



*Heartland Corridor, Walton Virginia to
Columbus Ohio*

Preliminary Engineering Phase Report



**BIG SANDY NO. 1
TUNNEL –
MP NA 3.30
PANCO SIDING,
WV**

October 14, 2005, Rev. 2



Preliminary Engineering Phase Report

PR219399 - Big Sandy No. 1
Page 1

October 14, 2005

Norfolk Southern Railway Heartland Corridor, Walton VA to Columbus OH

Big Sandy No. 1 Tunnel – MP NA–3.30

Statistics: Pocahontas Division
Single-width Tunnel for Main #2
Length = 2,627'
Concrete Lined
Degree of Curvature = 6.4 RT (per Track Chart)
Superelevation = 3.5" (per Track Chart)

1.	EXISTING CONDITIONS	2
2.	CLEARANCE IMPROVEMENT ALTERNATIVES	5
3.	PREFERRED ALTERNATIVE.....	5
4.	USGS TOPOGRAPHIC MAP.....	7
5.	AERIAL PHOTO.....	8
6.	TRACK CHART.....	9
7.	PHOTOS.....	10
8.	ESTIMATE	13
9.	DRAWINGS	15
	Tunnel Clearance Cross Sections	
	Plan and Profile	
	Valuation Map	

1. EXISTING CONDITIONS

1.1 Background

Valuation map V-17-WV/69A (16561) for the Big Sandy #1 Tunnel, also known as Tunnel 1, is dated Dec. 31, 1926. Parcels for the tunnel were acquired in 1902. Construction of the tunnel was completed in 1905 based on the date stamped on the portals. 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 April 1, June 16, and August 1 and 2, 2005.

1.2 General Area

The tunnel is located in Panco Siding, WV. The area near the tunnel is lightly populated residential. US Rte. 52 crosses over the east portal and crosses the railroad again over a bridge beyond the west portal. A state road, which once connected to Rte. 52, crosses over the west portal. This road appears abandoned and is becoming overgrown with brush. A suitable staging area is located near the tunnel beyond the west portal. Access to both portals is readily available via local roads connecting to railroad ROW.

1.3 Structural Conditions

The tunnel is 2,627' long with a concrete liner and a nominal width of 16.75'. It is a single width tunnel for one track. The liner is in good condition. Leaking and minor spalling, usually at the construction joints, is confined to within 150' of the east portal and 100' of the west portal. There was no leaking observed for the remainder of the tunnel. A signal cable is mounted on the face of the north wall. At the time of the initial inspection the ballast was in the process of being replaced. Excavation of the ballast exposed the footing; no undermining was observed.

A small portion of the tunnel invert material was excavated to fully expose the base of the tunnel liner footing. The footing thickness was found to be 15". The vertical distance from the top of rail to the base of the footing was measured at 38".

Liner cores were taken on August 1 and 2, 2005. Cores were drilled into the liner at locations 250', 1300', and 2377' into the tunnel from the east portal. The cores were taken at three of the 2, 5, 7, 10 or 12 o'clock positions at each location. A borescope was inserted into the holes to view inside the liner. The video from the borescope was recorded onto a DVD. The liner probe investigation is summarized in the table below:

Summary of Big Sandy #1 Tunnel Liner Core Investigation			
Distance from East Portal (feet)	Position	Liner Thickness	Notes
250	7 o'clock	23"	Bedrock immediately behind liner
250	2 o'clock	32"	
250	12 o'clock	28"	Bedrock immediately behind liner
1300	5 o'clock	30"	No void.
1300	10 o'clock	37"	No void.
1300	12 o'clock	18"	12" void behind liner
2377	7 o'clock	42"	
2377	10 o'clock	26"	Void behind liner
2377	12 o'clock	21"	Void behind liner

Three samples of concrete were taken from the liner core investigation and tested. A sample from the 7 o'clock position had a compressive strength of 3,907psi. A sample from 1300' in from the east portal, 10 o'clock position, taken from 16" – 37" into the core had a compressive strength of 3,139psi. A sample from 2377' in from the east portal, 10 o'clock position, taken from 0" – 15" into the core had a compressive strength of 2,189psi.

1.4 Track

The track is of conventional design with wooden crossties and a stone ballast section. The ballast has just been replaced. The continuous welded rail is 132 RE with a tie spacing of 20". The track is tangent for the majority of the tunnel. A spiral curve begins 213' from the west portal, and the track is curved 6.0 degrees to the right for the last 109' from the west portal. Standing water and mud pumping were evident in the subgrade. The water in the tunnel was tested and its pH reading was 8.33. This is a fairly neutral reading and indicates that the water is not unusually corrosive. 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.

1.5 Geotechnical

The tunnels in the west-central part of the Pocahontas Division (Williamson, Hatfield, Big Sandy Nos. 1-4 and 7) 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 is excavated through the Kanawha Formation, a medium- to thick-bedded fine- to medium-grained sandstone, with interbeds of shale, siltstone, and coal. Bedding in the Kanawha Formation is subhorizontal and gently rolls back and forth towards the northwest and southeast.

Joints in the rock cuts in both 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. A medium- to thick-bedded shale was visible at each portal of the Big Sandy tunnels. The shale was overlain and underlain by a medium- to thick-bedded, very fine- to fine-grained sandstone. Sand and sandstone were the predominant materials recovered from the geoprobe sample tubes in Big Sandy No. 1.

The rock quality designation, Q, at the portals was determined to be 22. 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 obtained from the tunnel portal on June 16, 2005. Lab testing of the sample indicates that the rock is sandstone and has a compressive strength of 7,710psi.

Geoprobes into the tunnel invert indicate that the top of rock is located between 1.3’ to 3.5’ (averaging about 2.0’) below the top of ballast throughout the tunnel. 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 both the “Double Stack Load” and the “High-Wide Load” portions of the composite clearance envelope.

For vertical clearance, the “Double Stack” portion of the envelope encroaches on either side of the tunnel crown by an average of 24” and varies up to 29”. At the crown itself there is encroachment by an average of 6” from the east portal to station 20+00. For the “High-Wide” portion of the clearance envelope, encroachment exists on left side of the crown by an average of 12” and on the right side of the tunnel crown (at points lower than the Double Stack portion) by an average of 18” and varying up to 21” throughout the tunnel. 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)	
	Left Side	Right Side
0	22	20
201	17	18
402	20	16
602	24	21
802	20	19
1002	22	23
1202	23	22

Distance (ft) from East Portal	Crown Encroachment (radial inches)	
	Left Side	Right Side
1402	23	21
1603	23	20
1801	24	18
2002	18	13
2204	18	14
2401	11	13
2600	20	20

Due to the small distance between the top of rail and the top of rock, a substandard track section is likely being used for much of the tunnel. The clearances in the above table are based on the existing track section; encroachments may be slightly larger if the track is redone with the standard section.

2. CLEARANCE IMPROVEMENT ALTERNATIVES

Given the magnitude of the vertical clearance deficiency, the only viable alternative for this tunnel is liner replacement. Track lowering by excavating or undercutting does not appear feasible due to the proximity of the top of rock to the surface. Deep notching is not feasible because the amount of encroachment exceeds the liner thickness in most, if not all, areas. Steel ties could be used in conjunction with liner replacement to decrease the magnitude of the cut, but the cost benefit of including steel ties would not be enough to warrant their expense.

2.1 Liner Replacement

To obtain the desired clearance, the concrete liner roof must be demolished, the native rock excavated to the clearance limits plus the new liner thickness, and a new concrete liner installed. This method is necessary for the entire tunnel.

The proximity of the roadway above the east portal may require that other methods be considered, including moving the tunnel portal back and constructing a bridge for the roadway. These issues will be looked at in greater detail in the final design phase. Conditions may warrant that the west portal also be moved back.

3. PREFERRED ALTERNATIVE

Given the magnitude of the vertical encroachment, liner roof replacement appears to be necessary to achieve the required clearance in the tunnel. Drainage improvements are also recommended to help alleviate the ballast-fouling problem. In the final design phase, it will be looked at in greater detail whether the clearance improvements need to be increased further to account for replacing the existing track section with a track section of standard thickness.

3.1 Preliminary Design

The preliminary design uses rock excavation of the tunnel crown, installation of rock dowels, and installation of a concrete liner to achieve the necessary clearance and provide for a lower-maintenance tunnel. At the portals however, the limited amount of competent rock cover above the tunnel crown appears to be ill-suited for the proposed clearance improvement method. Therefore, the portals will be moved back into the hillside by means of daylighting until a rock arch of sufficient thickness above the tunnel can be achieved. The daylighting method will impact the Rt. 52 roadway near the east portal and a bridge will be constructed in this area. It is assumed that the abandoned roadway near the west portal will not need to be reconstructed. The extent of the daylighting, and the proper replacement bridge can be further evaluated during final design. Signal cable located within the tunnel will be temporarily relocated during construction.

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 invert improvements consisting of ballast replacement by means of undercutting, track surfacing and lining and the installation of a new drainage system. Due to the proximity of the excavation required for the drainage trench to the tunnel footing, it is assumed that underpinning will be required to stabilize the wall during construction. The extent of underpinning will be further evaluated during final design.

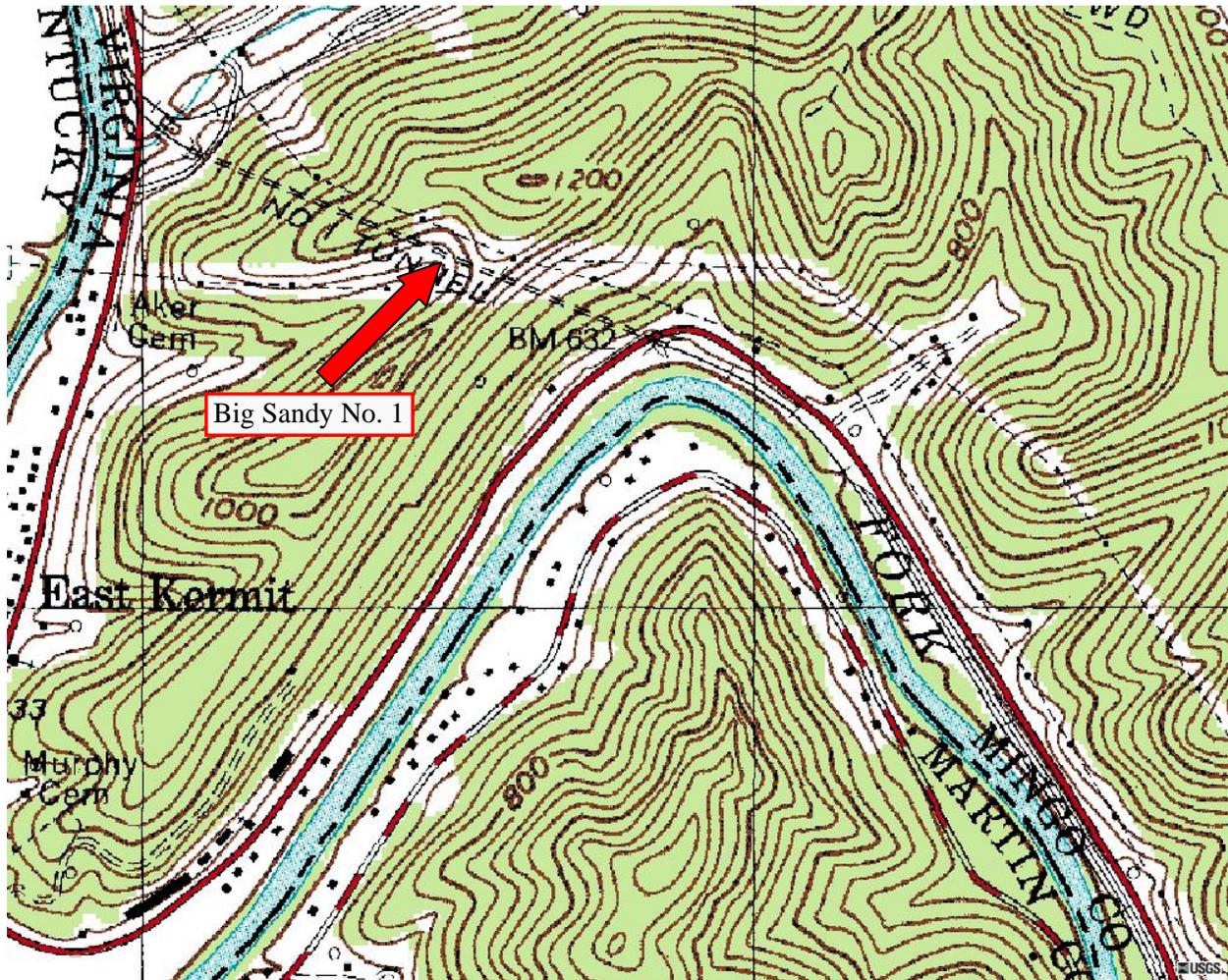
3.2 Schedule

The estimated schedule for completing improvements on this tunnel is fifty-three (53) weeks including mobilization and demobilization. The schedule assumes the track will be closed for eight hours, five days a week. The schedule assumes 12' of crown removal each day on one side of the tunnel, with liner removal, rock removal, installation of rock dowels and installation of shotcrete all occurring on the same day for each 12' segment. Drainage improvement operations would be undertaken at the same time as the crown removal, but at different locations in the tunnel. The schedule could be reduced to 32 weeks if the contractor mobilized a second crew to work from the opposite portal.

3.3 Estimate

The total estimated cost for achieving clearance at this location is \$12.8 million (2005 rates) or \$4,857 per foot of tunnel. The work items include mobilization, surveying, liner removal, rock removal, rock dowels, crown installation, rock cut for drainage trench, underpinning one wall at drainage trench, tunnel drainage system, ballast cleaning, and demobilization. The total cost is made up of tunnel, track, signal, and site work items at \$7.9 million, plus a 30% construction contingency, a 10% engineering allowance, and a 14% construction management allowance.

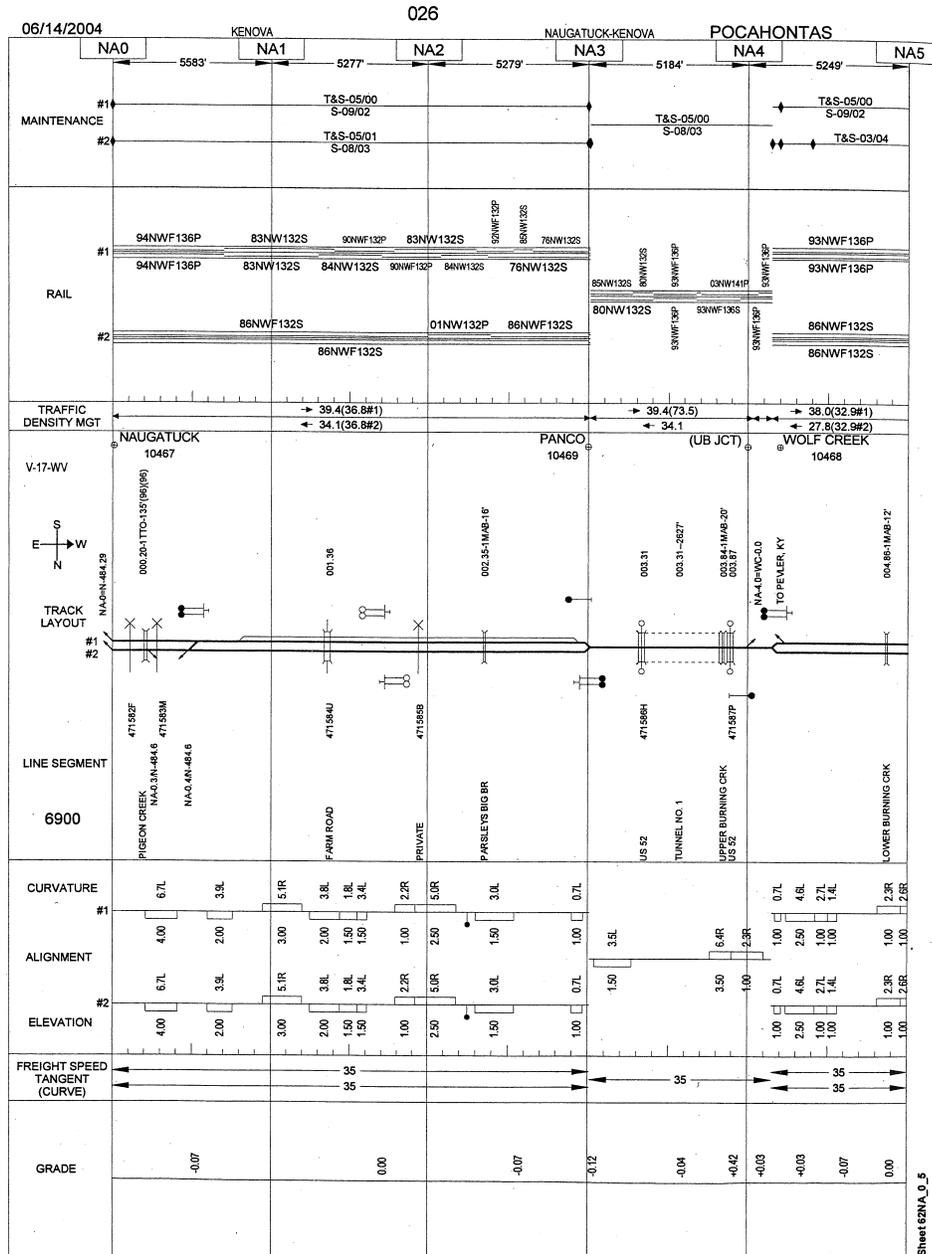
4. USGS TOPOGRAPHIC MAP



5. AERIAL PHOTO



6. TRACK CHART



7. PHOTOS



Photo 1. East Portal



Photo 2. View from East Portal



Photo 3. West Portal



Photo 4. View from West Portal



Photo 5. Exposed Footer with Standing Water South Side



Photo 6. Drainage Swale North Side at East Portal

**Preliminary Engineering Phase Report
MP NA-3.30 Big Sandy No. 1**

8. ESTIMATE
Big Sandy No. 1

Tunnel Length 2627 ft
 Tunnel Width 16.75 ft
 # of Tracks 1

	Contractor	Railroad
Work Window	8 hrs	10 hrs
Setup & Demobilization Allowance	2 hrs	2 hrs
Production Time	6 hrs	8 hrs

Tunnel Work Items	UOM	Quantity	Unit Rate	Total
Mobilization	%	5%		\$302,815.50
Surveying	DY	5	\$1,300.00	\$6,500.00
Rock Dowels 14' with Chain Link Mesh - Crown	EA	3065	\$409.62	\$1,255,412.13
Rock Dowels 14' with Chain Link Mesh - Wall	EA			
Rock Dowels 16'	EA			
Crown Removal	SF	70150	\$11.70	\$820,424.00
Wall Hydrodemolition	SF			
Wall Removal	SF			
Rock Removal - Crown	CY	2598	\$307.30	\$798,424.00
Rock Removal - Wall	CY			
Crown Installation	SF	70150	\$20.24	\$1,419,889.04
Wall Installation	SF			
Under Pinning	LF	2627	\$531.30	\$1,395,723.07
Rock Cut Drainage Trench	LF	3027	\$97.29	\$294,511.20
Tunnel Drainage	LF	3027	\$16.19	\$49,010.47
Demobilization	DY	5	\$3,283.20	\$16,416.00
Total Tunnel Work Items	LF	2627	\$2,420.68	\$6,359,125.40

Trackwork Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Surveying	DY			
Track Preparation/Restoration	DY			
Undercutting	PF	5254	\$19.82	\$104,118.88
Surfacing & Lining	PF	15762	\$1.96	\$30,912.19
Ballasting Track	TN	5254	\$38.27	\$201,083.96
Demobilization	DY			
Total Trackwork Items				\$336,115.03

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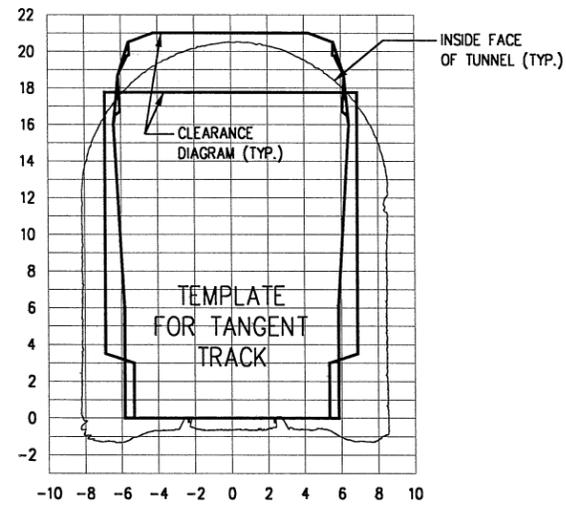
Signal Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Relocate Cables / Track Leads	LF	2627	\$11.45	\$30,070.55
Cut-in	EA			
New CP	EA			
Modify CP	EA			
Grade Crossing - Single to Double Track	EA			
Signal Location Modification	EA			
New Cut Section	EA			
Demobilization	DY			
Total Signal Items				\$30,070.55

Site Items	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	3000	\$71.83	\$215,486.96
Sub-Ballast	CY			
Drainage	LF			
Demobilization	DY			
Total Site Items				\$229,929.36

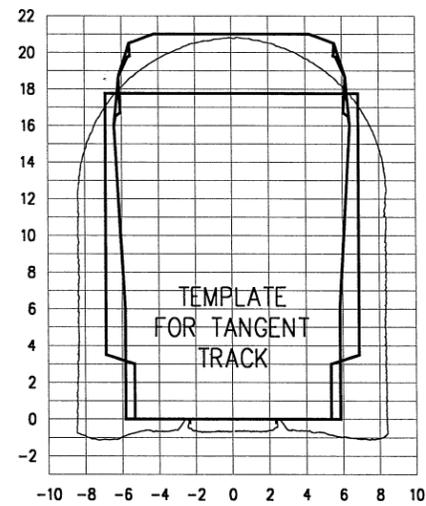
Special Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Flagging	DY	264	\$821.50	\$216,876.00
Flood Track with Ballast for Protection	TN	10508	\$38.31	\$402,595.14
Remove Flooded Ballast	TN	10508	\$8.54	\$89,739.67
Temporary Bridges	EA	1	\$250,000.00	\$250,000.00
New Railroad Bridges	EA			
New Highway Bridges	EA			
Invert/Crown Void Grouting	DY			
Demobilization	DY			
Total Specialty Items				\$959,210.81

Subtotal All Items		\$7,914,451.16
Construction Contingency	30%	\$2,374,335.35
Engineering Allowance	10%	\$1,028,878.65
Construction Management Allowance	14%	\$1,440,430.11
Total		\$12,758,095.26

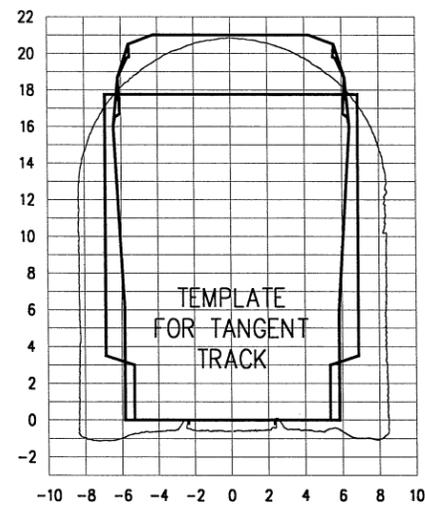
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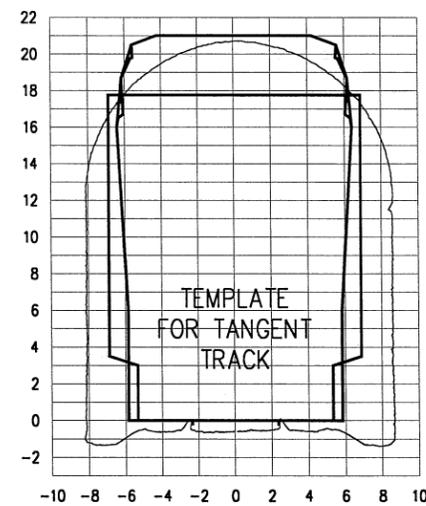
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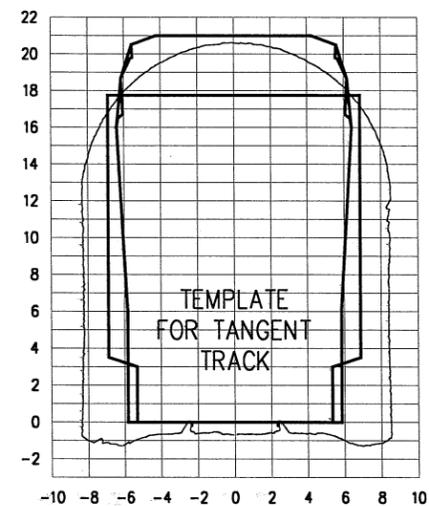
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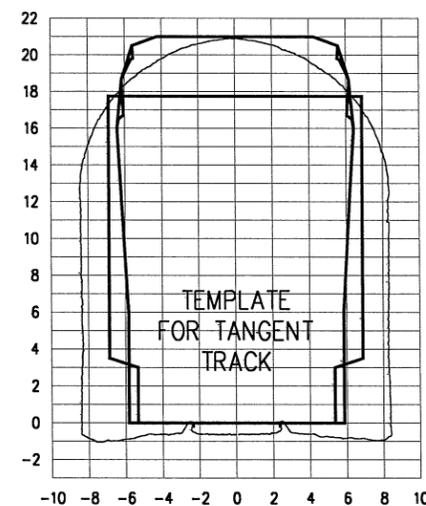
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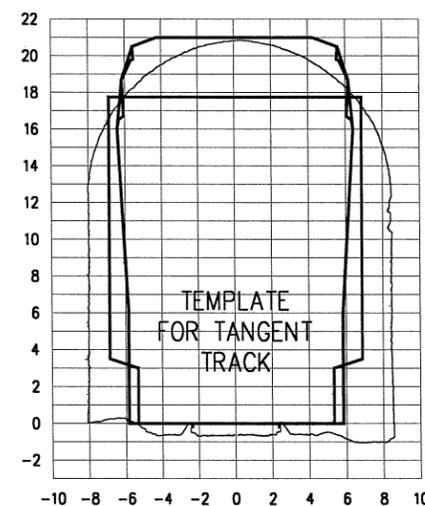
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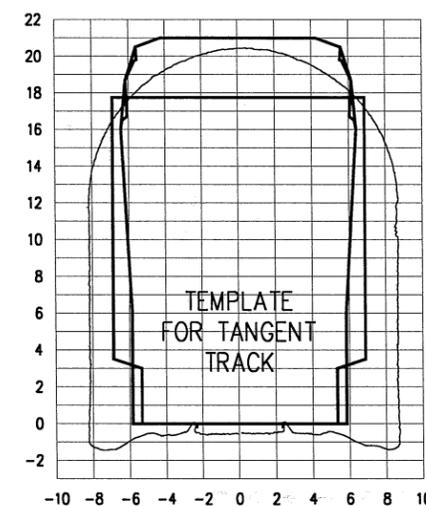
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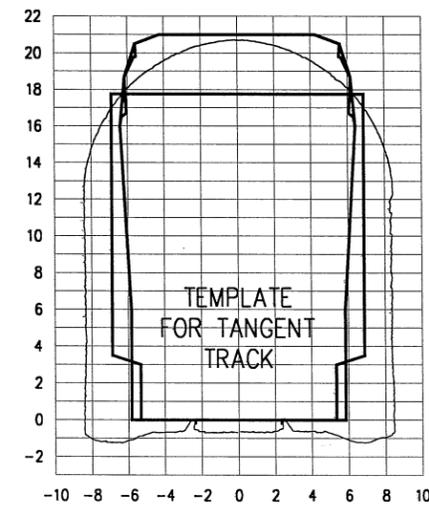
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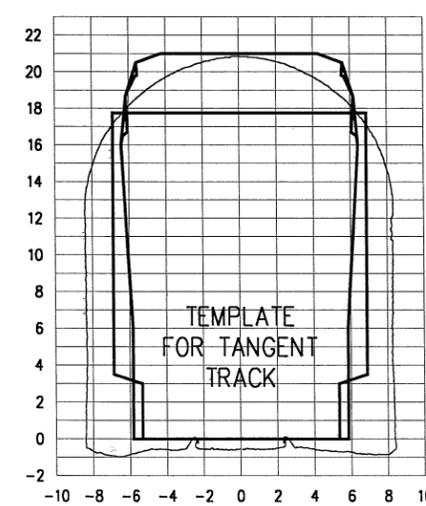
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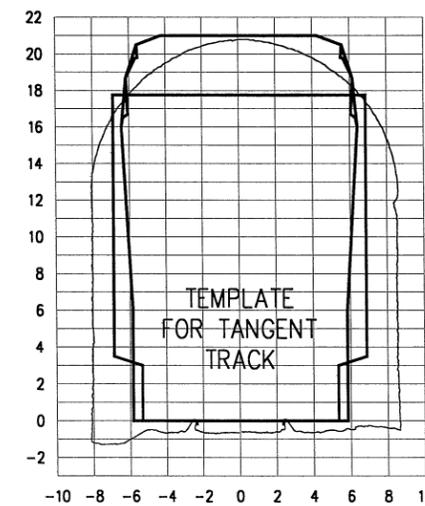
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1+02



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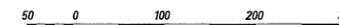
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NOTES:

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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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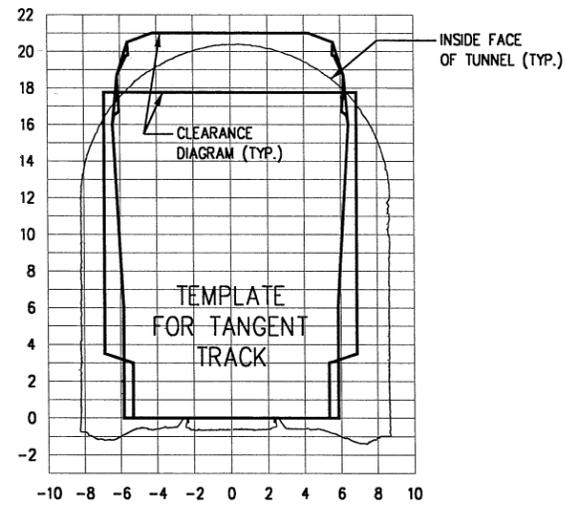


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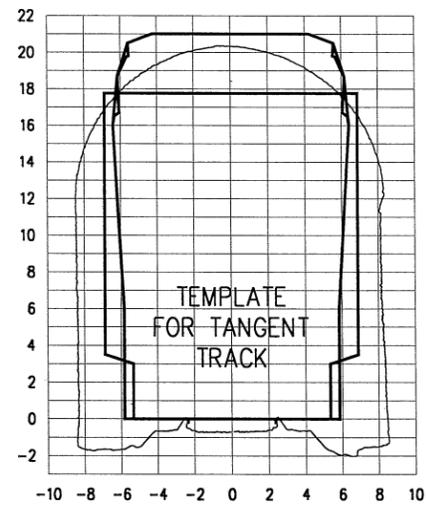
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POCAHONTAS

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

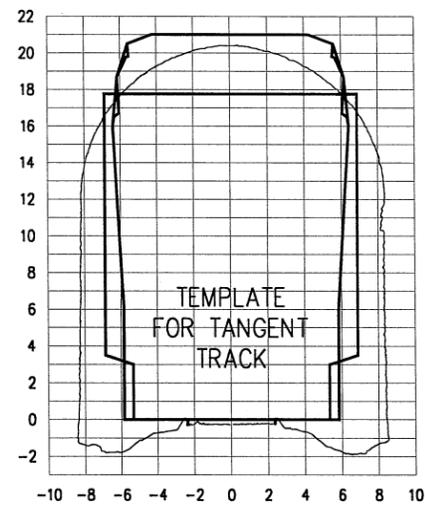
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CHK	DATE	APRIL 29, 2005	



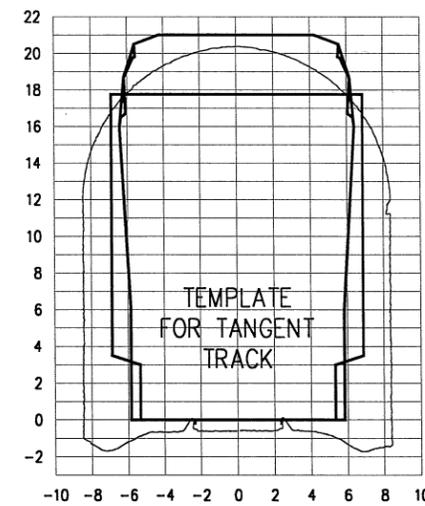
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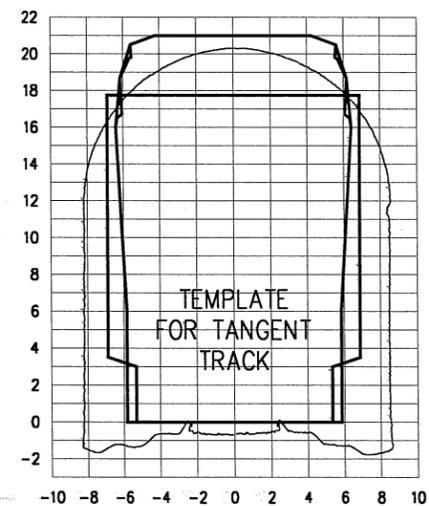
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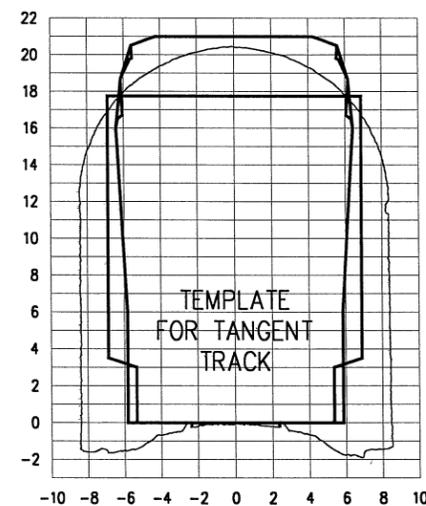
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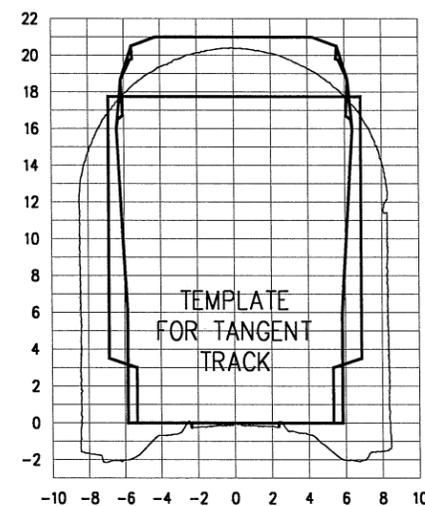
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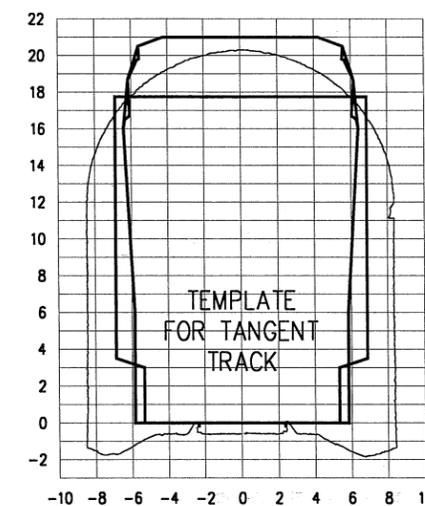
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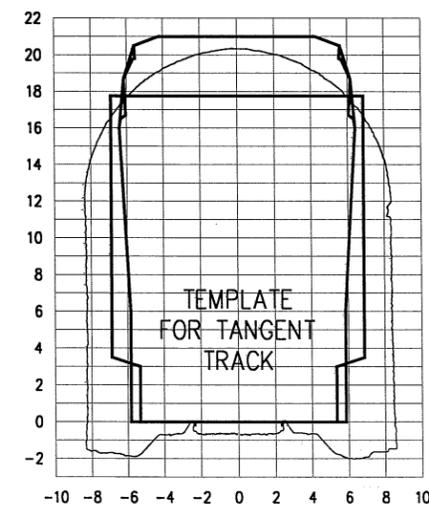
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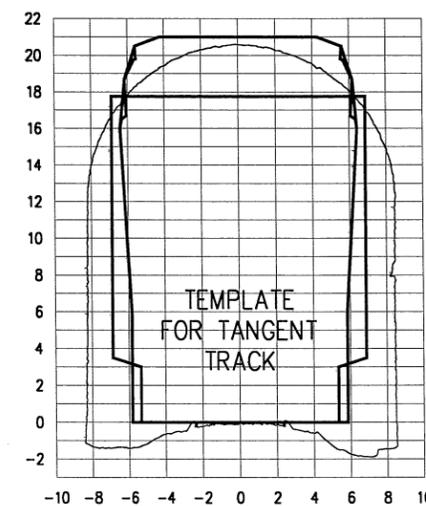
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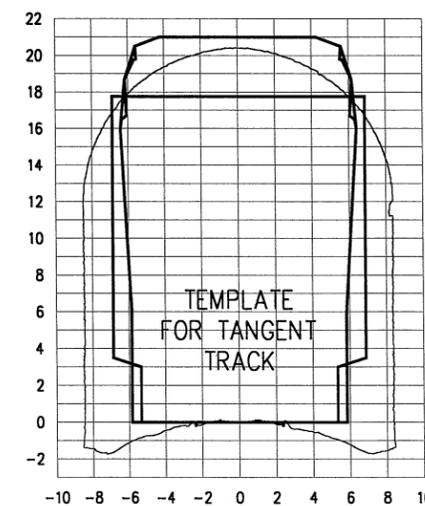
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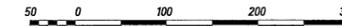
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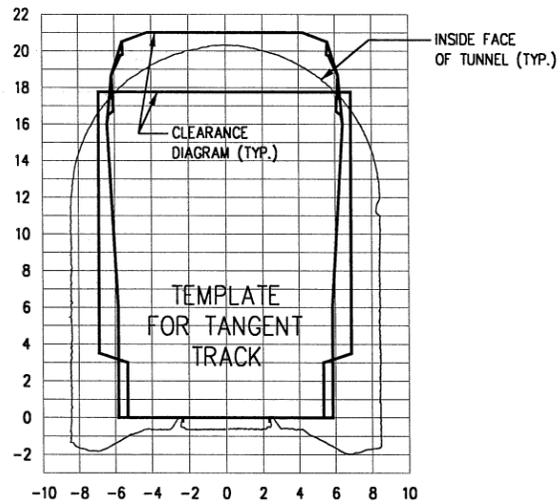
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NOT FOR CONSTRUCTION

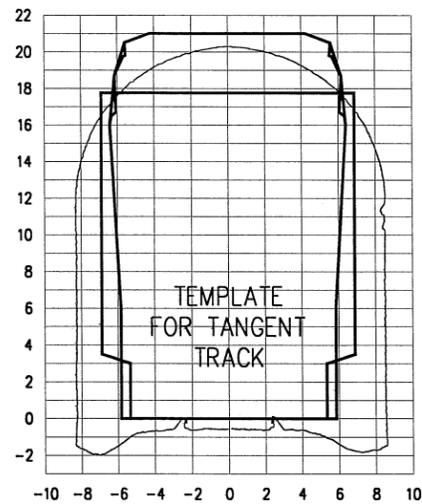
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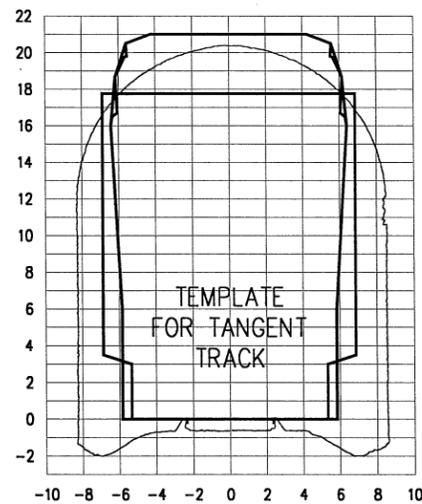
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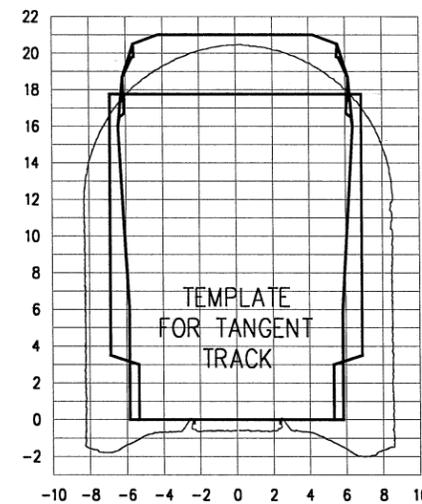
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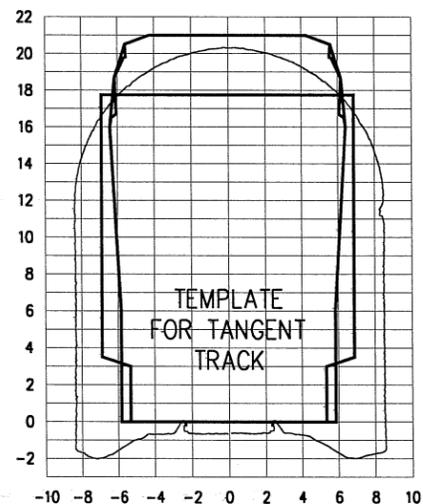
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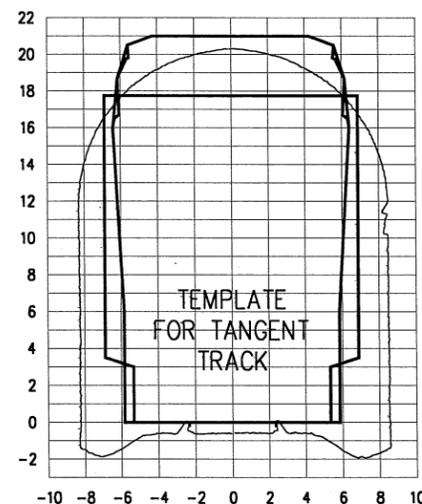
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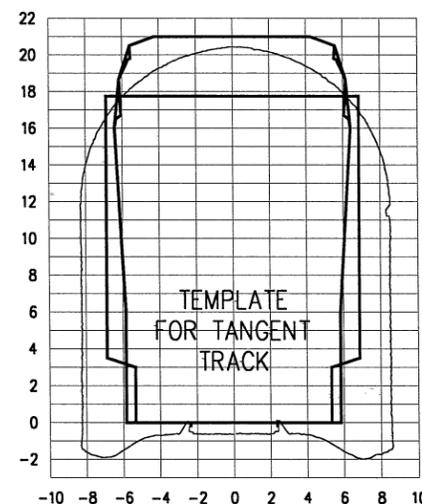
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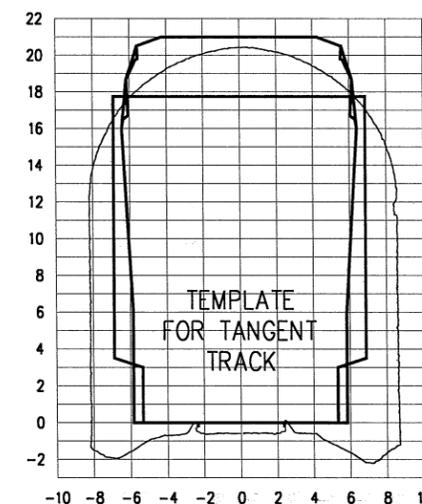
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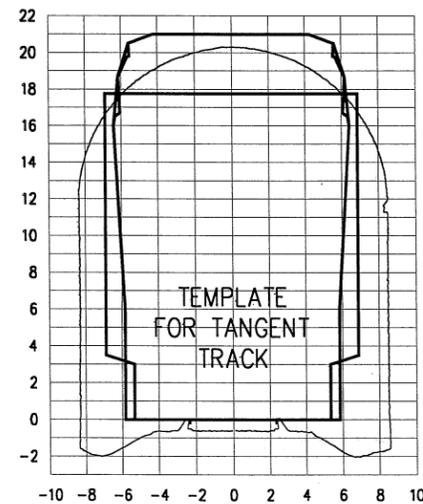
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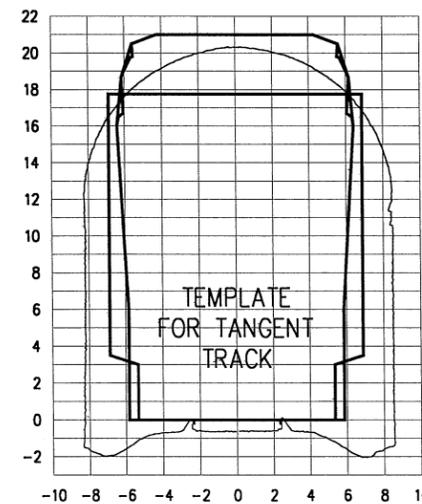
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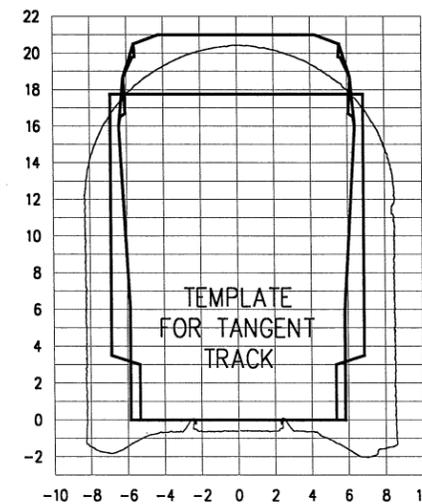
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12+02



13+52



15+03

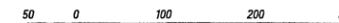
NOTES:

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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DATE/TIME = 08/11/2005 11:46:18 AM

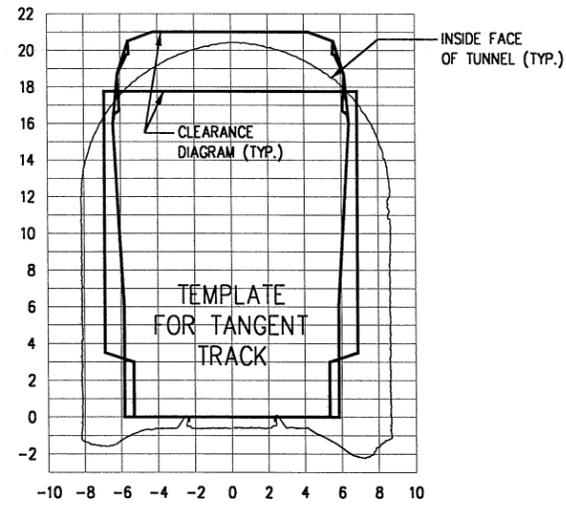
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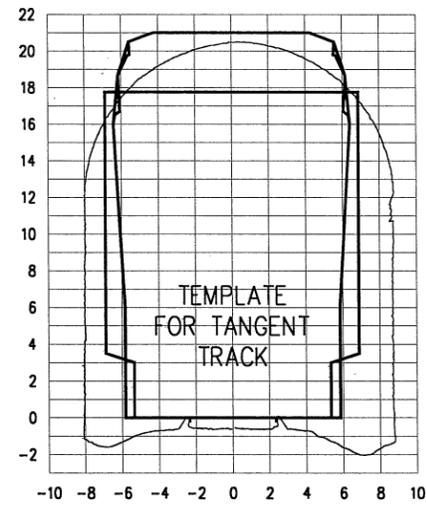
NORFOLK SOUTHERN

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

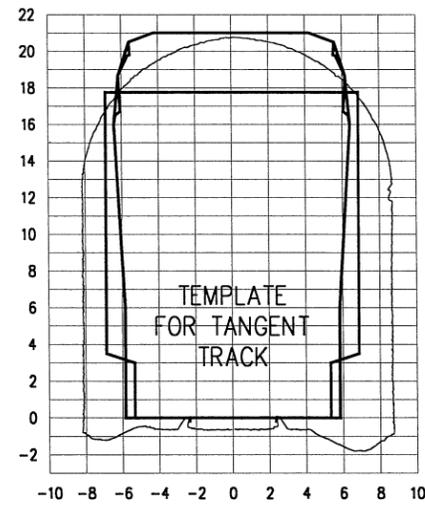
PI	DJI	8/5/05	PRELIMINARY ENGINEERING PHASE REPORT
REV	BY	DATE	DESCRIPTION
PROJECT: BIG SANDY NO. 1, PANCO SDG, WV			
TITLE: TUNNEL CLEARANCE CROSS SECTIONS - 3 OF 5			
DSN	P.T.D. NO.	DRW	16561
DMN	P.T.L. NO.	DATE	APRIL 29, 2005
CHK	DATE	FILE POST	NA-3.30
		DRAWING NUMBER	



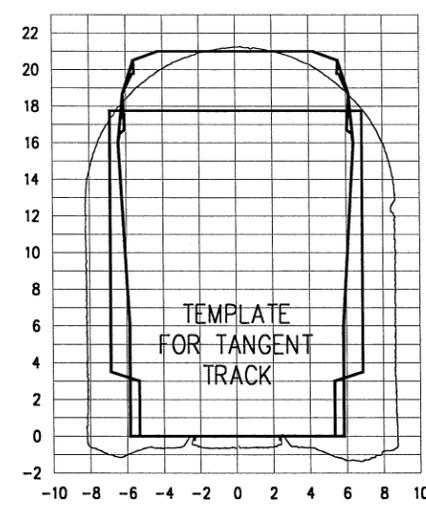
16+50



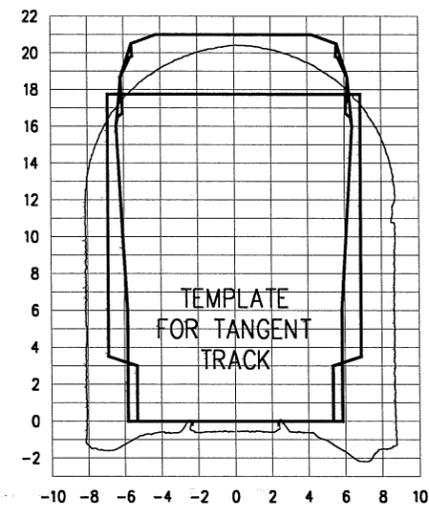
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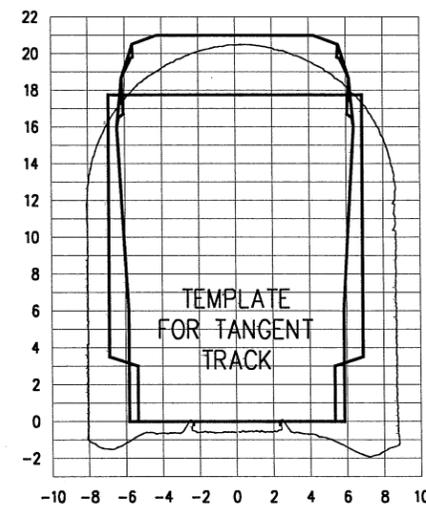
19+50



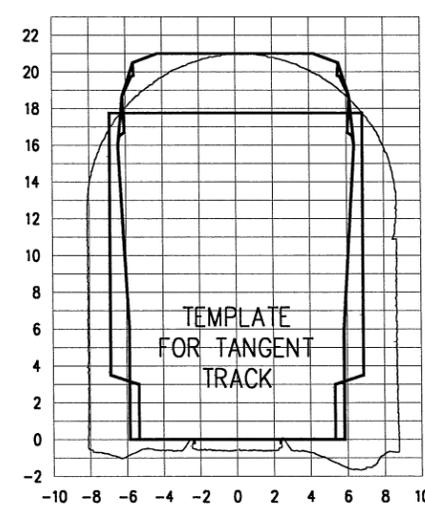
21+03



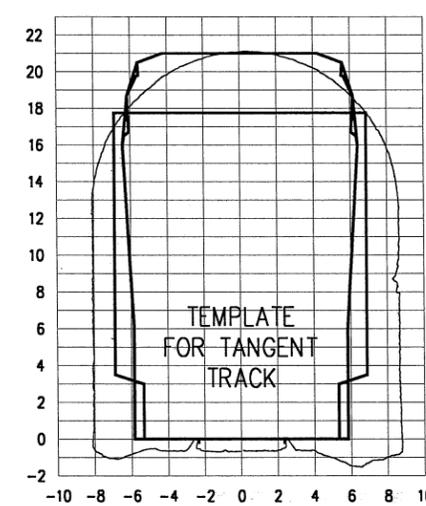
17+02



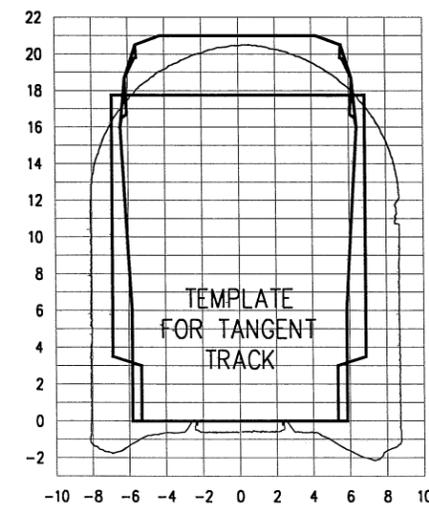
18+54



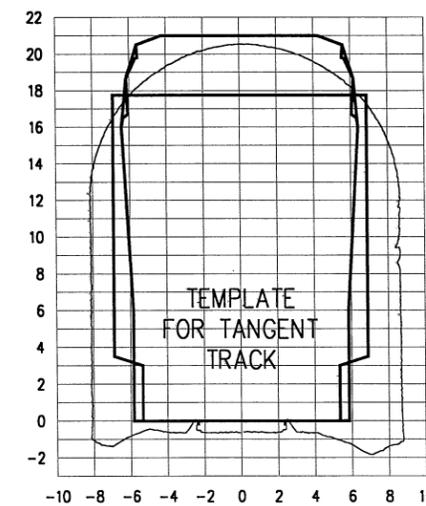
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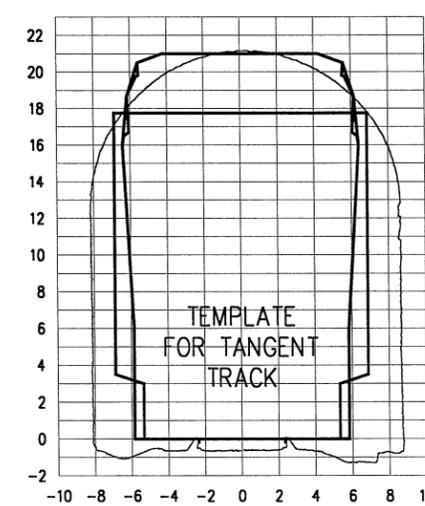
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17+52



19+03

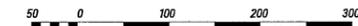


20+54

NOTES:

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NOT FOR CONSTRUCTION

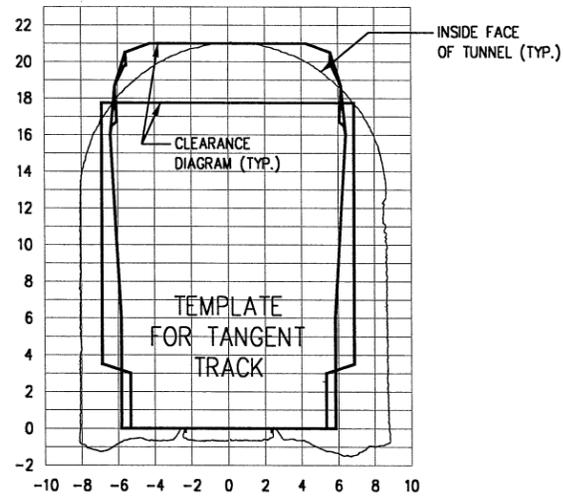


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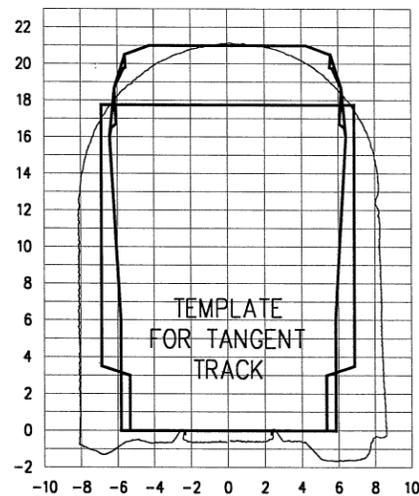
DESIGNING COMPANY		NORFOLK SOUTHERN	
OPERATING DIVISION		POCAHONTAS	
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.			
PI	D.J.L.	DATE	05/05
REV.	BY	DATE	
LOCATION			
BIG SANDY NO. 1, PANCO SDG, WV			
TITLE			
TUNNEL CLEARANCE			
CROSS SECTIONS - 4 OF 5			
DGN	FILE NO.	PRJ	15561
DATE	APRIL 29, 2005	TITLE POST	NA-3.30
CHK		DRAWING NUMBER	



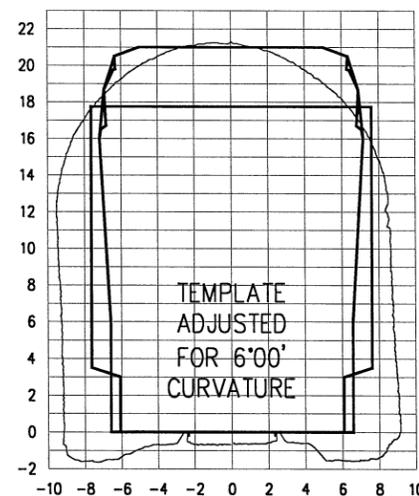
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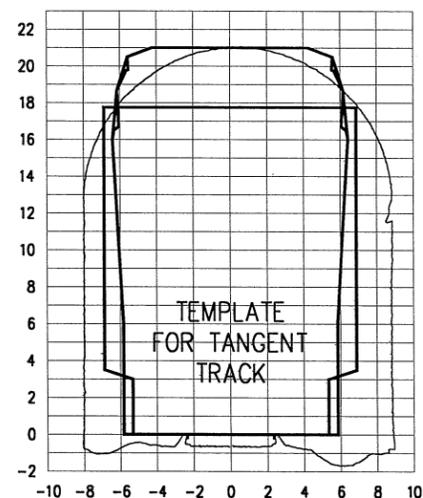
22+04



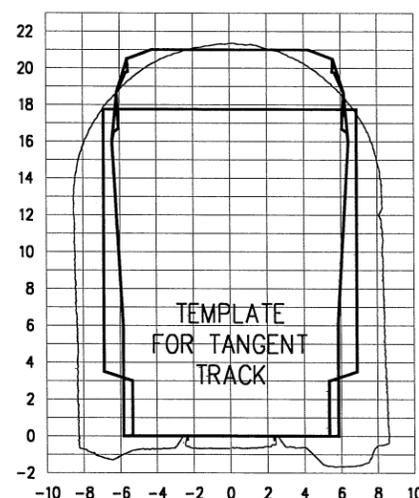
23+50



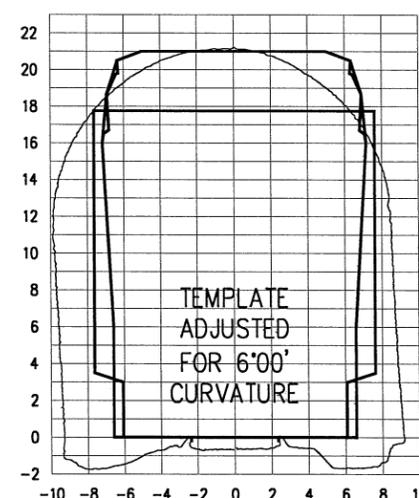
25+00



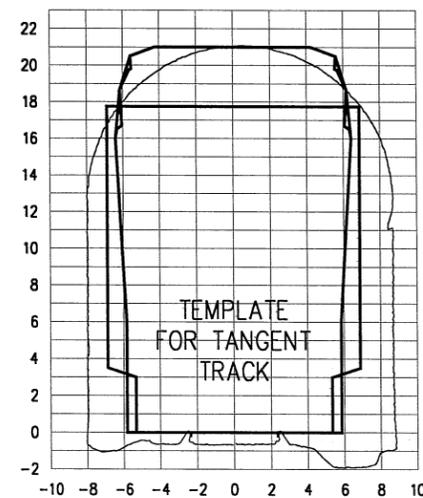
22+52



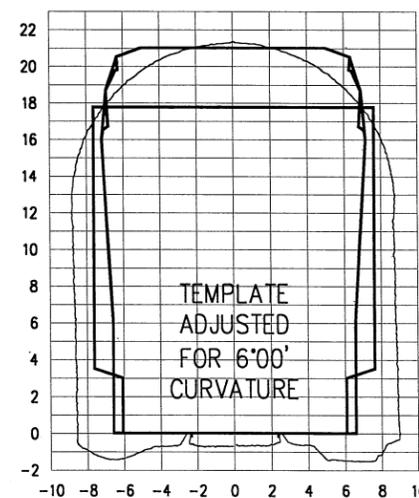
24+01



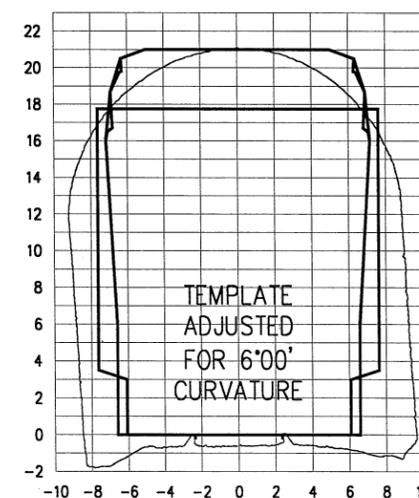
25+52



23+02



24+52



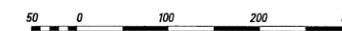
26+00

NOTES:

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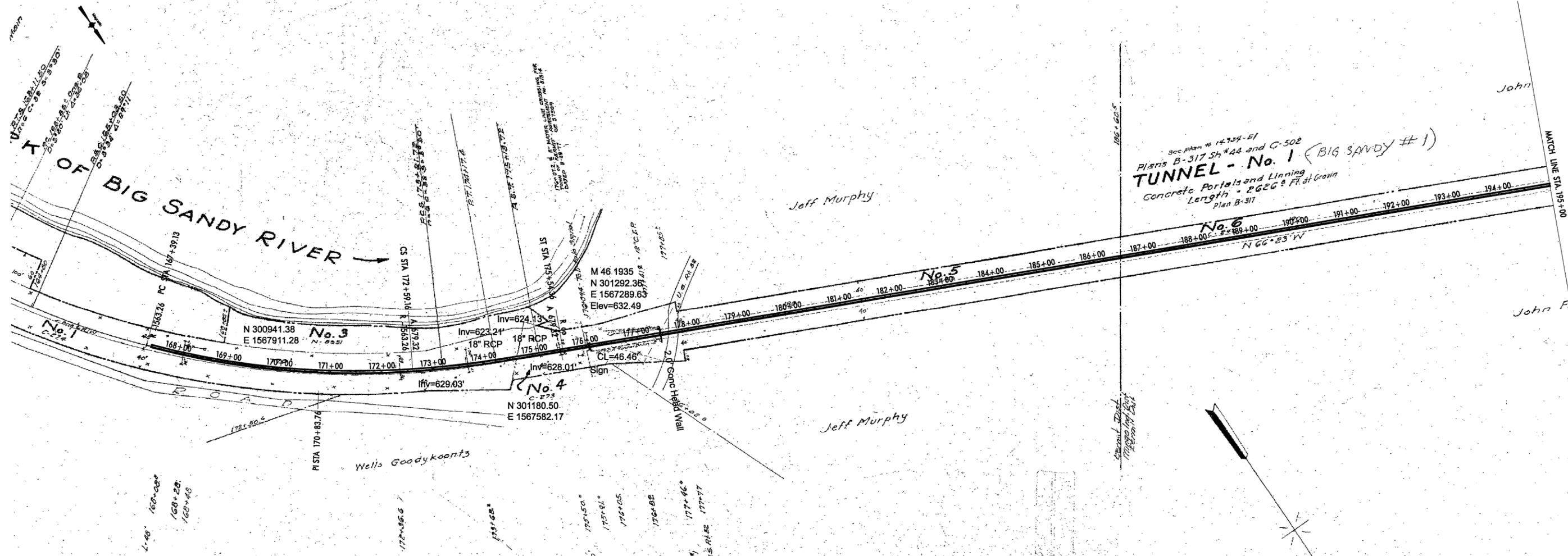
NOT FOR CONSTRUCTION

SCALE: 1" = 100'

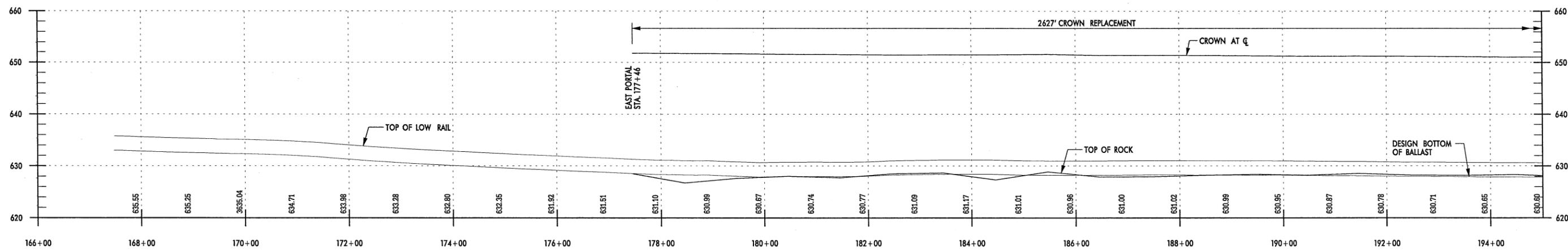


OWNING COMPANY
POCAHONTAS
OPERATING DIVISION
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

PI	DJL	8505	PRELIMINARY ENGINEERING PHASE REPORT
REV	BY	DATE	DESCRIPTION
LOCATION BIG SANDY NO. 1, PANCO SDG, WV			
TITLE TUNNEL CLEARANCE CROSS SECTIONS - 5 OF 5			
DGN	PTD NO.	VRN	16561 TITLE POST NA-3.30
DWN	FILE NO.	DRAWING NUMBER	
CHK	DATE	APRIL 29, 2005	



BIG SANDY NO. 1 PLAN
 SCALE: 1"=100'



BIG SANDY NO. 1 PROFILE
 SCALE: 1"=100' HORIZ.
 1"=10' VERT.

NOT FOR CONSTRUCTION

SCALE: 1"=100'

50 0 100 200 300

NORFOLK SOUTHERN

OWNING COMPANY
POCAHONTAS
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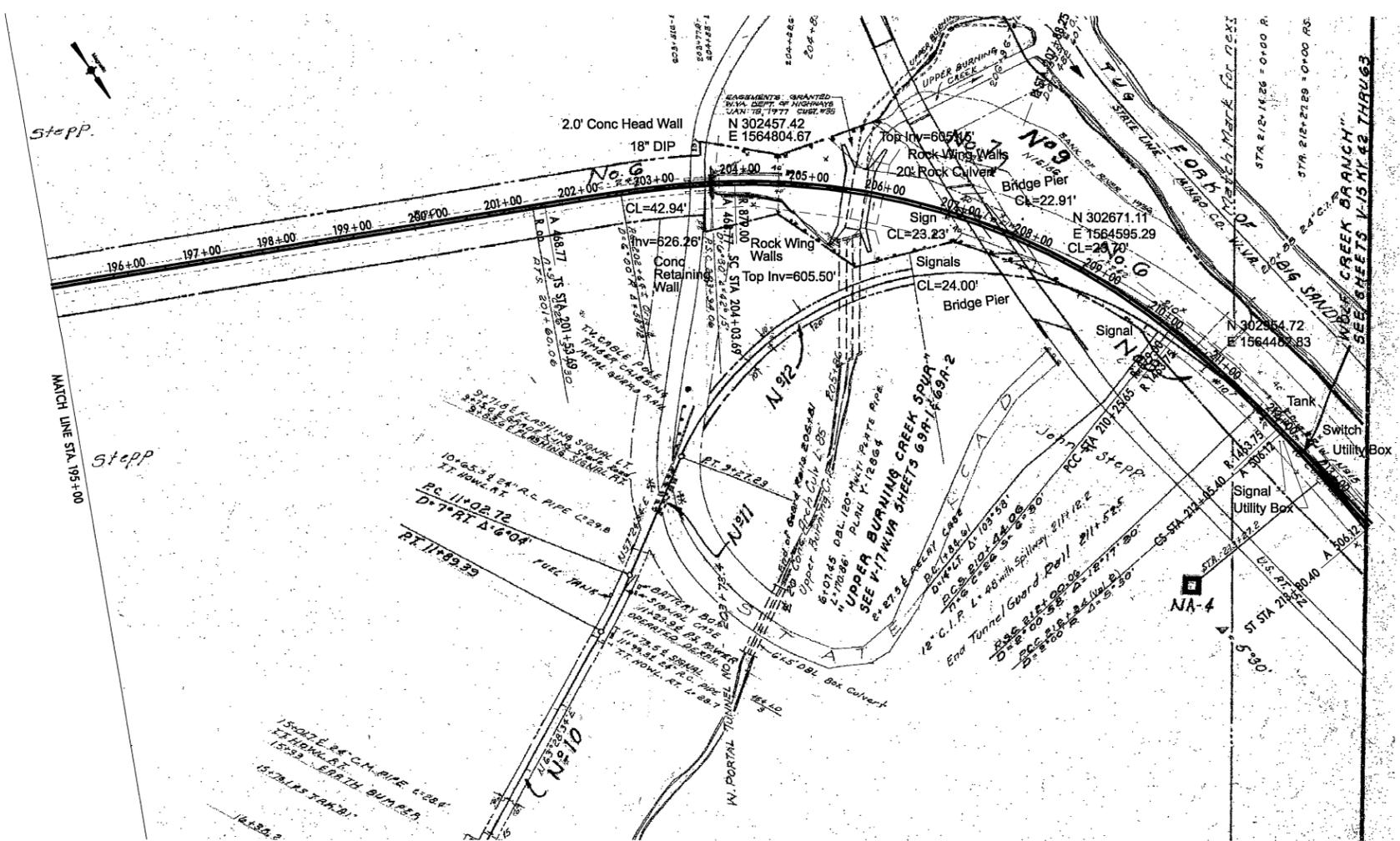
LOCATION: **BIG SANDY NO. 1 TUNNEL, PANCO SDG, WV**

TITLE: **PLAN AND PROFILE SHEET 1 OF 2**

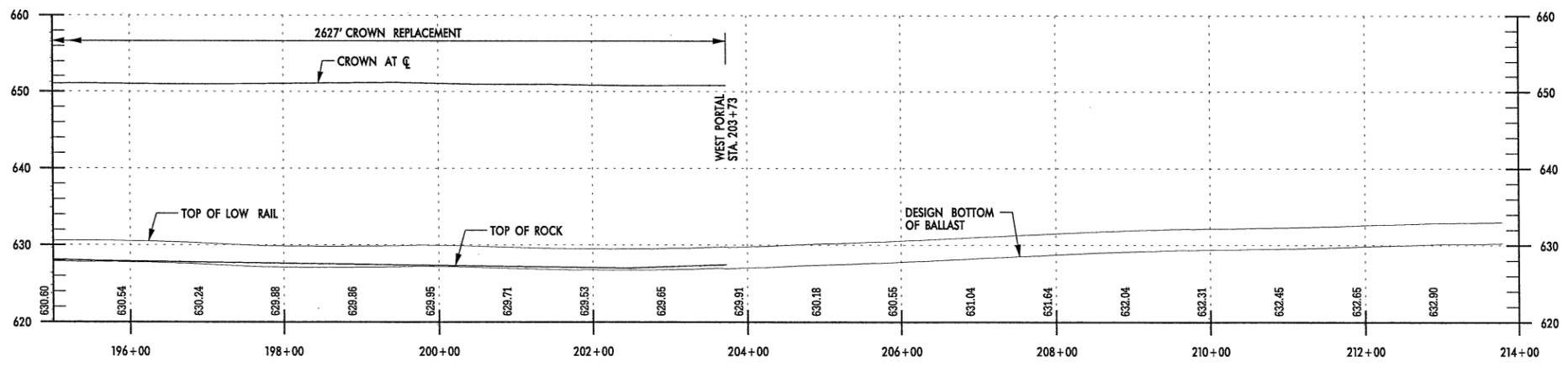
NO.	DATE	DESCRIPTION
P2 DJL 101405		PRELIMINARY ENGINEERING PHASE REPORT
P1 DJL 81905		PRELIMINARY ENGINEERING PHASE REPORT

DESIGNED BY	DATE	SCALE	PROJECT NO.	DATE
			16561	NA-3.30
CHECKED BY	DATE	SCALE	PROJECT NO.	DATE
	APRIL 29, 2005			

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 DATE/TIME = 02/22/2005 09:08:36 PM



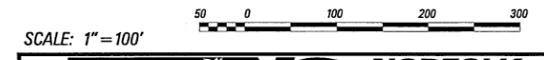
BIG SANDY NO. 1 PLAN
SCALE: 1"=100'



BIG SANDY NO. 1 PROFILE
SCALE: 1"=100' HORIZ.
1"=10' VERT.

FILE NAME = P:\NSR\219393\CAD\Survey\Info\005.30 Big Sandy No. 1 - B.dgn
 DATE/TIME = 10/22/2005 10:28:48 PM

NOT FOR CONSTRUCTION



NORFOLK SOUTHERN

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

LOCAL JOB	FILE NO.	DATE	DESCRIPTION
	P2 01/10/405		PRELIMINARY ENGINEERING PHASE REPORT
	P1 01/18/05		PRELIMINARY ENGINEERING PHASE REPORT
BIG SANDY NO. 1 TUNNEL, PANCO SDG, WV			
PLAN AND PROFILE			
SHEET 2 OF 2			
DWN	FILE NO.	DATE	DESCRIPTION
		16561	MILE POST NA-3.30
CHK	DATE	DRAWING NUMBER	
	APRIL 29, 2005		



