

# **Abo Canyon Engineering Study**



## **The Tunneling Option**



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**Project:** Proposed BNSF Railway Company Second Track through the Abo Canyon and DS Ranch, LLC

**Subject:** Alternative solution - Tunneling option

Mr. Richard Alvidrez of Keleher & McLeod, P.A. (Albuquerque, New Mexico) has asked me to evaluate the proposed construction of the second railroad track by BNSF Railway Company in Abo Canyon, New Mexico.

## **1.0 BACKGROUND:**

The original railroad in Abo Canyon was constructed as a single track at grade alignment about a century ago. BNSF wants to improve its Transcontinental Line capacity and in doing so is proposing to construct a second railroad track through the Abo Canyon to handle increased train traffic between Los Angeles and Chicago.

With large differences in elevation throughout the Abo Canyon, near vertical slopes and unfavorable geologic conditions in some locations, the design is challenging and construction of the BNSF proposed alignment will be particularly difficult. Considering all the engineering constraints, BNSF has evaluated three different alignment alternatives for the proposed second track. They are north alignment, tunnel alignment, and south alignment. Table 1 summarizes the alignment alternatives and options identified by HDR in the report produced by BNSF<sup>1</sup>.

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<sup>1</sup> Burlington Northern Santa Fe Railway, Abo Canyon Engineering Study, Draft Final Report, page 7, April 2005.

**Table 1:** Alternatives and options for the second railroad track

Alternatives	Options
#1 North Alignment	A. Max 1°-30' curvature (60 MPH)
#2 Tunnel Alignment	B. Max 2°-50' curvature (50 MPH)
#3 South Alignment	C. Max 4°-00' curvature (40 MPH)
	D. Reduce rockfall hazard on existing alignment

After reviewing the engineering and constructability constraints and the perceived environmental impacts of each proposed alternative on cultural, historical, and biological resources, as well as geotechnical and drainage considerations, BNSF concluded that the third alternative, which is the South Alignment, would be the most feasible. Given the existing geologic formations and the nature of the Abo Canyon, the South Alignment alternative appeared to have the fewest constructability problems and least potential for interruption of on-going train operations during construction. It also minimized the potential rockfall, which could make train operation hazardous. Considering the engineering factors only, the BNSF conclusion that the South Alignment would be the best solution of the three considered makes perfect sense. In a later report<sup>2</sup>, they have adopted a fourth alternative called “the refined alignment,” which places the second track on the south side of the existing track at various locations in order to reduce the earthwork and improve constructability.

However, the reports do not generate a convincing argument that the environmental impacts resulting from construction of the second track is acceptable, and the attempt to paint a rosy picture that the environment will not suffer as the result of this construction is not accurate. In reality, construction of the second track will have devastating effects and will cause irreversible changes to Abo Canyon. Construction activities occurring around-the-clock that include blasting and rock excavation on a massive scale over a long period of time with hundreds of crew working in the canyon causing construction-related noise and pollution will totally disrupt and dislocate the wildlife and destroy historically significant artifacts. The construction in Abo Canyon will result in changes to topography and result in changes to the natural drainage scheme and river channel in the canyon. There are many related additional points of concern that are covered in a letter from the DS Ranch, LLC owners to New Mexico Bureau of Land Management in Socorro, dated June 10, 2005, which outline in detail the impacts to the Abo Canyon caused by the construction of a second track in the canyon following the proposed BNSF preferred alignment. The points outlined above and contained in the referenced letter need to be seriously considered before such construction is permitted to proceed.

The proposed construction by BNSF will inflict irreversible environmental damage to Abo Canyon. A detailed discussion of these impacts is covered in a separate document<sup>3</sup>.

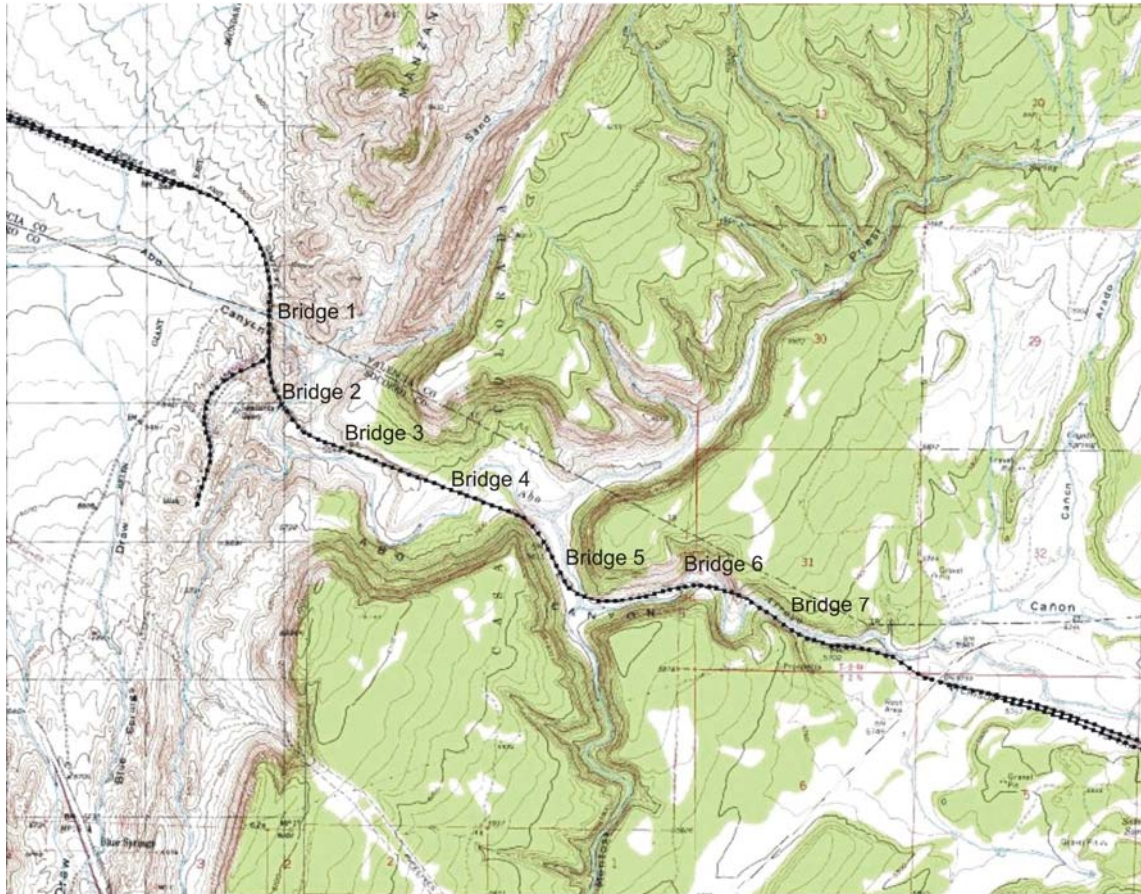
The purpose of this report is to propose alternative alignments that preserve the integrity of Abo Canyon, while providing the additional capacity that BNSF desires.

<sup>2</sup> BNSF Railway Company, Abo Canyon Second Track Project, Socorro and Valencia Counties, New Mexico, Draft Environmental Assessment, May 2005.

<sup>3</sup> “Would the BNSF Second Track Project have a Significant Impact on the Quality of Human Environment? EA Report by Thomas F. King, PhD, January 2006.

## 2.0 SITE ASSESSMENT:

Figure 1 shows a topographical map of Abo Canyon with the existing railroad alignment.



**Figure 1:** Topographical map of the Abo Canyon and the existing railroad track alignment

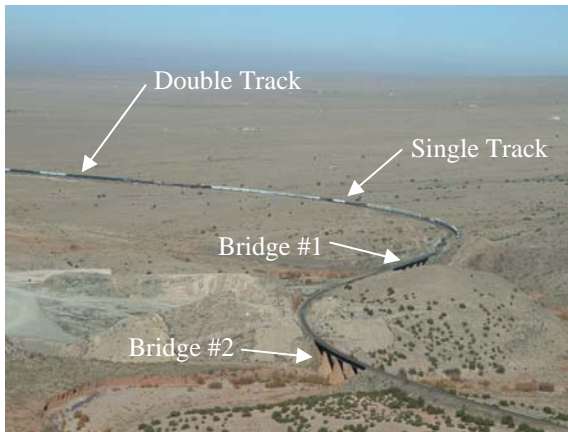
The existing alignment consists of seven bridges throughout the canyon. Table 2 shows the location of the bridges through the Abo Canyon.

**Table 2:** Bridge locations along the existing Railroad alignment through Abo Canyon

Bridge Number	Milepost
1	874.2
2	873.8
3	872.8
4	872.2
5	871.7
6	871.5
7	871.4



Figures 2 through 9 show the railroad bridges and some of the features along the Abo Canyon rail corridor.



**Figure 2:** Entering the Canyon from the west: bridges number 1 and 2



**Figure 3:** Bridge number 3



**Figure 4:** Bridge number 4



**Figure 5:** Bridge number 5



**Figure 6:** Bridge number 6





**Figure 7:** Bridge number 7



**Figure 8:** Narrow canyon between bridges number 6 and 7



**Figure 9:** Narrow canyon after bridge number 7



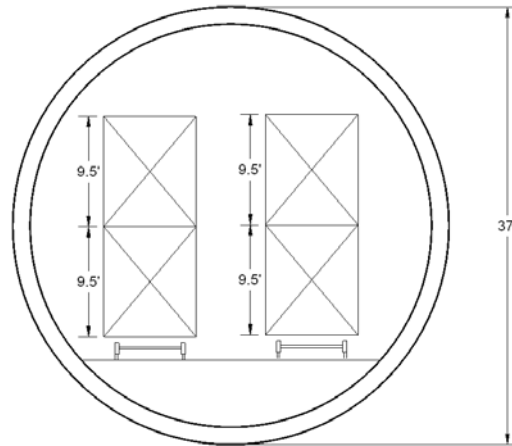
**Figure 10:** Switching from double track to single track at Scholle, just before the east entrance to Abo Canyon



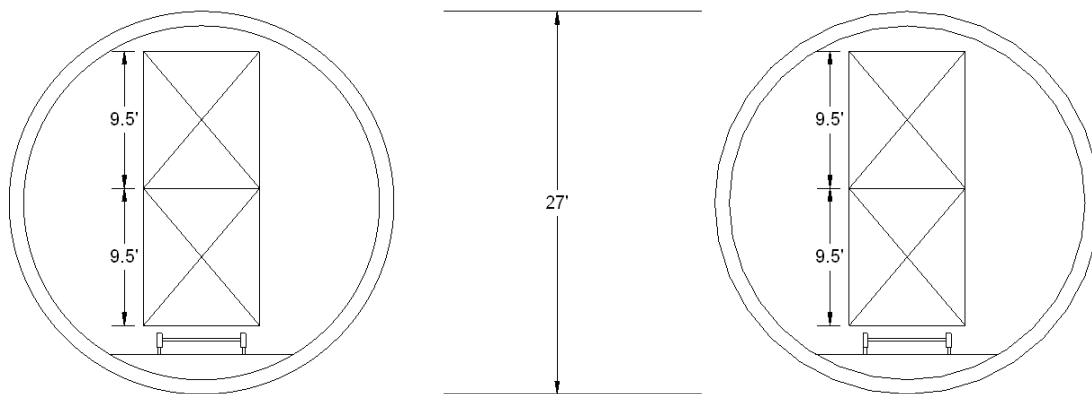
### 3.0 PROPOSED ALTERNATIVES:

Construction of a train tunnel in the rock formations adjacent the Abo Canyon, would greatly reduce the environmental and ecological damage associated with construction of BNSF's proposed at-grade alignment of a second railroad track through the canyon.

As twin tracks in a single tunnel is rarely done for long tunnels due to difficulty with ventilation, twin single tunnels are generally considered a more viable solution. Figures 11 and 12 show two possible railroad tunnel configurations.



**Figure 11:** Twin tracks in a single tunnel

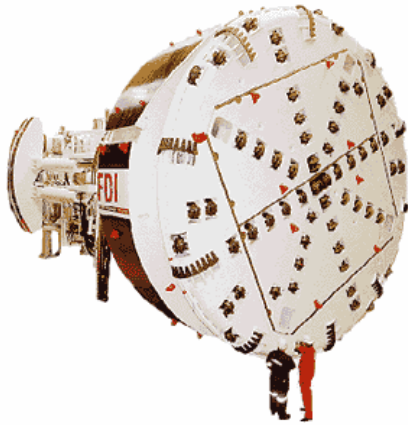


**Figure 12:** Twin single tunnels

Construction of a tunnel in the variable and generally weathered rock formations found in Abo Canyon would typically be done using a tunnel boring machine or TBM. In sound rock the tunnel could be left unlined with the use of rock bolts to stabilize any loose rock. Figure 13 shows a typical hard rock TBM.

If sufficient rock fragmentation and loose soil is found in borings along the proposed tunnel alignment, it may be more advisable to place a precast concrete lining in the tunnel. If good competent rock is found along the alignment, excavation can also be performed using a "drill and shoot" technique to create a horseshoe shape tunnel. Figure 14 shows typical tunnel portals.





**Figure 13:** A typical hard rock tunnel boring machine (TBM)



**Figure 14:** A typical tunnel entrance

Mr. Gordon Clark, a licensed consulting engineer who has designed and supervised the construction of tunnels in the United States and throughout the world, assisted in reviewing the proposed BNSF project, a study of the conceptual feasibility of the Abo Canyon tunnel, and the selection of the proposed alignments.

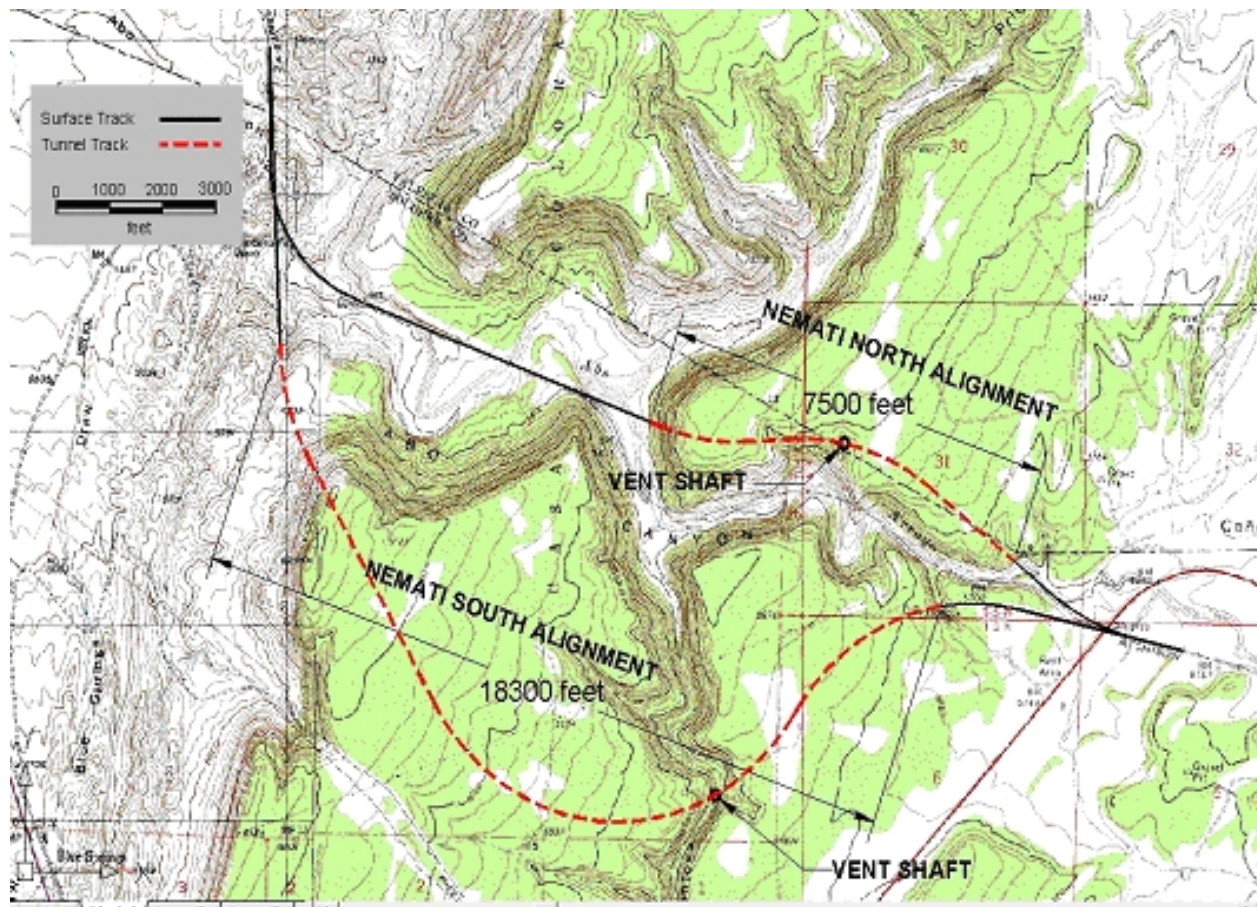
Figure 15 shows two possible tunnel alignments for Abo Canyon: “Nemati North” and “Nemati South”. These alignments are very conceptual in nature and are provided only in an attempt to illustrate that there are other viable ways to meet the need for a second railroad track through this area.

Before any tunnel alignment can be selected, extensive geotechnical investigations must be performed that identify and characterize the engineering properties of the insitu soil and rock formations. A thorough understanding of the location of aquifers and migration of groundwater through the area needs to be obtained so as to avoid the potential impact to existing wells and stream flows in the area.

Of the two tunnel alignments shown in Figure 15, one stays completely out of Abo Canyon and is referred to as “Nemati South” alignment while the other avoids the narrower reaches of the canyon and is referred to as the “Nemati North” alignment.

Either tunnel would greatly reduce the number of cattle, bears, and big horn sheep that are killed annually on the existing at-grade alignment. Use of a tunnel would reduce the train noise and train whistles heard around-the-clock in the canyon and would also reduce the amount of light pollution caused by trains that traverse the canyon at all hours of the night.





**Figure 15:** North and South tunnel alignment options

### 3.1 NEMAT SOUTH ALIGNMENT OPTION:

The south tunnel alignment is the total tunneling option, meaning that the railroad tunnel alignment would pass completely outside the Abo Canyon, hence imposing very little impact on the canyon. In fact, with this option, if twin tunnels were constructed, the existing railroad track could be totally removed from the canyon and the seven bridges demolished. This would almost restore the canyon to the condition it was in before the railroad was constructed a century ago.

The length of the south tunnel alignment is approximately 3.5 miles (18,300 feet). The criteria used to determine this alignment was to maximize train speed by using less than 1.5 degrees of curvature (4000 foot radius) while at the same time staying out of the Montosa Arroyo. As the result, the proposed south alignment swings a considerable distance south. This tunnel alignment can be constructed using grades of less than 1.5%. The existing alignment contains curves with greater than 2 degrees of curvature (curve radius of 2700 feet), and thus forces the trains to pass at much slower speeds. The grade of the south tunnel option can be maintained at less than 1.5% which would reduce the fuel consumption of the locomotives. The combination of this lower grade and flatter curvature means that the trains can travel with speeds of up to 60 miles per hour, which is substantially faster than the speed that the trains travel through the canyon with the existing alignment. The location of a ventilation shaft associated with this tunnel option is indicated on Figure 15.



### 3.2 NEMATI NORTH ALIGNMENT OPTION:

As a compromise to an obviously very costly, but highly environmentally-desirable south alignment option, a north tunnel alignment option was developed. It has many of the desirable features of the south tunnel alignment.

With this option, the railroad would utilize the existing railroad right-of-way and parallel the existing alignment over bridges 1 through 4 (see Figure 1). The alignment remains on the surface in the flat portion of the alignment and then enters a tunnel on the north side of the narrow reaches of Abo Canyon to the east (Figures 16 through 18). With this option, the length of the tunnel is reduced to 1.4 miles (7,500 feet) and an associated ventilation shaft can be constructed at a midpoint of the tunnel (Figure 19). Similar to the south tunnel alignment option, the north tunnel alignment option can maintain a grade of less than 1.5% and the track curvature can be held to less than 1.5 degrees of curvature. This combination of low grades and flat curves will result in much higher speeds of travel and increase throughput for BNSF.



**Figure 16:** Looking east-west portal of north tunnel option



**Figure 17:** Looking west-east portal of north tunnel option



**Figure 18:** Looking west-west portal of north tunnel option



**Figure 19:** Looking north – mid-tunnel vent location for the north tunnel option

In both proposed south and north tunnel alignment options, the fan structure of the ventilation shaft could be located underground in order to diminish visual impact.

#### **4.0 RECOMMENDATION:**

It is recommended that BNSF abandon construction plans for a second at-grade track in the Abo Canyon. Given the physical features of the canyon, such construction would require a massive blasting and excavation operation of surface rock and soil that would destroy the natural beauty of the canyon and cause permanent negative environmental impacts in the Abo Canyon.

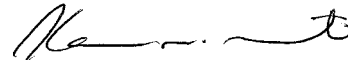
Constructing a single or potentially twin tunnels adjacent the Abo Canyon is a much more environmentally responsible approach that would pose the least amount of damage to the canyon. Selection of a route similar to the proposed south tunnel alignment that completely bypasses the canyon would preserve the canyon for future generations and would leave the canyon untouched while allowing BNSF to eliminate a single track choke point in their system.

Tunneling is a simple and very practical solution that can accommodate BNSF increased traffic demand, while keeping the Abo Canyon from further deterioration as the result of the second track construction.

Constructing a railroad alignment inside a tunnel will shield the track from the frequent rock slides that occur on the existing track and eliminate the train delays associated with temporary closure of the tracks. Elimination of the frequent rock slides will also greatly reduce the possibility for train derailment.

If there are any questions, please feel free to contact me. I would be willing to meet with BNSF, HDR, or your client if need be.

Sincerely yours,



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