



*Heartland Corridor, Walton Virginia to  
Columbus Ohio*

# Preliminary Engineering Phase Report



GORDON  
TUNNEL –  
MP N415.07  
MOHEGAN, WV

October 14, 2005, Rev. 2



## *Preliminary Engineering Phase Report*

PR219399 - Gordon Tunnel  
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October 14, 2005

Norfolk Southern Railway  
Heartland Corridor, Walton VA to Columbus OH

Gordon Tunnel – MP N415.07

**Statistics: Pocahontas Division**  
**Double-width Tunnel for Main #1 and Main #2**  
**Length = 1,271'**  
**Concrete lined**  
**Tangent Track (per Track Chart)**  
**Superelevation = 0.0" (per Track Chart)**

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## **1. EXISTING CONDITIONS**

### **1.1 Background**

Valuation Map V-13WV/39 (16294) for the Gordon Tunnel is dated June 30, 1916. Parcels for the tunnel were acquired in 1907. Therefore it is suspected that the tunnel was constructed in 1907 or shortly afterwards. A Norfolk Southern tunnel inspection sheet for the Gordon Tunnel references drawing Y-3338. This drawing is dated June 10, 1905, applies to tunnels on tangent track, and shows typical portal and lining construction. Additional information on this tunnel was obtained from various sources such as topographic maps, aerial photos, inspection reports, track charts, and field investigations that were performed on March 25 and June 14, 2005.

### **1.2 General Area**

The tunnel is located in a lightly populated area of the Town of Rogers, McDowell County, West Virginia. Nearby land use includes a residential area near the west portal and a lumber yard near the east portal. There is a staging area close to the west portal. The site can be accessed from Route 52 to the west portal. There are rail bridges in close proximity of both the east and west portals crossing Route 52 and the Tug Fork River.

### **1.3 Structural Conditions**

The tunnel is 1,271' long with a concrete lining and a width of approximately 27.5'. It is a double-width tunnel for two tracks. The track circuit cable is mounted on the south wall of the tunnel lining. The tunnel lining is generally in good condition, with only a few joints at the portals being wet.

The bridge outside of the east portal of the tunnel was investigated on June 14, 2005. It is a 4-span timber deck girder bridge. The girders are built-up steel plate girders with the south pair of girders carrying Main #1 and the north pair carrying Main #2. The girders bear on bearings on the two abutments and three piers. The bearings vary in height from 9" to 16". The bridge spans over the Tug Fork River and Route 52. A similar bridge is located outside of the west portal. The structure types and site geometry, coupled with the proximity of rock below the rail make bridge and track lowering a difficult and expensive option.

Excavation was done to expose a small portion of the tunnel liner footing. The footing thickness was found to be 9.5". The vertical distance from the top of rail to the base of the footing was measured at 31.5".

### **1.4 Track**

The track is continuous welded rail of conventional design with wooden crossties at approximately 19" on center and a stone ballast section. The rail is typically 132RE on 18" tie plates and fastened with rail spikes and anchors at every tie. The track is tangent throughout the tunnel. There are drainage ditches along each wall and in between the tracks, but drainage appears to be a problem as standing water is present at the south ditch, causing pumping on both

tracks. The ballast, which is approximately 2' below top of tie, is in generally poor condition and is pumping mud on both tracks. The ballast from this tunnel was tested and classified as being "Very Strong", requiring many blows of a geological hammer to break intact rock specimens. Most of the foundation is exposed on the south side of the tunnel where the pumping exists. There is a hole below the ties on Main #1 near the east portal.

## 1.5 Geotechnical

The tunnels in the east-central part of the Pocahontas Division (including Gordon) are located in the Appalachian Plateaus Physiographic Province, a region characterized by deeply incised plateaus underlain by flat-lying sedimentary rock. The tunnel itself is lined and no rock was exposed. The description of the site geology at each tunnel is based on our observations of the rockmass at the portals and adjacent cuts and the 1968 West Virginia Geologic Map prepared by the West Virginia Geologic and Economic Survey.

The tunnel was excavated through the medium- to thick-bedded fine-to medium grained sandstone of the New River Formation. The sandstone is locally interbedded with thin-bedded sandstone, siltstone, shale, and coal. Bedding is subhorizontal and gently rolls back and forth towards the northwest and southeast. Joints in the rock cuts of the formations are typically steeply dipping and widely spaced. Most joints are less than 15 feet in length and are not through-going across the exposure face.

The rock quality designation, Q, at the portals was determined to be 13. A Q rating between 10 and 40 is considered "Good" with 10 bordering on "Fair" and 40 bordering on "Very Good." A sample of rock was taken from the portal and tested. Lab testing of the sample indicates that the rock is sandstone and has a compressive strength of 14,148 psi.

The geoprobes indicate that the top of rock is located between 1.9' to 4.4' (averaging about 3.0') below the top of ballast throughout the tunnel for Main #1 and between 1.5' to 4.25' (averaging about 2.7') below the top of ballast throughout the tunnel for Main #2. Top of ballast is typically about 0.8' below top of low rail.

## 1.6 Clearances

The laser car measurements indicate that the existing tunnel has adequate horizontal clearance for the "Double Stack" portion of the composite clearance envelope but inadequate horizontal clearance for the "High-Wide Load" portion. For the "High-Wide Load," encroachment on the right wall averages 3", and varies up to 9" for 600' from the east portal. On the left wall the "High-Wide Load" encroaches 6" for approximately the first 50' in from the east portal.

For vertical clearance, the "Double Stack" portion of the envelope encroaches on the sides of the tunnel crown by an average of about 9" on the left wall and 17" on the right wall, but varies up to 23" on the right wall. The "High-Wide" portion of the envelope encroaches on the sides of the tunnel crown (at points lower than the "Double Stack") by an average of about 3" on the left wall and 10" on the right wall. Cross sections of the tunnel clearance encroachments are shown in the drawings at the end of this report. The maximum encroachments are summarized in the table below:

Distance (ft) from East Portal	Crown Encroachment (radial inches)		Wall Encroachment (inches)	
	Left Side	Right Side	Left Side	Right Side
0	22	19	6	9
102	3	15	0	4
205	2	17	0	7
304	3	15	0	5
409	3	15	0	5
505	5	15	0	5
604	8	17	0	1
702	8	17	0	1
809	9	17	0	1
904	9	17	0	1
1002	11	17	0	1
1105	14	17	0	1
1203	14	17	0	1
1256	12	17	0	1

## 2. CLEARANCE IMPROVEMENT ALTERNATIVES

Given the magnitude of the clearance deficiencies, there are several general alternatives that can be used to obtain the clearance; realigning the track, liner replacement, notching the liner or using steel ties to lower the track. Combinations of the general methods may be required to obtain a design that is cost effective and that can be constructed within reasonable track outages. Track lowering by excavating or undercutting does not appear feasible due to the proximity of the top of rock to the surface.

### 2.1 Liner Replacement

To obtain the desired clearance, the concrete liner must be demolished, the native rock excavated to the clearance limits plus the new liner thickness, and a new concrete liner installed. This alternative may be necessary at the east portal and for several hundred feet near the west portal.

### 2.2 Notching the Crown

Notching in the upper quadrants of the tunnel would not cut entirely through the liner and could be an alternative to complete liner replacement. Considering that the average vertical encroachment for the “Double Stack” portion of the envelope is about 13”, rock bolts and a deep notching scheme is necessary.

### **2.3 Steel Ties**

Substitution of steel ties for the standard wood ties would permit the rails to be lowered about 6 inches. Transition sections would be constructed at the tunnel approaches for the vertical curves and for a gradual transition in track stiffness. A proper drainage system is required to minimize corrosion of the ties.

Steel ties would not be sufficient to fix the entire clearance deficiencies, but in some cases could be used in conjunction with notching to provide a more economical solution. However, in this case, even with steel ties the amount of encroachment of the tunnel crown would still warrant either deep notching or crown replacement. Due to the close proximity of the rail bridges outside the portals, steel ties would require expensive and impractical bridge modifications in order to lower the bridge. Also, lateral shifting of the track is a concern when using steel ties. Steel ties do not provide any significant advantages that would warrant their expense. Therefore, they will no longer be considered as a viable alternative.

## **3. PREFERRED ALTERNATIVE**

Given the magnitude and location of the encroachments, realigning the track to the left is recommended to reduce the crown encroachments and eliminate the wall encroachments. To eliminate the remaining crown encroachments, approximately 350' of the tunnel will require replacement of the liner crown and 921' will require rock bolts and deep notching of the tunnel crown. In the final design stage, the potential for partial daylighting of the tunnel at the east portal will be looked into in greater detail. Drainage improvements are also recommended.

### **3.1 Preliminary Design**

The preliminary design uses a combination of realignment, replacement of the liner crown, and deep notching. The existing track structure is planned to be flooded with ballast to the top of the rail to provide access into the tunnel for the contractor to work and to protect the track during the construction. The preliminary design also proposes to install a new drainage system and undercut the track to replace the fouled ballast. Track realignment will be achieved as part of the undercutting and surfacing operations.

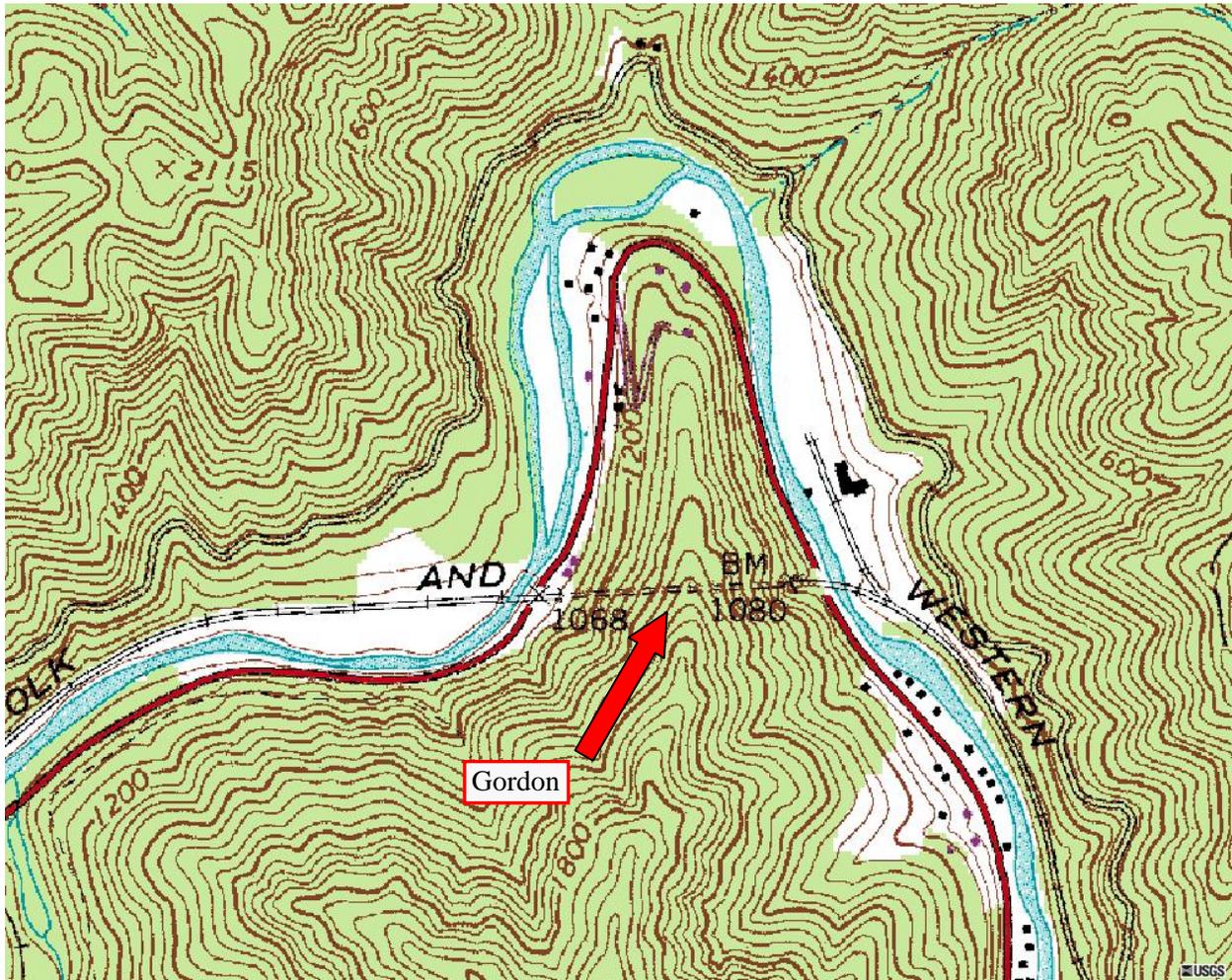
### **3.2 Schedule**

The estimated schedule for completing improvements on this tunnel is forty-eight (48) weeks from mobilization to demobilization. The schedule assumes one track being closed at a time, for ten hours each day, five days a week. The schedule assumes 12' of crown removal each day in one half of the tunnel, with concrete removal, rock removal, installation of rock dowels and installation of shotcrete all occurring on the same day for each 12' segment. Where notching is used rather than liner replacement, the installation of rock dowels at a given location would precede the deep notching, but the two operations could occur within the tunnel at different locations at the same time. Drainage improvement operations would be undertaken at the same time as the crown removal or deep notching, but at different locations in the tunnel.

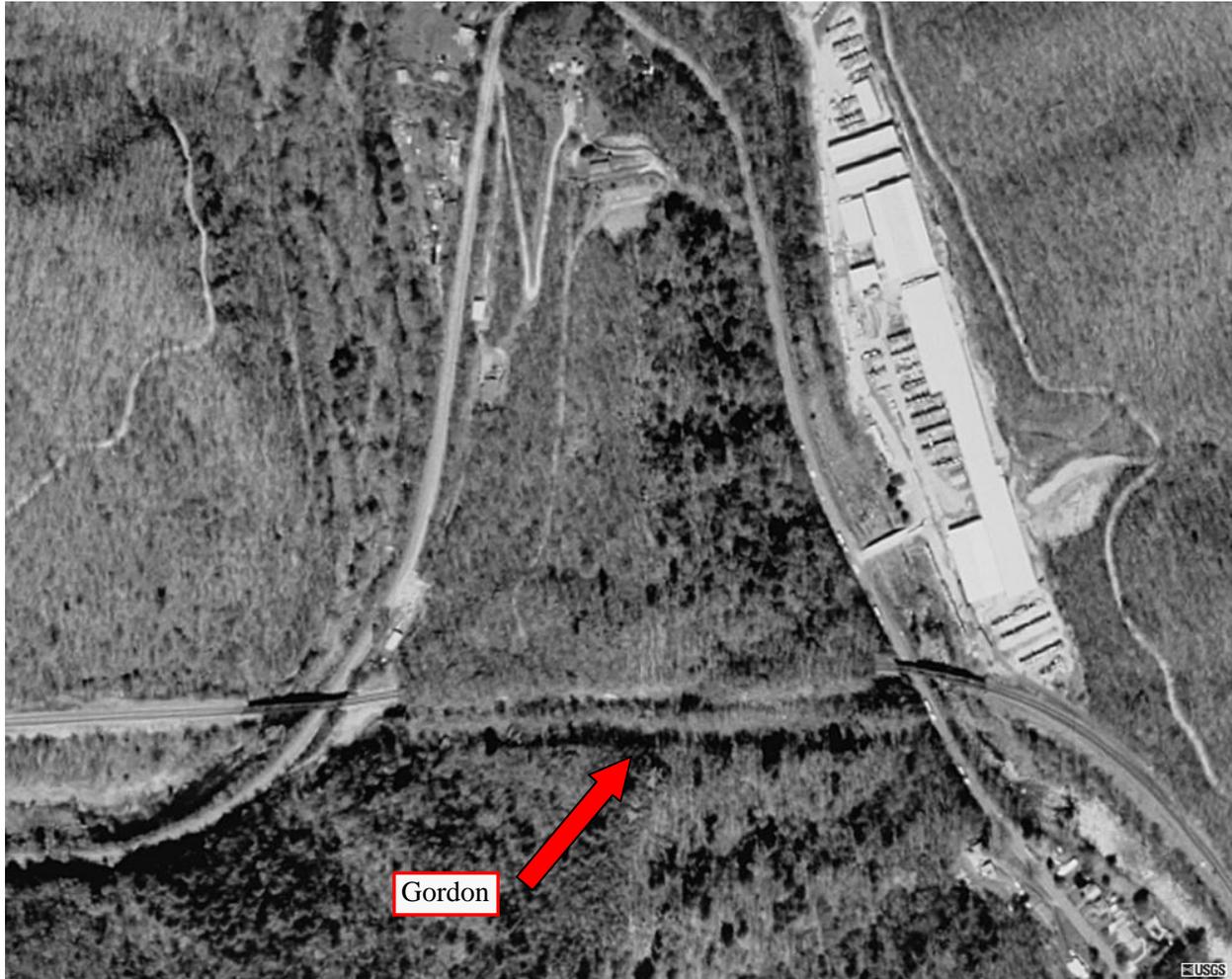
### **3.3 Estimate**

The total estimated cost for achieving clearance at this location is \$4.7 million (2005 rates) or \$3,672 per foot of tunnel. The work items include mobilization, surveying, liner removal, rock removal, rock dowels, crown installation, rock cut for drainage trench, tunnel drainage system, ballast cleaning, and demobilization. An allowance for grouting the invert void was also included. The total cost is made up of tunnel, track, signal, and site work items at \$2.9 million, plus a 30% construction contingency, a 10% engineering allowance, and a 14% construction management allowance.

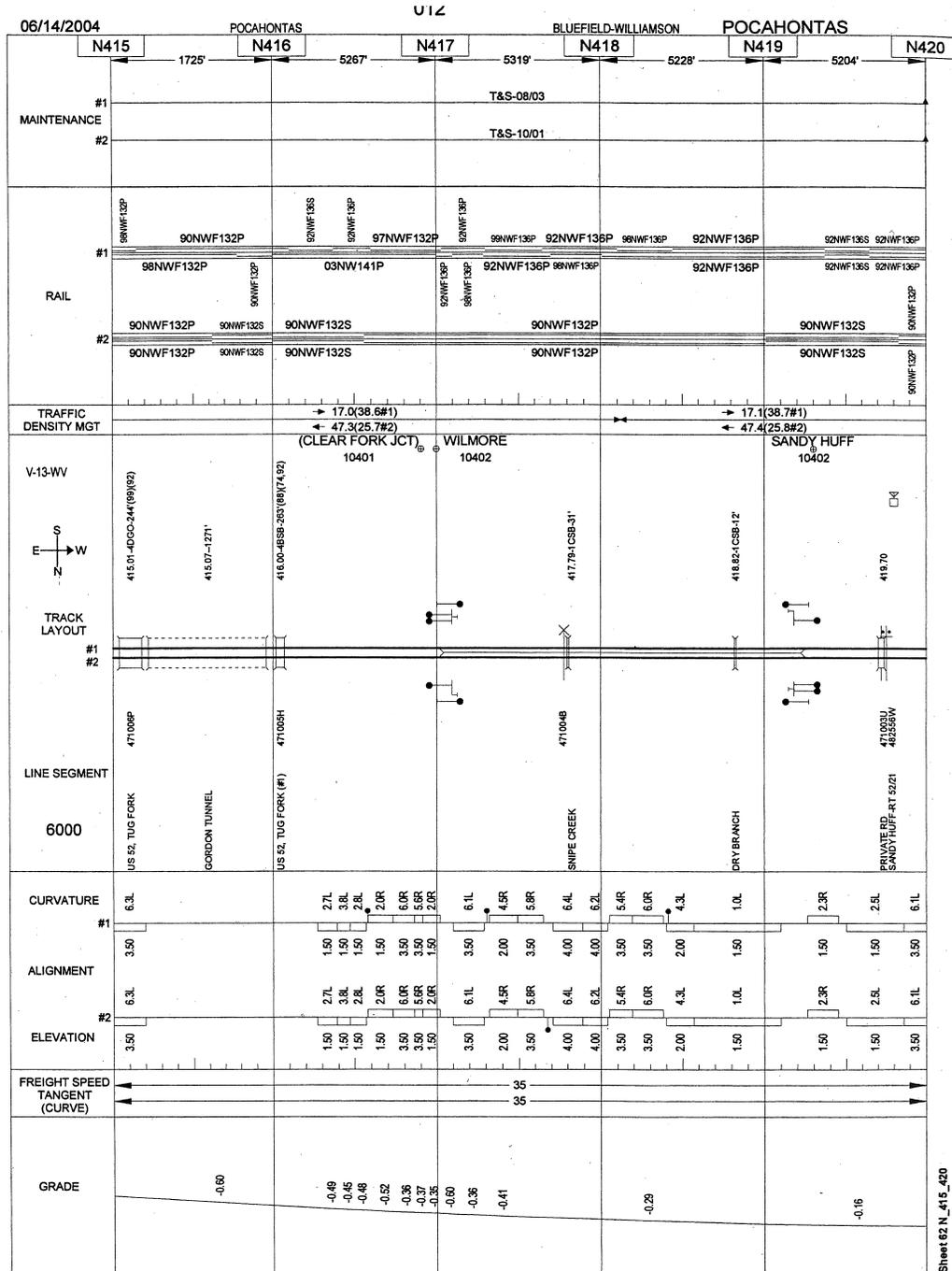
#### 4. USGS TOPOGRAPHIC MAP



**5. AERIAL PHOTO**



### 6. TRACK CHART



**7. PHOTOS**



Photo No. 1 – East Portal



Photo No. 2 – Bridge Over Highway at East Portal

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Photo No. 3. – West Portal



Photo No. 4. – View from West Portal



Photo No. 5. – Mud Pumping Through Ballast



Photo No. 6. – Spalling and Water Leaking Through Vertical Construction Joint

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**8. ESTIMATE**
**Gordon**

Tunnel Length 1271 ft  
 Tunnel Width 27.25 ft  
 # of Tracks 2

	Contractor		Railroad	
Work Window	10	hrs	10	hrs
Setup & Demobilization Allowance	2	hrs	2	hrs
Production Time	8	hrs	8	hrs

<b>Tunnel Work Items</b>	UOM	Quantity	Unit Rate	Total
Mobilization	%	5%		\$106,403.00
Surveying	DY	5	\$1,300.00	\$6,500.00
Deep Notching	LF	1842	\$218.73	\$402,895.82
Rock Dowels 14' with Chain Link Mesh - Crown	EA	583	\$605.95	\$353,470.93
Rock Dowels 14' with Chain Link Mesh - Wall	EA			
Rock Dowels 16'	EA	921	\$286.58	\$263,941.60
Crown Removal	SF	16493	\$16.26	\$268,237.60
Wall Hydrodemolition	SF			
Wall Removal	SF			
Rock Removal - Crown	CY	611	\$429.45	\$262,337.60
Rock Removal - Wall	CY			
Crown Installation	SF	16493	\$24.50	\$404,088.52
Wall Installation	SF			
Under Pinning	LF			
Rock Cut Drainage Trench	LF	1471	\$85.80	\$126,216.00
Tunnel Drainage	LF	1471	\$16.29	\$23,955.89
Demobilization	DY	5	\$3,283.20	\$16,416.00
<b>Total Tunnel Work Items</b>	<b>LF</b>	<b>1271</b>	<b>\$1,758.04</b>	<b>\$2,234,462.96</b>

<b>Trackwork Items</b>	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Surveying	DY			
Track Preparation/Restoration	DY			
Undercutting	PF	1271	\$20.48	\$26,029.72
Field Welds	EA			
Surfacing & Lining	PF	7626	\$2.03	\$15,456.10
Ballasting Track	TN	2542	\$39.51	\$100,432.64
Equalizing rail	DY			
Elastomeric Flangeway Crossing	EA			
Demobilization	DY			
<b>Total Trackwork Items</b>				<b>\$141,918.46</b>

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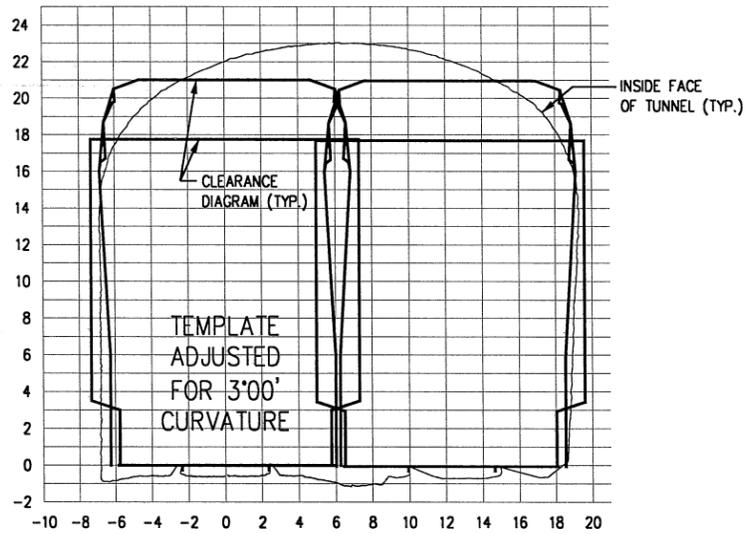
<b>Signal Items</b>	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Relocate Cables / Track Leads	LF	1271	\$11.66	\$14,822.78
Cut-in	EA			
New CP	EA			
Modify CP	EA			
Grade Crossing - Single to Double Track	EA			
Signal Location Modification	EA			
New Cut Section	EA			
Demobilization	DY			
<b>Total Signal Items</b>				<b>\$14,822.78</b>

<b>Site Items</b>	UOM	Quantity	Unit Rate	Total
Mobilization	DY	1	\$2,483.60	\$2,483.60
Erosion & Sedimentation Control	EA	1	\$11,958.80	\$11,958.80
Site Grading	CY			
Rock Excavation	CY			
Sub-Ballast	CY			
Drainage	LF			
Demobilization	DY			
<b>Total Site Items</b>				<b>\$14,442.40</b>

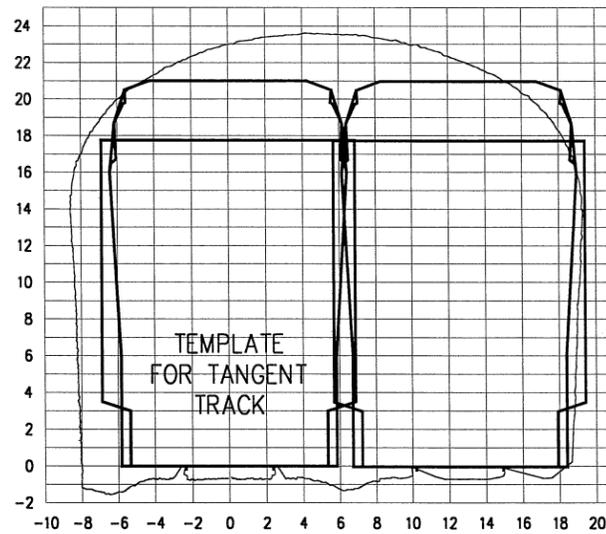
<b>Special Items</b>	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Flagging	DY	240	\$821.50	\$197,160.00
Flood Track with Ballast for Protection	TN	5084	\$39.11	\$198,829.08
Remove Flooded Ballast	TN	5084	\$9.63	\$48,948.91
Temporary Bridges	EA			
New Railroad Bridges	EA			
New Highway Bridges	EA			
Invert/Crown Void Grouting	DY	10	\$4,448.80	\$44,488.00
Demobilization	DY			
<b>Total Specialty Items</b>				<b>\$489,426.00</b>

<b>Subtotal All Items</b>		<b>\$2,895,072.59</b>
<b>Construction Contingency</b>	<b>30%</b>	<b>\$868,521.78</b>
<b>Engineering Allowance</b>	<b>10%</b>	<b>\$376,359.44</b>
<b>Construction Management Allowance</b>	<b>14%</b>	<b>\$526,903.21</b>
<b>Total</b>		<b>\$4,666,857.01</b>

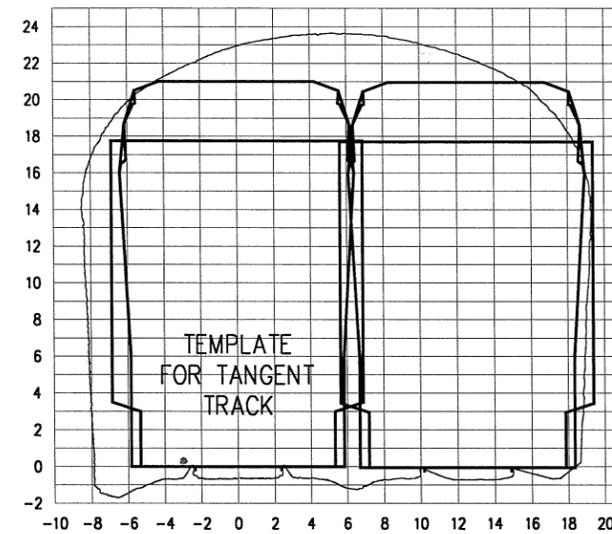
## 9. DRAWINGS



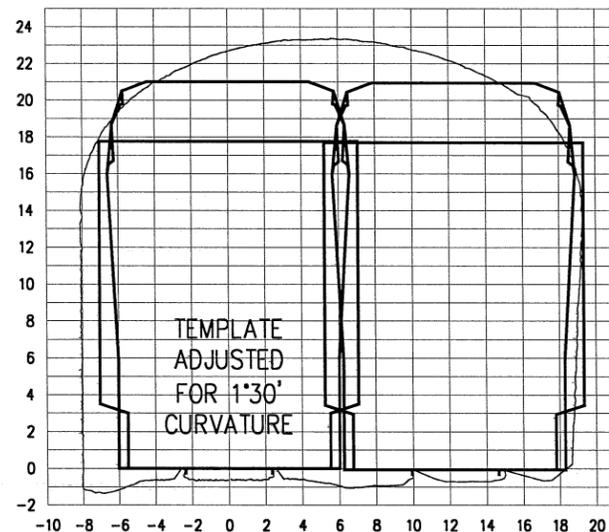
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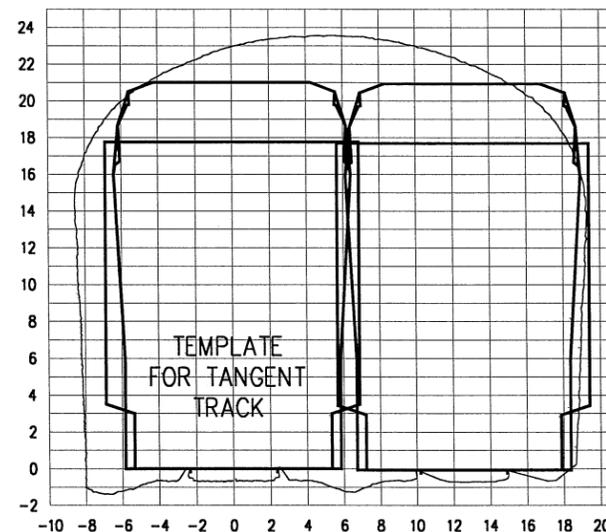
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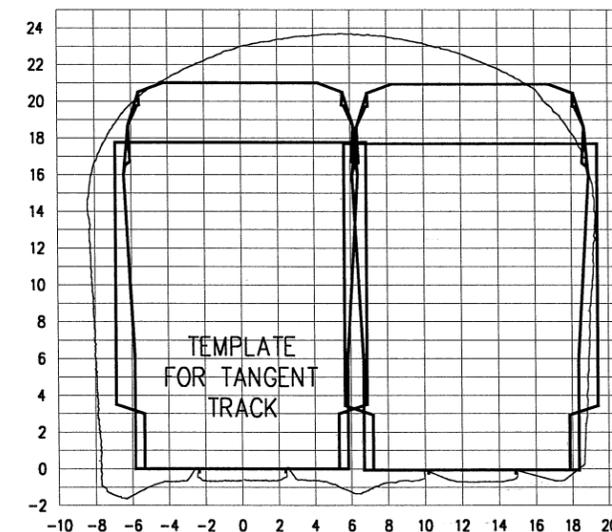
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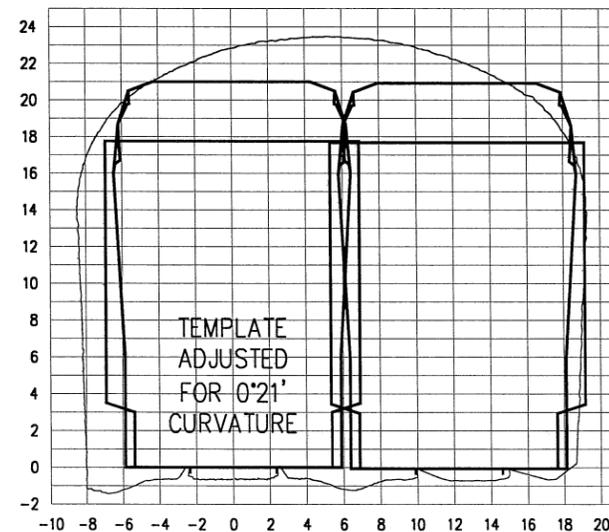
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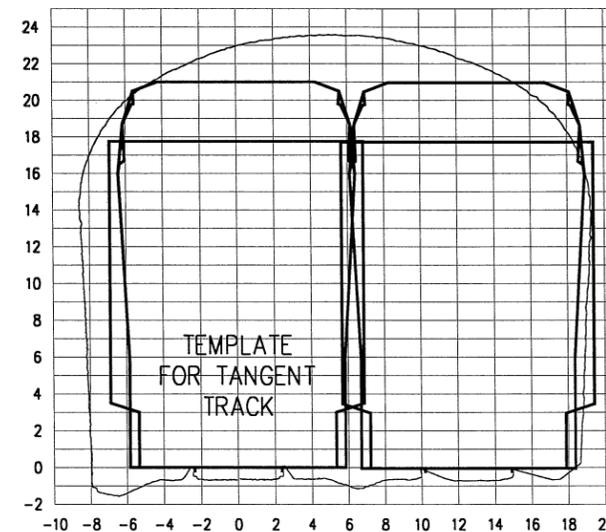
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2+54



1+02



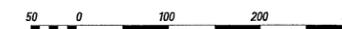
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NOTES:

1. HORIZONTAL DATUM IS PARALLEL TO TRACK. WHERE TRACK IS SUPERELEVATED, DATUM IS NOT PARALLEL WITH GROUND.
2. CROSS SECTION GIVEN FOR STA. 0+00 IS A COMPOSITE FOR THE TUNNEL FROM STA. 0+00 THROUGH 0+50. ALL OF THE SECTIONS FOLLOW THIS CONVENTION.

**NOT FOR CONSTRUCTION**

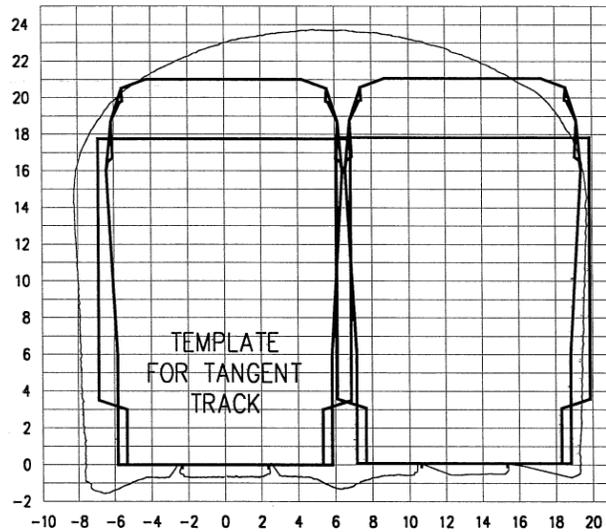
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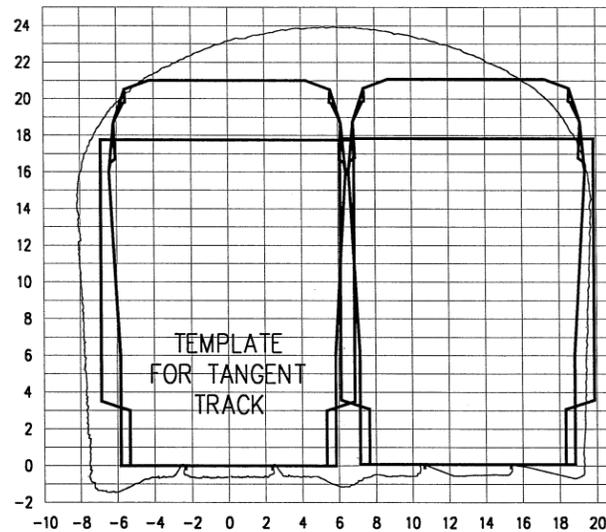
**NORFOLK SOUTHERN**

OPERATING DIVISION  
POCAHONTAS  
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

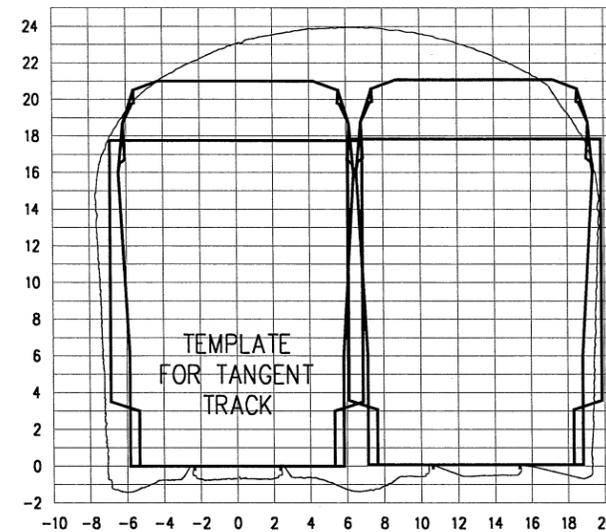
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CHK	DATE	MAY 6, 2005	DRAWING NUMBER



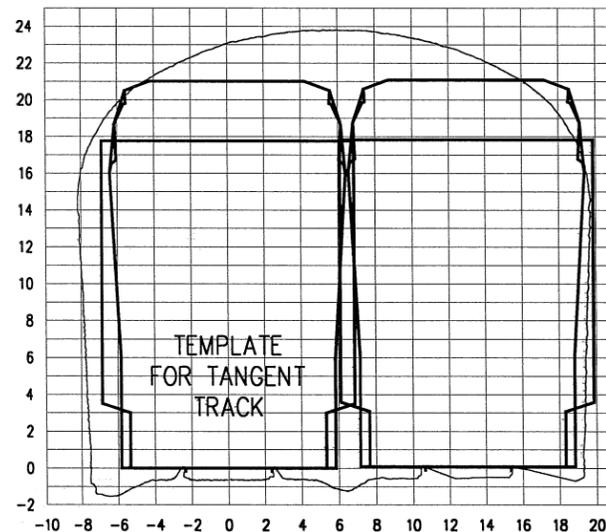
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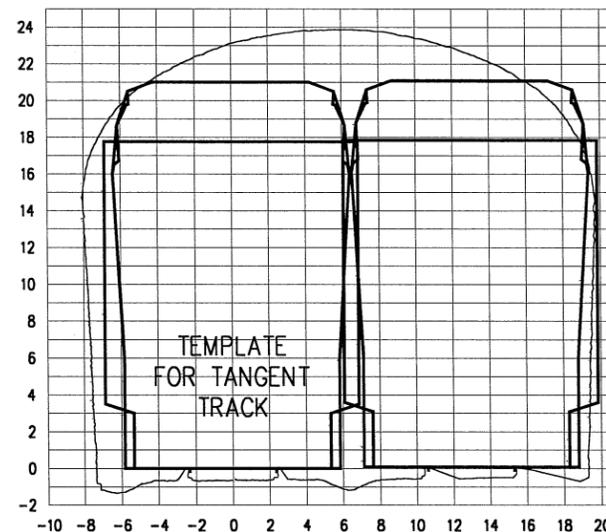
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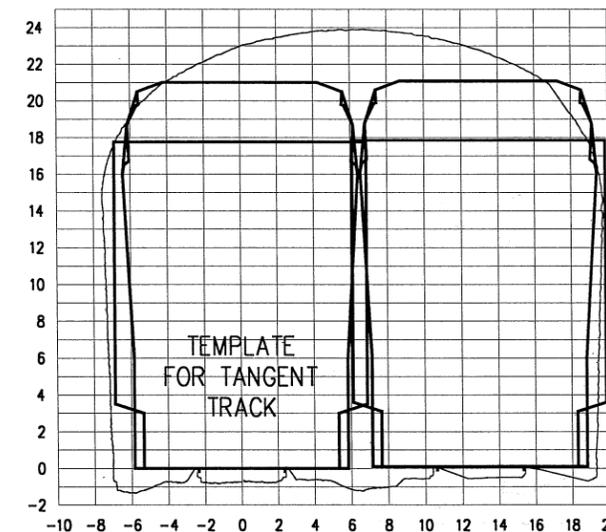
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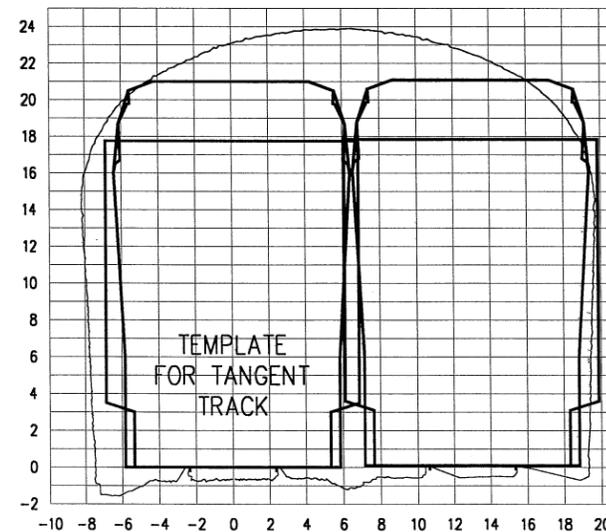
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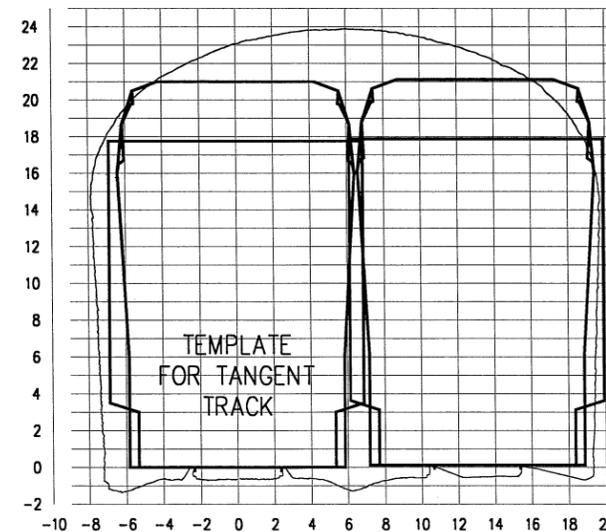
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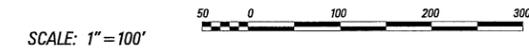
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- NOTES:
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**NOT FOR CONSTRUCTION**



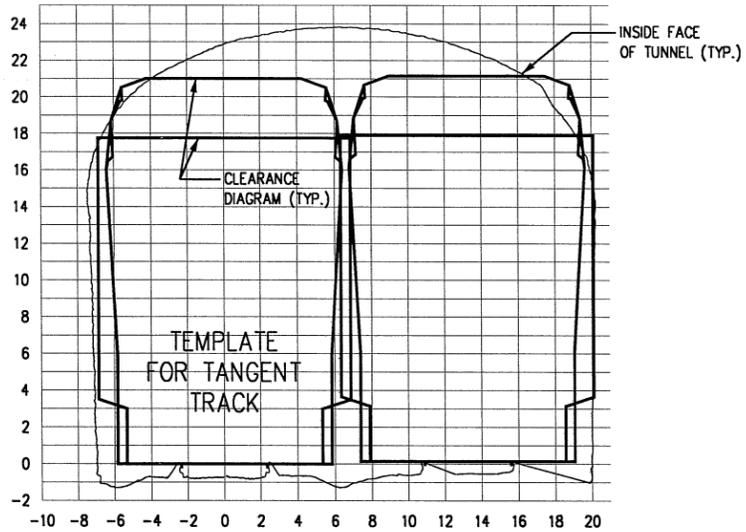
**NORFOLK SOUTHERN**

OWNING COMPANY  
POCAHONTAS

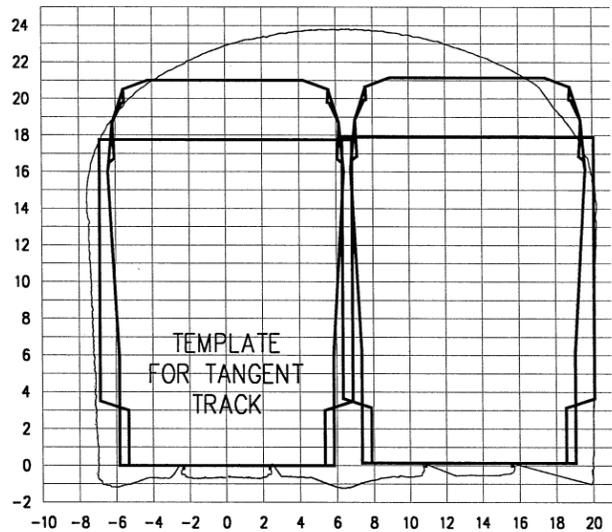
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OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

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CHK	DATE	MAY 6, 2005	DRAWING NUMBER

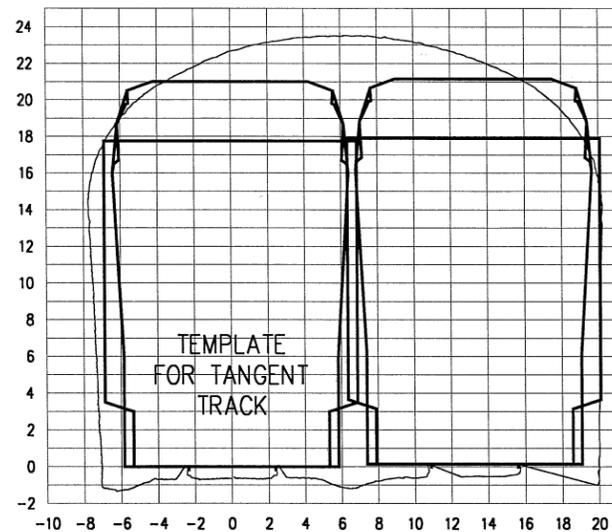
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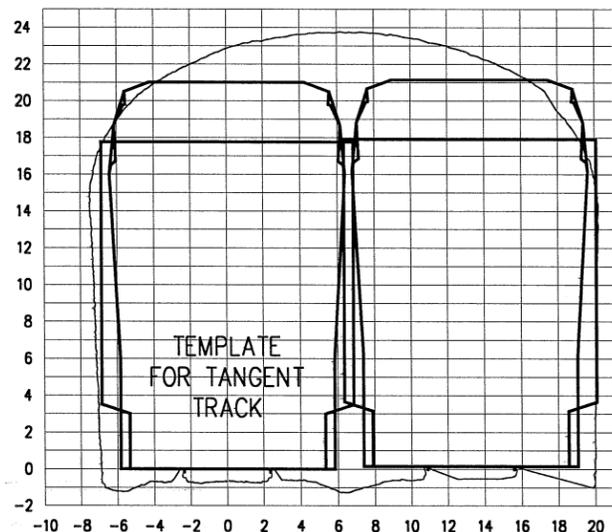
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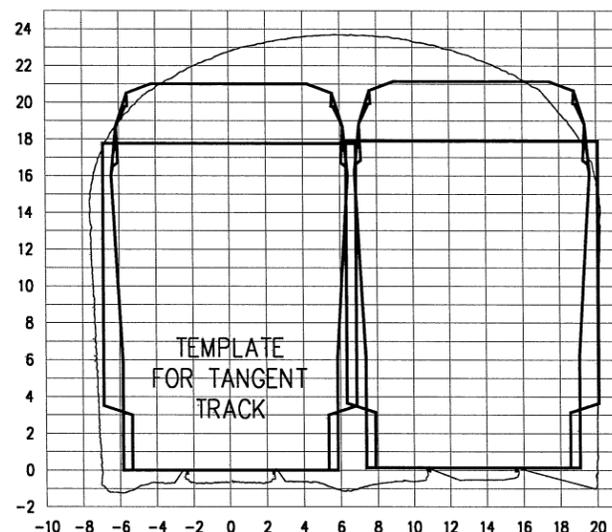
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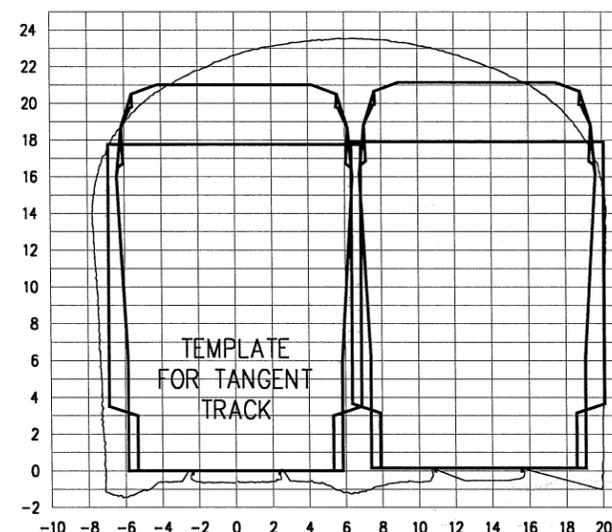
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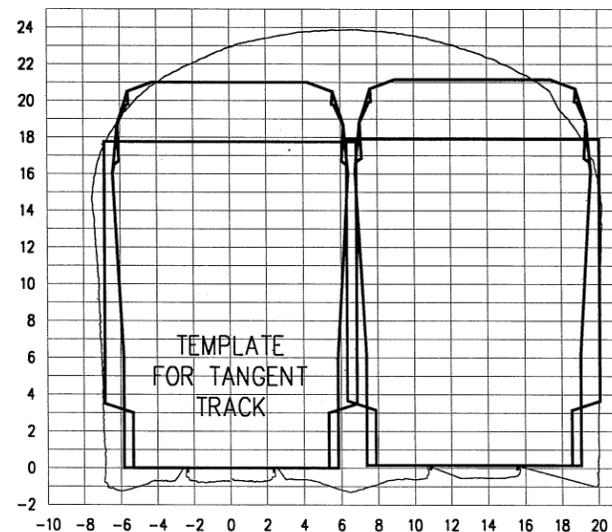
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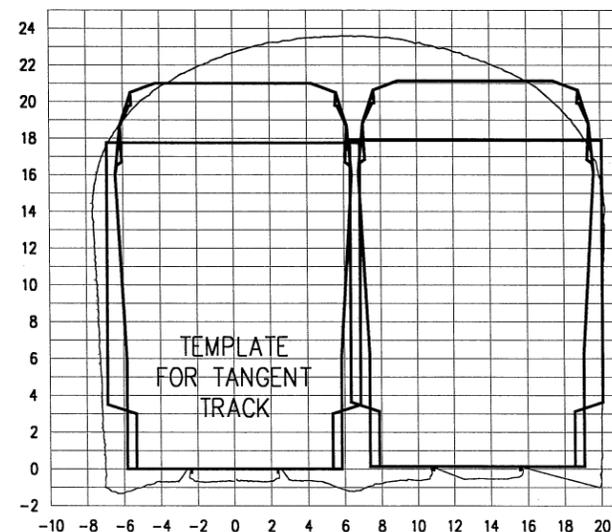
8+09



9+29



7+02



8+64

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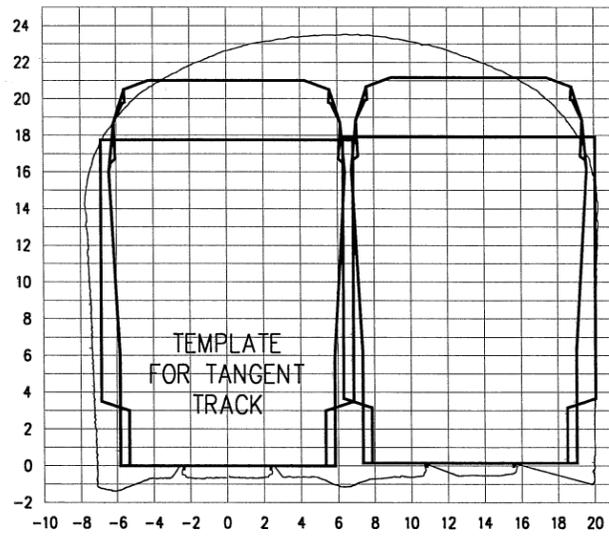
**NOT FOR CONSTRUCTION**



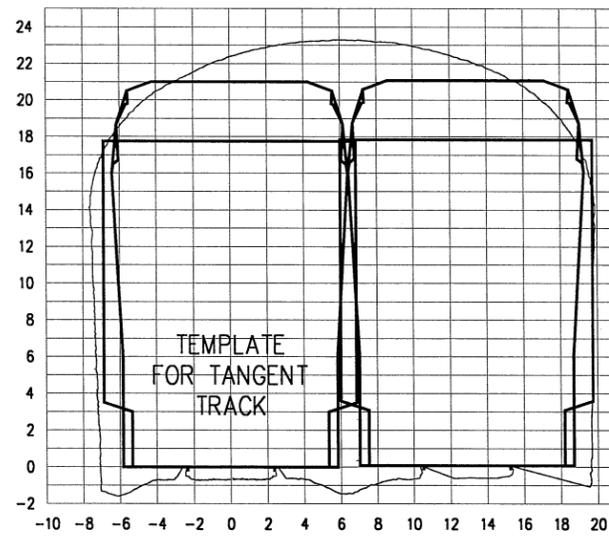
**NORFOLK SOUTHERN**  
 OPERATING DIVISION  
 POCAHONTAS  
 OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

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CHK	DATE	MAY 6 2005	

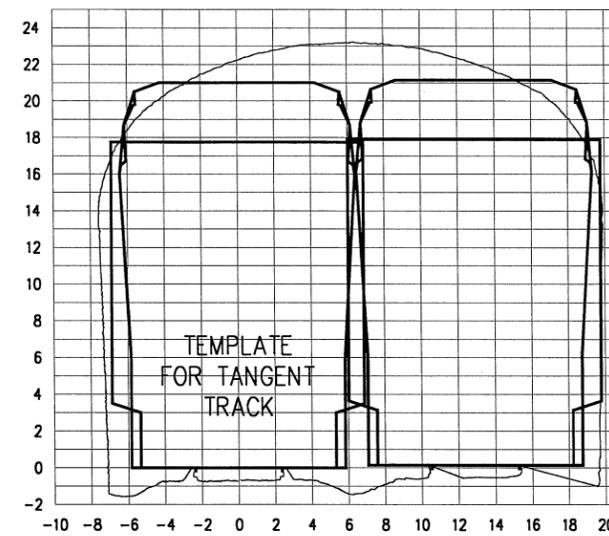
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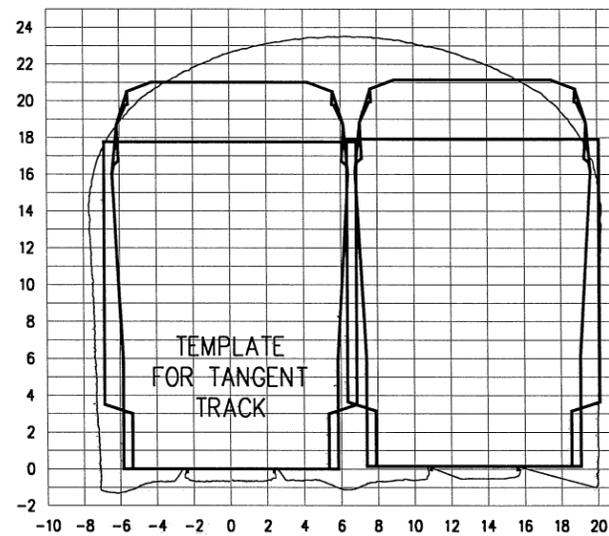
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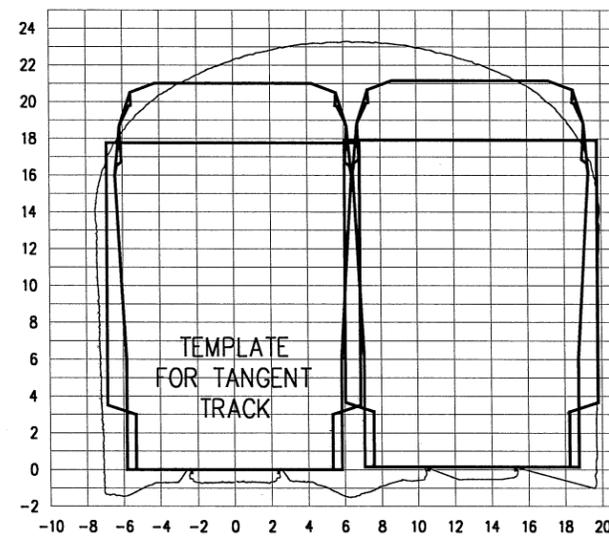
10+56



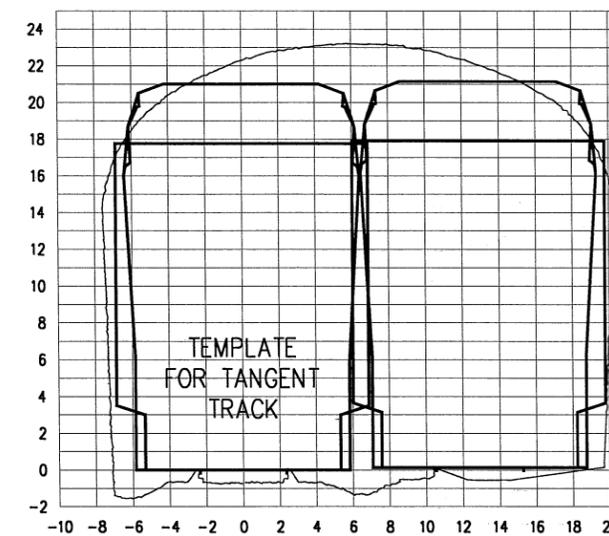
12+03



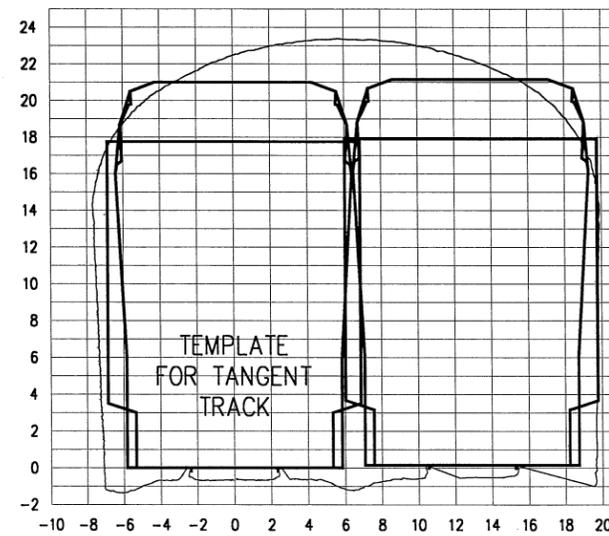
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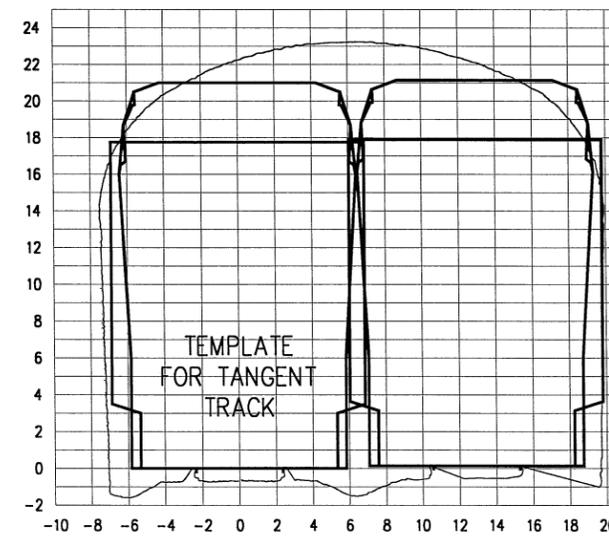
11+05



12+24



10+02



11+61

- NOTES:
1. HORIZONTAL DATUM IS PARALLEL TO TRACK. WHERE TRACK IS SUPERELEVATED, DATUM IS NOT PARALLEL WITH GROUND.
  2. CROSS SECTION GIVEN FOR STA. 0+00 IS A COMPOSITE FOR THE TUNNEL FROM STA. 0+00 THROUGH 0+50. ALL OF THE SECTIONS FOLLOW THIS CONVENTION.

**NOT FOR CONSTRUCTION**

SCALE: 1" = 100'

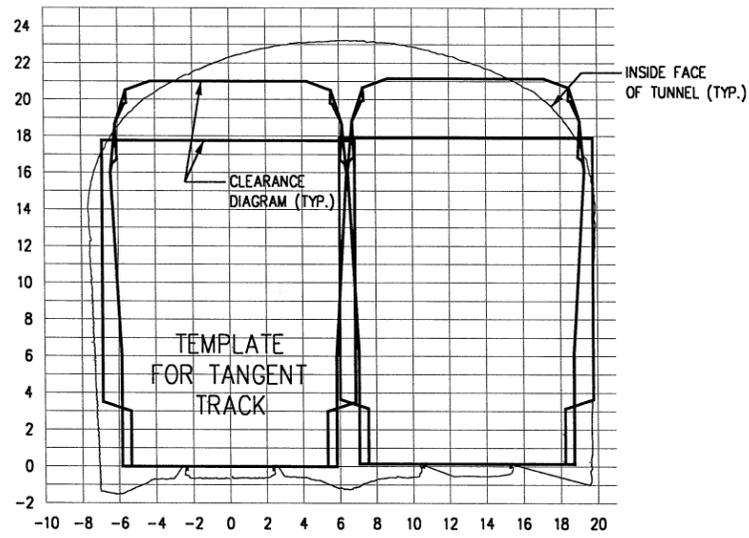


**NORFOLK SOUTHERN**

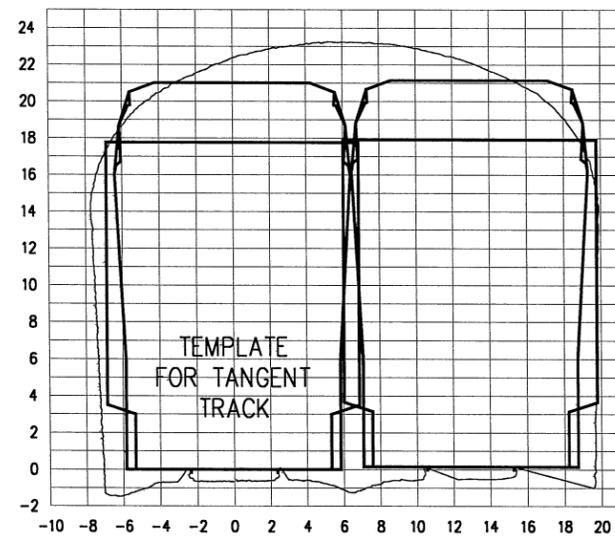
OWNING COMPANY  
**POCAHONTAS**  
 OPERATING DIVISION  
 OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

PI	DJL	8505	PRELIMINARY ENGINEERING PHASE REPORT
REV	BY	DATE	DESCRIPTION
LOCATION GORDON TUNNEL, ROGERS, WV			
TITLE TUNNEL CLEARANCE CROSS SECTIONS - 4 OF 5			
DGN	FILE NO.	WREN	16284
CHK	DATE	MAY 6, 2005	

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12+28



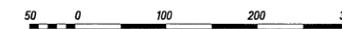
12+56

NOTES:

1. HORIZONTAL DATUM IS PARALLEL TO TRACK. WHERE TRACK IS SUPERELEVATED, DATUM IS NOT PARALLEL WITH GROUND.
2. CROSS SECTION GIVEN FOR STA. 0+00 IS A COMPOSITE FOR THE TUNNEL FROM STA. 0+00 THROUGH 0+50. ALL OF THE SECTIONS FOLLOW THIS CONVENTION.

**NOT FOR CONSTRUCTION**

SCALE: 1" = 100'

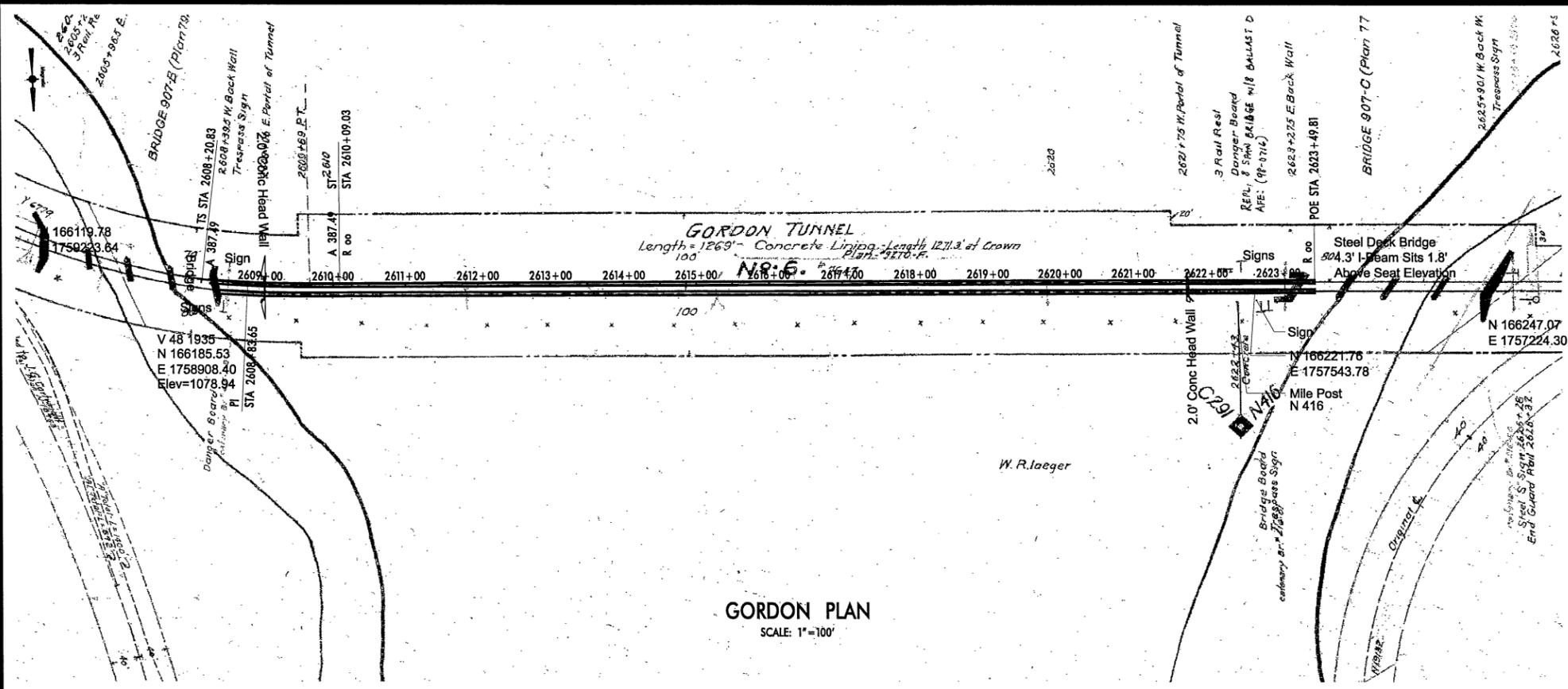


**NORFOLK SOUTHERN**

OWNING COMPANY  
POCAHONTAS

OPERATING DIVISION  
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA

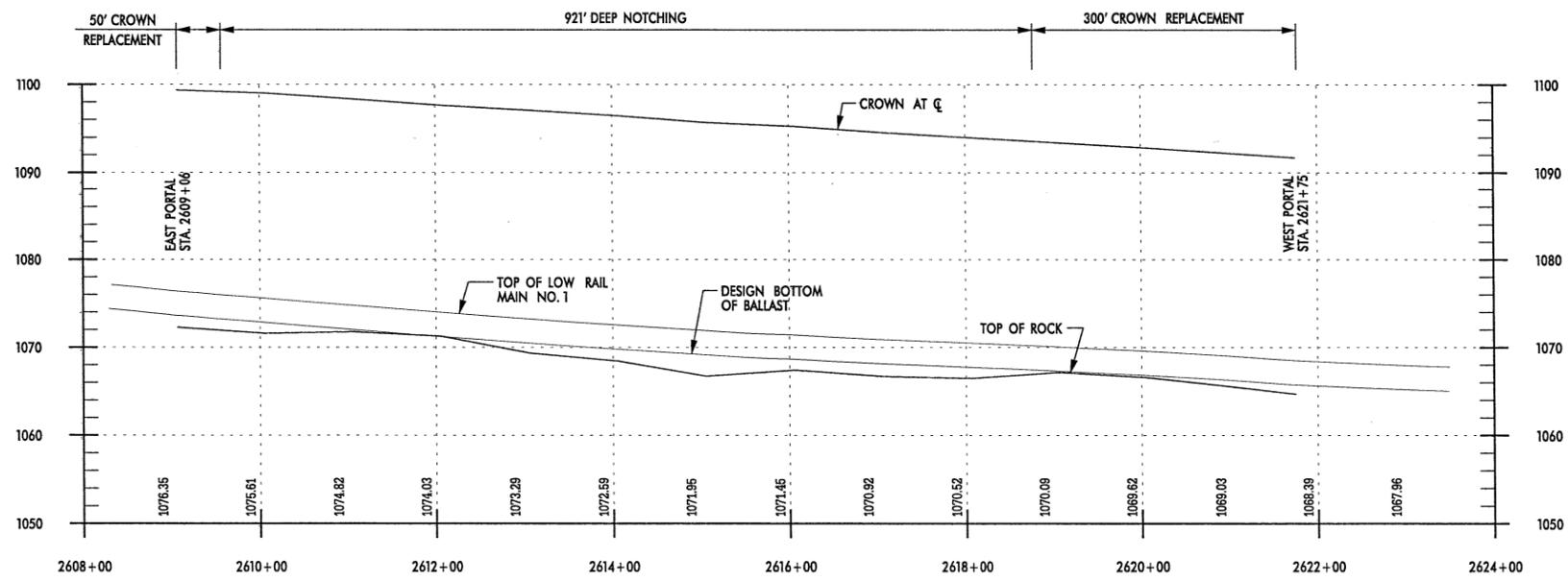
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REV	BY	DATE	DESCRIPTION
LOCATION			
GORDON TUNNEL, ROGERS, WV			
TITLE			
TUNNEL CLEARANCE CROSS SECTIONS - 5 OF 5			
DGN	P.T.D. No.	PRN	16294
DWN	FILE No.	DRAWING NUMBER	N-415.07
CWK	DATE	MAY 6, 2005	



GORDON CURVE DATA

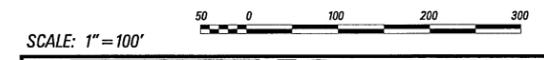
Project Name: gordon  
 Description:  
 Description:  
 Style:  
 Input Factor: 1.0000

Element:	STATION	NORTHING	EASTING
Clothoid	TS ( )	2608+20.83	166154.29
	SPI ( )	2608+83.65	166163.71
	ST ( )	2610+09.03	166167.78
	Entrance Radius:	797.80	
	Exit Radius:	0.00	
	Length:	188.20	
	Angle:	6°45'29" Left	
	Constant:	387.49	
	Long Tangent:	125.56	
	Short Tangent:	62.82	
Long Chord:	188.09		
Xs:	187.94		
Ys:	7.39		
P:	1.85		
K:	94.06		
Tangent Direction:	278°37'03"		
Radial Direction:	8°37'03"		
Chord Direction:	274°06'42"		
Radial Direction:	1°51'33"		
Tangent Direction:	271°51'33"		
Linear	ST ( 4)	2610+09.03	166167.78
	POE ( 3)	2623+49.81	166211.28
	Tangent Direction:	271°51'33"	
	Tangent Length:	1340.78	



GORDON PROFILE  
 SCALE: 1"=100' HORIZ.  
 1"=10' VERT.

NOT FOR CONSTRUCTION



**NORFOLK SOUTHERN**

OWNING COMPANY  
**POCAHONTAS**

OPERATING DIVISION  
 OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA

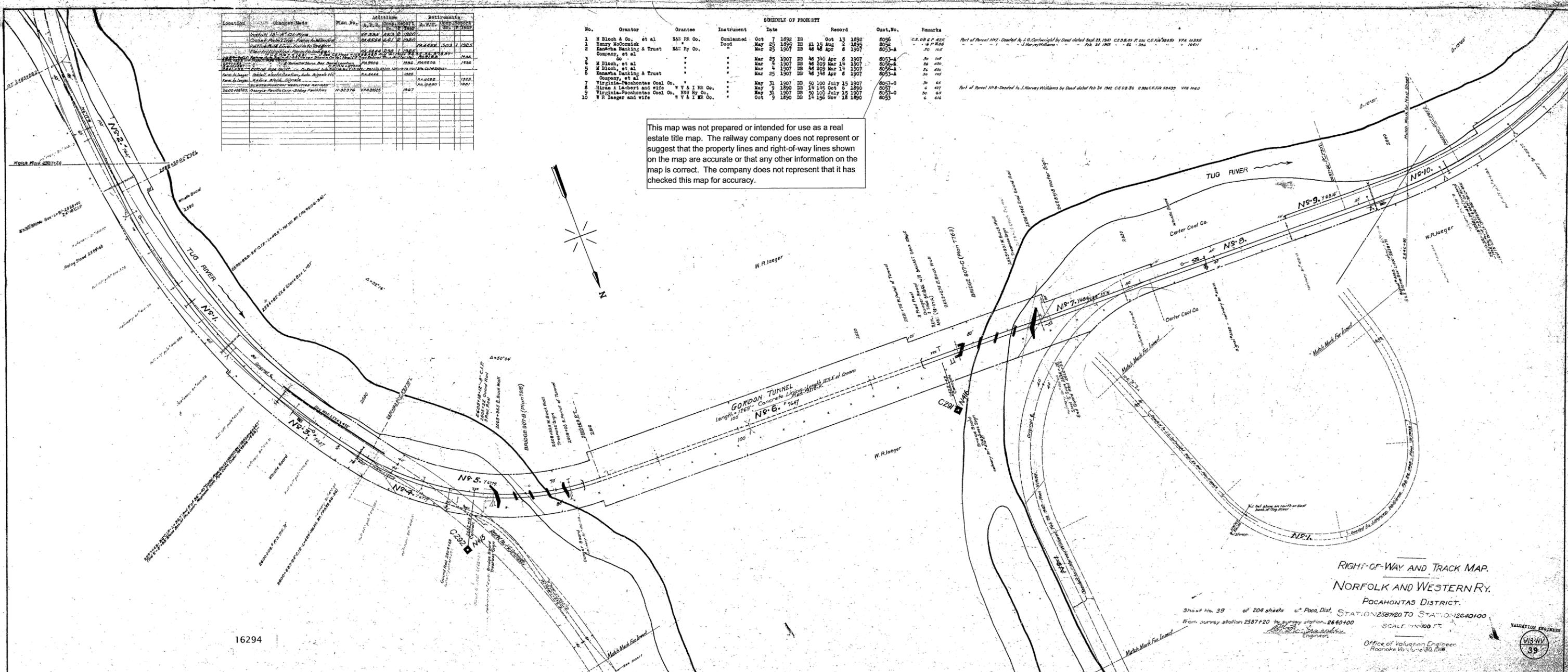
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11 JUL 8 16:05	PRELIMINARY ENGINEERING PHASE REPORT				
REV BY	DATE				
LOCATION	GORDON TUNNEL, ROGERS, WV				
TITLE	PLAN AND PROFILE				
DGN	PTD NO.	VRN	16294	MILE POST	N-415.07
DWN	FILE NO.	DRAWING NUMBER			
CHK	DATE	APRIL 22, 2005			

FILE NAME = P:\NSR\28395\CAD\survey\Info\165.07\_Gordon\165.07\_Gordon.dgn  
 DATE/TIME = 02/22/2005 03:04:48 PM

Location	Change of Grade	Plan No.	Acquisition	Retirements
Station 2587+20	Station 2587+20	NS-1	1892	1892
Station 2587+20	Station 2587+20	NS-2	1892	1892
Station 2587+20	Station 2587+20	NS-3	1892	1892
Station 2587+20	Station 2587+20	NS-4	1892	1892
Station 2587+20	Station 2587+20	NS-5	1892	1892
Station 2587+20	Station 2587+20	NS-6	1892	1892
Station 2587+20	Station 2587+20	NS-7	1892	1892
Station 2587+20	Station 2587+20	NS-8	1892	1892
Station 2587+20	Station 2587+20	NS-9	1892	1892
Station 2587+20	Station 2587+20	NS-10	1892	1892

No.	Grantor	Grantee	Instrument	Date	Record	Out.No.	Remarks
1	M Bloch & Co. et al	NW RR Co.	Condemned	Oct 7 1892	DB	8096	C.E. DB p 422
2	Henry Woodcock	"	Deed	Mar 25 1896	DB	8096	6 P. 262
3	Kanawha Banking & Trust Co.	NW Ry Co.	"	Mar 25 1907	DB	8053-A	70 105
4	Company, et al	"	"	Mar 25 1907	DB	8053-A	30 105
5	M Bloch, et al	"	"	Mar 4 1907	DB	8053-A	26 420
6	M Bloch, et al	"	"	Mar 4 1907	DB	8053-A	26 420
7	Virginia-Pocahontas Coal Co.	"	"	May 31 1907	DB	8057-C	30 68
8	Hiram A Lambert and wife	W V & I RR Co.	"	May 3 1890	DB	8057-C	30 421
9	Virginia-Pocahontas Coal Co.	W V & I RR Co.	"	May 31 1907	DB	8057-C	30 68
10	W R Jaeger and wife	W V & I RR Co.	"	Oct 9 1890	DB	8055	30 418

This map was not prepared or intended for use as a real estate title map. The railway company does not represent or suggest that the property lines and right-of-way lines shown on the map are accurate or that any other information on the map is correct. The company does not represent that it has checked this map for accuracy.



RIGHT-OF-WAY AND TRACK MAP.  
NORFOLK AND WESTERN RY.  
POCAHONTAS DISTRICT.

Sheet No. 39 of 204 sheets of Poc. Dist. STATION 2587+20 TO STATION 2640+00  
From survey station 2587+20 to survey station 2640+00  
SCALE 1"=100 FT.  
Office of Valuation Engineer  
Roanoke, Va. June 30, 1918.

