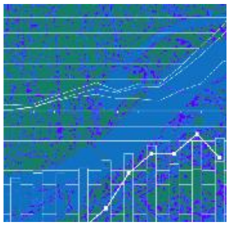

Humboldt Bay Alternative Rail Corridor Concept Level Construction Cost and Revenue Analysis

Final Report

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Humboldt Bay Alternative Rail Corridor
Concept Level Construction Cost and Revenue Analysis

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Executive Summary

BST Associates, along with the Burgel Rail Group, was retained by the Humboldt Bay Harbor, Recreation and Conservation District to examine the concept of restoring rail service to the Samoa Peninsula, either through restoration of the existing North Coast Rail line or through construction of a new east-west rail corridor linking the Humboldt Bay region with the mainline rail system near Red Bluff.

This analysis involved two main tasks: in the first task, the Burgel Rail Group developed preliminary cost estimates for constructing a new east-west alignment to the Red Bluff vicinity, as well as for reconstructing the existing North Coast Rail corridor. In the second task, BST Associates estimated the volume of cargo that would be required to cover construction costs if the project were to be self-financed, based on the net revenue generated per ton of cargo. This analysis assumes that the project would be financed through bonds, and the analysis used a range of interest rates to illustrate both public and private financing.

The goal of this analysis was to provide a preliminary estimate of the volume of rail cargo needed to make rail service to Humboldt County economically viable. The focus of this analysis is dry bulk cargos such as coal, iron ore, grain, potash, and others. The identification of these commodities was not intended to provide a market analysis for a rail line to the Humboldt Bay region, and makes no recommendations regarding potential rail cargo. Rather, these commodities were chosen due to the fact that they now move by rail in high volumes, and that these existing movements provide the revenue and cost data needed to estimate the volume of rail cargo required to finance a rail line to Humboldt Bay.

Because the focus of this analysis was high-volume cargoes, containerized cargo was not included. The concept of a container port on Humboldt Bay has been the subject of several past studies, and the cost estimates presented in this analysis assume that the rail corridor would support double-stack container operations. However, given the relative strength of the bulk cargo markets compared with the container market, bulks represent a stronger potential market for a Humboldt rail line at this time.

Conclusion

Rail service to Humboldt County will require a major investment, through either a new East-West rail alignment or through reconstruction of the former North-South line. In order for this investment to be financially feasible, the rail line will need to generate large volumes of cargo.

A rail line to Humboldt County would face strong competition from existing ports, primarily those on the U.S. West Coast. Humboldt County would face several competitive disadvantages relative to these other ports, including the need to cover the cost of constructing the new line, and the lack of a rail distance advantage.

In addition to the lack of rail infrastructure, waterborne exports of large volumes of bulk commodities (or containers) would likely require substantial investments in new cargo terminals. Also, the Humboldt Bay navigation channel is not as deep as that at most of the competing ports, which would also require a substantial investment.

In conclusion, development of rail service to Humboldt County is likely to be both high cost and high risk.

Humboldt Bay Rail Analysis

Introduction

BST Associates was retained by the Humboldt Bay Harbor, Recreation and Conservation District to examine the concept of restoring rail service to the Samoa Peninsula, either through restoration of the existing North Coast Rail line or through construction of a new east-west rail corridor linking the Humboldt Bay region with the mainline rail system near Red Bluff.

BST was founded by Paul Sorensen in 1986, and specializes in economic and financial evaluations of port and transportation projects. BST Associates expertise focuses on: financial planning (including bond feasibility studies), rate/tariff assessments, sensitivity analysis, market research, strategic planning, demand forecasting, benefit/cost analysis, cost effectiveness analysis, economic impact assessment, life cycle cost analysis, and project risk assessment. BST Associates has worked on several past projects in the Humboldt Bay region, including the *Port of Humboldt Bay Harbor Revitalization Plan* (2002), and the *NCRA Freight Rail Demand Assessment* (2002). BST Associates has completed port and transportation projects for most West Coast ports, including San Diego, Los Angeles, Long Beach, Oakland, San Francisco, Richmond, Coos Bay, Astoria, Longview, Kalama, Vancouver (WA), Portland, Grays Harbor, Seattle, Tacoma, Olympia, and others.

BST Associates worked closely with the Burgel Rail Group (BRG) on this project. BRG is led by Bill Burgel, who has more than 41 years of experience in engineering and railway operations. He has managed railway operations for several consulting companies and served as project manager/project engineer for railway and transportation engineering projects throughout the nation. Mr. Burgel understands the operations of railroads, including freight/materials movement, and passenger railroad traffic flow issues. He is a recognized expert in solving interface and capacity issues between the different modes. Mr. Burgel understands the importance of the total integration of a rail system in a corridor throughout the planning, design and implementation phases.

The current Humboldt Bay Rail Analysis involved two main tasks:

Task 1 – Preliminary Cost Estimates. In the first task, the Burgel Rail Group developed preliminary cost estimates for constructing a new east-west alignment to the Red Bluff vicinity, as well as for reconstructing the existing North Coast Rail corridor. Cost estimates for the east-west alignment were based on visual analysis of potential routes, conducted by air and by ground, as well as analysis of topographic maps, previous surveys, and other available information. The cost estimate for reconstructing the North Coast Rail alignment was based in large part on previous analyses of this line, updated with current costs.

Task 2 – Estimated Cargo Volumes. In the second task, BST Associates estimated the volume of cargo that would be required to cover construction costs. These estimates were developed using total revenue, total railroad cost, and net railroad revenue. Average revenue per ton-mile was based on current rail moves of various potential cargo types, using data from the Surface Transportation Board (STB). Railroad costs were estimated using the revenue to variable cost (RVC) data developed by the STB, and net revenues were estimated by subtracting cost from gross revenue. Based on this net revenue, the total volume of cargo required to covered costs was calculated.

The focus of this analysis is high-volume rail-served cargoes. Specifically, these included dry bulk cargos, such as coal, iron ore, grain, potash, and others.

Overview of Rail Service to Humboldt County

The following section was prepared by the Burgel Rail Group.

History

Beginning in 1902, the Humboldt Bay Region was served by the former Northwest Pacific (NWP) line of the Southern Pacific (SP). The NWP was an amalgam of over 43 different rail companies, including the Eureka & Oregon, which the SP pieced together with the Santa Fe Railway until that company's ownership was bought out by SP in 1929. The NWP connected the communities of Trinidad, Arcata, Samoa, Korbel, Blue Lake and Eureka with communities in Mendocino, Sonoma and Napa counties as well as the national rail network.

The railroad's alignment generally paralleled the northwest/southeast trending topography that resulted from ancient and on-going geologic processes associated with terrane and marine sediment accretion related to the Gorda Plate Subduction Zone. These processes create a series of ridges and valleys that run parallel to the Pacific Coast. The northern portion of the NWP rail line generally followed the Eel River through one of the valleys then crossed over a divide near Willits eventually dropping in the Russian River drainage until reaching Santa Rosa. US Highway 101 roughly follows this same path.

While owned by Southern Pacific, the primary traffic transported by the railroad was lumber and other forest products generated by the numerous sawmills located in Humboldt County and along the rail corridor. This business was routed south along the NWP to the SP main line near Vallejo, and then routed to the SP yard in Roseville (near Sacramento) for eventual transport to the product's final destination.

Throughout its history, the NWP was difficult to maintain and keep in service. In fact, the rail corridor has been out of service since the portion of the rail line most difficult to maintain (Eel River canyon near Dos Rios) washed out in 1998 and has not yet been placed back in service. Even before that washout, however, the number of carloads moving on the line had decreased, and in the 1980's SP sold portions of the line at various times to a shortline operator.

Even though the NWP continued to generate traffic into the 1990's, SP decided to sell the line due in part to its high maintenance costs. These costs were two to three times higher than on other branch lines owned and operated by SP. Limited shipments continued under the new ownership until the line washed out in the Eel River Canyon. The Federal Railroad Administration (FRA) embargoed the railroad in 1999, with only the southern portion south of Windsor reopened in 2011.

Current Situation

Lumber and forest products continue to be produced by Humboldt County mills. A portion of the output from these mills is currently transported over the North Coast Range to transload operations (locations where cargo is transferred from truck to rail or vice versa) located in the Redding area, via California Highway 299 that connects the Arcata/Eureka area with Redding.

Once the cargo is loaded onto a railcar in Redding, it is moved on Union Pacific (UP) "through" trains to its ultimate destination. The California Highway 36 corridor, located south of Eureka, is also used to transport a small amount of cargo. However, because of the tight curvature of this highway, trucks are limited to less than the California Legal length.

The Sacramento Valley is also a major center of agricultural production that generates significant volumes of export commodities. These commodities are currently shipped by rail or truck to ports in the Bay Area, as well as Sacramento and Stockton.

Preliminary Cost Analysis

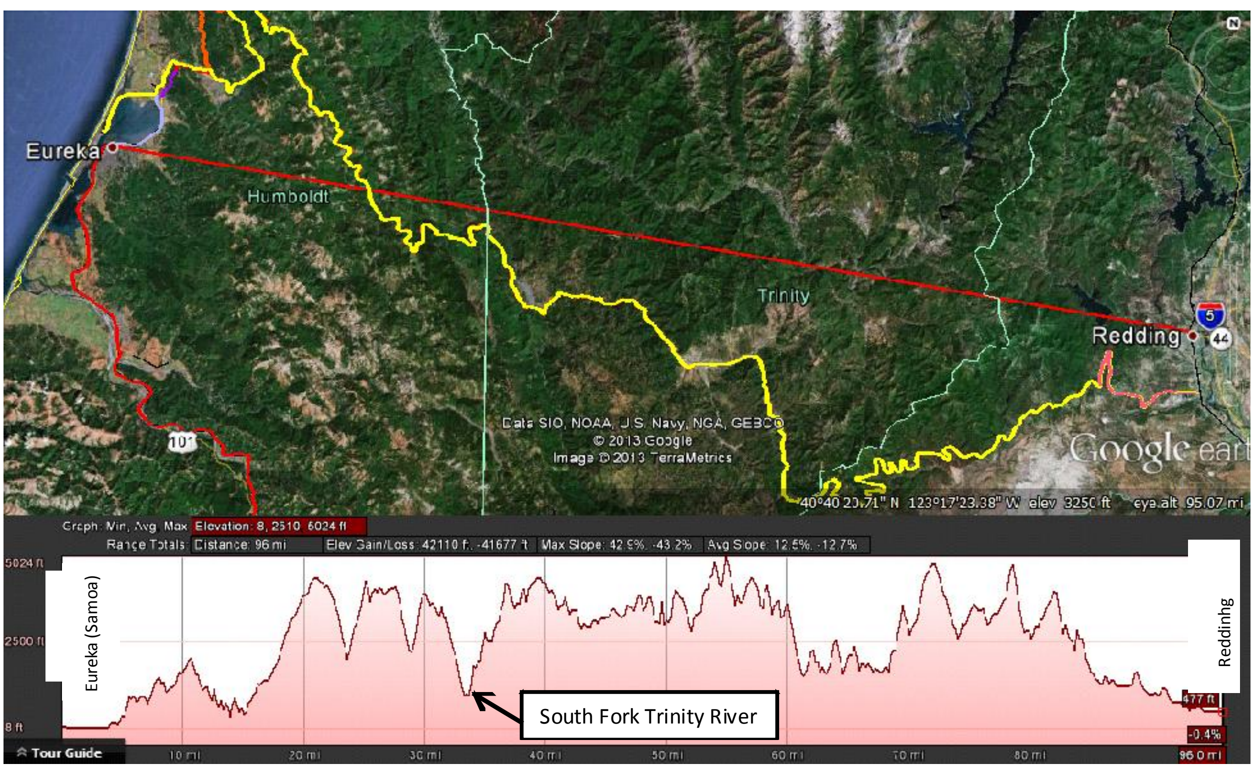
Regional Setting

Proponents of rail service to the Humboldt Bay region have suggested that an alternative east/west rail route that roughly parallels the existing truck route might better serve their commercial interests. In this analysis three potential routes have been suggested that begin in the Eureka/Arcata/Samoa area and extend east to Union Pacific railheads in Redding, Red Bluff and/or Gerber. A fourth route was also examined connecting some of the portions of the three routes with a direct connection to Red Bluff. The ultimate interchange location would likely be a decision for the Union Pacific based on what would make it operationally functional. None of the potential routes provides a connection to the Burlington Northern Santa Fe (BNSF). The potential routes are briefly described in the next section and are examined in depth in the body of the report.

The proposed east/west rail routes begin at Humboldt Bay and trend eastward through the very mountainous North Coast Range. The route profile presented at the bottom of Figure 1 demonstrates the extreme ruggedness of a potential east-west route. This route cross-section shows the ridges and valleys that lie along a direct route between Eureka and Redding, represented by the red line in the satellite image at the top of Figure 1.

As illustrated, a number of prominent ridges and valleys must be crossed between Eureka and Redding. Because trains can only climb 50 to 80 feet per mile, ridges that climb more steeply than that present difficulties in laying out a rail alignment. The direct 94-mile route between Eureka and Redding contains six or more such ridges. As with other western rail routes, the challenge is to design an alignment that provides the best trade-off between costs (construction and operations) and train operating speeds.

Figure 1 – Topography of Potential East-West Rail Route



Proposed Rail Routes

Three routes were developed for this analysis, including:

- Rail route #1 – Blue Lake Alignment
- Rail route #2 – Alton Alignment
- Rail route #3 – Eel Canyon/Southern Alignment

For the purposes of this report, all alignments use Cookhouse Road in Samoa as the initial milepost (MP 0.0). The analysis used three potential locations in the Sacramento Valley for interchanging rail traffic with the Union Pacific (UP), which included Redding, Red Bluff and Gerber.

For sections where a rail alignment route currently exists, this analysis used the existing alignment. For costing purposes however, the trackage will be upgraded to at least 115-pound rail (or better) and bridges to accommodate the 286K loading that is standard for bulk trains and containers. Although the market analysis in this report focuses on bulk shipments, the cost estimates assume that existing tunnels will be “cleared” to accommodate high-cube/double stack container rail equipment, so as to not preclude that type of traffic. Industry accepted unit costs were used. In 1909, Jess Lentell described two alignments which are also included in the analysis.

Railroad Engineering Basics

Since the 1830’s, railroads throughout the nation have generally followed river valleys and gentle plains as they connect cities and industry along their routes. Locating a railroad along routes with favorable topography had not only a direct impact on their capital costs (CAPEX) but over time reflected lower operating and maintenance (O&M) costs. If a competing railroad had already occupied a desirable river valley alignment, the next-to-build railroad had no choice but to locate on less desirable terrain with its attendant higher CAPEX and O&M costs.

Building westward from the Atlantic seaboard however, the nation’s railroads had no choice but to climb up and over the Allegheny Mountains. They did this on a 2.25% grade connecting the Potomac River grade near Cumberland, Maryland with Pittsburgh. Once west of Pittsburgh, the flat farmlands and prairies presented little opposition to the construction of hundreds of miles or railroads until the Rocky Mountains were encountered. In the building of the nation’s first transcontinental railroad, President Lincoln recognized that building in mountainous terrain was much more difficult than the flatland and paid out a subsidy three times as much ($48K/mile vs. $16K/mile for flat terrain).

Today, the agreed-upon design criteria for an optimal maximum railroad gradient is generally around 1.0%. Certainly steeper gradients are commonly encountered but seldom exceed the 2.25% grade that was initially used to lay out the first mountain crossing (this corridor, CSX’s main line, is still in use today).

Ideally, a railroad is located on as flat a grade as possible. In this manner, operating speeds can be optimized; once a hill is encountered, then velocities both for ascending as well as descending trains can be affected. If the railroad is composed of fairly gentle curves, sufficient horsepower can be placed on the train to allow ascending trains to achieve track speed. In other words, if a 1.5% gradient is encountered, one of the Class 1’s (a railroad such as BNSF or Union Pacific) can equip an important train with approximately 4.0 horsepower per trailing ton and the train can achieve speeds of 60 mph to 70 mph up the grade.

Descending a grade can be a problem, however, as it is necessary to control the speed of the down-slope train by using one or both of two braking methods: setting the air brakes on the train and/or using the dynamic braking located on the locomotives.

Braking on steep gradients in excess of 2.0% creates a problem, especially for heavy trains; once a train picks up speed, it is difficult to slow down. Accordingly, many railroads invoke a calculation known as Tons per Operative Brake (TOPB) which limits trains to fairly slow speeds (usually in the 20 mph to 25 mph range) as the train descends the grade.

This practice is similar to the speed restrictions placed on semi-trucks that are descending a mountain pass. In this example, the authorized truck speed is a function of the cargo weight being transported by the truck; the heavier the lading, the slower the maximum speed the truck is allowed on a steep descending grade.

In addition to steep grades, railroads traversing mountainous terrain are often characterized by numerous curves. Curves sharper than two and a half to three degrees will affect the operating velocity. For instance, a five degree curve can be negotiated at no faster than 40 mph. This speed is normally adequate for most freight trains. When curvature reaches ten degrees, however, the speed drops to 20 to 25 mph.

When combining grades and curves, the gradient must be lessened to compensate for the increased resistance a train experiences while pulling through a curve or series of curves. This factor is very important in assessing the amount of horsepower to place on a train. Without the curves, a train might otherwise be able to ascend a grade; however, the curves offer enough resistance that the train will stall if the grade has not been "compensated". For this analysis, a gradient of 1.5% is recommended as this slope, at 80 feet of rise or fall per mile, allows trains to operate at track speed on both the ascending and descending grades. Given the numerous curves likely to be encountered, the compensated curves will likely require the same horsepower as a 1.75% grade would require.

Route selection of a railroad by the pioneers combined all these factors. However, if a mountain range was encountered, the optimum grade sought after by all railroad scouts was a gentle grade that sloped upward (or downward) in the direction of travel that matched the gradient necessary to cross the pass ahead. This geographic feature was known as a "gangplank" and the most famous one was discovered by General Grenville Dodge when scouting a route for the first transcontinental railroad, the Union Pacific, just west of Cheyenne, Wyoming. Another key factor in mountainous railroading is to maintain as level a grade as possible. If a scout had a choice between maintaining a level route that was, for instance, 10 miles longer than a route that descended 500 feet then regained this same elevation, the more expeditious alignment might be the one that maintained the level alignment. This is due to the fact that train handling, locomotive horsepower assignments, and fuel consumption are all likely to be improved on the flatter but longer route.

The Federal Railroad Administration has designated Class of Track as a function of its track condition and geometry with associated maximum allowable speeds. According to a summary presented in *Trains Magazine*, the first primary freight rail line classifications include:

- Class 1: 10 mph for freight, 15 mph for passenger,
- Class 2: 25 mph for freight, 30 mph for passenger,
- Class 3: 40 mph for freight, 60 mph for passenger, and
- Class 4: 60 mph for freight, 80 mph for passenger.

Class 3 commonly includes regional railroads and secondary main lines, while Class 4 is the dominant class for main-line track used in passenger and long-haul freight service.

For the purposes of this study, the components that make up the track will likely be new or good second-hand material. The track will nominally be rated at Class 3 (40 mph) in order to provide acceptable service speed. However, because the actual curve geometry has not been determined, this rating is advisory only and the actual track class must wait until the railroad is more precisely located and the degree of curvature for each curve determined. This is an iterative process that goes hand-in-hand with grading volumes and over all construction costs. For example, if a modest-size side canyon is encountered while laying out the railroad, grading costs could be minimized if the curve is sharpened with minimal fill placed in spanning the side canyon. However, if this curve is perhaps the only curve in the vicinity that would otherwise limit an unrestricted timetable speed, then it might make sense to straighten out the curve and by doing so, increase the amount of fill (at higher costs) required to construct a more tangent subgrade.

Route Selection of a Railroad in the North Coast Range

Route Design Considerations

When designing a rail corridor, the factors discussed in the previous section must be evaluated in terms of the intended use of the railroad. One of the first questions to be addressed is whether the proposed railroad will be primarily passenger or freight.

Assuming that the primary rail traffic will be freight, modest grades not exceeding 2.0 degrees are recommended. Curves should be no sharper than 5.5 degrees.

Because the Coast Range in Northern California is rugged and steep, it is likely that numerous curves will be encountered as the proposed rail routes ascend and descend the multiple ridges between the Pacific Coast and Central Valley. For this reason, curves up to ten degrees and perhaps sharper are likely.

The location of restricting curves will have a significant impact on what train speed can actually be attained. For example, if the maximum allowable speed on a proposed route is 40 mph, but the route contains curves approximately every mile with speeds restricted to 25 mph, the entire corridor will effectively be operated at 25 mph. Typical dry bulk trains can have 100 cars or more and stretch for more than a mile, and the entire train must pass through the restricted curve at 25 mph before the head-end can accelerate. If restricted curves are located roughly a mile apart, then the head-end of the train will be entering another restricted curve just as the rear of the train clears the first curve.

Realistically, given the relatively slow acceleration and deceleration of a freight train, if restrictive curves are located every two miles apart, then the effect will likely be the same; namely that the entire railroad will operate at 25 mph instead of the desired 40 mph.

A grade of 1.0% climbs or descends approximately 50 feet for every mile traveled, and a grade of 2.0% climbs of descends approximately 100 feet per mile. If a proposed route crosses a mountain pass that is 3,000 feet in elevation and this pass is located 60 miles from the beginning of the line, the average grade along the route would be 1% (i.e. 50 feet per mile x 60 miles = 3,000 feet).

However, in this example there may be places where the ascending grade crosses relatively flat areas. If 50 feet of elevation is not gained over every mile, then the route must be lengthened in order to maintain the 1% grade. Therefore, terrain must be located that allows the track to continue to ascend.

As a second example, if the 3,000-foot pass is located only 30 miles from the beginning of the line, then either the grade must be steepened to 2.0% (100 feet per mile x 30 miles = 3,000 feet), or the line may be lengthened by an additional 30 miles to maintain a 1.0% grade. This additional mileage can be achieved by incorporating switchbacks and loops in order to gain or lose elevation in a gradual and uniform manner.

Rail Route Analysis

Burgel Rail Group (BRG) was retained by the Humboldt Bay Harbor, Recreation and Conservation District to conduct the rail route analysis. The inspection team was led by Mr. Bill Burgel, principal of BRG, who has an extensive background in rail engineering and operations as well as a professional understanding of geology.

The east/west rail routes were examined during a three day period beginning April 22nd through April 24th, 2013. The reconnaissance included a fly-over of Rail Route #1 that began on April 22nd by flying north to Fieldbrook then turning 180 degrees to then follow the west flank of Redwood Creek to South Fork Mountain, then a flight long Hayfork Creek to Wildwood with a continuation of the flight toward Platina. After following the Platina-Redding Road for approximately 20 miles, the flight recon then followed Rail Route #2 from a location southeast of Platina then along the South Fork of the Trinity River until reaching the ridge crest of South Fork Mountain. From Dinsmore, the flight followed the Van Duzen River Canyon then Hwy 36 until reaching Hwy 101 which concluded the flight inspection.

Figure 2 – Aerial View of the Van Duzen River Along Highway 36 West of Carlotta

Source: Burgel Rail Group

On April 23rd and 24th, Rail Routes #1 & #2 were surveyed by driving along the prescribed alignments. This windshield survey included an inspection of the terrain on either side of Highway 299 from its intersection with Hwy 101 east to the general vicinity of Lord Ellis Pass. The inspection also included a drive along Hwy 36 to Bridgeville, then north along Kneeland Road to the 2500 foot elevation to observe the Van Duzen River Corridor. The driving inspection continued east through the community of Mad River, over South Fork Mountain and through Forest Glen as well as the Hayfork River Canyon from Hayfork to Hyampom.

Over 800 photos were taken of the region through which these rail routes are proposed. Using the railroad basics discussed in the section above, the various alignments that connect Humboldt Bay communities with the Central Valley were plotted using Google Earth. This tool saved countless man-hours of route analysis plus the added expense of acquiring the necessary USGS Quadrangle topographic sheets for the various routes. Google Earth allows a route to be depicted and saved on a map by placing a “node” at the proposed location and elevation. By connecting these nodes, an alignment can be produced that displays the route at the proper gradient. By right-clicking, a profile of the route can be generated that shows route mileage, gradient (general and specific) and other pertinent features. Sites where bridges and tunnels will be required can also be determined using this technique. Google Earth cannot produce quantity estimates of cuts and fills necessary to accurately determine grading costs. At this scale of examination, the degree of curvature for each curve along the various alignments was not calculated although this type of analysis could be performed during future studies.

Existing reports were also reviewed including the 1909 Lentell alignment (which is, apparently, the general trend of Rail Routes #1 & #2). USGS geologic maps of the area were also inspected. It must be pointed out that “no silver bullets” were discovered during the analysis. As Lentell discovered in 1909, it is difficult to design an acceptable rail alignment connecting Humboldt Bay with the Central Valley.

In addition, Mr. Burgel, on a previous unrelated inspection, hi-railed the NWP from Willits to Fortuna when the line was still in-service.

Based on this reconnaissance, the following factors were used to more accurately determine the potential routes:

1) The numerous landslides evident along Hwy 299 between Blue Lake and Lord Ellis Pass (and confirmed by USGS maps) demonstrate that the area just north of Hwy 299 in the vicinity of Blue Lake should be avoided at all costs due to on-going landslides. Mapping performed by Lentell and others shows Rail Route #1 to be routed through this area of unstable ground.

2) Landslides on both the west and east flank of South Fork Mountain were seen during the fly-over and during the driving inspection. Both Rail Route #1 and Rail Route #2 traverse this area. Some of these observed landslides were major, and no alternative route was readily apparent.

3) The Carlotta Grove of redwoods east of Carlotta was avoided by placing Rail Route #2 high up the ridge, above the grove.

4) Placing Rail Route #2 on the ridge also avoids numerous landslides that are evident along Hwy 36 between Carlotta and Bridgeville, but may encounter ancient landslide areas upon closer inspection.

Description of Rail Routes

Maps of the rail routes described below are presented on pages 18-20.

Rail Route #1 – Blue Lake Alignment

Beginning in Samoa, this alignment follows the Samoa Branch of the NWP to the Arcata Wye, then proceeds north along the former Arcata and Mad River alignment, crossing the Mad River and Hwy 299 near Glendale. There the new alignment climbs northwesterly at a 1.5% (80 foot to the mile) grade before doubling back through several tunnels toward Hwy 299.

Figure 3 – Former Blue Lake Station

Source: Burgel Rail Group

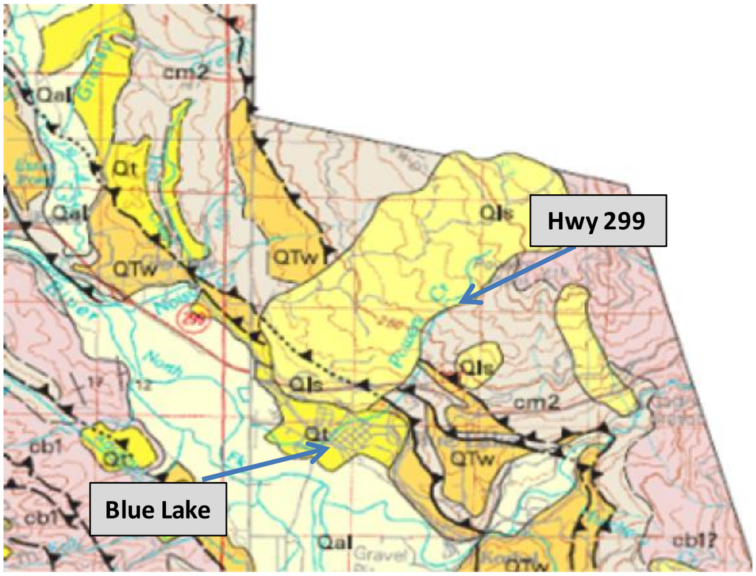
The alignment passes through a summit tunnel near Lord Ellis Pass then continues climbing on a 1.0% grade along the western flanks of Redwood Creek until summiting near Elev. 3,500 feet near Spike Buck Mountain. The alignment crosses into the South Fork Trinity River drainage through a summit tunnel using South Fork Mountain to descend 2,100 feet in the Hyampom Valley.

Near Hyampom, Rail Route #1 swings to the east following Hayfork Creek passing through numerous tunnels climbing at a 1.5% grade until reaching the community of Hayfork where the alignment turns south following Wildwood Road and Hayfork Creek climbing on a 1.5% grade reaching the Highway 36 corridor just south of the Trinity/Tehama County Line.

Here Rail Route #1 joins a continuation of one of the Rail Route #2 alignments (Alton to Red Bluff) and proceeds east to a 3800 foot summit before descending on a 1.5% grade into Platina where Rail Route #1 splits into three alignments that connect with (a) Redding, (b) Red Bluff and (c) Gerber respectively. These three routes all descend in an easterly direction at a 1.5% grade until reaching the valley floor where the slope flattens out.

The Lentell alignment generally follows this same path. However, in this analysis the first 20 miles from the Mad River Bridge until Elev. 1,400 is reached is on an entirely different alignment, passing just east of Fieldbrook and avoiding the large landslide located just north of Hwy 299 at Blue Lake (see Figure 4). This landslide is now apparent on the route identified by Lentell.

Figure 4 – Portion of Geologic Map near Blue Lake



Note: . The light yellow mass labeled Qls (code for landslide) is essentially the entire hillside just north of Blue Lake and Hwy 299

It should be noted that the Lentell alignment recommended a nominal gradient of 1.5% along Rail Route #1. The Fieldbrook bypass is approximately 0.8 miles longer than the original Lentell alignment.

Rail Route #2 – Alton Alignment

This route also begins in Samoa and turns south at the Arcata Wye, passing through Eureka and then following the former NWP railroad grade (roadbed) through Loleta and Fortuna before reaching Alton. Here, Rail Route #2 follows the grade of the former Carlotta Branch for 5.0 miles until reaching Carlotta.

One of the elevations through which this route must pass is at the 2,400 foot level near Dinsmore, 24 miles away. To reach this elevation, it is necessary to begin ascending immediately from Carlotta (elevation 120 ft) on a 1.5% grade in order to meet the elevation at Dinsmore (a 1.5% slope, which rises at 80 feet to the mile, requires nearly 29 miles to reach 2,400 feet).

The Lentell alignment which rises at a 1.0% grade is described below. Just east of Carlotta, the proposed Rail Route #2 alignment begins to climb roughly following the Van Duzen River corridor and CA Highway 36. The alignment then reaches Bridgeville where the route swings to the north, passing through two long tunnels before crossing the Van Duzen River on a high trestle.

The route continues to climb but the Van Duzen River climbs even faster and the proposed railroad and river are nearly next to each other as Dinsmore is approached. The route and river diverge again with the railroad climbing almost immediately east of Dinsmore to reach the small summit that marks the divide between the Van Duzen and Mad River drainages. The route crosses the Mad River at Elevation 2,500 feet before climbing South Fork Mountain before reaching a summit tunnel at 3,800 feet.

Crossing into the South Fork of the Trinity River drainage, the route descends to a possible junction with the Red Bluff (b) alternative of Rail Route #2.

At this junction, the Red Bluff alternative drops down to a 2400 foot elevation, crossing the South Fork of the Trinity River before swinging north and climbing on a 1.5% grade towards Forest Glen. This alternative route generally follows Hwy 36 passing through several tunnels and summiting at 3,900 feet and again at 4,200 feet before dropping down to Wildwood. The alignment between the 4200 foot summit and Wildwood (Elev. 3400') is convoluted, with many switchbacks, as the route must descend 900 feet in just 3.0 miles. Just east of Wildwood, the Red Bluff Alternative of Rail Route #2 connects with the routes mapped in the Rail Route #1 analysis.

Rail Route #2 continues southeast at the 3,700 foot elevation on virtually a level grade of nearly 20 miles until reaching the Black Rock Mountain area where the alignment begins to climb on a 1.5% up the East Fork of the Trinity River until reaching the 4,300 foot level where a 1.4 mile long tunnel crosses under the Stuart Gap divide and the Trinity/Tehama County Line. Because the elevation of the valley near Cold Fork is approximately 1,400 feet ,which is only 16 miles (as the crow flies) from Stuart Gap, it is necessary to run off the 2,900 feet of elevation difference over 36 miles of terrain. In other words, more than 20 extra miles will be needed to descend (or ascend) the mountain grade on a 1.5% slope.

Using the Wells Creek drainage, the route descends back on itself three times before reaching Vestal Road. Here Rail Route #2 connects with the Gerber Alignment established during the Rail Route #1 analysis. The 1909 Lentell alignment begins to rise on a 1.0% grade just outside of the town of Alton. A major fill and bridge over Yager Creek is required just north of Carlotta. The ascending grade is uniformly held at 1.0% until reaching the 2,600-2,700 foot elevation near the community of Mad River, where the grade flattens to nearly level.

After crossing Mad River, the alignment crosses through South Fork Mountain on a 1.5 mile long tunnel with both portals located at approximately 2,800 feet. Two routes were explored, with each route beginning at the east portal. Alignment "A" attempts to follow the Lentell graphic portrayal with about 10 miles of fairly gentle descending grade in a southeast direction until reaching the South Fork Trinity River near Elevation 2,800. Here the alignment begins to climb at a 1.0 % grade until reaching Elev. 3,500, after which a nearly flat grade should have been encountered. However, no such plateau was discovered, with most of the land surface rising in the shadow of Black Rock Mountain to nearly 5,300 feet.

A search for a continuation of this route in this general direction was halted and Alignment B was investigated. This route also begins at the east portal of the tunnel and descends on a 1.0% grade to cross the South Fork of the Trinity River at 2,800 foot elevation on a high bridge nearly 400 feet above the river near the Hwy 36. A route ascending at a 1.0 % grade was found and a flat grade of roughly 20 miles was also discovered. The route terminates in Redding after descending 65 miles on a 1.0% grade. This alignment seems to match the 1909 Lentell sketch with fair accuracy.

Rail Route #3 Alignment – Eel Canyon Alignment

This route takes advantage of using the former NWP alignment from Samoa and Eureka south to Fort Seward roughly 67 miles south of Eureka. The roadbed and general condition of the existing railroad is relatively good. However, several at-grade highway/rail crossings have been paved over.

Rail Route #3 breaks off from the NWP before it reaches the chronically fragile locations of the existing railroad south of Fort Seward. After crossing the Eel River on a bridge placed high above the Eel River, this alternative generally follows the North and South Forks of Dobbyn Creek as well as Alderpoint Road and Zenia Bluff Road to climb out of the Eel River Canyon.

One of the summits that this route must cross is located just southeast of the town of Xenia, at an elevation of 3,500 feet. Although this pass is only 10 miles from Fort Seward (as the crow flies), approximately 39 miles of railroad would be required to overcome the difference of elevation between these two locations at the railroad's slope of 80 feet to the mile. Consequently, Rail Route #3 must negotiate five switchbacks on a 1.5% grade in order to reach the pass. Tunneling through this ridge was also considered, and a three- to four mile tunnel might make sense as opposed to building the numerous switchbacks to maintain a 1.5% grade.

Once on the east side, the alignment trends north to avoid the North Fork of the Eel River Canyon before dropping into the Mad River drainage at elevation 2,800 feet. Here the route follows the North Fork of the Mad River to elevation 3,160 feet before resorting to switchbacks and tunnels to reach the South Fork Mountain summit, which it crosses using a 0.7 miles long tunnel. Once over the pass, Rail Route #3 connects with the previously described Rail Route #2, with a mainline connection at Gerber.

North-South Alignment – Connection with NCRA at Windsor

For purposes of comparison, the cost to reconstruct the former NWP line was also included. This line would run south from Humboldt County to Windsor, a distance of 214 miles, where it would connect to the NCRA. Rail service on the NCRA currently terminates at Windsor.

From Windsor, the currently existing NCRA service runs south through Santa Rosa and Petaluma to Schellville. Between Schellville and Fairfield trains run on the California Northern, and at Fairfield they are interchanged with the Union Pacific (Union Pacific assumed ownership of the Southern Pacific in 1997).

Summary of Proposed Rail Route Alignments

Table 1 summarizes the proposed rail route alignments that were analyzed for this report. All routes begin at Samoa. For comparison, highway distances are 148 miles to Redding; 162 miles to Red Bluff and 172 miles to Gerber. In all cases the additional mileage is used to ascend and descend the mountains with the grade not exceeding 1.5%.

It should be noted that the recent Drewry report examining the feasibility of a container port on Humboldt Bay specified that an acceptable alternative rail corridor for container service would require a grade not exceeding 1.0%.

Table 1 – Summary of Rail Route Alignments

Alignment	End	Mileage	Comments
Lentell #1	Redding	193.8	1.5% grade used east of Hayfork
Route #1	Redding	188.5	Avoids landslide area north of Blue Lake
Route #1	Red Bluff	200.5	
Route #1	Gerber	208.6	
Lentell #2	Redding	212.6	Generally follows Hwy 36, 1.5 mi long tunnel under South Fork Mountain
Lentell #2	Gerber	212.6	1.5 mi long tunnel under South Fork Mountain
Route #2	Redding	200.1	Generally follows Hwy 36 to Platina
Route #2	Red Bluff	211.6	Generally follows Hwy 36 to Red Bluff
Route #2	Gerber	220.6	1.4 mile long tunnel near Black Rock Mtn.
Route #3 Southern/ Eel Canyon	Gerber	257.9	Departs from NWP alignment at Fort Seward; 1.4 mile long tunnel near Black Rock Mtn.
North-South Route	Windsor	214.0	Connects with NCRA at Windsor.

North Coast Range Geology

Overview

The geology of the North Coast Range presents significant challenges for the sufficient siting of a railroad alignment. In particular, many landslides were observed during the fly-over and during the car reconnaissance (see photos below). The impact of the sensitive geology likely to be encountered by the various rail routes is that the cost of construction will likely be much higher than if the terrain through which the railroad was located was composed of competent bedrock.

Opening up the hillsides can certainly be accomplished (for example, numerous logging roads criss-cross the path of many of the proposed alignments). However, approval for the construction must be obtained, and to do so, comprehensive geologic surface and subsurface investigations must be performed. If an active or ancient (inactive) slide is discovered, then mitigation must be proposed and implemented. Even then, a slide can be reactivated with devastating and costly consequences.

Figure 5 – Photos of Active Landslides Near Proposed Rail Routes

According to the *Geology of Humboldt County* website:

> "The complexities of the geology and geological history of Humboldt County are largely responsible for the rugged topography of the Coast Range Mountains and geologic hazards of the area. The geology of coastal Humboldt, Shasta, Trinity and Tehama Counties consists of folded and faulted sedimentary rocks that include competent sandstone; intensely sheared, fine-grained material (melange); and youthful, poorly consolidated marine and river sediments. The combination of the broken and weak rocks and heavy rainfall in the region produces very high erosion rates and considerable slope

instability. Landslides are common within areas underlain by the less-sheared rock types, and slow-moving earthflows are characteristic in melange terrains. The probability of landslides and earthflows is greatly increased during the rainy season. Engineering structures (particularly roads) on or below unstable slopes are particularly at risk from slope failure during heavy precipitation events. Humboldt County routinely receives 100 inches of precipitation during the rainy season which is primarily during the winter months."

Eel River Basin

The Eel River basin is a mountainous area uplifted in the post-Miocene era and underlain by a deformed, faulted, locally sheared, and, in part, metamorphosed accumulation of subducted continental margin deposits. About 99 percent of the bedrock underlying the basin is sedimentary and metasedimentary. The four planning watersheds in the Eel River Basin (South Fork Eel, Lower Eel, Middle Main Eel, and Van Duzen) are generally comprised of highly erodible rocks, including substantial amounts of Franciscan Complex rocks. Over 85 percent of the Middle Main Eel and 65 percent of the Van Duzen are Franciscan Complex.

Klamath-Trinity Basin

The Klamath-Trinity Basin, composed of the Lower Klamath, Lower Trinity, and South Fork Trinity planning watersheds, is the only basin with notable amounts of plutonic and metavolcanic rocks. The Humboldt County portion of the basin encompasses the North Coast Ranges province. In the North Coast Ranges, landslides and soil slips are common due to the combination of sheared rocks, shallow soil profile development, steep slopes, and heavy seasonal precipitation. In addition, both the Lower Klamath and South Fork Trinity have substantial amounts of Franciscan Complex rocks.

Grassland Soils

The general characteristics of grassland soils vary widely. They range from shallow loamy soils to deep clay soils. Their permeability ranges from moderate to slow. The general nutrient level of these grassland soils is higher than that of the adjacent forest soils. The major portion of these soils is intermingled with other soils in the Douglas Fir zone beyond the fog belt. Some of these soils are formed on Franciscan parent material. Many of these are found in the shear zone or fault gouge material or on the melange material of the Franciscan. This parent material weathers rapidly, forming a grey-blue clay subsoil (commonly called "blue goo") that tends to slip when wet. Thus, because of the parent material, these soils are found in landslide topography."

According to the *Humboldt County General Plan Draft EIR*[1]:

"Landslides are characteristically abundant in areas of high seismicity, steep slope, and high rainfall, but may be triggered by any or a mixture of the following: (1) type and structure of earth materials; (2) steepness of slope; (3) water; (4) vegetation; (5) erosion; and (6) earthquake-generated groundshaking.

"The characteristics listed above are representative of the many complex variables contributing to the formation of landslides. The prediction of slope failure at a specific site, therefore, requires an analysis of all possible factors. As part of the Humboldt

[1] Humboldt County General Plan Update Draft Environmental Impact Report, April 2, 2012.

> County General Plan, relative slope stability maps have been prepared to provide general identification of the relative slope stability hazard associated with various bedrock types. These maps do not identify the hazards at particular sites but indicate the relative likelihood of site instability.
>
> "Steep slopes, which are shown in *Natural Resources and Hazards Report Volume 1*, Figure 10-3, occur in a large portion of the county, including 775,203 acres in the 30–50 percent range and 531,179 acres with over 50 percent slopes. Slope information for each planning watershed is shown in Natural Resources and Hazards Report Volume 1, Table 10-2, (Appendix D) and available at http://co.humboldt.ca.us/gpu/documentsbackground.aspx .
>
> "Landsliding is a major hazard concern in Humboldt County that cannot be eliminated. Many existing roads in hillside areas would continue to be affected by this hazard and in many cases; they require constant upkeep and maintenance. Many existing communities are currently affected by this hazard or would be in the future. An area of instability along U.S. 101, commonly referred to as the Confusion Hill slide, would close US-101 in both directions for an extended period of time. Caltrans constructed two bridges over the Eel River was completed in October 2009, at a total cost of over $50 million bypassing the slide area. A massive slide blocked both lanes of U.S. 101 north of Garberville on March 30, 2011. The highway was opened to one-way traffic within several days."

The purpose for including the above sections is the following: Humboldt County has adopted the California Building Code (CBC). Under Policy S-PX1, Site Suitability, new development may be approved only if it can be demonstrated that the proposed development will neither create nor significantly contribute to or be impacted by geologic instability or geologic hazards.

Wild and Scenic Rivers

Two rivers in the study area are including in the Wild and Scenic River designation. These include the South Fork of the Trinity River (along portions of Rail route #1) and the Van Duzen River (along portions of Rail route #2). It is likely that prohibitions as to the amount of sediment that can be introduced into these protected streams will affect the design and placement of the railroad.

Figure 6 – Van Duzen River near Bridgeville (left photo) and South Fork Trinity River (right photo)

Capital Costs

Track

Rebuilding existing track on established railroad sub-grade is typically estimated to cost $1.0 million per mile. For example, a recent report by AndersonPenna estimated that rehabilitation costs for the 14.9 miles of track between Samoa and Eureka to range between $14.2 and $16.5 million[2]. Accordingly, this cost will be used to rehab existing track and to provide a placeholder price for new track.

A "per mile" allowance for the installation or rehabilitation of at-grade highway/rail crossings is included in this $1.0 million/mile figure. The $1.0 million/mile figure is a composite of the costs of providing 2.0 linear miles of rail plus cross-ties (either concrete or creosoted wood) plus fasteners plus ballast. Also included is the labor to assemble and install these components on a roadbed that is essentially prepared. This assumes that minor culverts and bridges have been installed on a roadbed that has been graded using local materials on a nominally graded topography, with cuts and/or fills that range from two to four feet in height or depth. Costs not included in new construction are at-grade road crossings, signal appliances, fencing, engineering, and environmental approvals.

Also, not included in this analysis is the connection cost at the interchange (east) end of the alignment. Depending on the location of the connection and negotiations with Union Pacific, these costs could range from negligible to over $5 to $10 million.

A third item not included in the cost estimates is the construction of a switching/storage yard at or near Samoa. Class I railroads now insist that sufficient trackage is constructed to hold all of the cars and locomotives that new business is expected to generate. In contrast, in the past this storage was typically split between origin & destination sites.

Finally, not included in the budget are the costs for sidings for the meeting and passing of trains. Typically, sidings cost about $5 to $7 million each. Depending on the train volume, the number of sidings required may range from as few as one to as many as ten.

Grading

Grading costs are approximately $1.5-3.0 million per mile. The lower number applies to the relatively flat terrain found outside of Red Bluff and Gerber, while the higher figure applies to the majority of the alignments where extensive grading is required. The higher cost reflects the

[2] *Railroad Corridor Condition Assessment Northwestern Pacific Railroad (NWP), North Humboldt Bay, Eureka to Samoa*, AndersonPenna Partners, Inc., October 2012.

fact that nearly every surface for the proposed roadbeds either cuts into the side of a fairly steep slope or requires major fills to support the roadbed on the inside of the numerous curves encountered.

Typically, railroad roadbeds are 30 feet in width and are covered with 0.5 feet of sub-ballast. Cuts and fills are engineered to generally 2:1 slopes, with rock-supported cuts designed to 3:1 or 4:1 slopes. Roadbeds are widened to accommodate rock-fall and include a 10-foot wide ditch with a flat-bottom profile to aid in ditch clean-out. Rock slopes are either covered with mesh to minimize spalling, or the railroad is protected by a rock fence which is integrated with the signal system to provided locomotive engineers up to date information on the status of the track ahead.

Bridges

The number of bridges was estimated, with major bridges called out and costing an estimated $10,000 per linear foot (based on conversations with contractors and bridge eingineers). Existing bridges would also be upgraded to handle 286,000 pound rail cars.

Tunnels

Tunnels were estimated to cost $13,000 per linear foot (based on conversations with tunnel engineers). Tunnels were sited whenever the cost of tunneling was estimated to be lower than the cost of constructing track up and over the mountain to be crossed.

Landslide Mitigation

Much of the ground over which these rail routes are located is likely to be susceptible to landslides, and will therefore require extensive geotechnical investigations and possible mitigation. This cost is estimated to be $1.0 million per mile in the mountainous areas of the alignment.

At first glance, this cost appears to be rather high; however, a recent “fix” of a landslide on Hwy 299 was pegged at $50 million. The $1.0 million per mile figure could be viewed as a contingency for dealing with the fragile landscape common in the North Coast range. Included in this cost is the environmental review that will also be necessary.

Property Acquisition

Property acquisition costs are assumed to be roughly $25,000 per acre. Right-of-way width is assumed to be 100 feet, which is common in the railroad industry. Construction and slope easements were not included in the estimates.

Environmental Mitigation

Costs for environmental mitigation are not included.

Operations and Maintenance (O&M)

O&M costs are generally not considered during the preliminary engineering phase. However, this routing analysis is an exception because of the very difficult terrain over which these proposed routes are planned to cross.

As described elsewhere in this report, a shorter route may incur lower construction costs but higher operating and maintenance costs. For example, if the roadbed is “pinned” to a side of a steep mountain, it will be necessary to install slide fences and construct a wide apron on to which rockfalls could be accommodated.

While the construction cost of such features is included under the capital expenses, the maintenance of these features will be over and above the normal maintenance dedicated to just the track structure. As noted above, the former Southern Pacific spent three times as much for maintenance on the NWP line through Eel River Canyon as it did for other tracks. Assuming $90,000 per mile for maintenance, the annual maintenance budget may range between $18 and $20 million.

Typical Class I maintenance costs range in the $45,000 to $60,000 per mile. As noted previously, the experience of the SP in with the NWP was that maintenance costs for that line were three times the national average. Based on the higher cost to maintain the NWP, the higher maintenance cost of $90,000 per mile was used for the routes between Humboldt Bay and the Central Valley.

Train operations and its attendant costs are discussed below.

Summary of Cost Estimates:

These tables represent general costs for the various alignments between the Humboldt Bay area and the Central Valley. As indicated, the cost per mile of new and rehab costs ranges between $5.0 million to $5.9 million per mile of roadbed and track. While these costs may appear high, another recent analysis of a proposed 200-mile, 60-mph line to the Pacific Coast (not in Humboldt County) produced estimated construction costs of $2.3 billion, or over $11.0 million per mile.

Rebuild costs for the North-South route were based on the high cost estimate presented in the *NCRA Strategic Plan Update, February 15, 2007*, and which were updated to reflect inflation. The *NCRA Strategic Plan Update* presented range of costs that varied based on the level and timing of repair. The high estimate, used in this analysis, is based on upgrading the line to Class 3 standards, as are the cost estimates for the East-West routes. This will allow the route to carry the heavy-weight trains used in transporting bulk cargoes, which typically carry 10,000 tons of cargo or more.

As summarized in Table 2, the total construction cost for an east-west rail line between Humboldt County and the northern Sacramento Valley and is estimated to range between $1.1 and $1.2 billion. The construction cost per mile is estimated to range between $5.00 million and $5.90 million per mile. Reconstruction of the north-south line between Samoa and Windsor is estimated to cost $600 million, or $2.80 per mile.

Table 2 – Summary of Capital Costs by Route

Rail Route	From	To	Total Length (miles)	Total Cost ($ million)	Cost per mile ($ million)
Lentell #1	Samoa	Redding	194	$1,080	$5.60
Lentell #2	Samoa	Redding	213	$1,234	$5.80
	Samoa	Gerber	217	$1,166	$5.40
RR #1	Samoa	Redding	189	$1,067	$5.60
	Samoa	Red Bluff	201	$1,127	$5.60
	Samoa	Gerber	209	$1,239	$5.90
RR #2	Samoa	Redding	200	$1,066	$5.30
	Samoa	Red Bluff	212	$1,095	$5.20
	Samoa	Gerber	221	$1,197	$5.40
RR #3 Eel Canyon	Samoa	Gerber	241	$1,203	$5.00
Restore North- South	Samoa	Windsor	214	$.609	$2.80

Figure 7: Rail Route 1 (Lentell Route 1, Blue Lake to Redding)

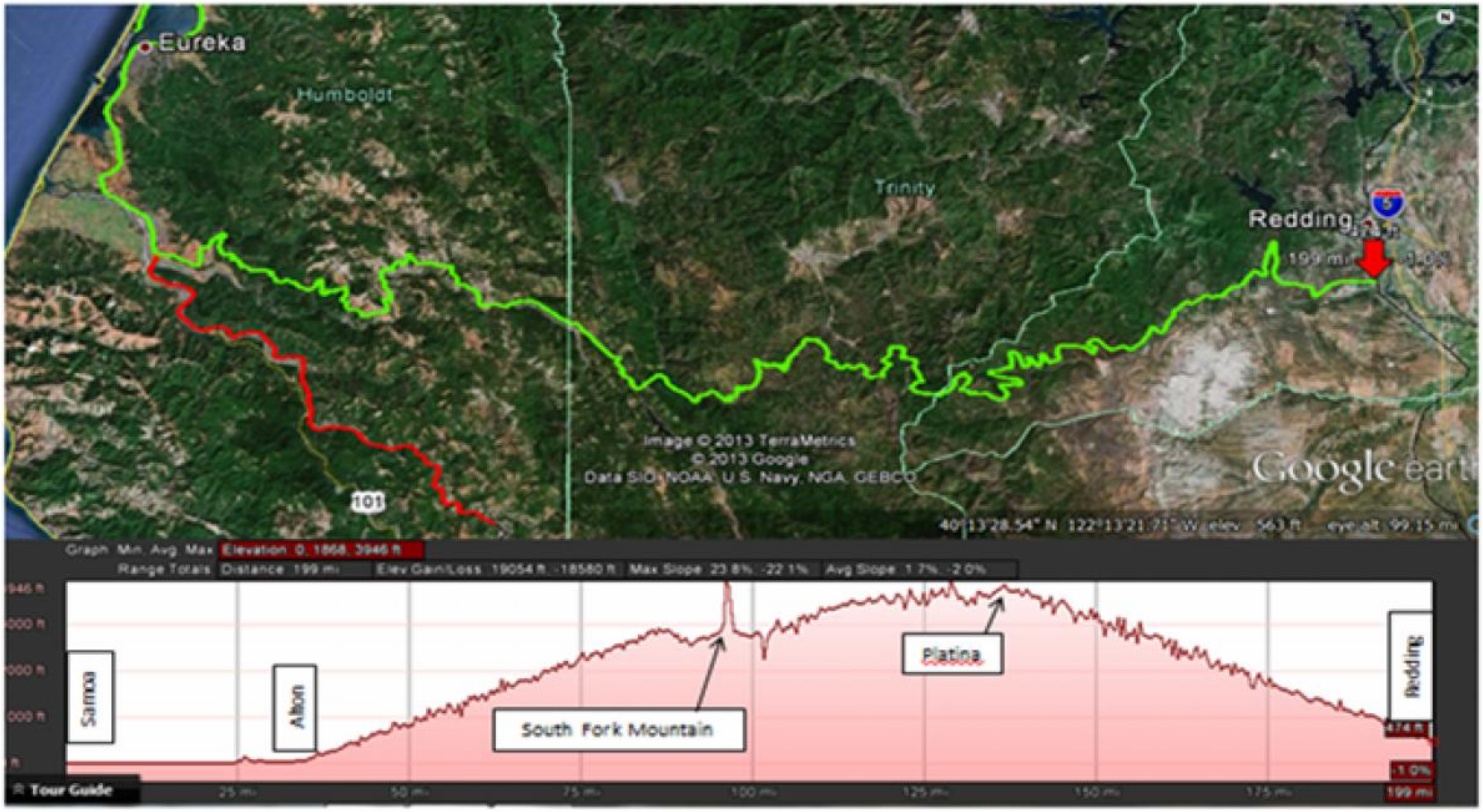
Lentell #1 =

Alternative Route to Avoid Landslide Area =

Former NWP =

Diagram #1: Lentell Route - Blue Lake to Redding (Rail Route #1)
190 miles with Mileage beginning at Samoa.
Maximum Gradient: 1.5%
Maximum Speed: 40 MPH

Figure 8: Rail Route 2 (Lentell Route 2, Alton to Redding)



Lentell #2 = (green line)

Former NWP = (red line)

Diagram #2 – Lentell #2 - Alton to Redding – Railroute #2

212.6 miles with mileage beginning in Samoa

Maximum Gradient = 1.0%

Maximum Speed: 40 MPH

Figure 9: Rail Route 3 (Eel Canyon Route)

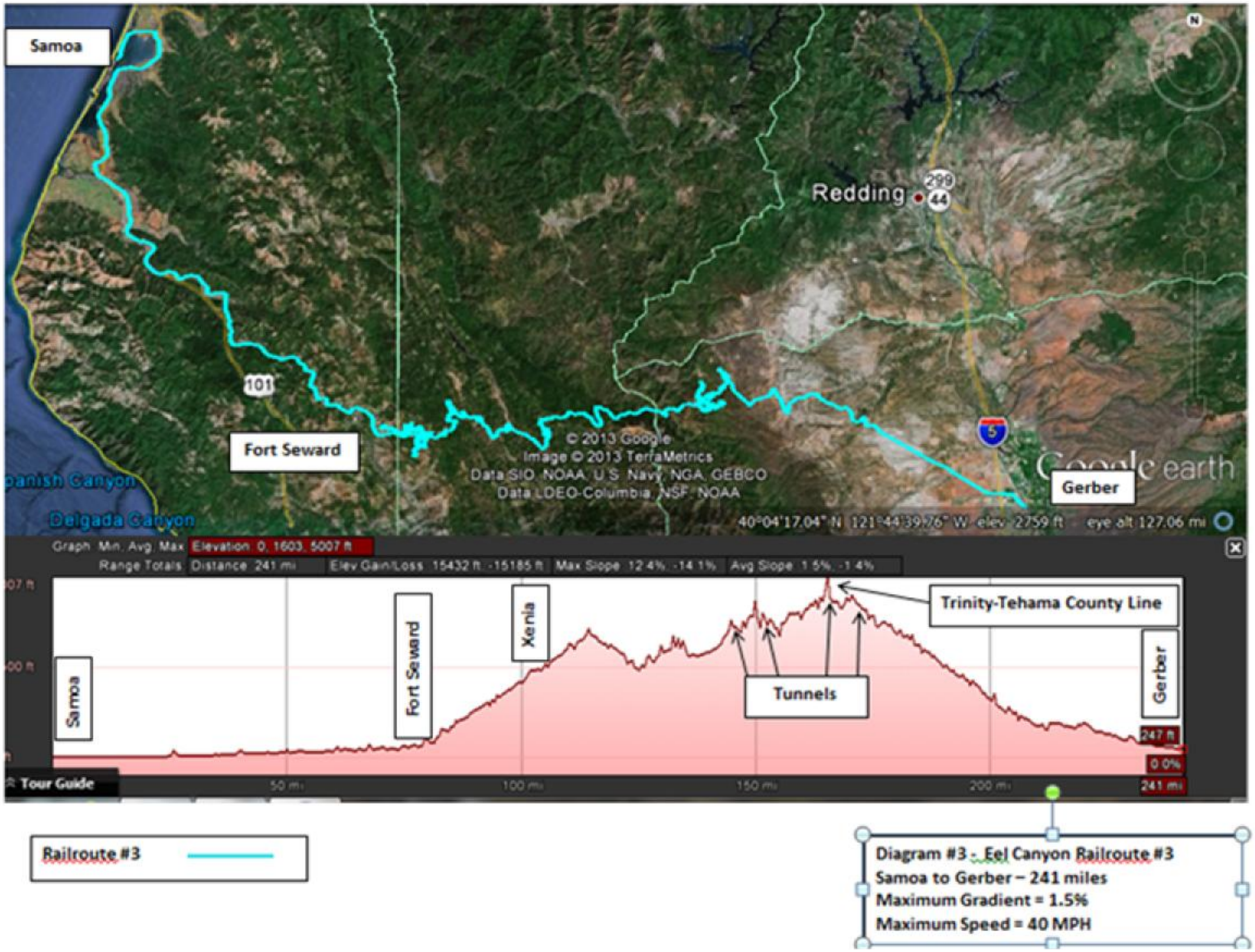


Figure 10: NWP Rail Route

Train Operations

The criteria for the various east/west rail routes described above was to determine whether or not it would possible to design a 1.0% grade railroad that could be operated at 40 mph (FRA Class 3 standard, acceptable for freight service). Notwithstanding the calculation of curve radius and its significant influence on grading costs (i.e. the more tangent the track, the more fill required), let's assume that 40 mph can be achieved. If this is the case, then the average mileage for the 10 routes listed above is 211 miles.

At 40 mph, it should require about 5.5 hours for a train to negotiate the distance between Samoa and Central Valley interchange locations. However, 40 mph is not likely to be realized between Samoa and Blue Lake or between Samoa and Alton or Fort Seward, with 25 mph a more realistic operating speed. As the proposed train service reaches the outskirts of Redding, Red Bluff and/or Gerber, the train will also need to slow to approximately 25 mph. These slower velocities will make the average run approximately 6 to 7 hours.

A rule of thumb in train operations is that running time of 6 to 7 hours is the upper limit for a train crew due to the 12 hour "Hours of Service" regulation. If financial considerations dictate that grading costs need to be reduced, then curve radii will necessarily increase, resulting in decreased operating speed. If this occurs then two crews will be needed to handle a train between Samoa and the Central Valley interchange locations. Along Rail Route #1 and #2, a logical train crew change out location could be Wildwood or Platina. There does not appear to be a logical crew change location along Rail Route #3.

Estimated Cargo Volumes

Identification of Potential Commodities

The second task in this analysis was to estimate the volume of cargo required to make a rail route economically viable. The first part of this task involved identifying cargoes that might potentially use the rail line to Humboldt County. BST Associates prepared this section using data from the U.S. Department of Commerce and the Surface Transportation Board.

Potential commodities were identified in two ways. First, waterborne export data was used to document the types of commodities that are currently exported from the United States, with an emphasis on those commodities destined for Asia. The analysis focused on non-containerized exports.

Rail volumes were documented using Public Use Waybill Sample data from the Surface Transportation Board. This portion of the analysis focused on commodities shipped by rail and destined for coastal areas.

This identification of commodities is not intended to be a market analysis for a rail line to the Humboldt Bay region, and makes no recommendations regarding potential rail cargo. Its sole purpose is to identify those commodities that currently move by rail in high volumes, in order to estimate potential revenue and the volumes required to finance a rail line.

Waterborne Exports

A new or rebuilt rail line to Humboldt County is likely to require a large volume of cargo in order to cover capital costs. Based on previous analyses it is likely that local industry does not generate this volume of cargo. As a result, waterborne trade would be the most likely driver of demand for rail service.

Waterborne cargo can be divided into several major categories, including: containerized, dry bulk, liquid bulk, breakbulk, and roll-on/roll-off.

- Containerized cargo moves in standard 20-foot or 40-foot vans, on specially designed cellular container vessels.
- Dry bulk cargo is shipped by water in bulk vessels, and is loaded and unloaded in loose form, typically via conveyor belt. A large share of dry bulk cargo is shipped to port by rail.
- Liquid bulk cargo is moved in tankers, and is loaded and unloaded via pipes or hoses. On the West Coast, the largest share of liquid bulk cargo is made up of crude oil and refined petroleum products. Most of this moves directly to and from refineries located at waterfront locations.
- Breakbulk cargo includes a wide variety of commodities that are loaded onto ships by crane. This category includes logs, palletized cargo, and others.
- Roll-on/roll-off (“RO/RO”) cargo includes motor vehicles and other equipment that is driven on and off of ships.

Because of the large volumes shipped by rail from inland points, exports of dry bulk cargoes were the focus of this analysis. Exports of dry bulk commodities also represent a strong and growing market for West Coast ports.

The potential to move containerized cargo through Humboldt Bay has been investigated in several past analyses. Because there is significant competition from existing container ports and few capacity constraints, containers do not present the same market potential as dry bulks. Most recently, the Drewry consulting firm delivered a report to Security National that summarized the conditions necessary to justify investing in a container port on Humboldt Bay. In highlighting the risk of such an investment, this report concluded that "*Under no foreseeable circumstances should Security National consider building a new container terminal at the port, without the prior contractual support of at least one shipping line, in the hope that 'the lines will come when it is built'*". The report also concluded that "*The difficulty will lie in convincing the shipping lines that the Port of Humboldt Bay offers sufficient competitive advantages over Prince Rupert, Vancouver, Seattle, Tacoma, Portland and Oakland for it to fully support the project before construction commences*."

Breakbulk cargo and Ro/Ro commodities move in relatively limited volumes, and are less likely than dry bulks to produce sufficient revenue to cover the construction cost of a rail line to Humboldt County.

The Sacramento Valley is also a major center of agricultural production that generates significant volumes of export commodities. These commodities are currently shipped by rail or truck to ports in the Bay Area, as well as Sacramento and Stockton. Because of the competition from these existing ports, and the need to focus on high-volume rail-shipped commodities, exports of products from the Sacramento Valley were not included in this analysis. It is possible, however, that an east-west rail line might be able to attract a portion of this cargo.

Non-Containerized Waterborne Exports

The following analysis documents waterborne exports in two parts: the first part focuses on exports from the U.S. West Coast to all world destinations, while the second focuses on exports to Asia from all U.S. port regions.

In 2011 and 2012 the volume of U.S. West Coast non-containerized exports averaged 85 million metric tons. Of this volume, 20 commodities accounted for approximately 90% of the total, and most of these consisted of farm products, petroleum products, forest products, chemicals, and waste products. (See Table 3)

Farm products include grain (e.g. wheat and corn), oilseeds (e.g. soybeans), hay and feed, and by-products of grain and oilseed processing (e.g. distilling dregs from ethanol production and oil seed meal). Combined, these commodities account for approximately 31 million metric tons, or nearly 37% of the total.

Petroleum products, including petroleum coke and petroleum oils, generated 16 million metric tons of exports, or 19% of the total. Chemicals (including carbonates, potassic fertilizer, and sulfur), waste paper, and ferrous waste (scrap steel) each generated more than 5.6 million metric tons, or nearly 7% of the total.

Table 3 – West Coast Non-Containerized Exports (1,000 Metric Tons)

Rank	HS Code	Description	2009	2010	2011	2012
1	1001	WHEAT	9,540	10,850	13,500	12,440
2	1201	SOYBEANS	9,710	10,480	7,960	10,780
3	2713	PETROLEUM COKE	7,370	7,240	7,670	8,120
4	2710	PETROLEUM OILS	7,270	6,440	8,010	7,960
5	1005	CORN	8,540	9,920	9,200	5,670
6	4707	WASTE PAPER	4,810	4,830	6,040	5,640
7	7204	FERROUS WASTE	5,510	5,470	6,280	5,290
8	4403	LOGS	2,240	3,910	5,820	4,930
9	2836	CARBONATES	2,120	2,680	2,730	3,170
10	1214	HAY, FEED	1,170	1,250	1,410	1,710
11	3104	POTASSIC FERTILIZER	1,030	2,500	2,590	1,670
12	2701	COAL	140	620	1,230	1,620
13	4401	WOOD CHIPS	1,070	1,610	1,540	1,360
14	2601	IRON ORE	-	200	1,520	1,270
15	2303	DISTILLING DREGS	510	1,230	710	1,140
16	1208	OIL SEED MEAL	40	30	50	970
17	2503	SULFUR	550	580	610	940
18	0802	NUTS	210	220	270	480
19	4407	LUMBER	160	300	530	450
20	2603	COPPER ORES	340	360	320	410
		OTHER	7,890	9,240	8,850	8,170
		TOTAL	70,220	79,960	86,840	84,190

Source: U.S. Department of Commerce

In order to expand the list of potential commodities for a Humboldt Rail line, the list of non-containerized commodities was expanded to show what is currently shipped to Asia from all U.S. ports. For this list it is assumed that if Humboldt County were to attract a commodity that is not currently shipped through another West Coast port, it would most likely be destined for Asia. As illustrated in Table 4, the list of top 20 non-containerized commodities exported to Asia from all U.S. ports is similar to the list of West Coast commodities illustrated in Table 3.

The primary commodity that is currently shipped through U.S. West Coast ports in only limited volumes, but does move from the East Coast, Gulf Coast, and Canadian West Coast to Asia, is coal. The volume of coal shipped to from U.S. ports to Asia has risen sharply in recent years, to more than 16 million metric tons in 2012. In addition, a number of coal export terminals have been proposed in Oregon and Washington, several of which are currently in the environmental permitting process.

Corn is a major export commodity for West Coast ports; more than 12 million tons of corn was exported to Asia in 2012, with West Coast accounting for less than 6 million tons.

In addition to coal and oil, other commodities that are exported to Asia in larger volumes from East and Gulf Coast ports than from the West Coast include several coal products and petroleum products.

Table 4 – U.S. Non-Containerized Exports to Asia (1,000 Metric Tons)

Rank	HS Code	Description	2009	2010	2011	2012
1	2701	COAL	4,480	8,560	15,760	16,350
2	1005	CORN	23,700	24,430	20,570	12,480
3	1001	WHEAT	7,530	8,500	10,020	10,060
4	2710	PETROLEUM OILS	7,730	8,350	7,760	7,680
5	2713	PETROLEUM COKE	5,600	4,950	5,300	7,490
6	1201	SOYBEANS	5,690	5,620	4,200	5,200
7	7204	FERROUS WASTE	5,670	5,220	5,520	5,150
8	4403	LOGS	2,350	2,480	2,510	2,630
9	2707	COAL DISTILLATE	3,210	3,370	3,340	2,470
10	2836	CARBONATES	1,020	1,460	1,480	1,710
11	3105	MINERAL FERTILIZERS	3,880	2,960	2,470	1,460
12	4707	SCRAP PAPER	1,260	1,160	1,310	1,230
13	2303	DISTILLING DREGS	770	1,100	940	1,160
14	4401	WOOD CHIPS	940	1,480	1,320	1,120
15	1208	OIL SEED MEAL	150	150	230	1,060
16	3104	POTASSIC FERTIILIZER	790	1,250	1,000	870
17	1214	HAY & FEED	930	800	740	810
18	2711	PETROLEUM GASES	930	1,170	1,050	700
19	2909	ETHERS & ALCOHOLS	210	680	590	690
20	2902	HYDROCARBONS	680	700	720	670

Source: U.S. Department of Commerce

Commodities Moving by Rail

There is not a direct way to link export commodities to movements by rail. However, Surface Transportation Board (STB) data can be use to illustrate what is currently moving by rail, and this information can then be compared to the waterborne cargo statistics.

Table 5 presents a summary of the tonnage that moved by rail to coastal destinations in 2011 (most recent data available). These rail movements may be associated with exports, but may also represent products destined for domestic users. In this usage, coastal destinations are defined as those Business Economic Areas (BEAs) that border the East, Gulf, or Pacific coasts, in addition to British Columbia. (BEAs are the type of region used in STB data).

As illustrated in Table 5, coal represents the largest volume moved by rail to coastal destinations. The amount of coal that terminated in coastal destinations in 2011 was more than three times that of the next highest-volume commodity, aggregates, which do not represent major a waterborne export.

Corn, wheat and soybeans, which are all key waterborne exports, all move by rail in large volumes to coastal regions. The combined volume of these three commodities is more than 48 million metric tons. Sodium compounds (primarily soda ash) and potassium compounds (primarily potash) are also key waterborne exports that move by rail.

Based on the waterborne export data and the rail data, six commodities were chosen to use as potential cargoes for a Humboldt Rail line. These included wheat, coal, potash, soda ash, and iron ore. In the next section, a financial model was created to estimate the volume of these cargoes that would be needed to make the Humboldt rail lines financially feasible.

Table 5 – Rail Volumes Terminating at Coastal Regions in 2011
All U.S. Coasts and British Columbia

Rank	STCC Code	STCC Description	Metric Tons (1,000's)
1	11212	Coal	123,468
2	14219	Aggregates	35,648
3	01132	Corn	20,432
4	28211	Plastics	17,784
5	01137	Wheat	17,624
6	28184	Alcohols	13,983
7	01144	Soybeans	10,121
8	26311	Fiberboard & paperboard	6,046
9	29121	Liquefied gases	5,497
10	20923	Soybean cake	3,959
11	24211	Lumber	3,722
12	28123	Sodium compounds	3,690
13	40211	Steel scrap	3,674
14	37111	Vehicles	3,473
15	28125	Potassium compounds	3,404
16	20461	Corn syrup	3,207
17	33123	Steel sheet & strip	3,178
18	26111	Pulp	2,914
19	28712	Superphosphate	2,779
20	14413	Industrial Sand	2,370

Source: Surface Transportation Board data

Rail Volume Requirements

The second portion of Task 2 was to estimate the volume of cargo that would be needed for a rail line to Humboldt County to be financially feasible. BST Associates prepared this analysis based on the commodities discussed above.

The financial feasibility of the construction of a new rail line to Humboldt County will depend on the net revenue generated by the transport of cargo by rail. This net revenue is a function of the gross freight revenue generated by the railroad, less the cost of operations, maintenance, and other expenses.

Rail Cost

In this analysis, rail costs were estimated using the USRail.desktop model from RSI Logistics, Inc. This model is used by major rail shippers to understand how railroads set rates, and to provide them information for use in negotiating with the railroads.

The USRail.desktop model provides estimates of the variable cost of providing rail service, and includes such items as

- Fuel cost
- Labor
- Road locomotive
- Switching
- Equipment costs, and
- Track & right of way maintenance

Because the proposed east-west rail lines between Humboldt Bay and the Central Valley do not currently exist, they are not in the USRail.desktop model. In order to estimate the total cost to ship the selected commodities from their origin to Samoa (Humboldt County), the model used Gerber, California as the termination point, although the actual interchange location would be a decision made by the UP. Based on the distance of the haul and the volume of cargo per train, costs were calculated on a ton-mile basis. (A ton-mile is equal to one ton of cargo moved one mile). The additional cost for the rail move between Gerber and Samoa was estimated based on this ton-mile figure and the additional mileage. Similarly, for the north-south route the USRail.desktop model was used to calculate the distance and cost to Windsor (the current end of the line), and then that information was used to estimate the cost for the Windsor to Samoa portion.

As discussed previously in this analysis, because the route between Gerber and Samoa is winding and mountainous it is likely to have significantly higher maintenance costs. The model created for this analysis assumed that the maintenance cost will be double that of the mainline portion of the haul, but the cost could be even higher. The north-south route has a demonstrated history of higher maintenance costs, and for this analysis they were also assumed to be double the route average.

Based on the analysis of waterborne cargo presented above, rail costs were analyzed for six different bulk cargoes, including two grains (wheat and corn), three minerals (coal, potash, and soda ash), and one metal ore (iron ore).

The origin for each of these commodities was chosen based on STB waybill data, which shows the origin and destination of existing rail moves. Preference was also given to origins where the distance to Humboldt Bay was relatively competitive with other West Coast ports. For example, the largest volume of potash exported from the West Coast originates in Saskatchewan, Canada, and Humboldt Bay is significantly farther from Saskatchewan than are ports in western Canada and the Pacific Northwest. Instead, potash that originates in the Ogden, Utah region is more proximate to Humboldt Bay, and was chosen for this analysis.

For coal, wheat, and corn, three different points of origin were used for each commodity. These commodities are all produced in multiple locations, and using multiple origins allows the analysis of the feasibility of several rail moves. Production of potash, soda ash, and iron ore is more localized, so one origin for each was analyzed.

The costs shown in Table 6 for the east-west routes are for the shortest of the three routes identified, which is 194 miles in length. For the other east-west routes, the portion of the rail cost for Gerber to Samoa would be higher. The north-south line would extend 214 miles from Samoa to the current end of service at Windsor.

Table 6 – Railroad Cost for Selected Commodities

`	East-West Routes					North-South Route				
	Distance (miles)			$/ton-mile		Distance (miles)			$/ton-mile	
Commodity/Origin	Origin to Gerber	Gerber to Samoa	Total	Origin to Gerber	Gerber to Samoa	Origin to Windsor	Windsor to Samoa	Total	Origin to Windsor	Windsor to Samoa
Coal										
Antelope Mine, WY	1,537	194	1,731	0.0161	0.0213	1,564	214	1,778	0.0172	0.0232
Oak Creek, CO	1,296	194	1,490	0.0163	0.0213	1,324	214	1,538	0.0176	0.0232
Sharp, UT	908	194	1,102	0.0167	0.0213	936	214	1,150	0.0186	0.0232
Soda Ash										
Green River, WY	957	194	1,151	0.0159	0.0207	984.6	214	1,199	0.0178	0.0231
Wheat										
Great Falls, MT	1,403	194	1,597	0.0183	0.0230	1,635	214	1,849	0.0193	0.0239
Sioux Falls, SD	1,921	194	2,115	0.0174	0.0230	1,948	214	2,162	0.0184	0.0239
Topeka, KS	1,813	194	2,007	0.0175	0.0230	1,841	214	2,055	0.0174	0.0239
Corn										
Minneapolis, MN	2,109	194	2,303	0.0173	0.0227	2,136	214	2,350	0.0183	0.0240
Grand Island, NE	1,622	194	1,816	0.0176	0.0227	1,650	214	1,864	0.0188	0.0240
Des Moines, IA	1,956	194	2,150	0.0174	0.0227	1,983	214	2,197	0.0184	0.0240
Potash										
Ogden, UT	780	194	974	0.0207	0.0269	807	214	1,021	0.0169	0.0220
Iron Ore										
Cedar City, UT	967	194	1,161	0.0170	0.0221	994	214	1,208	0.0231	0.0300

Source: USRail.desktop, BST Associates

Sacramento Valley Cargo

As discussed previously in this report, the Sacramento Valley is a major center of export production, particularly of agricultural products. These exports currently move through existing ports, such as Sacramento, Stockton, Oakland, and other Bay Area ports. It is possible that a portion of these exports may be able to use an east-west rail line for export through Humboldt Bay, providing additional traffic to that line. For the purpose of this report, however, the focus was on commodities moving in the highest volumes, i.e. dry bulk export commodities.

In addition to the focus on high-volume commodities, the rail distance from Sacramento Valley origins to Humboldt Bay for the most part does not offer shippers an advantage over existing ports. Humboldt Bay is most competitive from the north end of the valley, in Redding. The farther south the products originate, however, the greater the rail disadvantage to Humboldt Bay becomes. (See Table 7).

Distance is also an important factor in determining whether cargo moves by rail or by truck. In general, the longer the haul the more competitive rail is compared to truck. A rule of thumb is that for distances of less than 500 miles trucks have an advantage over rail, unless the commodity has a low unit value and moves in high volumes. The relatively short distance between the Sacramento Valley and the Humboldt Bay region is likely to limit the volume of cargo that shippers would choose to move by rail rather than truck.

Table 7 – Rail Distance from Sacramento Valley Origins

	Port			
Inland Location	Samoa	Richmond	Oakland	West Sacramento
Redding	189	178	192	161
Red Bluff	201	143	157	126
Gerber	209	133	147	116

Source: USRail.desktop, BST Associates

Rail Revenue

In this analysis, rail revenue was estimated using data from the Surface Transportation Board (STB) *Commodity Revenue Stratification Report for 2011*. This report analyzes the revenue and variable cost for commodities moved by rail, which are used to calculate the Revenue to Variable Cost ("RVC") ratio. The RVC is an important indicator for examining freight rail rates, because traffic with rates greater than 180% RVC are subject to potential STB review for being unreasonably high.

Based on the RVC calculated from the data in the *Stratification Report*, as well as the costs developed in the previous section, the revenue per ton for the 194-mile move between Gerber and Samoa was estimated for each of the commodities. These are shown in Table 8.

Table 8 – Estimate of Rail Revenue, Gerber to Samoa

	Gerber to Samoa				Windsor to Samoa			
Origin	Cost/ ton-mile	RVC	Rail Cost per Ton	Rail Rev. per Ton	Cost/ ton-mile	RVC	Rail Cost per Ton	Rail Rev. per Ton
Coal								
Antelope Mine, WY	0.0213	1.636	$4.12	$6.75	0.0232	1.636	$4.96	$8.11
Oak Creek, CO	0.0213	1.636	$4.12	$6.75	0.0232	1.636	$4.96	$8.11
Sharp, UT	0.0213	1.636	$4.12	$6.75	0.0232	1.636	$4.96	$8.11
Soda Ash								
Green River, WY	0.0207	1.727	$4.02	$6.94	0.0231	1.727	$4.94	$8.53
Wheat								
Great Falls, MT	0.0230	1.498	$4.47	$6.69	0.0239	1.498	$5.11	$7.66
Sioux Falls, SD	0.0230	1.498	$4.47	$6.69	0.0239	1.498	$5.11	$7.66
Topeka, KS	0.0230	1.498	$4.47	$6.69	0.0239	1.498	$5.11	$7.66
Corn								
Minneapolis, MN	0.0227	1.498	$4.39	$6.58	0.0240	1.498	$5.14	$7.70
Grand Island, NE	0.0227	1.498	$4.39	$6.58	0.0240	1.498	$5.14	$7.70
Des Moines, IA	0.0227	1.498	$4.39	$6.58	0.0240	1.498	$5.14	$7.70
Potash								
Ogden, UT	0.0269	1.727	$5.23	$7.40	0.0220	1.727	$4.71	$8.14
Iron Ore								
Cedar City, UT	0.0221	1.638	$4.29	$8.56	0.0300	1.638	$6.42	$10.53

Source: USRail.desktop, BST Associates

Estimated Rail Volume

The volume of cargo that would be needed to make a rail line to Humboldt County financially feasible was estimated based on the net present value of the projected revenue and cost streams. Several assumptions were included in the net present value calculations, including:

- Construction period – three years
- Ramp up in rail volume – five years from end of construction to reach target volumes
- Discount rate – 3%, 7% and 15% (The discount rate is the rate used to calculate the current value of future cash flows; higher-risk investments tend to have higher discount rates)
- Finance period – 50 years

Table 9 presents the results of these calculations. Under the most optimistic scenario (i.e. low construction cost estimate and 3.0% discount rate), between 11.5 million and 18.5 million metric tons of cargo per year would be required. Under the highest-cost scenario (i.e. high construction cost and 15.0% discount rate), between 65.6 million and 100.0 million metric tons of cargo would be needed.

Under the North-South scenario, a discount rate of 3.0% would require 5.6 million metric tons to 9.1 million metric tons per year, while a 15.0% discount rate would require between 26.2 million and 42.3 million metric tons. The lower discount rates are applicable to a publicly financed project, while the higher discount rate is reflective of privately financed project. As illustrated in Table 9, the lower discount rates result in lower volume requirements.

For a project of this scale and level of risk, the higher discount rate is most appropriate.

Table 9 – Estimate of Required Rail Volumes

	East-West Routes		North-South Route
	Low	High	High
Construction Cost ($ billion)	$1.066	$1.239	$0.609
Discount Rate			
3.0%	11.5 - 18.5	14.2 - 21.5	5.6 - 9.1
7.0%	24 - 36.7	27.9 - 42.6	11.2 - 18.1
15.0%	56.5 - 86.2	65.6 – 100.0	26.2 - 42.3

Source: BST Associates

As discussed previously, the scope of this project involved estimating the cost to construct a rail alignment to Class 3 (40 mph) standards, which are the costs shown in Table 9. The construction costs could be reduced by constructing the line to Class 2 (25 mph) or Class 1 (10 mph) standards. Doing so, however, would significantly increase the running time, thereby increasing operating costs. This would result in a different RVC ratio, and therefore in different volume requirements.

These calculations also assume that the necessary port facilities and navigation channel improvements will be in place when the rail line opens. Although these items were not included in the scope of this analysis, they are discussed briefly below.

Other Considerations

The financial feasibility of the proposed rail routes to Humboldt County is only one of several factors in determining whether the project is viable. Other key factors include: rail distance to competing ports, railroad market considerations, vessel characteristics of potential fleet, marine terminal requirements, and navigation channel needs. Without addressing each of these factors, the rail line in and of itself will not generate the traffic needed to justify the construction cost.

Rail Distance to Competing Ports

For most of the commodities and origins studied in this analysis, the proposed rail routes to Humboldt County do not offer a rail distance advantage. As illustrated in Table 10, the Humboldt County routes offer no advantage relative to Richmond and Stockton, California, or to Longview, Washington, for any of commodities and origins. In several instances the Humboldt routes do have a rail distance advantage, but for the most part these advantages are small. Commodities and origins for which the east-west Humboldt County rail routes have an advantage include:

- For wheat originating in Great Falls, Montana, Humboldt County is 370 miles closer than Los Angeles,
- For most commodities the east-west route to Humboldt County is shorter than the existing line to Coos Bay, but this difference is relatively small,
- There is a very slight advantage versus Aberdeen, Washington, for coal, potash, and iron ore, from some origins,
- Potash and iron ore from Utah are approximately 60 miles closer to Humboldt County than to Seattle, and
- For coal from Utah and Colorado, the east-west Humboldt route is approximately 200 miles shorter than to the neighboring ports of Cherry Point, Washington and Roberts Bank, British Columbia. Prince Rupert, British Columbia is a much longer rail move.

A critical advantage that all of these other ports have relative to Humboldt County is that the rail lines are already in place. In addition, most of these existing rail routes are capable of handling large volumes of heavy rail traffic, without the billion dollar-plus investment needed for an east-west route to Humboldt County.

Table 10 – Rail Distance Advantage/Disadvantage to Humboldt

Commodity	Origin	Los Angeles, CA	Stockton, CA	Richmond, CA	Coos Bay, OR	Longview, WA	Aberdeen, WA	Seattle, WA	Cherry Point, WA	Roberts Bank, BC	Prince Rupert, BC	Humboldt
Rail Miles												
Coal	Sharp, UT	705	865	968	1,229	1,025	1,124		1,289	1,314	2,258	1,102
Coal	Oak Creek, CO	1,189	1,253	1,356	1,617	1,413	1,512		1,677	1,702	2,646	1,490
Coal	Antelope Mine, WY	1,576	1,493	1,596	1,790	1,364	1,463		1,624	1,649	2,593	1,731
Soda Ash	Green River, WY	997	914	1,017	1,211	1,007	1,106		1,272	1,296	2,240	1,151
Wheat	Great Falls, MT	1,967	1,439	1,475	1,123	906	1,005	1,046				1,597
Wheat	Sioux Falls, SD	1,960	1,878	1,981	2,091	1,874	1,973	2,014				2,115
Wheat	Topeka, KS	1,728	1,770	1,873	2,067	1,863	1,962	2,003				2,007
Corn	Minneapolis, MN	2,148	2,065	2,168	2,036	1,819	1,918	1,959				2,303
Corn	Grand Island, NE	1,661	1,579	1,682	1,876	1,672	1,771	1,812				1,816
Corn	Des Moines, IA	1,995	1,912	2,015	2,209	2,005	2,104	2,145				2,150
Potash	Ogden, UT	823	736	840	1,098	897	996	1,036				974
Iron Ore	Cedar, UT	859	923	1,026	1,284	1,083	1,182	1,223				1,161
Humboldt Rail Advantage (Miles)												
Coal	Sharp, UT	8	**(237)**	**(134)**	126	**(77)**	22		187	212	1,156	
Coal	Oak Creek, CO	**(301)**	**(237)**	**(134)**	126	**(77)**	22		187	212	1,156	
Coal	Antelope Mine, WY	**(155)**	**(237)**	**(134)**	60	**(366)**	**(268)**		**(106)**	**(82)**	862	
Soda Ash	Green River, WY	**(155)**	**(237)**	**(134)**	60	**(144)**	**(45)**		120	145	1,089	
Wheat	Great Falls, MT	370	**(158)**	**(122)**	**(474)**	**(691)**	**(592)**	**(551)**				
Wheat	Sioux Falls, SD	**(155)**	**(237)**	**(134)**	**(24)**	**(241)**	**(142)**	**(101)**				
Wheat	Topeka, KS	**(279)**	**(237)**	**(134)**	60	**(144)**	**(45)**	**(5)**				
Corn	Minneapolis, MN	**(155)**	**(237)**	**(134)**	**(267)**	**(484)**	**(385)**	**(344)**				
Corn	Grand Island, NE	**(155)**	**(237)**	**(134)**	60	**(144)**	**(45)**	**(5)**				
Corn	Des Moines, IA	**(155)**	**(237)**	**(134)**	60	**(144)**	**(45)**	**(5)**				
Potash	Ogden, UT	**(151)**	**(237)**	**(134)**	124	**(77)**	22	62				
Iron Ore	Cedar, UT	**(301)**	**(237)**	**(134)**	124	**(77)**	22	62				

Note: Numbers in parentheses indicate a disadvantage, or longer distance, to Humboldt
Source: BST Associates

Existing West Coast Bulk Traffic

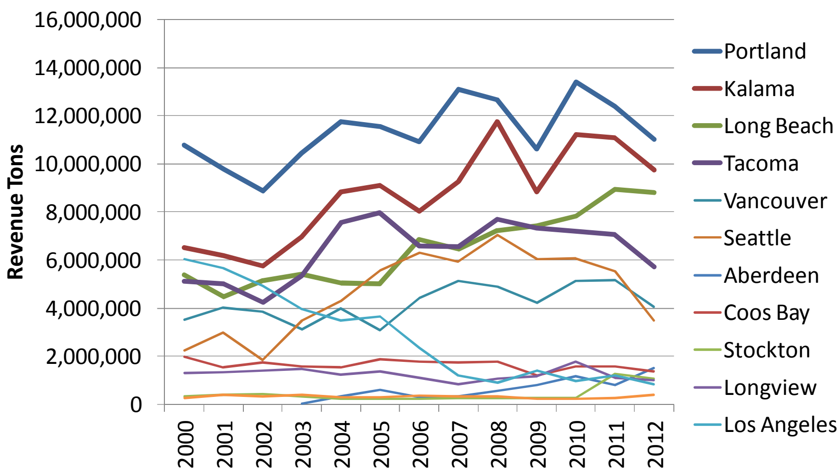
The estimated volume of rail cargo required to make a new rail route to Humboldt County economically feasible would make Humboldt Bay one of the largest dry bulk ports on the West Coast. As shown in Table 9 above, the lowest volume requirement is for rebuilding the north-south line using on a discount rate of 3.0%. Under these assumptions, the volume required would likely range between 5.6 million and 9.1 million metric tons per year. For the east-west lines, the lowest estimated volume requirement is 11.5 million to 18.5 million metric tons per year, assuming a 3.0% discount rate. Under higher discount rates the volume increases sharply, to as much as 100 million metric tons per year.

Typical shuttle trains for dry bulk commodities carry 10,000 tons of traffic or more. At a range of 5.6 million to 9.1 million metric tons per year, this would translate to approximately 1.5 to 2.5 full trains per day, or 3.1 to 5.0 total trains per day. The low estimate for east-west lines of 11.5 million to 18.5 million metric tons per year translates into approximately 3.1 to 5.1 full trains per day, or 6.3 to 10.1 total trains per day. Using higher discount rates and/or higher construction costs will substantially increase the number of trains.

Data from the Pacific Maritime Association shows that the level of cargo needed for an east-west line this level of exports would be among the largest bulk export volumes on the West

Coast (see Figure 11). The Columbia River ports of Portland, Oregon and Kalama, Washington have each exported an average of more than 10 million tons of dry bulk commodities per year in recent years. Long Beach exported approximately nine million tons in 2012, but since 2000 no other port has exported more than eight million tons of dry bulk commodities per year.

Figure 11 – Bulk Export Volumes at West Coast Ports



Source: Pacific Maritime Association data

Navigation Channel Requirements

The navigation channel in Humboldt Bay is authorized for a depth of 38 feet. This compares favorably with several other ports on the West Coast, but is substantially less than at most of the major bulk-handling ports.

As illustrated above, the largest bulk exporting ports on the West Coast are on the lower Columbia River. In addition to Portland and Kalama, these ports include Vancouver, Washington and Longview, Washington. As shown in Table 11, the authorized channel depth to Longview (and the other lower Columbia River ports) is 43 feet. The lower Columbia River channel was deepened in recent years from 40 feet down to 43 feet, and vessel transit data shows an upward trend in the draft of loaded vessels.

Table 11 – Navigation Channel Depths at West Coast Ports

Port	Channel Depth
Los Angeles, CA	50+
Stockton, CA	35
Richmond, CA	38
Humboldt, CA	38
Coos Bay, OR	37
Longview, Kalama, and Vancouver, WA and Portland, OR	43
Grays Harbor, WA	36
Seattle, WA	50+
Cherry Point (WA)	78
Roberts Bank (BC)	68
Prince Rupert (BC)	48+

Source: NOAA, USACE, individual ports

In addition to the 43 feet in the Columbia River, Puget Sound ports (e.g. Seattle) have water depth of 50 feet or more at their bulk facilities. Farther north, the neighboring port facilities at Cherry Point, Washington and Roberts Bank, British Columbia have water depth of 68 feet or more. To the south, Los Angeles has a depth of 50 feet or more at many of its facilities.

Humboldt Bay would likely require a deeper navigation channel to handle the numbers and sizes of ships needed to handle the estimated volume of cargo. Such a deepening project would likely be costly.

Marine Terminal Requirements

Dry bulk cargos such as grain, coal, ores, and minerals are increasingly being moved in shuttle trains with as many as 100 to 125 cars per train. New facilities to handle these trains typically require rail trackage sufficient to hold several complete trains at once, as well as unloading equipment that can send a train back out in less than one day. This trackage is typically in the form of a rail loop, but sometimes consists of several long, linear tracks. The mainline railroads offer their lowest rates to facilities that are able to receive, unload, and return the empty train in less than 24 hours.

A prime example of such a facility is the new EGT grain export terminal in Longview, Washington. This terminal has a loop track layout capable of holding four trains, and which can unload two trains simultaneously. This facility was required by the railroads to include four extra loop tracks in order to accommodate all of EGT’s train sets in the event of a rail stoppage The grain terminals at both Seattle and Tacoma have long parallel tracks, or “ladder tracks”, instead of loop tracks, but both are able to turn shuttle trains in the required time.

The Samoa Peninsula may be too narrow for a loop track, necessitating the use of ladder tracks.

In addition to rail infrastructure, a new bulk terminal may require a new dock, as well as storage facilities and handling equipment.

While the cost of a new bulk terminal has not been included in this analysis, the $200 million investment in the new EGT terminal provides a recent example of the potential cost.

Figure 12 – EGT Longview Terminal

Source: EGT

Railroad Market Considerations

All three Central Valley interchanges are located on the Union Pacific Railroad. For shippers seeking to use the east/west railroad, also having access to the Burlington Northern Santa Fe (BNSF) would be desirable for obtaining competitive rates. BNSF operates transcontinental service fairly near the Redding/Red Bluff/Gerber area. However, their nearest railhead is located at Bieber Junction and/or the Stockton – Richmond area. It is not likely that Union Pacific would grant BNSF access to the Redding/Red Bluff/Gerber interchanges. With only one Class 1 carrier accessing the Humboldt Bay area, shippers could be subjected to higher rates, with reduced market access.

Should interest continue in developing a new east/west rail line to connect the UP mainline with the Humboldt Bay area, it will be necessary to present to the STB an environmental impact statement that describes the potential impact of the new line.

Conclusion

Rail service to Humboldt County will require a major investment, through either a new East-West rail alignment or through reconstruction of the former North-South line. In order for this investment to be financially feasible, the rail line will need to move very large volumes of cargo.

A rail line to Humboldt County would face strong competition from existing ports, primarily those on the U.S. West Coast. Humboldt County would face several competitive disadvantages relative to these other ports, including that rail traffic would need to generate sufficient net revenue to finance the construction of a rail line, and the lack of a rail distance advantage.

In addition to the lack of rail infrastructure, waterborne exports of large volumes of bulk commodities would likely require substantial investments in new cargo terminals. Also, the Humboldt navigation channel is not at deep as that at most of the competing ports, which would also require a substantial investment.

In conclusion, development of rail service to Humboldt County is likely to be both high cost and high risk.

Appendix

Table 12 – Rail Alignment Cost Details
1909 Lentell Alignment 1

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	194 mi	$1.0 (M/mile)	$194M	Samoa to Redding
Grading (Hvy)	150 mi	$3.0 (M/mile)	$450M	
Grading (Lite)	34 mi	$1.5 (M/mile)	$51M	Deducts 10.0 miles between Samoa and Aldergrove
Landslide Mitigation	150 mi	$1.0 (M/mile)	$150M	Incl Environmental Review and Contingency
Tunnels	7000 LF	$13K/LF	$90M	Includes 5 tunnels in Hayfork River Cyn
Bridges	9000 LF	$10K/LF	$90M	
Property	184 mi	$300K/mile	$55M	Deducts 10.0 miles between Samoa and Aldergrove
		Total	$1080M	$5.6M/mile

Table 13 – Rail Alignment Cost Details
Rail Route 1

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	189 mi	$1.0 (M/mile)	$189M	Samoa to Redding
Grading (Hvy)	150 mi	$3.0 (M/mile)	$450M	
Grading (Lite)	29 mi	$1.5 (M/mile)	$44M	Deducts 10.0 miles between Samoa and Aldergrove Rd
Landslide Mitigation	150 mi	$1.0 (M/mile)	$150M	Incl Environmental Review and Contingency
Tunnels	7000 LF	$13K/LF	$90M	Includes 5 tunnels in Hayfork River Cyn
Bridges	9000 LF	$10K/LF	$90M	
Property	179 mi	$300K/mile	$54M	Deducts 10.0 miles between Samoa and Aldergrove Rd
		Total	$1067M	$5.6M/mile

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	201 mi	$1.0 (M/mile)	$201M	Samoa to Red Bluff
Grading (Hvy)	175 mi	$3.0 (M/mile)	$525M	
Grading (Lite)	16 mi	$1.5 (M/mile)	$24M	Deducts 10.0 miles between Samoa and Aldergrove Rd
Landslide Mitigation	140 mi	$1.0 (M/mile)	$140M	Incl Environmental Review and Contingency
Tunnels	7000 LF	$13K/LF	$90M	Includes 5 tunnels in Hayfork River Cyn
Bridges	9000 LF	$10K/LF	$90M	
Property	191 mi	$300K/mile	$57M	Deducts 10.0 miles between Samoa and Aldergrove Rd
		Total	$1127M	5.6M/mile

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	209 mi	$1.0 (M/mile)	$209M	Samoa to Gerber
Grading (Hvy)	190 mi	$3.0 (M/mile)	$570M	
Grading (Lite)	20 mi	$1.5 (M/mile)	$30M	Deducts 10.0 miles between Samoa and Aldergrove
Landslide Mitigation	190 mi	$1.0 (M/mile)	$190M	Incl Environmental Review and Contingency
Tunnels	7000 LF	$13K/LF	$90M	Includes 5 tunnels in Hayfork River Cyn
Bridges	9000 LF	$10K/LF	$90M	
Property	199 mi	$300K/mile	$60M	Deducts 10.0 miles between Samoa and Aldergrove Rd
		Total	$1239M	$5.9M/mile

Table 14 – Rail Alignment Cost Details
1909 Lentell Alignment 2

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	213 mi	$1.0 (M/mile)	$213M	Samoa to Redding
Grading (Hvy)	176 mi	$3.0 (M/mile)	$528M	
Grading (Lite)	mi	$1.5 (M/mile)	$M	Deducts 37.0 miles between Samoa and Alton
Landslide Mitigation	160 mi	$1.0 (M/mile)	$160M	Deducts 10.0 miles of relatively flat ground near Redding; Incl Environmental Review and Contingency
Tunnels	13,000 LF	$13K/LF	$170M	Includes 1.5 miles tunnel under South Fork Mtn.
Bridges	11,000 LF	$10K/LF	$110M	Incl Major 400' high bridge over SF Trinity River
Property	176 mi	$300K/mile	$53M	Deducts 37.0 miles between Samoa and Alton
		Total	$1234M	$5.8M/mile

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	217 mi	$1.0 (M/mile)	$217M	Samoa to Gerber
Grading (Hvy)	150 mi	$3.0 (M/mile)	$450M	
Grading (Lite)	30 mi	$1.5 (M/mile)	$45M	Deducts 37.0 miles between Samoa and Alton
Landslide Mitigation	120 mi	$1.0 (M/mile)	$120M	Deducts 30.0 miles of relatively flat ground near Gerber; Incl Environmental Review and Contingency
Tunnels	13,000 LF	$13K/LF	$170M	Includes 1.5 miles tunnel under South Fork Mtn.
Bridges	11,000 LF	$10K/LF	$110M	Incl Major 400' high bridge over SF Trinity River
Property	180 mi	$300K/mile	$54M	Deducts 37.0 miles between Samoa and Alton
		Total	$1166M	$5.4M/mile

Table 15 – Rail Alignment Cost Details
Rail Route 2

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	200 mi	$1.0 (M/mile)	$200M	Samoa to Redding
Grading (Hvy)	153 mi	$3.0 (M/mile)	$459M	
Grading (Lite)	10 mi	$1.5 (M/mile)	$15M	Deducts 37.0 miles between Samoa and Alton
Landslide Mitigation	143 mi	$1.0 (M/mile)	$143M	Deducts 10.0 miles of relatively flat ground near Redding; Incl Environmental Review and Contingency
Tunnels	7,000 LF	$13K/LF	$90M	
Bridges	11,000 LF	$10K/LF	$110M	Incl Major 400' high bridge over SF Trinity River
Property	163 mi	$300K/mile	$49M	Deducts 37.0 miles between Samoa and Alton
		Total	$1066M	$5.3M/mile

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	212 mi	$1.0 (M/mile)	$212M	Samoa to Red Bluff
Grading (Hvy)	155 mi	$3.0 (M/mile)	$465M	
Grading (Lite)	20 mi	$1.5 (M/mile)	$30M	Deducts 37.0 miles between Samoa and Alton
Landslide Mitigation	135 mi	$1.0 (M/mile)	$135M	Deducts 20.0 miles of relatively flat ground near Red Bluff; Incl Environmental Review and Contingency
Tunnels	7,000 LF	$13K/LF	$90M	
Bridges	11,000 LF	$10K/LF	$110M	Incl Major 400' high bridge over SF Trinity River
Property	175 mi	$300K/mile	$53M	Deducts 37.0 miles between Samoa and Alton
		Total	$1095M	$5.2M/mile

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	221 mi	$1.0 (M/mile)	$221M	Samoa to Gerber
Grading (Hvy)	154 mi	$3.0 (M/mile)	$462M	
Grading (Lite)	30 mi	$1.5 (M/mile)	$45M	Deducts 37.0 miles between Samoa and Alton
Landslide Mitigation	1240 mi	$1.0 (M/mile)	$124M	Deducts 30.0 miles of relatively flat ground near Gerber; Incl Environmental Review and Contingency
Tunnels	14,000 LF	$13K/LF	$180M	Incl 1.4 mile long tunnel near Black rock Mtn
Bridges	11,000 LF	$10K/LF	$110M	Incl Major 400' high bridge over SF Trinity River
Property	184 mi	$300K/mile	$55M	Deducts 37.0 miles between Samoa and Alton
		Total	$1197M	$5.4M/mile

Table 16 – Rail Alignment Cost Details
Rail Route 3 (Eel Canyon)

Cost Item	Length	Unit Cost	Subtotal	Comments
Track	241.0 mi	$1.0 (M/mile)	$241M	Samoa to Gerber
Grading (Hvy)	144 mi	$3.0 (M/mile)	$432M	
Grading (Lite)	30 mi	$1.5 (M/mile)	$45M	Deducts 67.0 miles between Samoa and Fort Seward
Landslide Mitigation	113 mi	$1.0 (M/mile)	$113M	Deducts 30.0 miles of relatively flat ground near Gerber; Incl Environmental Review and Contingency
Tunnels	14,000 LF	$13K/LF	$180M	Incl 1.4 mile long tunnel near Black rock Mtn
Bridges	11,000 LF	$10K/LF	$140M	Incl major 400' high bridge over Eel River at Ft. Seward ; incl $30M to upgrade existing Van Duzen and Eel River bridges to 286K
Property	174 mi	$300K/mile	$52M	Deducts 67.0 miles between Samoa and Fort Seward
		Total	$1203M	$5.0M/mile