VANCOUVER ISLAND RAIL CORRIDOR (VIRC)

VANCOUVER ISLAND RAIL CORRIDOR
UPGRADE PLAN ASSESSMENT-2014

For:

BC Ministry of Transportation and Infrastructure

December 13, 2014 *Documents ID:20141213MOTIBCSA*

RTC RAIL SOLUTIONS LTD.

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Contents

OVERVIEW

This assessment is based on documentation provided by the BC Ministry of Transport and Infrastructure.

RTC Rail Solutions Ltd. (RTC), was not part of and did not provide a visual inspection or other inspection or audit of the subject tracks for the purpose of this assessment.

The Vancouver Island Rail Corridor (VIRC) has been deteriorating over many years as per the provided documentation. Several reports have been established on the condition of the rail infrastructure and the required upgrade to maintain and enhance operations for economic and social benefits.

Since 2006, the Southern Railway of Vancouver Island Limited (SVI) has been operating the VIRC on behalf of the Island Corridor Foundation (ICF). The SVI is a subsidiary of the Southern Railway of British Columbia Limited (SRY). It is a well-recognized railway in British Columbia.

In 2008 the SVI on behalf of the ICF identified "the need for a capital investment of $103.8 million to rehabilitate and upgrade the entire rail corridor (as per this assessment) in order to bring the track structure up to ***industry standards*** and enhance operational viability".

As per the provided documentation, "the larger renewal proposal ($103.8 million) is still considered to be the total required to render the railway sustainable in the long term" However, the BC Ministry of Transport and Infrastructure (MOTI) through a commissioned study of the railway advocated an "incremental approach". As a result the SVI developed a plan to upgrade the VIRC (Victoria Subdivision 139.7 miles and the Wellcox Spur 3.2 miles).

The plan calls for the investment of $20.9 million into the railway infrastructure, covering the track and bridgework.

This assessment **does not** include **bridgework** and therefore addresses only track upgrade funding of $15.0 million.

This viability assessment is based on "the planned" operation of the VIRC track at Class 3, as defined within the Rules Respecting Track Safety (TSR). Operating speed for Passenger Trains of 60 MPH and Freight Trains of 40 Miles per hour.

It is noted that within BC Ministry of Transport and Infrastructure "Evaluation of the E&N Railway Corridor: Baseline Reference Report", conducted June 15-17 2009, that the mainline speed had been reduced to 20mph for freight account of poor tie condition.

DEFINITIONS WITHIN THIS DOCUMENT

Industry Standards (when within this document "Industry Standards are made reference to, this is referring to railway industry leaders, such as CP, CN, BNSF, UP, CSX and other railways which through years of operational expertise have developed a set of Standards that are applied for construction and maintenance of railway track. In cases where the TSR is applicable, these standards are more restrictive.)

Rules Respecting Track Safety (TSR) – Transport Canada Regulatory Compliance for Track Safety.

The BC Ministry of Transportation & Infrastructure Evaluation of the E&N Railway Corridor: Baseline Reference Report is reference with in this document as the **BRR-2009**

INITIAL RAILWAY CORRIDOR UPGRADE PLAN – 2014 is reference with in this document as the **IRCP-2014**

RTC Assignment Overview

RTC has been assigned to determine the viability of the "Reinstatement and Long Term Viability Operations Plan" based on:

1. The ability to meet the requirements of the Rules Respecting Track Safety (TSR) for the requested Class of Track (Class 3).
2. The ability to meet the requirements of Industry Recommended Standards.
3. The constraints of the funding.

To which the final resolve will be the Safe Transportation of Passengers, Freight, the public and the environment.

Meeting the requirements of the Rules Respecting Track Safety (TSR) for the requested Class of Track (Class 3)

The Rules Respecting Track Safety are provided as the absolute minimal standard on which train traffic is allowed to operate. However, in initiating an upgrade plan where passenger traffic is to be operated at speed of up to 60 mph and freight trains up to 40 miles per hour, Railroad Engineered Industry Standards in practice must be taken into consideration.

The upgrade plan identifies its capability of addressing the minimum TSR Standards for the required class of track. However, in the interest of Safe Railway Operations, railways have developed Standards for track that exceeds the minimal "isolated" TSR rules.

In short the TSR came after the engineering of track and is based on practices of the railways, addressing those standards.

Example:

Within the Rules Respecting Track Safety (TSR) it states:

(c) Each 39 foot segment of:

Class 1 track shall have five crossties;
Class 2 track shall have eight crossties;
Class 3 track shall have 10 crossties; and
Classes 4 and 5 track shall have 12 crossties, which are not:

(1) broken through;

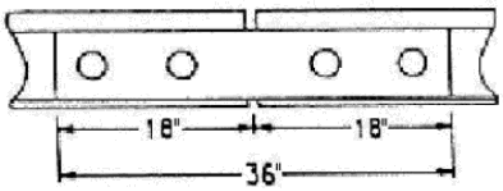
(2) split or otherwise impaired to the extent the crossties will allow the ballast to work through, or will not hold spikes or rail fasteners;

(3) so deteriorated that the tie plate or base of rail can move laterally more than 1/2 inch relative to the crossties; or

(4) cut by the tie plate through more than 40 percent of a tie's thickness.

It further stipulates specific requirements for sound ties at joints.

Classes 3 through 5



Each rail joint in Class 3 through 5 track shall be supported by at least one crosstie specified in paragraph (c) of this section whose centerline is within 36 inches shown above.

And yet further….

(b) Each 39 foot segment of track shall have:

(1) a sufficient number of crossties which in combination provide effective support that will:

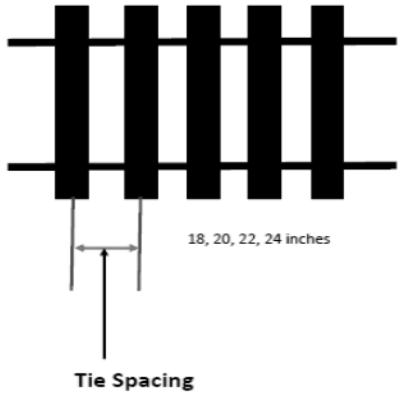
(i) hold gauge within the limits prescribed in C. 2.3;
(ii) maintain surface within the limits prescribed in C. 6; and
(iii) maintain alignment within the limits prescribed in C. 3.

(2) the minimum number and type of crossties specified in paragraph(c) of this section effectively distributed to support the entire segment; and

(3) At least one crosstie of the type specified in paragraph (c) of this section that is located at a joint location as specified in paragraph(d) of this section.

By regulatory definition, the requirements to meet Class 3 Track rules for tie condition may be met by having 10 ties that are compliant under the TSR. However, as per the TSR inserts, such ties must be able to maintain gauge, surface and alignment.

Industry Standards have established "tie spacing" for track. This "tie spacing" is the distance between each tie from the center of a tie to center of tie.



Therefore, within a rail segment of 39 feet, while the TSR states that we must have a minimum of 10 sound cross ties, it takes into assumption that one of these industry standards have been applied for tie spacing.

39 FOOT SEGMENT OF RAIL TIE REQUIREMENT					
	TSR	Industry Standard			
Tie spacing in Inches	46.8	18	20	22	24
Total Ties per segment	10	26	23.4	21.27	19.5

Tie spacing plays an important role in the ability of the track structure to support the three fundamentals of the Rules Respecting Track Safety (TSR); Gauge, Surface and Alignment.

In this situation as in others within the TSR, it defines specific isolated items that must be met based on Industry established standards.

The industry takes into consideration many factors to determine the type of track structure to be built in order to support the anticipated traffic. Passenger, freight, Commodities types, rural areas of passage, crossings and bridges are some major considerations. The combination of these will determine what standards will be applied to any one track.

We in the industry would not operate a Class 3 railway with only 10 ties per 39-foot segment of track.

TIE CONDITION AT THE VIRC

TIE SPACING

The Vancouver Island Rail Corridor (VIRC) Initial Railway Corridor Upgrade Plan – **issued July 2014** is referenced for this document.

As per the documentation provided within the BC Ministry of Transport and Infrastructure Evaluation of the E&N Railway Corridor: Baseline Reference Report, the VIRC (E&N Railway Corridor, VIRC has 22 inch spacing for ties or approximately 2880 ties per mile.

39 FOOT SEGMENT OF RAIL TIE REQUIREMENT					
	TSR	Industry Standard			
Tie spacing in Inches	46.8	18	20	22	24
Total Ties per segment	10	26	23.4	21.27	19.5
			COMMON	VIRC	

While the preferred tie spacing though out industry today is 20 inches for all track and the VIRC has 22 inch spacing, the spacing will not be detrimental to intended use of track.

Additional maintenance funding must be taken into consideration due to the tie spacing. This is particularly important in the budget planning stages of the anticipated Business Prospects and possibility of unit trains.

TIE REPLACEMENT - TRACK

A total of 110,300 ties are planned to be replaced (according the 2014 plan).

The BC Ministry of Transportation & Infrastructure Evaluation of the E&N Railway Corridor: Baseline Reference Report (BRR-2009) was conducted June 15th to June 17th 2009.

Tie Replacement not including switch Ties								
	Total Track Miles	Tie Spacing (Inches)	Total Ties in Track based on 22"	Total Ties in Track minus BRG & TRN	Total Ties to be Replaced	% Replaced	Every _ Tie Replaced	YEAR Evaluated
Plan	142.9	22	411,552	404,938	110,300	27.24%	3.7	2014
BRR-2009	142.9	22	411,552	404,938	140,000	34.57%	2.9	2009
Difference					29,700	7%	-0.8	-5.0

The BRR-2009 on an evaluation conducted in 2009, recommends the replacement of 140,000 ties. However, five years later the plan indicates that 110,300 ties will be replaced.

It is uncertain as to whether or not ties have been replaced over the last five years to reduce the number of that recommended. In theory, we would expect that the number of defective ties would rise, if ties have not been replaced over the elapsed period of time.

It must be noted that the BRR-2009 was conducted within 3 days and therefore it is expected that the required ties to be replaced was estimated rather than "counted" by walking the track.

Tie Replacement not including switch Ties								
	Total Track Miles	Tie Spacing (Inches)	Total Ties in Track based on 22"	Total Ties in Track minus BRG & TRN	Total Ties to be Replaced	% Replaced	Every _ Tie Replaced	YEAR Evaluated
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The difference between the two evaluations, given the time period is significant. Ties installed within the five year difference should be assessed.

If there were no ties replaced within the five year period or insignificant amounts to note, it is expected that the number of ties required would rise.

Tie counts in curves should be noted separately and as per the recommendations of BRR-2009 and given the requested Class 3 Track (40mph fright and 60mph Passenger) number 1 hardwood ties should be used. (This is an industry recommendation and NOT a TSR rule).

Based on the INITIAL RAILWAY CORRIDOR UPGRADE PLAN – 2014 – tie replacement plan and the BRR-2009 recommendations, the discrepancy is great enough to review the tie counts.

Given the provided information, a definitive closure to the feasibility of tie replacement is not possible. However, serious concern is warranted.

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TIE REPLACEMENT - TURNOUTS

The Upgrade Plan indicates that there are 43 turnouts (switches) on the system.

The BRR-2009 indicates that the turnouts are in fair to good condition. It states that most of them are 90lbs and 85lbs with some new 115lbs. There is not specific information on turnout size or how many of each.

The BRR-2009 does indicate that all turnouts are restricted to 10mph. No specific reason(s) is provided as to why.

The IRCP-2014 plans to replace 974 ties in the turnouts (10,927 linear feet).

Bill of Ties for one Turnout					Total Turnout Ties System	
Length		Number 9	Linear	Total	Total	Total
Meters	Feet/Inches	Turnout	Feet	Turnouts	Ties	L. Feet
2.80	9'-0"	19	171	43	817	7,353.00
3.10	10'-0"	10	100	43	430	4,300.00
3.40	11'-0"	7	77	43	301	3,311.00
3.70	12'-0"	6	72	43	258	3,096.00
4.00	13'-0"	6	78	43	258	3,354.00
4.30	14'-0"	6	84	43	258	3,612.00
4.60	15'-0"	6	90	43	258	3,870.00
4.90	16'-0"	8	128	43	344	5,504.00
Total Number of Ties		68	800		2,924.00	34,400.00
IRCP-2014 Tie Replacement Plan					974.00	10,927.00
		Difference Numbers			1,950.00	23,473.00
		Difference Percentage			33.3%	31.8%

The chart above provides information in relation to a Number 9 (*turnout size*) turnout. The chart is a comparative look at what is expected to be in track based on a Number 9 (*turnout size*) turnout, since information relating to each turnout size is note provided with in the documents.

Based on the 43 turnouts the chart information may have an error of 5% or 3.4 ties per turnout for a total of 146.2 ties for the system. This margin of error is relative to turnout length (turnout size) and required ties.

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Since there is insufficient information on each turnout, other than total ties being replaced and BRR-2009 indicating that turnouts are in fair to good condition, tie conditions or replacement rate of ties for turnouts may be considered as part of the reason for the system 10mph slow order, for turnouts.

Rate of Replacement	
Total Number of Switch Ties System	2,924.00
Total Ties to be replaced as per IRCP-2014	974.00
Total Turnouts in System	43
Total average number of Ties being replaced on each Turnout	**22.7**
Total Ties per Turnout based on a Number 9 Turnout	68
Total Compliant Ties within each turnout	45.3
Percentage of replacement	33.31%
Tie replacement rate in track is every third tie.	3.0

However, taking into account that the majority of the turnouts have been identified as 85lbs and 90lbs, it is anticipated that other factors, surface, rail and components may be primary concerns for the speed reduction (slow order).

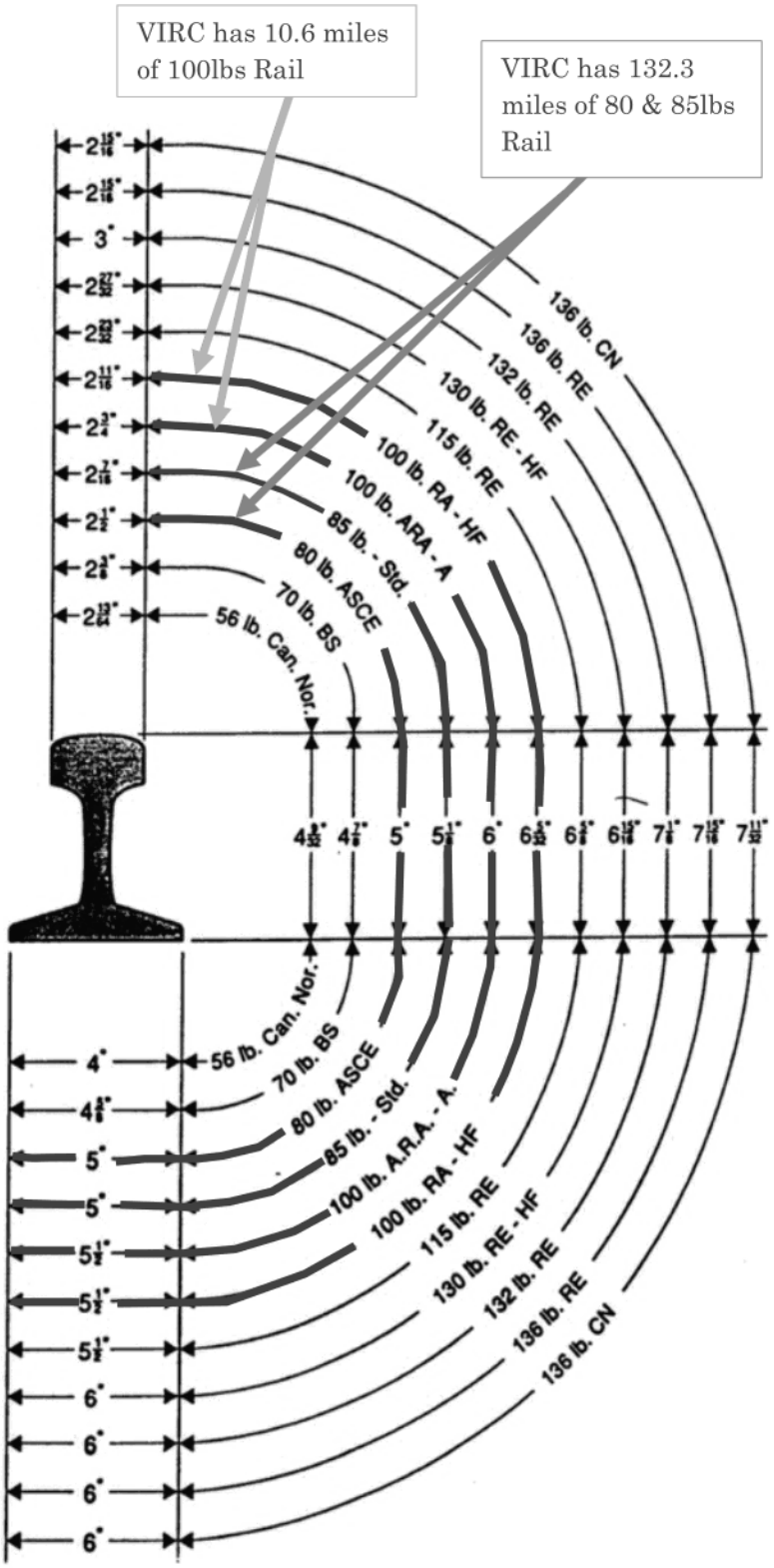
It is significant to note that the track has been slowed to 20mph and that the turnouts have been reduced yet further to 10mph, indicating great issues than that on track.

There is no contingency or plan within the IRCP-2014 to address rail and components needs for turnouts.

Rail

Rail is one of the most important and most expensive individual items on all railways.

The VIRC is equipped with the one of the smallest and lowest grade Railway Industry Standard rail available.



Rail	Track Miles	Track Feet	Linear Feet	Percentage
Total Rail in Track - Mainline	142.9	754,512.00	1,509,024.00	100.0%
100lbs Rail	10.6	55,968.00	111,936.00	7.4%
80lbs and 85lbs Rail	132.3	698,544.00	1,397,088.00	92.6%

The rail weight or size of rail is extremely significant to the IRCP-2014 to enable business opportunities in freight and more specific coal as indicated within the document. Additionally, Class of track considerations must be taken into account when 80lbs and 85lbs rail is in place.

The carload capacity as per BRR-2009 at the VIRC is limited to 263,000lbs. This is significantly lower than mainland freight car loads of 286,000lbs.

In order to increase the freight car load the 80lbs and 85lbs rail should be replaced to prevent rail break and ultimately derailment. To operate freight trains and passenger trains at Class 3 Track with speed of up to 40 mph freight and 60 mph passengers is not advised.

Under the Rules Respecting Track Safety (TSR), operating at Class 3 speeds on 80lbs and 85lbs rail is not restricted, nor classified as a defect. Under 5.2(b) the only requirement is to provide a Rail Flaw Inspection;

(b) In the case of Class 2 track where Passenger trains are operated, track must be inspected at least annually with a Rail Flaw detector

However, overall Industry Standards must take precedence in certain circumstances where the risk of operations on track structures, based on components is not recommended, has been amended by industry due to identified high risk factors leading to derailments.

As an example:

In industry today, Yard Tracks or Industrial Tracks facilitate the movement of rail cars to load and unload commodities within and confined rail yard or spur.

Under the TSR, 6.1(a) the maximum authorized speed is 15mph.

6. Yard Track - Inspections

6.1 General

(a) Maximum track speed on a yard track is 15 mph.

Industry leaders have set standards that tracks being serviced in Yard Tracks or Industrial Tracks that are of new construction or require upgrade must be built with not less than 100lbs rail.

Larger rail in combination with heaver components (tie plates, more spikes) required to support the rail provides great stability to forces of passing trains.

For passenger trains, 85lbs rail supports the weight of the passenger cars without issue. However, weight in this case is not the primary factor, it is speed.

As per BRR-2009 joints will not stay up due to rail end batter. In conditions where rail end batter is present, high speed is particularly high risk due to continuous pounding of car wheels on Joints. This action contributes to joint bar breakage and creates an extremely uncomfortable ride for passengers, to a point where standing in a car may be difficult.

The photo below is NOT taken at the VIRC and in this case the rail is 100lbs. However it demonstrates the effect of joints with batter that will not stay up.

In many cases, where rail is older and smaller, the only way to correct this issue is to cut out (crop) the end of each rail. Surfacing track and rail in this condition will not resolve the issue.

It is well to note that the severity of the battered rail ends at VIRC is not known. However, such conditions must be taken into consideration for the safe passage of trains and determination of speed.

Operating at Class 3 speed (40 mph Freight and 60 mph Passenger) as per the request within these documents is the primary focus and risk. Speed is the worst enemy of light rail even when the track structure is in excellent condition.

Rail wear is not addressed within these documents but must also be taken into consideration for rail replacement. Maximum rail wear is established by each railway as a standard, under direct requirements of the TSR. These standards for the VIRC were not available within these documents. None-the-less, rail wear measurements are also not available.

The IRCP-2014 does not have funding with in the plan to address rail end battered, rail wear or replacement of rail.

It is expected that a substantial amount of funding will be required for rail to operate safely.

Based on the potential of business opportunities within these documents, 80lbs rail and 85lbs rail would have to be replaced to accommodate traffic volumes and car load weights. Provided below is an overview of potential costs for **rail only**. *These dollar amounts are estimated and are provided as reference only. (Wellcox Spur not accounted for)*

Total Mainline Track Miles	139.7
Track with 100lbs Rail	10.6
Total rail replacement in Miles	129.1
Total rail replacement in Linear Feet	1,363,296.0
Estimated cost of 115lbs Rail per foot	$28.00
Total Rail Cost - Material Only	$38,172,288.00

Class 3 track enables a passenger train to travel at speeds of up to 60 mph and freight trains up to 40 mph.

Based on the information provided with in these documents, in relation to rail, the potential risk of derailment is extreme for all trains traveling at these speeds.

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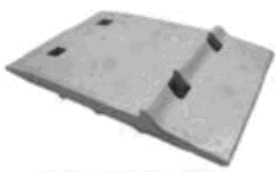
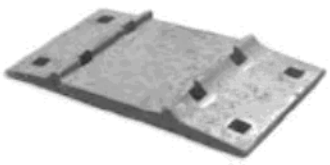
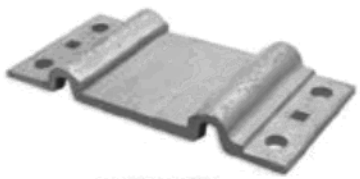
TIE PLATES



Single Shoulder Plate



Double Shoulder Plate



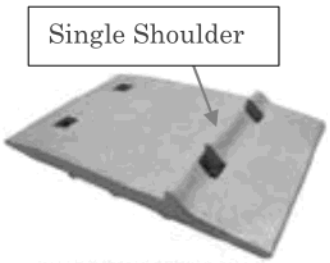
Pandrol Plate

Tie plates provide support for the rail seat to counter forces of trains adding stability to the track, length of life of a wood tie and provide uniform wear on the rail head.

There are many type of tie plates in the industry in some cases specifically designed to meet a specific need of a railway.

As per BRR-2009 tie plates on the VIRC are typically single shoulder. The shoulder on the tie plates provides support to lateral loading of passing trains. However there is no support on the low side of the plate for the lack of a shoulder. This transfers all forces to the spike(s) trying to hold the rail from rolling over.

Single shoulder tie plates are generally no longer used and where they are in place, are removed in tie replacement programs.



Single Shoulder Plate

As per the Rules Respecting Track Safety (TSR)

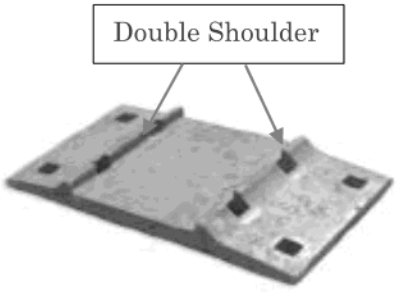
VI. Tie Plates

In Classes 3 through 5 track where timber crossties are in use there must be tie plates under the running rails on at least eight of any 10 consecutive ties.

The tie plates presently in track meet the requirment of the rule.

However, again in Industry Standards, the minumum requirement is double shoulder.

A double shoulder tie plate provides support on both sides of the rail, high and low. Double shoulder tie plates are about 60% larger than a single shoulder tie plate. This translates into added support for carloads and train forces.



Double Shoulder Plate

The BRR-2009 recommends that single shoulder tie plates be replaced with double shoulder tie plates where ties are replaced. However, if replacements cannot be found, then such plates will not be replaced. *These dollar amounts are estimated and are provided as reference only*

Total ties being replaced	110,300
Total plates required	220,600

Estimated cost per plate	$5.00
Total Estimated Cost for material	$1,103,000.00

Single shoulder tie plates will not be able to support anticipated traffic volumes going into the future.

Operating at Class 3 speed with single shoulder tie plates is not recommended. The risk of derailment, especially, on curves is extremely high.

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ANCHORS

Unit Channel | Unit Wrench-On | Improved Fair

The BRR-2009 indicates that the anchor pattern on the VIRC is inadequate or non-existent.

The BRR-2009 report recommends box anchoring every third tie where trains may operate. It further states that there is no evidence of rail creep, at the time of the report.

Consideration must be given to traffic volumes today, as reason for the lack of rail creep and such consideration must take into account the proposed business plane to increase rail traffic volumes into the future.

Rail anchors are vital to ensure that rail creep does not occur. This is especially important on grade (hills) approaches to bridges and turnouts. Rail creep can lead to derailment of trains.

The Rules Respecting Track Safety stipulate that:

VII. Rail Anchoring

A sufficient number of anchoring devices will be applied to provide adequate longitudinal restraint.

While at this time it is confirmed in two reports that rail creep is not occurring, as per above it is highly expected that increased traffic will promote rail creep. *These dollar amounts are estimated and are provided as reference only.*

Total Ties in Track *including Wellcox Spur*	411,552
Box Anchoring every 4th Tie	411,552

Estimated cost per plate	$2.50
Total Estimated Cost for material	$1,028,880.00

There are no budgetary provisos within the IRCP_2014 for the application of rail anchors.

Industry Standards require the anchoring of all track at a minimum of every forth tie.

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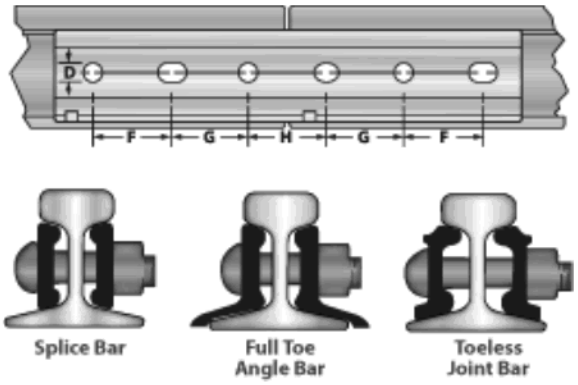
JOINT BARS



9000 Full Toe Angle Bars are being replaced. This is represented of all remaining joint bars in track.

Joint Bar Total	35,067

TRACK BALLAST

Track Ballast is the backbone of track component support.

Ballast provides support to restrain the track (ties and rail) under load of passaging trains. While ties, rail, tie plates, spikes and anchors all play vital rolls in component stability, ballast plays the crucial role of stabilizing the track.

The Rules Respecting Track Safety (TSR) stipulates;

I. Ballast: General

Unless it is otherwise structurally supported, all track must be supported by material which will:

(a) transmit and distribute the load of the track and railroad rolling equipment to the subgrade;

(b) restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by railway rolling equipment and thermal stress exerted by the rails;

(c) provide adequate drainage for the track; and

(d) maintain proper track cross-level, surface, and alignment.

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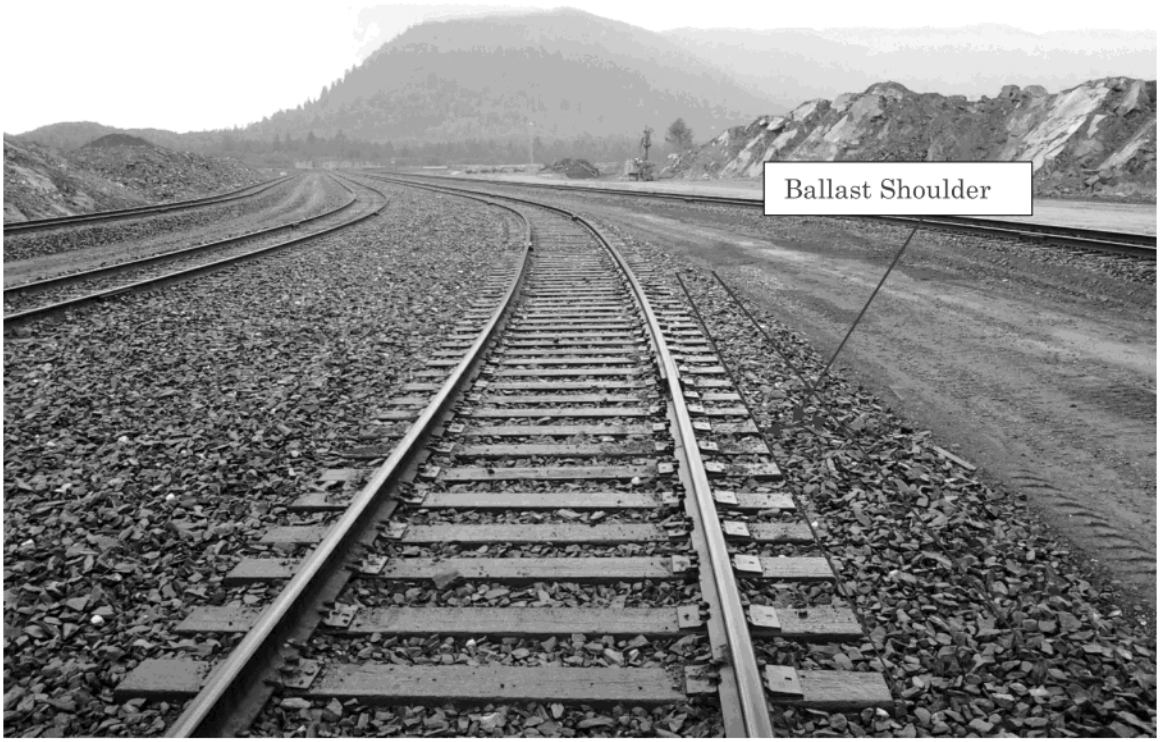
Newly constructed Class 2 Track to handle coal trains



The BRR-2009 report indicates that the ballast through the VIRC is contaminated pit run ballast with a proportion of large round rock (2" to 4").

Recommendations are made to provide crush rock at a rate of 480 to 600 cubic yards per mile. This amount is required to facilitate the replacement of the track shoulders to improve drainage and replace lost ballast from tie change out.

The IRCP-2014 plan is providing an average lift of two inches for both the Victoria Subdivision and the Wilcox Spur. However, it is not taking into consideration the required ballast to improve drainage.

As part of this improvement, the result of replacing the track shoulder would also remove vegetation from the track. *These dollar amounts are estimated and are provided as reference only.*

	Cubic Yards		IRCP-2014 - PLAN	Difference	
Total Recommended Ballast Per Mile	480	600	311.01	480	600
Total Track Miles	142.9	142.9	142.9	142.9	142.9
Total Cubic Yards	68,592.0	85,740.0	44,443.3	-24,148.7	-41,296.7

Price Per Cubic Yard	$25.42	$25.42	$25.42	$25.42	$25.42
Total Cost of Ballast Only	$1,743,608.64	$2,179,510.80	$1,129,749.42	-$613,859.22	-1,049,761.4

Average between the two $	$1,961,559.72	$1,129,749.42	-$831,810.30
Average Cubic Yards	77,166.0		

The chart above provides a review of the ballast recommendations and that, which was provided by the IRCP-2014-plan. The plan does not sufficiently fund the recommendations. It is important to supply sufficient ballast to hold the track structure and provide adequate drainage.

Ballast Lift 2 Inch Average	Required for 2" lift	IRCP-2014 - PLAN	Difference
Miles	142.9	142.9	0.0
Cubic Yards	37,259.90	44,443.3	7,183.4
Price Per Cubic Yard	$25.42	$25.42	0.0
Total	$947,146.66	$1,129,748.69	182,602.0

The IRCP-2014 stipulates that an average of a two inch lift will be provided as per the chart above, ballast is adequately provided within the plan.

Providing a minimum lift without addressing the shoulders is not recommended. With the proposed business plan, the ballast shoulder will have to be addressed.

Further, the requested Class of track must meet specific super elevation (banking of the track) standards to maintain the requested speeds. This requirement is not addressed within the documents provided.

This is important, as should curvature required additional super elevation to maintain the required speeds than additional ballast will be required.

The ballast volumes may be dramatically increased if the present super elevation is insufficient for class three track.

This should be addressed to determine the necessity and if so, required additional ballast volumes.

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CROSSINGS

There are 104 signalized crossing between Victoria and Courtenay. The BRR-2009 report provides some detail into the concerns and potential safety hazards of the crossings.

As per the report, 10 new crossing signal systems have been installed and a few older crossings upgraded. (Numbers are not provided).

The report spotlights the following as areas of concern:

The crossing equipment presently in place is dramatically out of date to a point where some parts are no longer manufactured. In general, the report identifies the equipment as antiquated and in need of update to maintain the safe passage of trains and the public.

A serious safety issue noted is the old rusty rail and fouled ballast. These items, isolated and combined, can cause poor shunting and train detection. This could result in a train approaching a crossing without notification (lights, bells and gates (where equipped) will not turn on) to the public of its approach.

Given the many crossing and public interaction, a train traveling at Class 3 speeds would be of great concern and present extreme high risk.

Crossing Sight Lines are poor at many locations (no numbers provided). "In some cases, sight lines are so restricted, that motorists have to be almost on the track before they can see an oncoming train".

"In more rural areas, uncontrolled vegetation growth on the right of way is blocking the sight lines."

"In urban areas of Nanaimo and Victoria the right of way is very narrow and buildings often block sight lines."

The report notes that a great effort has been made to maintain the equipment as best as possible. However, it states, "in many cases it (the equipment) has reached the end of its service life and needs to be upgraded or replaced."

As per the document before any additional traffic and prior to Passenger Trains, each crossing should be assessed for Transport Canada Grade Crossing Standards.

Recently Part C of these standards has been updated and includes:

- 5. Grade Crossing Surface
- 6. Road Geometry (Grade Crossings and Road Approaches)
- 7. Sightlines
- 8. Signs
- 9. Warning Systems Specification

The IRCP-2014 plan makes no concessions for the rehabilitation crossings with the upgrade budget. However, the SVI has stipulated that "necessary maintenance expense funds are allocated as part of the 10 year operating financial plan and budgeting as required in order to continue the maintain all level crossing signal systems in a safe condition and in compliance with the applicable regulatory standards."

No further information is provided.

It is high recommended that this funding be reviewed to allow for the recently updated standards.

There should be a budget allocated for the review of all crossing and their ability to meet standards prior to any other track work being performed. A clear funding scope should be devised to understand the true cost of these upgrades.

Crossings may be protected by slowing train traffic to ensure that safety is maintained. However, given the number of crossing on the VIRC, this is impracticable. In the case of passenger trains, schedules would be greatly influenced.

Crossings are a vital part of the infrastructure and high risk area of operations for train traffic and the general public.

Based on the information provided with in these documents it is highly unlikely that sufficient funds are available to deal with both signals, crossing sightlines and the new standards.

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VEGETATION / CULVERTS / DRAINAGE

Water is the number one enemy of any track structure.

Vegetation retains water, water promotes vegetation, which contaminates ballast, promotes tie rot, creates surface defects, increases joint pumping, and increases the probability of rail and joint failure through soft grade and low joints.

The BRR-2009 report identifies vegetation as a major concern.

"The vegetation conditions are considered to be in contravention of the rules"

The IRCP-2014 does not provide specific funding for rectifying this condition under the proposed funding.

However, the SVI has stipulated within the IRCP-2014 that "funds are allocated, as part of the 10 year operational plan and related budget forecast for the railway, as necessary to maintain vegetation control to address all necessary track maintenance and safety issues."

It is recommended that funds be put in place to address the necessary vegetation control before other track work is initiated.

Drainage and Culvert work should also have funds and be addressed before other track work.

The BRR-2009 indicates that at least one culvert in in serious condition where a 10mph slow has been issued. It is probable that this has been corrected since the report.

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SCHEDULES

Refer to: Appendix 1

The condition of the track structure has great influence on the ability of any train being able to maintain a schedule.

In determining the ability of a train to meet the requirements of a schedule and assigning a class of track, the specific components must be taken into consideration.

A review of the Proposed Passenger Schedule for Monday to Friday and Saturday – Sunday – Statutory Holidays indicates as per the IRCP-2014 plan that Class 3 Track is required to meet the schedule.

The Monday to Friday runs from Victoria West to Nanaimo will, according to the schedule, take two hours and twenty-nine minutes. The average speed of the trip will be 29.23 mph. This will include all necessary scheduled stops.

The Saturday, Sunday and Statutory Holiday runs from Victoria West to Courtenay will, according to the schedule, take four hours and twenty minutes. The average speed of the trip will be 29.23 mph. This will include all necessary scheduled stops.

While the average speed is 29.23 mph, in certain areas of the track, the train speed must increase speed to 42 mph (in one area for 8.4 miles) to maintain schedule. This is a constant situation throughout the runs VIRC.

The schedule as per the IRCP-2014 clearly indicates that Class 3 track must be sustained to make this a viable venture.

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DOCUMENTATION OVERVIEW

DOCUMENTATION OVERVIEW

Accuracy of information provided

Document: BC Ministry of Transport and Infrastructure - Evaluation of the E&N Railway Corridor: Baseline Reference Report.

This document is dated.

This evaluation was comprised with documentation dated back to 2003, 2004, 2005, 2006, 2007 and 2009. An inspection conducted by hi-rail of 142.9 miles of track, plus one yard, was initiated in 2009 by the authors over a period of three days, to help compile the evaluation.

This leaves a large gap between the evaluation and the intended project start date of 2015 (5 years). Given the state of the track structure and deterioration at the time of evaluation, it is expected that the structure, if not effectively maintained over that period of time (5 years), has entered into a state of greater disrepair.

This was made evident in March 2011 when VIA Rail passenger service was ceased due to deteriorating track conditions and the inability of the rail operation to maintain train speeds.

Document: Vancouver Island Rail Corridor (VIRC) – Reinstatement and Long Term Viability Operational Plan June 2012.

And

Document: Vancouver Island Rail Corridor (VIRC) – Initial Railway Corridor Upgrade Plan 2014.

Both documents are consistent with the amount of funding request.

CONCLUSION

RTC Rail Solutions Ltd. was retained to review the associated documents and provide a conclusion based on facts, in combination with the Rules Respecting Track Safety (TSR) and Industry Leader Standards, to assess the feasibility of Vancouver Island Rail Corridor (VIRC) – Initial Railway Corridor Upgrade Plan.

RAILWAY STRUCTURE – IN TO THE FUTURE

The IRCP-20104 is based on the future potential for Freight Expansion.

The funds for the initial upgrade plan is a stepping-stone to forming the initial part of an overall $103.4 million plan.

As per the document "Potential for Freight Expansion" 3.1 "The primary market for freight rail service are high weight, low value commodities that are not time sensitive." The document continues to outline several new prospects "The most significant of these prospects are new customers in the coal, aggregate and forestry industries."

Increased volumes of these high weight commodities should play a vital role in consideration of Railway Industry Standards, not just meeting the minimum rules of the Rules Respecting Track Safety (TSR), for the upgrade plan. Specifically, rail, tie plates, anchors and ballast. (The safety factors of crossings are not to be diminished by these component considerations).

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MEETING INDUSTRY STANDARDS FOR CONTINUED SAFE OPERATIONS

The Initial Railway Corridor Upgrade Plan cannot support the intended rail operations at TSR Class 3, in a safe manner under Industry Standard and recommendations, **after the plan is executed**, due to:

1. **Class 3 Speed** – 40 MPH Fright and 60 MPH Passenger.
    a. The Track infrastructure is to light for operation speeds, passenger or freight.
        i. Note: Speed restriction may be applied, however the request for Class 3 operations must take into consideration the **maximum** operating speed possible.

2. **Rail** – 93% of the rail in place does not meet Industry Standards for track speed.
    a. There are no provision within the plan for any rail upgrade or replacement of defective rail if found.

3. **Tie Plates** – 93% of the tie plates in place do not meet Industry Standards for track speed. Only tie plates where ties are changed out will be replaced, if available.

4. **Anchors** – 100% of track does not meet Industry Standards for anchor application.
    a. This is a TSR related issued, that if track creep is evident at any time during operations, immediate action must be taken to correct or track must be remove from service.

5. **Ballast & Drainage** – Ballast is severely contaminated preventing adequate drainage and does not meet Industry Standards.

6. **Public Crossings at Grade & Signals** – Documentation does not adequately address public safety at public crossings at grade for Track Speed and crossing equipment deterioration.

7. **Requirements of Super Elevation** - Curves require a certain amount of super elevation (lifting the outside rail of a curve, higher than that of the inside) to accommodate track speed and maintain equilibrium (equal weight on all wheels) of railway cars and their loads, so that trains do not fall roll over. (Banking Curves). This information is not provided and must be taken into consideration.

Ultimately, when track meets the requirements of the Rules Respecting Track Safety, the intent of the rules must be applied with Industry Standards. It is the responsibility of the owner, operators and maintainer of the track to ensure the safety of their employees, the public and the environment.

These items as listed create serious safety concerns in the operation of the railway at the proposed Class 3 Track.

MEETING REGULATORY REQUIREMENTS

Rules Respecting Track Safety

Notwithstanding Bridge Structures (not evaluated), the proposed Vancouver Island Rail Corridor (VIRC) – Initial Railway Corridor Upgrade Plan funding is sufficient to bring the track back into compliance with the Rules Respecting Track Safety in isolated defects for Class 3 track.

However, it is pushing the limits of safety to the extreme. This review identifies specific areas of serious concern of maintaining compliant and moreover, meeting a safe level of Railway Industry Standard, for the specific class of track over any significant duration of time.

The Rules Respecting Track Safety are provided as the **absolute** minimal standard on which train traffic is allowed to operate. In short, the TSR came after the engineering of track and is based on Railway Industry Standards of the railways, addressing those standards.

Initiating an upgrade plan where passenger traffic is to be operated at speeds of up to 60 mph and freight trains up to 40 miles per hour, Industry Standards in practice today must be taken into consideration for the safety of the railway and those around it.

The upgrade plan identifies its capability of addressing the absolute minimal railway standards in accordance to the Rules Respecting Track Safety for the required class of track.

This assessment was provided by Alberto Simoes of RTC Rail Solutions Ltd.

Alberto has direct hand on expertise of railway track structures and their behaviors with 28 years on track with Class 1 Railways, branch lines, industrial railways and yards across North America.

He has held positions as a Track Laborer, Railway Equipment Operator, Track Inspector, Supervisor of Track Maintenance (Road Master), Capital Project Supervisor, Departmental Investigator and Track Inspector Trainer.

Alberto provides training for Track Inspectors, Develops and Executes RFPs, Designs, Executes and Maintains Safety Management Systems and provides Track Evaluations Reports with immediate remedial action directions for defects, through the operation of Track Evaluation vehicles.

Alberto has extensive experience working with tracks similar to the VIRC.

Railway Industry Standards for mainlines are private and confidential documents, belonging to each railway. There are no documents attached to this assessment of these standards. However, Industrial Railway Standards are made public and as reference material, two have been attached.

ID

Appendix 1

Vancouver Island Rail Corridor (VIRC)
SCHEDULES

Private and Confidential

Prepared by: *Alberto Simoes*
RTC Rail Solutions Ltd.
5909 Great Bear St.
Prince George, B.C.
V2N 6R2
Phone: 250-614-9182
Fax: 604-357-1100
Email: info@rtcrailsolutions.net
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Train Nos.	Days of Operation			Departure	From	To
398	Mon-Fri (no SH)			06:30	Nanaimo	Victoria
399	Mon-Fri (no SH)			09:15	Victoria	Nanaimo
498	Mon-Fri (no SH)			12:00	Nanaimo	Victoria
499	Mon-Fri (no SH)			14:45	Victoria	Nanaimo

Detailed Service Schedule:

Vancouver Island • Proposed Passenger Rail Schedule

Monday to Friday Schedule - No Statutory Holiday Service

	Proposed 499 Weekdays Mon-Fri	Proposed 399 Weekdays Mon-Fri	Run Time	Distance Miles	Speed Required to destination based on time (MPH)	Mile POST	STATION	Proposed 398 Weekdays Mon-Fri	Proposed 498 Weekdays Mon-Fri	Run Time	
	14:45	09:15				0.8	VICTORIA WEST*	08:59	14:29		
N	14:52	09:22	00:07:00	1.83	15.69	2.63	ESQUIMALT*	08:52	14:22	00:07:00	S
						4.9	PALMER				
O	15:03	09:33	00:11:00	5.27	28.75	7.9	LANGFORD*	08:41	14:11	00:11:00	O
	15:06	09:36	00:03:00	1.80	36.00	9.7	WESTHILLS* (Prop.}	08:38	14:08	00:03:00	
R	15:31	10:01	00:25:00	10.30	24.72	20	MALAHAT	08:13	13:43	00:25:00	U
						25	CLIFFSIDE				
T						26.2	STRATHCONA				T
	15:50	10:20	00:19:00	7.80	24.63	27.8	SHAWNIGAN*	07:54	13:24	00:19:00	
H	15:59	10:29	00:09:00	3.40	22.67	31.2	COBBLE HILL	07:45	13:15	00:09:00	H
	16:09	10:39	00:10:00	4.30	25.80	35.5	COWICHAN*	07:35	13:05	00:10:00	
	16:17	10:47	00:08:00	4.20	31.50	39.7	DUNCAN*	07:27	12:57	00:08:00	
						41.8	HAYWARD				
B	16:37	11:07	00:20:00	11.50	34.50	51.2	CHEMAINUS*	07:07	12:37	00:20:00	B
	16:48	11:18	00:11:00	7.20	39.27	58.4	LADYSMITH*	06:56	12:26	00:11:00	
O	16:58	11:28	00:10:00	6.30	37.80	64.7	CASSIDY	06:46	12:16	00:10:00	O
						66.9	S. WELLINGTON				
U						69.2	STARKS				U
	17:14	11:44	00:16:00	7.80	29.25	72.5	NANAIMO*	06:30	12:00	00:16:00	
N						77.3	WELLINGTON				N
						86.8	NANOOSEBAY				
D						95.2	PARKSVILLE*				D
						101.8	QUALICUM BEACH*				
						110.2	DUNSMUIR				
						116.8	DEEP BAY				
						126.1	BUCKLEY BAY				
						130.2	UNION BAY				
						139.7	COURTENAY*				

Run Time	02:29:00	02:29:00	02:29:00	71.70		02:29:00	02:29:00	02:29:00	Run Time
Aver. Spd	29.23	29.23			29.21	29.23	29.23		Aver. Spd
Class of Track	2	2			2	2	2		Class of Track
Total Miles at Class 3				31.00	42.76%				
Average Speed					35.81				
Class of Track					3				

****Factors of acceleration and deceleration are not calculated.

Train Nos.	Days of Operation			Departure	From	To
398	Mon-Fri (no SH)			06:30	Nanaimo	Victoria
399	Mon-Fri (no SH)			09:15	Victoria	Nanaimo
498	Mon-Fri (no SH)			12:00	Nanaimo	Victoria
499	Mon-Fri (no SH)			14:45	Victoria	Nanaimo

Detailed Service Schedule:

Vancouver Island • Proposed Passenger Rail Schedule

Saturday - Sunday - Statutory Holiday (10) Shedule

	Proposed 699 Weekends Sat/Sun/SH	Proposed 599 Weekends Sat/Sun/SH	Run Time	Distance Miles	Speed Required to destination based on time (MPH)	Mile POST	STATION	Proposed 598 Weekends Sat/Sun/SH	Proposed 598 Weekends Sat/Sun/SH	Run Time	
	19:00	9:45				0.8	VICTORIA WEST*	9:29	18:50		
N	19:07	9:52	00:07:00	1.83	15.69	2.63	ESQUIMALT*	9:22	18:43	00:07:00	S
						4.9	PALMER				
O	19:18	10:03	00:11:00	5.27	28.75	7.9	LANGFORD*	9:11	18:32	00:11:00	O
	19:21	10:06	00:03:00	1.80	36.00	9.7	WESTHILLS* (Prop.}	9:08	18:29	00:03:00	
R	19:46	10:31	00:25:00	10.30	24.72	20	MALAHAT	8:43	18:04	00:25:00	U
						25	CLIFFSIDE				
T						26.2	STRATHCONA				T
	20:05	10:50	00:19:00	7.80	24.63	27.8	SHAWNIGAN*	08:24	17:45	00:19:00	
H	20:14	10:59	00:09:00	3.40	22.67	31.2	COBBLE HILL	8:15	17:36	00:09:00	H
	20:24	11:09	00:10:00	4.30	25.80	35.5	COWICHAN*	8:05	17:26	00:10:00	
	20:32	11:17	00:08:00	4.20	31.50	39.7	DUNCAN*	7:57	17:18	00:08:00	
						41.8	HAYWARD				
B	20:52	11:37	00:20:00	11.50	34.50	51.2	CHEMAINUS*	7:37	16:58	00:20:00	B
	21:03	11:48	00:11:00	7.20	39.27	58.4	LADYSMITH*	7:26	16:47	00:11:00	
O	21:13	11:58	00:10:00	6.30	37.80	64.7	CASSIDY	7:16	16:37	00:10:00	O
						66.9	S. WELLINGTON				
U						69.2	STARKS				U
	21:29	12:14	00:16:00	7.80	29.25	72.5	NANAIMO*	7:00	16:21	00:16:00	
N		12:22	00:08:00	4.80	36.00	77.3	WELLINGTON		16:13		N
						86.8	NANOOSEBAY				
D		12:50	00:28:00	17.90	38.36	95.2	PARKSVILLE*		15:45		D
		13:01	00:11:00	6.60	36.00	101.8	QUALICUM BEACH*		15:34		
		13:13	00:12:00	8.40	42.00	110.2	DUNSMUIR		15:22		
						116.8	DEEP BAY				
						126.1	BUCKLEY BAY				
		13:42	00:29:00	20.00	41.38	130.2	UNION BAY		14:53		
		14:05	00:23:00	9.50	24.78	139.7	COURTENAY*		14:30		

Run Time	04:20:00	04:20:00	04:20:00	138.90		02:29:00	02:29:00	02:29:00	Run Time
Aver. Spd	29.23	29.23			31.62	29.23	29.23		Aver. Spd
Class of Track	2	2			3	2	2		Class of Track
Total Miles at Class 3				88.70	63.86%				
Average Speed					37.28				
Class of Track					3				

****Factors of acceleration and deceleration are not calculated.

CN INDUSTRIAL-TRACK-SPEC

ENGINEERING SPECIFICATIONS
FOR
INDUSTRIAL TRACKS

CN – ENGINEERING
OFFICE of DESIGN & CONSTRUCTION

Effective: September 12, 2011

Specifications for Industrial Tracks

Table of Contents

1.0 Foreword

These specifications are provided only as a guideline for design purposes and should not be taken as authority to construct industry trackage without prior review and approval from CN Design and Construction. This document is addressed to firms, developers and local authorities who want to construct a rail siding to an existing facility, to a green field site, including rail access to industrial parks, and to rail-truck transload facilities. The document is an especially useful guide to the Consulting Engineers and to the Contractors retained by groups/firms requiring rail access.

The specifications represent the minimum standard of construction and design for Industrial lead and service tracks and in-plant tracks. Tracks exceeding 1/2 mile in length or that are planned for speeds in excess of 10 mph or that are to handle cars greater than 70 feet in length, hazardous materials, and unit trains are subject to more restrictive specifications. Deviations from these standards, as provided for within the specifications, must have approval from the office of the CN Senior Manager Design and Construction. All other changes requested must be approved by office of the CN Chief Regional Engineer.

Please note that the information contained within this document is the property of CN, and that this information cannot be used outside of its intended purpose. CN reserves the right to modify this document at any time.

2.0 Development of Industrial Projects

2.1 Process for Industrial Track Projects

The development of an Industrial Project requiring rail service by CN can be broken into five distinct steps. These steps identify the various stages of development and levels of contact with CN.

Step 1 - Initial Contact with CN Business Development/Real Estate

The initial contact for Industries requiring rail service is the CN Business Development / Real Estate Group. The Business Development/Real Estate Group can provide assistance with site location, preliminary rail layout, rail serviceability, and shipping rates. The Business Development/Real Estate Group will consult with the CN Engineering and Transportation Departments to ensure the project is the most effective combination of location, shipping rates and serviceability.

Step 2 - Development of Detailed Design

Once the conceptual work has been completed with the assistance of CN Business Development/Real Estate, the Industry is to obtain the services of an Engineering Consultant or Rail Contractor to develop a detailed design for their facility. The development at this stage will ensure the rail portion of the project integrates with the remainder of the project and will provide sufficient details to allow CN Design and Construction to evaluate the design for compliance to CN Engineering Track Standards.

Step 3 - Submission of Detailed Design to CN Design and Construction

The detailed design drawing prepared by the Industry's consultant is to be submitted to CN Design and Construction for review. The proposed design will be evaluated against CN Engineering Track Standards, which are outlined in this document. The design will also be confirmed with CN Transportation to verify serviceability. Approval at this stage ensures the design meets requirements specific to CN. The drawings must be approved and signed and stamped by a Professional Engineer prior to submission.

Step 4 - Construction

CN forces will be involved in any work that is located on CN property. This usually involves installation of mainline turnouts, signals work, etc. It is the Industry's responsibility, along with its contractors, to ensure that construction of the project is in accordance with the project design specifications.

Step 5 - Completion

Once construction is complete and the rail facility is ready to enter into service, CN will conduct a final inspection to ensure the track is safe for rail operation. This is typically done by the local track supervisor, which can be arranged through CN Design and Construction. CN also requires a paper or electronic copy of the As-Constructed/Agreement drawing(s) for sidetrack agreement purposes and will retain a copy of the sidetrack agreement(s) for CN's records.

2.2 Contacts

Primary Contact is:

Local CN Business Development/Real Estate Manager

Name	Phone Number
Fax Number	Email Address

Local CN Design and Construction Contact

Name	Phone Number
Fax Number	Email Address

3.0 Design Standards

When designing track to serve an Industrial Facility or Lead Track, the following elements must be considered:

- Direction of Inbound and Outbound traffic;
- Car Lengths and car floor heights (if applicable)
- Loading method and capacity;
- Frequency of service
- Commodity transported.

3.1 General

1. All new construction is to comply with all CN Engineering Track Standards and appropriate regulatory requirements including those outlined in Section 4.
2. Industrial spurs or lead tracks longer than ½ mile in length must provide for a run-around track. If a spur or lead track is less than a ½ mile but does not have all switch points facing the same direction, a run-around may also be required.
3. Maximum gradient on industrial spur track is to be no greater than 2% and should be limited to 1% on lead tracks. Grades on track at locations used for spotting rail cars should be 0%, but in no case should exceed 0.2%.
4. Track shall be designed for standard gauge of 56-1/2”.
5. Minimum track centers shall be as follows:
    a. Unless physically restricted, 25' track centers should be used to provide safe working space for employees between Main and industrial spurs or lead tracks.
    b. Between industrial or yard tracks: 14 ft.
    c. Greater track centers may be required to accommodate loading of specific commodities. For example, a minimum of 25’ track centers is required at log/pole loading facilities.
6. The horizontal clearance envelope as well as the minimum distance between track centers shall be increased to account for curvature and super elevation as follows:
    a. 1” per degree of curvature of track for single track
    b. 2” per degree of curvature of track for parallel track
7. Clearance envelopes will comply with the Regulatory Requirements per Section 4.2.
8. Industrial track shall be constructed with maximum 20” tie spacing.
9. For new construction the minimum railway clearance requirements (in addition to or at least to meet regulatory requirements) will be:

Vertical: 23'-0" Nearest Obstruction (clear headway above the top of the highest rail) except:
27’-0” Overhead Wire Lines (clear headway above the top of the highest rail)

Horizontal: 8' 6" from the centerline of track to the nearest obstruction, unless otherwise provided in these specifications.

3.2 Design Process

All design work is to be reviewed by CN Design and Construction.

3.2.1 Drawings

1. Drawing submissions to CN may be in hard copy format or electronic in AutoCAD format and pdf. Six (6) copies of the design are required if they are submitted in hard copy.

2. The drawings shall be to scale (minimum scale of 1"=200' OR 1:2000) and a minimum of 11" x 17" in size. The submitted drawing shall comply with the standard format as indicated on pages 37, 38 and 39 and contain the following information:
    - Mile and subdivision of the mainline connection
    - Legal Land description of the proposed development
    - Width of the CN Right of Way
    - Plan, profile and typical cross-sections
    - Proposed top of rail grades
    - Rail Size
    - Turnout type and locations
    - Stationing will be in 100 foot increments
    - Actual mainline stationing on point of switch (PS) locations
    - Stationing for PS, clearance point, right-of-way line, and derail shall be shown, with PS = 1 + 00
    - Derail type
    - Curve data including PC/PT points, spirals (if any), and degree of curve
    - Vertical curve data, including length of vertical curve
    - Track center dimensions
    - Drainage and culverts
    - Wetlands delineation
    - Easements
    - Location of utilities
    - Location and details of fencing and gates
    - Proposed car spots, maximum car lengths and proposed maximum gross weight
    - Track length
    - Clearance envelopes superimposed on cross-section
3. A proposed schedule for completing the work shall also be included with any submission for a proposed development.

3.2.2 Approval of Material and Equipment

Both Industry and Contractor must certify that track related materials and equipment meet CN specifications.

3.3 Curves

1. Maximum curvature on industrial track should be 9° unless approved by CN Sr. Manager Design and Construction. (or equivalent curve compensation per AREMA 3.7),
2. The chord definition of curvature is to be used. Degree of Curve is defined as the angle at the center of a circular arc subtended by a 100' chord. Degree of Curve is related to radius as follows:

$$\sin(Dc/2) = 50/R$$

Where Dc = Degree of Curve and R = Radius

3. If cars are to be coupled on a curve, the maximum curvature shall be 9°. This will help prevent couplers from bypassing and cars derailing. Where the curve is in excess of 9° there must be a minimum of 30 feet of tangent track between the last car and the point of curve (PC) in order to couple cars on the section of tangent track.
4. Gauge of track on all curves will be 56-1/2".
5. The minimum tangent distance shall be at least 70 feet between reverse curves.

6. The rate of change for Vertical Curves should not be more than 1.2% per station in Sags and 1.5% per station in Summits for industrial tracks. The rate of change for Vertical Curves should not be more than 0.60% per station in Sags and 1.0% per station in Summits for lead tracks.

7. No portion of mainline turnouts is to be located in horizontal or vertical curves, spirals or within track with superelevation. Point of switch of any turnout or switch point derail not to be within twenty-five (25) feet of point of vertical curve. See Chart for minimum distances to bridges, curves, and road crossings. It is highly desired that no portion of the mainline turnout be installed closer than 100 feet to any bridge or public road crossing.

3.4 Road Bed and Ditching

1. Construction of an adequate roadbed and drainage system is the responsibility of the individual industry. The subgrade / sub-ballast / ballast structure must be designed by a Professional Engineer licensed in the state or province of the project to ensure structural capacity based upon the anticipated loading (i.e. 286,000 lb cars).
2. The drainage system shall be capable of handling the maximum expected flow of water and may not compromise the existing drainage system of the railway. Post-development flow rates to CN property must not be increased as a result of altered runoff characteristics.
3. Grading shall ensure there is adequate drainage away from the track structure.
4. Compact full width of subgrade and sub-ballast to density not less than 95% maximum dry density in accordance with Standard Proctor Density Compaction Test (ASTM D698).
5. Roadbed shall conform with Typical Cross-section as shown on page 20
    a. The top of the subgrade shall be shaped with a minimum 1:40 slope for drainage, typically each way from the centerline of the track.
    b. Embankments must have a slide slope of not less than 2H: 1V.
    c. Minimum depth of sub-ballast structure must be 12” and must extend at least 4 feet beyond the edge of ballast, unless otherwise approved by CN Design and Construction. Maintained top width shall be a minimum of 24 feet
    d. Minimum depth of ballast structure must be 6” under industrial track and must provide a minimum 6” shoulder for jointed rail or 12" shoulder for continuous welded rail. Minimum ballast depth of mainline track class 2 or higher is 12”. Particular attention must be paid to turnout locations to ensure all minimum requirements are met.
6. The width of sub-ballast on the diverging side of turnouts shall be increased to create a walkway for train service employees. The sub-ballast width shall taper from the minimum of 12’-0” up to 20’ from the centerline of the tangent side of the turnout at the end of the stock rail ahead of the point of switch, until it reaches a point that is 12’-0” from the centerline of the diverging track. The 12’-0” minimum width should be maintained away from the point of switch until either 4’ past the location of a derail or 50’ past the clearance point if no derail is installed, and then should be tapered (if needed) to minimum width of 12’-0” from centerline of the track. Tennessee law requires that a walkway be provided, which requires a sub-ballast width a minimum of 12’-0’ from track centerline be provided on one side of any industry track for the entire length.
7. Ditch profile must be designed prior to the commencement of any excavation.
8. Drainage must be given particular attention at the following places: Switches, frogs, diamond crossings, grade crossings, and other places with limited vertical and side clearance.
9. Culverts shall be Corrugated Steel Pipes, Structural Plate Corrugated Steel Pipes, Seamless Steel Pipes or Reinforced Concrete Pipes to the latest CN and ASTM Specifications and must be sufficient to withstand 286,000 lb loading. These documents

are available upon request.

3.5 Turnouts

1. Mainline turnouts must be new and comply with the current CN Engineering Standard Plans, copies of which are available from CN Design and Construction. The turnout must be of rail weight equivalent or greater than the mainline track and must be number 10 turnout or higher.
2. All turnouts within Industrial facilities may be new or second hand and must be a number 8 turnout or higher, or a number 10 turnout or higher if facility is to be serviced by six axle locomotives. Turnout rail weight must be 115RE or greater, unless approved by CN Design and Construction. Second hand turnouts must be of acceptable quality; rail may only be one spot rail, as defined in RM 1303-0. One spot rail is rail that is free of physical defects and has less than 20% of allowable head wear.
3. Industrial turnouts should be in accordance with CN Engineering Track Standard Plans. CN Sr. Manager Design and Construction may approve alternate turnout designs upon review.
4. All turnouts must have new hardwood switch ties.
5. All turnouts must be equipped with adjustable braces.
6. Second hand turnout material is not to be painted.
7. Switch stands will be of ergonomic design and can be new or second hand, and must be complete with connecting rods, targets, and reflective tips as required.
8. Frogs in other than Main Track turnouts will be either Self Guarded Solid Manganese (SGSM) or Rail Bound Manganese (RBM). Frogs in Main Track turnouts will be Rail Bound Manganese (RBM), Spring (SPR), or Flange Bearing (FB).

3.6 Derails

1. Derails must be installed:
    a. Where there is any possibility of equipment, which has been left standing on tracks other than main tracks or sidings, being moved by gravity so as to obstruct a main track or siding;
    b. On tracks on which an industry will move cars or equipment and
    c. On mining and other bulk loading facility tracks where cars are dropped by gravity toward the main or other track that is to be protected
    d. Any location where directed by CN Sr. Manager Design and Construction.
2. Hinge and sliding type derails may be used where the speed of the equipment to be derailed will not exceed 15 mph. A derail wheel crowder should also be installed where any of the following conditions apply:
    a. Derailing speed could exceed 9 mph; or
    b. The derail is installed on the inside of a curve.
3. Switch point derails must be used when speed of the equipment to be derailed could exceed 15 mph. Where switch point derails are used, adequate rail anchorage must be provided to prevent rail creep.
4. Where a private locomotive, track mobile or other car moving device is in use on industrial track, a switch point derail must be installed on the industrial track where it joins railway track. Exact locations will be coordinated with CN Design and Construction.
5. CN Regional Chief Engineer or designate will approve the derail selection for each installation.

6. The following table shall be used in selecting the appropriate derail:

Distance (Feet) in which a Free-Rolling Car will achieve the Following Speed:

Gradient (%)	**8 mph**	**9 mph**	**12 mph**	**15 mph**
0.30	1000	1280	2350	3800
0.50	485	615	1125	1805
0.75	310	395	700	1090
1.00	225	285	555	785
1.50	155	190	330	510
2.00	115	140	245	380

7. Derails must be installed so that equipment will derail away from the track being protected and shall be at least 20' beyond the 13' 6" clearance (fouling) point. Derails must be far enough behind any insulated joints to ensure that equipment derails before fouling the track circuit.
8. Hinge and sliding derails will be painted yellow, and any track equipped with a derail shall have the switch stand lever painted yellow. Proper signage shall also be erected at derail locations.

3.7 Cable Progressioners (Car Movers)

1. Must comply with clearance specifications.
2. Must have adequate lighting to ensure permanent mounted snatch blocks are visible at all times and that cables will not impede normal working activity.
3. Must be painted a conspicuous color.
4. Lockout controls must be installed on car progressioner panel to ensure no operation during switching or track maintenance.
5. Alarm system (i.e. bell, buzzer, etc.) should be integrated with start control so that a five second warning is given to personnel in the vicinity that car progressioner will be operating.
6. Standard warning sign should read “Caution: Car Puller Cables on Ground”.

3.8 Under Track Pits

1. Unloading Pits shall be designed and constructed in accordance with the provisions of the AREMA Manual, Specifications, Chapter 15, Part 8, Section 8.4 and must be stamped by a Structural Engineer Licensed in the state or province which the project is in.
2. Unsupported Running Rail
    a. No Joints in running rail shall be permitted over the pit.
    b. The top of the concrete pit walls shall be true and level to provide full bearing for the running rails.
3. Structural supporting Beams
    a. Running rails should be attached to the supporting beams at 2’ centers.

b. Welding of rails to beams is not permitted.

c. Beams should be provided with masonry plates.

d. Two anchor bolts for each masonry plate (bearing plate) should be provided.

4. The cover for the unloading pit will have to be installed flush with the top of the ties or constructed to provide minimum slopes of 4:1 from top of the ties to top of the opening and must not protrude above the rail. Both the cover and slope sections should be of metal and removable for ready inspection of rail and supports.

3.9 Material

3.9.1 Rail

1. Continuous Welded Rail (CWR) may be specified and will be laid and anchored under separate specifications per CN Engineering Track Standards.
2. For tracks handling dangerous commodities, all rail must be control cooled and approved by CN.
3. New rail, if used, shall be 115RE or greater.
4. Secondhand rail may be used in all locations except mainline switches, provided it meets the following standards:
   a. Rail lengths of 27 feet or greater are acceptable although rail less than 39 feet may not make up more than 25% of the total rail. Rails 78 foot or longer should be used through road crossing with joints no closer than 25' from each end of the crossing surface.
   b. Rail section shall be 112RE or greater U.S and **100RA or greater Canada only**.
   c. If rail of a smaller section is desired due to availability it may be used on approval from CN Sr. Manager Design and Construction.
   d. Quality must be at least 4 spot rail, meaning: Rails may have minor imperfections in line and/or surface, or minor physical defects that will not interfere with the safe use of the rail in yard tracks, industrial tracks and light density spurs.
5. Rail must be within the following limits of wear:

Section	136RE	132RE	115RE	112RE	100RA **(Canada Only)**
Maximum Loss of Vertical Height	3/8"	9/16"	1/2"	3/8"	5/16"
Maximum Gauge Face Wear	3/8"	3/8"	3/8"	3/8"	3/8"
End Batter	5/32"	5/32"	5/32"	5/32"	5/32"

3.9.2 Joint Bars

1. All rail joints must be of proper design and dimension for the rail on which it is to be applied.
2. "Skirted" or "Toed" bars are not permitted.
3. Second hand joint bars in good condition may be used; except insulated or compromise joints

which must be new in all cases.
4. All joints shall be fully bolted with rail drilling that conforms to proper dimension and design for the rail section.

3.9.3 Sub-ballast

1. Sub-ballast gradation shall be sufficient to prevent penetration of the sub-ballast into the subgrade and shall conform to AREMA Manual Chapter 1, Section 2.11.2.5.

3.9.4 Ballast (Crushed Gravel)

1. Ballast shall conform to the following gradation, or be subject to the approval of CN Sr. Manager Design and Construction (type and size may be modified slightly to meet local conditions):

Nominal Size	1-½"	1"	¾"	½"	⅜"	No. 4
% Passing by Weight	100	90 - 100	40 - 75	15 - 35	0 - 15	0 - 5

2. Upon request of CN Design and Construction, customer must provide a sieve analysis of the ballast.
    a. Provide a sample for testing by a recognized materials testing consultant.
    b. Pay for material testing.

3. Ballast to have a minimum count of particles with one or more fractured faces of 70% on each sieve size.
4. The percent of wear due to abrasion shall be less than 30% for the ballast per ASTM C 131 “A” Grading

3.9.5 Rail Anchors

1. Rail anchors are to be new or manufacturer certified refurbished rail anchors of appropriate size.
2. A minimum of 8 ties per 39 feet of track shall be fully box anchored (unless using Continuously Welded Rail or otherwise directed by CN)

3.9.6 Tie Plates

1. Recommended Tie Plate Usage found on “Turnout Return Curves and Spiking Pattern for Industrial Track” drawing, see page 33.
2. Tie plates for 5 ½” base rail to be a minimum of 12” in tangent up to a 2 degree curve, 14” greater than 2 degrees and tie cast Pandrol plated as per turnout spike pattern Page 33 greater than 6 degrees.
3. Tie plates for 6” base rail a minimum of 14” in tangent up to a 2 degree curve, 16” up to 6 degrees and tie cast Pandrol plated as per turnout spike pattern Page 33 greater than 6 degrees.
4. Tie Plates to be double shouldered with 1 in 40 cant.
5. Tie plates may be second hand provided they are not broken or damaged.
6. All ties are to be fully plated.

3.9.7 Ties

1. All ties are to be treated in accordance with the latest edition of AREMA Manual Chapter 30.
2. Timber Track Ties
    a. Track ties are to be a minimum of #2 hardwood ties. Ties should be new, however, second hand ties, of quality approved by the CN Sr. Manger Design and Construction, may be allowed if used in tangents.
    b. Track ties are to be a minimum 8'-6" in length and have minimum cross section dimensions of 6" x 8". The corners may be beveled provided a minimum 7-1/2" flat surface exists on the top and bottom.
3. Where desired or if readily available the use of concrete ties is permitted with approval by CN Design and Construction.
4. Steel ties are not to be used in industrial tracks except upon approval from CN Design and Construction.
5. Switch Ties shall be new hardwood ties, minimum 7"x9" in size with length as required per the appropriate CN Engineering Track Standard plan.

3.9.8 Hardware

1. All hardware (bolts, nuts, spring washers, etc.) shall be new.
2. Track bolts shall be of appropriate size, complete with nuts and conform to latest edition of AREMA Manual, Chapter 4.
3. Spring washers shall be of appropriate size and conform to the latest edition of the AREMA Manual, Chapter 4.

3.9.9 Track and Screw Spikes

Track spikes shall be new 6" x 5/8" square.
Screw spikes shall be new 6" x 7/8" diameter with rectangular head

3.9.10 Bumping Posts/Earthen Bumpers

1. Bumping posts shall be Hayes Type WG or HD (or equivalent) for the designated rail section.
2. Install bumping posts/earthen bumpers 10 feet from the end of track, with 10 ties in front of and all ties behind it fully anchored.
3. Due to the potential damage to rail car undercarriages, wheel stops are not acceptable for new track construction, except upon approval by CN Design and Construction.
4. A typical earthen bumper is shown on page 21.

3.9.11 Derails

1. Install derails in accordance with the appropriate standard plans, as follows:
    a. Hayes EB (Hinged Type Derail)
    b. Hayes HB (Sliding Type Derail
    c. Switch Point Derail - See Page 31
2. The correct size of derail to be used on various rail sections is as follows:
    a. Size 6: 100# (Canada only), 112 lb & 115 lb (worn)
    b. Size 7: 115 lb (new) and larger
3. A plywood or steel shim of the correct thickness with holes punched or drilled for all fasteners may be necessary under the derail to ensure the block lies flat on the top of the rail.

3.9.12 Bonding and Track Grounding

1. At any location where flammable commodities may be loaded or off-loaded, bonding wires and track grounding are to be provided per CN Engineering Track Standards.

4.0 Regulatory Requirements

Regulatory requirements pertaining to the design and construction of railway tracks are established at the national, state and local level. They pertain to a variety of issues such as the handling of Hazardous Materials, Pipe and Wire Crossings, Regulatory Clearances, minimum construction and maintenance requirements, and road crossings. Prior to commencing development of a project, the CN Business Development/Real Estate department should be contacted to acquire current and local information pertaining to regulatory requirements and submissions.

4.1 Pipe and Wire Crossings

Pipe and Wire crossings must be submitted for approval to CN. Detailed instructions and requirements for pipe and wire crossings are available through the CN Design and Construction contact. U.S. information is also available on the CN website:

www.cn.ca and view “quick links public issues”

The general process is as follows:

1. Submissions to CN for permission to cross the railway with any type of pipe or wire must conform to the relevant General Order or Standard. The application must be submitted to the appropriate CN contact for approval. The steps for obtaining approval for an application are as follows:

    a. Application - submit for review three (3) copies of an acceptable plan to CN with the Application Fee.
    b. Agreement - once the plans are approved an agreement will be sent outlining the agreement, costs, special conditions, and Industry’s responsibilities.
    c. Installation - installation of pipes or wires may begin once the terms and condition letter is received by CN and three (3) working days notice is given to arrange flagging protection and signals locating as required.
    d. Additional information regarding the requirements for an Application for a Pipe or Wire crossing may be obtained from CN Design and Construction.

4.2 Operating and Structural Clearances

4.2.1 Restricted Clearance Proposals

1. Requests for permanent restricted clearances require approval from the appropriate governing Regulatory agency. Any proposal for permanent restricted clearances shall be reviewed by CN Design and Construction in order to:

    a. Ensure that there is business justification for the proposed restriction and that it cannot be economically or conveniently eliminated.
    b. Ensure that the proposal is reviewed in the engineering context of structure adequacy and safety.
    c. Ensure that CN Transportation is satisfied that locomotives, railcars, and employees can safely operate past the proposed restriction.

2. Requests for approval of restricted clearances shall be submitted to CN Design and Construction and shall include the following information:

    a. Location of the facility and restricted clearance, including mile post and subdivision;

b. Location of standard restricted clearance signs;
c. Reason(s) for restricted clearance;
d. Method of operations over the track concerned (locomotive, car progressioner or gravity);
e. Need for locomotives to pass the point of restricted clearance;
f. Operations to be conducted over the track concerned;
g. Confirmation that the restricted clearance is unavoidable;
h. Nature of the restricted clearance (permanent or temporary);
i. Six (6) copies of drawing showing the relative position of the track and the obstruction, with cross sections at each point of restricted clearance. That drawing will indicate the following:
    i. Vertical clearance from the top of rail;
    ii. Horizontal clearance from the centerline of track;
    iii. Location of the "Restricted Clearance" sign.

4.3 Safety and Right of Entry

Authorized personnel working within the CN right of way must adhere to “Safety Guidelines for Contractors and Non-CN Personnel” and must be in the possession of a "Right of Entry Permit" issued by an Officer of the Railway that is only valid for the time period outlined in the document. To obtain a copy of the permit, contact CN Design and Construction. Insurance required by the “Right of Entry Permit” must be approved prior to working on CN property.

4.4 Certification and Training

Contractors working on or near CN property must present proof that all personnel have completed the required training. All contractor personnel must also complete safety and security training per CN Police and Risk Management requirements (including Erailsafe.com).

CN Training requirements are:

U.S.	FRA On-Track Worker Safety E-Railsafe
Canada	Contractor Safety Orientation Canadian Rail Operating Rules (CROR)

Flagging will be required for all work performed by contractors within 25 feet of CN operating tracks, or where CN representative deems it necessary.

5.0 Track Construction

5.1 Site Grading

Construction of an adequate subgrade, which conforms to all submitted drawings, will be the responsibility of the individual industry. The Industry shall retain the services of a Professional Engineer to design the subgrade. The subgrade shall be designed and constructed to ensure there is adequate drainage away from the track structure.

5.1.1 Site Clearing and Grubbing

1. The contractor is responsible for the identification and protection of overhead and underground utilities at the site, including the portion of CN right-of-way affected by the

construction.

2. The Contractor shall clear all vegetation and brush (except for trees and shrubs which are to be preserved, as indicated on the drawings), rocks, expansive soils, and other similar objectionable materials from the project site, including the portion of CN right-of-way affected by the construction. The contractor is responsible for the safe and appropriate disposal of materials removed.

5.1.2 Embankment Construction

Embankments shall be constructed and compacted to the lines and grades set forth in the submitted drawings. If the quantity of materials required for construction of embankments is in excess of the quantity of material removed from excavations.

Additional material may be obtained by widening cuts in the grading area, with the approval of CN Design and Construction; cuts shall be widened in such a manner as to:

a. Be stable
b. Provide adequate drainage for the cut slope and roadbed
c. Provide adequate protection against erosion
d. Adequately permitted by governing authorities.

5.1.3 Moisture and Density Control

Unless otherwise shown on the Drawings, embankments and those portions of cut sections designated, shall be constructed with moisture and density control. The moisture content of the soil at the time of compaction shall be at the optimum moisture content plus or minus four (4) percentage points of the optimum moisture content as determined by ASTM specification D 698.

5.1.4 Erosion Control

A seed and fertilizer mixture, in compliance with local, state/province and federal specifications, shall be applied so as to provide adequate erosion control and slope protection. Creeping grasses shall not be used. Additional erosion control methods, such as the use of Jute fabric or geo-textiles, or silt fence shall be applied to ensure the long-term integrity of slopes and embankments, as required.

5.2 Sub-ballast

1. Sub-ballast material may be placed once the finished subgrade is inspected. It shall be placed, using methods that do not lead to segregation or degradation of material.

2. Place material to full width of section in uniform layers not exceeding 12" thickness and compact to specified density.
3. Compact full width to density not less than 95% maximum dry density in accordance with Standard Proctor Density Compaction Test (ASTM D698).
4. Control
    a. Representative samples should be taken for laboratory tests to approve its quality and nature prior and/or during its use.
    b. Finished sub-ballast surface to be within ½" of design elevations but not uniformly high or low.

5.3 Use and Handling of Track Material

5.3.1 Timber Track Ties

1. Line the end of the track ties true on one side of the entire length of the track. All ties are to be installed at right angles to the rail.
2. Treated ties must not be handled with any tool having sharp points that will penetrate beyond the depth of the treatment, or cause damage to the ties.
3. When ties are re-spiked, the spike holes must be plugged.

5.3.2 Rail

1. Use rail saws and rail drills only for cutting and drilling rail respectively. Rail having cuts or holes made with an oxy-acetylene torch or an electric arc must not be used. When sawing rail for re-use, saw cut must be made at least 4" from any torch mark on the rail.
2. Rail must be handled carefully at all times. It should be unloaded by use of a crane, skids or threader and must not be dropped. Rail must not be struck with a steel hammer or similar tool.
3. Expansion space between rail ends, when laying bolted rail or track panels, must be provided. Fiber, hardwood or metal shims may be used to obtain the proper expansion space by bringing rail ends squarely together against the expansion shims. Expansion shims must not be removed until the rail is properly spiked, the bolts tightened and rail anchors applied. Expansion space should conform to the following:

Expansion Gap Inches	33 ft. Rail Temp. Degree F.	39 ft. Rail Temp. Degree F.
5/16	Below 10	Below 6
¼	10 to 14	6 to 25
3/16	15 to 34	26 to 45
1/8	35 to 59	46 to 65
1/16	60 to 85	65 to 85
0	Above 85	Above 85

4. Where the length of rail being laid is in excess of 78', rails 39' or less in length shall be laid on each side of non-bonded insulated joints, turnouts and railway crossings at grade.
5. Lay second hand rail in the same position it occupied before removal from the previous track so that the gauge side remains the gauge side.
6. All installations shall be designed using the same rail section throughout, if possible. Use compromise rails, compromise welds or compromise joints to join rails of different sections.

7. Rail joints on opposite rails shall be staggered by at least 12 feet. Rail joints must not be placed in road crossings if possible.
8. If Continuous Welded Rail (CWR) is used, ensure that it is destressed before placing the track into service and that Neutral Temperature of 105 degrees F has been achieved, unless the track is north of Duluth, MN. or in Canada, where the neutral temperature is 100 degrees F.
9. Anchor rails immediately after installation or proper destressing.
10. Place joint bars and tighten bolts before spiking the rail.
11. Tighten bolts in the rail joints in the following sequence:
    a. The two bolts at the center of the bar,
    b. The second bolt from the end of each rail,

c. The third bolt from the end of each rail.

12. Tighten bolts to the following torque:

Size of Bolt	Torque (ft-lb)
1"	490
⅞"	375

13. Gauge of track after laying must be uniform and within 1/8” of design.
14. Where new rail adjoins second hand rail the maximum mismatch shall not exceed 1/8". Where required, mismatch shall be reduced through welding, grinding or replacement of the rail.

5.3.3 Turnouts

1. Minimum 13" Tie Plates are to be used in all turnout construction.
2. Tamp turnout ties firmly throughout the entire length.
3. The turnout stock rail must be bent horizontally, as shown on the standard plan. Only standard carbon and 3HB rail, in 115 lb section or smaller, may be field bent with an approved bender. For safety reasons, under no circumstances are head hardened rails or rails greater than 115 lb to be bent in the field.
4. Ensure the switch point fits snugly against the stock rail for the entire length of the planed portion.
5. Bolt switches, frogs and guard rails fully. Provide proper washers and cotter pins for bolts as required. Lock tight nuts are recommended.
6. Switch stands must be securely bolted or lagged to the head block ties.
7. All switches must be equipped with the appropriate reflectorized target assembly (in some locations a double bladed target tip is required). Target assemblies will be properly adjusted to display green when the switch is lined for the normal route and yellow (siding/industrial) or red (main line) when lined for the diverging route.
8. Switch targets will bear 3” black numbers on the yellow target representing the track number.
9. Install switch rod bolts and connecting rod bolts, except the bolt under the switch stand, with the nut on the upper side to permit ready inspection of the cotter pin.
10. Install the connecting rod bolt under the switch stand with the head on the upper side.
11. Install cotter pins on all connecting and switch rod bolts.
12. Position the handle to be on the frog side of switch stand when the switch is lined in the normal position.
13. Ergonomically designed switch stands are to be used on all turnouts.
14. Lubricate switch stands, switch plates, connecting rod bolts and spring frogs properly after assembly.
15. Maintain the distance between the gauge side of a frog and the bearing side of the guard rail at 4' 6-⅝".
16. Fully anchor the length of the turnout as per CN Engineering Track Standards Section 3.1, to the maximum extent possible.
17. Once installed, line new turnouts for through movement and clamp or spike the switch point. Switch points shall remain clamped or spiked until inspected by a CN Track Supervisor or his designate.

5.3.4 Other Track Materials

1. Anchor rails per “Anchor Pattern for Continuous Welded & Jointed Track”, page 28.
2. Spiking on Industrial Spurs is to be done per “Turnout Return Curves & Spike

Patterns for Industrial Tracks". .

3. Spiking on Industrial Leads is to be done per "Turnout Return Curves & Spike Patterns for Industrial Tracks".
4. Spiking in Turnouts must fill all spike holes in the plate, up to a maximum of 6 spikes per plate.
5. Pandrol Plates and clips required on every other tie in curves 6 and greater.
6. Pandrol Plates will require four (4) screw spikes installed per plate.
7. Screw spikes shall be 6" x 7/8" diameter with rectangular head.

5.4 Lifting, Lining, and Surfacing

5.4.1 Distribute Ballast

1. The Contractor is cautioned that damage caused by his equipment to track and turnouts during the distribution of ballast will be repaired by the Contractor at his expense.
2. Lifts in excess of 6" are prohibited.
3. Care must be taken to protect signal appliances during track surfacing operations.

5.4.2 Lifting

1. Raise all tracks and turnouts with the ballast to provide a minimum depth of 6" from the bottom of the tie to top of sub-ballast or to a depth directed by the Engineer.
2. Use tamping machines or other mechanical tamping equipment to tamp the ballast.
3. Tamp both sides of ties from a point 16" inside each rail to the end of the ties.
    a. Tamp inside and outside of the rail simultaneously.
    b. Do not tamp at the center of the ties between the inside limits stated above.
4. Tamp turnout ties firmly for 16 inches on either side of the mainline and turnout rails.
    a. Tamp by hand the areas under the frog, guard rails, and heel castings, using bars or mechanical hand tampers
    b. Hand tamping to be permitted only where power or mechanical tamping is not possible.

5.4.3 Lining

Line all track and turnouts to conform to the approved drawings.

5.4.4 Dressing

Dress the ballast to conform to the ballast sections as shown on attached standard drawing "Typical Cross Section Detail".

5.4.5 Surfacing

Bring track to a uniform gradient with corresponding cross-level to suit the alignment.

5.4.6 Tolerances

1. Gauge: The difference between gauge measurements taken 19'-6" apart may not be more than 1/4".
2. Alignment: The maximum out-of-alignment measured from mid-ordinate of a 62' chord may not be more than 1/8".
3. Surface: The deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than 3/16".
4. Cross-level: The deviation in height from one rail to the other may not exceed 3/16".

5.5 Road Crossings

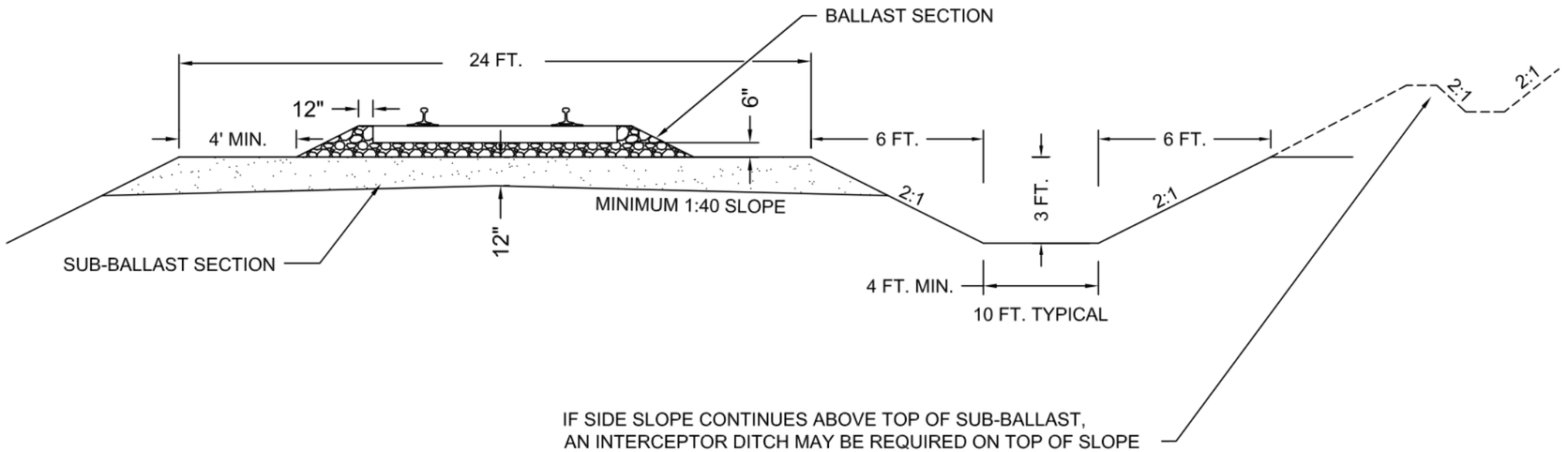
1. All new crossings shall conform to all applicable regulations.
2. All crossings shall be located clear of turnouts, switches and other track appliances.
3. Rail joints shall be kept clear of crossings and where practicable should not be located closer than 25' to the edge of the crossing.
4. Insulated rail joints at crossings shall be installed per CN Engineering Track Standards.
5. Drainage of the track at all crossings must be properly maintained at all times.
6. Crossing surface to be as follows:
    a. Only fully planked timber, concrete or solid rubber planking will be accepted. Gravel and Asphalt crossing surfaces are not permitted.
    b. Planks to be full depth of the crossing to match the height of rail. Planks shall not protrude above the top of the rail.
    c. Shim planks with shims covering the full contact area between the tie and the plank.
7. Provide a flangeway space of not more than 3" or less than 2” deep, and not less that 2 ½" or more than 3" wide.
8. Fasten timber planks with ½" x 12" crossing spikes or lag screws, with one fastening in every other tie and at each end. Countersink planks for recessing of the washer and the lag bolt head.
9. Trim the ends of the planks parallel to the road centerline. Bevel edges to prevent dragging equipment from catching on planks
10. Where the width of crossing necessitates, replace jointed rail with welded rail.
11. Crossing sightlines are to comply with all regulatory requirements.

6.0 Post Construction

6.1 Post Construction Requirements and Submissions

1. Once construction is complete, the local CN Track Supervisor must inspect the track before the facility is placed into service. The inspection can be arranged directly with the Track Supervisor or by contacting CN Design and Construction.
2. CN also requires that an agreement/as–constructed drawing be submitted to complete their records and to form the basis for an agreement for service. The preparation of this drawing is the responsibility of Industries’ Engineering Consultant or Rail Contractor. The drawing may be submitted in the same manner as the design drawing, but must include the following additional information:
    a. Track that is owned by the Industry is to be colored Green.
    b. Track that is owned by CN is to be colored Red.
    c. Complete formal name of Industry to be registered on the Agreement.
3. The electronic file (AutoCAD format) or six (6) copies of the Agreement/As-Constructed drawing are to be submitted to the Business Development/Real Estate Manager as soon as possible after construction, prior to track being put into service.

7.0 Sample Documents



TYPICAL CROSS SECTION

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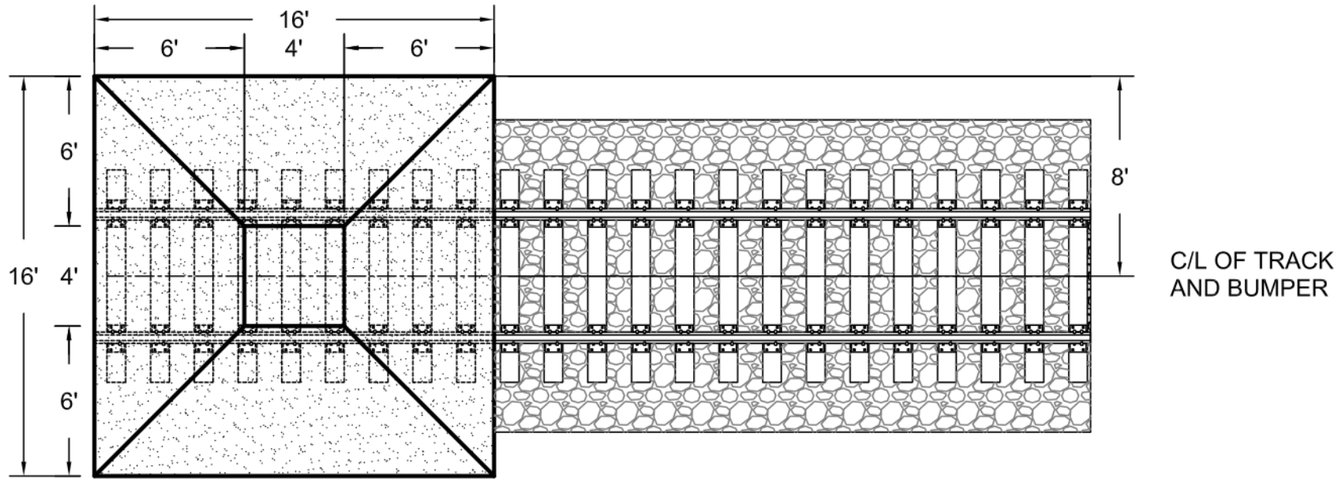
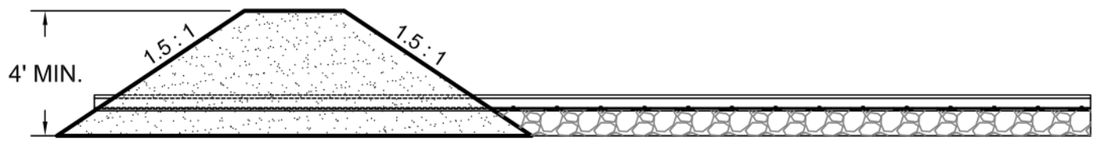
TYPICAL CROSS SECTION DETAIL





STANDARD EARTHEN BUMPER FOR END OF TRACK

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EARTHEN BUMPER DETAIL

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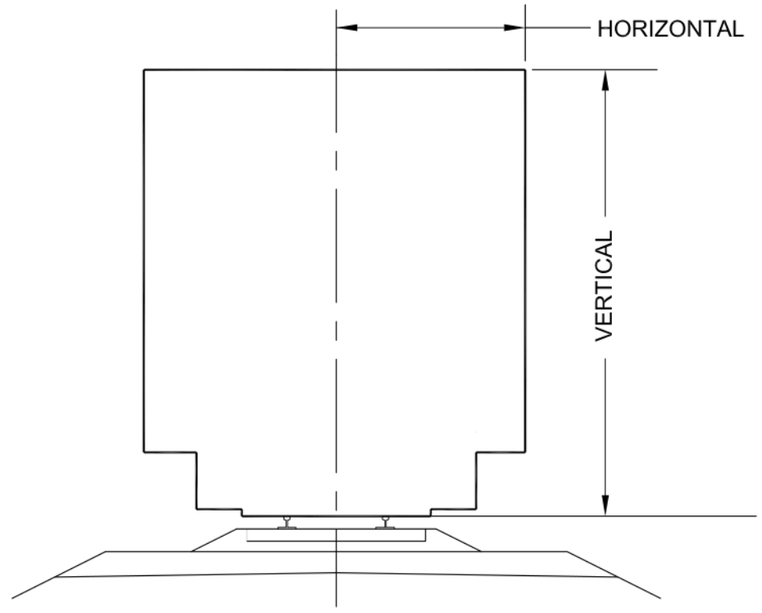
Source: Chapter 28, Table 3-3, AREMA Engineering Manual

VERTICAL													
STATES	GENERAL STRUCTURES	THROUGH BRIDGES	HIGHWAY BRIDGES	TUNNELS	BUILDING DOORS	STRUCTURES IN BUILDINGS	ENGINE HOUSES (SHOPS, SHEDS ETC.)	TIPPLES, STONE CRUSHERS, ETC.	AWNINGS AND CANOPIES	POLES, POSTS AND SIGNS	FENCES (BETWEEN TRACKS)	TELLTALE REQUIRED FOR LESS THAN MINIMUM CLEARANCE	WARNING SIGNS REQUIRED FOR LESS THAN MINIMUM CLEARANCE
ALABAMA	--	--	23' 0"	--	--	--	--	--	--	--	--	--	--
ILLINOIS	21' 6"	21' 3"	21' 6"	21' 6"	H	--	H	H	21' 6"	15' 0"	4' 6"	--	YES
INDIANA	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	21' 0"	21' 0"	21' 0"	21' 0"	--	--	--
IOWA	--	--	--	--	--	--	H	H	22' 0"	17' 0"	4' 0"	--	YES
KENTUCKY	--	--	22' 0"	--	--	--	--	--	--	--	--	YES	--
LOUISIANA	--	--	--	--	--	--	--	--	--	--	--	YES	--
MICHIGAN	22' 6"	E	E	22' 6"	22' 6"	22' 6"	22' 6"	22' 6"	22' 6"	22' 6"	--	--	YES
MINNESOTA	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	22' 0"	17' 6"	22' 0"	22' 0"	--	--	YES	YES
MISSISSIPPI	--	--	--	--	--	--	--	--	--	--	--	YES	--
NEBRASKA	22' 6"	22' 6"	23' 0"	23' 0"	17' 0"	18' 0"	E	--	--	--	--	YES	YES
OHIO	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	21' 0"	--	--	--
PENNSYLVANIA	22' 0"	22' 0"	22' 0"	22' 0"	18' 0"	18' 0"	18' 0"	--	--	--	--	--	--
TENNESSEE	22' 0"	22' 0"	22' 0"	22' 0"	17' 0"	17' 0"	17' 0"	22' 0"	22' 0"	22' 0"	--	--	--
WISCONSIN	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	23' 0"	--	YES	--

HORIZONTAL													
STATES	GENERAL STRUCTURES	THROUGH BRIDGES	HIGHWAY BRIDGES	TUNNELS	BUILDING DOORS	STRUCTURES IN BUILDINGS	ENGINE HOUSES (SHOPS, SHEDS ETC.)	TIPPLES, STONE CRUSHERS, ETC.	AWNINGS AND CANOPIES	POLES, POSTS AND SIGNS	ORE AND COAL DOCKS	BUILDING MATERIAL AND SUPPLY STORAGE (LONG TERM)	WARNING SIGNS REQUIRED FOR LESS THAN MINIMUM CLEARANCE
ALABAMA	--	9' 0"	9' 0"	--	--	--	--	--	--	--	--	--	--
ILLINOIS	8' 0"	8' 0"	8' 0"	8' 0"	7' 0"	8' 0"	7' 0"	8' 0"	8' 0"	9' 0"	8' 0"	9' 0"	YES
INDIANA	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	6' 6"	7' 0"	8' 0"	8' 0"	8' 0"	9' 0"	YES
IOWA	--	--	--	--	--	--	--	--	--	--	--	--	--
KENTUCKY	--	--	--	--	--	--	--	--	--	--	--	--	--
LOUISIANA	--	--	--	--	--	--	--	--	--	--	--	--	--
MICHIGAN	8' 6"	E	E	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	E	8' 6"	YES
MINNESOTA	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	8' 6"	14' 6"	8' 6"	8' 6"	--
MISSISSIPPI	--	--	--	--	--	--	--	--	--	--	--	--	--
NEBRASKA	8' 6"	8' 0"	8' 6"	8' 0"	7' 0"	7' 0"	E	--	--	8' 6"	8' 6"	8' 6"	YES
OHIO	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	--	--	--		8' 0"	8' 0"	--
PENNSYLVANIA	12' 0"	8' 0"	12' 0"	8' 0"	8' 0"	8' 0"	--	--	--	12' 0"	E	--	--
TENNESSEE	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	8' 0"	--
WISCONSIN	8' 6"	E	8' 6"	8' 6"	8' 6"	8' 6"	--	--	--	12' 0"	8' 6"	--	--

NOTE: FOR CANADIAN LINES, TRANSPORT CANADA CLEARANCES GOVERN.



E= EXEMPT
H= HEIGHT OF CAR GOVERNS

REVISIONS
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HORIZONTAL AND VERTICAL CLEARANCES

OFFICE OF DESIGN & CONSTRUCTION

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Source: Table 28-3-3, AREMA Engineering Manual

PLATFORMS

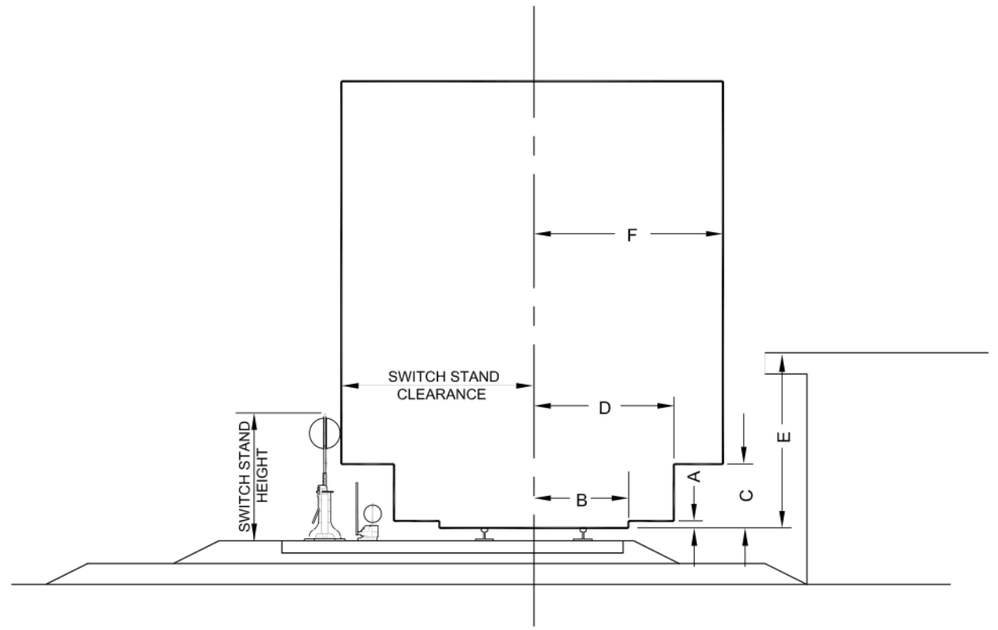
STATES	DIAGRAM DIMENSIONS A	B	C	D	E	F
ALABAMA	--	--	--	--	--	--
ILLINOIS	0' 4"	4' 6"	4' 8"	5' 1"	CFH	6' 2"
INDIANA	--	--	--	--	--	--
IOWA	--	--	--	--	--	--
KENTUCKY	--	--	--	--	--	--
LOUISIANA	--	--	--	--	--	--
MICHIGAN	--	--	--	--	--	--
MINNESOTA	--	--	--	--	--	--
MISSISSIPPI	--	--	--	--	--	--
NEBRASKA	0' 8"	5' 0"	4' 0"	5' 9"	4' 0"	8' 6"
OHIO	--	--	--	--	--	--
PENNSYLVANIA	0' 8"	5' 1"	4' 0"	5' 7"	4' 0"	8' 6"
TENNESSEE	0' 8"	4' 8"	4' 0"	5' 9"	4' 0"	7' 6"
WISCONSIN	0' 4"	4' 6"	1' 9"	6' 0"	5' 0"	6' 4"
	0' 8"	5' 1"				

E= EXEMPT
CFH = CAR FLOOR HEIGHT

SIGNALS

STATES	SWITCH STANDS: MAIN HEIGHT ABOVE BASE OF RAIL	MAIN CLEARANCE	SECONDARY HEIGHT ABOVE BASE OF RAIL	SECONDARY CLEARANCE	LOW, BETWEEN OR ADJACENT TO TRACKS HEIGHT	LOW, BETWEEN OR ADJACENT TO TRACKS CLEARANCE	SWITCH BOXES ETC. HEIGHT	SWITCH BOXES ETC. CLEARANCE	HIGH (SEMAPHORE & COLOR LIGHT)
ALABAMA	--	--	--	--	--	--	--	--	--
ILLINOIS	2' 10" to 4' 0"	8' 0"	2' 10" to 4' 0"	7' 6"	0 to 2' 10"	8' 0"			8' 6"
	over 4' 0"	8' 3"	over 4' 0"	8' 0"					
INDIANA	--	--	--	--	--	--	--	--	8' 0"
IOWA	2' 10" to 4' 0"	8' 0"	2' 10" to 4' 0"	7' 6"	--	--	--	--	--
	over 4' 0"	8' 3"	over 4' 0"	8' 0"					
KENTUCKY	--	--	--	--	--	--	--	--	--
LOUISIANA	--	--	--	--	--	--	--	--	--
MICHIGAN	--	--	--	--	--	--	E	E	E
MINNESOTA	--	--	--	--	--	--	--	--	8' 6"
MISSISSIPPI	--	--	--	--	--	--	--	--	--
NEBRASKA	3' 0" +	8' 3"	3' 0" +	8' 3"	3' 0"	6' 0"	0' 4"	3' 0"	8' 6"
OHIO	--	--	--	--	--	--	--		8' 0"
PENNSYLVANIA	--	--	--	--	3' 0"	6' 0"	0' 4"	3' 0"	12' 0"
TENNESSEE	--	--	--	--	--	6' 6"	0' 4"	3' 0"	8' 0"
WISCONSIN	--	--	--	--	E	E	E	E	8' 6"

NOTE: FOR CANADIAN LINES, TRANSPORT CANADA CLEARANCES GOVERN.



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PLATFORM AND SIGNAL CLEARANCES

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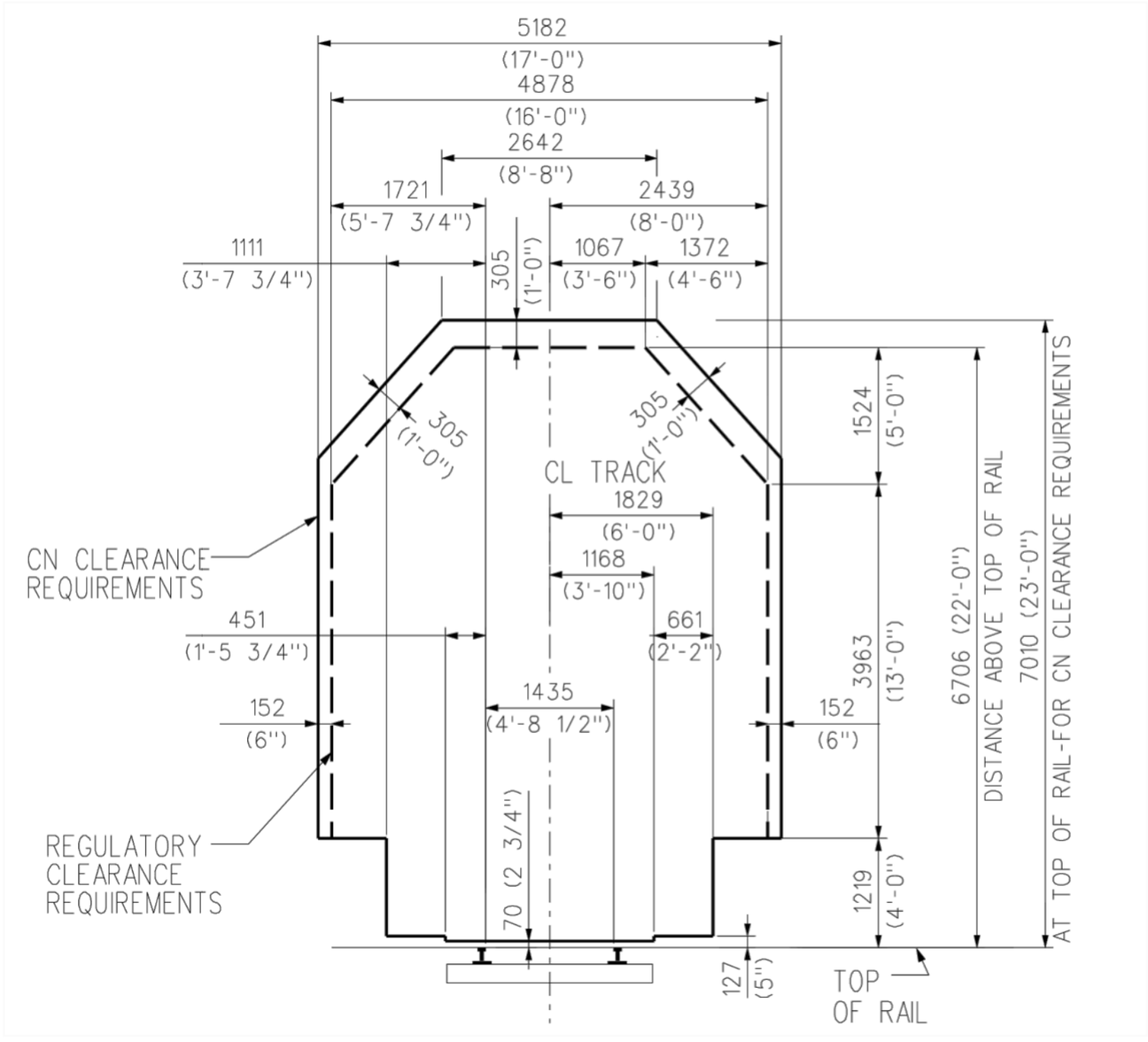

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HORIZONTAL AND VERTICAL CLEARANCES
CANADA ONLY

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Design Criterion

Track Classification		Maximum (M) Minimum (m)	Industry Lead Track						Industry Service Track					
			HAZMAT/Leads > 1/2 mi		Unit Train		General Service		HAZMAT		Unit Train		General Service	
			Switched by		Switched by		Switched by		Switched by		Switched by		Switched by	
Design Criterion			RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry
Degree of Curve		M	7 deg 30 min		8 deg		9 deg		7 deg 30 min		8 deg		9 deg	
Radius of Curve			764.48		716.78		637.27		764.48		716.78		637.27	
Grade	Moving		0.80%				1.50%		1.00%				2.00%	
	Spotting		0% optimum not to exceed 0.20%											
Vertical Curve Factor	Sag		0.60% per 100 ft										1.20% per 100 ft	
	Summit		1.00% per 100 ft										1.50% per 100 ft	
Tangent Between Curves			100'				70'							
Track Centers	Main	m	25' TC's minimum from Working Track to Main											
	Other		15'				14'							
Distance from T/O	To Curve		100'									70'		
	To Bridge-Xing		100'											

Material Specifications

Track Classification		Maximum (M) Minimum (m)	Industry Lead Track (1)						Industry Service Track (1)					
			HAZMAT/Leads > 1/2 mi		Unit Train		General Service		HAZMAT		Unit Train		General Service	
			Switched by		Switched by		Switched by		Switched by		Switched by		Switched by	
Design Criterion			RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry	RR	Industry
Operating Speed		M	25 MPH / 15 MPH	15 MPH	25 MPH	15 MPH		< 10 MPH	15 MPH				< 10 MPH	
Turnout No/Wgt/Type		m	#12 New / #10 New	#10 New	#12 New	#10 New	#8 New		#10 New					#8 New/SH
Type of Frog	Mainline		Spring (SPR) or Rail Bound Manganese (RBM)											
	Other		Rail Bound Manganese (RBM) or Self Guarded Solid Manganese (SGSM)											
Rail Weight/Section			115# RE New				115# RE SH					112# RE SH (100# RA SH Canada Only)		
Switch Tie - size			7" x 9" hardwood											
Cross Tie - size			7"x9"x8'-6" Grade HW				7"x9"x8'-6" Ind Grade HW					6"x8"x8'-6" Grade HW		
Cross Tie - spacing (2)		M	20"										22"	
Ballast depth		m	12"				6"		12"				6"	
Sub-ballast depth			12"											

(1) - mainline turnout weight to match main line section (not less than #10-115# New)

(2) - tie spacing in xing areas are to match crossing surface specifications

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CN

DESIGN AND MATERIAL TABLES

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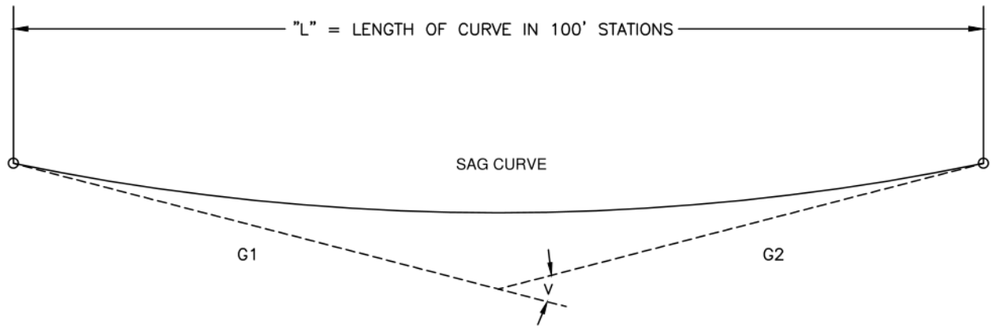

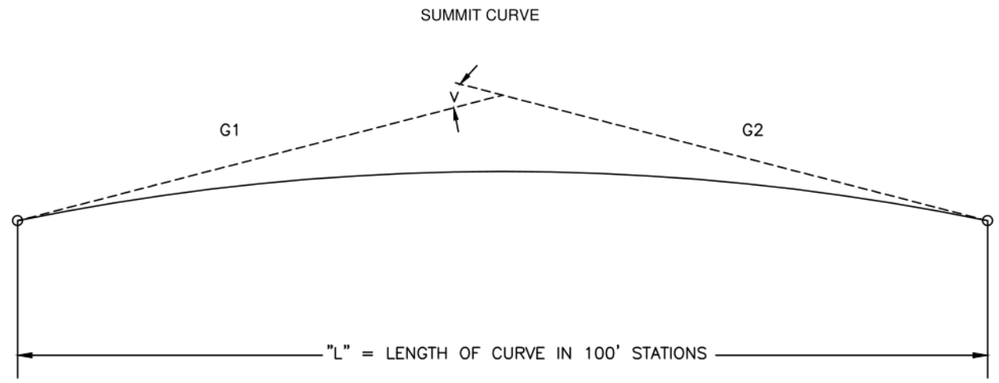

$$V/L = \frac{(G2-G1)}{L}$$

TRACK	MAXIMUM V/L	
	SAG	SUMMIT
YARD TRACKS	0.40	0.80
INDUSTRIAL LEADS	0.60	1.00
INDUSTRY TRACK	1.20	1.50

G1 AND G2 DESIGNATE GRADES IN PERCENT.
L= LENGTH OF CURVE IN 100' STATIONS
V= ALGEBRAIC DIFFERENCE IN GRADES IN PERCENT (G2−G1)
V/L= AVERAGE CHANGE IN GRADIENT PER 100' STATIONS
TO DETERMINE LENGTH (L), DIVIDE V BY THE DESIRED V/L
ROUND UP THE RESULT TO THE NEAREST 100' STATION.

EXAMPLES:
GIVEN G1 = 1.05 AND G2 = 0.71 V=(−.71)−(1.05) = 1.76%
GIVEN V/L = .10 L= −1.76/.10= 17.6' STATION.
VERTICAL CURVE LENGTH = 1800' (ROUNDED UP).

NOTES:

VERTICAL CURVES SHALL NOT FALL WITHIN THE LIMITS OF HORIZONTAL CURVES OR TURNOUTS UNLESS AUTHORIZED BY THE CHIEF ENGINEER.

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VERTICAL CURVES FOR INDUSTRIAL TRACKS

OFFICE OF DESIGN & CONSTRUCTION

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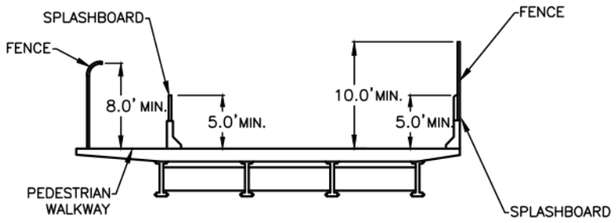
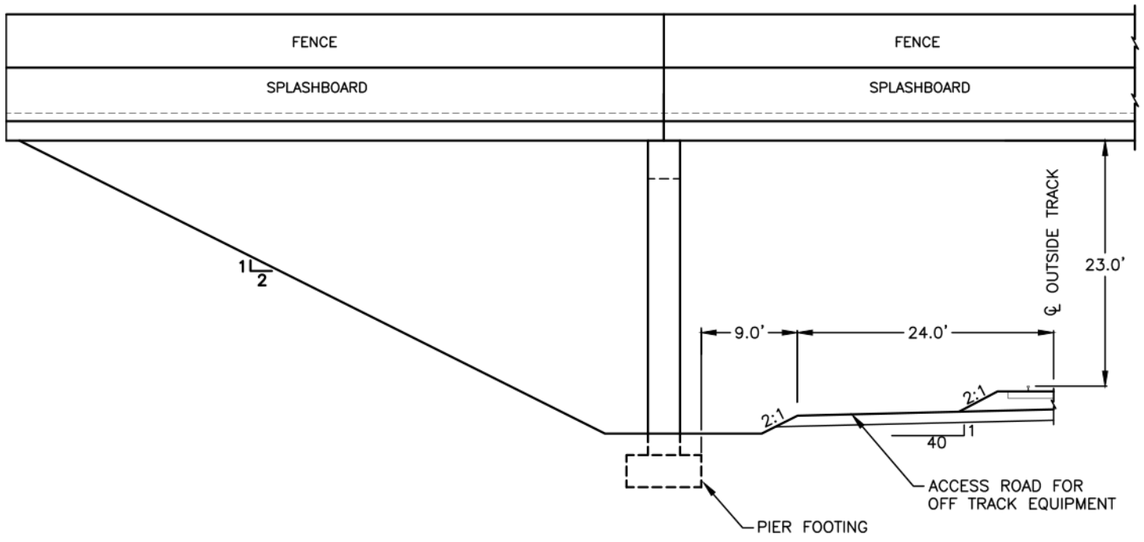


OVERPASS CROSS SECTION



ELEVATION

GENERAL:

1. FENCE SHALL BE PROVIDED AS INDICATED ON THE CROSS SECTION ON BOTH SIDES OF THE VIADUCT. THE FENCE SHALL EXTEND COMPLETELY ACROSS THE STRUCTURE OR CN RIGHT–OF–WAY, WHICHEVER IS SHORTER.
2. SPLASH BOARDS SHALL BE PROVIDED ON BOTH SIDES OF THE VIADUCT IN LOCATIONS WHERE SWITCHING OR OTHER FREQUENT RAILROAD ACTIVITIES ARE PERFORMED.THE SPLASH BOARD SHALL EXTEND COMPLETELY ACROSS THE STRUCTURE OR CN RIGHT–OF–WAY, WHICHEVER IS SHORTER.
3. LIGHTS ARE TO BE INSTALLED ON THE UNDERSIDE OF THE VIADUCT WHERE SHADOWS CAST BY THE STRUCTURE WOULD INTERFERE WITH THE RAILROAD OPERATIONS.
4. SLOPE PAVING SHALL BE PROVIDED WHERE END SLOPES ARE STEEPER THAN 2 HORIZONTAL TO 1 VERTICAL.
5. FALSEWORK, NETTING OR OTHER SUITABLE PROTECTION SHALL BE PROVIDED TO PREVENT DEBRIS FROM FALLING ON THE TRACK DURING DEMOLITION AND CONSTRUCTION OPERATIONS.
6. APPLICANT SHALL BE RESPONSIBLE FOR IDENTIFICATION, LOCATION AND PROTECTION OF EXISTING UTILITIES.
7. CONTACT CN'S PUBLIC WORKS ENGINEER FOR THE DESIGNATED PROJECT IN THE STATE IN WHICH IT IS LOCATED AT LEAST 1 WEEK PRIOR TO COMMENCEMENT OF WORK TO LOCATE CN UNDERGROUND SIGNAL INFRASTRUCTURE.
8. 2 WEEKS PRIOR TO PROJECT START, CONTACT PUBLIC WORKS ENGINEER WHO WILL ARRANGE FOR FLAG PROTECTION TO BE PUT IN PLACE.
9. APPLICANT MUST CONTACT JOINT UTILITY LOCATION SERVICE TO DETERMINE LOCATION OF FIBER OPTICS.
10. CERTAIN LOCATIONS MAY REQUIRE ADDITIONAL CLEARANCES OR FEATURES BEYOND THOSE SHOWN IN THIS DRAWING BASED ON LOCAL CONDITIONS.
11. EXCEPTIONS TO THESE STANDARDS MUST BE APPROVED BY CN.

NOTES:

1. CLEARANCES:

   MINIMUM VERTICAL CLEARANCE SHALL BE 23' ABOVE THE PLANE OF TOP–OF–RAIL, ADDITIONAL CLEARANCE MAY BE REQUIRED IF SAG OF VERTICAL CURVE MUST BE ADJUSTED OR IF FUTURE TRACK RAISE FOR FLOOD CONSIDERATIONS OR MAINTENANCE IS PROBABLE.

   MINIMUM HORIZONTAL CLEARANCES, MEASURED AT RIGHT ANGLE FROM THE CENTERLINE OF TRACK, SHALL BE AS SHOWN.

   MINIMUM CONSTRUCTION CLEARANCES SHALL BE 22' VERTICAL ABOVE THE PLANE OF TOP–OF–RAIL AND 12' HORIZONTAL AT RIGHT ANGLE FROM CENTERLINE OF TRACK. DEPENDING ON TYPE OF STRUCTURE, CLEARANCES MAY BE INCREASED.

   HORIZONTAL CLEARANCES ARE TO BE INCREASED 1 ½" PER DEGREE OF CURVE WHERE THE STRUCTURE IS LOCATED ADJACENT TO OR WITHIN 80' OF THE CURVE LIMITS.

2. FUTURE TRACKS:

   SPACE IS TO BE PROVIDED FOR ONE OR MORE FUTURE TRACKS AS REQUIRED FOR LONG RANGE PLANNING OR OTHER OPERATING REQUIREMENTS, WHERE PROVISION IS MADE FOR MORE THAN TWO TRACKS, SPACE IS TO BE PROVIDED FOR ACCESS ROADS ON BOTH SIDES OF TRACK.

3. PIERS:

   PIER PROTECTION (CRASH WALLS) SHALL BE PROVIDED IN ACCORDANCE WITH AREMA CHAPTER 8, PART 2.1.5 FOR PIERS WITHIN 25 FEET OF THE CENTERLINE OF TRACK.

   TOP OF FOOTING SHALL BE A MINIMUM OF 6' BELOW BASE OF RAIL AND A MINIMUM OF 1 FOOT BELOW FLOW LINE OF DITCH.

   TEMPORARY OR PERMANENT SHORING SHALL BE DESIGNED AND SEALED BY A LICENSED ENGINEER OF THE STATE IN WHICH THE STRUCTURE IS BEING BUILT AND SUBMITTED TO CN'S STRUCTURES GROUP FOR REVIEW (SEE SPECIFICATION DRAWING)

4. DRAINAGE:

   DRAINAGE FROM THE OVERPASS SHALL BE DIVERTED AWAY FROM CN TRACKS AND NOT DISCHARGED ONTO THE TRACKS OR ROADBED.

   A STANDARD FLAT–BOTTOM DITCH SHALL BE PROVIDED ON EACH SIDE OF TRACKS AS NECESSARY

   CULVERTS MAY BE INSTALLED ON THE OPPOSITE SIDES OF COLUMN FROM TRACK IN LIEU OF STANDARD RAILROAD DITCHES WHEN APPROVED BY TECHNICAL SERVICE ENGINEER. MAINTENANCE OF CULVERTS IS TO BE AT APPLICANT'S EXPENSE.

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US ONLY
DESIGN CLEARANCES FOR HIGHWAY AND PEDESTRIAN OVERPASS

OFFICE OF DESIGN & CONSTRUCTION

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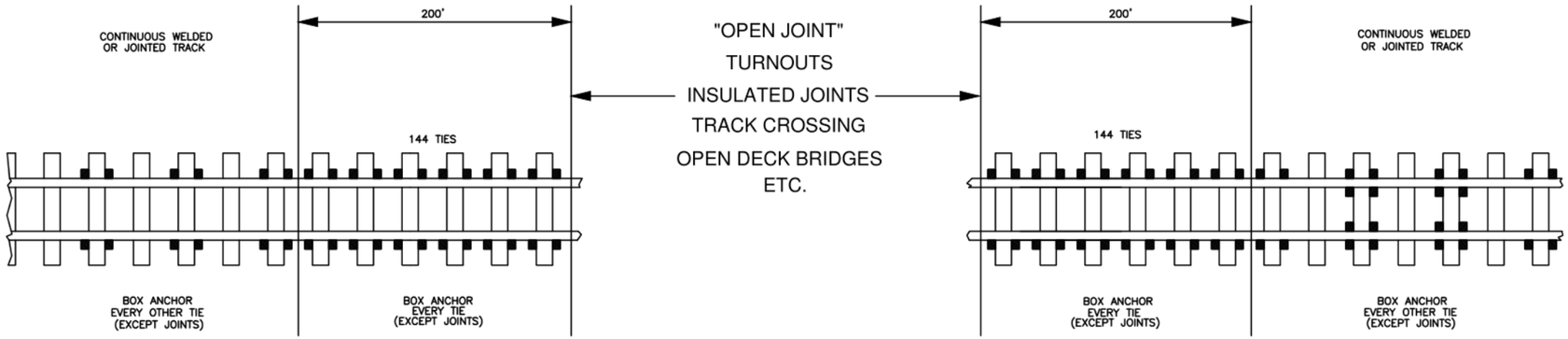
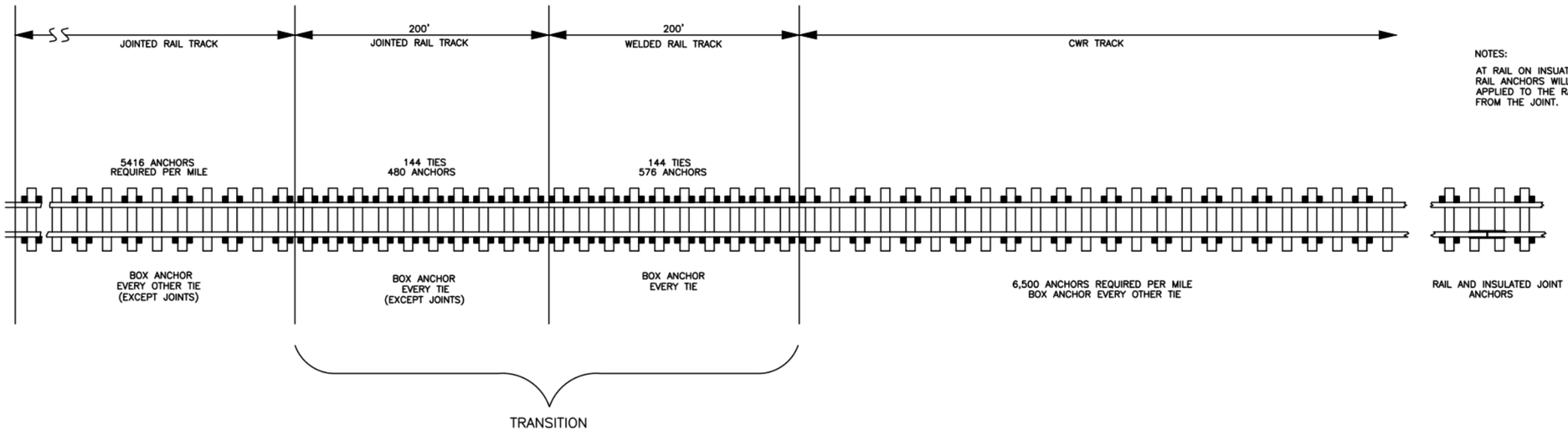
ANCHOR PATTERN NEAR FIXED OBJECTS.



NOTES:

ANCHORS WILL BE APPLIED TO BOTH SIDES OF EACH TIE.

ANCHOR PATTERN OF TRACK.



NOTES:

AT RAIL ON INSUATED JOINTS, RAIL ANCHORS WILL NOT BE APPLIED TO THE RAIL ACROSS FROM THE JOINT.

NOTE:

ON JOINTED RAIL ABUTTING A COMPLETED LENGTH OF CONTINUOUS WELDED RAIL, THE FIRST 6 JOINTED RAILS (234') IN EACH DIRECTION MUST BE FULLY BOX ANCHORED ON ALL TIES BUT JOINT TIES AND THEREAFTER EVER OTHER TIE MUST BE BOX ANCHORED.

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ANCHOR PATTERN FOR CONTINUOUS WELDED & JOINTED TRACK

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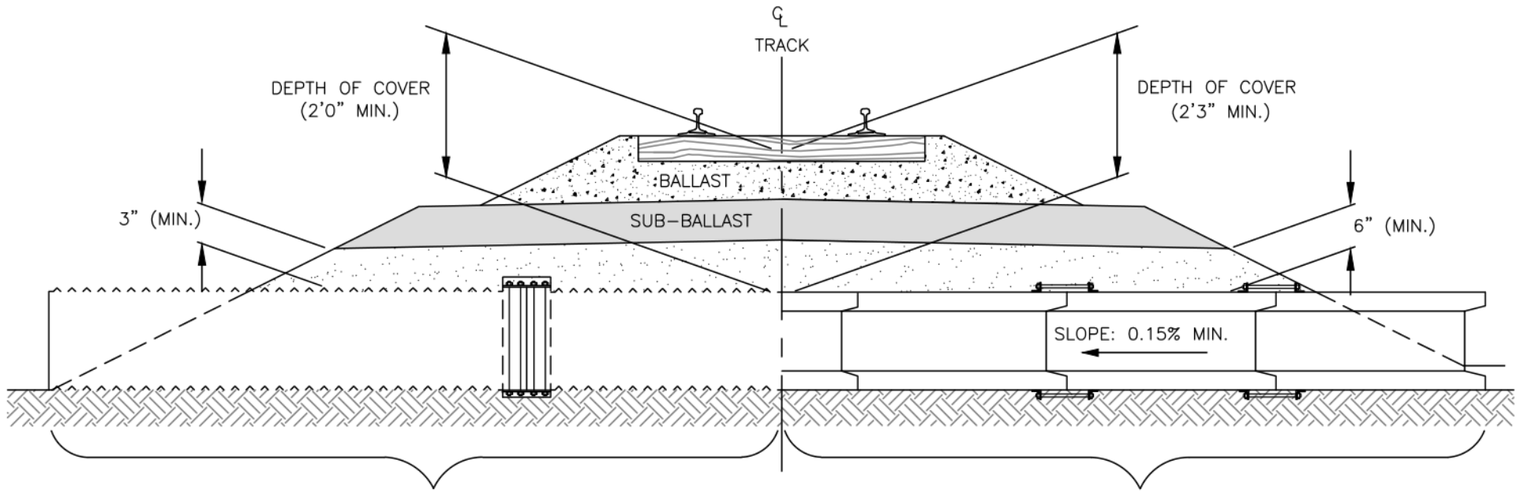

TYPICAL SECTION CMP/ ALUMINUM/ STEEL

DEPTH OF COVER	PIPE DIA.	MIN. GAUGE
MIN. TO 20'–0"	24" TO 30"	12
	36" TO 42"	10
	48" TO 60"	8

DEPTH OF COVER – ROUND CMP (MINIMUM):

24" TO 36" MINIMUM AS SHOWN ABOVE.
42" TO 60" 1/2 NOMINAL PIPE DIAMETER.
OVER 60" INSTALLATION TO BE APPROVED BY CN DESIGN & CONSTRUCTION

TYPICAL SECTION RCP

DEPTH OF COVER	PIPE DIA.	CLASS	WALL
MIN. TO 25'–0"	24" TO 72"	IV	B
GREATER THAN 25–0"	24" TO 48"	V	
	54" TO 72"		C

DEPTH OF COVER – ROUND RCP (MINIMUM):

24" TO 54" MINIMUM AS SHOWN ABOVE.
54" TO 72" 1/2 NOMINAL PIPE DIAMETER.
OVER 72" INSTALLATION TO BE APPROVED BY CN DESIGN & CONSTRUCTION
(* PIPE TO BE BOLT CONNECTED *)

CMP NOTES:

1. CORRUGATED METAL PIPE (CMP) DESIGN, MATERIALS AND FABRICATION TO BE IN ACCORDANCE WITH AREMA CHAPTER 1, PART 4 CLASS I & II.
2. CMP TO BE GALVANIZED, FIBER – BONDED AND BITUMINOUS COATED OR ALUMINUM.
3. JOINTS BY STANDARD COUPLING BAND.
4. BEDDING TO BE CLASS B OR BETTER
5. BITUMINOUS PAVING ONLY IF WARRANTED BY ABRASIVE FLOW.
6. OTHER THAN ROUND SECTION TO BE APPROVED BY CN'S STRUCTURES DEPT.
7. CMP LESS THAN 24" TO BE AVOIDED.

RCP NOTES:

1. REINFORCED CONCRETE PIPE (RCP) DESIGN, MATERIALS, AND FABRICATION TO BE IN ACCORDANCE WITH ASTM DESIGNATION C–76.
2. CLASS WALL DESIGN TO BE AS NOTED.
3. BEDDING TO BE CLASS B OR BETTER
4. OTHER THAN ROUND SECTION TO BE APPROVED BY CN'S STRUCTURES DEPT.
5. JOINTS AND LIFT HOLES TO BE MORTARED.
6. RCP LESS THAN 24" TO BE AVOIDED.

GENERAL NOTES:

1. A DEPTH OF COVER GREATER THAN 25'–0" NEEDS TO BE APPROVED BY THE CN'S STRUCTURES DEPARTMENT.
2. 24" DIAMETER MINIMUM.

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CULVERT INSTALLATION GUIDELINES

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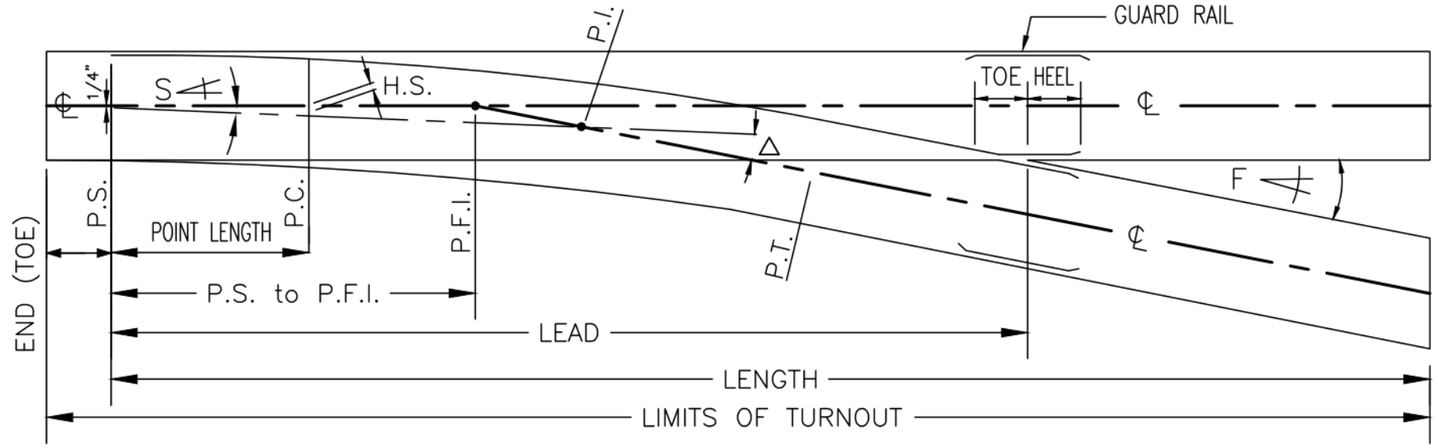

PLAN OF RIGHT HAND TURNOUT

	#8	#10	#12	#15	#20
END TO P.S.	3'– 5 5/8"	3'– 5 5/8"	3'– 5 5/8"	3'– 5 5/8"	3'– 5 5/8"
POINT LENGTH	16'– 6"	31'– 6"	36'– 7"	45'– 9"	58'– 10"
S ∠	1° 42' 01"	1° 42' 01"	1° 16' 31"	1° 02' 00"	1° 04' 30"
H.S. (HEEL SEPARATION)	5 5/8"	6 1/4"	6 1/4"	6 1/4"	6 1/4"
P.S. TO P.F.I.	29'– 10 3/4"	34' – 0 1/2"	41' – 1"	41' – 1 1/8"	61'– 1 3/64"
LEAD	67'– 10 3/4"	81' – 6"	98' – 1"	112'– 4 1/8"	156'– 0 1/2"
LENGTH	91'– 0 3/8"	110'– 8 7/8"	137'– 3 3/4"	175'– 1 1/2"	220'– 0"
△(F ∠ – S ∠)	5° 27' 09"	4° 01' 28"	3° 29' 48"	2° 47' 06"	1° 47' 21"
TOE LENGTH (FROG)	5'– 0"	12'– 0"	14'– 3"	13'– 8"	16'– 1 1/2"
HEEL LENGTH (FROG)	8'– 0"	14'– 0"	17'– 3"	18'– 3"	24'– 10 1/2"
F ∠ (FROG)	7° 09' 10"	5° 43' 29"	4° 46' 19"	3° 49' 06"	2° 51' 51"
LIMITS OF TURNOUT	94'– 6"	114'– 2 1/2"	140'– 9 3/8"	178'– 7 1/8"	223'– 5 5/8"

ABBREVIATIONS:

P.S. POINT OF SWITCH
S∠ SWITCH ANGLE
H.S. HEEL SEPARATION
P.C. POINT OF CURVE
P.F.I. POINT OF FROG INTERSECTION
P.I. POINT OF CURVE INTERSECTION
P.T. POINT OF TANGENCY
F∠ FROG ANGLE

NOTES:

1. LEFT HAND TURNOUT IS OPPOSITE HAND.
2. HEAVY LINES REPRESENT TRACK GAUGE LINE

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TURNOUT GEOMETRY

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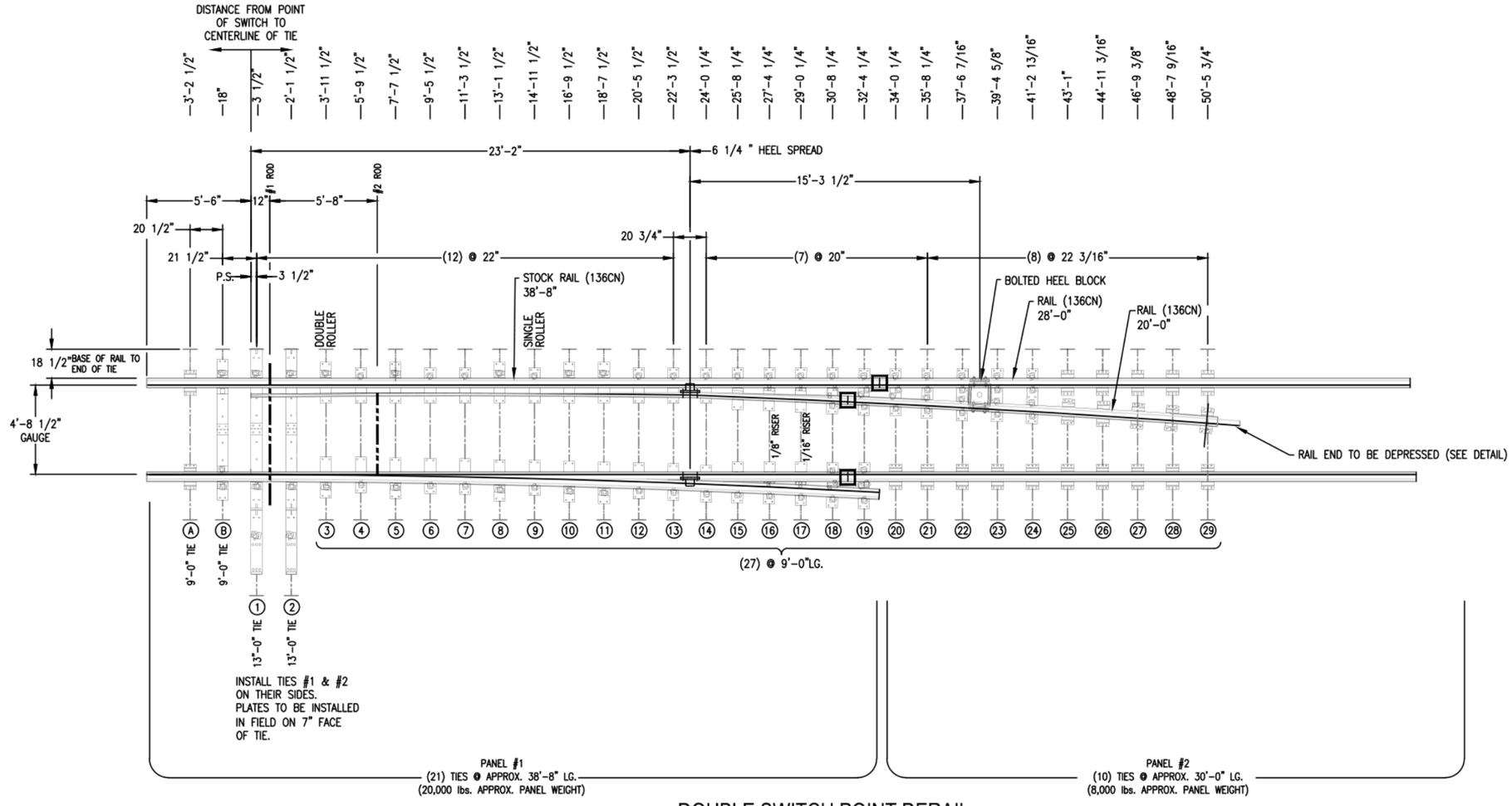


DOUBLE SWITCH POINT DERAIL

RIGHT HAND SHOWN, LEFT HAND OPPOSITE

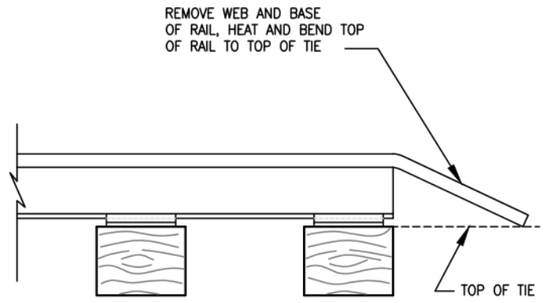
NOTES:
1. TIES TO BE PRE-DRILLED FOR SCREW SPIKES 21/32" DIA. 6" DEEP.
2. ☐ – INDICATES LOCATION OF FIELD WELDED JOINTS 0" OPENING.
3. ☒ – INDICATES LOCATION OF RAIL HOLD DOWN CLIP ASSEMBLIES.
4. END DRILLING 9 1/2" x 6" ~ 1 5/16" DIA. 3 3/32" A.B.
5. BEFORE SHIPPING, THROW THE SWITCH, PLACE WOOD BLOCK BETWEEN OPEN SWITCH & STOCK RAIL TO HOLD THROW, THEN BAND BOTH SWITCH POINTS TO STOCK RAILS.

SWITCH	DERAIL DATA	
	LENGTH OF POINT	23'-2" ON 31'-6"
	HEEL SPREAD	6 1/4"
	POINT THICKNESS	0"
	RADIUS OF CVD. POINT	809.55'
	SWITCH ANGLE	0°-27'-58"
	CENTERLINE RADIUS	807.20'

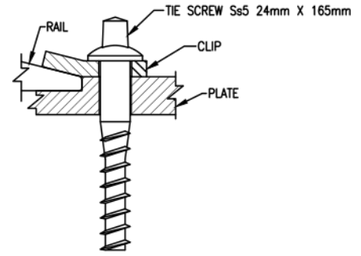
TANGENT OFFSETS FROM HEEL OF SWITCH	
5'-0"	8 21/32"
10'-0"	11 13/32"
15'-0"	14 17/32"
20'-0"	18 1/32"
25'-0"	21 15/16"

TIE SCHEDULE	
29	7" x 9" x 9'-0"
2	7" x 9" x 13'-0" HEADBLOCK TIES

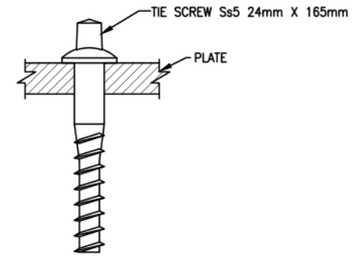
SWITCH POINT THROW	
@ #1 ROD	5"
@ #2 ROD	3 23/32"



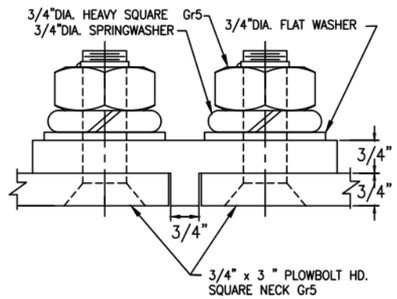
DEPRESS RAIL HEAD DETAIL



HOLD DOWN CLIP ASSEMBLY



TIE SCREW ASSEMBLY DETAIL



INSULATED PLATE JOINT ASSEMBLY

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DOUBLE SWITCH POINT DERAIL

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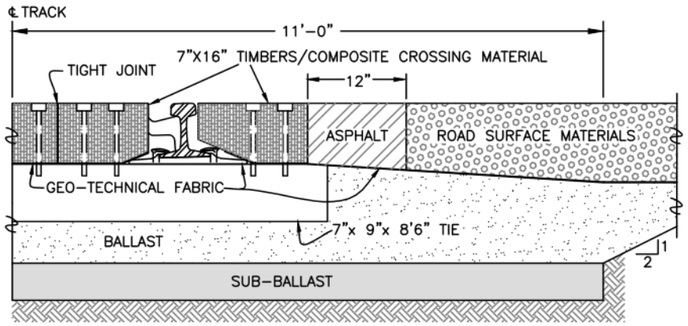
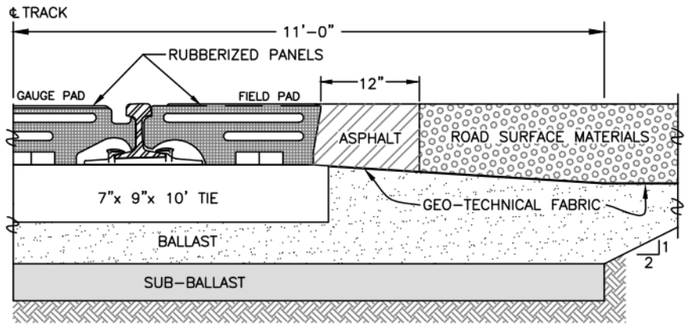


HALF SECTION SOLID OR COMPOSITE CROSSING

N.T.S.



HALF SECTION RUBBERIZED CROSSING

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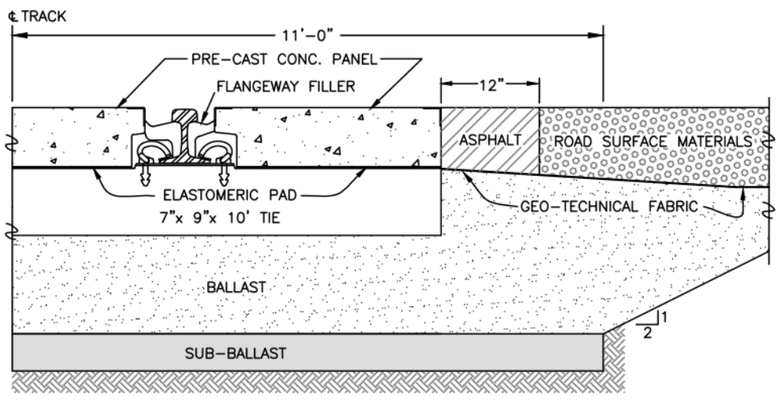

HALF SECTION CONCRETE CROSSING

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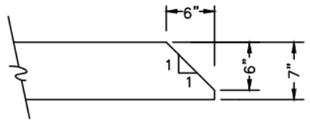
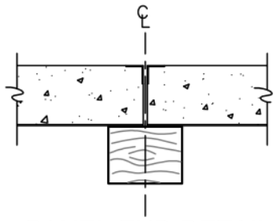


END CHAMFER DETAIL

FOR WOOD CROSSING TIMBER ONLY

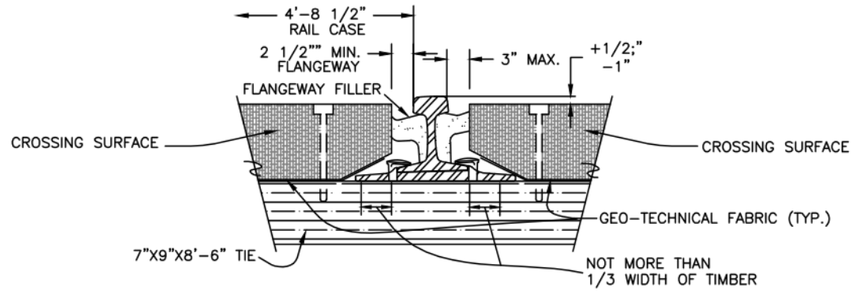
N.T.S.



PANEL END DETAIL

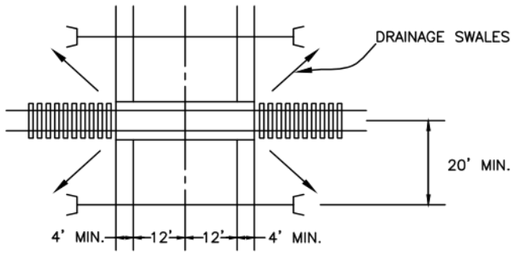
CROSSING PANELS ARE TO BE BUTTED TOGETHER OVER THE ℄ OF TIE

N.T.S.



TYPICAL DETAIL FLANGEWAY

N.T.S.



PLAN

CROSS-SECTION

NOTES:

1. CROSSING LENGTH SHOULD EXTEND ENTIRE WIDTH OF USABLE SHOULDERS.
2. CROWN IN ROADWAY SHOULD BE ELIMINATED AT CROSSING SO AS TO MATCH GRADE AND PROFILE OF RAILROAD.
3. DRAINAGE CULVERTS IN TRACKSIDE DITCHES SHOULD BE APPROPRIATELY SIZED (24"MINIMUM DIAMETER) AND INSTALLED AT AN ELEVATION WHICH PERMITS UNRESTRICTED FLOW. CULVERTS SHOULD ALSO BE OF SUFFICIENT LENGTH AND/OR EQUIPPED WITH FLARED ENDS OR HEADWALLS TO PRECLUDE COLLAPSE OF ROADWAY SHOULDER AT OR AROUND CULVERT ENDS.

NOTE:

1. FASTENING TO BE WITH 5/8" DRIVE SPIKE OF A LENGTH TO PENETRATE CROSS TIE 3" OR MORE.
2. USE ONE FASTENING PER TIMBER PER CROSS TIE, ALTERNATE POSITION BORE TIMBER 9/16" AND COUNTERSINK PILOT BORE CROSS TIE.
3. FULLY ASPHALTED OR AGGREGATE CROSSINGS ARE NOT ALLOWED
4. CROSSINGS IN CURVES WILL NEED TIES TO BE SPACED IN RADIAL FAN ARRANGEMENT
5. CROSSINGS IN CURVES MAY NEED TO BE SPECIALLY ORDERED.

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ROAD CROSSING DETAILS

OFFICE OF DESIGN & CONSTRUCTION

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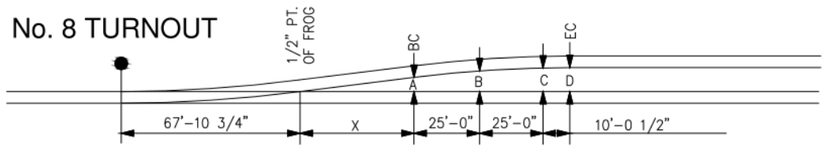
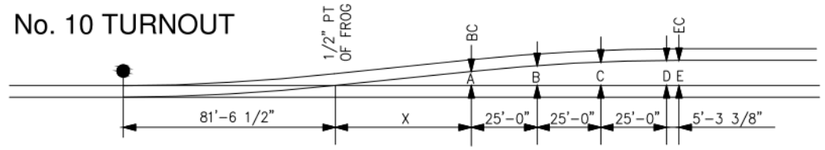
TURNOUT RETURN CURVES

No. 8 TURNOUT



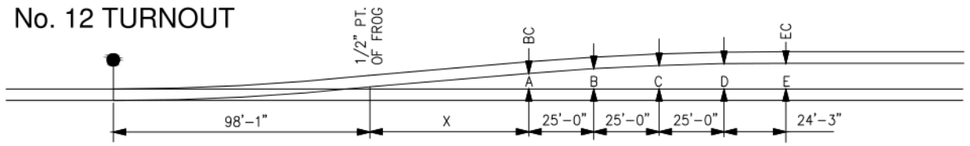
TRACK CENTERS	X	A	B	C	D
13'-0"	35'-10"	4'-6 1/2"	7'-0 1/4"	8'-2 1/4"	8'-3 1/2"
13'-6"	39'-9 13/16"	5'-0 1/2"	7'-6 1/4"	8'-8 1/4"	8'-9 1/2"
14'-0"	43'-9 5/8"	5-6 1/2"	8'-0 1/4"	9'-2 1/4"	9'-3 1/2"
14'-6"	47'-9 7/16"	6'-0 1/2"	8'-6 1/4"	9'-8 1/4"	9'-9 1/2"
15'-0"	51'- 9 1/4"	6'-6 1/2"	9'-0 1/4"	10'-2 1/4"	10'-3 1/2"

No. 10 TURNOUT



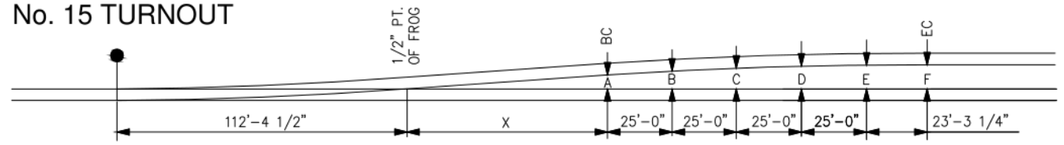
TRACK CENTERS	X	A	B	C	D	E
13'-0"	42'- 3 1/8"	4'-3 3/8"	6'-4 3/4"	7'-8 5/8"	8'-3 1/4"	8'-3 1/2"
13'-6"	47'-2 15/16"	4'-9 3/8"	6'-10 3/4"	8'-2 5/8"	8'-9 1/4"	8'-9 1/2"
14'-0"	52'-2 13/16"	5'-3 3/8"	7'-4 3/4"	8'-8 5/8"	9'-3 1/4"	9'-3 1/2"
14'-6"	57'-2 11/16"	5'-9 3/8"	7'-10 3/4"	9'-2 5/8"	9'-9 1/4"	9'-9 1/2"
15'-0"	62'-2 1/2"	6'-3 3/8"	8'-4 3/4"	9'-8 5/8"	10'-3 1/4"	10'-3 1/2"

No. 12 TURNOUT



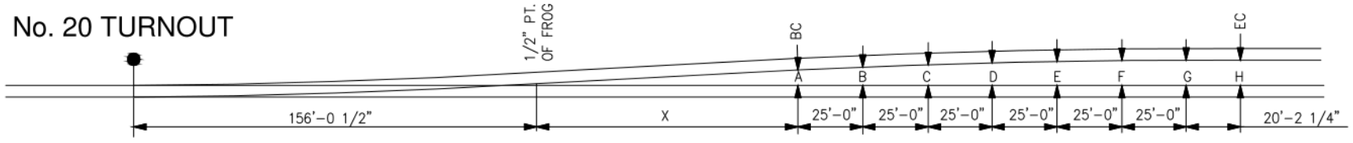
TRACK CENTERS	X	A	B	C	D	E
13'-0"	49'-3 3/8"	4'-1 7/8"	5'-11 3/4"	7'-3 1/4"	8'-0 1/2"	8'-3 1/2"
13'-6"	55'-3 1/4"	4'-7 7/8"	6'-5 3/4"	7'-9 1/4"	8'-6 1/2"	8'-9 1/2"
14'-0"	61'-3 1/8"	5'-1 7/8"	6'-11 3/4"	8'-3 1/4"	9'-0 1/2"	9'-3 1/2"
14'-6"	67'-3"	5'-7 7/8"	7'-5 3/4"	8'-9 1/4"	9'-6 1/2"	9'-9 1/2"
15'-0"	73'-2 7/8"	6'-1 7/8"	7'-11 3/4"	9'-3 1/4"	10'-0 1/2"	10'-3 1/2"

No. 15 TURNOUT



TRACK CENTERS	X	A	B	C	D	E	F
13'-0"	62'-0 1/2"	4'-2 1/4"	5'-8 1/8"	6'-10 1/8"	7'-7"	8'-1 3/4"	8'-3 1/2"
13'-6"	69'-6 3/8"	4'-8 1/4"	6'-2 1/8"	7'-4 1/8"	8'-1"	8'-7 3/4"	8'-9 1/2"
14'-0"	77'-0 5/16"	5'-2 1/4"	6'-8 1/8"	7'-10 1/8"	8'-7"	9'-1 3/4"	9'-3 1/2"
14'-6"	84'-6 3/16"	5'-8 1/4"	7'-2 1/8"	8'-4 1/8"	9'-1"	9'-7 3/4"	9'-9 1/2"
15'-0"	92'-0 1/8"	6'-2 1/4"	7'-8 1/8"	8'-10 1/8"	9'-7"	10'-1 3/4"	10'-3 1/2"

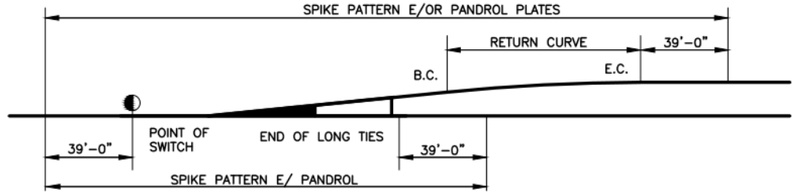
No. 20 TURNOUT



TRACK CENTERS	X	A	B	C	D	E	F	G	H
13'-0"	79'-10 1/4"	4'-0 1/2"	5'-2 3/8"	6'-2"	6'-11 1/2"	7'-6 7/8"	7'-11 7/8"	8'-2 3/4"	8'-3 1/2"
13'-6"	89'-10 1/4"	4'-6 1/2"	5'-8 3/8"	6'-8"	7'-5 1/2"	8'-0 7/8"	8'-5 7/8"	8'-8 3/4"	8'-9 1/2"
14'-0"	99'-10 1/8"	5'-0 1/2"	6'-2 3/8"	7'-2"	7'-11 1/2"	8'-6 7/8"	8'-11 7/8"	9'-2 3/4"	9'-3 1/2"
14'-6"	109'-10 1/8"	5'-6 1/2"	6'-8 3/8"	7'-8"	8'-5 1/2"	9'-0 7/8"	9'-5 7/8"	9'-8 3/4"	9'-9 1/2"
15'-0"	119'-10"	6'-0 1/2"	7'-2 3/8"	8'-2"	8'-11 1/2"	9'-6 7/8"	9'-11 7/8"	10'-2 3/4"	10'-3 1/2"

SPIKING PATTERNS NO.	FIELD	GUAGE	MGT'S PER YEAR	DEGREE OF CURVE: TANGENT UP TO 2°	2° TO 6°	6° TO 8°	MORE THAN 6°
B			0-20	X			
C		OR 	0-20		X		
			MORE THAN 20	X			
D			0-20			*X	
			MORE THAN 20		X		
E			MORE THAN 20			*X	
			TURNOUTS SPIKING PATTERN E WILL BE APPLIED TO TURNOUTS AS PER TRACK DIAGRAM				
G							*X
			PLATES WILL BE APPLIED TO TURNOUTS AS PER TRACK DIAGRAM				
* EVERY OTHER TIE CAST PANDROL PLATED							

TURNOUT SPIKE PATTERN



TRACK DIAGRAM

NOTE:

MEASUREMENTS ARE FROM THE GAUGE SIDE OF RAIL TO GAUGE SIDE OF RAIL

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TURNOUT RETURN CURVES & SPIKING PATTERNS FOR INDUSTRIAL TRACKS

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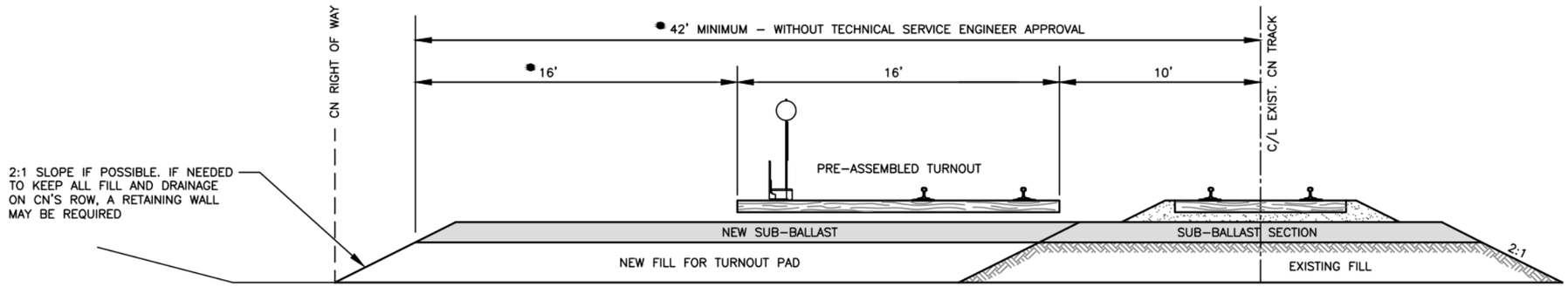
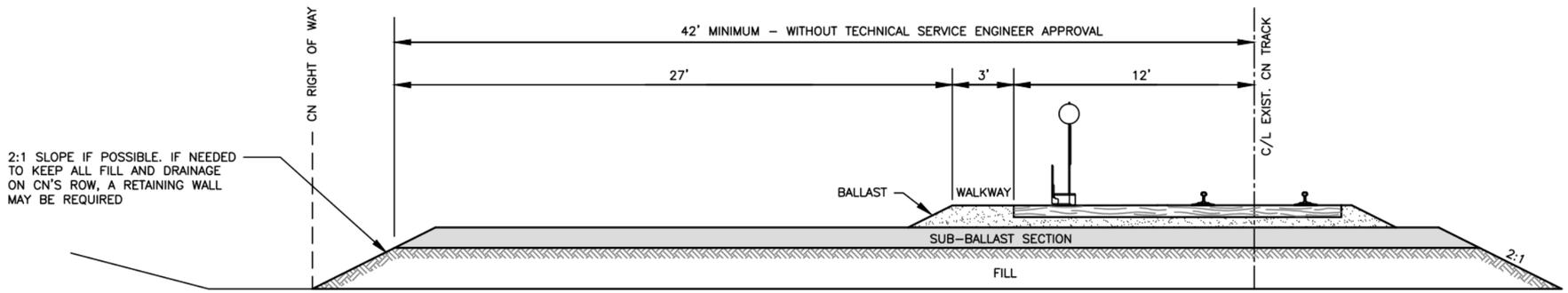
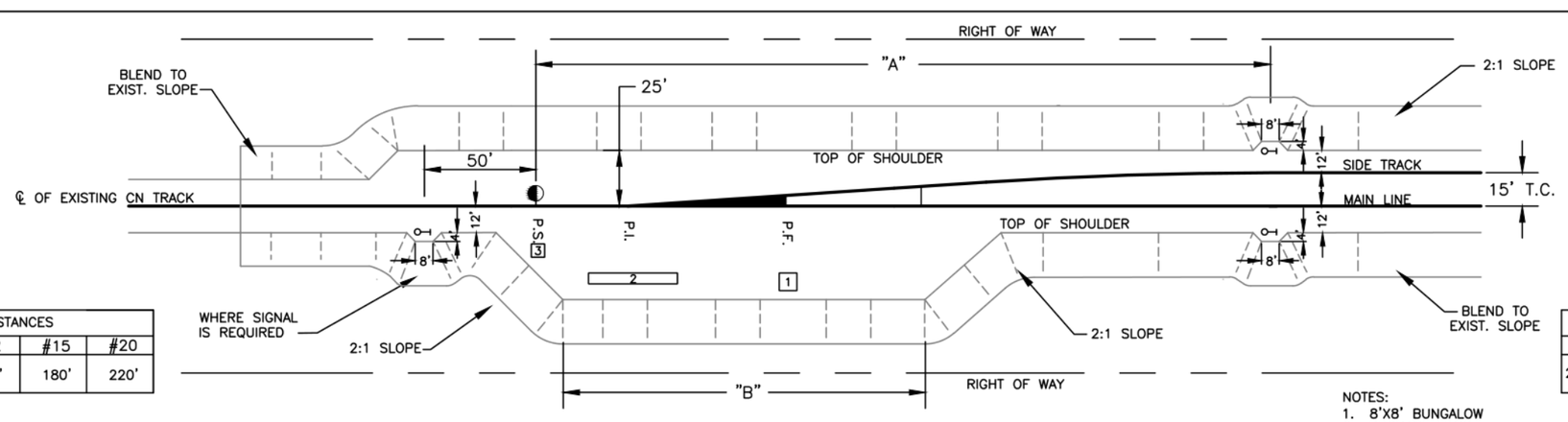


PRE CONSTRUCTION GRADING - TURNOUT PAD



POST CONSTRUCTION GRADING - TURNOUT PAD



LOCATION	TURNOUT DISTANCES				
	#8	#10	#12	#15	#20
"B"	102'	120'	140'	180'	220'

"A" DISTANCE FOR 15' TRACK CENTERS			
#10	#12	#15	#20
224'–0 3/8"	270'–6 7/8"	327'–7 1/2"	446'–0 3/4"

NOTES:
1. 8'X8' BUNGALOW
2. PROPANE TANK
3. 6'X6' SWITCH HEATER HOUSING

PLAN VIEW

NOTE: CONSTRUCTION OF INDUSTRY TURNOUT PAD IS FOR THE PLACEMENT OF THE PROPOSED PACKAGE TURNOUT FOR ASSEMBLY AND INSTALLATION. TURNOUT PAD IS ALSO TO PROVIDE FOUNDATION FOR ANY REQUIRED SIGNAL EQUIPMENT.

TURNOUT PAD FILL MATERIAL SHALL BE PLACED BY THE INDUSTRY AS PART OF THE GRADING FOR THE NEW INDUSTRY SPUR. PAD IS TO BE CONSTRUCTED USING STANDARD COMPACTION AND FILL PLACEMENT PROCESSES AS PER THE CN INDUSTRY TRACK GUIDELINES. TOP OF PAD IS TO BE 2' BELOW THE EXISTING TOP OF RAIL.

CONTRACTOR SHALL COORDINATE WITH THE TECHNICAL SERVICE ENGINEER AND ASSOCIATED PROJECT ENGINEER FOR ANY DEVIATION OF FILL AND FOR FLAGMAN PROTECTION.

● NOTE: IF RIGHT OF WAY IS OVER 50' FROM ℄ OF EXISTING CN TRACK, THIS DISTANCE SHALL BE INCREASED TO 25' AND 50' RESPECTIVELY

ROADWAY ACCESS SHALL BE PROVIDED

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TYPICAL GRADING AT MAINLINE TURNOUT LOCATIONS

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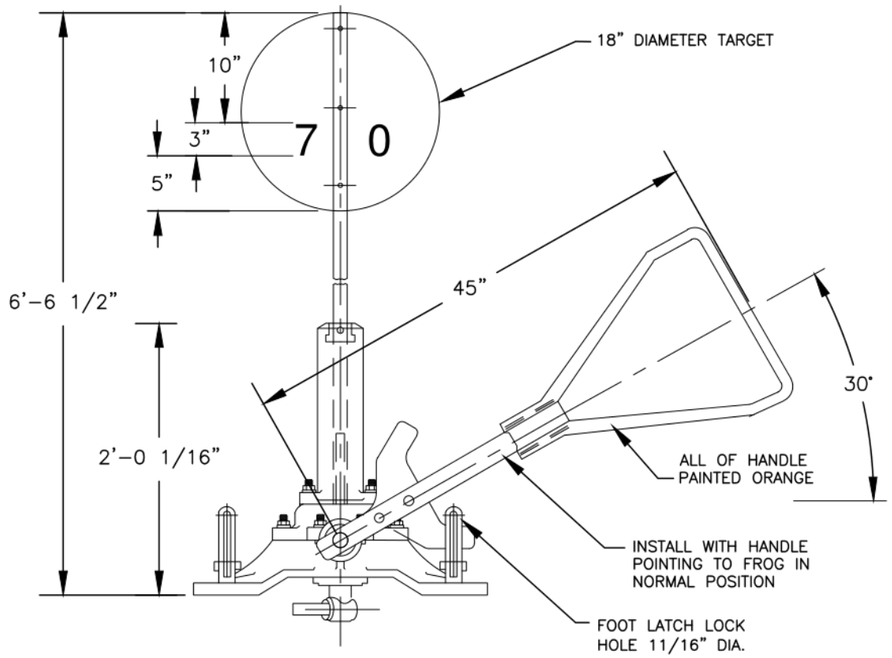
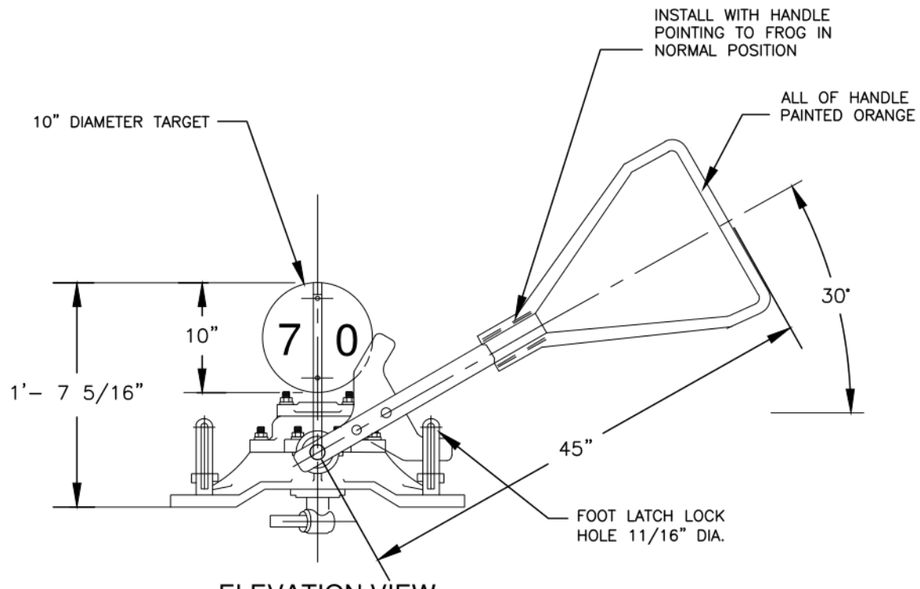
CHECKED BY:	DATE: 19 JUL 10	FILE:

PAGE 84



ELEVATION VIEW

36EH STANDS
SHOWN WITH HIGH STAFF
AND TRI–HANDLE

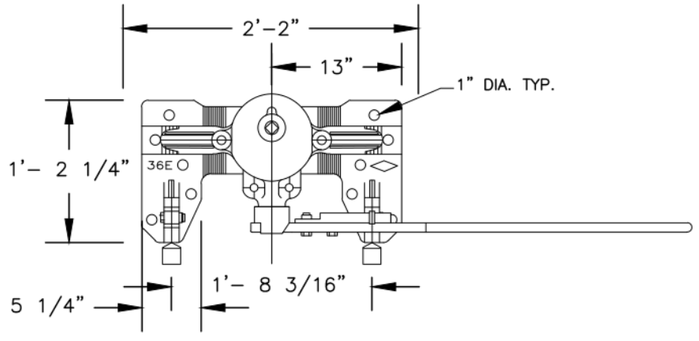


ELEVATION VIEW

36E STANDS
SHOWN WITH LOW STAFF
AND TRI–HANDLE

NOTES:

1. SEE DWG. 2156 & 2160 FOR SPINDLE AND CRANK EYE DETAILS.
2. HANDLE KITS (STRAIGHT OR TRI–HANDLE) ARE AVAILABLE FROM FIELD RETRO FIT OR EXISTING 36 STYLE SWITCH STANDS.
3. STAND 36 EH IS FOR MAIN LINE USE ONLY. FURNISHED WITH NO. 1.2 STAFF.
4. STAND 36E IS FOR MAIN LINE OR YARD USE, FURNISHED WITH NO. 2 STAFF.
5. USE 18" TARGETS FOR 36EH STANDS AND 10" TARGETS FOR 36E STANDS.
6. SWITCH STANDS ARE TO BE INSTALLED WITH HANDLE DIRECTED TOWARD FROG WHEN LINED TO THE NORMAL POSITION.
7. USE RED TARGETS TO INDICATE "REVERSE" ROUTE ON MAINLINE TURNOUTS. USE YELLOW TARGETS TO INDICATE "REVERSE" ROUTE ON ALL OTHER TURNOUTS.
8. GREEN TARGETS WILL BE INSTALLED ON ALL TURNOUTS INDICATING "NORMAL" POSITION
9. TRACK IDENTIFICATION NUMBERS TO BE APPLIED TO EACH SIDE OF "REVERSE" TARGET.
10. TRACK IDENTIFICATION NUMBERS TO BE 3" FLAT BLACK BLOCK TYPE FONT.
11. SWITCH STAND TO BE SECURED WITH SCREW SPIKES



PLAN VIEW

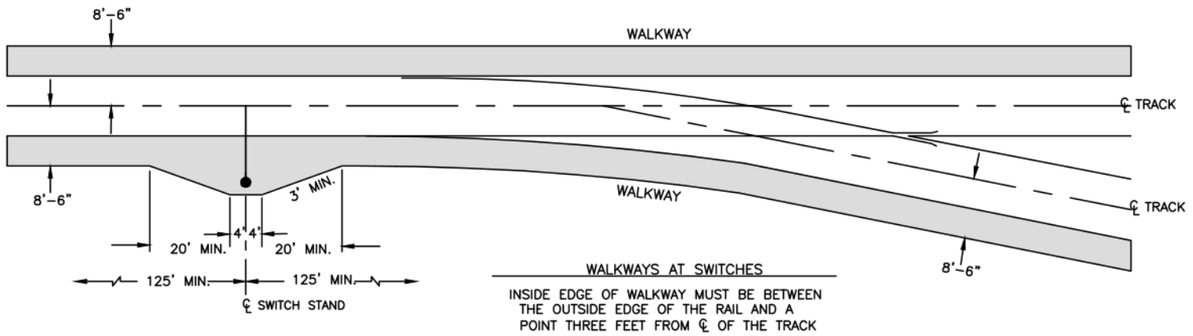
36 E STANDS,
SHOWN WITH LOW STAFF
AND TRI–HANDLE

REVISIONS	
DATE	BY
18 OCT 10	DAP
APPROVALS	

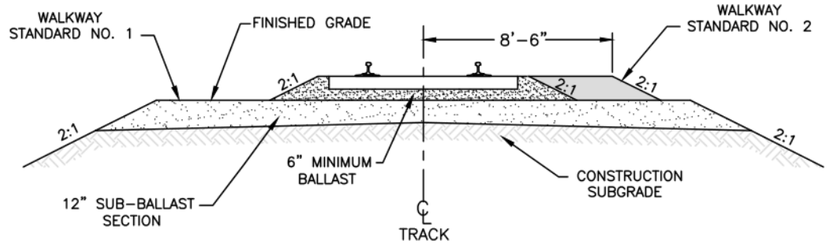
CN

SWITCH STAND
36E & 36EH

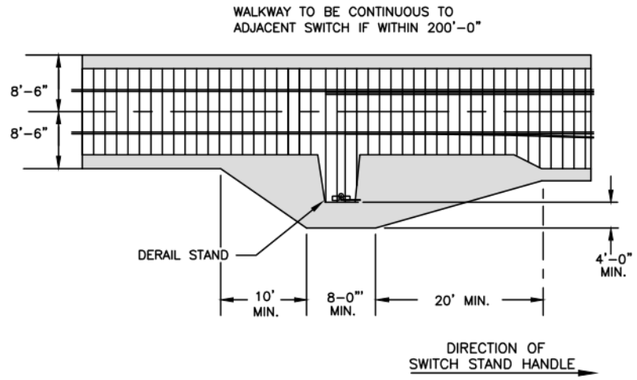
SHEET	OFFICE OF DESIGN & CONSTRUCTION		
1 OF 1	DRAWN BY: DAP	SCALE: NONE	DWG NO:
	CHECKED BY:	DATE: 22 JUL 10	FILE:



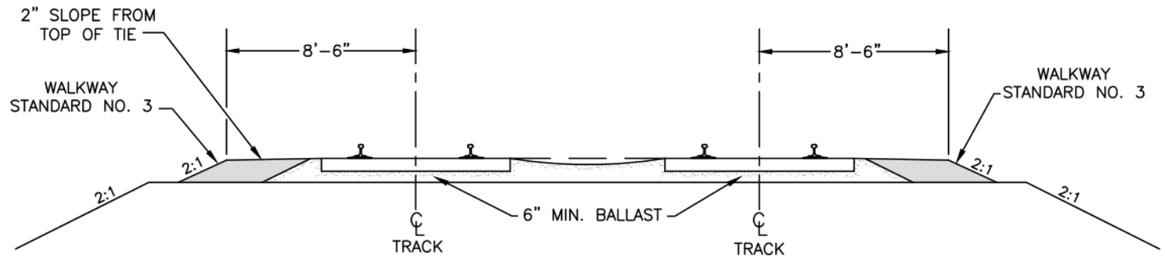
WALKWAY STANDARD NO. 3
INDUSTRIAL TRACK ROADBED ONLY



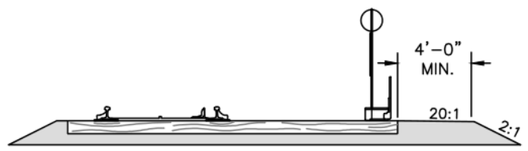
WALKWAY STANDARD NO. 1 AND 2
INDUSTRIAL TRACK ROADBED



WALKWAY STANDARD NO. 4
INDUSTRIAL TRACK ROADBED



WALKWAY STANDARD NO. 5
INDUSTRIAL ROADBED FOR TWO OR MORE TRACKS



TYP. SWITCH STAND SECTION

NOTE:

WALKWAYS ARE TO BE CONSTRUCTED ONLY WITHIN LIMITS OF INDUSTRIAL TRACKS AND ARE NOT TO BE BUILT ALONG MAIN TRACK SWITCHES. USE ONLY NO. 5 TYPE BALLAST

REVISIONS	
DATE	BY
APPROVALS	
SHEET 1 OF 1	

WALKWAYS FOR INDUSTRIAL TRACKS

OFFICE OF DESIGN & CONSTRUCTION		
DRAWN BY: DAP	SCALE: NONE	DWG NO:
CHECKED BY:	DATE: 26 JUN 10	FILE:

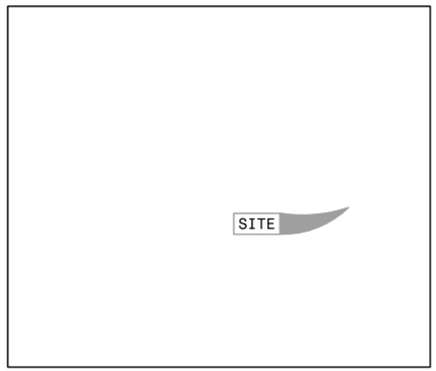
CONSTRUCTION DRAWINGS

TITLE SPECIFIC TO PROJECT

NNN STNAME STREET

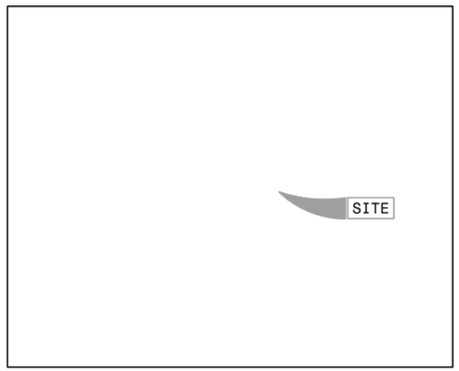
XXCITYXX, XXSTATE/PROV.XX XZIP/POSTALCODEX

DD MMM YYYY



SITE LOCATION MAP

SCALE: N.T.S.



SITE VICINITY MAP

SCALE: N.T.S.

INDEX

STANDARD REFERENCE DRAWINGS

THE REFERENCE DRAWINGS LISTED ON THIS PLAN SHALL BE CONSIDERED A PART THEREOF:

NONE USED

BENCHMARKS

BM #1
TOP OF RAILROAD TRACK AT _____. TOP OF THE LETTER "O" OF "xx". PAINTED _____.
ELEVATION = XXX.XX' (NAVD XX)

BM #2

FLOOD ZONE INFORMATION

THIS IS TO CERTIFY THAT THIS PROPERTY (THE SUBJECT PROPERTY OR PORTION OF SURVEYED) IS NOT WITHIN THE LIMITS OF A DESIGNATED FLOOD HAZARD AREA. THIS PROPERTY FALLS WITHIN AN "OTHER AREAS", ZONE X BEING DEFINED AS, "AREAS DETERMINED TO BE OUTSIDE 500-YEAR FLOOD PLAIN" PER FEMA FIRM MAP NUMBER _____ DATED MMM XX, YYYY BASED UPON OUR INTERPRETATION OF THE LOCATION OF THE FLOOD HAZARD BOUNDARY LIMITS IN RELATION TO THE PROPERTY LINES. NO FLOOD STUDY WAS PERFORMED FOR THIS SURVEY.

ISSUED FOR
XXXXXX

SUBIVISION: XXSUBDIVISION NAMEXX
MILE POST.: XXNUMBER.OXX
RR STATION: XXNEAREST STATIONXX

FOR CN REVIEW

DIG LOGO

SAFE DIGGING INFORMATION
CALL BEFORE YOU DIG
1-800-XXX-XXXX

STAMP

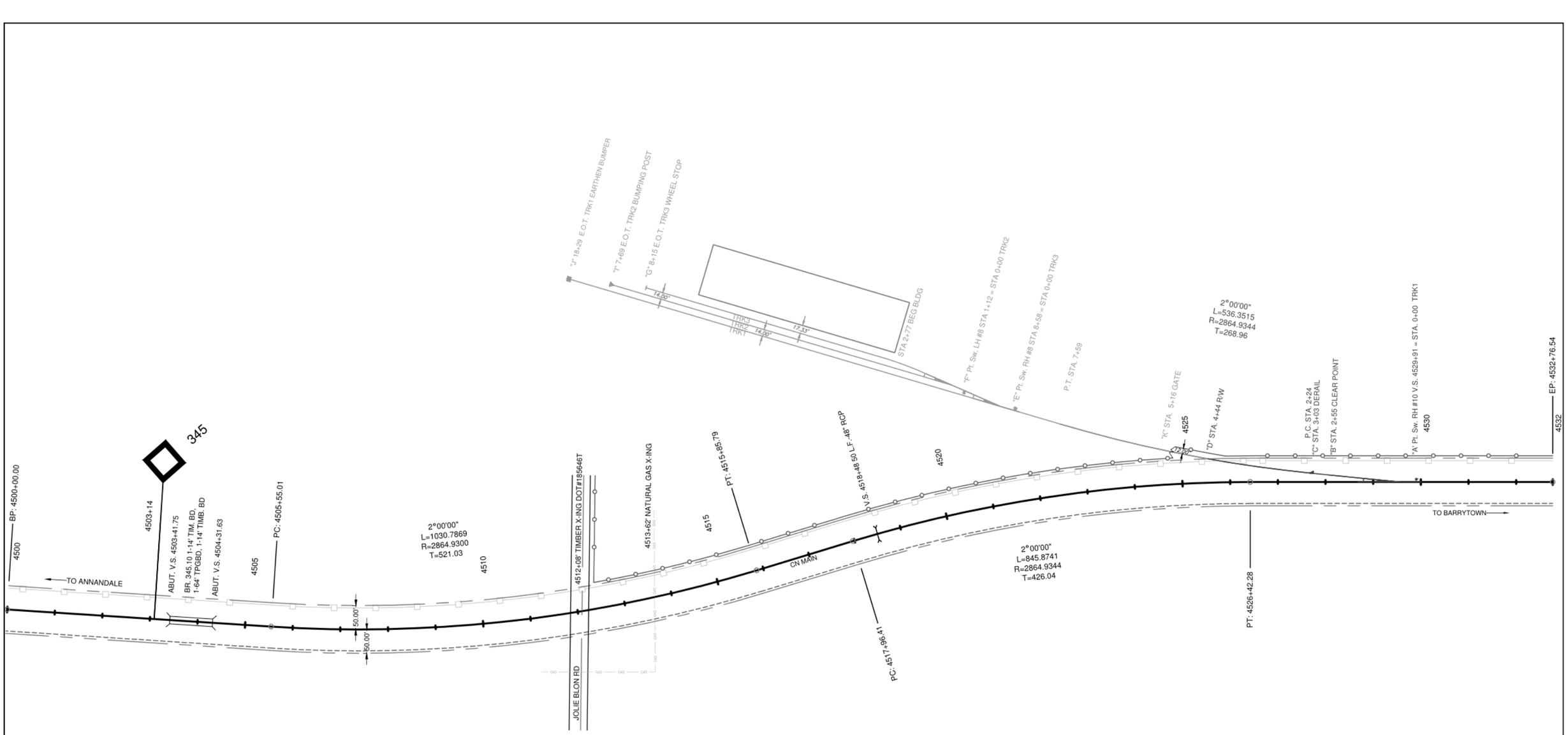
REV.	DATE	DRN.	CHK'D	REVISIONS DESCRIPTION	APPR.

INDUSTRY LOGO HERE

APPROVED FOR CONST.	REV. #	LOCATION		TITLE
BY	DATE	UNIT-BLDG		TITLE SHEET
		DRN.		
		DATE		
		CHK'D		
		DATE		DRAWING NO. / REV.
		SCALE		
		PLOT		
PROJ. #		PROJ. TITLE		TITLE SPECIFIC TO PROJECT

ENGINEER LOGO

ADDRESS
CITY, STATE
PHONE: (XXX)XXX-XXXX
FAX: (XXX)XXX-XXXX
www.WEBSITE.com



DESIGN FIRM NAME
AND/OR LOGO
GOES HERE

LEGEND:

- EXISTING MAIN TRACK
- EXISTING SIDING/SPUR TRACK
- PROPOSED TRACK
- INDUSTRY MAINTAIN
- REMOVED TRACK
- SHIFTED TRACK
- FUTURE TRACK
- RIGHT OF WAY
- TURNOUTS HAND THROWN/POWER
- WHEEL STOP
- BUMPING POST
- FIBER OPTIC
- EARTHEN BUMPER
- DERAIL
- SWITCH POINT DERAIL
- CULVERT
- BRIDGE
- BUILDING
- FENCE
- OVERHEAD POWER LINE
- GAS LINE

NOTES:

WORK BY CN
1. CN TO INSTALL MAINLINE RH #10 TURNOUT
2. CN TO BUILD TO THE CLEARANCE POINT STA. 2+55

WORK BY CONTRACTOR
1. INSTALL TRACK FROM CLEARANCE POINT. 2888 T.F.
2. INSTALL 1-RH #8 TURNOUT, 1-LH #8 TURNOUT
3. INSTALL 1 EARTHEN BUMPER, 1-BUMPING POST, 1-SET WHEEL STOPS

REVISIONS	
DATE	BY
DD MMM YY	XXX
APPROVALS	

CN

OPERATNG RAILROAD
XXXX DIVISION
XXX SUB
LOCATION

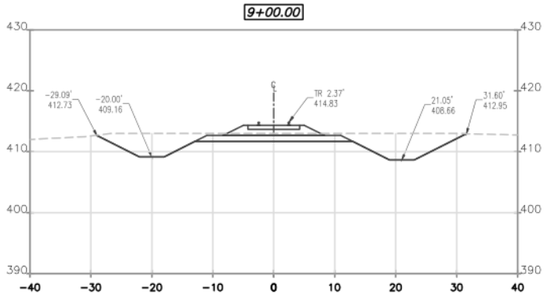
TRACKAGE TO SERVE: INDUSTRY NAME

OFFICE OF DESIGN & CONSTRUCTION

SHEET	DRAWN BY: XXX	SCALE: 1" TO XXX'	DWG NO:
1 OF 1	CHECKED BY: XXX	DATE: DD MMM YY	FILE:

PAGE 88

9+00.00



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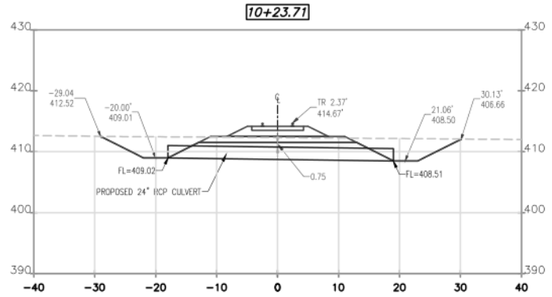

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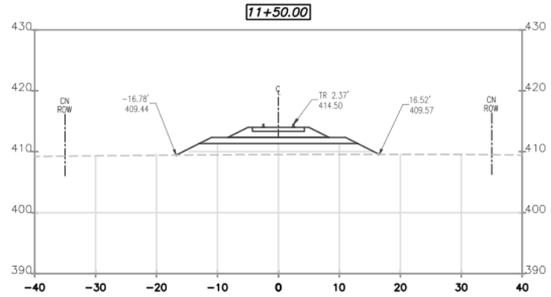

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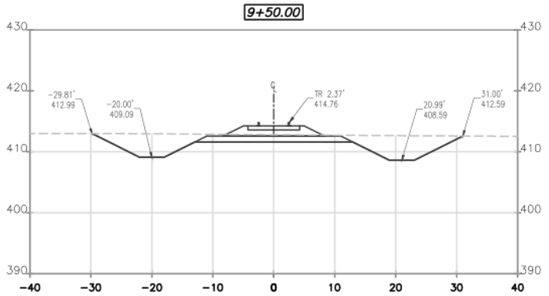

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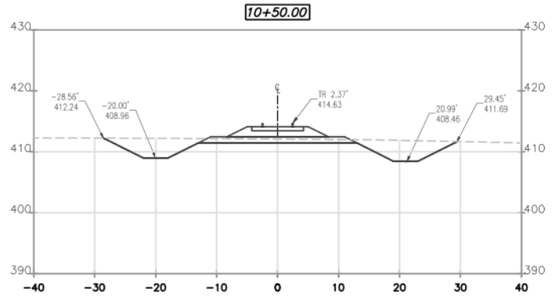

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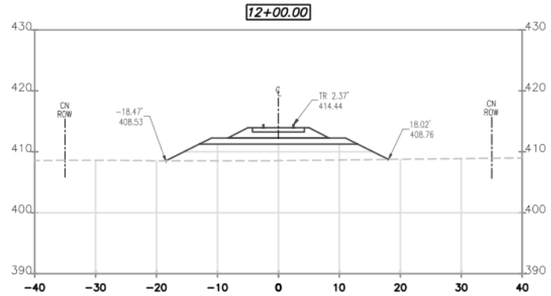

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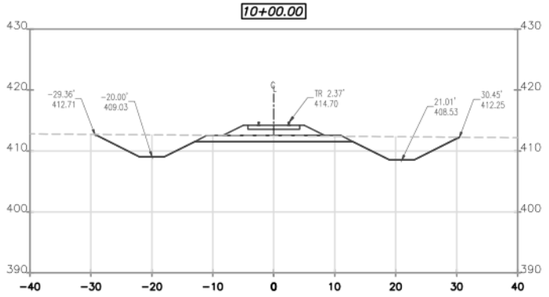

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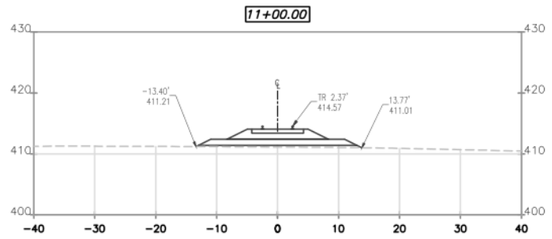

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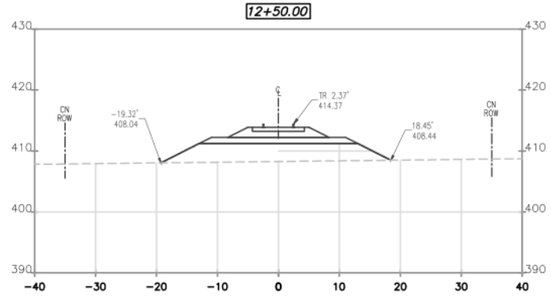


DESIGN FIRM NAME
AND/OR LOGO
GOES HERE

LEGEND:

EXISTING GROUND

PROPOSED SECTION

REVISIONS	
DATE	BY
DD MMM YY	XXX

APPROVALS

SHEET
1 OF 1

OPERATNG RAILROAD
XXXXX DIVISION
XXXXX SUB
LOCATION

PROJECT NAME
TYPICAL CROSS SECTIONS
9+00 TO 12+50

OFFICE OF DESIGN & CONSTRUCTION

DRAWN BY: XXX	SCALE: 1" TO XXX'	DWG NO:
CHECKED BY: XXX	DATE: DD MMM YY	FILE:

BNSF DESIGN GUIDELINES FOR INDUSTRIAL TRACK PROJECTS

BNSF RAILWAY COMPANY

DESIGN GUIDELINES
FOR
INDUSTRIAL TRACK PROJECTS

Engineering Services

4515 Kansas Avenue
Kansas City, KS 66106

May 2011 – Revised Dec 2011

BNSF RAILWAY COMPANY

DESIGN GUIDELINES FOR INDUSTRIAL TRACK PROJECTS

MAY 2011

TABLE OF CONTENTS **PAGE**

GENERAL PROCEDURE FOR DEVELOPMENT OF TRACK PLANS AND

ESTIMATES FOR INDUSTRIAL TRACK PROJECTS

These guidelines are intended for the development of industry tracks and facilities. Build-ins and tracks other than industrial need to follow BNSF's Main Line Design Guidelines for Track Projects.

1. Customer will contact BNSF's Economic Development (ED) representative. A questionnaire will be completed that will be used in preparing the New Business Review (NBR) to be reviewed by various BNSF groups, including Service Design & Performance (SDP).

2. Customer will be required to furnish a track plan for the project. Prior to preparing the track plan, it is recommended a site meeting be held to review the proposal. BNSF's ED, Engineering, Division Maintenance, Signal Engineering and Division Operating personnel should attend as appropriate to meet with the Customer.

   The feasibility of constructing the project at the location will be discussed along with operating issues and recommendations from the NBR. Track layout concepts and constraints will be identified with the Customer, the intent being to guide the track design to an efficient layout given specific site conditions. The Customer's track designer can attend this meeting. Following meeting, BNSF Engineering will prepare a project schematic (see appendix, page A-9, for example) and forward to Division Operating, Division Maintenance, Signal Engineering and ED for review and approval. Approvals and comments are returned to BNSF Engineering and the sketch is edited as necessary. ED will furnish a copy to the Customer upon BNSF internal approval.

3. The Customer may use a designer or contractor of its choice to prepare the track plans. The project schematic is to be used as a guide for preparation of the track plans. Plans should be complete and follow the example outlined herein. Questions concerning these guidelines should be directed to the BNSF Engineering representative. Customers are encouraged to reference this document, including standard plan drawings, in the construction specifications.

4. The Customer will develop an industrial track plan (in electronic format), including plan/profile and drainage plan, which is to be submitted to ED for further handling by BNSF. Design plans shall include all information contained in "Industrial Track Survey and Plan Requirements" section, pages 10 and 11. BNSF Engineering will review and approve the track design, and if there are significant changes from the project schematic, the plan may need to be reviewed by other BNSF departments.

5. BNSF Engineering will communicate directly with the Customer regarding any plan revisions. Any revisions will be documented on the prints and communicated in writing to the Customer. BNSF Engineering will notify ED when the industrial track plan has been approved.

6. BNSF Engineering will prepare a cost estimate, chargeable to the Customer, for ***the BNSF portion of track construction***, and revise the project schematic if necessary. In general, BNSF will construct from point of switch to the 14-ft clearance point. When a power turnout is required, BNSF will construct from the point of switch to just beyond the power derail.

7. Upon receiving the Firm Bid Cost Estimate, ED will present the formal industrial track package, including all agreements and cost proposal, to the Customer for consideration.

8. Upon Customer's acceptance of the proposal (check, fully executed agreements, and submittal of the final plans) ED will notify all concerned the project has been approved and funded. The final plans must be approved by BNSF Engineering prior to start of work on BNSF property. Materials for BNSF's portion of the project are ordered, work scheduled and construction completed.

1. **Roadbed:**

   Roadbed and ballast section for industrial trackage shall conform to the special roadbed section (see appendix, page A-10), and to the ballast material requirements on page 16.

2. **Curvature:**

   Maximum degree of curve shall not exceed 9°30' (603.80' radius). All curves are defined using the chord definition method. A minimum tangent length of 50 feet must be placed between reversing curves. No turnouts (switches) can be placed in a curve. Mainline turnouts must be placed at least 200 feet from the end of a mainline curve.

3. **Profile Grade:**

   Track profile grades shall be limited to a maximum of 1.5%.

4. **Vertical Curves:**

   Vertical curves must be provided at break points in profile grade. The rate of change shall not exceed 2.0 in summits or sags. Vertical curves shall not extend into limits of turnout switch ties. See appendix, pages A-41 and A-42 for BNSF's standard for vertical curves.

5. **Track:**

   Recommended rail section is 112-lb. or greater. Hardwood ties shall be new 7" X 8" (No. 4) or 7" X 9" (No. 5), 8'-6" long, placed on 21.5" centers with a 6" ballast section. Rail anchorage shall be provided at a minimum rate of 16 anchors per 39' panel. Continuous welded rail (CWR) shall be box-anchored every other tie. Concrete ties can be spaced at 28" center to center with an 8" ballast section. CWR is recommended when using concrete ties. Steel ties are spaced at 24" centers with 8" ballast section.

6. **Turnouts:**

   All main line, controlled siding and passing track turnouts will be a minimum new No. 11-141 lb. and include either a spring-rail frog or a rigid, railbound manganese frog, as specified by BNSF Engineering. For other turnouts maintained by BNSF, the size and weight will be determined dependent upon the transportation commodity, with a No. 11-141 lb. recommended, and a No. 9 - 112 lb. as the minimum (see appendix, pages A-15 to A-32). Main line turnout switch ties shall be new and hardwood. All mainline, controlled siding and passing track turnouts and trackage are to be placed by BNSF personnel out to the 14' clearance point.
   Mainline, controlled siding and passing track turnouts will require the placement of a construction berm alongside the track to allow assembly of the turnout, with no disruption to traffic. After the turnout is assembled, a track window is obtained to remove the trackage and insert the turnout. An example of a construction berm is shown in the appendix on page A-13.
   For turnouts placed off of BNSF property and/or maintained by the Customer, and operated by BNSF, the recommended minimum is a No. 9 - 112 lb. All switch stands need to include a "30 Degree" handle (see appendix, page A-34).
   Switch heaters are required for mainline turnouts where snow and ice present operational challenges. If a power turnout requires a switch heater, the power derail will require one also. The cost estimate will include installation of the switch heaters when required.

7. **Derails:**

A derail shall be placed on all tracks connecting with a main line, siding, or industrial lead. Derails protecting mainline tracks and controlled sidings shall be double switch point (see appendix, page A-33) and installed so that the derailed car is directed away from BNSF trackage. A power derail is required when the mainline turnout is powered, and BNSF will install track and signal from the point of switch to the insulated joints just beyond the power derail. Derails protecting mainline tracks shall be placed a minimum of 100 feet behind the 14' clearance point, and placed on tangent track where possible. Derails protecting other-than-mainline tracks shall be placed a minimum of 50 feet behind the 14' clearance point, and placed on tangent track where possible. The type of derail and actual location may be determined by BNSF Operating Department requirements. A "Derail" sign needs to be placed next to the derail.

8. **Structures:**

Bridges, drainage structures, track hoppers, retaining walls, etc. shall be designed to carry Cooper E-80 live load with diesel impact. Structures shall be designed per American Railway Engineering and Maintenance of Way Association (AREMA) Manual chapters 1, 7, 8, or 15 as applicable, and designed by a licensed engineer. See AREMA standards for unloading pits. All structural plans will need to be reviewed and accepted by BNSF Engineering. Gratings covering open pits must be bolted in place.

9. **Road Crossings**

The standard for a road crossing surface installed and maintained by the BNSF is concrete plank (for 141-lb. rail) placed on 10-ft. switch ties. Also, ten each 10-ft. switch ties are placed on both ends of the crossing, replacing any standard cross-ties. For crossings installed and maintained by the Customer, a concrete plank is recommended, with a wood plank surface as acceptable (see appendix, pages A-35 to A-37).

10. **Clearances:**

BNSF will adhere to the "Clearance Requirements By State," BNSF Dwg. No. 2509, Sheet No. 2 (see appendix, page A-38) for each state. If a state does not have its own clearances, the "BNSF Minimum Clearances Diagram," BNSF Dwg. No. 2509, Sheet No. 1 (see appendix, page A-39) will apply. Side clearances for curves should have an additional 1-1/2" per degree of curvature. All effort should be made to provide adequate clearances. In the event clearances cannot be provided for as prescribed, warning signs will be installed and they must be illuminated at night (see appendix, page A-40).
All loading/unloading equipment that fouls the clearance envelope during operation must positively lock in a non-fouling position when not in use.
All new tracks constructed will maintain a minimum distance of 25 feet for track centers from any main track, controlled siding or passing track. New tracks adjacent to other tracks will maintain a minimum distance of 14 feet for track centers.
At road crossings the set-back distance for storing rail cars on multiple adjacent tracks (track centers less than 25') is 250 feet from the edge of roadway. For single tracks, the setback distance varies for each state and is regulated by the states' appropriate agencies**, but 150 feet from the edge of roadway is the minimum.** However, operating conditions may require greater distances.

11. **Walkways:**

Walkways on bridges and adjacent to switches and trackage are governed by the appropriate State Public Service Commission, Railway Commission or other State and/or Federal agencies. However, the example on page A-11 depicts requirements for most states. Walkway ballast shall be Class 2 and no larger than 1" in size (ballast gradation shown on page 16).

12. **Signals and Electrical Service**

Customer shall provide electrical service to BNSF property should the proposed trackwork require power for the signal facilities. The requirement and locations will be identified at the initial on-site meeting. If the service is for an electric switch heater, a 200 Amp, Single Phase, 120/240 volt service, with meter socket and service disconnect is required. The service disconnect shall be a 200 amp, 2 pole breaker by either Cutler Hammer or Square D (QO style), with the meter socket requirement as per the power company specifications. No additional electrical panels are necessary as BNSF will take a feeder from the load side of the 200 amp service disconnect switch. The service may be either overhead or underground. All electrical installations will be made in accordance with the prevailing State/local electrical code(s), or if there is none, the current edition of the National Electrical Code will govern the installation. If an electric switch heater is not involved, 100 Amp service will be sufficient.

13. **Inspection of Materials and Track:**

BNSF's Division Engineer representative should inspect all track materials prior to placement to avoid subsequent removal of sub-standard material. BNSF personnel will inspect the completed track before placing it into service.

14. **General:**

a. Loading and unloading tracks must be designed so that they are completely independent of railroad operating lines and passing tracks such that loading and unloading operations in no way interfere with train operations. Design of trackage must be approved by BNSF Engineering.

b. Utility installations may require a permit. Pipelines under track are to be encased per BNSF requirements. Wirelines are to be installed per BNSF requirements. Refer to "BNSF Utility Accommodation Policy" booklet. Utilities within 50 feet beyond the end of track must be underground, and protected as if they were under the track.

c. The effect on sight distance must be considered when planning construction of trackage in the vicinity of any grade crossings. The required sight distance should be determined and preserved when performing and designing for construction near any grade crossing. Less than the required sight distance will be the liability of the Customer.

Maintenance of Way Operating Rule No. 6.32.4:
"Leave cars, engines, or equipment clear of road crossings and crossing signal circuits. If possible, avoid leaving cars, engines, or equipment standing closer than 250 feet from the road crossing when there is an adjacent track (<25' track centers)."

d. An earthen berm (see appendix, page A-14) or suitable bumping post shall be installed at the end of track. Also, a red retro-reflective marker shall be placed at the end of track.

e. **Customer is responsible for all grading including placing all subballast up to BNSF ballast and the placement of a construction berm.**

f. Customer is to acquire any additional property required to construct grade and drainage. If the proposed trackage or facility will increase runoff onto BNSF property, a detailed drainage plan needs to be submitted for review prior to construction. Drainage should be handled in a manner as not to overload current drainage structures on BNSF property.

g. **Contractor must not at any time foul the main line tracks.** A BNSF flagman will be required, at the Contractor's expense, when working within 25 feet from centerline of the track.

Billing for the flagman is separate from the cost for BNSF portion of the track work. Current cost for BNSF flagging is approximately $1,000 per day with billing based on actual charges.

h. Adequate lighting must be provided for train crews working at night. Work areas near switches, gates, doors, pits and buildings should be illuminated to prevent walking/tripping hazards and allow crewmen riding rail cars to see without reliance upon a flashlight.

1. **Roadbed:**

   Roadbed and ballast section for industrial trackage shall conform to the special roadbed section (see appendix, page A-10), and to the ballast material requirements on page 16.

2. **Curvature:**

   Maximum degree of curve shall not exceed 7°30' (764.49' radius). All curves are defined using the chord definition method. A minimum tangent length of 200 feet must be placed between reversing curves. No turnouts (switches) can be placed in a curve. Mainline turnouts must be placed at least 200 feet from the end of a mainline curve.

3. **Profile Grade:**

   Track profile grades shall be limited to a maximum of 1.5%. For loop tracks, the maximum grade will be 0.5%. Other restrictions may be defined for individual projects.

4. **Vertical Curves:**

   Vertical curves must be provided at break points in profile grade. The rate of change shall not exceed 1.0 in summits or 0.5 in sags. Vertical curves shall not extend into limits of turnout switch ties. See appendix, pages A-41 and A-42 for BNSF's standard for vertical curves.

5. **Track:**

   For New Unit Train Facilities minimum rail section is 112-lb and continuous welded rail (CWR) is recommended. Hardwood ties shall be new 7" X 8" (No. 4) or 7" X 9" (No. 5), 8'-6" long, placed on 21.5" centers with a 6" ballast section. Rail anchorage shall be provided at a minimum rate of 16 anchors per 39' panel. Continuous welded rail (CWR) shall be box-anchored every other tie. Concrete ties can be spaced at 28" center to center with an 8" ballast section. CWR is recommended when using concrete ties. Steel ties are spaced at 24" centers with 8" ballast section.

6. **Turnouts:**

   All main line, controlled siding and passing track turnouts will be a minimum new No. 11-141 lb. and include either a spring-rail frog or a rigid, railbound manganese frog, as specified by BNSF Engineering. For other turnouts maintained by BNSF, a No. 11-115 lb. is the minimum (see appendix, pages A-21 to A-32). Main line turnout switch ties shall be new and hardwood. All mainline, controlled siding and passing track turnouts and trackage are to be placed by BNSF personnel out to the 14' clearance point. All joints in the side of turnout receiving majority of traffic will be thermite welded.
   Mainline, controlled siding and passing track turnouts will require the placement of a construction berm alongside the track to allow assembly of the turnout, with no disruption to traffic. After the turnout is assembled, a track window is obtained to remove the trackage and insert the turnout. An example of a construction berm is shown in the appendix on page A-13.
   For turnouts placed off of BNSF property and/or maintained by the Customer, and operated by BNSF, a No. 11 - 112 lb. turnout will be the minimum. All switch stands need to include a "30 Degree" handle (see appendix, page A-34).

Switch heaters are required for mainline turnouts where snow and ice present operational challenges. If a power turnout requires a switch heater, the power derail will require one also. The cost estimate will include installation of the switch heaters when required.

7. **Derails:**

A derail shall be placed on all tracks connecting with a main line, siding, or industrial lead. Derails protecting mainline tracks and controlled sidings shall be double switch point (see appendix, page A-33) and installed so that the derailed car is directed away from BNSF trackage. A power derail is required when the mainline turnout is powered, and BNSF will install track and signal from the point of switch to the insulated joints just beyond the power derail. Derails protecting mainline tracks shall be placed a minimum of 100 feet behind the 14' clearance point, and placed on tangent track where possible. Derails protecting other-than-mainline tracks shall be placed a minimum of 50 feet behind the 14' clearance point, and placed on tangent track where possible. The type of derail and actual location may be determined by BNSF Operating Department requirements. A "Derail" sign needs to be placed next to the derail.

8. **Structures:**

Bridges, drainage structures, track hoppers, retaining walls, etc. shall be designed to carry Cooper E-80 live load with diesel impact. Structures shall be designed per American Railway Engineering and Maintenance of Way Association (AREMA) Manual chapters 1, 7, 8, or 15 as applicable, and designed by a licensed engineer. See AREMA standards for unloading pits. All structural plans will need to be reviewed and accepted by BNSF Engineering. Gratings covering open pits must be bolted in place.

9. **Road Crossings**

The standard for a road crossing surface installed and maintained by the BNSF is concrete plank (for 141-lb. rail) placed on 10-ft. switch ties. Also, ten each 10-ft. switch ties are placed on both ends of the crossing, replacing any standard cross-ties. For crossings installed and maintained by the Customer, a concrete plank is recommended, with a wood plank surface as acceptable (see appendix, pages A-35 to A-37).

10. **Clearances:**

BNSF will adhere to the "Clearance Requirements By State," BNSF Dwg. No. 2509, Sheet No. 2 (see appendix, page A-38) for each state. If a state does not have its own clearances, the "BNSF Minimum Clearances Diagram," BNSF Dwg. No. 2509, Sheet No. 1 (see appendix, page A-39) will apply. Side clearances for curves should have an additional 1-1/2" per degree of curvature. All effort should be made to provide adequate clearances. In the event clearances cannot be provided for as prescribed, warning signs will be installed and they must be illuminated at night (see appendix, page A-40).
All loading/unloading equipment that fouls the clearance envelope during operation must positively lock in a non-fouling position when not in use.
All new tracks constructed will maintain a minimum distance of 25 feet for track centers from any main track, controlled siding or passing track. New tracks adjacent to other tracks will maintain a minimum distance of 14 feet for track centers.
At road crossings the set-back distance for storing rail cars on multiple adjacent tracks (track centers less than 25') is 250 feet from the edge of roadway. For single tracks, the setback distance varies for each state and is regulated by the states' appropriate agencies**, but 150 feet from the edge of roadway is the minimum.** However, operating conditions may require greater distances.

11. **Walkways:**

Walkways on bridges and adjacent to switches and trackage are governed by the appropriate State Public Service Commission, Railway Commission or other State and/or Federal agencies. Due to revised FRA Airbrake and Train Handling Rules, outbound trains are required to have an airbrake inspection on both sides of the train. New shuttle projects will be required to have a minimum 13' inspection road on one side and a minimum 8.5' walkway on the other. See appendix pages A-11 and A-12 for typical sections of roads and walkways. Walkway ballast shall be Class 2 and no larger than 1" in size (ballast gradation shown on page 16).

12. **Signals and Electrical Service**

Customer shall provide electrical service to BNSF property should the proposed trackwork require power for the signal facilities. The requirement and locations will be identified at the initial on-site meeting. If the service is for an electric switch heater, a 200 Amp, Single Phase, 120/240 volt service, with meter socket and service disconnect is required. The service disconnect shall be a 200 amp, 2 pole breaker by either Cutler Hammer or Square D (QO style), with the meter socket requirement as per the power company specifications. No additional electrical panels are necessary as BNSF will take a feeder from the load side of the 200 amp service disconnect switch. The service may be either overhead or underground. All electrical installations will be made in accordance with the prevailing State/local electrical code(s), or if there is none, the current edition of the National Electrical Code will govern the installation. If an electric switch heater is not involved, 100 Amp service will be sufficient.

13. **Access Road:**

Unless otherwise directed a road will be required that will provide access to inspect the entire train prior to movement from the facility. Due to revised FRA Airbrake and Train Handling Rules, outbound trains are required to have an airbrake inspection on both sides of the train. New shuttle projects will be required to have a minimum 13' inspection road on one side and a minimum 8.5' walkway on the other. See appendix pages A-11 and A-12 for typical sections of roads and walkways. A standard section with a 13-ft wide roadway is shown in the appendix, page A-12. The roadway can be constructed using subballast materials as specified in the Grading & Embankment section of this document, page 12.

14. **Inspection of Materials and Track:**

BNSF's Division Engineer representative should inspect all track materials prior to placement to avoid subsequent removal of sub-standard material. BNSF personnel will inspect the completed track before placing it into service.

15. **General:**

a. Loading and unloading tracks should be designed so that they are completely independent of railroad operating lines and passing tracks such that loading and unloading operations in no way interfere with train operations. Design of trackage must be approved by BNSF Engineering.

b. Utility installations may require a permit. Pipelines under track are to be encased per BNSF requirements. Wirelines are to be installed per BNSF requirements. Refer to "BNSF Utility Accommodation Policy" booklet. Utilities within 50 feet beyond the end of track must be underground, and protected as if they were under the track.

c. The effect on sight distance must be considered when planning construction of trackage in the vicinity of any grade crossings. The required sight distance should be determined and preserved when performing and designing for construction near any grade crossing. Less than the required sight distance will be the liability of the Customer.

Maintenance of Way Operating Rule No. 6.32.4:
"Leave cars, engines, or equipment clear of road crossings and crossing signal circuits. If possible, avoid leaving cars, engines, or equipment standing closer than 250 feet from the road crossing when there is an adjacent track (<25' track centers)."

d. An earthen berm (see appendix, page A-14) or suitable bumping post shall be installed at the end of track. Also, a red retro-reflective marker shall be placed at the end of track.

e. **Customer is responsible for all grading including placing all subballast up to BNSF ballast and the placement of a construction berm, if required.**

f. Customer is to acquire any additional property required to construct grade and drainage. If the proposed trackage or facility will increase runoff onto BNSF property, a detailed drainage plan needs to be submitted for review prior to construction. Drainage should be handled in a manner as not to overload current drainage structures on BNSF property.

g. **Contractor must not at any time foul the main line tracks.** A BNSF flagman will be required, at the Contractor's expense, when working within 25 feet from centerline of the track. Billing for the flagman is separate from the cost for BNSF portion of the track work. Current cost for BNSF flagging is approximately $1,000 per day with billing based on actual charges.

h. Adequate lighting must be provided for train crews working at night. Work areas near switches, gates, doors, pits and buildings should be illuminated to prevent walking/tripping hazards and allow crewmen riding rail cars to see without reliance upon a flashlight.

i. A track to set out bad order cars unsuitable for loading or unloading needs to be added to the overall design. Set out track should be long enough to place at least 5 rail cars and be accessible to a repair crew. A locomotive tie-up track may also need to be incorporated into the design. This need will be determined at the on-site meeting.

INDUSTRIAL TRACK SURVEY AND PLAN REQUIREMENTS

Provide a Plan View of new track(s):

Show complete description of all proposed trackage, including mainline or lead track stationing, curvature, milepost location and size (#9, #11, #15) of proposed or future turnouts, car capacities, and location of bumpers or wheel stops and derails. Include at least one existing fixed object (road xing, point of switch) to assist with staking the new trackage.

With track stationing show location of 14′ clearance point, railroad property line and pertinent property corners, and any previously dedicated railroad easements. Ex: "Sta 1+85.0 Clear Pt". Note length of storage capacity of each track (clear length).

Show the location of present or proposed buildings including locations of unloading doors, ramps or docks. Show clearance from centerline of track to these facilities.

Show all existing trackage using railroad stationing, and locate all obstructions such as poles, pole lines, utilities, ditches and road crossings. Note the type of signal protection at grade crossings and location of insulated joints where applicable, and whether modifications to any of these facilities are required.

Note weight of rail in existing and proposed tracks, and list materials to be used for proposed tracks.

Furnish Milepost and Line Segment (if known) in the Title Block, along with name of Industry and date of plan preparation. Contact information for engineering firm should also be included on plans.

Suggested plan scale: 1" = 50'. **All plans and drawings need to be prepared electronically in MicroStation format (AutoCad acceptable)**. This allows for updates to BNSF's maps and records to be done electronically. All information is to be in English units. Plan submittals should be in Adobe's Acrobat pdf format, with 11" x 17" sheet size. Upon approval, BNSF Engineering will revise the project schematic, if necessary.

Establish and document one local benchmark near industrial track site.

Provide a Profile View of new track(s):

Include profile of top/rail of new track and ground line at centerline of track.

Include profile of existing track at location of switch and switch ties.

Include cross-sections for proposed tracks and existing affected tracks.

Show drainage structures, if required, with invert elevations and ditch profiles.

Suggested scales for drawings:
Profiles: 1" = 50' horizontal and 1" = 5' vertical
Cross Sections: 1"=10' horizontal and vertical

Include a description of work to be performed by the railroad:

Example: "Construct 185 track feet including a #11-141 lb turnout from point of switch to clearance point, raise railroad pole line, adjust signals."

Include a description of work to be performed by the contractor:

Example: "Construct remaining trackage from clearance point to end, place wheel stops, install plank crossing and signs, perform all grading, install all drainage structures, install double switch point derail, provide electrical service to a point opposite the proposed switch locations."

Include a list of track materials to be used by the contractor:

Example: "115-lb continuous welded rail (CWR) on #4 new cross-ties, #11-115lb BNSF standard turnouts, 32-ft full depth timber crossing planks to be placed in new construction."

Provide an Operating Plan

Prepare a sketch (does not have to be to-scale) showing in-bound and out-bound switching plans and lengths of tracks to be used. Accompany sketch with a brief narrative of a typical move to switch facility.

Customers are encouraged to reference this document, including standard plan drawings, in the construction specifications.

CONTRACTOR'S RESPONSIBILITY

By acceptance of the contract the contractor assumes complete responsibility for construction of the work. The Contractor should understand that any work not specifically mentioned in the written specifications, but which is necessary, either directly or indirectly, for the proper carrying out of the intent thereof, shall be required and applied, and will perform all such work just as though it were particularly delineated or described. Contractor should also understand that final approval of the track for service is the prerogative of BNSF and close contact with BNSF's Engineering and Division Engineer (if applicable) is required. No work is to be performed on BNSF's right-of-way, or in such proximity as to interfere with BNSF's tracks or roadbed, without advance permission by BNSF, including insurance and if necessary, flagging protection.

INSURANCE REQUIREMENTS

Contained within the Contract for Industrial Track Agreement to be signed prior to construction.

GRADING & EMBANKMENT

The work covered by this section of the specifications consists of furnishing all plant, labor, material and equipment and performing all operations in connection with construction of track roadbed, including clearing and grubbing, excavation, construction of embankments and incidental items, all in accordance with the contract drawings and specifications.

The Contractor shall load, haul, spread, place and compact suitable materials in embankments and shall finish the embankments to the grade, slope and alignment as shown in the plans. Suitable materials shall consist of mineral soils free from organics, debris, and frozen materials. Embankment slopes shall be compacted and dressed to provide a uniform and dense slope. Embankments shall be built with approved materials from excavation of cuts or from borrow unless otherwise shown on the plans.

If materials unsuitable for embankments (organics, debris, brush and trees, etc.) are encountered within the areas to be excavated, or material existing below the designated subgrade in cuts or within areas on which embankments are to be placed are of such nature that stability of the roadbed will be impaired, such materials shall be removed and wasted or stockpiled for other use. Topsoil removed from embankment areas shall be spread uniformly over the embankment slopes.

Unsuitable material removed from embankment foundations or below subgrade elevation in excavation areas shall be replaced to grade with suitable material compacted as specified for embankments in these specifications.

Wherever an embankment is to be placed on or against an existing slope steeper than four horizontal to one vertical, such slope shall be cut into steps as the construction of the new embankment progresses. Such steps shall each have a horizontal dimension of not less than three feet and a vertical rise of one foot.

At all times, the Contractor shall operate sufficient equipment to compact the embankment at the rate at which it is being placed. Compaction shall be accomplished by sheep’s foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Use construction procedures and drainage design that will provide a stable roadbed.

Each layer in embankments made up primarily of materials other than rock shall not exceed 6" in loose depth and shall be compacted to the dry density as specified hereinafter before additional layers are placed. All embankments shall be compacted to a density of not less than 95% of the maximum standard laboratory density, and not more than +4 percentage points above the optimum moisture content, unless otherwise specified on the drawings. The standard laboratory density and optimum moisture content shall be the maximum density and optimum moisture as determined in accordance with ASTM Designation: D 698 (Standard Proctor Test). Copies of soil test results shall be furnished to owner.

On top of the embankment fill, the Contractor shall place a minimum of 6 inches of granular sub-ballast which meets the above criteria and contains no material larger than that which will pass through a (3) inch square sieve. Sub-ballast shall be crushed gravel or crushed stone with a minimum 75% of the material having two fractured faces. Sub-ballast must meet the quality requirements of ASTM Designation: D 1241 and be approved by the Engineer. Additional sub-ballast may be required as determined from an engineering soil analysis.

CORRUGATED METAL CULVERTS

These instructions cover the selection, installation, and fabrication of circular type zinc coated (galvanized) corrugated steel culverts for nominal diameters of 36-inch to 96-inch, inclusive. Additional protective coatings may be specified or allowed by BNSF Engineering. The minimum diameter for all culverts installed under main tracks or tracks maintained by BNSF is 36 inches. This diameter will allow for inspection and cleaning. For culverts maintained by the Customer, 24 inches is the minimum diameter.

Galvanized corrugated steel pipe shall be manufactured in accordance with ASSHTO Specifications M 36 and M 218. All areas of surface rust on re-corrugated ends or lockseams shall be painted using the hot-dip or metallizing process.

Design, installation, and fabrication shall be in accordance with current American Railway Engineering and Maintenance of Way Association (AREMA) Specifications Chapter 1, Part 4, Culverts. Additionally, all culvert pipes shall meet the requirements shown in Table 1.

TABLE 1

Nominal Diameter (Inches)	Nominal* Corrugation (Inches)	Minimum** Width of Lap (Inches)	Nominal Thickness (Inches)	Thickness U.S. Std. Gage	Rivet** Diameter (Inches)	Max. Cover	Min. Cover
36	2-2/3 x 1/2	2	0.109	12	3/8	40'	***
42	2-2/3 X 1/2	3	0.138	10	3/8	70'	***
42	3 x 1 &5 x 1	3	0.109	12	7/16	70'	***
48	2-2/3 x 1/2	3	0.138	10	3/8	65'	***
48	3 x 1 & 5 x 1	3	0.109	12	7/16	70'	***
54	2-2/3 x 1/2	3	0.168	8	3/8	60'	***
54	3 x 1 & 5 x1	3	0.138	10	7/16	75'	***
60	2-2/3 x 1/2	3	0.168	8	3/8	55'	***
60	3 x 1 & 5 x 1	3	0.138	10	7/16	70'	***
66	3 X 1 & 5 X 1	3	0.138	10	7/16	60'	***
72	3 X 1 & 5 X 1	3	0.168	10	7/16	65'	***
84	3 X 1 & 5 X 1	3	0.168	8	7/16	55'	***
96	3 X 1 & 5 X 1	3	0.168	8	7/16	45'	***

* Where two types of corrugation are acceptable, the use of standard 2-2/3" x 1/2" material is preferred, if available. 5 x 1 corrugations to be used only on helical pipe.

** For riveted pipe.
Pipes 48 inches or greater in diameter shall be shop-elongated 5 percent of their diameter in a vertical direction and have lifting lugs.

***Minimum cover to be one-half diameter of culvert pipe from top of subgrade to top of pipe.

Due to settlement of culvert pipes, cambering longitudinally is recommended to improve the flow line profile after settlement. This is accomplished by laying the upstream half of the pipe on a flatter grade than the downstream half. Riveted pipe shall be placed with the inside circumferential laps pointing downstream and with the longitudinal laps at the side. Pipes shall be installed with a camber suitable to the height of the cover over the pipe and bearing capacity of the supporting soil.

Firm support must be provided to obtain a satisfactory installation. The filling material adjacent to pipes shall be loose granular material, free from large stones, frozen lumps, cinders, or rubbish. The filling shall be deposited alternately on opposite sides of the pipe in layers not exceeding 6 inches in depth, and each layer shall be thoroughly tamped before placing the next layer. Special care shall be taken in tamping under the lower part of the pipe. For a trench installation, the backfill shall be tamped the entire width of the trench, and for surface installation it shall be tamped not less than one half the pipe diameter out from the sides of the pipe. The density of the backfill after tamping must be at least 95% of its maximum density, as determined by ASTM D 698.

Any other type or size drainage structure shall have approval of BNSF Engineering prior to installation under track locations.

UTILITY CROSSINGS

Utility crossings and relocations shall conform to BNSF standards as outlined in the "BNSF Utility Accommodation Policy." Applications for utility crossings and relocations are handled by Jones, Lang, LaSalle, phone number 1- 866-498-6647. Any questions regarding utilities can be directed to the BNSF Engineering representative.

CURVATURE AND GRADES

Tracks will be staked by the customer's surveyor (under flag protection if necessary) and constructed as shown on the approved plans. Any changes to the approved design need to be reviewed by BNSF Engineering or appointed representative.

CLEARANCES

BNSF will adhere to the "Clearance Requirements By State," BNSF Dwg. No. 2509, Sheet No. 2 (see appendix, page A-38) for each state. If a state does not have its own clearances, the "BNSF Minimum Clearances Diagram," BNSF Dwg. No. 2509, Sheet No. 1 (see appendix, page A-39) will apply. Side clearances for curves should have an additional 1-1/2" per degree of curvature. Warning signs will be installed for all close clearances less than standard (see appendix, page A-40). All loading/unloading equipment that fouls the clearance envelope during operation must positively lock in a non-fouling position when not in use.

MATERIAL

BNSF's Division Engineer representative should inspect all track materials prior to placement to avoid removal of sub-standard material. BNSF personnel will also inspect the track before placing it into service.

Rail:

For trackage maintained by the Customer the minimum acceptable rail shall be 112# section (5-1/2" base) and shall be compatible with BNSF standard rail section. For locations where trackage will be maintained by BNSF rail and fastenings shall conform to the BNSF standard rail section in use in that area. Contractor shall contact BNSF Engineering for approved section. Transition rails or compromise joints at the BNSF-Customer interface are the responsibility of the customer. Minimum length shall not be less than 39 feet except in turnouts and shall be free from defects. Rail should be minimum full ball relay rail, not exceeding 3/16 inch wear on any surface. Continuous welded rail (CWR) will need to be de-stressed as soon as possible after laying (see "Procedures for the Installation, Adjustment, Maintenance, and Inspection of CWR in Industry Tracks" appendix, page A-1 thru A-8). CWR is recommended when using concrete ties. Thermite and flash-butt welds must be placed in crib area between ties. An abrasive rail saw will be used to cut rail—no torch-cutting.

Anchors:

Rail anchors shall be new or reconditioned, sized to fit the rail section, and shall be provided per industrial track design criteria on pages 3 and 6. High traffic volumes or unusual grade or alignment problems may require additional anchors as determined by BNSF Engineering. Turnouts shall also be anchored.

Ties:

Hardwood ties shall be new 7" X 8" (AREMA No. 4) or 7" X 9" (No. 5), 8'-6" long, placed on 21.5" centers. Switch ties shall have a minimum cross section of 7" x 9" and minimum lengths shall conform to applicable BNSF Standard plans.

Concrete ties shall be pre-stressed, measure 11" wide at the bottom and 9" high with a length of 8' 3" and weight of 630 pounds. Concrete ties can be placed on 28" centers provided there is a minimum ballast section of 8" below the tie. Second-hand, or "3/4" concrete ties can be used after inspection and approval from the BNSF Roadmaster. When placing 3/4 ties, the damaged shoulders should be alternated from left to right sides so that they are not on the same side.

Steel ties are spaced at 24" centers with 8" ballast section and can be used with timber or concrete ties. Steel ties should not be used within 200 feet of a signal circuit identified by insulated joints.

Turnouts (Switches, Frogs & Guardrails):

All parts shall be new or good secondhand, with secondhand parts being free of injurious defects.

Tie Plates:

Tie plates may be new or secondhand, free of injurious defects and foreign material, conforming to AREMA Specifications, and shall fit rail being used. For rail 110# section and greater, all plates will be double-shouldered.

Joints:

New or secondhand joints, free of foreign material and without injurious defects, and with 4 or 6 bolt holes, conforming to AREMA requirements, may be furnished to fit rail section for which they are designed. Bolt holes must be drilled with proper equipment. Torch-cutting of bolt holes is not allowed. New or secondhand compromise joints of manufactured type (welded or homemade are not acceptable), free of foreign material and without injurious defects, shall be furnished and used where rail section (weight or design) changes. Rail section by weight shall not be compromised where difference in weight is in excess of 25 lbs. When this becomes necessary, a rail of some weight between the two different rail sections, in excess of 25 lbs., shall be used and the compromise made in two steps. The length of the medium-weight rail should be 39 feet where practical.

Spikes:

5/8" x 6" cut track spikes shall be installed. All spikes shall conform to AREMA requirements.

Track Bolts & Nuts:

Track bolts and nuts shall be installed conforming to AREMA Specifications. Bolts will be correct size and length to fit rail.

Lock Washers:

One lock washer conforming to AREMA Specifications shall be installed on each track bolt.

Ballast:

Track ballast shall be Class 2 (1" - 3/8"). Ballast shall be free from loam, dust, and other foreign particles and shall not have less than 75% crushed particles with two or more fractured faces, unless otherwise approved by BNSF.

Processed ballast shall be hard, dense, of angular particle structure, providing sharp corners and cubicle fragments and free of deleterious materials. Ballast materials shall provide high resistance to temperature changes, chemical attack, have high electrical resistance, low absorption properties and free of cementing characteristics. Materials shall have sufficient unit weight (measured in pounds per cubic foot) and have a limited amount of flat and elongated particles.

Unless it meets or exceeds BNSF requirements, slag is not an approved ballast material.

Walkway ballast shall be Class 2 (1" - 3/8").

NOMINAL BALLAST SIZE	PERCENT PASSING (BY WEIGHT)											
SIZE NO.	SQ. OPENING	2 ½"	2"	1 ¾"	1 ½"	1 ¼"	1"	3/4"	1/2"	3/8"	No. 4	
Class 2	1" – 3/8"				100		90-100	40-75	15-35	0-15	0-5	

Bumping Post:

An earthen berm (see appendix, page A-14) or suitable bumping post, approved by the Railroad, shall be installed at the ends of tracks. Also, a red retro-reflective marker shall be placed at the end of track.

Derails:

A derail shall be placed on all tracks connecting with a main line, siding, or industrial lead. Derails protecting mainline tracks and controlled sidings shall be double switch point (see appendix, page A-33) and installed so that the derailed car is directed away from BNSF trackage. A power derail is

required when the mainline turnout is powered, and BNSF will install track and signal from the point of switch to the insulated joints just beyond the power derail. Derails protecting mainline tracks shall be placed a minimum of 100 feet behind the 14' clearance point, and placed on tangent track where possible. Derails protecting other-than-mainline tracks shall be placed a minimum of 50 feet behind the 14' clearance point, and placed on tangent track where possible. The type of derail and actual location may be determined by BNSF Operating Department requirements. A “Derail” sign needs to be placed next to the derail.

A second derail may be required where BNSF locomotives are parked during unit train loading operations. BNSF's Operating department will determine the necessity and type. If required, placement will be 275 feet from first derail. A “Derail” sign needs to be placed next to the derail.

Timber ties are recommended within 50 feet of a derail.

Highway Crossings:

All crossings shall be approved by BNSF Engineering and local governments as to type and design, in advance of placing order. Effect on sight distance of crossings must be considered when planning construction of trackage in vicinity of public grade crossings not equipped with automatic signals.

Under Track Hoppers or Pits:

Plans shall be approved by BNSF Engineering or authorized representative. Specifications for unloading pits are covered in the "AREMA Manual for Railway Engineering," Section 8.4. Gratings covering open pits must be bolted in place.

TRACK CONSTRUCTION

General:

All work shall be of good quality in materials, equipment and workmanship and shall conform in every respect with the specifications and instructions.

Ties:

Ties will be unloaded and handled in such a manner as not to damage ties, using approved handling equipment.

Ties to be placed at design spacing of 21.5-inch center to center (22 ties/39 feet) for wood, and 28-inch centers for concrete, on the finished subgrade, perpendicular to center line of track with the right hand ends of ties being parallel. Exception: On curves, align the ties to the inside of the curve. All joints are to be suspended between ties.

Top surface of ties shall be clean and smooth to provide full bearing for tie plates.

Lay wood ties with heartwood face down, and if not possible to determine position of the heartwood, lay the widest surface of the tie down.

If spikes are pulled from any tie, hole shall be filled by driving in a treated wood tie plug the full depth of the hole.

Boring or adzing of ties shall be kept to a minimum.

Tie Plates:

Double-shouldered tie plates will be used on all ties and set in position with cant surface sloping inward, making sure they are firmly seated and have full bearing. After rails are in place, shoulder of plates shall be in full contact with outside edge of rail base.

Rails:

Assemble joints before fastening rails to ties, using joint bars with full number of track bolts and spring washer for each bolt, first removing loose mill scale and rust from contact surfaces or joint bars and rails.

In laying secondhand rail, care must be taken to rail end mismatch at the joints.

Under no circumstances must rail be struck in web with tool or any metal object.

The right-hand rail facing in direction of increasing construction shall be spiked to ties, and the opposite rail shall be brought to gage of 4' 8-1/2", measured at right angles between the rails, in a place 5/8" below top of rail. A track gauge manufactured for the purpose of measuring gage should be used rather than a tape measure. Gage is to be checked at every third tie. Do not strike rail directly with a maul, either on top when driving spikes, or on side to obtain track gage.

Rail shall be laid with staggered joints. Joints shall be located as nearly as possible to the middle of the opposite rails with the following variation: (a) except through turnouts, the staggering of the joints on one side shall not vary more than 6' in either direction from the center of the opposite rail.

Continuous welded rail (CWR) will need to be de-stressed as soon as possible after laying (see "Procedures for the Installation, Adjustment, Maintenance, and Inspection of CWR in Industry Tracks" appendix, pages A-1 thru A-8). The completed "Record of Neutral Temperature of Welded Rail as Laid" form will be completed and presented to the BNSF Roadmaster at time of final track inspection.

Joints:

If necessary to force joint bar into position, strike lower edge of bar lightly with 4-lb. maul. Do not drive bolts in place. Tighten bolts in sequence, beginning at joint center and working out to ends. Bolts are to be tightened to a range of 20,000 to 30,000 ft-lbs. tension. If a bolt tightening machine is not used, a standard track wrench with a 42" long handle may be used.

At the time of installation, rail expansion shims of softwood not over 1" width shall be placed between the ends of adjacent rails to insure proper space allowance for expansion required by the rail temperatures in the following table, and shall be left in place:

39-ft Rail Temperature

Deg. F	Expansion
Over 85	None
66 to 85	1/16
46 to 65	1/8
26 to 45	3/16
6 to 25	1/4
Below 6	5/16

Bending Stock Rails:

Use approved rail bending equipment. Make bends uniform and accurate for all stock rails.

Spiking to Wood Ties:

Rails shall be spiked to every tie, using not less than 2 spikes for each rail at each tie. Drive spikes through tie plate holes into ties, located diagonally opposite each other but not less than 2" from edge of tie. Start and drive spikes vertically and square with rail. Take care to avoid slanting, bending, or causing sideways movement of spike.

Each rail will be spiked with two spikes per tie plate on tangent track staggered with inside spikes to the east or north and outside spikes to the west or south. On curves a third spike is required on the gage side of the rail. Spikes should not be placed in the slots on skirted joint bars when such practice can be avoided by providing other plates with a hole pattern that will clear the skirts.

When spikes are driven by machine, work shall be closely supervised to see that they are driven with hammer centered exactly over each spike head and drive spike vertically. Set stop bolt on the machine to prevent over-driving.

Withdraw spikes that are incorrectly driven and fill hole by driving a tie plug to full depth of hole. Locate replacement spike at another hole in tie plate and tie.

Ballast and Surfacing:

Raise track by means of jacks placed close enough together to prevent excessive bending of rails or

strain on joint. Lift both rails simultaneously and as uniformly as possible. Power jack may also be used. Each track raise shall not exceed 4" with ties tamped prior to additional raise.

Unloading and Tamping Ballast:

Unload and level down ballast by most practical means, taking care not to disturb grade stakes. Perform tamping, using power tamping machines wherever possible, or manually, using approved AREMA tamping tools appropriate for type of ballast being placed. Tamp each layer of ballast from a line 15" inside each rail, on both sides of and to the ends of ties. Center area between these limits shall be filled lightly with ballast but not tamped. At turnouts and crossovers, tamp ballast uniformly for full length of ties. Tamping shall proceed simultaneously at both ends of same tie, making sure ballast is forced directly under the ties and against sides and ends of ties.

Finishing and Dressing:

Dress ballast in conformance with dimensions shown on drawings, placing additional ballast material as necessary. When placing pavement up to the track and flush with top of rail it is important to make sure water drains away from the track. This will prevent pooling and freezing which create hazardous walking conditions. Lines should be painted 10 feet parallel to the centerline of track on both sides to serve as visual reminder of the track's foul zone. Crushed rock or fabric should be placed over the ties to keep the pavement from adhering to them. Flange ways need to be kept clean to allow wheels to contact top of rail at all times.

Final Inspection:

After ballasting and surfacing are completed, inspect track to see that joints are tight and rail attachments to ties are secure.

Customer will notify the BNSF Economic Development Manager that the trackwork is complete and ready for inspection. The ED Mgr will arrange an on-site inspection with the BNSF Roadmaster, or designate, who will inspect the finished trackwork and complete the checklist on page 20, or similar document. The Contractor will provide a copy of the "Record of Neutral Temp of Welded Rail as Laid" form to the Roadmaster prior to or during inspection. After the Roadmaster's approval the track will be placed in service by the Division's General Manager and can then accept rail cars. Rail cars delivered to site before the track is in service will be stored at another location at an additional cost to the customer, or returned to origination point.

MISCELLANEOUS

Fencing and Gates:

Gates and fences must be grounded in accordance with National Electric Safety Code requirements to prevent an injury resulting from an electrical charge. Gates crossing tracks must have the ability to lock in the open position during train operations. If a fence parallel to a track has an angled piece at the top with security wire it must not foul the clearance envelope of the track.

ACCEPTANCE

Final acceptance of the work will be subject to the inspection by BNSF, and any portion of the work not accepted will have its faults corrected before the track is put into service.

Customer _____ Contractor _____

Location _____

Roadmaster's Check List: Indicate OK, NO, N/A or other comments

Before traffic is permitted on trackage constructed by private contractor, Roadmaster shall make an inspection for compliance with the attached specifications and submit form to Division Engineer and Manager Economic Development:

Subgrade	_____	Drainage	_____
Ballast	_____	Curvature & Alignment	_____
Surface	_____	Any Clearance Problems?	_____
Rail/Gage	_____	Anchors	_____
Record of Neutral Temp of Welded Rail as Laid (from Contractor)			_____
Tie	_____	Switches, Frogs & Guard Rails	_____
Tie Plates	_____	Joint Bars	_____
Spikes	_____	Bolts, Nuts & Washers	_____
Earthen Berm or Bumping Post	_____	Derails, Derail Signs	_____

Walkways _____

Track or Highway Crossings _____

_____

Comments _____

_____

_____
Roadmaster

_____
Date

REQUIREMENTS FOR CONTRACTORS WORKING

ON BNSF RIGHT-OF-WAY

In order to protect BNSF's investment in its right-of-way and for the safety of persons coming onto BNSF property, BNSF has established certain requirements. The following constitute minimum requirements for all persons coming on or near BNSF right-of-way. Contractors are encouraged to develop their own safety rules that meet or exceed the following requirements. A web site has been set up to assist in preparation of a safety plan—www.contractororientation.com. Contractors will not be allowed to occupy or work on BNSF right-of-way prior to registering on the web site and completing the course.

1. All permits and agreements must be in effect, required payments made, and insurance certificates received and approved prior to Contractor entering BNSF right-of-way. All of these documents are included in the packet containing the cost proposal. Prior to performing the preliminary survey, the consultant will obtain a "Temporary Occupancy Permit". To obtain a permit, contact Jones, Lang, LaSalle, phone number 1-866-498-6647. The permit requires a preparation fee and some lead time. Copies of all documents should be kept on the job site.

2. Any de-watering utilizing drains or ditches on BNSF property must be approved by BNSF Engineering.

3. Contractor must have BNSF approved "Final Construction Plans" prior to commencing work on a project. No change will be made to "Final Construction Plans" without approval by all parties involved. Approved revised plan will be furnished to all parties prior to implementation of changes.

4. Road Authority or Contractor will incur all costs for track work, including flagging, etc., made necessary due to their construction operation.

5. Pursuant to BNSF safety rules, flagging protection is always required when equipment crosses or is working within 25 feet of center of any track. When deemed necessary by BNSF, a flagman may be required at all times while working on BNSF right-of-way.

6. Crossing of any railroad tracks must be done at approved locations and must be over full depth timbers, rubber, etc. Any equipment with steel wheels, lugs, or tracks must not cross steel rails without aid of rubber tires or other approved protection and proper flagging will be required.

7. All temporary construction crossings must be covered by a "Private Roadway & Crossing Agreement," and must be barricaded when not in use.

8. Contractor must furnish details on how work will be performed that may affect existing drainage and/or possible fouling of track ballast as well as removal of overhead bridges/structures. (Structures and bridge spans over tracks must be removed intact.)

9. Absolutely no piling of construction materials or any other material, including dirt, sand, etc., within 25 feet of any track or on property of BNSF not covered by construction easement, permit, lease or agreement, or within 250 feet of a public grade crossing. A 10-foot clear area on both sides of a main track must remain unobstructed at all times to allow for stopped train inspection.

10. No construction will be allowed within 25 feet of center of any track unless authorized by BNSF's Division Engineer and as shown on Final Plan approved by the Railroad. This includes any excavation, slope encroachment and driving of sheet piles.

11. No vehicles or machines shall remain unattended within 25 feet of any track. All machines will be disabled when not in use to prevent unauthorized operation.

12. **IMPORTANT:** Disregard of any of these items will result in Contractor being shut down and prohibited from working on BNSF right-of-way while infraction is investigated. Based on findings of the investigation, it will be determined if the Contractor will be allowed to work on BNSF right-of-way in the future.

13. Contractor safety rules, including rules regarding Personal Safety Equipment, must not conflict with BNSF safety policies. Contractor's personnel will obtain BNSF's safety orientation prior to entering BNSF property. A job safety briefing will be held prior to beginning work each day and any time work conditions change. All personnel will wear proper personal protective equipment (PPE) while on BNSF property. Any person working on BNSF property may be subjected to a safety audit by BNSF personnel, and is required to comply with the audit. The results of the audit will be presented to the contractor's supervisor immediately upon completion. Any questions regarding safety should be directed to the BNSF project representative.

14. Articles included in Agreement should compliment this document or exceed its contents.

Procedures for the Installation, Adjustment, Maintenance, and Inspection of CWR in Industry Tracks

October 13, 2010

Table of Contents

Materials contained within this document are excerpts from BNSF's Engineering Instructions, and the EI chapter numbers and references are retained. Sections unrelated to construction of industry tracks have been removed.

Procedures for the Installation, Adjustment, Maintenance, and Inspection of CWR in Industry Tracks

This document details the Railroad's policy on installing, adjusting, maintaining, and inspecting Continuous Welded Rail (CWR) track. Each chapter details how the Railroad applies its standards and procedures to comply with FRA standards. The procedures listed in this document apply to CWR on all tracks.

Chapter 1 CWR Installation Procedures

Rail length that exceeds 400 feet is considered CWR. Rail installed as CWR remains CWR, regardless of whether a joint or plug is installed into the rail at a later time. Temperature variations affect rail length. Rail expands (lengthens) when heated and contracts (shortens) when cooled.

1.1 Neutral Temperature

The neutral temperature is the temperature at which a rail is neither in tension nor compression. Target neutral temperatures have been established to provide a specific desired neutral temperature to prevent track buckling. When laying or adjusting CWR, use Figure 6-1, *Target Rail Laying Temperatures*, located in Engineering Instruction 6.2.3 A, reproduced below (page 3).

1.2 Temperature Differential

The difference between the target neutral temperature and the actual rail temperature taken at the time of installation is called the temperature differential. CWR laying and adjusting procedures have been established to compensate for this temperature difference.

1.3 Installing CWR

Follow these general requirements when laying CWR:

- Refer to Figure 6-1 (page 3) for the target rail laying temperature for your area.
- Take the rail temperature and calculate the expansion required before making adjustments.
- Record the rail laying temperature, location, and date on approved forms.
- Rail does not need to be adjusted when the actual rail temperature exceeds the target neutral temperature.
- Use rail heaters or rail expanders to adjust the rail to the correct length when the actual rail temperature is less than the target neutral temperature. Heat the rail evenly and uniformly so that the rail expansion occurs evenly and uniformly throughout its length.

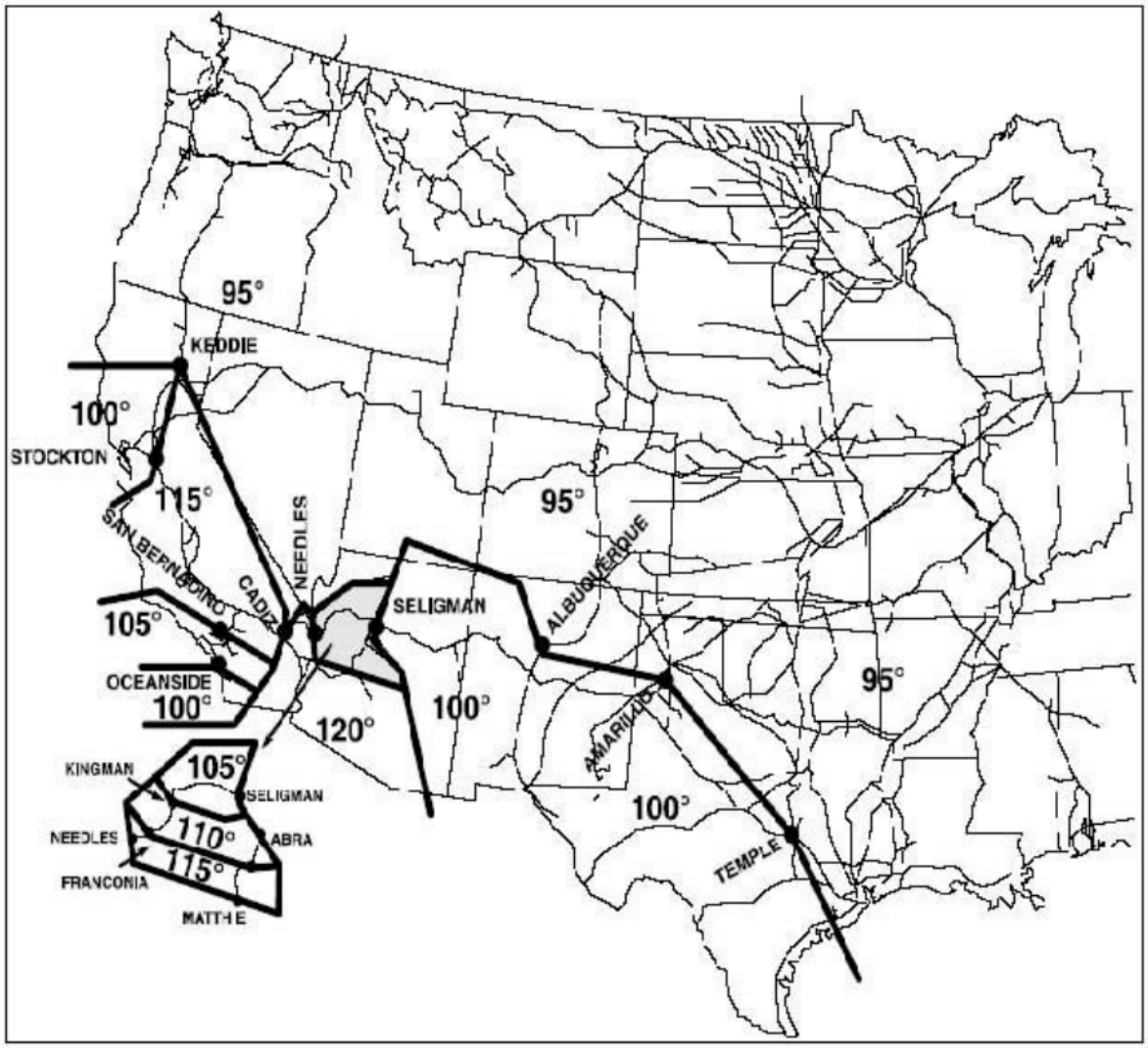


Figure 6-1. Target Rail Laying Temperatures

Chapter 2 Rail Anchoring Requirements

Where the anchoring function is otherwise provided, rail anchors may be omitted. Anchors may not be applied where they will interfere with signal or other track appliances, where they are inaccessible for adjustment or inspection, or on rail opposite a joint. Anchor pattern may be varied as reasonable to avoid placing anchors against deteriorated ties.

Installation

The following anchoring requirements apply to CWR installations on all main tracks, sidings, and other tracks over which trains operate at speeds above Class 1.

2.1 Standard Box Pattern

When installing CWR, box anchor every other tie except as outlined in Section 2.2.

2.2 Solid Box Pattern

When installing CWR, box anchor every sound (effective) tie at specific locations listed below to provide additional restraint against rail movement.

Condition	Action
Turnouts Crossing Frogs Joint where CWR abuts bolted rail	Anchor every tie for 195 feet in each direction
Bolted joint created during CWR installation/construction when using heater, rail expander, or at or above Target Neutral Temperature	**Within 60 days from date of creation:** Weld Joint, **OR** Install joint with 6 bolts**, OR** Anchor every tie for 195' in both directions

2.3 Bridge Pattern

When installing CWR, follow these bridge anchoring requirements:

1. Ballast deck bridges should be anchored with the same pattern as in section 2.1 and 2.2.
2. Open deck bridges should be anchored according to Engineering Instruction 6.4.5:
   - On open-deck timber bridges, apply anchors to all ties fastened to the stringers.
   - On open-deck steel bridges 150 feet long or less, apply anchors to all ties fastened to the steel structure.

2.5 Anchor Requirements after Rail Repair

When rail repairs result in a joint added to CWR, the anchor pattern shall match the existing pattern in track. At least every other tie will be box anchored for a distance of 195 feet in each direction unless anchoring is otherwise provided. When repairs are made to a stripped joint or failed joint bar, the adjustment or addition of anchors will be as prescribed in the following table.

Condition	Action
Bolted joint in CWR experiencing service failure (stripped joint) or failed bar(s) with gap* present. *gap exists if it cannot be closed by drift pin	**1.** Weld joint, **OR** **2.** Remediate joint conditions (per Chapter 6.5) **and** replace bolts (new, in-kind or stronger), **and** weld joint within 30 days, **OR** **3.** Replace failed bar(s), install 2 additional bolts **and** adjust anchors **OR** **4.** Replace bars, bolts (if failed or missing) **and** anchor every tie for 195' in both directions **OR** **5.** Add rail (with provisions for adjusting later, if necessary)

Chapter 3 Preventive Maintenance on Existing CWR Track

Performing track buckling preventive maintenance can reduce the risk of buckles. When tight rail conditions exist, be governed by Chapter 7.1.

3.2 De-Stressing Rail

Rail can be de-stressed by cutting rail out or by re-aligning a curve. When cutting rail out, use this procedure:

Procedure

1. Cut rail to be de-stressed.
2. Remove or reposition anchors or clips for a minimum of 200 feet in both directions from the cut or up to a restriction that prevents rail movement.
3. Wait until the rails stop moving. The rail ends may need to be trimmed more than one time to allow for expansion.
4. Take the rail temperature (far enough away from the cut so that the reading is not affected by the cutting procedure).
5. Use Figure 6-1 (page 3) to compare the rail temperature with the target neutral temperature for the territory. This is known as the temperature differential.
6. If the actual rail temperature is lower than the target neutral temperature for the territory, use Table 6-3, *Change in Length of Welded Rail to Change Neutral Temperature* (page 8), to determine the rail length to be removed based on the total distance the anchors or clips have been removed.
7. If the rail temperature is at or above the Target Neutral Temperature, no additional adjustments are needed.
8. Weld the joint or apply joint bars.
9. Replace the rail anchors or clips.

Chapter 9 Recordkeeping

9.1 Report of CWR Installations

Rail temperature, location, and date of CWR installations should be recorded on the prescribed form, "Record of Neutral Temperature of Welded Rail as Laid", as shown below in Figure 6-2.

Record of Neutral Temperature
of Welded Rail as Laid

Division _____ Subdivn _____ Line Segment _____

Relay Between _____ and _____ Recorded by _____

Target Neutral Temperature = _____° F (see Figure 6-1)

Date Rail Laid	Curve No and/or MP Loc	Position		Trk No	Actual Rail Temp	Temp Diff	Distance to Match Mark	Expansion at Matchmark		Length of String	Remarks
		N/W Rail	S/E Rail					Required	Actual		

Figure 6-2. Record of Neutral Temperature of Welded Rail as Laid

9.2 Report Maintenance Work in CWR

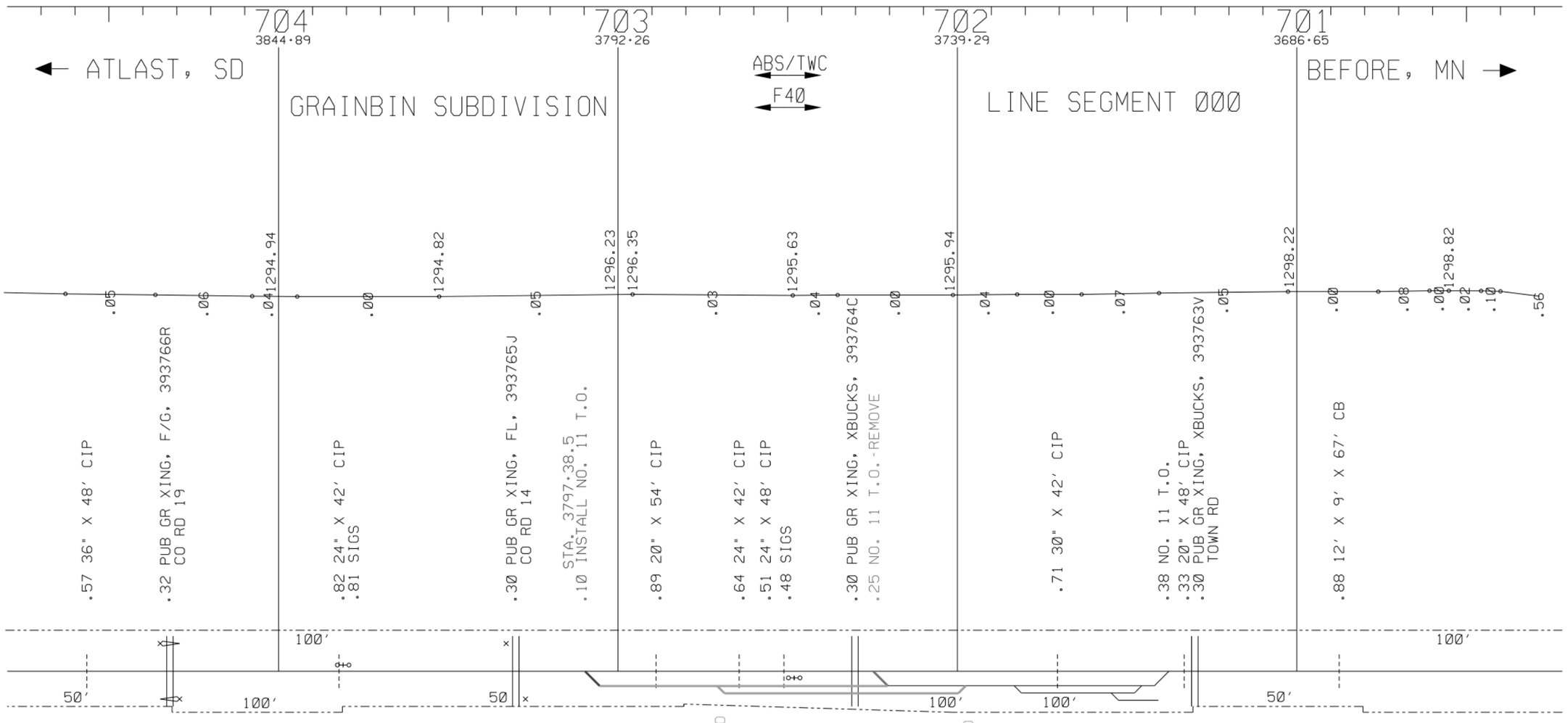
Because track maintenance can disturb the lateral and longitudinal resistance of the track, records of the following must be kept until corrections or adjustments are made:

- Rail that is added for any reason, including repair of broken or defective rail, pullaparts, and welding of rail joints
- Where a curve has been staked and inward lateral curve movement exceeds 3"
- CWR installation or maintenance work that does not conform to these written procedures. A record of rail neutral temperature will be maintained where rail has pulled apart, broken or been cut for defect removal.

The Division Engineer and Roadmaster will review these records during initial and periodic track inspections.

Table 6-3. Change in Length of Welded Rail to Change Neutral Temperature.

Temp. Diff. in Deg. F	Length of Unrestrained Rail							
	200'	400'	600'	800'	1,000'	1,200'	1,400'	1,600'
5°	1/8"	1/4"	1/4"	1/4"	1/2"	1/2"	1/2"	1/2"
10°	1/8"	1/4"	1/2"	1/2"	3/4"	1"	1"	1-1/4"
15°	1/4"	1/2"	3/4"	1"	1 1/4"	1 1/2"	1 3/4"	1 3/4"
20°	1/4"	1/2"	1"	1-1/4"	1-1/2"	1-3/4"	2-1/4"	2-1/2"
25°	3/8"	3/4"	1-1/4"	1-1/2"	2"	2-1/4"	2-3/4"	3"
30°	1/2"	1"	1-1/2"	1-3/4"	2-1/4"	2-3/4"	3-1/4"	3-3/4"
35°	1/2"	1"	1-3/4"	2-1/4"	2-3/4"	3-1/4"	3-3/4"	4-1/4"
40°	5/8"	1-1/4"	1-3/4"	2-1/2"	3"	3-3/4"	4-1/4"	5"
45°	3/4"	1-1/2"	2"	2-3/4"	3-1/2"	4-1/4"	5"	5-1/2"
50°	3/4"	1-1/2"	2-1/4"	3"	4"	4-3/4"	5-1/2"	6-1/4"
55°	7/8"	1-3/4"	2-1/2"	3-1/2"	4-1/4"	5-1/4"	6"	6-3/4"
60°	7/8"	1-3/4"	2-3/4"	3-3/4"	4-3/4"	5-1/2"	6-1/2"	7-1/2"
65°	1"	2"	3"	4"	5"	6"	7"	8"
70°	1-1/8"	2-1/4"	3-1/4"	4-1/4"	5-1/2"	6-1/2"	7-3/4"	8-3/4"
75°	1-1/8"	2-1/4"	3-1/2"	4-3/4"	5-3/4"	7"	8-1/4"	9-1/4"
80°	1-1/4"	2-1/2"	3-3/4"	5"	6-1/4"	7-1/2"	8-3/4"	10"
85°	1-3/8"	2-3/4"	4"	5-1/4"	6-3/4"	8"	9-1/4"	10-1/2"
90°	1-3/8"	2-3/4"	4-1/4"	5-1/2"	7"	8-1/2"	9-3/4"	11-1/4"
95°	1-1/2"	3"	4-1/2"	6"	7-1/2"	9"	10-1/4"	11-3/4"
100°	1-1/2"	3"	4-3/4"	6-1/4"	7-3/4"	9-1/4"	11"	12-1/2"



GRAIN BELT
MP 702.3

BNSF WORK

INSTALL #11-115LB RHTO
AT MP 703.10

REMOVE #11-112LB RHTO
AT MP 702.25

CUSTOMER TO CONSTRUCT
REMAINING TRACKAGE

CONCEPTUAL DRAWING ONLY!
THIS LAYOUT HAS NOT BEEN ENGINEERED AND NEEDS TO BE VERIFIED BY FIELD SURVEY

APPROVALS - (NAME - TITLE)	DATE	APPROVALS - (NAME - TITLE)	DATE

DAKOTA DIVISION
GRAINBIN SUBDIVISION
LINE SEGMENT 000

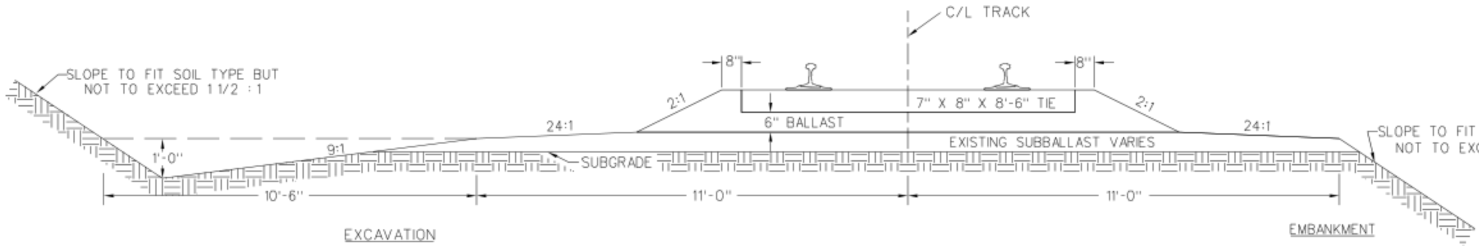
REVISIONS

NO.	DESCRIPTION	DATE	BY

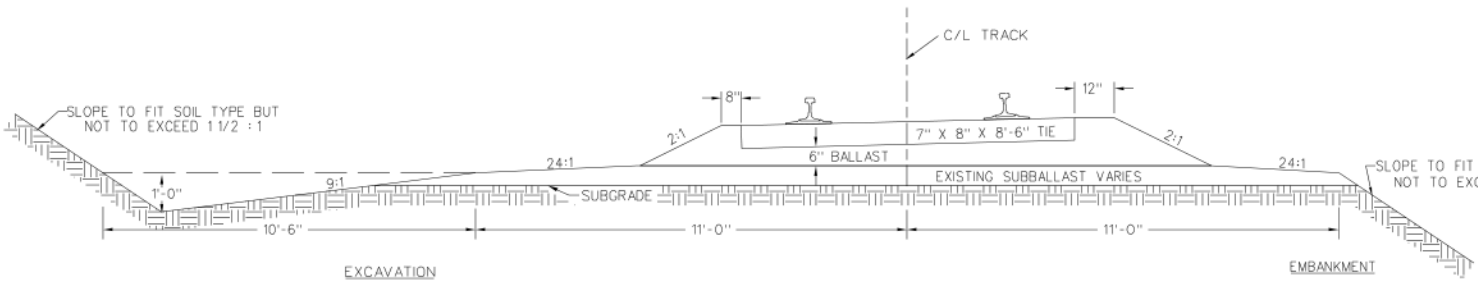
BNSF RAILWAY

NW GRAIN GROWERS
GRAIN BELT, SD

DRAWN	CHECKED		PROTRAK SEQ NO	STATUS	FILE	SHEET	DATE
JRG	JRG	BNSF RAILWAY COMPANY - ENGINEERING SERVICES		PRELIMINARY	grainbelt.dgn	1 OF 1	04/28/2011



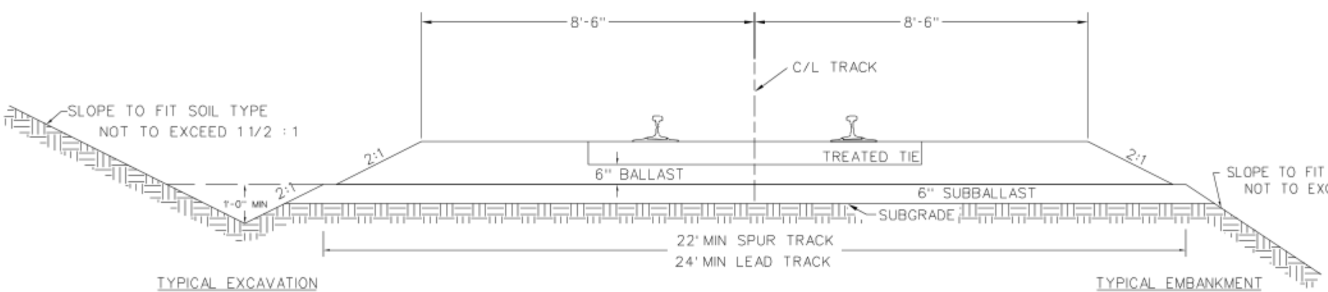
TANGENT TRACK LIGHT TRAFFIC LINES



CURVED TRACK LIGHT TRAFFIC LINES

NOTE:

1. 6" MIN. GRANULAR SUBBALLAST OR AS REQUIRED PER LOCAL SUBGRADE CONDITION.
2. BALLAST PER MILE OF TRACK:
   6" BALLAST 2,435 CU. YARDS TANGENT
3. FOR INDUSTRY TRACK BALLAST SECTION TO BE LEVEL WITH TOP OF TIE WHERE WALKING REQUIRED, 8'-6" MIN FROM CENTER LINE.



SLOPE DITCH LONGITUDINALLY TO DRAIN

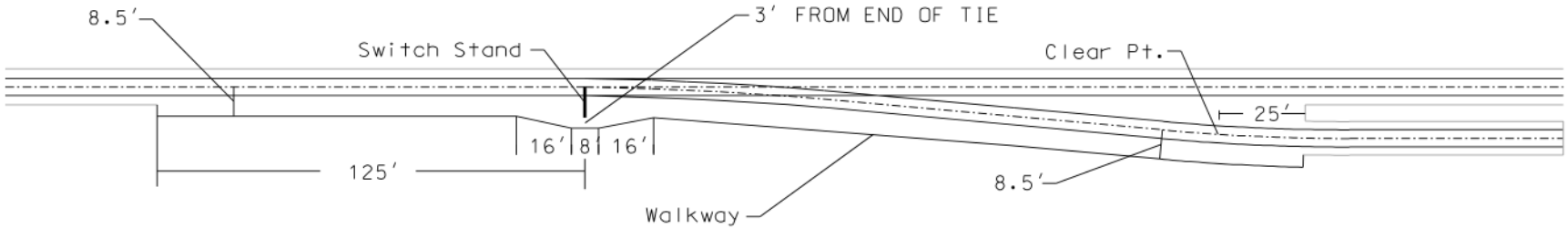
INDUSTRY TRACK

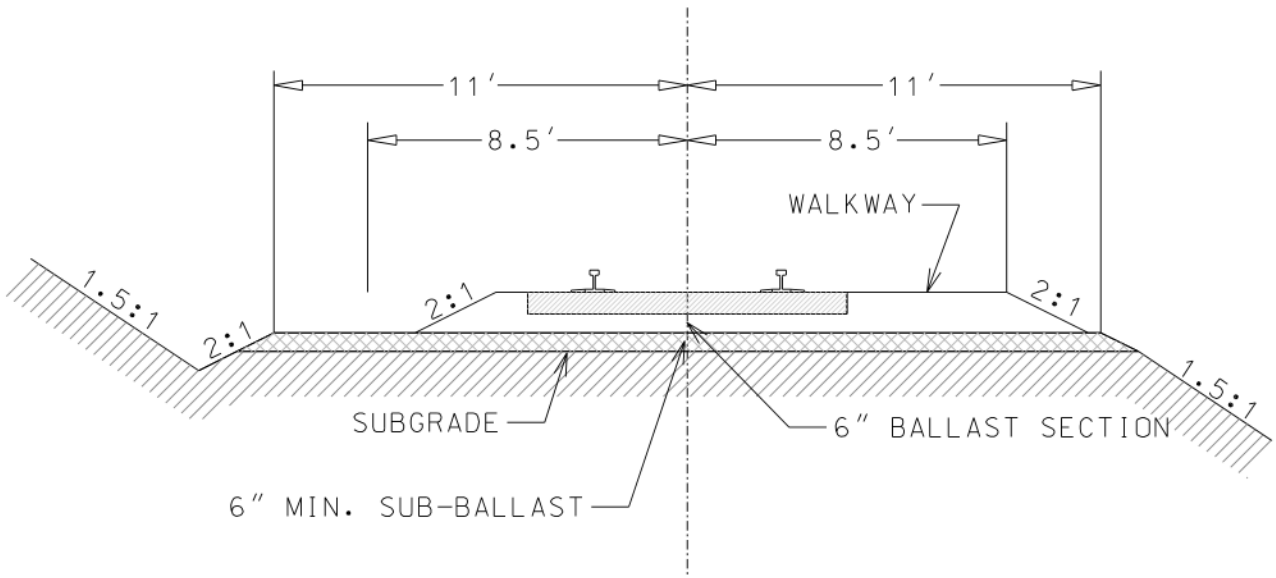
BURLINGTON NORTHERN SANTA FE
STANDARD PLAN
ENGINEERING DEPT., FORT WORTH, TEXAS

LIGHT TRAFFIC LINES
AND
INDUSTRY TRACK

RAIL:	
DATE: 10/29/97	SCALE: NONE

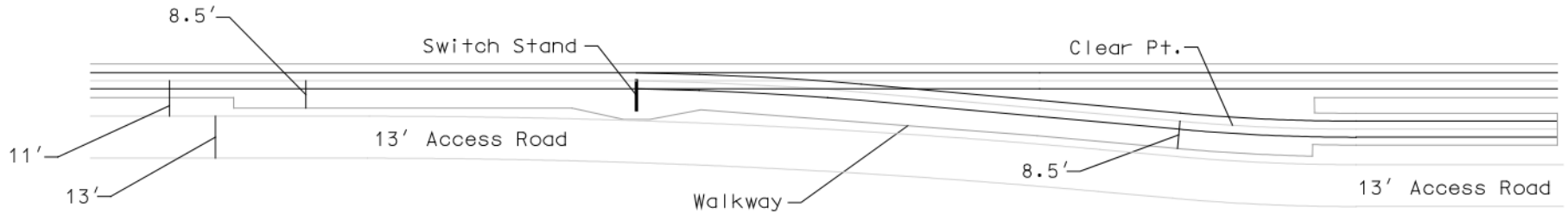
DWG. NO.	SHEET NO.	REV. NO.
1000	03	01

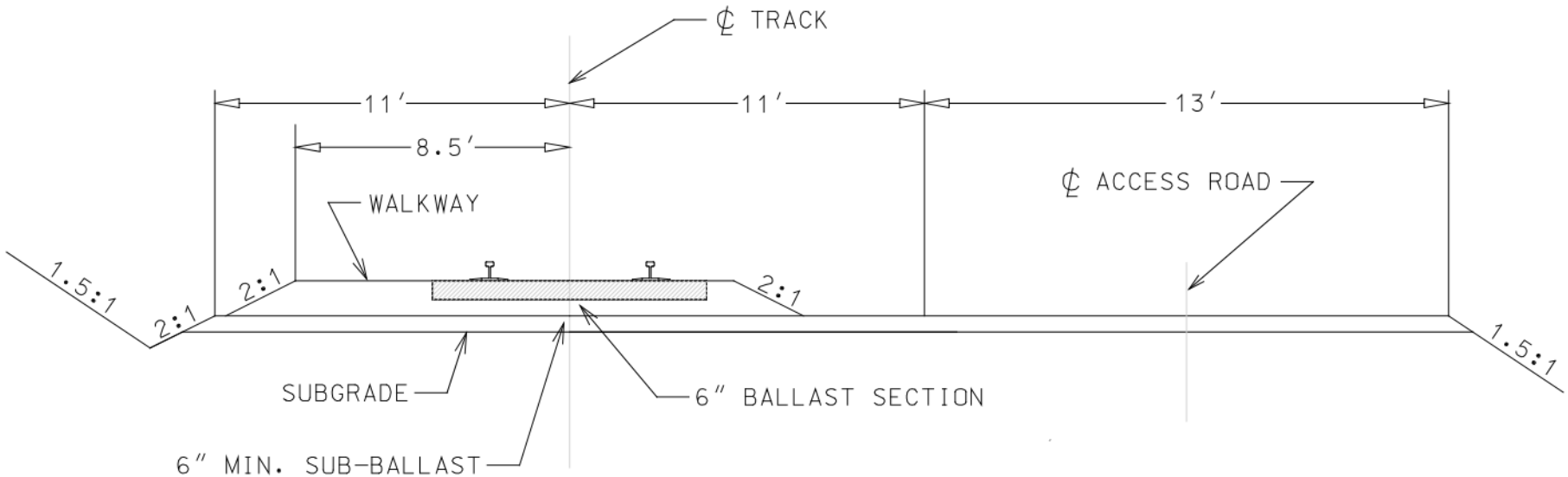




INDUSTRY TRACK STD SECTION WITH 8.5' WALKWAY

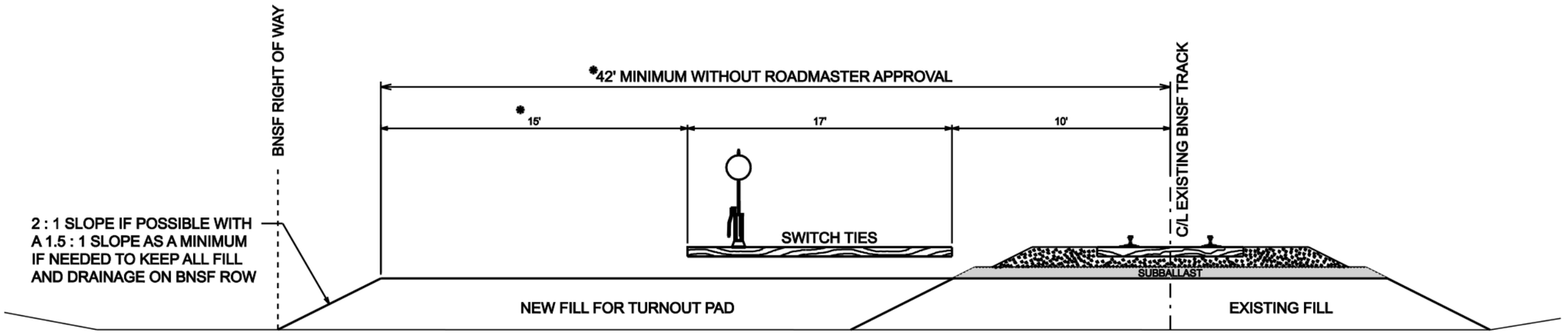
BNSF ENG SVCS - 10/12/01

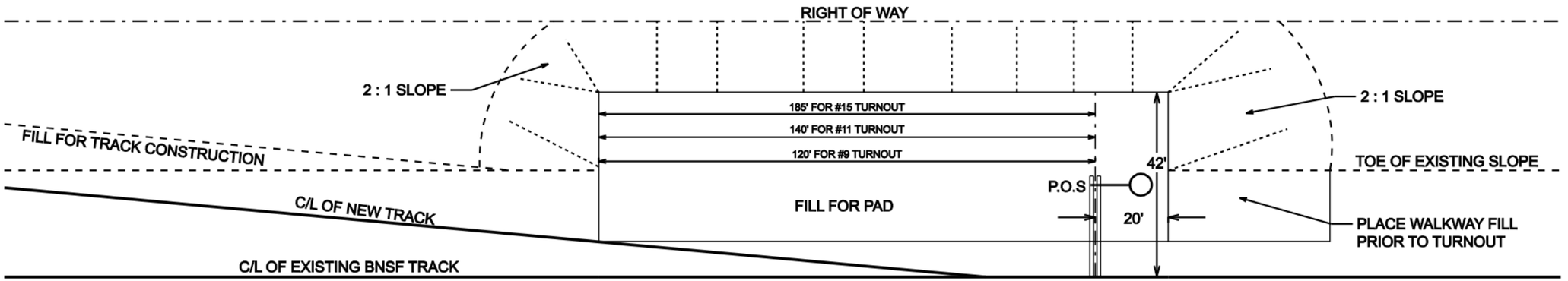




INDUSTRY TRACK STD SECTION WITH 13′ ACCESS ROAD

BNSF ENG SVCS – 04/02/04





NOTE: CONSTRUCTION OF INDUSTRY TURNOUT PAD IS FOR THE PLACEMENT OF THE PROPOSED PACKAGE TURNOUT FOR ASSEMBLY AND INSTALLATION. TURNOUT PAD IS ALSO TO PROVIDE FOUNDATION FOR ANY REQUIRED SIGNAL EQUIPMENT

TURNOUT PAD FILL MATERIAL SHALL BE PLACED BY THE INDUSTRY AS PART OF THE GRADING FOR THE NEW INDUSTRY SPUR. PAD IS TO BE CONSTRUCTED USING STANDARD COMPACTION AND FILL PLACEMENT PROCESSES AS PER THE BNSF INDUSTRY TRACK GUIDELINES. TOP OF PAD IS TO BE 2' BELOW THE EXISTING TOP OF RAIL.

CONTRACTOR SHALL COORDINATE WITH THE ROADMASTER AND ASSOCIATED PROJECT ENGINEER FOR ANY DEVIATION OF FILL AND FOR FLAGMAN PROTECTION.

*NOTE: IF RIGHT OF WAY IS OVER 50' FROM C/L OF EXISTING BNSF TRACK THIS DISTANCE SHALL BE INCREASED TO 25' AND 50' RESPECTIVELY

APPROVALS - (NAME - TITLE)	DATE	APPROVALS - (NAME - TITLE)	DATE

DRAWN | CHECKED | BNSF RAILWAY COMPANY - ENGINEERING SERVICES | PROGRAM SEQ NO | STATUS PRELIMINARY

BNSF STANDARD TURNOUT PAD *9, *11 AND *15

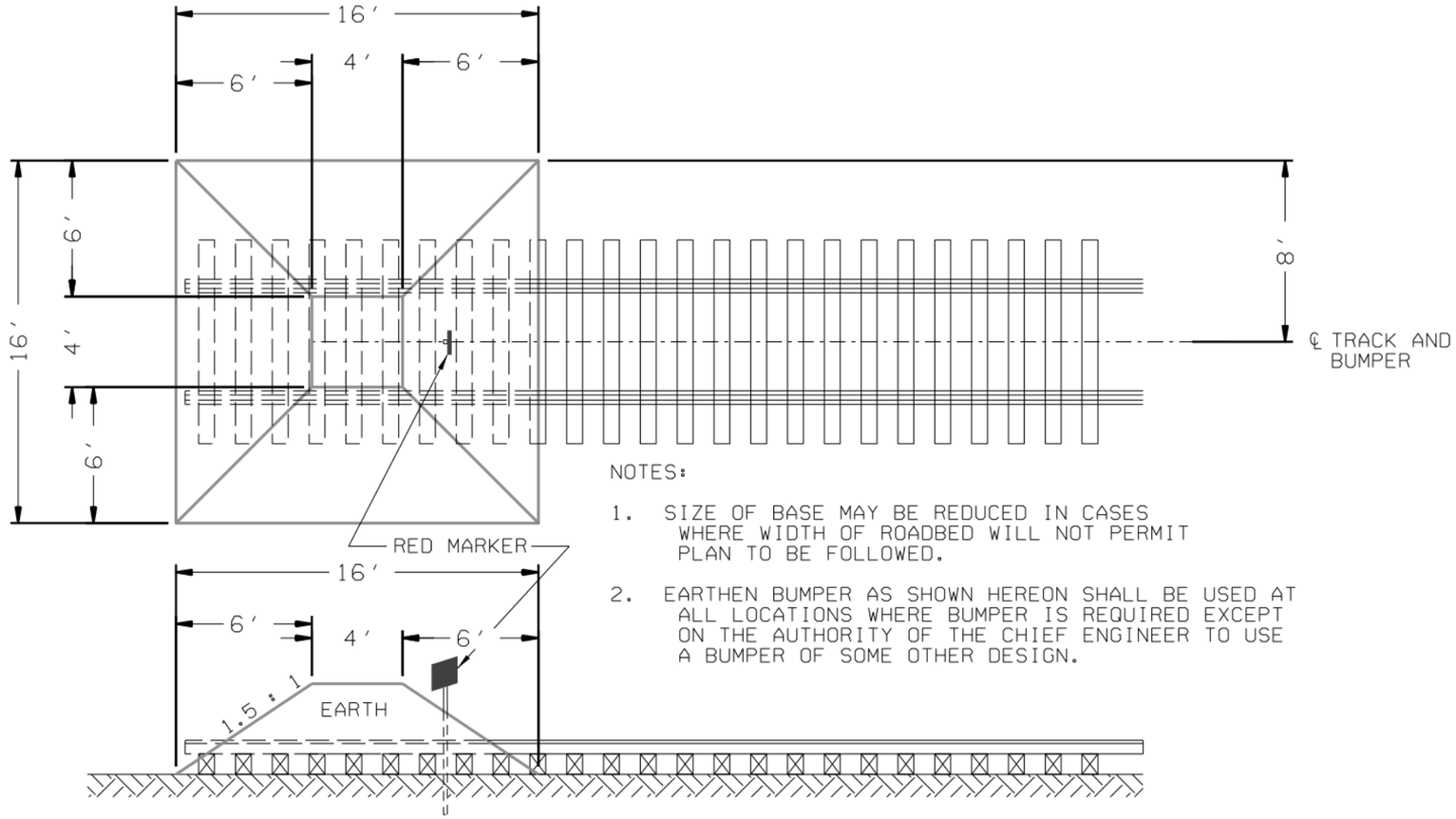
BNSF RAILWAY

REVISIONS

NO.	DESCRIPTION	DATE	BY

SYSTEM WIDE
NOT TO SCALE
REFERENCE ONLY

FILE: ...\Instructions\Turnouts\Turnut Pad.dgn | SHEET 1 OF 1 | DATE: 05/09/2011



NOTES:

1. SIZE OF BASE MAY BE REDUCED IN CASES WHERE WIDTH OF ROADBED WILL NOT PERMIT PLAN TO BE FOLLOWED.
2. EARTHEN BUMPER AS SHOWN HEREON SHALL BE USED AT ALL LOCATIONS WHERE BUMPER IS REQUIRED EXCEPT ON THE AUTHORITY OF THE CHIEF ENGINEER TO USE A BUMPER OF SOME OTHER DESIGN.

TYPICAL PLAN & SECTION FOR EARTHEN BUMPER FOR END OF TRACK

SCALE: N.T.S.

APPROVALS - (NAME - TITLE)	DATE	APPROVALS - (NAME - TITLE)	DATE

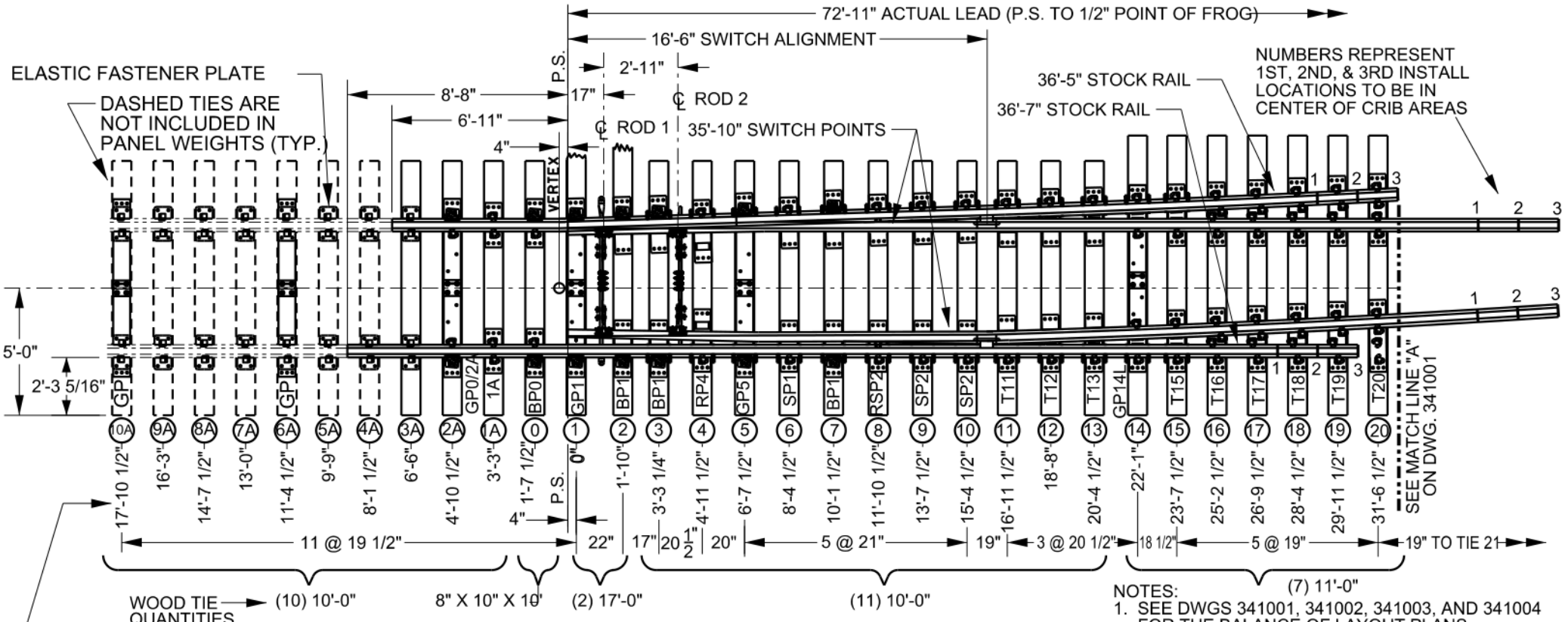
REVISIONS

NO.	DESCRIPTION	DATE	BY

BNSF RAILWAY

EARTHEN BUMPER FOR END OF TRACK

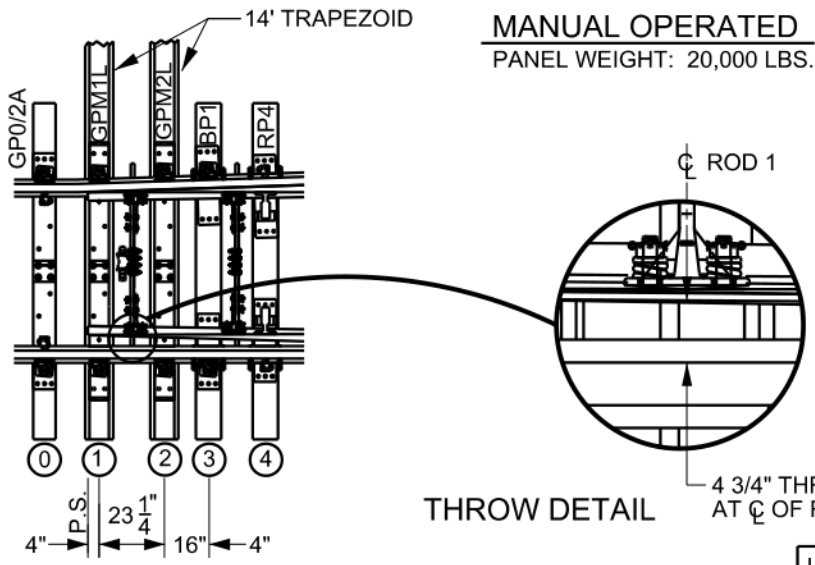
DRAWN	CHECKED	BNSF RAILWAY COMPANY - ENGINEERING SERVICES	PROTRAK SEQ NO	STATUS PRELIMINARY	FILE: EARTHEN BUMPER.DGN	SHEET 1 OF 1	DATE: 05/05/2011



WOOD TIE QUANTITIES BY LENGTH → (10) 10'-0" | 8" X 10" X 19' | (2) 17'-0" | (11) 10'-0" | (7) 11'-0"

ACCUMULATIVE TIE SPACING FROM ℄ TIE 1

NOTES:
1. SEE DWGS 341001, 341002, 341003, AND 341004 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
3. SEE DWG 341100 FOR TURNOUT GEOMETRY.
4. SEE DWG 341200 FOR TURNOUT BILL OF MATERIAL.
5. FULLY BOX ANCHOR STOCK RAILS, TIES 3-15 FOR SHIPPING OF PANELS ONLY.
6. APPLY 5" SAFE BOND WIRES ONE CRIB AHEAD OF HEEL OF SWITCH ON STOCK AND SWITCH POINT RAILS.



MANUAL OPERATED
PANEL WEIGHT: 20,000 LBS.

POWER OPERATED
PANEL WEIGHT: 20,000 LBS.

THROW DETAIL

	UPRR	BNSF RH	BNSF LH
POWER	N/A	518030061	518030073
MANUAL	N/A	518030074	518030075

BNSF RAILWAY

COMMON STANDARDS

NO. 9 TURNOUT 136 LB PANEL NO. 1

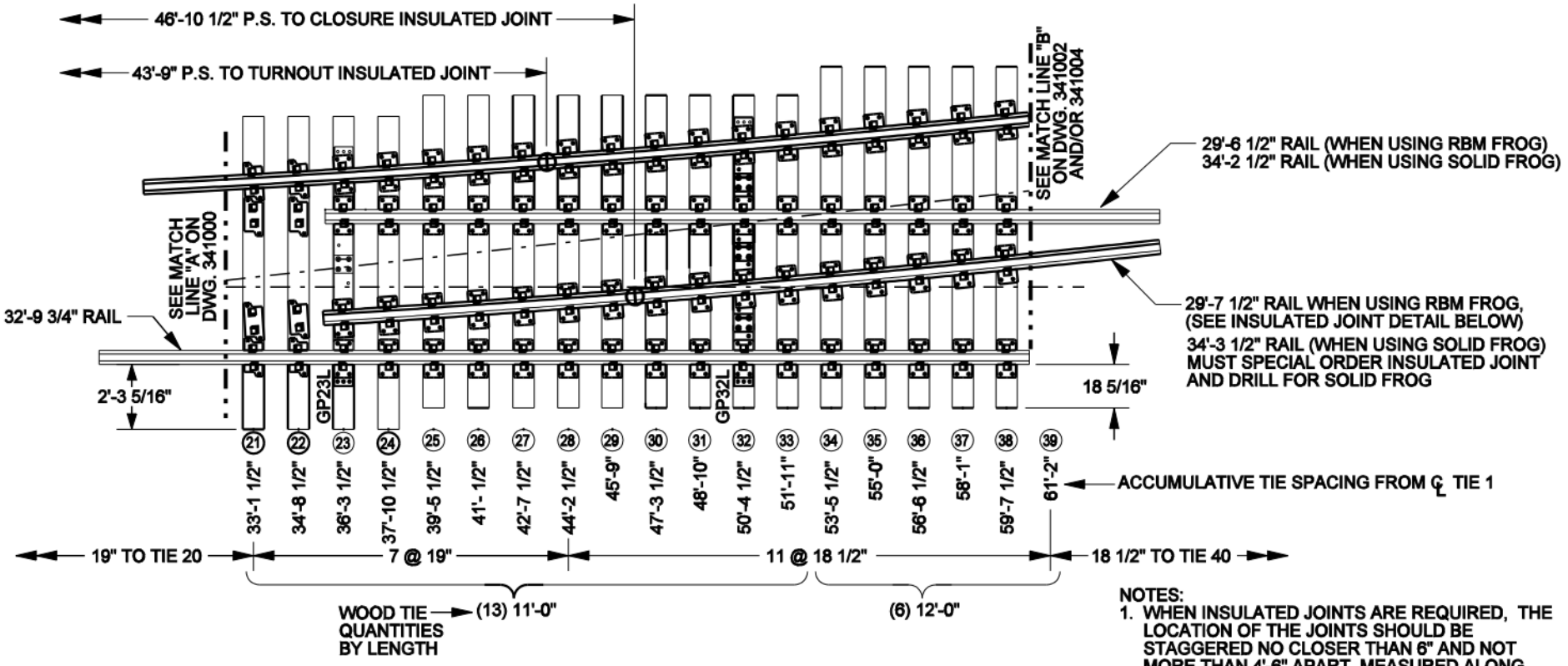
UPRR VP ENGINEERING

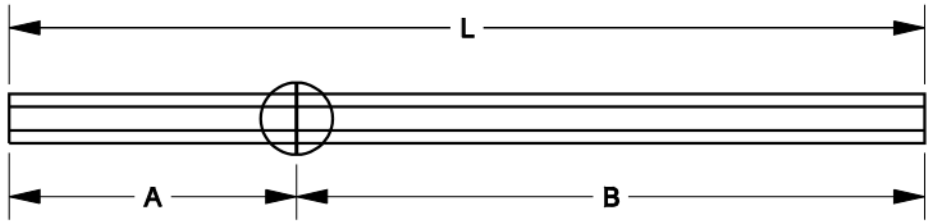
BNSF VP ENGINEERING

FILE OWNER: BNSF | DATE: OCT. 5, 2010

REV. NO.: 4 | DWG NO: 341000

22-1





	A	B	L	BNSF ITEM NO.
TURNOUT INSULATED JOINT RAIL	14'-3 1/4"	17'-0 3/4"	31'-4"	524400027
CLOSURE INSULATED JOINT RAIL	11'-0 1/2"	18'-7"	29'-7 1/2"	524400030

INSULATED JOINT DETAIL
(FOR USE WITH RBM FROG ONLY)

NOTES:
1. WHEN INSULATED JOINTS ARE REQUIRED, THE LOCATION OF THE JOINTS SHOULD BE STAGGERED NO CLOSER THAN 6" AND NOT MORE THAN 4'-6" APART, MEASURED ALONG THE TURNOUT.
2. SEE DWGS 341000, 341002, 341003, AND 341004 FOR THE BALANCE OF LAYOUT PLANS.
3. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
4. SEE DWG 341100 FOR TURNOUT GEOMETRY.
5. SEE DWG 341200 FOR TURNOUT BILL OF MATERIAL.
6. PANEL WEIGHT = 14,500 LBS.

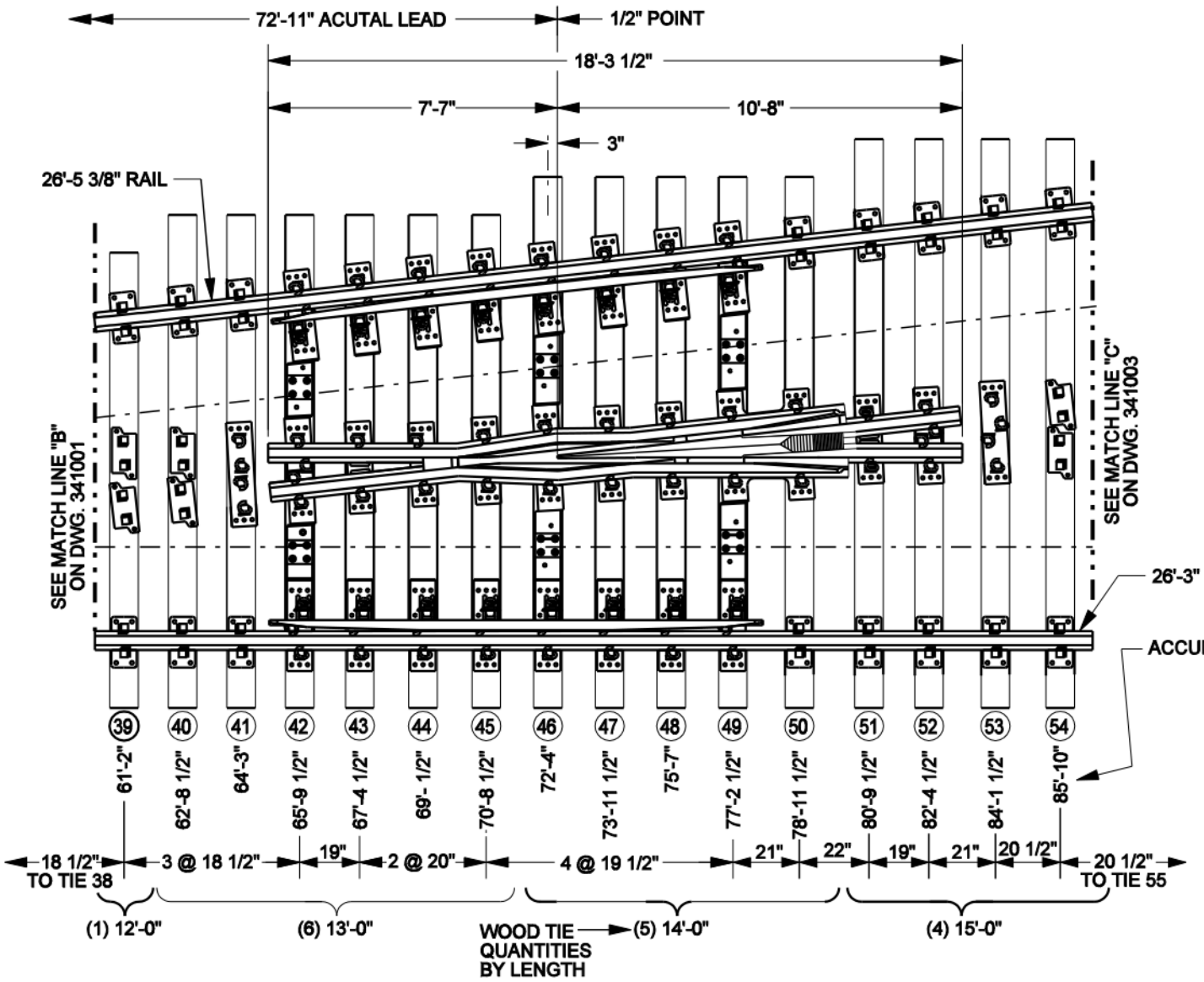
BNSF RAILWAY

COMMON STANDARDS

NO. 9 TURNOUT 136 LB.
PANEL NO. 2

FILE OWNER: BNSF	DATE: MAR. 1, 2007
REV. NO.: 4	DWG NO: 341001

22-2



NOTES:
1. SEE DWGS 341000, 341001, 341003, AND 341004 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
3. SEE DWG 341100 FOR TURNOUT GEOMETRY.
4. SEE DWG 341200 FOR TURNOUT BILL OF MATERIAL.
5. PANEL WEIGHT = 18,000 LBS.
6. SEE DWG 3413004 FOR SOLID MANGANESE FROG PANEL.

	UPRR	BNSF RH	BNSF LH
RBM	N/A	513450048	513450049
SOLID	N/A	513450050	513450051

BNSF RAILWAY

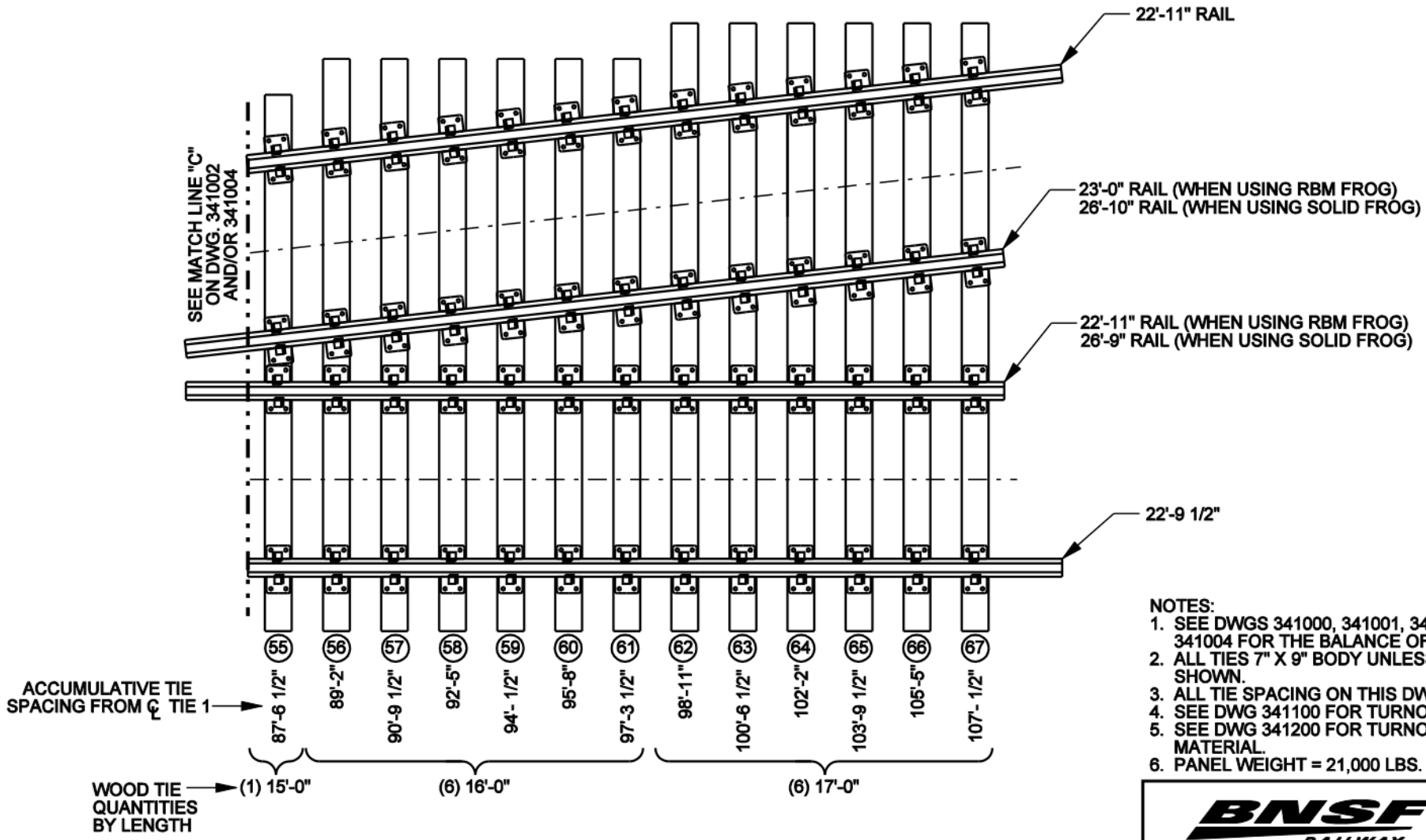
COMMON STANDARDS

NO. 9 TURNOUT 136 LB. PANEL NO. 3 WITH OPTIONAL RBM FROG

FILE OWNER: BNSF | DATE: MAY 19, 2008

REV. NO.: 5 | DWG NO: 341002

22-3



NOTES:
1. SEE DWGS 341000, 341001, 341002, AND 341004 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
3. ALL TIE SPACING ON THIS DWG IS 19 1/2".
4. SEE DWG 341100 FOR TURNOUT GEOMETRY.
5. SEE DWG 341200 FOR TURNOUT BILL OF MATERIAL.
6. PANEL WEIGHT = 21,000 LBS.

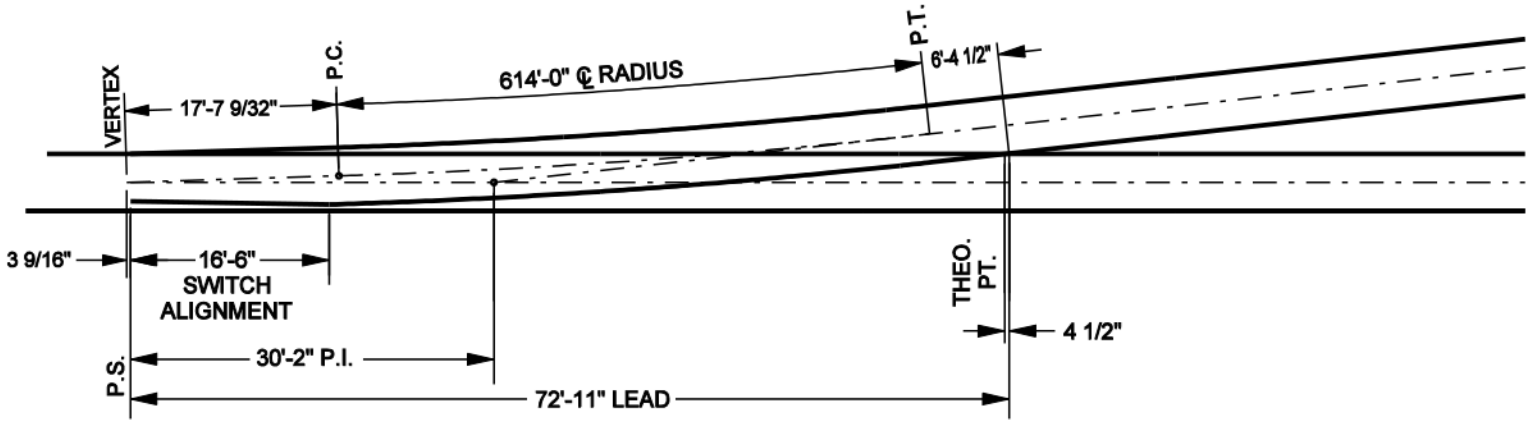
BNSF RAILWAY

COMMON STANDARDS

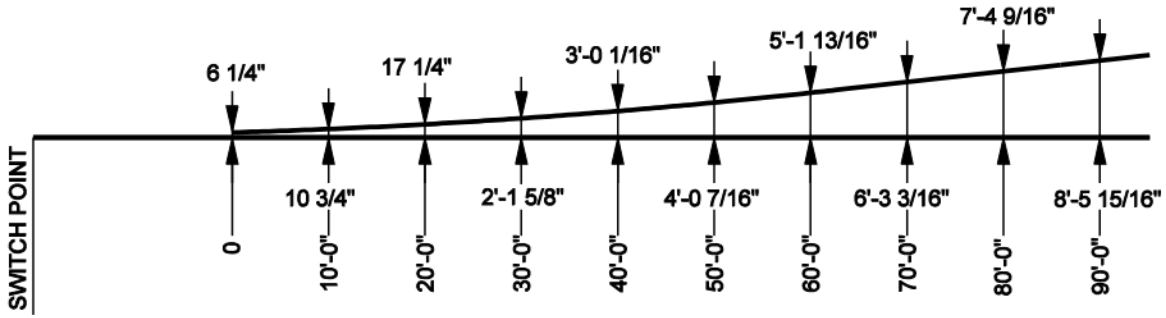
NO. 9 TURNOUT 136 LB. PANEL NO. 4

FILE OWNER: BNSF	DATE: FEB 28, 2007
REV. NO.: 2	DWG NO: 341003

22-4



GENERAL LAYOUT



SPREAD LAYOUT

SWITCH DATA	
SWITCH LENGTH	16'-6"
HEEL SPREAD	6 1/4"
HEEL ANGLE	1°-46'-22"
SWITCH ANGLE	1°-46'-22"
THROW AT ROD #1	4 3/4"
TURNOUT POINT — THICKNESS AT POINT	0"
TURNOUT POINT — RADIUS (CLOSURE CURVE)	616.3542'
TURNOUT POINT — VERTEX DISTANCE	7 1/16"

FROG DATA	
ANGLE	6°-21'-35"
LENGTH	VARIES

TURNOUT DATA	
RADIUS OF CENTER LINE	614'
T =	24.59'
CENTRAL ANGLE - CLOSURE CURVE	4°35'13"
DEGREE OF CURVE	9°20'31"

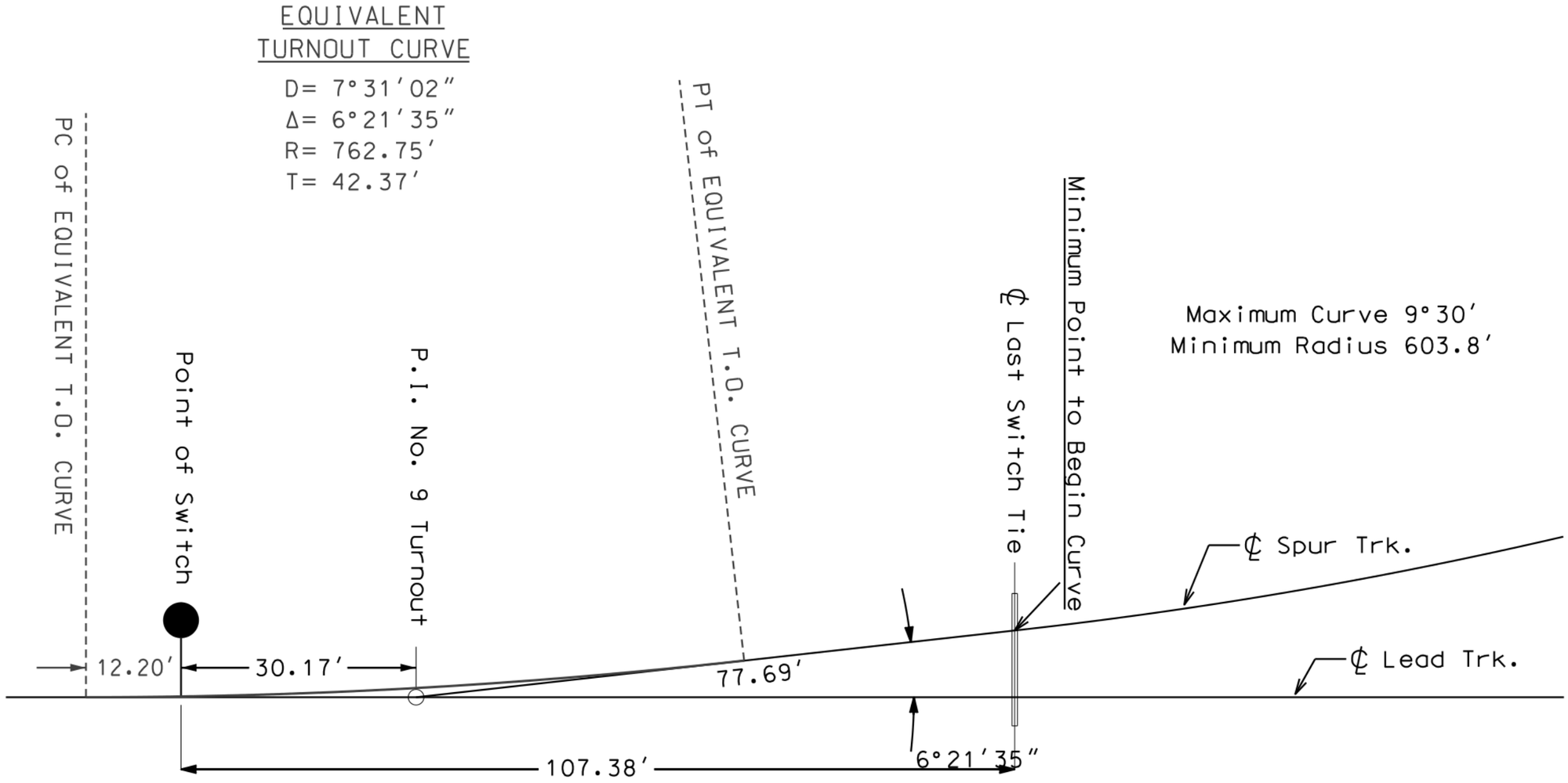
BNSF RAILWAY

COMMON STANDARDS

NO. 9 TURNOUT 16-6" STRAIGHT SWITCH TURNOUT GEOMETRY

FILE OWNER: BNSF | DATE: JAN. 8, 2003
REV. NO.: 0 | DWG NO: 341100

22-5



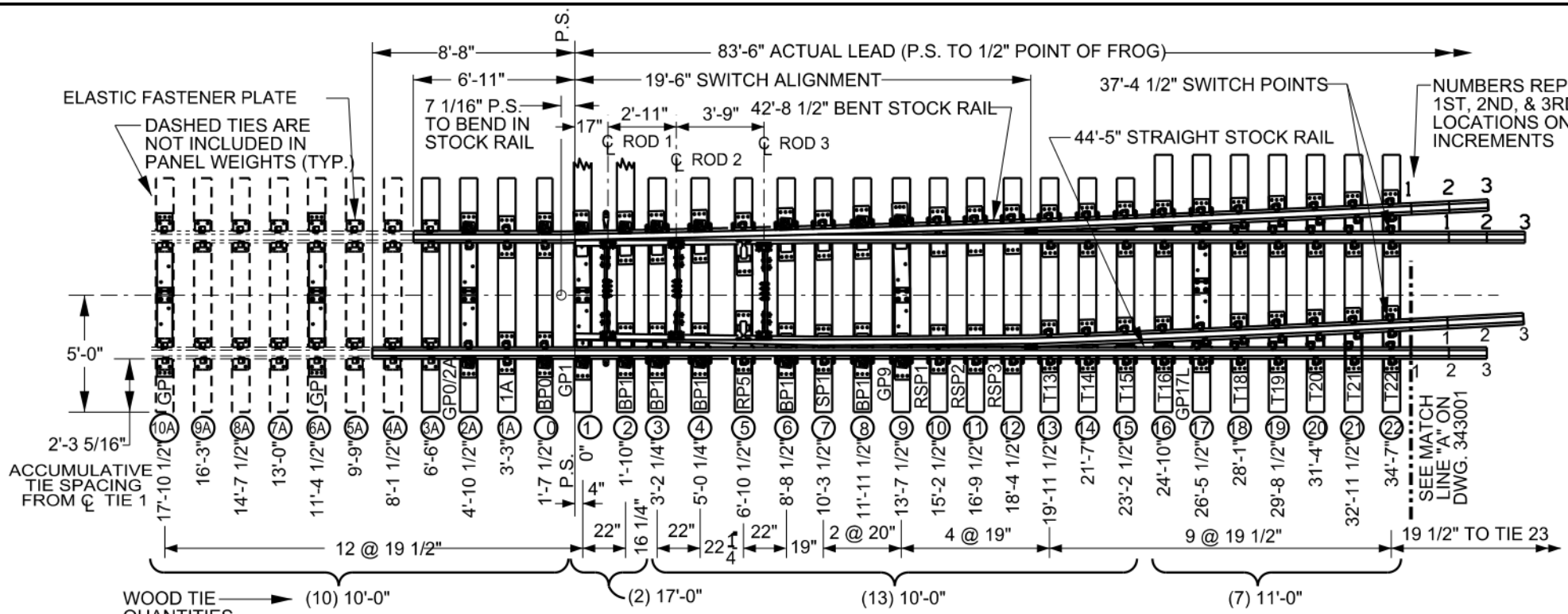
APPROVALS - (NAME - TITLE)	DATE	APPROVALS - (NAME - TITLE)	DATE

REVISIONS			
NO.	DESCRIPTION	DATE	BY

BNSF RAILWAY

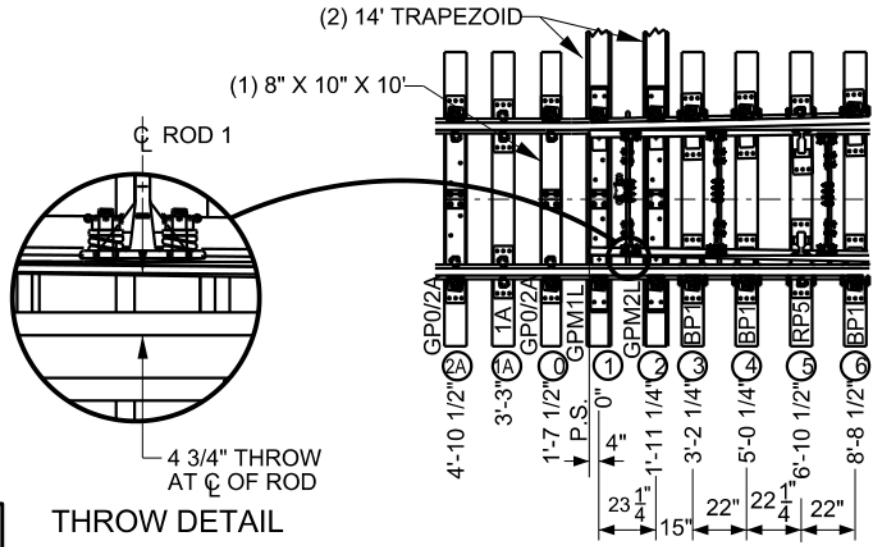
NUMBER 9 TURNOUT
TRACK ALIGNMENT GEOMETRY

DRAWN	CHECKED	BNSF RAILWAY COMPANY - ENGINEERING SERVICES	PROTRAK SEQ NO	STATUS PRELIMINARY	FILE: TURNOUTS.DGN	SHEET 1 OF 1	DATE: 05/06/2011



MANUAL OPERATED
PANEL WEIGHT: 20,000 LBS.

NOTES:
1. SEE DWGS 343001 THRU 343005 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
3. SEE DWG 343100 FOR TURNOUT GEOMETRY.
4. SEE DWG 343200 FOR TURNOUT BILL OF MATERIAL.
5. FULLY BOX ANCHOR STOCK RAILS, TIES 3-15 FOR SHIPPING OF PANELS ONLY.
6. APPLY 5" SAFE BOND WIRES ONE CRIB AHEAD OF HEEL OF SWITCH ON STOCK AND SWITCH POINT RAILS
7. ALL SWITCH POINT AND STOCKRAIL DIMENSIONS ARE TO FIRST INSTALL, SEE PLAN 241500 FOR FULL LENGTH.



THROW DETAIL

POWER OPERATED
PANEL WEIGHT: 20,000 LBS.

	UPRR	BNSF RH	BNSF LH
136LB. POWER	N/A	004734653	004734810
136LB. MANUAL	N/A	004734828	004734836
136LB. MAN. SPR. SW.	N/A	004734869	004734877
141LB. POWER	N/A	005253505	005253497
141LB. MANUAL	N/A	005253521	005253513
141LB. MAN. SPR. SW.	N/A	005253547	005253539

BNSF RAILWAY

COMMON STANDARDS

NO. 11 TURNOUT136/141 LB. PANEL NO. 1

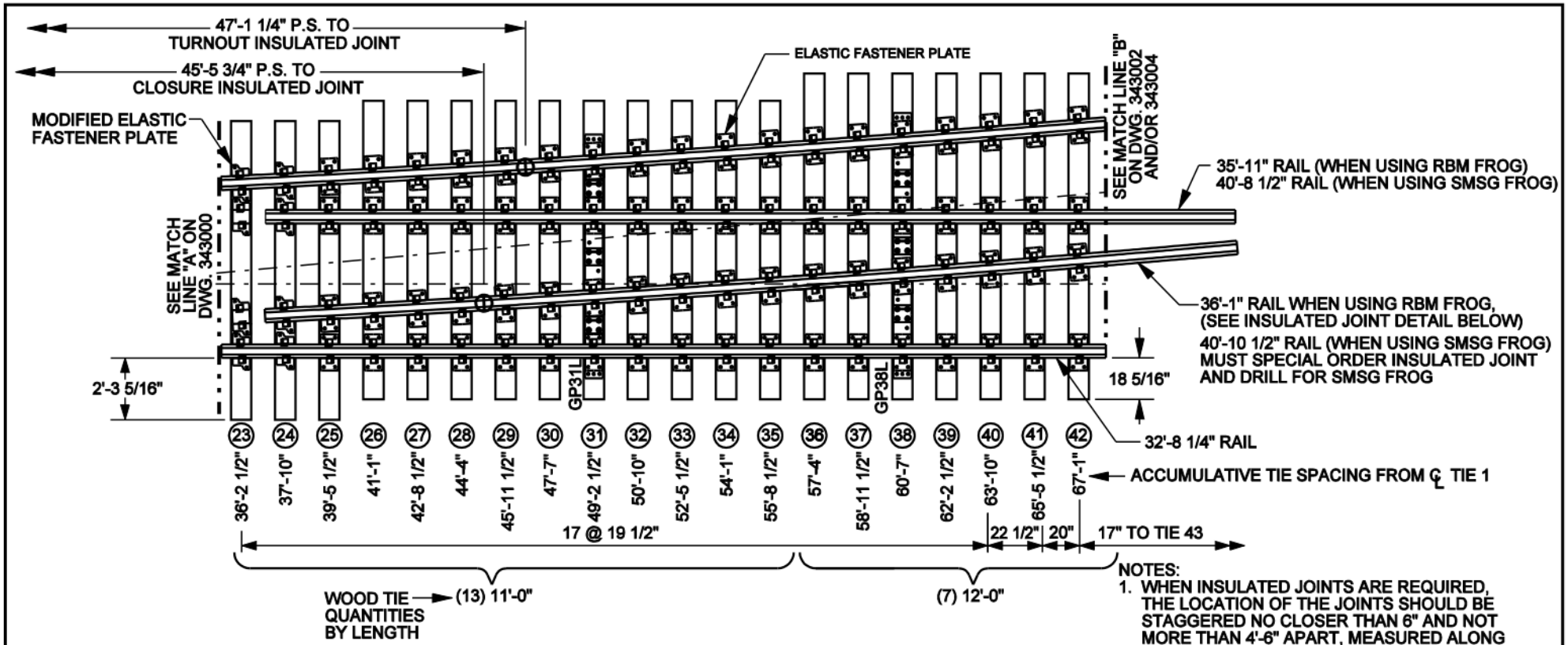
UPRR VP ENGINEERING

BNSF VP ENGINEERING

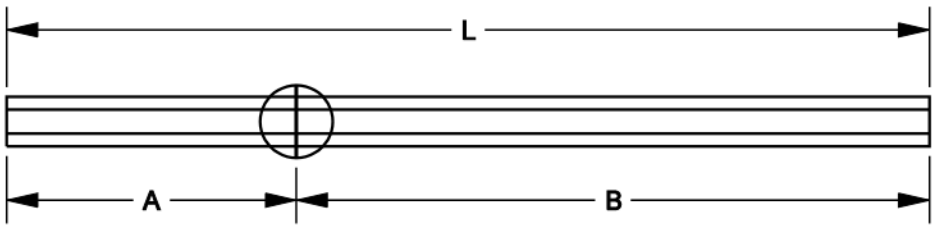
FILE OWNER: BNSF | DATE: OCT. 5, 2010

REV. NO.: 6 | DWG NO: 343000

22-7



NOTES:
1. WHEN INSULATED JOINTS ARE REQUIRED, THE LOCATION OF THE JOINTS SHOULD BE STAGGERED NO CLOSER THAN 6" AND NOT MORE THAN 4'-6" APART, MEASURED ALONG THE TURNOUT.
2. SEE DWGS 343000, 343002, 343003, 343004, AND 343005 FOR THE BALANCE OF LAYOUT PLANS.
3. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
4. SEE DWG 343100 FOR TURNOUT GEOMETRY.
5. SEE DWG 343200 FOR TURNOUT BILL OF MATERIAL.
6. PANEL WEIGHT = 17,000 LBS.



INSULATED JOINT DETAIL
(FOR USE WITH RBM FROG ONLY)

	A	B	L
TURNOUT INSULATED JOINT RAIL	11'-4"	21'-5"	32'-9"
CLOSURE INSULATED JOINT RAIL	8'-2"	27'-11"	36'-1"

	BNSF STOCK CODE	
	136LB.	141LB.
LH TURNOUT INSULATED JOINT RAIL	005253760	005253554
LH CLOSURE INSULATED JOINT RAIL	005253778	005253562
RH TURNOUT INSULATED JOINT RAIL	005253786	005253570
RH CLOSURE INSULATED JOINT RAIL	005253794	005253588

BNSF RAILWAY

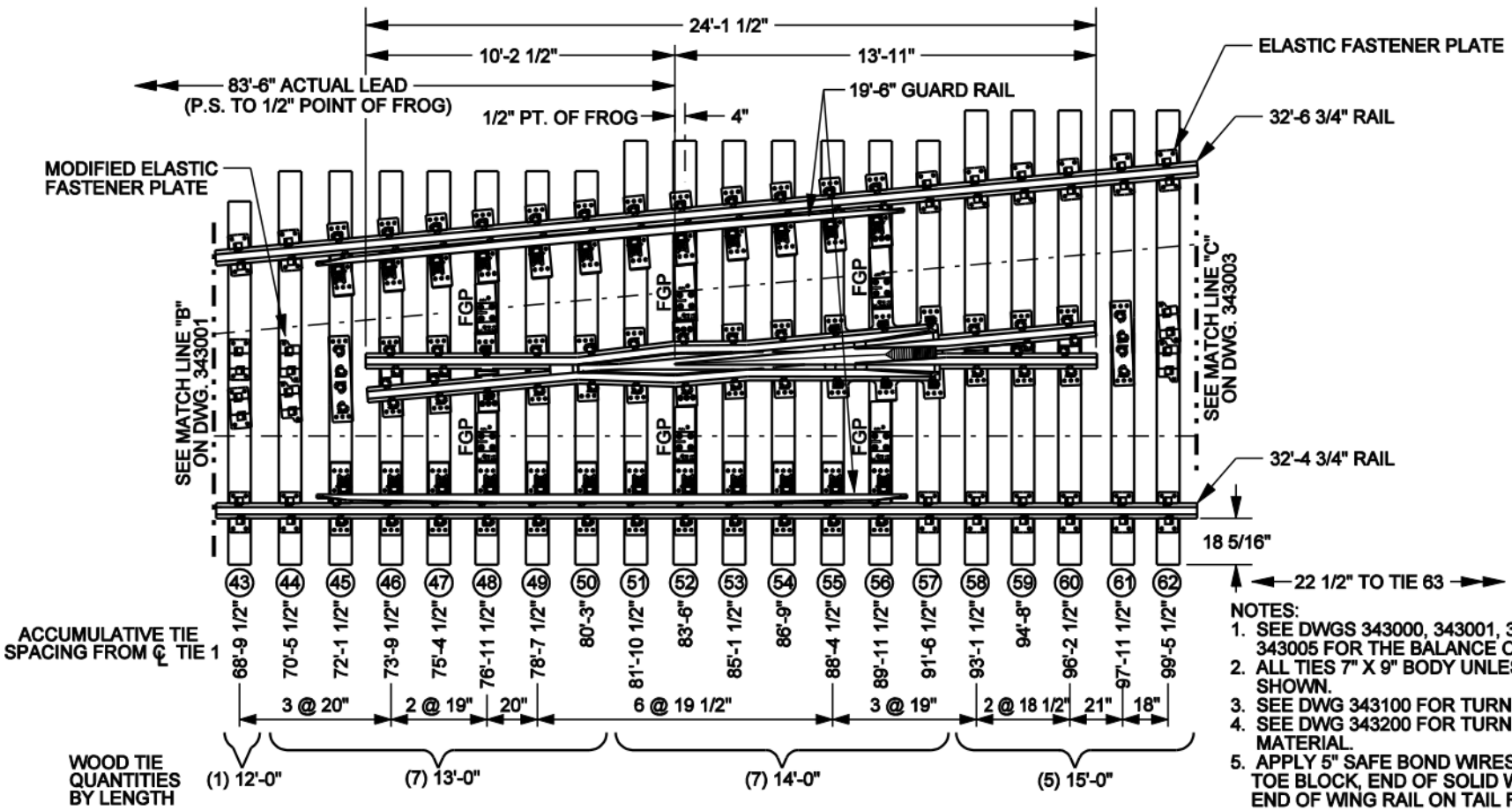
COMMON STANDARDS

NO. 11 TURNOUT 136/141 LB. PANEL NO. 2

FILE OWNER: BNSF | DATE: AUG. 26, 2009

REV. NO.: 5 | DWG NO: 343001

22-8



NOTES:
1. SEE DWGS 343000, 343001, 343003, 343004, AND 343005 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
3. SEE DWG 343100 FOR TURNOUT GEOMETRY.
4. SEE DWG 343200 FOR TURNOUT BILL OF MATERIAL.
5. APPLY 5" SAFE BOND WIRES ONE CRIB AHEAD OF TOE BLOCK, END OF SOLID WING RAIL, BEHIND END OF WING RAIL ON TAIL RAIL AND ONE CRIB BEHIND HEEL BLOCK OF FROG.
6. PANEL WEIGHT = 22,000 LBS.
7. SEE DWGS 343004 AND 343005 FOR SMSG AND LIFT FROG PANELS.

	UPRR	BNSF RH	BNSF LH
136LB. RBM	N/A	004710299	004710307
136LB. SPR	N/A	004710315	004710323
136LB. SOLID	N/A	004710331	004710349
141LB. RBM	N/A	005252739	005252721
141LB. SPR	N/A	005252754	005252747
141LB. SOLID	N/A	N/A	N/A

BNSF RAILWAY

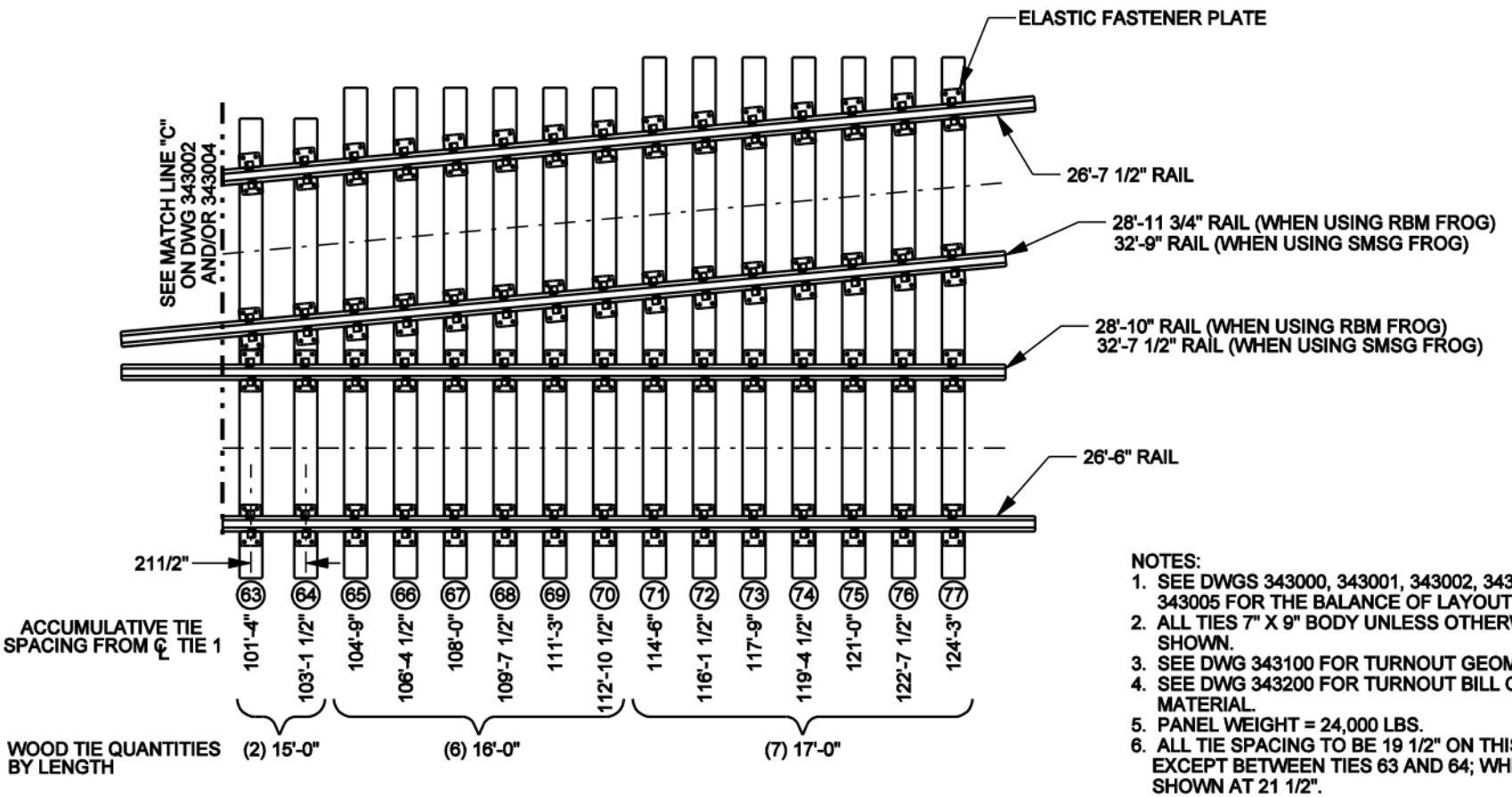
COMMON STANDARDS

NO. 11 TURNOUT 136/141 LB. PANEL NO. 3 WITH OPTIONAL RBM FROG

FILE OWNER: BNSF | DATE: AUG. 26, 2009

REV. NO.: 5 | DWG NO: 343002

22-9



NOTES:
1. SEE DWGS 343000, 343001, 343002, 343004, AND 343005 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
3. SEE DWG 343100 FOR TURNOUT GEOMETRY.
4. SEE DWG 343200 FOR TURNOUT BILL OF MATERIAL.
5. PANEL WEIGHT = 24,000 LBS.
6. ALL TIE SPACING TO BE 19 1/2" ON THIS DWG. EXCEPT BETWEEN TIES 63 AND 64; WHICH ARE SHOWN AT 21 1/2".

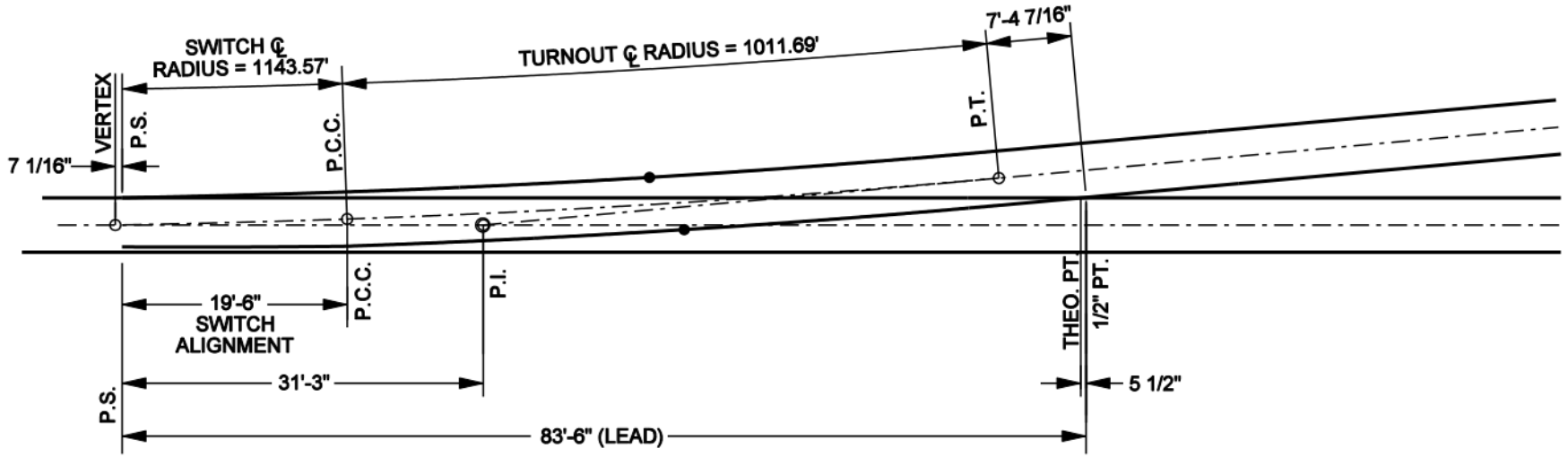
BNSF RAILWAY

COMMON STANDARDS

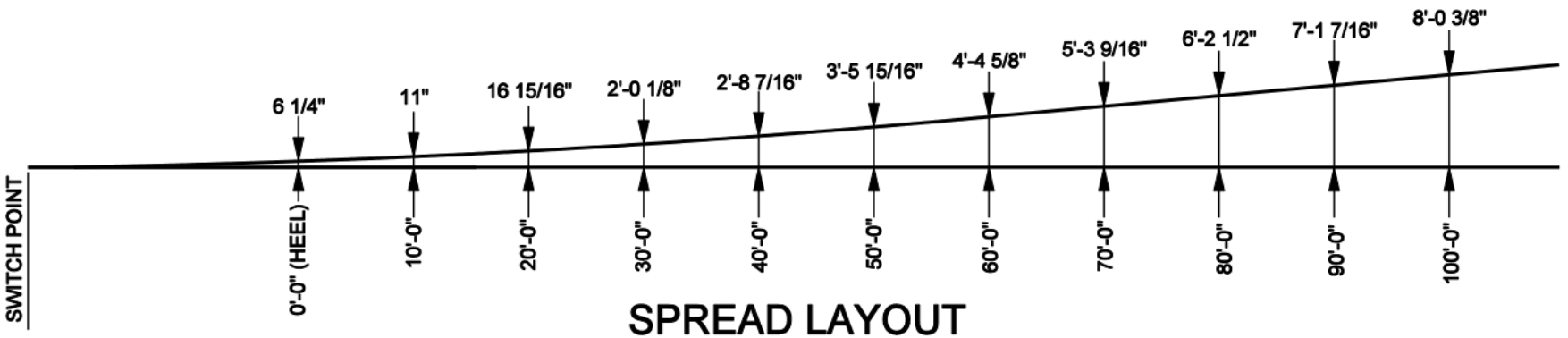
NO. 11 TURNOUT 136/141 LB. PANEL NO. 4

FILE OWNER: BNSF	DATE: AUG. 26, 2009
REV. NO.: 3	DWG NO: 343003

21-10



GENERAL LAYOUT



SPREAD LAYOUT

SWITCH DATA	
SWITCH LENGTH	19'-6"
HEEL SPREAD	6 1/4"
HEEL ANGLE	1°-59'-16"
SWITCH ANGLE	1°-00'-40"
THROW AT ROD #1	4 3/4"
RADIUS (CENTER LINE)	1143.57'
T =	9.69'
CENTRAL ANGLE - CLOSURE CURVE	0°58'16"
DEGREE OF CURVE	5°00'06"
TURNOUT POINT: THICKNESS AT POINT	1/8"
TURNOUT POINT: RADIUS (CLOSURE CURVE)	1145.92'
TURNOUT POINT: VERTEX DISTANCE	7 1/16"

FROG DATA	
ANGLE	5°-12'-18"
LENGTH	VARIES

TURNOUT DATA	
RADIUS OF CENTER LINE	1011.69'
T =	28.35'
CENTRAL ANGLE - CLOSURE CURVE	3°13'02"
DEGREE OF CURVE	5°40'44"

NOTES:

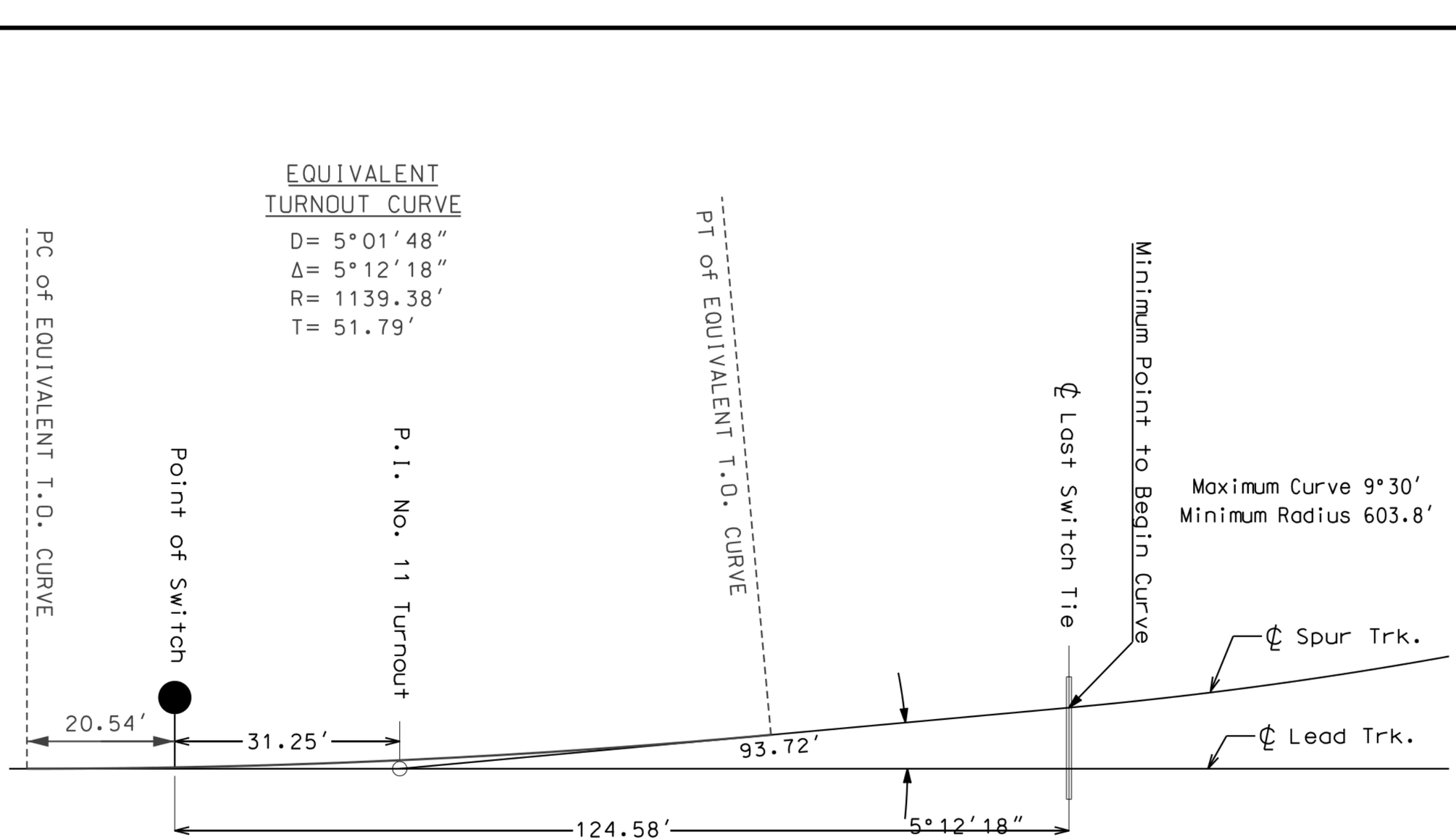
COMMON STANDARDS

NO. 11 TURNOUT 19'-6" CURVED SWITCH TURNOUT GEOMETRY

FILE OWNER: BNSF	DATE: JAN. 9, 2003
REV. NO.: 0	DWG NO: 343100

22-11

...\No 11\343100.dgn 3/2/2005 2:22:57 PM



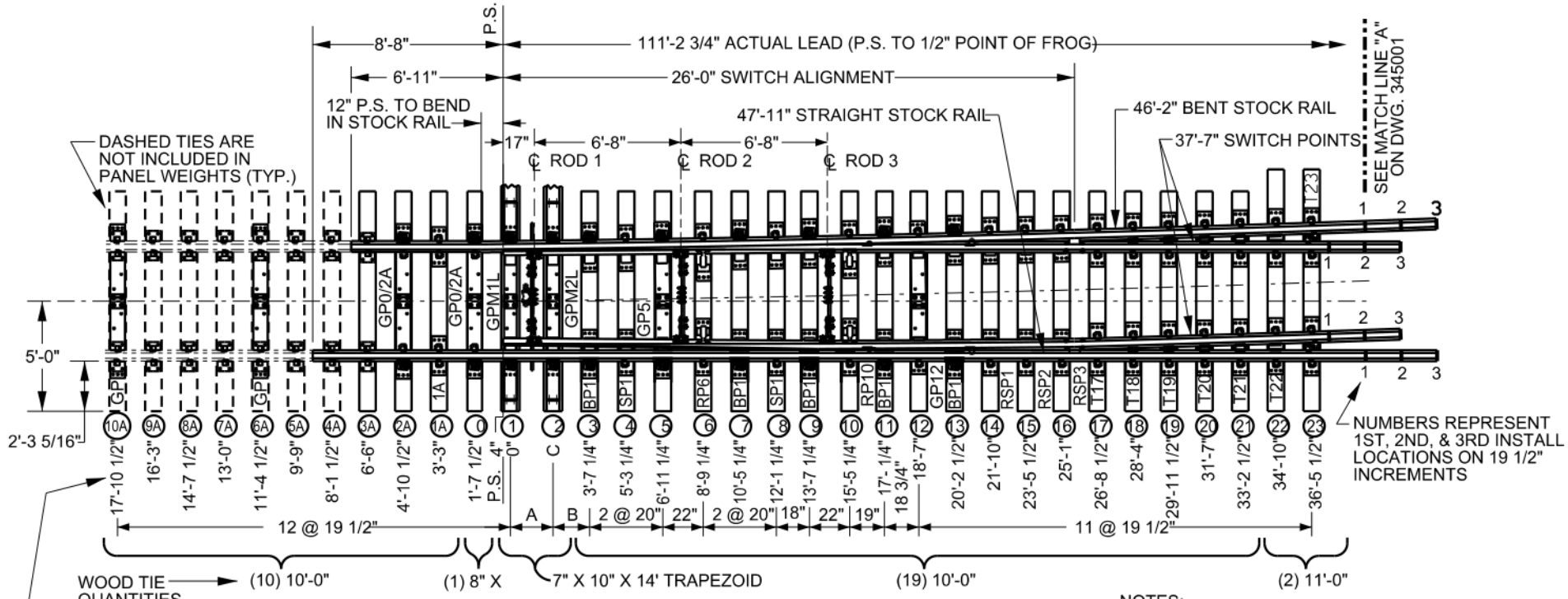
APPROVALS - (NAME - TITLE)	DATE	APPROVALS - (NAME - TITLE)	DATE

REVISIONS			
NO.	DESCRIPTION	DATE	BY

BNSF RAILWAY

NUMBER 11 TURNOUT
TRACK ALIGNMENT GEOMETRY

DRAWN	CHECKED	BNSF RAILWAY COMPANY - ENGINEERING SERVICES	PROTRAK SEQ NO	STATUS PRELIMINARY	FILE: TURNOUTS.DGN	SHEET 1 OF 1	DATE: 05/06/2011



VARIABLE TIE SPACING		
VARIABLE	UPRR	BNSF
A	23 1/4"	22"
B	20"	21 1/4"
C	23 1/4"	22"

NOTES:
1. SEE DWGS 345001, 345002, AND 345003 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIE SPACING 19 1/2" EXCEPT WHERE NOTED.
3. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
4. SEE DWG 345100 FOR TURNOUT GEOMETRY.
5. SEE DWG 345200 FOR TURNOUT BILL OF MATERIAL.
6. APPLY 5" SAFE BOND WIRES ONE CRIB AHEAD OF HEEL OF SWITCH ON STOCK AND SWITCH POINT RAILS.
7. BNSF MANUAL AND MANUAL SPRING SWITCHES WILL BE SUPPLIED WITH UHMWPE PADS ON TIES 1 THROUGH 14.
8. PANEL WEIGHT = APPROXIMATELY 20,900 LBS.

	UPRR	BNSF LH	BNSF RH
136LB. POWER	N/A	518030091	518030065
136LB. MANUAL	N/A	518030093	518030092
136LB. MAN. SPRG.	N/A	518030095	518030094
141LB. POWER	N/A	518030134	518030135
141LB. MANUAL	N/A	518030136	518030137
141LB. MAN. SPRG.	N/A	518030138	518030139

BNSF RAILWAY

COMMON STANDARDS

NO. 15 TURNOUT 136/141 LB. PANEL NO. 1

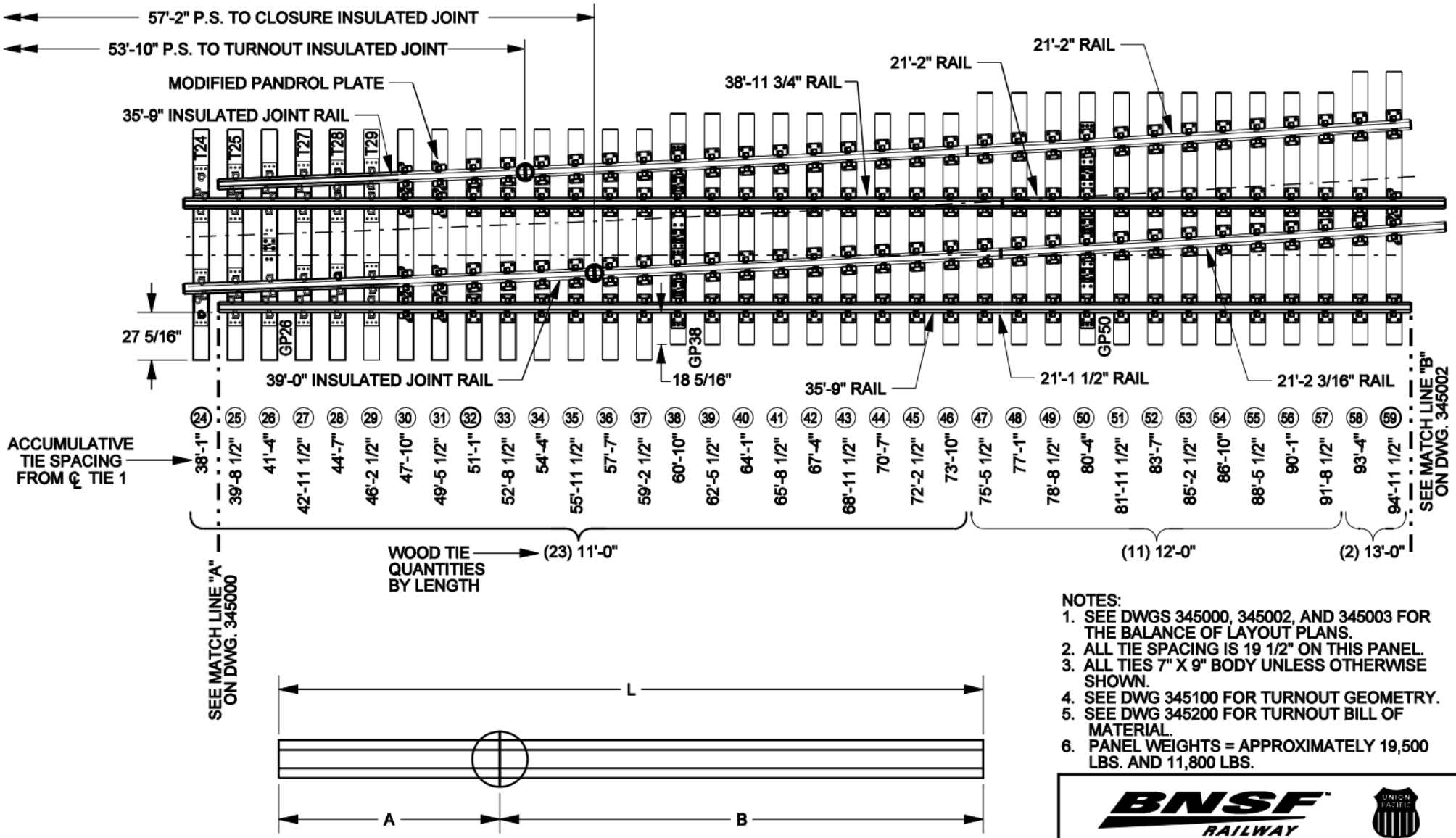
UPRR VP ENGINEERING

BNSF VP ENGINEERING

FILE OWNER: UPRR | DATE: OCT. 5, 2010

REV. NO.: 5 | DWG NO: 345000

22-13



NOTES:
1. SEE DWGS 345000, 345002, AND 345003 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIE SPACING IS 19 1/2" ON THIS PANEL.
3. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
4. SEE DWG 345100 FOR TURNOUT GEOMETRY.
5. SEE DWG 345200 FOR TURNOUT BILL OF MATERIAL.
6. PANEL WEIGHTS = APPROXIMATELY 19,500 LBS. AND 11,800 LBS.

	A	B	L
TURNOUT INSULATED JOINT RAIL	14'-8"	21'-1"	35'-9"
CLOSURE INSULATED JOINT RAIL	19'-7"	19'-5"	39'-0"

	BNSF ITEM NUMBER	
	136LB.	141LB.
LH TURNOUT INSULATED JOINT RAIL	518030155	518030140
LH CLOSURE INSULATED JOINT RAIL	518030156	518030141
RH TURNOUT INSULATED JOINT RAIL	518030157	518030142
RH CLOSURE INSULATED JOINT RAIL	518030158	518030143

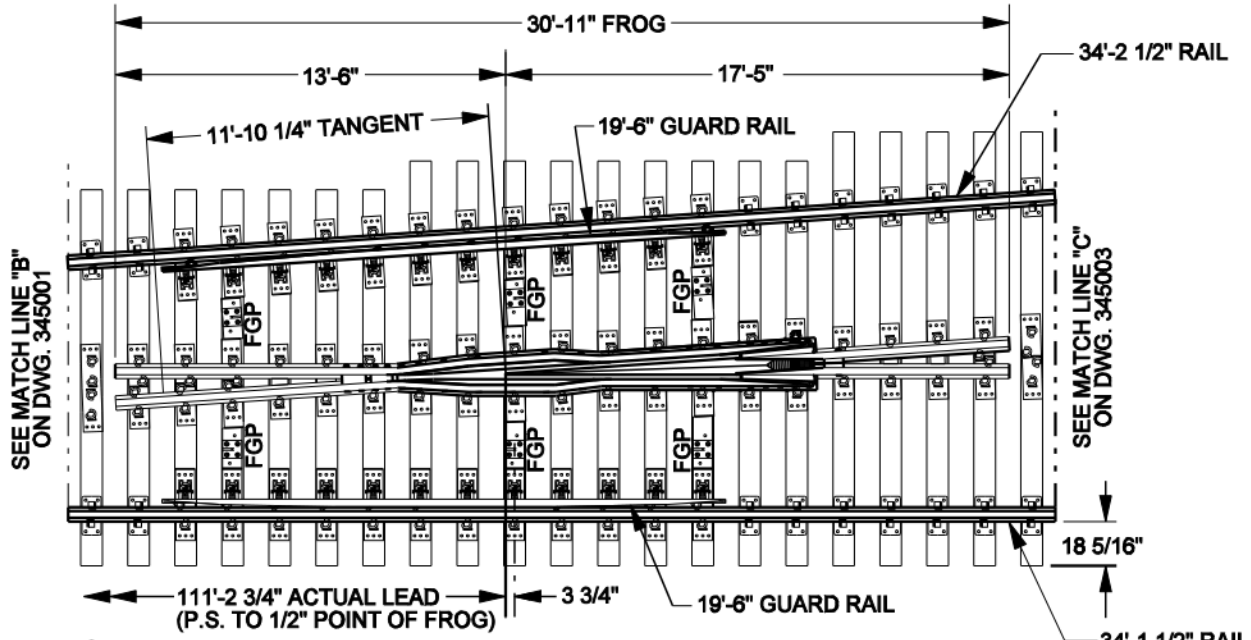
BNSF RAILWAY

COMMON STANDARDS

NO. 15 TURNOUT 136/141 LB. PANELS NO. 2 AND NO. 3

FILE OWNER: UPRR	DATE: MAY 19, 2008
REV. NO.: 3	DWG NO: 345001

22-14



ACCUMULATIVE TIE SPACING FROM ℄ TIE 1	96'-7"	98'-2 1/2"	99'-10"	101'-5 1/2"	103'-1"	104'-8 1/2"	106'-4"	107'-11 1/2"	109'-7"	111'-2 1/2"	112'-10"	114'-5 1/2"	116'-1"	117'-8 1/2"	119'-4"	120'-11 1/2"	122'-7"	124'-2 1/2"	125'-10"	127'-5 1/2"	129'-1"
TIE NO.	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

(7) 13'-0" | WOOD TIE QUANTITIES BY LENGTH → (9) 14'-0" | (5) 15'-0"

NOTES:
1. SEE DWGS 345000, 345001, AND 345003 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIE SPACING IS 19 1/2" ON THIS PANEL.
3. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
4. SEE DWG 345100 FOR TURNOUT GEOMETRY.
5. SEE DWG 345200 FOR TURNOUT BILL OF MATERIAL.
6. PANEL WEIGHT = APPROXIMATELY 28,800 LBS.

BNSF RAILWAY

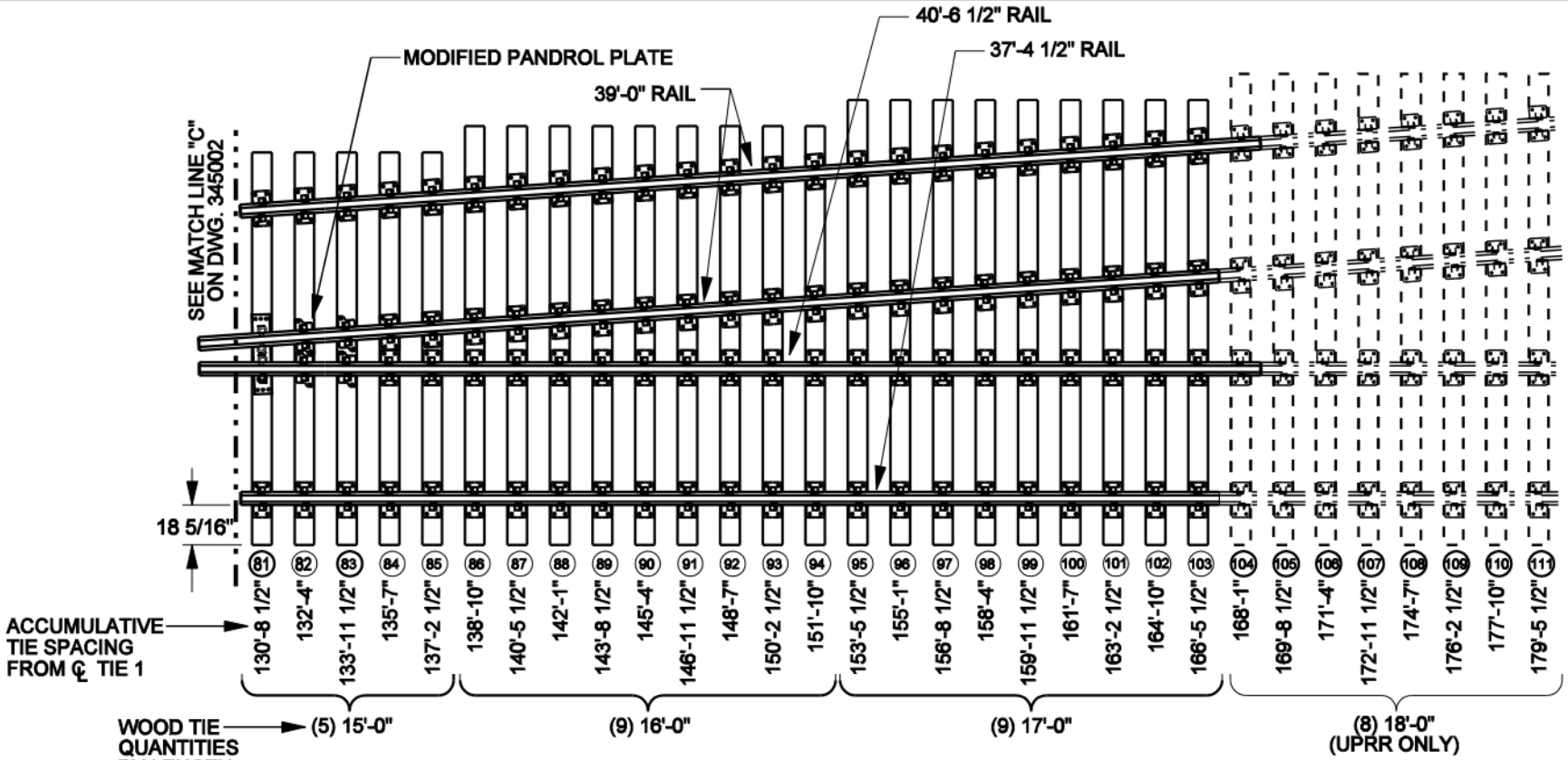
COMMON STANDARDS

NO. 15 TURNOUT 136/141 LB. PANEL NO. 4

	UPRR	BNSF LH	BNSF RH
136LB. RBM	N/A	513450060	513450059
136 LB. SPRING	N/A	513450063	513450061
141 LB. RBM	N/A	513450232	513450233
141 LB. SPRING	N/A	513450234	513450235

FILE OWNER: UPRR	DATE: MAY 16, 2008
REV. NO.: 3	DWG NO: 345002

22-15



NOTES:
1. SEE DWGS 345000, 345001, AND 345002 FOR THE BALANCE OF LAYOUT PLANS.
2. ALL TIE SPACING IS 19 1/2" ON THIS PANEL.
3. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN.
4. SEE DWG 345100 FOR TURNOUT GEOMETRY.
5. SEE DWG 345200 FOR TURNOUT BILL OF MATERIAL.
6. PANEL WEIGHT = APPROXIMATELY 23,650 LBS.

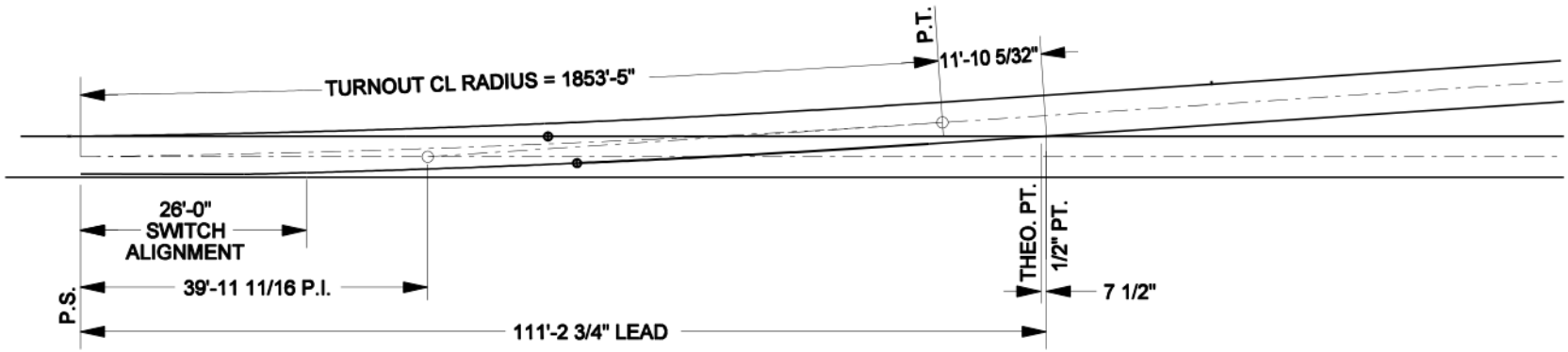
BNSF RAILWAY

COMMON STANDARDS

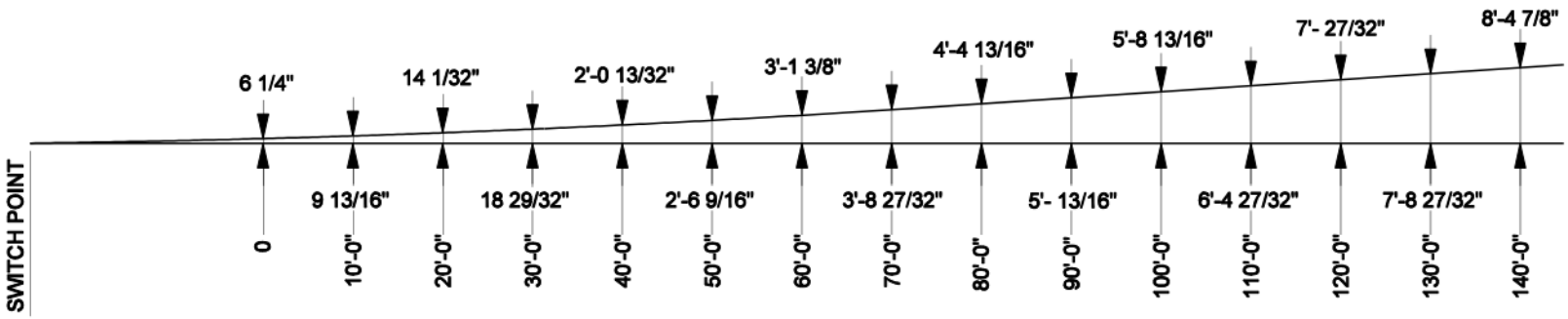
NO. 15 TURNOUT 136/141 LB. PANEL NO. 5

FILE OWNER: UPRR	DATE: MAY 2, 2008
REV. NO.: 1	DWG NO: 345003

22-16



GENERAL LAYOUT



SPREAD LAYOUT

SWITCH DATA	
SWITCH LENGTH	26'-0"
HEEL SPREAD	6 1/4"
HEEL ANGLE	1°-33'-2"
SWITCH ANGLE	0°-44'-47"
THROW AT ROD #1	4 3/4"
RADIUS (CENTER LINE)	1853.42'
T =	49.68'
CENTRAL ANGLE - CLOSURE CURVE	3°-04'-16"
DEGREE OF CURVE	3°-05'-30"
TURNOUT POINT: THICKNESS AT POINT	1/4"
TURNOUT POINT: RADIUS (CLOSURE CURVE)	1855.77'
TURNOUT POINT: VERTEX DISTANCE	0"

FROG DATA	
ANGLE	3°-49'-06"
LENGTH	VARIES

TURNOUT DATA	
RADIUS OF CENTER LINE	1853.42'
T =	49.68'
CENTRAL ANGLE - CLOSURE CURVE	3°-04'-16"
DEGREE OF CURVE	3°-05'-30"

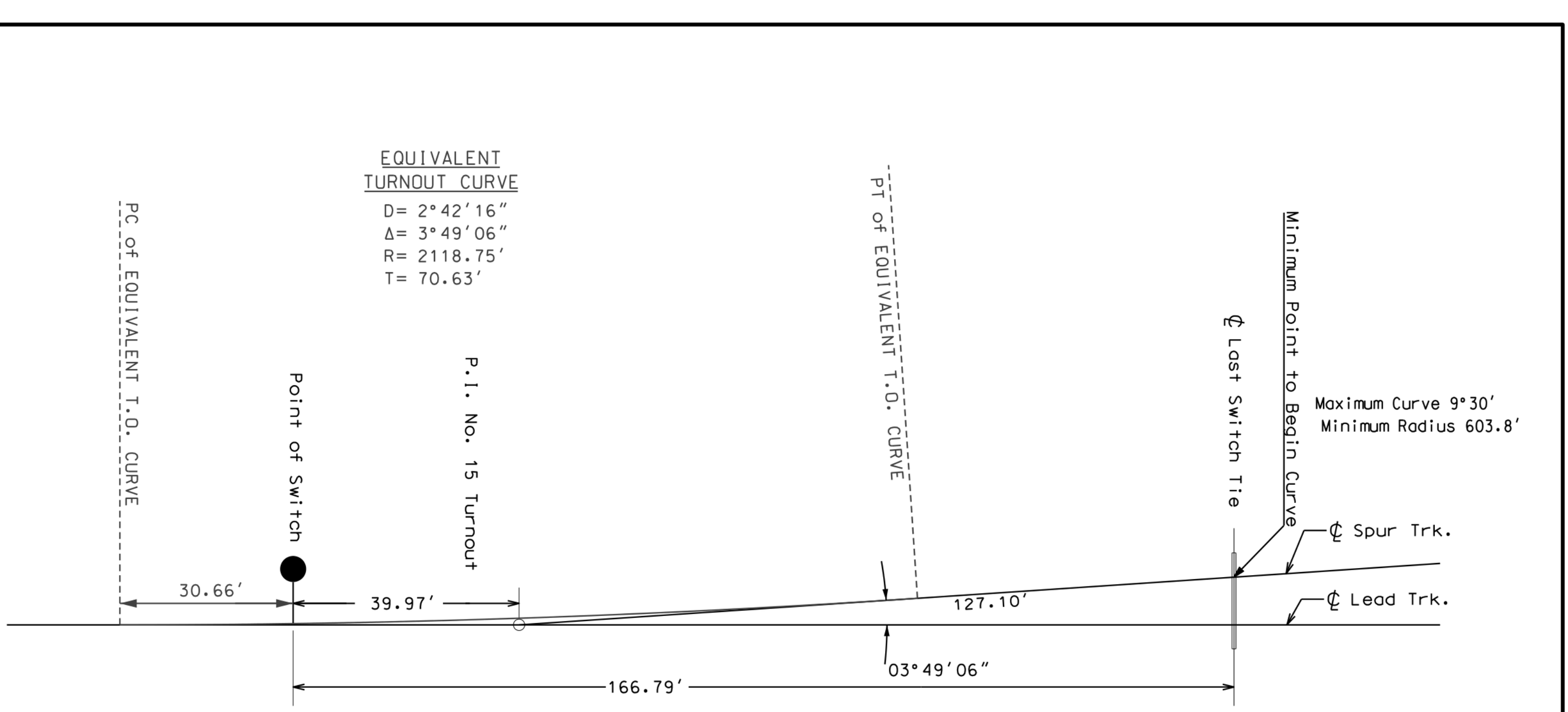
NOTES:

COMMON STANDARDS

NO. 15 TURNOUT 26'-0" CURVED SWITCH, TURNOUT GEOMETRY

FILE OWNER: UPRR	DATE: JAN. 14, 2003
REV. NO.: 0	DWG NO: 345100

345100



APPROVALS - (NAME - TITLE)	DATE	APPROVALS - (NAME - TITLE)	DATE

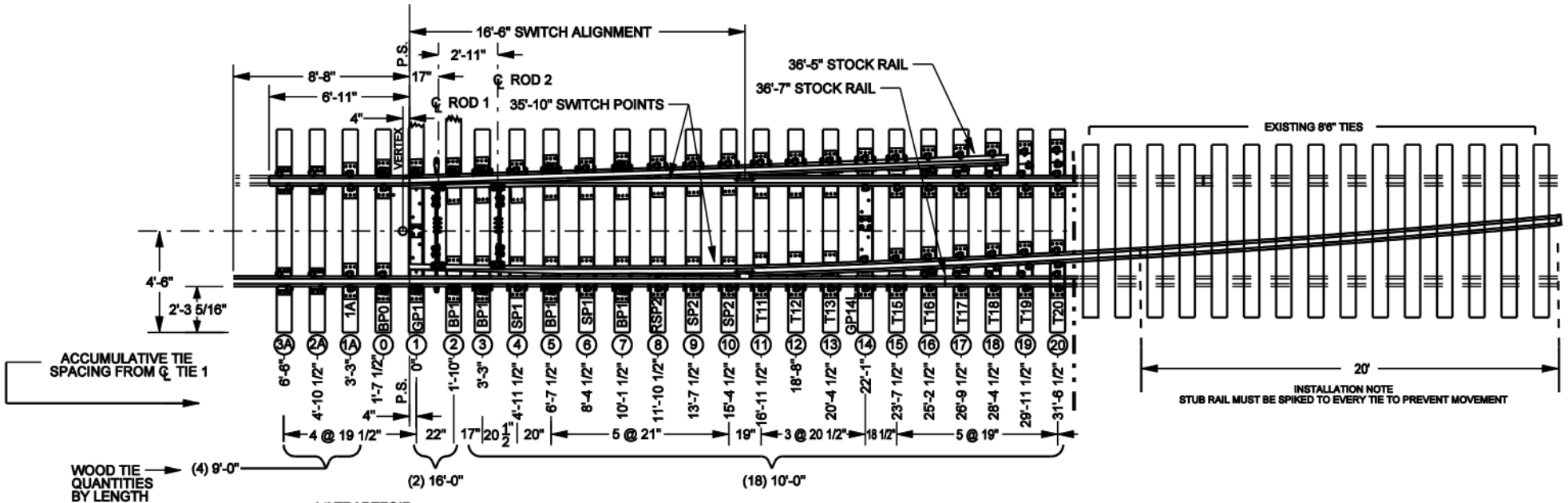
REVISIONS

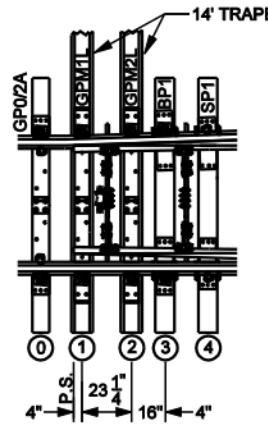
NO.	DESCRIPTION	DATE	BY

BNSF RAILWAY

NUMBER 15 TURNOUT
TRACK ALIGNMENT GEOMETRY

DRAWN	CHECKED	BNSF RAILWAY COMPANY - ENGINEERING SERVICES	PROTRAK SEQ NO	STATUS PRELIMINARY	FILE: TURNOUTS.DGN	SHEET 1 OF 1	DATE: 05/06/2011

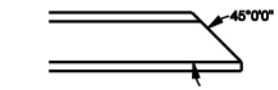




POWER OPERATED
PANEL WEIGHT: 20,000 LBS.

MANUAL OPERATED
PANEL WEIGHT: 20,000 LBS.
Panel Length 44' 6"

END RAMP 45°



NOTES:
1. ALL TIES 7" X 9" BODY UNLESS OTHERWISE SHOWN ABOVE.
2. SEE DWG 341100 FOR TRACK GEOMETRY.
3. FULLY BOX ANCHOR STOCK RAILS, TIES 3-15 FOR SHIPPING OF PANELS ONLY.
4. SWITCH POINT DERAIL FURNISHED AS A COMPLETE PANEL.
5. WHEN ORDERING SPECIFY LEFT OR RIGHT HAND AND POWER OR MANUAL OPERATION. SUPPLIER TO PROVIDE CORRECT PLATING AND TIES FOR POWER APPLICATIONS..
6. FOR OPERATING STANDS SEE STANDARD PLANS 2501.02 & 2153.01. FOR ROD PLAN SEE DRAWING 2156.01 AND DERAIL SIGN ON PLAN 3020.01.
7. SEE STANDARD PLAN 24000202 FOR DOUBLE SWITCH POINT DERAIL REQUIREMENTS.
8. SEE LATEST REVISED ENGINEERING INSTRUCTIONS 9.3.3 FOR INSTALLATION AND USE.
9. MANUFACTURER WILL PROVIDE A DRILLED 20' STUB RAIL, A DRILLED TURNOUT SWITCH POINT AND ANGLE BARS FOR HOOK UP.
10. END RAMPS REQUIRED ON STUB RAIL AND TURNOUT STOCK RAIL.

	LH	RH
POWER 141	054333703	054333711
POWER 136	054333646	054333653
POWER 115	054333687	054333695
MANUAL 141	054333661	054333679
MANUAL 115	054333638	-

BNSF RAILWAY

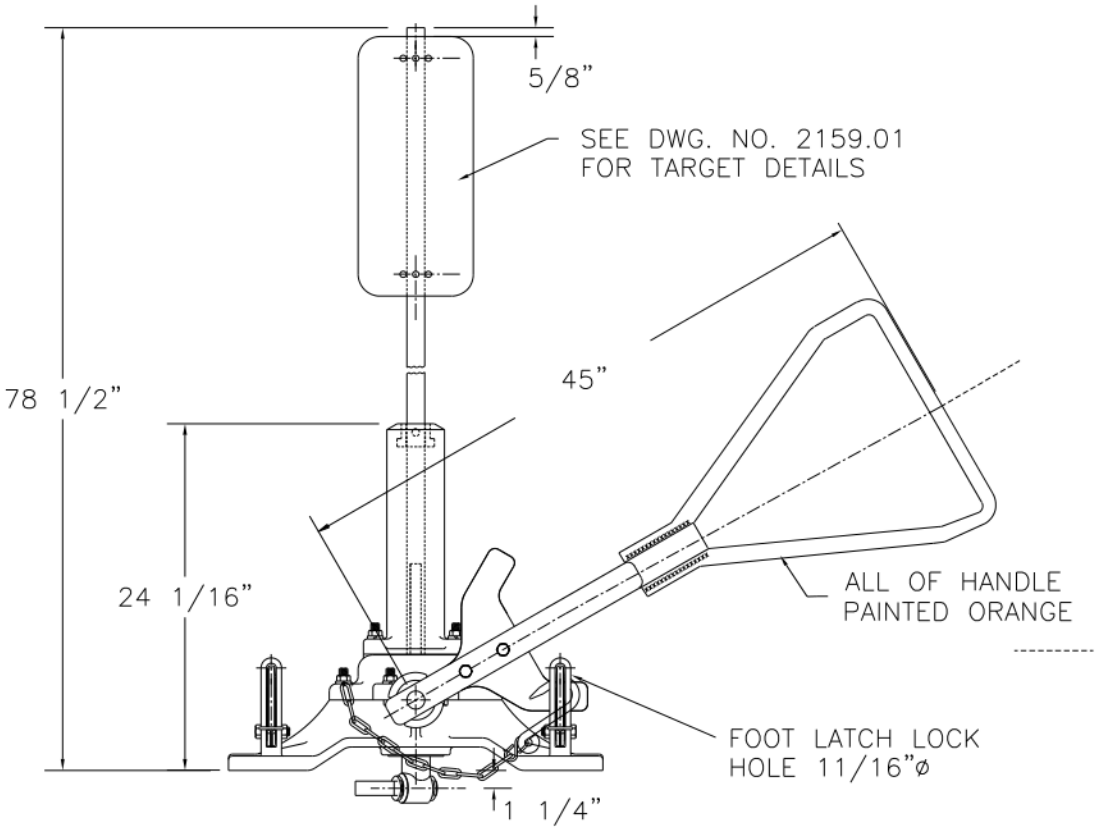
STANDARD PLAN

DOUBLE SWITCH POINT DERAIL
16' 6" POINTS 136 LB

DATE: MAY 22, 2009 | FILE OWNER: BNSF

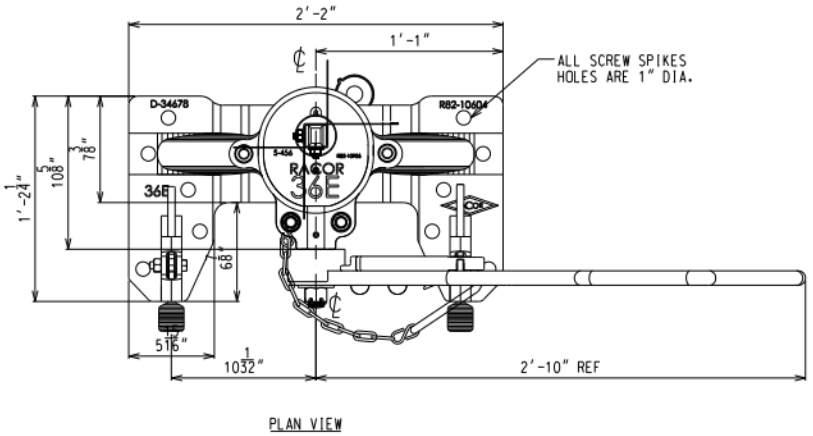
DWG NO: 240003 | REV NO 04

3 - 6



ELEVATION VIEW

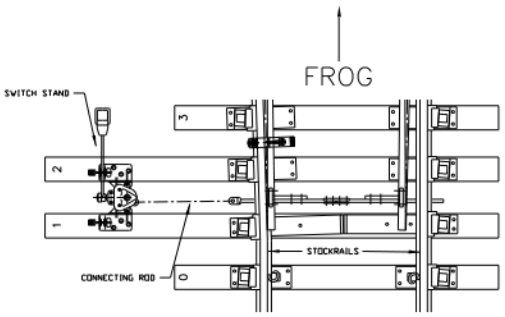
36 EH STANDS,
SHOWN WITH HIGH STAFF
AND TRI-HANDLE.



PLAN VIEW

PLAN VIEW

36 E STANDS,
SHOWN WITH LOW STAFF
AND TRI-HANDLE.



INSTALLATION VIEW

BILL OF MATERIALS

QUANTITY	SWITCH STAND DESCRIPTION	
1 EA.	36E LOW TARGET WITH TRI-HANDLE @ 30°	ITEM NO. 517740985N
1 EA.	36EH HIGH TARGET WITH TRI-HANDLE @ 30°	ITEM NO. 517740995N
1 EA.	36D RETRO-FIT KIT WITH TRI-HANDLE @ 30°	ITEM NO. 513960006N

NOTES:

1. SEE DWG. 2156 & 2160 FOR SPINDLE AND CRANK EYE DETAILS.
2. HANDLE KITS (STRAIGHT OR TRI-HANDLE) ARE AVAILABLE FOR FIELD RETRO FIT OF EXISTING 36 STYLE SWITCH STANDS.
3. STAND 36EH IS FOR MAIN LINE USE ONLY. FURNISHED WITH NO. 1.2 STAFF, SEE DWG. 2160.01.
4. STAND 36E IS FOR MAIN LINE OR YARD USE, FURNISHED WITH NO. 2 STAFF, SEE DWG. 2160.01.
5. 16:1 MECHANICAL ADVANTAGE.
6. SWITCH STANDS ARE TO BE INSTALLED WITH HANDLE DIRECTED TOWARDS FROG WHEN LINED TO THE STRAIGHT SIDE OF SWITCH.
6. STAND INCLUDES ½" DIAMETER HOOK ON 19" CHAIN

BNSF RAILWAY

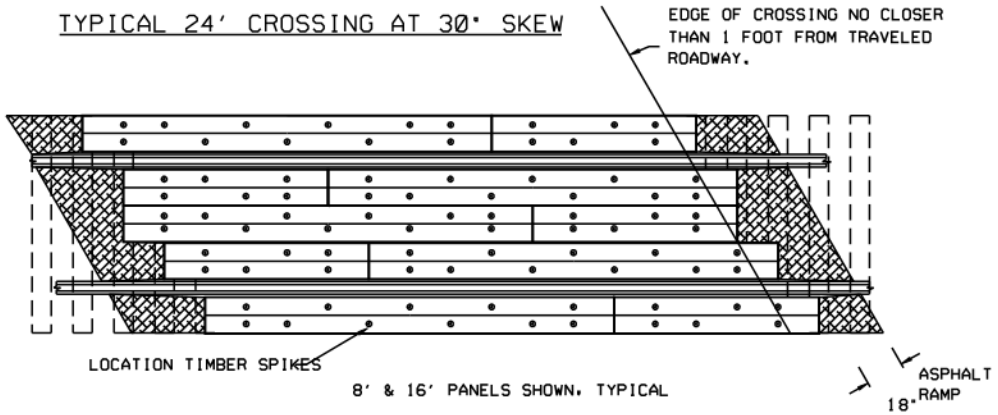
STANDARD PLAN

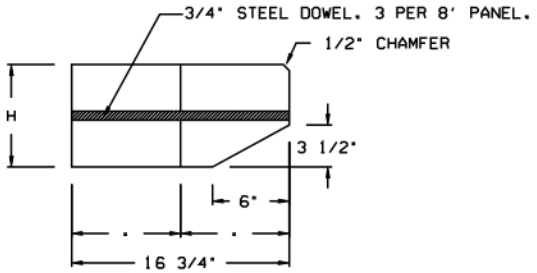
RACOR STYLE 36E & 36EH
SWITCH STAND
WITH 45" TRI-HANDLE

FILE OWNER BNSF	DATE: DECEMBER 10, 2010
REV. NO.: 13	DWG NO: 215301

19-15

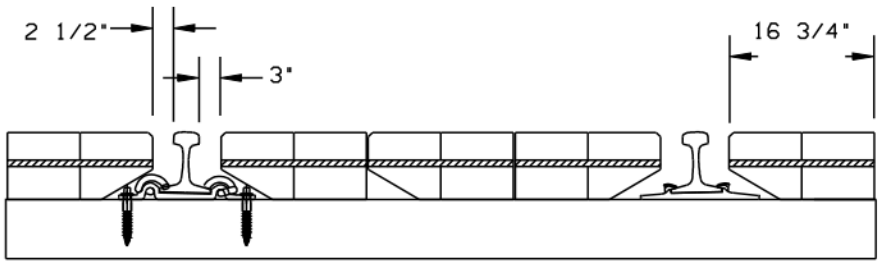
TYPICAL 24' CROSSING AT 30° SKEW





TWO PIECE PANEL

H = 7" FOR 100 LB RAIL
H = 7 1/2" FOR 115 LB RAIL
H = 8" FOR 136 LB. RAIL



8'6" CROSS TIE

MATERIAL & FABRICATION

1. HARDWOOD PANELS TO BE TREATED (BNSF SPECIFICATIONS) MIXED HARDWOOD, FREE OF WANE.
2. BRANDING: EACH CROSSING PANEL SHALL BE IDENTIFIED ON THE END WITH MANUFACTURER ID, MO/YR MANUFACTURED, WEIGHT RAIL.

INSTALLATION

1. BALLAST THROUGH CROSSING AREA SHALL BE CLEAN CRUSHED ROCK BALLAST, 12" BELOW BOTTOM OF TIES. TOP OF BALLAST TO BE 2" BELOW TOP OF TIES. TIES THROUGH CROSSING SHALL BE NO. 5 TREATED HARDWOOD 19 3/16" ON CENTERS, IN GOOD CONDITION.
2. IF REQUIRED BY GDLM, PERFORATED DRAINAGE PIPE RECOMMENDED FOR PROPER DRAINAGE PER BNSF DWG. 2259.01.
3. ENDS OF CROSSING PANELS SHOULD BE CENTERED ON TIE.
4. THERMITE WELDS OR RAIL JOINTS SHOULD BE LOCATED OUTSIDE THE CROSSING, WHEREVER POSSIBLE. WELDED RAIL SHOULD BE RELAYED THROUGH CROSSING (MINIMUM RAIL WEIGHT, 112 LB.) BEFORE NEW TIES AND CROSSING PANELS ARE INSTALLED.
5. PANELS SHALL BE HANDLED CAREFULLY. SLATTED AND STACKED ON LEVEL GROUND TO PREVENT WORPAGE.
6. PUBLIC CROSSINGS SHALL BE OF SUCH WIDTH AS PRESCRIBED BY LAW, BUT IN NO CASE SHALL THE WIDTH BE LESS THAN THAT OF THE ADJACENT TRAVELED ROADWAY PLUS 2 FEET.
7. TWIN LEAD TIMBER SPIKES FURNISHED SEPARATELY.
8. 3/8" DIA. HOLES SHOULD BE BORED IN FIELD, TO PATTERN SHOWN.
9. GAGE SIDE AND FIELD SIDE PANELS ARE INTERCHANGEABLE.
10. ALL CROSSING PANELS HAVE CLEARANCE FOR PANDROL PLATES AND CLIPS.
11. USE OF 10' TIES IS REQUIRED IN HEAVILY RAIL TRAFFIC CROSSINGS SEE DWG. 2253.03.
12. PANELS ARE FURNISHED FOR ANY LENGTH CROSSING IN INCREMENTS OF 8 AND 16 FEET. THE ITEM NUMBERS LISTED BELOW COVERS THE REQUIRED PANELS BY THE TRACK FOOT.

	BILL OF MATERIAL	
WT. RAIL	DESCRIPTION	STOCK CODE
100 LB	8' FULL DEPTH PANEL (2 PCS. DOWELED)	004938916
115 LB	8' FULL DEPTH PANEL (2 PCS. DOWELED)	004938940
115 LB	16' FULL DEPTH PANEL (2 PCS. DOWELED)	004938932
136 LB	8' FULL DEPTH PANEL (2 PCS. DOWELED)	004938866
136 LB	16' FULL DEPTH PANEL (2 PCS. DOWELED)	004938957
	3/4" X 12" TWIN LEAD TIMBER SPIKE	004744074
	3/4" X 13" TWIN LEAD TIMBER SPIKE	004743985

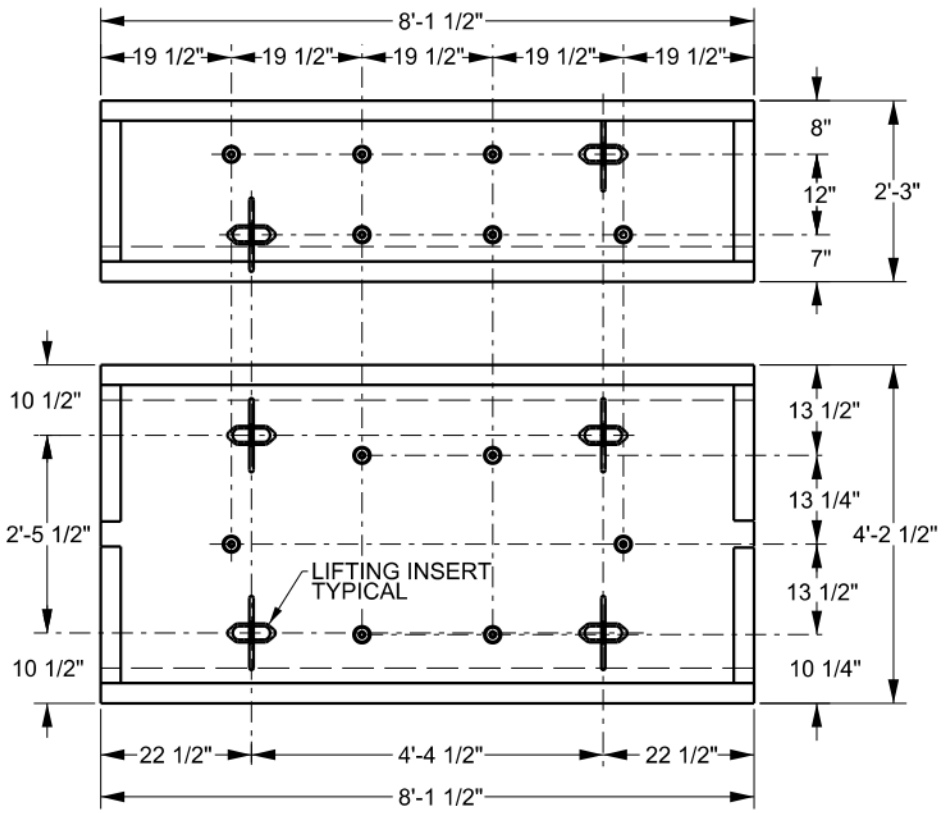
BNSF RAILWAY

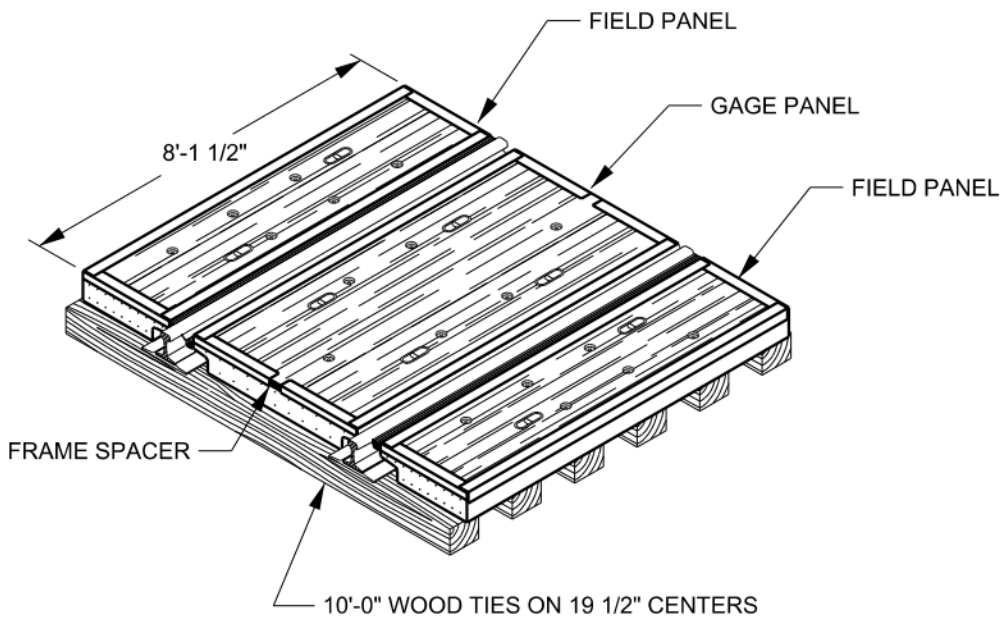
STANDARD PLAN

TIMBER CROSSING PANELS FOR LOW DENSITY RAIL TRAFFIC ON 8'6" WOOD TIES

SCALE: NONE	FILE OWNER BNSF	DATE: MAY 11, 2010
	REV. NO.: 07	DWG NO: 225302

15-17





NOTES:
1/4" RUBBER INTERFACE PAD TO BE PLACED BETWEEN PANEL AND TIES FOR 141 LB. RAIL SECTION. PAD TO BE NAILED TO TIES,

CROSSING TYPE - 10W

RAIL SIZE	PANEL HEIGHT	GAGE PANEL WEIGHT	FIELD PANEL WEIGHT
115	7 1/8"	2850 LBS.	1550 LBS.
132-141	7 7/8"	3125 LBS.	1675 LBS.

ITEM NUMBERS				
141 LB. BNSF	133-141 LB. UPRR	132-136 LB. BNSF	115 LB. UPRR	115 LB. BNSF
054374616	540-1301	004935722	540-0202	004935706

BNSF RAILWAY

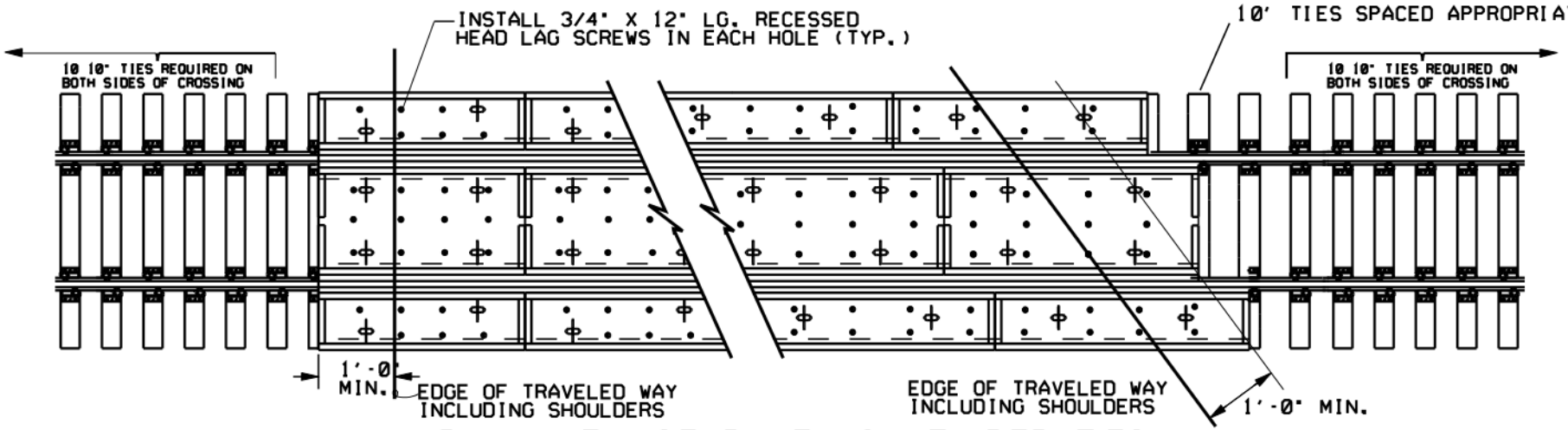
COMMON STANDARDS

LAYOUT FOR CONCRETE PANELS ON 10'-0" LONG WOOD TIES (10W)

FILE OWNER: UPRR | DATE: DEC. 6, 2010

REV. NO.: 2 | DWG NO: 200100

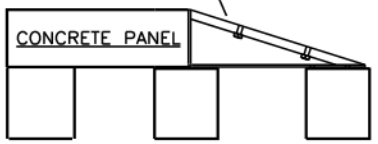
15-1



PLAN VIEW OF PANEL ON TIMBER TIES WITH ELASTIC FASTENERS

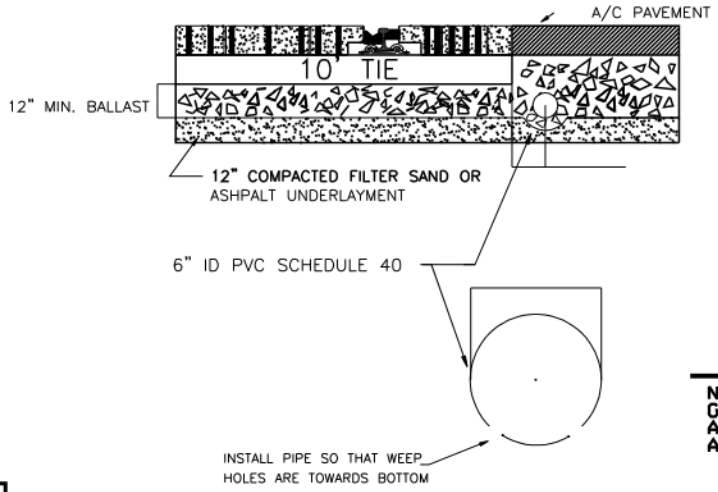
ENDS OF CONCRETE PANELS MUST BE SUPPORTED BY TIES AS SHOWN.

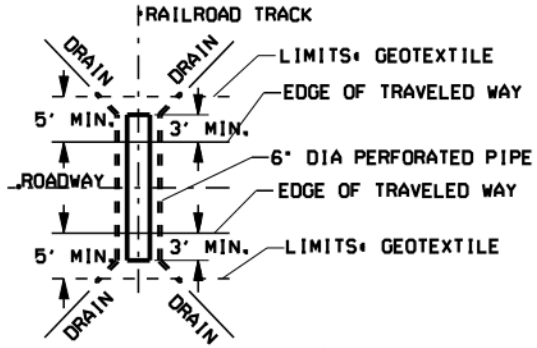
MANUFACTURED OR ASPHALT END RAMPS REQUIRED.



SIDE VIEW

FIELD RAMP BASE REFER TO PLAN 22580301 FOR END RAMP RESTRAINT SYSTEM





TYPICAL PIPE LAYOUT

NOTE:
GEOTEXTILE & PIPE TO BE INSTALLED ONLY AT LOCATIONS WHERE REQUIRED BY STATE OR LOCAL AGENCIES OR WHERE DESIGNATED BY CHIEF ENGINEER.

SEE ENGINEERING INSTRUCTIONS SECTION 10 FOR INSTALLATION AND MAINTENANCE DETAILS.

BNSF RAILWAY

STANDARD PLAN

MINIMUM INSTALLATION REQUIREMENTS FOR STANDARD ROAD CROSSINGS AT GRADE

SHEET NO. 01	FILE OWNER BNSF	DATE: MAR 07, 2007
	REV. NO.: 05	DWG NO: 2259

15-22

		TRACK CENTERS									VERTICAL						HORIZONTAL																			
																							PLATFORMS H=HORIZONTAL CLEARANCE (MIN) V=VERTICAL CLEARANCE (MAX)						SIGNALS											
STATE	REGULATION REFERENCE	YEAR OF LATEST AMENDMENT	MAIN TRACKS	ANY TWO SUBSIDIARY TRACKS	ADJACENT SUBSIDIARY TRACK TO ANY MAIN TRACKS	LADDER TRACK ADJACENT TO ANY PARALLEL TRACK	TWO ADJACENT PARALLEL LADDER TRACKS	LEAD, REPAIR AND CABOOSE TRACKS	TEAM TRACKS IN PAIRS	UNLOADING TRACKS AT PLATFORMS	GENERAL	THRU BRIDGES	HIGHWAY BRIDGES	TUNNELS	BUILDING DOORS	IN BUILDINGS	GENERAL	THRU BRIDGES	HIGHWAY BRIDGES	TUNNELS	BUILDING DOORS	IN BUILDINGS	V_1	H_1	V_2	H_2	V_3	H_3	HIGH	LOW BETWEEN TRACKS HEIGHT (MAX)	LOW BETWEEN TRACKS CLEARANCE	SWITCH BOXES, ETC. HEIGHT (MAX)	SWITCH BOXES, ETC. CLEARANCE	POLES	ORE AND COAL DOCKS	CATTLE CHUTES
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
ALABAMA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
ARIZONA	CHPTR. 5, ART. 1	1987	14-0	14-0	15-0	20-0	20-0	NR	13-0	13-6	22-0	22-0	23-0	22-0	$18-3\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$7-3\frac{8}{8}$	8-6	0-8	4-8			4-6	8-0	8-6	3-0	6-0	0-5	3-0	8-6	8-6	8-6
ARKANSAS	CASE R-1012	1956	14-0	14-0	14-0	17-0	20-0	14-0	13-0	13-0	22-0	22-0	22-0	23-0	$17-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$7-4\frac{0}{0}$ 2	$7-3\frac{6}{0}$	0-8	5-0	4-0	$5-5\frac{6}{0}$	4-0	8-0	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
CALIFORNIA	G.O. 26-D	1988	14-0	14-0	15-0	20-0	20-0	14-0	13-0	13-0	22-6	22-6	22-6	22-6	18-0	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	8-6	8-6	0-8	4-8	NR	NR	4-0	$7-8\frac{6}{0}$	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
CANADA	CHPTR. 1189	1983	13-0	13-6	14-0	15-0	18-0	13-6	12-0	12-0	22-6	22-6	22-6	22-6	22-6	22-6	8-4 1/4	8-0	8-4 1/4	8-0	8-4 1/4	8-4 1/4	12	12	12	12	4-0	12	8-4 1/4	3-0	8-4 1/4	NR	NR	8-4 1/4	8-4 1/4	8-4 1/4
COLORADO	DEC. 55621	1987	14-0	14-0	15-0	17-0	20-0	14-0	13-0	13-6	22-6	22-0	22-6	23-0	$17-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	7-0	$8-5\frac{0}{0}$	0-8	5-0	4-0	$5-5\frac{6}{9}$	4-0	8-6	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
IDAHO	G.O. NO. 158	1980	14-0	14-0	15-0	20-0	20-0	14-0	13-0	13-0	23-6	22-6	22-6	22-6	$18-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$8-2\frac{6}{6}$	$8-2\frac{6}{6}$	0-8	4-8	4-0	7-3	4-0	$8-8\frac{6}{6}$	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
ILLINOIS	TITLE 92 I.A.C.	1986	$13-6\frac{11}{6}$	13-6	15-0	$17-5\frac{15}{0}$	$19-6\frac{16}{0}$	NR	13-6	13-6	21-6	21-3	21-6	$21-1\frac{1}{6}$	H	21-6	8-0	8-0	8-0	$8-1\frac{1}{0}$	$7-2\frac{0}{0}$	8-0	0-4	4-6	0-8	$5-5\frac{7}{1}$	CFH	6-2	8-6	NR	NR	NR	NR	9-0	8-0	8-0
IOWA	NR	1982	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
KANSAS	ART. 5 -RSR	1987	14-0	14-0	14-0	17-0	20-0	14-0	13-0	13-6	22-6	22-6	22-6	23-0	17-0	18-0	8-6	8-6	8-6	8-0	$7-13\frac{0}{0}$	$7-14\frac{0}{0}$	0-8	5-0	4-0	$6-8\frac{2}{2}$	4-0	8-6	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
KENTUCKY	277.240	1942	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	22-0	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
MINNESOTA	219.47	1980	14-0	14-0	14-0	17-0	19-0	14-0	14-0	14-0	22-0	22-0	22-0	22-0	$22-2\frac{0}{0}$	22-0	8-6	8-6	8-6	8-6	$8-2\frac{6}{6}$	8-6	NR	NR	NR	NR	NR	NR	8-6	NR	NR	NR	NR	8-6	8-6	8-6
MISSISSIPPI	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
MISSOURI	TTL 4 CSR 265-8.060	1987	14-0	14-0	14-0	17-0	19-0	14-0	13-6	14-0	22-0	22-0	22-0	22-0	22-0	22-0	8-6	8-0	8-0	8-6	$8-2\frac{6}{6}$	8-6	0-4	4-6	0-8	$5-5\frac{7}{1}$	CFH	8-6	8-6	4-0	$\frac{5-0}{8-0}\,^{10}$	0-3	4-2	8-6	8-6	8-6
MONTANA	ADM. RULES	1980	14-0	14-0	15-0	20-0	20-0	14-0	13-0	13-0	22-6	22-6	22-6	22-6	$18-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$8-2\frac{6}{6}$	8-6	0-8	4-8	4-0	$5-5\frac{6}{9}$	4-0	$8-8\frac{6}{6}$	8-0	3-0	6-0	0-4	3-0	8-6	8-6	8-6
NEBRASKA	ORD 16, CHPT 5, ART 4	1987	14-0	14-0	15-0	17-0	20-0	14-0	13-0	13-6	22-6	22-0	23-0	23-0	$17-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$7-2\frac{0}{0}$	$8-5\frac{6}{6}$	0-8	5-0	4-0	$5-5\frac{6}{9}$	4-0	8-6	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
NEW MEXICO	ORDER 2202	1987	14-0	14-0	15-0	17-0	20-0	14-0	13-0	13-6	22-6	22-0	22-6	23-0	$17-1\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$7-4\frac{0}{0}$	$7-5\frac{0}{0}$	0-8	4-8	4-0	$5-5\frac{6}{9}$	4-0	8-6	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
NORTH DAKOTA	SEC.49.10.1-13	1981	NR	NR	NR	NR	NR	NR	NR	NR	21-0	$21-1\frac{0}{0}$	21-0	$21-1\frac{0}{0}$	21-0	21-0	$8-1\frac{0}{0}$	$8-1\frac{0}{0}$	8-0	$8-1\frac{0}{0}$	8-0	8-0	NR	NR	NR	NR	4-0	8-0	8-0	NR	NR	NR	NR	8-0	8-0	8-0
OKLAHOMA	ORDER 33847	1987	14-0	14-0	14-0	17-0	20-0	14-0	13-0	13-6	22-0	22-0	22-0	23-0	$17-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$7-2\frac{0}{0}$ 4	$7-5\frac{0}{0}$	0-8	4-8	4-0	$5-5\frac{6}{9}$	4-0	8-6	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
OREGON	ORDER 83-313	1983	15-0	14-0	15-0	20-0	20-0	14-0	14-0	13-0	20-9	20-9	20-9	20-9	$18-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	8-6	8-6	0-8	4-8	NR	NR	4-0	$7-8\frac{6}{3}$	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
SOUTH DAKOTA	ORDER F2465	1957	NR	NR	NR	NR	NR	NR	NR	NR	22-6	22-6	$22-1\frac{6}{6}$	22-6	17-0	22-6	8-6	8-0	$8-1\frac{0}{0}$	8-6	7-0	8-6	0-8	4-8	CFH	$5-5\frac{6}{9}$	NR	NR	8-0	NR	NR	0-4	3-0	8-6	8-6	8-6
TENNESSEE	RULE 1220-3-1-.12	1970	14-0	13-0	14-0	18-0	18-0	14-0	13-0	13-0	22-0	22-0	22-0	22-0	17-0	$17-3\frac{0}{0}$	8-0	8-0	8-0	8-0	8-0	8-0	0-8	4-8	4-0	5-9	4-0	7-6	8-0	NR	6-6	0-4	3-0	8-0	8-0	8-0
TEXAS	SEC. 5, CHPT 11	1988	NR	NR	NR	NR	NR	NR	NR	NR	22-0	22-0	22-0	NR	$22-2\frac{0}{0}$	22-0	8-6	7-6	8-6	NR	$8-2\frac{6}{6}$	8-6	1-0	4-6	NR	NR	4-0	8-6	8-6	2-6	5-6	0-6	4-0	8-6	8-6	8-6
WASHINGTON	CHPTR. 480-60	1969	14-0	14-0	15-0	20-0	20-0	14-0	13-0	13-0	22-6	22-6	22-6	22-6	$18-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$8-2\frac{6}{6}$	8-6	0-8	4-8	4-0	$7-6\frac{6}{3}$	4-0	$8-8\frac{6}{6}$	8-0	3-0	6-0	0-4	3-0	8-6	8-6	8-6
WISCONSIN	CHPTR. TC-3	1982	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0	22-0	$22-1\frac{0}{0}$	22-0	$22-1\frac{0}{0}$	22-0	22-0	8-6	E	8-6	$8-1\frac{6}{6}$	8-6	8-6	$\frac{0-4}{0-8}$	$\frac{4-6}{5-1}$	1-9	$6-6\frac{0}{0}$	5-0	6-4	8-6	E	E	E	E	12-0	8-6	8-6
WYOMING	CHPTR. XIII	1979	14-0	14-0	15-0	17-0	20-0	14-0	13-0	13-0	22-6	22-0	23-6	23-0	$17-2\frac{0}{0}$	$18-3\frac{0}{0}$	8-6	8-0	8-6	8-0	$7-2\frac{0}{0}$ 4	$7-5\frac{0}{0}$	0-8	5-0	4-0	$5-5\frac{6}{9}$	4-0	8-6	8-6	3-0	6-0	0-4	3-0	8-6	8-6	8-6
BNSF RY. CO.	18	1997	$25-1\frac{19}{0}$	14-0	25-0	20-0	20-0	14-0	14-0	20	23-0	23-0	21	23-0	20	20	$8-17\frac{6}{6}$	8-6	21	8-6	20	20	20	20	20	20	20	20	8-6	20	$6-12\frac{0}{0}$	20	20	8-6	8-6	8-6

THIS CHART FOR INFORMATION ONLY - NO LIABILITY CAN BE ASSUMED
ARCHITECTS, CONTRACTORS, ETC., SHOULD CHECK WITH STATE INVOLVED.

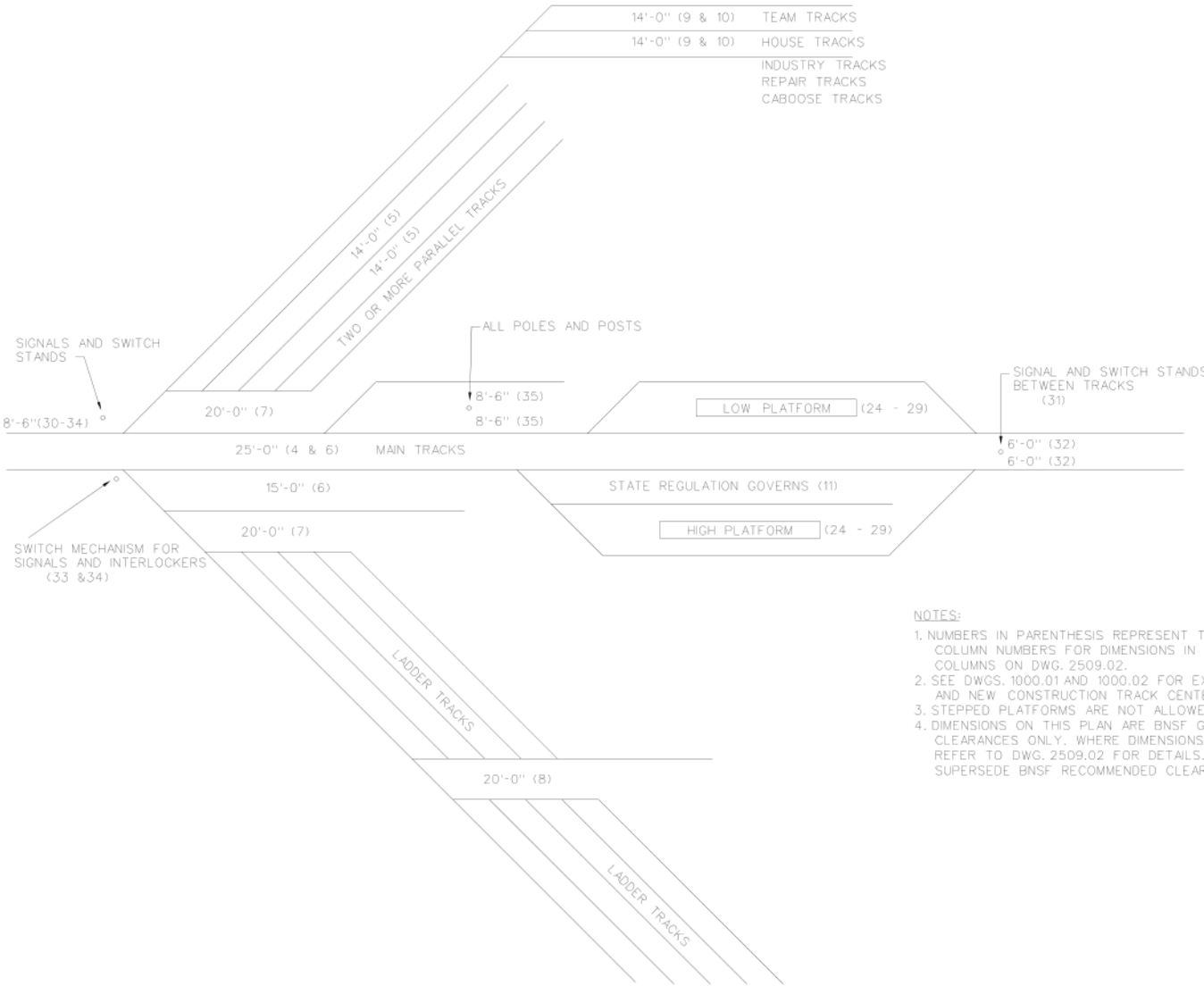
DIMENSIONS:
SHOWN IN FEET AND INCHES.
ARE FOR TANGENT TRACK - MOST LAWS SPECIFY INCREASES FOR CURVED AND SUPERELEVATED TRACK.
VERTICAL - MEASURED FROM TOP OF RAIL, EXCEPT CANADA BASE OF RAIL FOR OTHER THAN PLATFORMS.
HORIZONTAL - MEASURED FROM CENTER LINE OF TRACK.
APPLY TO NEW CONSTRUCTION. SOME RECONSTRUCTION AND SOME EXTENSIONS SOME CAN BE VARIED UPON APPROVAL OF APPLICATION BY GOVERNING BODY.
ARE BASED ON MAXIMUM CAR SIZE FOR CALIFORNIA, IDAHO, MINNESOTA, MONTANA, NORTH DAKOTA, OREGON AND WASHINGTON.
ALL ARE MINIMUM EXCEPT COLUMNS 24, 26, 28, 31 AND 33 WHICH ARE MAXIMUM.

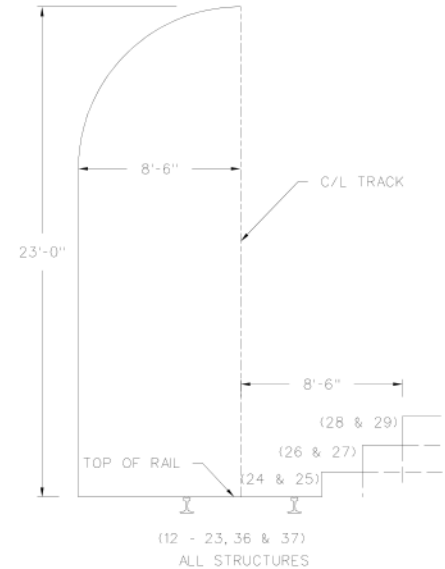
ABBREVIATIONS
CFH - CAR FLOOR HEIGHT
E - EXEMPT
H - HEIGHT OF CAR GOVERNS
NR - NO CURRENT REGULATION TO COVER

COLUMN HEADINGS
2 SHOWS BASIC REGULATION
3 SHOWS EFFECTIVE YEAR OR YEAR OF LATEST AMENDMENT
7 & 8 APPLY TO HAND AND MECHANICALLY OPERATED SWITCHES EXCEPT AS NOTED
12 & 18 PREVAILS FOR ALL ITEMS NOT OTHERWISE PROVIDED FOR
13 & 19 BRIDGES SUPPORTING TRACKS
14 & 20 BRIDGES SPANNING TRACKS
24 & 25 PASSENGER PLATFORMS
26 & 27 PASSENGER/FREIGHT PLATFORMS ON SIDE TRACKS EXCEPT AS NOTED.
28 & 29 FREIGHT PLATFORMS ON SIDE TRACKS
STEPPED PLATFORMS ARE NOT ALLOWED.
35 OTHER THAN TROLLEY CONTACT POLES.
36 TO CENTER OF STAND EXCEPT AS NOTED.
37 APPLIES TO BOTH SUPPORTS AND PLATFORMS EXCEPT AS NOTED.

FOOTNOTES:
1 LESSER CLEARANCES NOT PERMITTED IN QUADRANTS
2 ENGINE HOUSES AND SHOP BUILDINGS EXEMPT OR PERMITTED LESSER DIMENSIONS
3 ONLY IF TRACKS END WITHIN BUILDINGS.
4 MAY BE REDUCED TO 5-9 IF 8-3 (8-6 FOR WY) PROVIDED ON OPPOSITE SIDE
5 MAY BE REDUCED TO 5-9 IF 8-0 (8-6 FOR NE, MO & WY) PROVIDED ON OPPOSITE SIDE
6 ONLY IF 8-0 (7-3 FOR MT & WY; 8-6 FOR WA & SD) PROVIDED ON OPP. SIDE
7 PASSENGER PLATFORMS ONLY.
8 MAY BE 8-0 AT 4-6 FOR REFRIGERATOR CAR PLATFORMS ONLY.
9 TO ENDS OF ARMS IN OPERATING POSITION.
10 FOR PLATFORMS AT CAR EAVE HEIGHT - SUPPORTS TO BE 8-0 (8-6 FOR TEXAS).
11 FOR FREIGHT TRACKS - CAN BE 13-0 FOR PASSENGER TRACKS.
12 REGARDING CANADA - CHECK STANDARD CLEARANCE DIAGRAM APPROVED BY BOARD OF TRANSPORT COMMISSIONERS FOR CANADA FOR RAILWAY INVOLVED.
13 MAY BE REDUCED TO 6-2 IF 8-3 PROVIDED ON OPPOSITE SIDE.
14 MAY BE REDUCED TO 6-2 IF 8-0 PROVIDED ON OPPOSITE SIDE.
15 FOR HAND OPERATED SWITCHES - MAY BE 15-0 FOR MECHNICALLY OPERATED SWITCHES.
16 FOR HAND OPERATED SWITCHES - MAY BE 17-0 FOR MECHANICALLY OPERATED SWITCHES.
17 MUST HAVE ADDITIONAL SIDE CLEARANCE OF 1 1/2 INCH PER DEGREE OF CURVATURE.
18 IF NO FIGURE IS GIVEN USE STATUORY CLEARANCE.
19 NEW CONSTRUCTION 25-0 CENTER TO CENTER MAIN TRACK/CONTROL SIDING.
20 STATE REGULATION GOVERNS.
21 CENTER LINE OF TRACK TO CLOSEST EDGE OF PIER: MAIN LINE-25'0", OTHERS-18'-0".

BURLINGTON NORTHERN SANTA FE STANDARD PLAN ENGINEERING DEPT., FORT WORTH, TEXAS	CLEARANCE REQUIREMENTS BY STATE AND RECOMMENDED BNSF CLEARANCE	DATE: 10/29/97	DWG. NO. 25000 SHEET NO. 02 REV. NO. 01





NOTES:

1. NUMBERS IN PARENTHESIS REPRESENT THE COLUMN NUMBERS FOR DIMENSIONS IN COLUMNS ON DWG. 2509.02.
2. SEE DWGS. 1000.01 AND 1000.02 FOR EXISTING AND NEW CONSTRUCTION TRACK CENTERS.
3. STEPPED PLATFORMS ARE NOT ALLOWED.
4. DIMENSIONS ON THIS PLAN ARE BNSF GENERAL CLEARANCES ONLY. WHERE DIMENSIONS ARE NOT SHOWN, REFER TO DWG. 2509.02 FOR DETAILS. STATE REGULATIONS SUPERSEDE BNSF RECOMMENDED CLEARANCES.

BURLINGTON NORTHERN SANTA FE
STANDARD PLAN
ENGINEERING DEPT., FORT WORTH, TEXAS

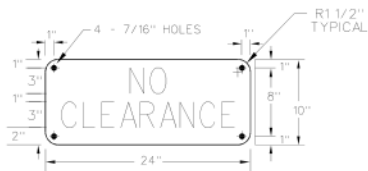
BNSF
MINIMUM CLEARANCES
DIAGRAM

RAIL: NONE

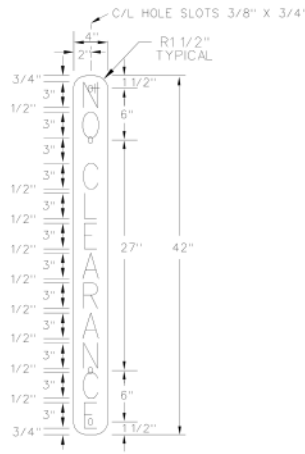
DATE: 10/29/97 | SCALE: NONE

DWG. NO.	SHEET NO.	REV. NO.
2509	01	09

EXAMPLE 1



EXAMPLE 2



SIGNS:

NO. 44 - "NO CLEARANCE"

PLACE NO CLEARANCE SIGN ON BUILDING STRUCTURE OVER C/L TRACK WHERE VERTICAL CLEARANCE IS LESS THAN REQUIRED. LETTERED AND MOUNTED AS SHOWN IN EXAMPLE 1.

NO. 44A - "NO CLEARANCE"

PLACE NO CLEARANCE SIGN ON BUILDING STRUCTURE OR POST WHERE HORIZONTAL CLEARANCE IS LESS THAN REQUIRED. LETTERED AND MOUNTED AS SHOWN IN EXAMPLE 2.

NOTES:

1. THE SIGNS LISTED IN THIS PLAN ARE 10" X 24" AND 4" X 42" SIZED WITH WHITE BACKGROUND AND BLACK LETTERS, ONE SIDE ONLY, AS SHOWN IN EXAMPLES 1 AND 2.
2. SEE PLAN 3000.01 FOR ADDITIONAL SPECIFICATIONS AND INFORMATION CONCERNING THE REFLECTIVE AND PANEL MATERIAL.
3. FOR USE IN THE STATE OF MINNESOTA AS ORDERED BY THE PUB. SERV. COMM. AT POINTS WHERE CLEARENCE IS LESS THAN THE LEGAL REQUIREMENT.

BILL OF MATERIALS

QUANTITY	SIGN PANEL
1 EA.	SIGN NO. 44-NO CLEARANCE ITEM NO. 047220983
1 EA.	SIGN NO. 44A-NO CLEARANCE ITEM NO. 047220984
	OPTIONAL HARDWARE
1 EA.	2 LB. PER LIN. FT. GALVANIZED FLANGED CHANNEL STEEL POST, 8'-0" LONG WITH 3/8"O MONTING HOLES, 1" CENTERS, WITH POINTED END.
2 EA.	5/16" DIA. X 2" GALVANIZED ROUND HEAD SQUARE NECK MACHINE BOLT, ALL THREAD, WITH LOCK NUT AND WASHER.

BURLINGTON NORTHERN SANTA FE
STANDARD PLAN
ENGINEERING DEPT., FORT WORTH, TEXAS

CLEARANCE SIGNS

RAIL:

DATE: 06/10/96 SCALE:

DWG. NO. 3044 SHEET NO. 01 REV. NO. 04

Vertical Curves

a. Vertical curves should be used to round off all intersecting grades.

b. The length of a vertical curve is determined by the grades to be connected and the speed of the traffic.

c. The rate of change for tracks with a vertical curve concave upwards (sag) should be one-half the rate of change of a vertical curve concave downward (summit).

d. The rate of change for high-speed main tracks (> 50 MPH) should not be more than 0.05 feet per station (of 100 feet) in sags, and not more than 0.10 feet per station on summits.

e. For secondary main tracks (speed < 50 MPH), the rate of change should not be more than 0.10 feet per station in sags, and not more than 0.20 feet per station on summits.

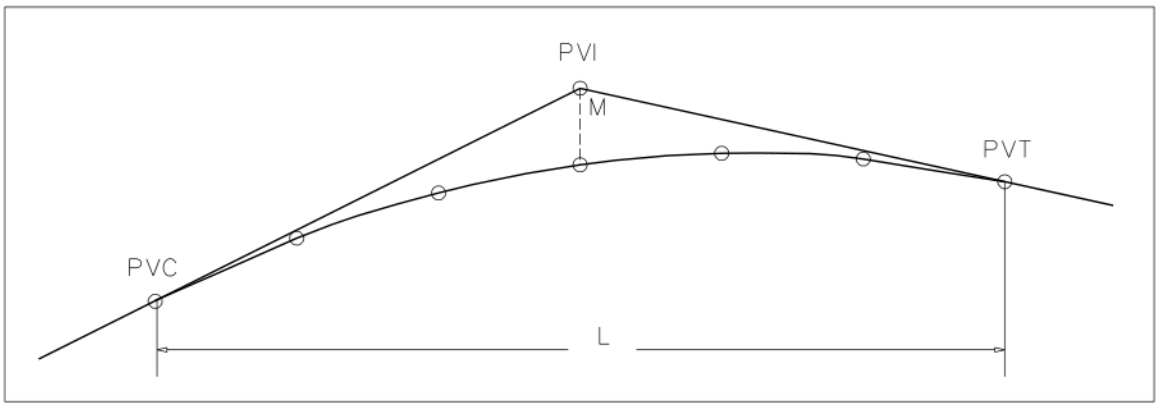
f. For industry tracks and non-main tracks with speeds not greater than 20 MPH, the rate of change should not be more than 2.0 feet per station for both sags and summits.

g. The rate of change per station is calculated as follows: R = D/L Where:

R = Rate of change per station
D = Algebraic difference of the two intercepting grades
L = Length of vertical curve in 100-ft. stations

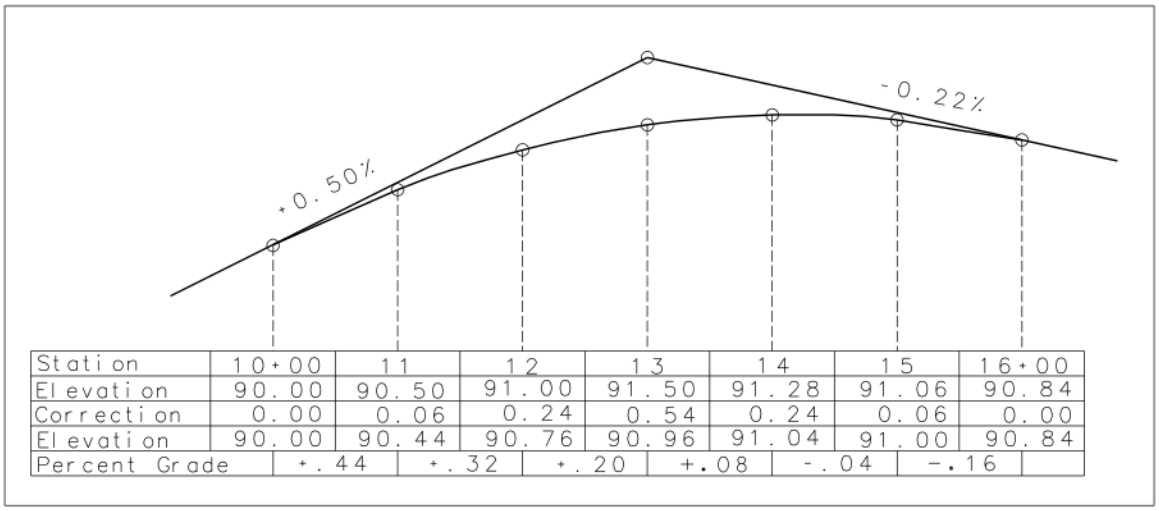
M = Correction from the straight grade to the vertical curve

A parabola is used for the vertical curve in which the correction from the straight grade for the first station is one half the rate of change, and the others vary as the square of the distance from the point of tangency. Where points fall on full stations, it will be necessary to figure these for only one half the vertical curve, as they are the same for corresponding points each side of the vertex. Corrections are (-) when the vertical curve is concave downwards (summit), and (+) when the vertical curve is concave upwards (sag). The rate of change may be assumed and the length of vertical curve computed, or preferable the length assumed and the rate computed.



For example:

Assume length = 600 feet (6 stations)
D – 0.50 minus –0.22 = 0.72
R = 0.72/6 = 0.12



Station	10+00	11	12	13	14	15	16+00
Elevation	90.00	90.50	91.00	91.50	91.28	91.06	90.84
Correction	0.00	0.06	0.24	0.54	0.24	0.06	0.00
Elevation	90.00	90.44	90.76	90.96	91.04	91.00	90.84
Percent Grade		+.44	+.32	+.20	+.08	-.04	-.16	

Calculate the straight-grade elevations for each station.

The correction for the first station is one-half the rate of change (R). So, the correction for station 11 is 0.06 (minus since it concaves downwards).

The correction for the Station 12 is 4(0.06) = 0.24. This is the correction to the first station (one-half the rate of change) multiplied by the square of the length, in stations, from the PVC. At Station 13 (the PVI), the correction is 9(0.06) = 0.54. Notice the corrections for Stations 11 and 15 are the same. Likewise for 12 and 14, since they are the same distance from the PVC and PVT. So, only one-half of the curve's corrections need to be calculated.

Next, apply the correction at each station to the straight-grade elevation to obtain the elevation on the vertical curve.

A simpler method of computing this and one that furnishes a check throughout is the following:

Sta. 10	90.00	
	+0.44	(% grade sta. 9 to 10) minus one half rate = 0.50 – 0.06
Sta. 11	90.44	
	+0.32	(% grade sta. 10 to 11) minus rate = 0.44 – 0.12
Sta. 12	90.76	
	+0.20	(% grade sta. 11 to 12) minus rate = 0.32 – 0.12
Sta. 13	90.96	
	+0.08	(% grade sta. 12 to 13) minus rate = 0.20 – 0.12
Sta. 14	91.04	
	-0.04	(% grade sta. 13 to 14) minus rate = 0.08 – 0.12
Sta. 15	91.00	
	-0.16	(% grade sta. 14 to 15) minus rate = -0.04 – 0.12
Sta. 16	90.84	

_____

(PROJECT NAME – STATION, ST)

I acknowledge that I have received the internet link and/or hard copy of BNSF's "Design Guidelines for Industrial Track Projects" dated May 2011. I understand that the design and construction of this facility will follow the Guidelines. Questions concerning the Guidelines are to be directed to the BNSF Project Engineer listed below.

http://www.bnsf.com/customers/pdf/IndyTrkStds_1007a.pdf

Owner Representative

_____ _____

Signature Date

_____ _____

Printed Company Name

_____

BNSF Project Engineer