



*Heartland Corridor, Walton Virginia to
Columbus Ohio*

Preliminary Engineering Phase Report



**TWIN BRANCH NO. 1
TUNNEL –
MP N407.71
MOHEGAN, WV**

October 14, 2005, Rev. 2



Preliminary Engineering Phase Report

PR219399 - Twin Branch No. 1
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October 14, 2005

Norfolk Southern Railway Heartland Corridor, Walton VA to Columbus OH

Twin Branch No. 1 Tunnel – MP N407.71

Statistics: Pocahontas Division
Double-width Tunnel for Main #1 and Main #2
Length = 760'
Concrete lined
Degree of Curvature = 5.5 RT (per Track Chart)
Superelevation = 3.0" (per Track Chart)

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1. EXISTING CONDITIONS

1.1 Background

Valuation Map V-13WV/33 & 34 (16289 & 16290) for the Twin Branch No.1 Tunnel are dated June 30, 1916. Parcels for the tunnel were acquired in 1903. Therefore it is suspected that the tunnel was constructed in 1903 or shortly afterwards. 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 23, June 14, and July 9-10, 2005.

1.2 General Area

The tunnel is located in a lightly populated area of the Town of Twin Branch, McDowell County, West Virginia. Nearby land use includes a residential area near the west portal and a scrap yard at the east portal. The tunnel can be accessed only at the west portal, from Route 7. There is a small staging area near the west portal, between the two Twin Branch Tunnels. A rail greaser is located outside of the west portal for tracks 1 and 2.

1.3 Structural Conditions

The tunnel is 760' long with a concrete lining and a width of approximately 30'. It is a double-width tunnel for two tracks. The track circuit is buried south of Main #1 east of the east portal and mounted on the north wall of the tunnel. The tunnel lining is in fair condition, with approximately fifty percent of the construction joints open and wet. The concrete face is spalling at the portals. Many of the liner cores identified potentially poorly consolidated concrete.

Liner cores were taken on July 9 and 10, 2005. Cores were drilled into the liner at locations 250' and 700' into the tunnel from the east portal. The cores were taken at the 7, 10 and 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 Twin Branch No. 1 Tunnel Liner Core Investigation			
Distance from East Portal	Position	Liner Thickness	Notes
250'	7 o'clock	35"	Concrete in poor condition. No voids behind liner.
250'	10 o'clock	37"	Concrete has a large number of voids within the core. 2" void between concrete liner and rock.
250'	12 o'clock	37"	Concrete very broken, no voids.

Summary of Twin Branch No. 1 Tunnel Liner Core Investigation			
Distance from East Portal	Position	Liner Thickness	Notes
700'	7 o'clock	43"	Some broken concrete, no void behind liner.
700'	10 o'clock	41"	No void behind liner.
700'	12 o'clock	50"	No void behind liner.

The bridge outside of the west 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 directly on the abutments. The bridge spans over the Tug Fork River and two roads. There is only 9'-1" of clearance from the road to the bottom of the girder. The structure type and site geometry, coupled with the proximity of rock below the rail make 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". The vertical distance from the top of rail to the base of the footing was measured at 20".

1.4 Track

The track is continuous welded rail of conventional design with wooden cross-ties 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 curves right 5.5 degrees with a superelevation of 3.0" on both tracks. The ballast is approximately 2' below top of tie and is fouled, and the majority of the top of the foundation along the north side of the tunnel is exposed. There are drainage ditches along each wall and in between the tracks, and drainage appears to be a problem as standing water is present in the north ditch, causing pumping on the low rail of Main #2. The water in the tunnel was tested and its pH reading was 7.74. 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 east-central part of the Pocahontas Division (including Twin Branch No. 1) 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.

Beds of thin-bedded sandstone and shale up to five feet thick were infrequently noted within the sandstone. At the west portal of Twin Branch No. 1, the thin bedded sandstone and shale were undercut and were observed to slowly spall over time. A two-foot thick coal bed was noted at the base of the rock cut at the east portal of the Twin Branch No. 1 Tunnel and may also have been observed in the bottom of probes at the west portal. Joints in the rock cuts 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 18. 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.

The geoprobes indicate that the top of rock is located between 2.2’ to 3.7’ (averaging about 2.9’) below the top of ballast throughout the tunnel for Main #1 and between 2.0’ to 4.1’ (averaging about 3.8’) 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 both the “High-Wide Load” and the “Double-Stack Load” portions of the composite clearance envelope throughout the entire tunnel. For vertical clearance, the “Double Stack” portion of the envelope encroaches on the sides of the tunnel crown by an average of about 18” on the left wall and 21” on the right, and varies up to a maximum of 25”. The “High-Wide” portion of the envelope encroaches on the sides of the tunnel crown (at points lower than the “Double Stack” envelope) by an average of about 9” on the left wall and 13” on the right, and varies up to a maximum of 16”. Cross sections of the tunnel clearance encroachments are shown in the drawings at the end of this report. The maximum vertical encroachments are summarized in the table below:

Distance (ft) from East Portal	Crown Encroachment (radial inches)	
	Left Side	Right Side
0	22	24
101	22	21
202	17	23
301	19	23
401	18	20
502	18	19
601	14	22

Distance (ft) from East Portal	Crown Encroachment (radial inches)	
	Left Side	Right Side
701	13	24
758	16	19

2. CLEARANCE IMPROVEMENT ALTERNATIVES

Given the magnitude of the vertical clearance deficiency, there are several general alternatives that can be used to obtain the clearance; replacing the lining, notching the lining 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 roof must be demolished, the native rock excavated to the clearance limits plus the new liner thickness, and a new concrete liner installed. This alternative appears necessary for entire tunnel. If the encroachment, could be reduced using steel ties or other methods, then notching may be employed instead of liner replacement.

2.2 Notching the Crown

Notching in the upper quadrants of the tunnel crown may not cut entirely through the liner and could be an alternative to complete liner replacement. However, the encroachment is large enough that a minimum liner thickness of at least 10" might not be maintained. The six cores taken in July 2005 varied in thickness from 35" to 50", which is more than the minimum thickness of 26" at crown and 34" minimum in the sidewalls that was indicated on drawings for adjacent tunnels. However, additional investigations would be required before the apparent additional thickness of concrete can be relied on in the reconstruction. Therefore, deep notching of the tunnel crown will no longer be considered as a viable alternative for achieving the necessary vertical clearance, unless additional investigations in the Final Design Phase conclude that an adequate thickness can be maintained.

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 be significant enough to eliminate deep notching as a practical alternative. Due to the close proximity of the rail bridge outside the west portal, 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 of the vertical encroachment, liner replacement of the tunnel crown is necessary to achieve the required clearance in the tunnel. Additional investigations in the final design phase may determine that notching is possible for some of the tunnel. Drainage improvements are also recommended.

3.1 Preliminary Design

The preliminary design uses replacement of the liner crown. 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.

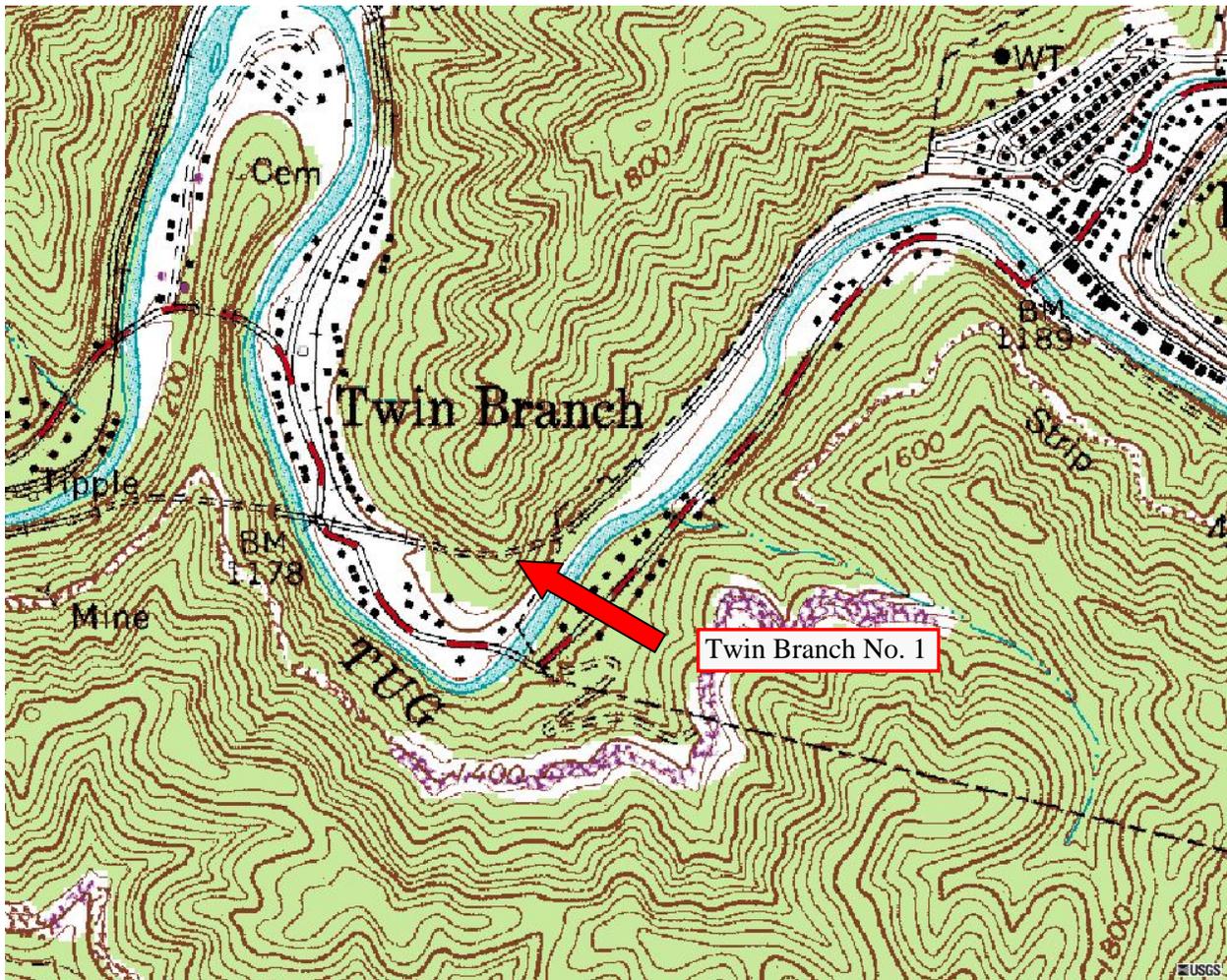
3.2 Schedule

The estimated schedule for completing improvements on this tunnel is thirty (30) weeks from mobilization to demobilization. The schedule assumes one track being closed at a time, for ten hours, five days a week. The schedule assumes 12' of crown removal each day, with concrete 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.

3.3 Estimate

The total estimated cost for achieving clearance at this location is \$5.6 million, or \$7,338 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. The total cost is made up of tunnel, track, signal, and site work items at \$3.5 million, plus a 30% construction contingency, a 10% engineering allowance, and a 14% construction management allowance.

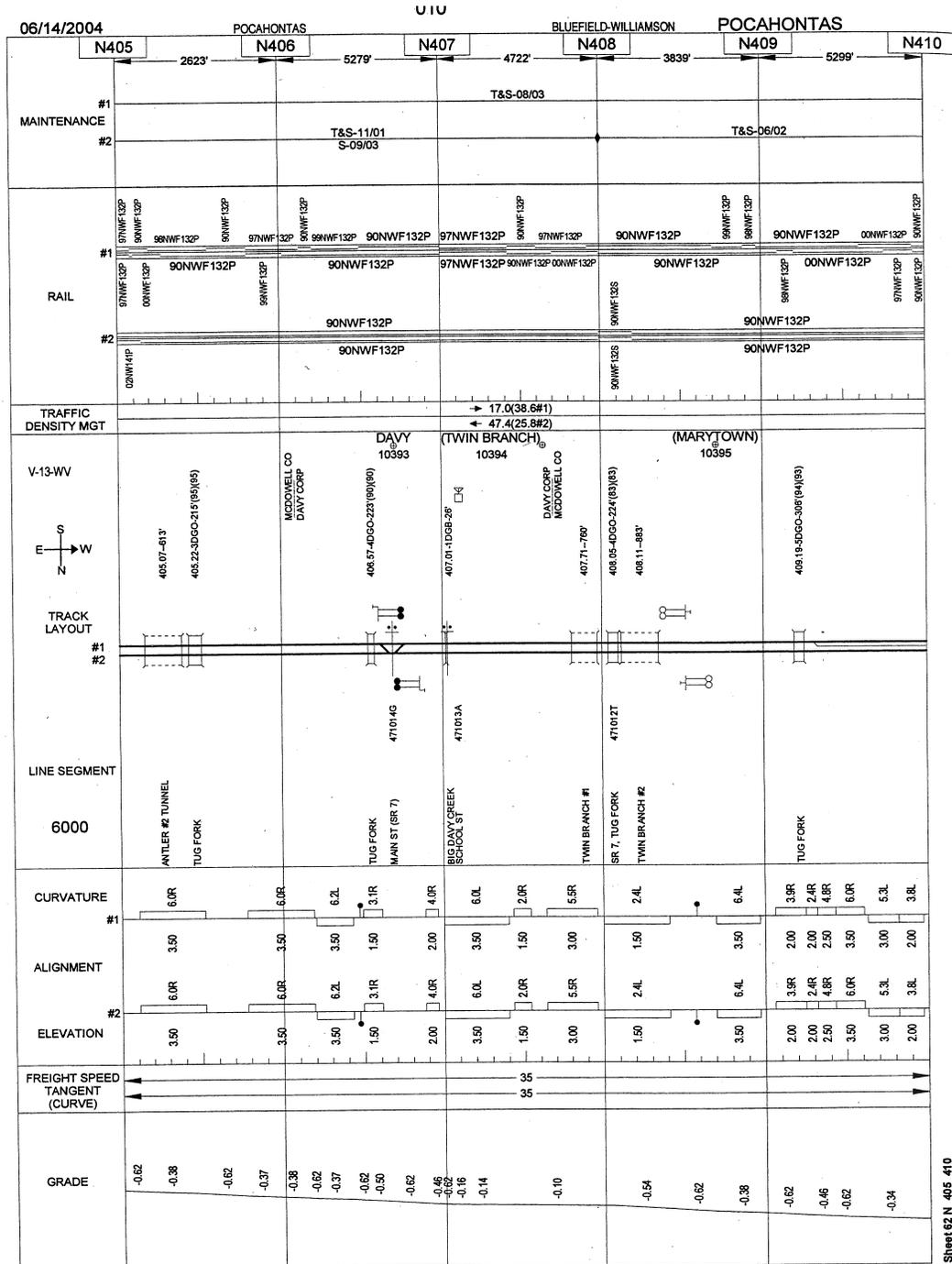
4. USGS TOPOGRAPHIC MAP



5. AERIAL PHOTO



6. TRACK CHART



Sheet 62_N_405_410

7. PHOTOS



Photo No. 1 – East Portal



Photo No. 2 – Looking from East Portal

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Photo No. 3. – West Portal



Photo No. 4. – Looking from West Portal



Photo No. 5. – Mud Pumping Through Ballast



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

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8. ESTIMATE
Twin Branch No. 1

Tunnel Length **760** ft
 Tunnel Width **29.5** 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

Tunnel Work Items	UOM	Quantity	Unit Rate	Total
Mobilization	%	5%		\$146,027.03
Surveying	DY	5	\$1,300.00	\$6,500.00
Rock Dowels 14' with Chain Link Mesh - Crown	EA	1267	\$601.86	\$762,359.47
Crown Removal	SF	35814	\$16.12	\$577,392.80
Rock Removal - Crown	CY	1326	\$425.72	\$564,692.80
Crown Installation	SF	35814	\$24.38	\$873,163.37
Rock Cut Drainage Trench	LF	1160	\$87.05	\$100,972.80
Tunnel Drainage	LF	1160	\$16.42	\$19,043.38
Demobilization	DY	5	\$3,283.20	\$16,416.00
Total Tunnel Work Items	LF	760	\$4,034.96	\$3,066,567.64

Trackwork Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Undercutting	PF	1520	\$17.12	\$26,029.72
Surfacing & Lining	PF	4560	\$2.26	\$10,304.06
Ballasting Track	TN	1520	\$38.77	\$58,931.32
Demobilization	DY			
Total Trackwork Items				\$95,265.10

Signal Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Relocate Cables / Track Leads	LF	760	\$12.43	\$9,445.18
Demobilization	DY			
Total Signal Items				\$9,445.18

**Preliminary Engineering Phase Report
MP N-407.71-Twin Branch No. 1**

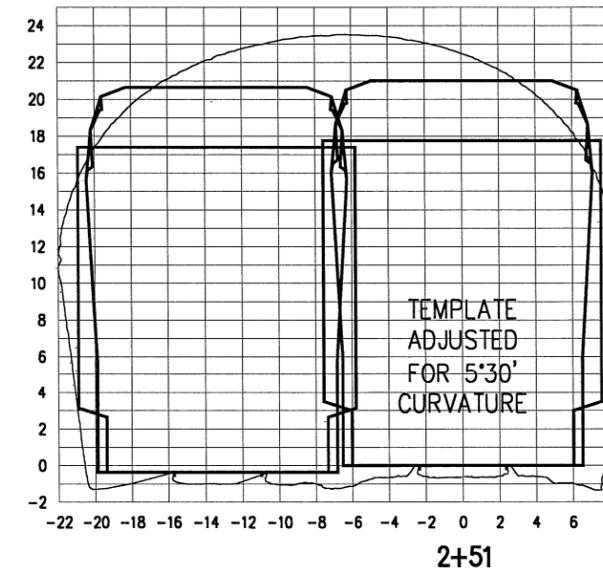
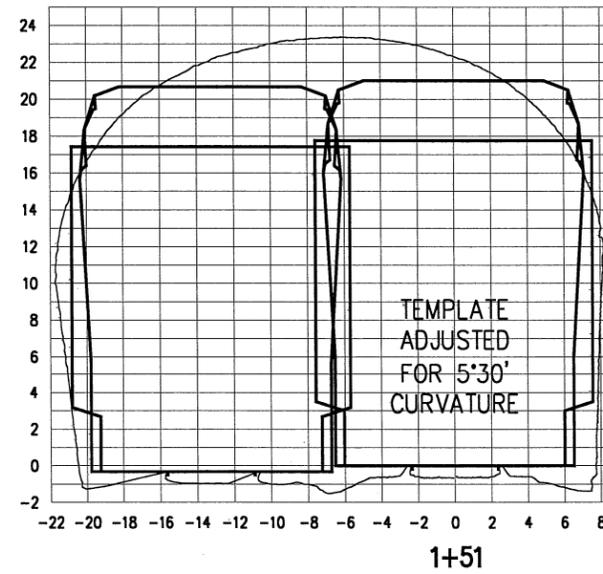
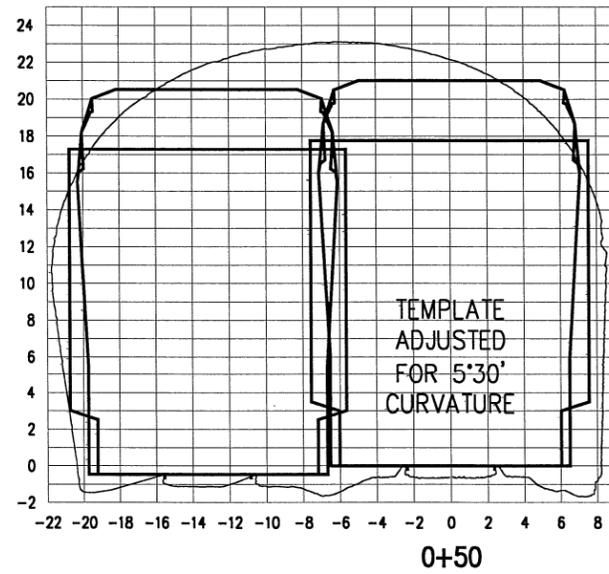
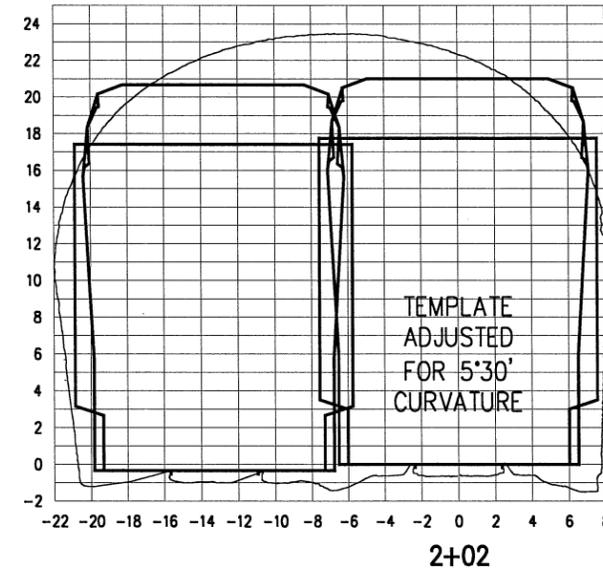
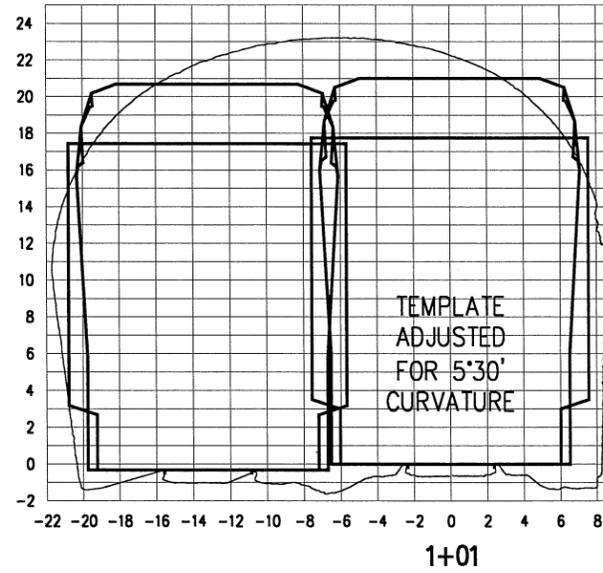
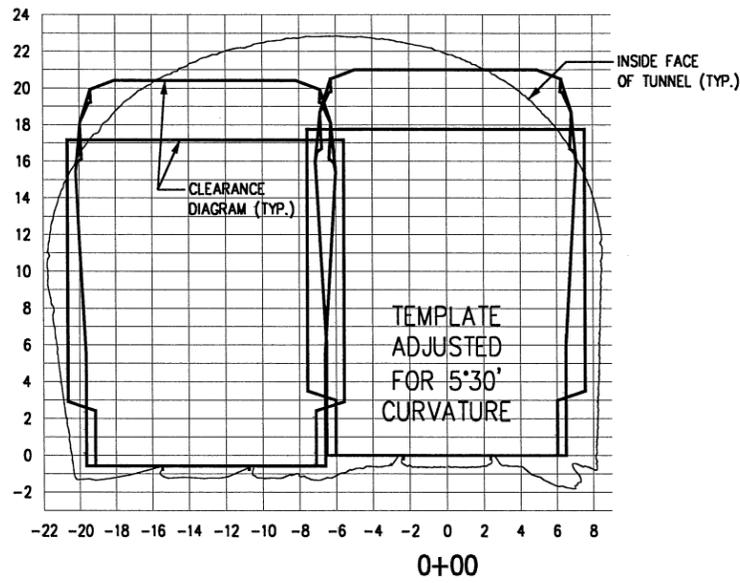
Bridge Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Demobilization	DY			
Total Bridge Items				

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
Demobilization	DY			
Total Site Items				\$14,442.40

Special Items	UOM	Quantity	Unit Rate	Total
Mobilization	DY			
Flagging	DY	147	\$821.50	\$120,760.50
Flood Track with Ballast for Protection	TN	3040	\$39.58	\$120,326.06
Remove Flooded Ballast	TN	3040	\$10.73	\$32,632.61
Demobilization	DY			
Total Specialty Items				\$273,719.16

Subtotal All Items		\$3,459,439.49
Construction Contingency	30%	\$1,037,831.85
Engineering Allowance	10%	\$449,727.13
Construction Management Allowance	14%	\$629,617.99
Total		\$5,576,616.46

9. DRAWINGS

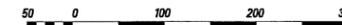


NOTES:

- HORIZONTAL DATUM IS PARALLEL TO TRACK, WHERE TRACK IS SUPERELEVATED, DATUM IS NOT PARALLEL WITH GROUND.
- 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.

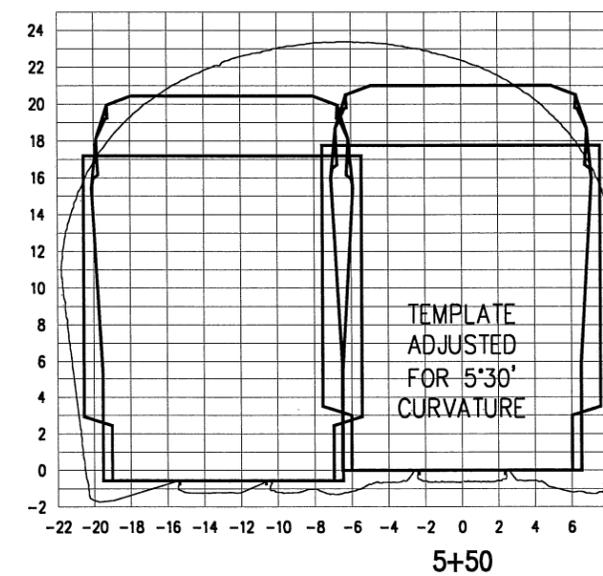
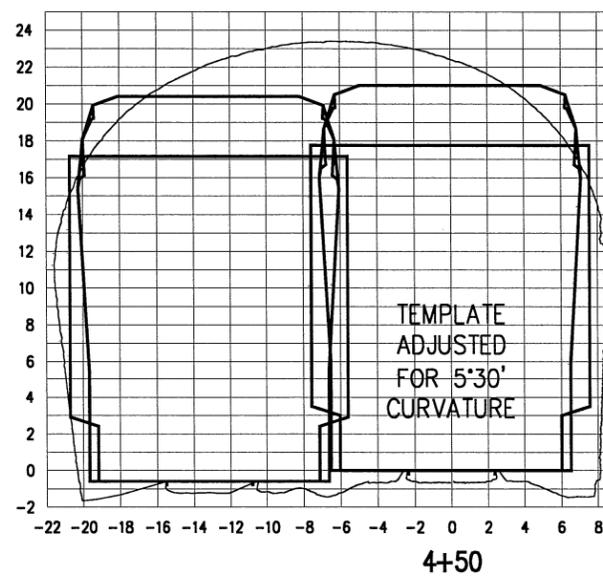
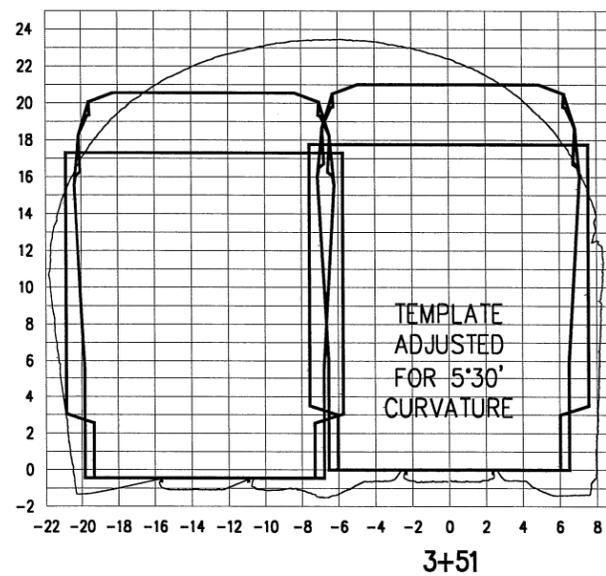
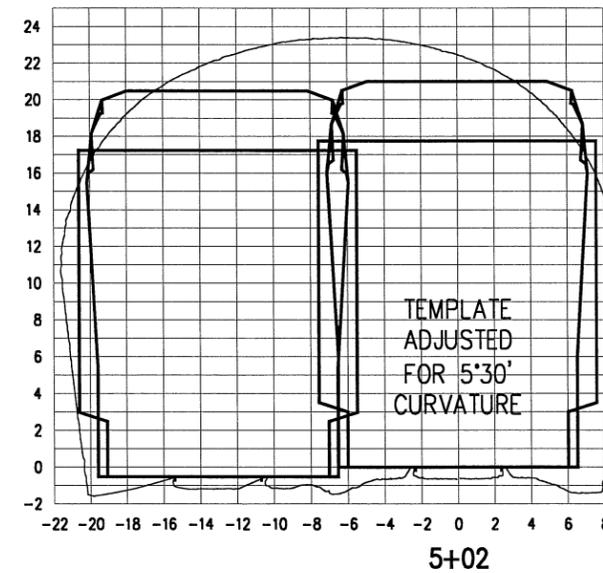
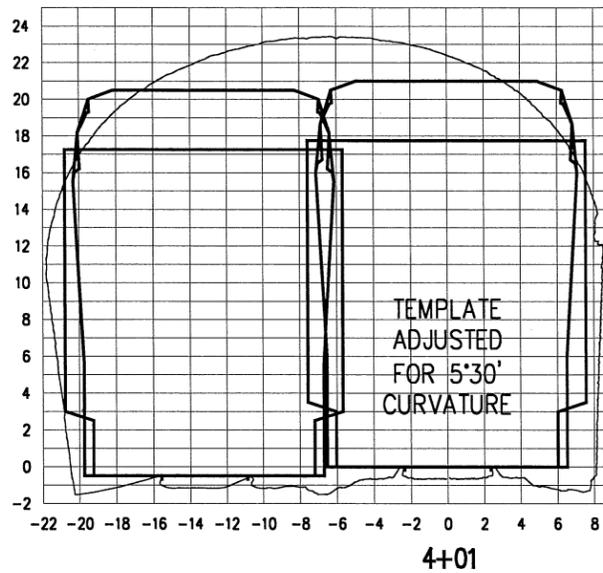
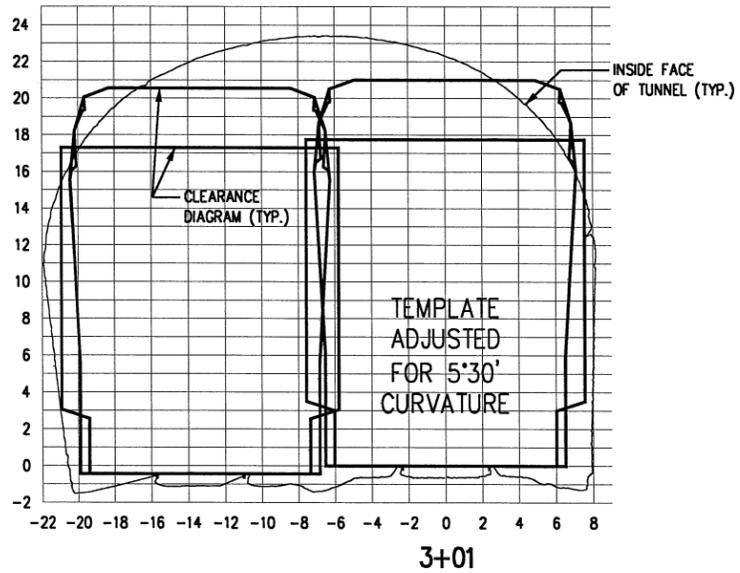
NOT FOR CONSTRUCTION

SCALE: 1" = 100'



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

PI	D.J.L.	7/29/05	PRELIMINARY ENGINEERING PHASE REPORT
REV	BY	DATE	DESCRIPTION
LOCATION			
TWIN BRANCH NO. 1, TWIN BRANCH, WV			
TITLE			
TUNNEL CLEARANCE			
CROSS SECTIONS - 1 OF 3			
DEN	P.T.D. No.	BY	16289 TITLE POST N-407.71
DWN	FILE No.	DRAWING NUMBER	
CHK	DATE	APRIL 15, 2005	

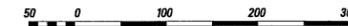


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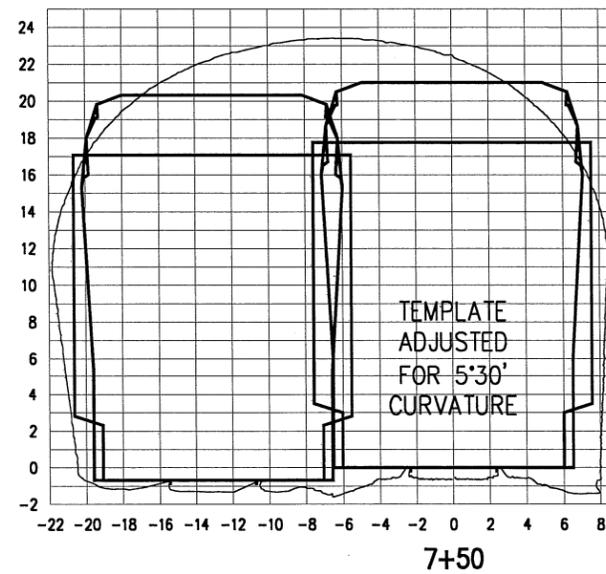
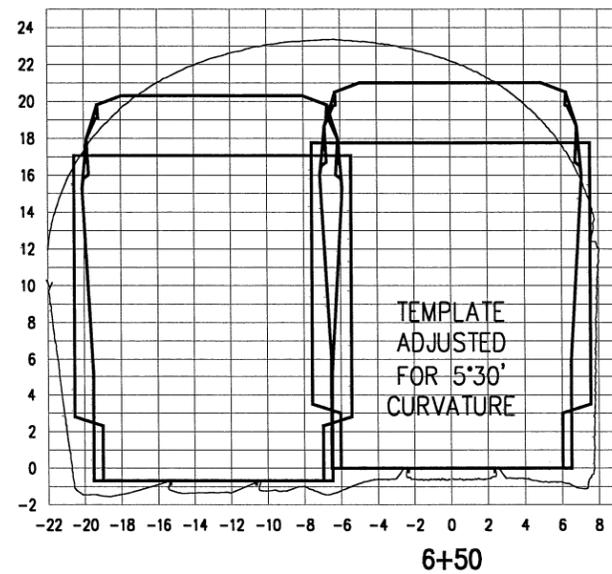
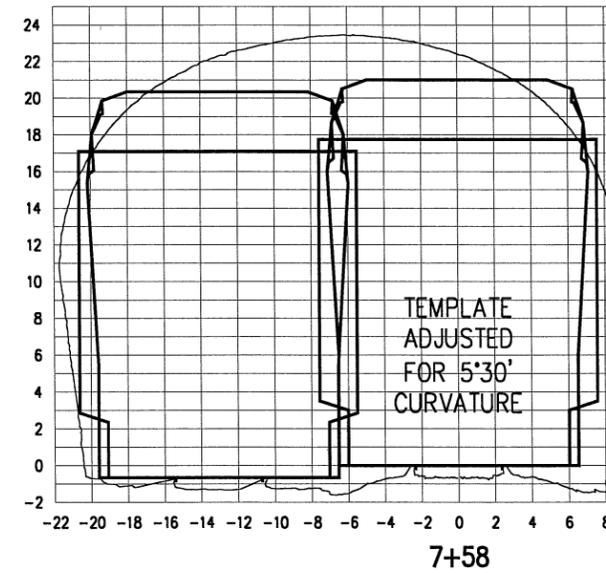
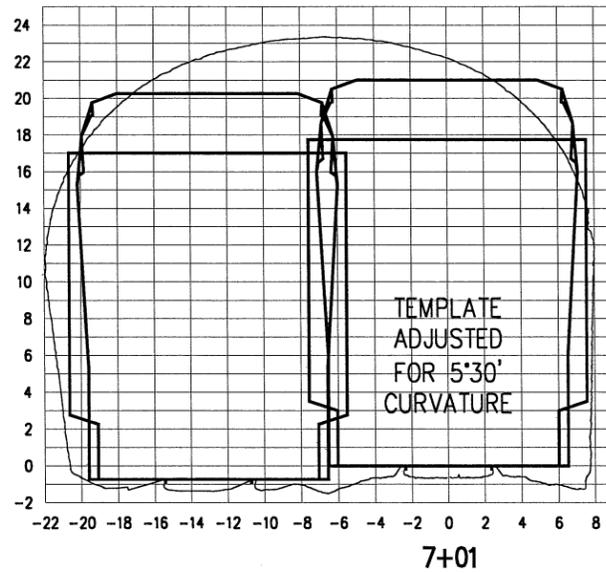
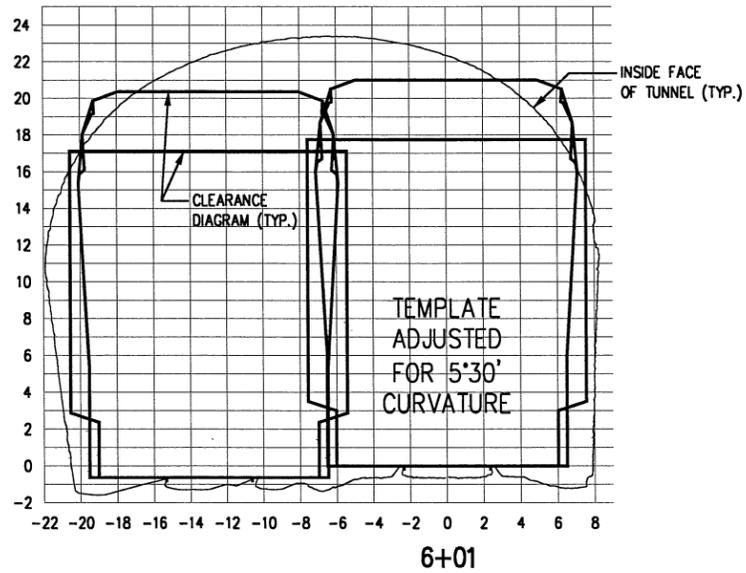
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SCALE: 1" = 100'



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

PI	DJL	7/29/05	PRELIMINARY ENGINEERING PHASE REPORT
REV	BY	DATE	DESCRIPTION
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TITLE TUNNEL CLEARANCE CROSS SECTIONS - 2 OF 3			
OWN	FILE NO.	16289	FILE POST N-407.71
CHK	DATE	APRIL 15, 2005	DRAWING NUMBER



NOTES:

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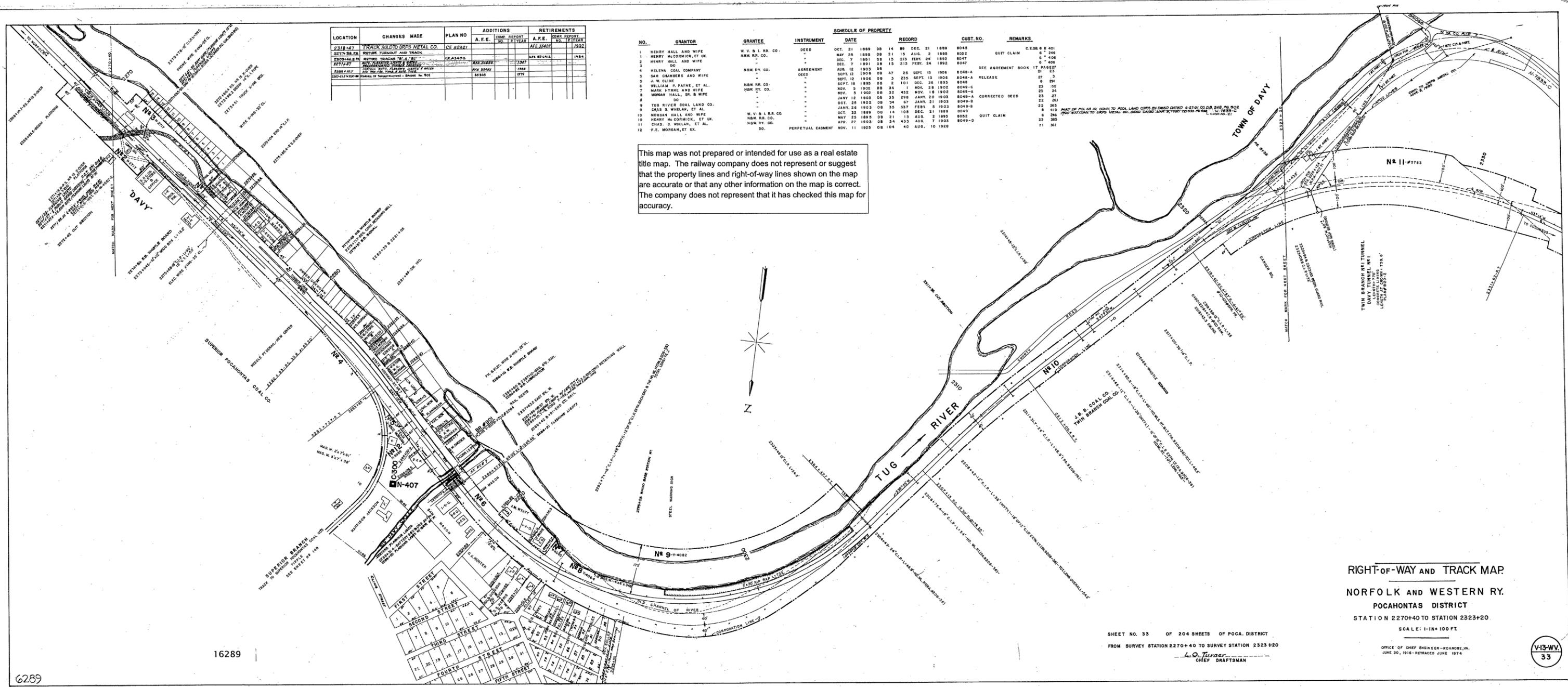
NOT FOR CONSTRUCTION

SCALE: 1" = 100'



OWNING COMPANY
NORFOLK SOUTHERN
 OPERATING DIVISION
 DEPT. OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.

PI	D/JL	7/29/05	PRELIMINARY ENGINEERING PHASE REPORT
REV	BY	DATE	DESCRIPTION
TWIN BRANCH NO. 1, TWIN BRANCH, WV			
TUNNEL CLEARANCE			
CROSS SECTIONS - 3 OF 3			
DWN	FILE NO.	16289	W/LL POST N-407.71
DWN	FILE NO.		DRAWING NUMBER
CHK	DATE	APRIL 15, 2005	



LOCATION	CHANGES MADE	PLAN NO.	ADDITIONS		RETIREMENTS	
			A. F. E. NO.	COMP. REPORT NO.	A. F. E. NO.	COMP. REPORT NO.
2318 1/2	TRACK SOLD TO METAL CO.	CE 6232			AFE 5842	1982
2270 1/2	RETIRE, TURNOUT AND TRACK					
2209 1/2	RETIRE TRACKS TO 'A' 781	CE 4347			AFE 5841	1984
2277 1/2	RETIRE TRACKS TO 'A' 781					
2288 1/2	RETIRE TRACKS TO 'A' 781					
2281 1/2	RETIRE TRACKS TO 'A' 781					

NO.	GRANTOR	GRANTEE	INSTRUMENT	SCHEDULE OF PROPERTY		RECORD	CUST. NO.	REMARKS
				DATE	DATE			
1	HENRY HALL AND WIFE	W. V. & I. R. CO.	DEED	OCT. 21 1889	DB 14 89	DEC. 21 1889	8042	QUIT CLAIM C. 608 6 2 401
2	HENRY MCCORMICK, ET AL.	N.W. R.R. CO.	"	MAY 25 1905	DB 21 15	AUG. 2 1895	8025	QUIT CLAIM 6 2 246
3	HENRY HALL AND WIFE	"	"	DEC. 7 1891	DB 15 213	FEB. 24 1892	8047	6 2 406
4	DO	"	"	DEC. 7 1891	DB 15 213	FEB. 24 1892	8047	6 2 406
5	SAM CHAMBERS AND WIFE	N.W. RY. CO.	AGREEMENT	AUG. 12 1903	DB			SEE AGREEMENT BOOK 17 PAGE 27
6	HELENA COAL COMPANY	"	DEED	SEPT. 12 1906	DB 47 23	SEPT. 13 1906	8048-A	RELEASE 27 3
7	S. W. CLINE	"	"	SEPT. 18 1895	DB 2 101	DEC. 26 1895	8048	6 2 291
8	WILLIAM P. PATNE, ET AL.	N.W. RY. CO.	"	NOV. 5 1902	DB 34 1	NOV. 26 1902	8048-C	23 30
9	MARK HYRRE AND WIFE	"	"	NOV. 5 1902	DB 32 432	NOV. 18 1902	8049-A	23 24
10	NORMAN HALL, SR. & WIFE	"	"	JAN. 12 1903	DB 35 228	JAN. 20 1903	8049-B	23 27
11	DO	"	"	OCT. 25 1902	DB 34 67	JAN. 21 1903	8049-B	22 281
12	TUG RIVER COAL LAND CO.	"	"	JAN. 26 1903	DB 35 337	FEB. 5 1903	8049-B	22 285
13	CHAS. S. WHELAN, ET AL.	W. V. & I. R. CO.	"	OCT. 22 1889	DB 14 102	DEC. 21 1889	8049	6 2 102
14	HENRY HALL AND WIFE	N.W. RY. CO.	"	MAY 25 1895	DB 21 15	AUG. 2 1895	8052	QUIT CLAIM 6 2 246
15	HENRY MCCORMICK, ET AL.	N.W. RY. CO.	"	APR. 27 1903	DB 34 432	AUG. 7 1903	8049-D	23 285
16	CHAS. S. WHELAN, ET AL.	"	"	PERPETUAL EASEMENT	NOV. 11 1925	DB 104 40	AUG. 10 1928	71 361

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
 STATION 2270+40 TO STATION 2323+20
 SCALE: 1-IN=100 FT.

SHEET NO. 33 OF 204 SHEETS OF POCA. DISTRICT
 FROM SURVEY STATION 2270+40 TO SURVEY STATION 2323+20
 L. O. Turner
 CHIEF DRAFTSMAN

OFFICE OF CHIEF ENGINEER—ROANOKE, VA.
 JUNE 30, 1918—RETRACED JUNE 1914

