment and footpaths, kept weed-free, and roadway access maintained.

Staffing Plan

A Staffing Plan identifies anticipated personnel requirements. It is assumed that one staffing plan will be representative for all the Route Options, since all Route Options are approximately the same length, have generally similar topography, are expected to have similar infrastructure characteristics, and are expected to have the same revenue tonnage regardless of route.

Direct employment requirements for operations and maintenance of all Route Options are estimated to be approximately 37 full-time railroad employees for three trains each way per day for the "high" forecast volume scenario detailed in Subtask 4.1.

- **Train, Engine, and Yard (TE&Y): 18 employees**
    - 16 - Train Crew: It is assumed that, like many short line railroads, train crew positions will be cross-trained so that any train crew person can serve as either a locomotive engineer or conductor. Train crew staffing is based on the following assumptions:
        - One (1) two (2)-person train crew (one (1) engineer, one (1) conductor) can make one (1) round trip per day.
        - Three (3) round trips per day, seven (7) days per week, are required to handle the traffic.
        - This results in 21 crew shifts per week. Each shift is anticipated to last from 10 hours up to 12 hours.
        - Each two (2)-person crew will work three (3) shifts per week.
        - Thus, seven (7), two (2)-person crews are required, at minimum. This would be 14 people.

    - An additional two (2) crew members, cross-trained for any position, would be available as "spares" to cover vacations, holidays, and "patching" crews that exceeded federally mandated hours of service limitations.
  - 2 – Train Operations Supervisors: Manages, schedules, and coordinates the activities of workers on the main line and in rail yards and develops and reviews train consists. Coordinates interchange with BNSF and adjusts crew schedules as needed. It is assumed that this position would be cross-trained and could also support train operations if the need arises. These positions also serve as Designated Supervisor of Locomotive Engineers to oversee crew qualifications.

- **Maintenance of Way (MoW): 10 employees**
  - One (1) – Foreman: Responsible for the direction of crews involved in the construction, maintenance, and repair of railroad assets. Cross-trained as a track inspector.
  - One (1) – Track Inspector: Inspects railroad track and other assets to ensure compliance with railroad standards, state regulations, and FRA Track Safety Standards (CFR Part 213). Cross-trained as a foreman.
  - Two (2) – Track Worker / Truck Driver: Work as a member of a crew to maintain existing track and right-of-way.
  - Two (2) –Equipment Operator: Operate equipment, such as tamper, ballast regulator, backhoe, and rented equipment such as end loaders. Works in conjunction with track workers and Foreman to supplement track crew when there is no need for equipment to be operated.
  - Two (2) – Welder: Repair and maintain all aspects of rail including frogs, switch points, glue joints, and destressing using arc, propane, or thermite welding processes.
  - One (1) – Roadway Mechanic: Troubleshoot, repair, and maintain heavy off-track equipment and roadway machinery.
  - One (1) – Signal Maintainer: Assist in the repair and maintenance of railroad crossing signals & communications equipment. Due to minimal equipment, it is assumed that after-hours support and vacation time for the one full-time employee would be handled by contractors.

- **Mechanical: Four (5) employees**
  - Two (2) – Diesel Mechanic: Inspect, service, repair and maintain diesel locomotives.
  - Two (2) – Carmen: Inspect and repair railroad cars. One carman maybe utilized at the BNSF Interchange dependent on interchange conditions to assist with train / airbrake inspections and hostling of locomotives.
  - One (1) – Utility Worker: Services and cleans locomotives, transports supplies between work areas and storage areas, and performs a variety of other activities to support locomotive and car repair activities.

- **Supervisory: Five (5) employees**
  - One (1) – General Manager: Oversight for entire operation.
  - One (1) – Engineering Supervisor: manages track, signal, and structures, management of safety and training for MoW crews.
  - One (1) – Train Master: oversight of train operations, management of safety and training for TE&Y crews, shipper interface.
  - One (1) – Mechanical Manager: Oversight of locomotive and car maintenance.
  - One (1) – Administrative: supports regulatory administrative tasks, administrative activities associated with equipment interchange, and purchasing activities.

- **Contracted Services:**
  - **Dispatching:** Several companies provide dispatching services for short line railroads on a contract basis. This provides 24-hour coverage for the client railroads, with no need for a separate staffing

plan, hour of service recordkeeping and restrictions, etc. It is assumed the proposed railroad will contract for dispatching.

- **Crew transport services:** When needed, it is assumed a crew van (e.g., to transport a crew to a train whose crew is about to exceed hours of service limitations) would be contracted. The BNSF main line regularly requires crew van services, and it is assumed that the same companies can provide service to the proposed railroad on an as-needed basis, rather than the proposed railroad staffing a full-time crew van.
- **Accounting and bookkeeping:** contracted accounting and bookkeeping services for recordkeeping, invoicing customers, etc.
- **Information Technology (IT):** IT support would be from one of many contract vendors catering to small businesses.
- **Heavy equipment:** Specialized equipment, such as dump trucks, end-loaders, etc., would be rented from equipment rental operators, such as Hertz Equipment Rental, Sunstate, or others.
- **Extra track, signal, and structures maintenance and major repairs**: since it would not be financially viable to have spare personnel for every eventuality, it is assumed that local track and signal contractors would be on-call to supplement the railroad's own staff.

Support Equipment Fleet

The equipment fleet needed for infrastructure maintenance is indicated below:

- Four (4) - Pickup trucks: one each for the foreman, track inspector, roadway mechanic, and signal maintainer.
- One (1) – Boom truck/gang truck: three (3)-axle boom truck with crew cab to accommodate five (5) people.
- One (1) – Trailer for boom truck
- One (1) – Ballast tamper
- One (1) – Ballast regulator
- One (1) – Backhoe (e.g., John Deere 410, Cat 416)

The equipment fleet needed for mechanical activities includes:

- Three (3) – side-by-side or "Gator" small all-terrain vehicles for inspecting trains – two (2) to remain at NAPI and one (1) to remain at the BNSF interchange area.
- One (1) – Battery powered forklift for use inside shop.
- One (1) – Off-road forklift for use at car maintenance facility and for general use.

The equipment fleet needed for supervisory and support staff is indicated below:

- Five (5) – Pickup trucks: one (1) each for the general manager, mechanical manager, train master, engineering supervisor, and train operations supervisor

The roadway mechanic would handle maintenance of the off-road equipment fleet and minor maintenance of vehicles. This would include changing fluids, replacing worn parts (such as backhoe bucket teeth), replacing hydraulic hoses, preventative maintenance, etc. Heavy maintenance of off-road vehicles (e.g., engine overhauls) would be performed by outside vendors; due to industrial activity in the area, these vendors are locally available or, at the very least, available in Albuquerque, New Mexico. On-road vehicles (pickup trucks, boom truck) would be maintained at local dealerships.

Training Program

Below is an outline of the training requirements for various disciplines and possible methods to deliver that training to the staff. Proper training and qualification for railroad personnel is critical to ensuring that employees possess the knowledge, skills, and abilities necessary to perform their jobs safely and effectively. Fundamentally, the purpose of training program is to provide a safe work environment, promote safe practices, and ultimately protect both property and human health and safety.

Any person employed by a railroad or a contractor of a railroad as a safety-related railroad employee must have training. CFR Part 243 - Training, Qualification, and Oversight for Safety-Related Railroad Employees details the general minimum training and qualification requirements for each category and subcategory of safety-related railroad employee, regardless of whether the employee is employed by a railroad or a contractor of a railroad[11]. Note that contractors shall coordinate with railroads and comply with the contents of CFR Part 243, including those aspects of training that are specific to the contracting railroad's rules and procedures.

The proposed railroad will develop a CFR Part 243-compliant training program that generally includes:

- Occupational categories and subcategories of employees for which the training applies.
- Courses that cover specific content related to the class of employee and the type of work they will be performing.
- The method of delivery pf the course which may include, but are not limited to, classroom, computer-based, on-the-job (OJT), simulator, laboratory, correspondence courses, or any combination thereof.
- The kind of assessment (written test, performance test, verbal test, OJT standard, etc.) performed to demonstrate employee competency.

Training records will need to be maintained in such a way to demonstrate the qualification status of each safety-related railroad employee. The proposed railroad will also need to include a plan to conduct periodic oversight tests and inspections to determine if safety-related railroad employees comply with federal railroad safety laws, regulations, and orders particular to FRA-regulated personal and work group safety.

Training will be based on the requirements in 49 CFR Chapter II, which includes the minimum safety requirements for railroads and the minimum training requirements for staff. Note that FRA regulations take precedence over Occupational Safety and Health Administration (OSHA) regulations. However, where the FRA regulations are silent, OSHA regulations apply. Thus, OSHA training will also be required. A full list of every training course is beyond the scope of this document.

Railroad employees and contractors would also be subject to the provisions of FRA Part 219 Control of Alcohol and Drug Abuse and subject to testing.

As a new railroad, extra attention would need to be paid to training at start-up, since all staff will effectively be “new” and there will be no pre-existing staff from which employees can learn how the railroad operates. The Federal Transit Administration has a process known as a “Hazard Analysis” which systematizes the identification, elimination, or mitigation of potential hazards; this process may be adopted for the proposed railroad. In addition, it is likely that, upon posting notification of job openings, the proposed railroad may have interest from employees of other railroads. Their experience may (to the extent it does not replicate “bad habits”) be helpful in mentoring new staff unfamiliar with the railroad environment.

Safety training presented to proposed railroad employees would be based on and specific to employee job classification. For example, maintenance employees would be trained regarding the proper use of tools and

[11] https://www.ecfr.gov/current/title-49/part-243

equipment. It is important to note that training efforts and programs may entail not only formal in-class training but also on the job training that is overseen by a supervisor, human resources manager, or veteran employee.

It would be the responsibility of managers and supervisors to not only oversee employee work practices and performance, but to also enforce rules and procedures, as well as to ensure that employees are properly trained to perform the duties with respect to their job classifications in a safe and efficient manner. When an employee's duties change, it would be the responsibility of the manager or supervisor to ensure that the employee is retrained, as necessary. It would also be the responsibility of managers and supervisors to ensure personnel receive training regarding potential hazards associated with or encountered within employee work areas.

When contractors work on the proposed railroad, especially under day-to-day operating conditions, training as required by the FRA would be applied to all members of the contractor workforce.

DATA COLLECTION

Data collection will include utilizing information from the Freight Demand Forecast developed in Task 2 and the Route Options developed in Task 3, and Subtasks 4.1 and 4.3.

APPENDICES

- Appendix A – Train Performance Calculator Results
- Appendix B – Stringlines