



**NORFOLK SOUTHERN RAILWAY COMPANY
SPECIFICATIONS FOR DESIGN
AND CONSTRUCTION OF
PRIVATELY OWNED
INDUSTRY TRACKS**

JULY 2020

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I. INTRODUCTION

All requests for new Industry track should be directed to the appropriate Norfolk Southern Industrial Development Manager. Specific contact information is located on Norfolk Southern Corporation's website at <http://www.nscorp.com/content/nscorp/en/industrial-development.html>.

The intent of these specifications is to provide Industry desiring rail service from Norfolk Southern with all necessary information required for the design and construction of Industry track. Please note that these specifications are subject to revision without notice.

INFORMATION CONTAINED WITHIN THESE SPECIFICATIONS APPLY TO PRIVATELY OWNED INDUSTRY TRACKS AND DO NOT APPLY TO TRACKS OWNED OR TO BE OWNED BY THE RAILWAY COMPANY. MATERIALS AND SPECIFICATIONS FOR TRACKS TO BE OWNED BY THE RAILWAY COMPANY MUST BE APPROVED BY THE RAILWAY COMPANY'S CHIEF ENGINEER - DESIGN AND CONSTRUCTION OR DESIGNATED REPRESENTATIVE.

In general, the Industry shall construct, or cause to be constructed, the subgrade (embankment and / or excavation), sub-ballast, and all drainage structures necessary for installation of the track on both the Industry and Railway Company's right-of-way.

Prior to the commencement of train service, an industry track agreement in accordance with the standard procedures of the Railway Company shall be executed by both the Industry and the Railway Company.

The following pages include specifications, requirements, and/or recommendations for the design and construction of Industry tracks to be served by the Railway Company and shall supersede all prior publication of same. General engineering questions may be directed to the Norfolk Southern Design & Construction Department at NSENG.ContactD&C@nscorp.com.



II. DEFINITIONS

2.01 When the following words and acronyms are used in these Specifications, they shall have the meaning as defined below:

2.01.1 AASHTO

American Association of State Highway and Transportation Officials

2.01.2 AREMA

American Railway Engineering and Maintenance-of-Way Association

AREMA design information and specifications can be purchased on the website www.arema.org.

2.01.3 CHIEF ENGINEER, ENGINEER, OPERATING OFFICER

The officer of the Railway Company acting for, or on behalf of the Railway Company in its transactions, or the authorized representative of such officer.

2.01.4 CLEAR POINT

That point on spur, lead, or siding track located adjacent to main line track where the distance between tracks is 15 feet, or where the distance between adjacent tracks other than main line track is 14 feet. The clear point is established by horizontal measurement between the centerlines of each track and provides the minimum clear distance that will allow for the safe passage of freight cars and/or locomotives.

2.01.5 COMPANY

Norfolk Southern Railway Company (NSRC), or the Operating Rail Subsidiary Company of NSRC within whose territory the Industry track is located.

2.01.6 DERAIL

A device built on, or attached to, track for the purpose of derailing rail cars, locomotives, and on-track equipment.

2.01.7 EOT (END OF TRACK) DEVICE

A contrivance built on, or established at the end of a track, for the purpose of stopping the movement of rail cars, locomotives, and on-track equipment at the end of a track.

2.01.8 FOULING A TRACK

The placement of an individual, or equipment in such proximity to a track that the individual, or equipment could be struck by a train, engine, or other on-track equipment, or in any case is within four feet of the field side of the near running rail.*

2.01.9 FROG

A track structure used at the intersection of two running rails to provide support for wheels and passageways for their flanges, thus permitting wheels on either rail to cross the other.**

2.01.10 INDUSTRY

That company and/or individual for which a rail spur, siding, and/or lead track is to serve.

2.01.11 INDUSTRY TRACK AGREEMENT

An agreement between Norfolk Southern Railway Company and Industry that sets forth predetermined conditions regulating track construction, liability, insurance, clearances, and other standard requirements of Norfolk Southern Railway Company, while clearly delineating the division of ownership and maintenance point(s) for the industry track, all to ensure safe and efficient rail service to the industry.

2.01.12 LEAD TRACK

Track serving, or with the ability to serve more than one industry with individual spur tracks for each industry.

2.01.13 MAIN LINE TRACK

Any track, not specifically designated otherwise, owned by the Company which has a milepost.

2.01.14 OTM (OTHER TRACK MATERIAL)

Acronym used to describe track structure components other than rail, ties, and ballast such as rail anchors and spikes.

2.01.15 PLANS

Drawings, maps, cross-sections, and/or profiles showing the character of the work to be performed and prepared as a guide for construction of track.

2.01.16 RAIL OR RUNNING RAIL

A single piece of steel usually paired with another to form a track.

2.01.17 RUNAROUND TRACK

Track used by locomotive(s) to run around to the other end of a cut (group) of cars.

2.01.18 “SHALL”

Where the term “shall” appears in these specifications, it is to mean that the information following is a requirement.

2.01.19 “SHOULD”

Where the term “should” appears in these specifications, it is to mean that the information following is a recommendation.

2.01.20 SIDING

Track owned by the Company and used for meeting and passing trains.

2.01.21 SPUR TRACK

Track serving only one industry.

2.01.22 SWITCHING TRACK

Track used to set off cars, run around cars, and/or to facilitate the general switching operations required to serve an industry.

2.01.23 TRACK

Structure consisting of two rails, crossties, OTM, and ballast which is designed to carry railroad cars, locomotives, and equipment.

2.01.24 TURNOUT (SWITCH)

An arrangement of switch points and a frog with closure rails, and appurtenances by means of which rolling stock may be diverted from one track to another.

**Source:* Norfolk Southern Roadway Worker Protection Rules

***Source:* Practical Guide to Railway Engineering, AREMA, pg. Glossary-11, 2003

III. INDUSTRIAL SIDETRACK PROCESS

3.01 OVERVIEW

The typical sequential process for the handling of Industry projects involving new or expanded rail service by Company is as follows:

1. Initial contact between Industry and Company
2. Development of a preliminary Industry plan
3. Company Transportation approval
4. Development of agreement and sidetrack design plans
5. Company Engineering approval
6. Secure construction and track operating agreements
7. Trackbed construction by Industry
8. Track construction
9. Inspect track and place in service

3.01.01 INITIAL CONTACT BETWEEN INDUSTRY AND COMPANY

The Industry contacts the Company's Industrial Development Manager (IDM) to initiate the project and discuss requirements for rail service to the Industry. The IDM provides assistance to the Industry in identifying possible sites for industry location, developing a preliminary Industry plan, and beginning the Industrial Sidetrack Process for new or expanding rail-served facilities.

3.01.02 DEVELOPMENT OF A PRELIMINARY INDUSTRY PLAN

The IDM works with the Industry to make appropriate site, track and/or building layout recommendations and provides assistance as needed to develop a preliminary Industry plan.

3.01.03 COMPANY TRANSPORTATION APPROVAL

The IDM provides Company's Transportation Department (Transportation) the preliminary Industry plan (with anticipated commodities, volumes and service levels) to secure Transportation approval of the proposal ensuring required service can be provided.

3.01.04 DEVELOPMENT OF AGREEMENT AND SIDETRACK DESIGN PLANS

With Transportation approval of the preliminary Industry plan, the Company's IDM will provide Industry with Company requirements for development of agreement and sidetrack design plans and Company's Design & Construction Department (D&C) contact information. Industry *shall* contact D&C prior to beginning work on the plans to discuss the project and any questions that the Industry may have. The IDM and D&C will work with Industry to develop final agreement and sidetrack design plans.

3.01.05 COMPANY ENGINEERING APPROVAL

Upon completion of the agreement and sidetrack design plans, the Industry will submit the plans to the Company's IDM. The IDM will forward the plans to D&C for review, comments, and/or engineering approval. D&C will contact the Industry and IDM to discuss any required revisions for engineering approval. ***PLEASE NOTE THAT SIDETRACK DESIGN PLANS THAT DEVIATE FROM THE TRANSPORTATION APPROVED PRELIMINARY INDUSTRY PLAN MAY REQUIRE ADDITIONAL REVIEW AND APPROVAL OF THE COMPANY'S TRANSPORTATION DEPARTMENT.*** Upon engineering approval of the sidetrack design plans by the Assistant Chief Engineer Design, the Assistant Chief Engineer Design will provide notice of approval to the IDM.

3.01.06 SECURE CONSTRUCTION AND TRACK OPERATING AGREEMENTS

The IDM will prepare a Track Proposal Letter and Siding Agreement and send to Industry for review. Upon approval, Industry will execute the Siding Agreement and return with a valid Certificate of Insurance and required funds. The IDM, with D&C, will then coordinate installation of the portion of track to be owned by the Company.

3.01.07 TRACKBED CONSTRUCTION BY INDUSTRY

The Industry shall be responsible for construction of all required site work, including sub-ballast, required for installation of both Industry and Company owned track.

3.01.08 TRACK CONSTRUCTION

The Industry shall notify the Company's D&C engineer upon completion of the trackbed work and at least 2 weeks prior to the field stakeout of the proposed track centerline. It is preferred that D&C be present during the field stakeout of the Industry track for verification that the stakeout is accurate. Also, at this time, D&C will inspect the trackbed for compliance with the approved track construction plans and specifications. The Industry shall perform all track work on the Industry owned portion of the track, and the Company shall perform all track work for the Company owned portion of the track in accordance with the approved plans.

3.01.09 INSPECT TRACK AND PLACE IN SERVICE

The Industry shall notify the Company upon completion of all Industry track work. Company representatives from the Maintenance-of-Way (MW&S) and Transportation Departments will inspect the Industry track and components to verify compliance with the approved track construction plans and specifications, providing written notice of defects or approval. Upon approval, the track will be placed in service. The IDM will ensure that the Industry has been established as a new customer prior to the ordering or placement of any railcars.

IV. SAFETY AND ENVIRONMENTAL PERMITTING

4.01 SAFETY

The Company's highest priority is the safety of its employees, customers and the public. The Company gives careful consideration to anything that could adversely affect customer service and cause risk to railroad operations.

Industry and/or anyone contracted by Industry that will be surveying for, staking out or inspecting Industry track(s) on Company property *shall* first obtain a right of entry permit from the Company's Industrial Development Manager for that region. Company owned track shall not be fouled without a Company flagman or watchman/lookout present. **A RIGHT OF ENTRY IS NOT A RIGHT TO FOUL COMPANY TRACK.** Please see the following URL for details:

<http://www.nscorp.com/content/nscorp/en/industrial-development/contact-norfolk-southern-industrial-development/project-management-contact-directory.html>

The applicant will be responsible for the costs of Company flagman if flagging protection is required by the Company's Division Superintendent.

4.02 ENVIRONMENTAL PERMITTING

The Industry is responsible for all required environmental permitting for the project, including work on Company property. If it is determined that wetland and/or stream delineation is required on Company property for permit application(s), the Industry *shall* contact the Company's Design & Construction representative **PRIOR TO PERFORMANCE OF THE DELINEATION.**

Upon completion of the environmental field delineation, the Industry shall provide Company with copy of all data, notes, photographs, and/or other information related to the delineation and shall provide a copy of any draft report(s) prepared for submittal to any governmental entity, court, or third party prior to submittal for Company review and comment. The Industry shall maintain all information regarding such information as confidential except as required for the purpose of obtaining permit(s).

V. FIELD SURVEY AND STAKEOUT

5.01 FIELD SURVEY

Accurate field survey and data collection is of utmost importance for the development and approval of an acceptable plan. In particular, the following five categories are typically the most important elements of industry track surveys: existing track, utilities, structures, control points and topography. Below is a categorized list of information for each element that should be collected and shown on the plans. A field survey performed by drone or other aerial methods shall be tied to local ground control. A Right of Entry *shall* be executed and on file prior to access being granted onto the Company's property.

5.01.01 EXISTING TRACK

Proper depiction of the existing track is essential to developing a workable design. Photogrammetry shall not be used to determine track alignments, features and top of rail elevations. The following items should be located and shown on the plans:

- centerline of existing track at top of rail
 - for tangent track, measurements should be taken at a maximum interval of 100 feet
 - for curved track, measurements should be taken at a maximum interval of 50 feet
 - Measurements should be collected at closer intervals as needed to define sudden changes in horizontal and vertical alignments such as kinks and dips in the track. Sufficient measurements should be collected to extrapolate existing vertical curves and identify grades.
 - Measurements should be collected every 50 feet or less in vertical curves to allow for identification of crests and / or sags.
 - Measurements should be collected for the greater of :
 - at least 300' or to the nearest curve, on both sides of the proposed turnout location
 - the entire length of the project site
- point of curve (PC), point of tangent to spiral (TS), point of tangent (PT) and point of spiral to tangent (ST)
- existing super-elevation tags
- point of switch (PS) for all turnouts and method of operation i.e. hand throw, spring, power operated
- whether switch is right hand or left hand throw
- point of frog (PF), diverging and straight side, for all turnouts
- derails and type (Hayes Model HB or double switch point)
- division of ownership and maintenance signs
- close clearance signs
- nearest milepost and direction of increasing mileposts

- track centerline location for all pipes and / or utility lines passing under and / or over track
- bumping posts, rail stops, and / or earth mounds
- road crossings (centerline of track at edge of crossing surface)
- type, size, or weight of all key track components including compromise joints (used between rails of different sizes)
- construction of rail, i.e. jointed rail (JTR) or continuously welded rail (CWR)
- rail lubricators
- insulated joints
- track wires for signal circuits connecting to the rails (including crossing activators)
- signals and signal structures including AEI tag readers, hot box detectors, dragging equipment detectors, pedestals, signal pole lines, and bungalows

5.01.02 UTILITIES

Utilities must be accurately depicted. A missed utility pole or manhole can drastically alter project acceptability and cost if not identified prior to construction. The following utility items should be located and shown on the drawings:

- aerial utility and light poles, guy wires, and guy poles
- natural gas line (valves, markers, and/or vents)
- telephone or fiber optic lines (junction boxes, or markers)
- water lines (taps, valves, meters, markers)
- sewer lines (taps, cleanouts, manholes, markers)
- storm water facilities (inlets, outfalls, catch basins, manholes, headwalls, pipe inverts, pipe diameter, top of pipe)

Overhead wires should be surveyed for their elevation at the point at which they cross the existing track, if applicable. Their location and elevation should also be determined at the point of their greatest sag and referenced to the corresponding existing ground elevation along with an additional point at the center line of proposed track.

5.01.03 STRUCTURES

Structures, existing and / or proposed, have the potential to adversely impact side and/or overhead clearances. The following items shall be shown on the plans with measured clearances to the centerline of track:

- doorways, sides and top
- corners of docks and finished floor elevations
- fences and gates
- unloading pits and scales, inside and outside walls
- corners/sides of buildings and finished floor elevations
- roadways
- retention pond levees and drainage structures
- retaining walls

- utility poles for side clearances
- overhead and under grade bridges
- other structures that might impact clearances

5.01.04 CONTROL POINTS

All control points established or found during the course of the field survey should be shown and labeled with description (PK nail, iron pin, survey monument, etc.) and NEZ coordinates based on the controlling datum. The controlling datum shall be identified in the corresponding NAD83, NGVD88 state plane coordinate system for the project site allowing Company to incorporate the project into the Company GIS database.

Real estate information, such as property pins or corners, should also be collected and shown on the plans.

5.01.05 TOPOGRAPHY

Although the Company does not typically require submittal of complete grading plans, the collection of adequate ground shots to accurately depict the nature of the ground topography in the vicinity of track and employee walkways, and drainage features is very important. Large or sudden changes in ground topography adjacent to proposed track must also be measured.

5.02 STAKEOUT

For projects designed by the Industry, the Industry shall be responsible for the field stakeout of proposed track, including the portion of track to be owned by the Company. Field stakeout work will not be performed on Company property until the industry track agreement has been executed and the Industry secures flagging protection through the Company's Division Superintendent. The Industry shall be responsible for this flagging cost. Additionally, the Industry must notify the Company's Design & Construction Department and Maintenance of Way Department at least two weeks prior to performing field stakeout so that Company representative may be present for stakeout verification. For proposed track alignment(s) designed by Company and used in the industry track agreement, Company will provide field stakeout of Company portion of Industry spur track.

The following shall be performed during field stakeout for portion of track to be owned by Company:

- For main line track, the centerline of track at the proposed Point of Switch (PS) and Point of Frog (PF) shall be set with flagging with legible note(s) indicating station and point description. Pins, nails, spikes, etc. shall be nailed flush into the cross-tie or set so that the top is flush with the ballast line to prevent tripping hazards.

- For the Industry spur, the centerline for the PS, PF, PC, PT, PVC, PVT and every 50' beyond the turnout (Sta. 1+50, 2+00, etc.) up to and including the proposed derail shall be set with flagging indicating the station and point description. Pins, nails, spikes, etc. shall be nailed flush into the cross tie or set so that the top is flush with the ballast/sub-ballast to prevent tripping hazards.
- Offset stakes for the above described points on the Industry spur track shall be set at 12' offset to the proposed Industry spur track centerline. Stakes shall be painted fluorescent orange and flagged. The station, point description, offset distance, and top of rail elevation with reference mark shall be legibly written on the stake.

VI. INDUSTRY TRACK DESIGN

6.01 GENERAL

The following sections describe the criteria to be used in the design of industry track(s) served, or to be served, by the Company. Any exception to these requirements must be approved by the Company's Chief Engineer or designated representative.

6.02 HORIZONTAL CURVATURE

DEGREE OF CURVE

All horizontal curve calculations shall be based on the chord definition.

The chord definition for horizontal curves is as follows:

$$R \text{ (chord definition)} = \frac{50}{\sin (D/2)}$$

where: R = Radius (feet)
D = Degree of Curve

Tracks should be designed utilizing the minimum degree of curvature practicable, but must be limited to a maximum of 12 Degrees (R = 478.34 feet) on spur tracks and 10 Degrees (R = 573.69 feet) on lead and loop tracks.

Tracks for rail cars with coupler to coupler length exceeding 73 feet should be designed based on maximum degree of curvature of 10 Degrees (R = 573.69 feet).

Horizontal curves should be at least 100 feet in length if at all possible, but not less than 50 feet.

REVERSE CURVES

Tangent distance between the points of tangency of reverse curves should be at least 100 feet if at all possible, but not less than 70 feet.

Distance between facing point switches leading from opposite sides of a through track (creating a reverse effect) should be at least 100 feet if at all possible, but not less than 70 feet.

RETURN CURVES

Return curves, C₂ (in Degrees), shall correspond to *NSRC Plan 2-17* for the proposed turnout(s) to be used for all parallel sidetracks and industry tracks at minimum track centers.

SPIRALS AND SUPER-ELEVATION

Spiral curves and/or super-elevation are required where the speed of operation dictates. Design for lead tracks of one mile or longer will be evaluated by the Company on an individual basis to determine if spirals and super-elevation are required.

CURVE PLACEMENT

Horizontal curves shall not begin on the long ties of a turnout. Horizontal curves should not be located within a double switch point derail (DSPD).

6.03 VERTICAL CURVATURE

CURVE PLACEMENT

Vertical curves shall be provided at break points in the profile of the track and should be as long as practicable. A minimum vertical curve length of 100 feet is preferred.

Vertical curves shall not begin or end on the long ties of a turnout. The track profile through the proposed turnout shall match the track profile of the existing track from which it diverges.

Tangency between crest and sag curves should be 50-100' preferred.

VERTICAL CURVE RATE OF CHANGE

Vertical curve rate of change (r) shall be calculated as follows:

$$r = \frac{(G_2 - G_1)}{L}$$

where: r = Rate of Change
L = Length of Curve in 100' Stations
G₁ = Entrance Grade
G₂ = Exit Grade

MINIMUM CURVE LENGTH FOR LEAD TRACKS

The calculated minimum vertical curve length for lead tracks, in feet, is 100 times the algebraic difference of grades in percent for summits and sags, i.e., maximum rate of change for summits and sags = 1.0.

MINIMUM CURVE LENGTH FOR SPUR TRACKS UP TO 1500 FT IN LENGTH

The calculated minimum vertical curve length for spur tracks up to 1500 feet in length is 33.3 times the algebraic difference of grades in percent for summits and 40 times the algebraic difference for sags, i.e., maximum rate of change for summits = 3.0 and maximum rate of change for sags = 2.5.

MINIMUM CURVE LENGTH FOR SPUR TRACKS OVER 1500 FT IN LENGTH

The calculated minimum vertical curve length, in feet, for spur tracks over 1500 feet in length shall be 40 times the algebraic difference of grades in percent for summits and 50 times the difference for sags, i.e., maximum rate of change for summits = 2.5 and maximum rate of change for sags = 2.0.

6.04 GRADES

Track grades should be kept to a minimum and shall be restricted to a maximum of 2 percent (compensated) on lead tracks, and 3 percent (compensated) on individual spur tracks. Loop track grades shall be 0% preferred, 0.2 percent maximum, with the pit/loading area on a 0% grade. Any grade should be ascending to the pit/loading area.

Grade compensation for curvature shall be a 0.04 percent reduction per degree of curvature. For example, the maximum grade on a lead track with a 10° horizontal curve is: $2.0\% - (0.04 \times 10) = 1.6\%$.

6.05 LOADING, UNLOADING AND STORAGE TRACKS

Industry track where rail cars are loaded and unloaded shall be on a 0% (flat) grade. Storage tracks shall be on a 0% grade, unless approved by the Company.

Tracks are to be designed to avoid coupling cars in curves during switching operations.

Industry tracks should have 30 feet or 1/2 the proposed car length, whichever is greater, between the end of any vertical curve and the beginning of the nearest car spot for loading / unloading.

Industry tracks shall have 30 feet or 1/2 the proposed car length, whichever is greater, between the end of the last car spot for loading / unloading and the end of track device (see section 6.09).

Tracks with turnouts and ladders at both ends shall be designed to include a clearance buffer equal to 30 feet or 1/2 the proposed car length, whichever is greater.

Loop tracks shall include a minimum safety buffer of at least 100 feet.

6.06 TRACK CENTERS AND CLEAR POINTS

TRACK CENTERS

(TRACK LOCATED ON INDUSTRY PROPERTY)

Track centers for parallel Industry tracks located on Industry property shall be no closer than 14 feet, centerline of track to centerline of track, and shall be adjusted (increased) for curvature in accordance with *NSRC Plan 7-1*.

(TRACK LOCATED ON COMPANY RIGHT-OF-WAY)

Track centers for Industry track located on Company right-of-way and parallel to main line or siding shall be no closer than 15 feet, centerline of track to centerline of track, to main line or siding and shall be adjusted (increased) 1" per degree of curve on curved tracks. In multiple curved track territory, when the track on the inside of the curve has less super-elevation than the track on the outside of the curve, track centers shall be increased by 4-1/2 inches for each inch difference in super-elevation between the involved tracks. Track centers between multiple industry tracks shall be no closer than 14 feet and shall be similarly adjusted for curvature.

Where public law or regulation requires clearances greater than Company standard, such laws or regulations will govern.

(YARD LADDERS)

Tracks parallel to yard ladders shall be no closer than 22 feet, centerline of track to centerline of track.

CLEAR POINTS

The following apply to clear points and car storage limits:

- Clear points shall be shown on the plans and indicated in the field by the presence of a derail, clearance post or crosstie painted green.
- Rail cars shall not be spotted within 300 feet of the edge of public or private at-grade crossing on any tracks on Company right of way where practical.
- At locations where Industry track crosses privately owned Industry at-grade road crossings, cars shall be spotted as far as practicable from the grade crossing to provide adequate site distance.

6.07 TURNOUTS

All main line turnout shall be No. 10 or larger. Turnouts in Industry tracks shall also be No. 10 unless space will not permit, in which case a No. 8 turnout will be considered.

Turnout geometry, layout and materials are shown on the attached *NSRC Plans 2-4, 2-6, 2-8 and 2-17*.

Mainline turnouts shall not be placed within horizontal or vertical curves. Industry turnouts should not be placed within horizontal curves and shall not be placed within vertical curves.

For two turnouts in the same track diverging in opposite directions, thereby creating a reverse curve situation, it shall be necessary to provide preferably 100 feet but at a minimum of 70 feet between the points of switches of the two turnouts.

Facing point switches located in the same track and diverging to the same side of said track shall be separated by a minimum distance of 14 feet.

For a main line turnout diverging in the same direction as a preceding curve, the turnout should be placed 50 feet preferred, 25 feet minimum from the end of the curve.

For an industry turnout diverging in the same direction as a preceding curve, the turnout should be placed at least 10 feet from the end of curve.

For a main line turnout diverging in the opposite direction from the preceding curve, the turnout cannot be placed before 100 feet beyond the end of the curve.

All work on Company tracks, including main line turnouts, shall be accomplished by the Company.

Turnouts in the main line should not be placed within 100 feet of an at-grade road crossing.

Turnouts in Industry tracks shall not be placed within 10 feet of an at-grade road crossing.

Turnouts in the main line shall not be placed within 50 feet of a railroad signal.

Turnouts in the main line should not be placed on a railroad bridge or within 100 feet of a railroad track bridge face of back-wall.

Turnouts in the main line shall not be placed underneath an overpass.

6.08 DERAILS

Derails are installed on Industry track(s) at the clear point to derail away from the main line anything moving on the Industry track that does not have authority to use Company tracks.

Derails can also be used where safety is a concern. For example, derails can be placed before tracks cross public or private streets at grade or at the top of steep grades to prevent "run-away" situations.

All derails to be operated by Company personnel shall be equipped with a Company supplied lock and key. These locks shall be operated by Company personnel **Only**.

A double switch point (DSP) derail shall be installed by the Company, with the non-switch end of the derail at the clear point of the Industry track, on Industry track with descending grade towards the Company track. The entire DSP derail (43' long) shall be located in vertical tangent track outside of any vertical curves. The long timber (end) of the derail shall be placed at the clear point, NOT the point of switch (beginning). See attachment for derail details.

Hayes Model HB Derails will be installed, by the Company, at the clear point of tracks which have no grade or a descending grade away from the Company track.

A DSP derail will be installed at the clear point on *any* track that handles hazardous materials (*NSRC MW&S Standard Procedure 100*).

Derails are to be painted international orange. Glass beads should be sprinkled on after painting while paint is still wet to increase night time viability (*NSRC MW&S Standard Procedure 100*).

Additional derails may be required due to site specific safety concerns and / or operational considerations.

6.09 END OF TRACK DEVICES

End of Track (EOT) Devices shall be placed at the open end of all stub-ended tracks.

Earth mounds are the preferred EOT Device. Earth mounds should be of an approved design sufficient to stop a moving car and should be protected against erosion.

Where earth mounds are impractical, bumping posts shall be used on all stub end tracks which end at a structure, dock, or road. Bumping posts shall be either new or second-hand, of good quality and approved design.

Use of wheel stops should be avoided and are only allowed with the expressed written consent of the Company.

6.10 SIDE AND OVERHEAD CLEARANCES

Standard vertical and horizontal clearances based on the centerline of Industry track at top of rail are shown on *NSRC Plan 7-1*, attached to these guidelines. ***Where law or regulation requires clearance(s) greater than Company standard, such laws and regulations will govern.*** All substandard clearances must be approved by the responsible Operating Officer of the Company provided that the Company Clearance Engineer determines that there are no issues related to the proposed substandard clearance.

NSRC Plan 7-1 should be referenced for design clearance requirements for all structures including buildings, loading racks, stairways, and overhead fall arrest protection supports, etc... to be constructed adjacent to or over Industry tracks. ***The Industry should review all federal, state and local safety and environmental regulations to determine what structures and/or appurtenances will be required for their particular method of operation and commodity early in the design process.***

Although the maximum vertical distance from the proposed top of rail to a platform, loading dock, or building finished floor elevation is shown as 4 feet – 0 inches on *NSRC Plan 7-1*, the Company recommends a design distance of 3 feet – 9 inches. This is the average floor height of a standard box car. The Industry's engineer should coordinate rail car information with the Company's engineer to verify the proper design distance between the top of rail and the finished floor elevation of the dock or building.

Standard vertical clearances from the centerline of track at top of rail for overhead electric lines are shown on *SP-1621*, attached to these guidelines.

Required side clearances for storage of rail cars and storage tanks for hazardous commodities can be found in Chapter 14 of these guidelines.

“Close Clearance” signs, if required, shall be posted as directed by the Company. Close clearance signage shall be as shown in *NSRC Plan 6–14*, attached.

6.11 ROADBED SECTION

Requirements for roadbed shoulder width, ditches, and slopes are shown on the following Company Plans (attached to these guidelines):

NSRC Plan 1–21 - ROADBED SECTION FOR HEAVY TONNAGE TRACKS
OTHER THAN MAIN TRACKS

NSRC Plan 1–22 - ROADBED SECTION FOR INDUSTRIAL TRACKS

NSRC Plan 1-22A - TURNOUT PAD FOR No. 10 INDUSTRY TURNOUTS

Industry should note the importance of constructing these typical roadbed sections which will provide an adequate walkway for both Company and Industry personnel. This is especially true in the area between switch stands and derails and any other areas as required by federal, state and/or local regulations.

Consideration of operational and tonnage requirements must be taken into account when designing roadbed sections for new track. The *NSRC Plan 1–22* roadbed section can be used for most spur tracks.

Heavy tonnage spur tracks such as those serving coal facilities typically require a roadbed section as shown on *NSRC Plan 1–21*.

Lead tracks of considerable length such as those serving an industrial park typically require a roadbed section as shown on *NSRC Plan 1–21*.

6.12 GRADE CROSSINGS AND ROADS

Roads Crossing or Parallel to Company Tracks

New at-grade road crossings over Company Tracks should be avoided. Design, permitting, and approval for new grade crossings over Company tracks can be an extensive and time consuming process. The applicant should initiate the crossing permit application early in the conceptual phase of project planning with the Industrial Development Manager, who will coordinate the application with the various departments involved in the approval process. The Industry should work closely with the Company's Engineering Department on design and location of the proposed crossing and preparation of plans for final approval submittal to the Division Superintendent.

Safety is always the controlling factor in design of new at-grade road crossings. Factors such as sight distance of train and vehicle operators, type of vehicles utilizing the proposed crossing, grade of the proposed road, vehicle braking ability, and accessibility of the location to be served by the crossing if the crossing is blocked by a stopped train are examples of factors which must be considered, to name a few. It is the Industry's responsibility to incorporate any local, state or federal regulations, guidelines or

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mandates which may govern grade crossing design at their proposed location. This is often, but not always, governed by the type (e.g. local, state or federal highway) of road.

Grade crossing warning devices such as cross bucks (Passive Warning) or flashing light signals with or without gates (Active Warning) are highway traffic control devices. The Division Superintendent shall determine the level of warning or device to be installed for a crossing over a private road. For a crossing over a public road or street the state agency or local authority (road authority) with jurisdiction over the road shall evaluate and determine the level of warning or device required for that crossing. The Industry should work closely with both the road authority and the Company to assist in determining the adequate level of warning device for the proposed crossing.

If the governmental agency having jurisdiction requires that automatic warning devices be installed at the crossing, before industry purchases and installs said devices, it will be necessary that the plans for installation for such control apparatus and equipment be submitted to the Company's Signal and Electrical Department for review and approval. Engineering plans for installation of the grade crossing warning devices must also be reviewed and approved by the governmental agency prior to installation. This level of involvement may vary depending on the type of Company owned track involved, i.e. main line vs. lead track serving an industrial park.

Asphalt paving with rubber flange way (a.k.a. Rubber Rail Seal) is the current standard crossing surface for at-grade road crossings over Company tracks (see *NSRC Plan 7-05B*). Any desired use of alternative surface types, such as Concrete Panels (see *NSRC Plans 7-6 and 7-6A*), by any party should be discussed with the Company's Engineering personnel and will be covered in the crossing agreement.

Roads parallel to Company tracks on Company property shall be designed to provide for the safety of all parties using the proposed road. Many factors contribute to roadway design and the Industry should work closely with the Company in this regard. This type of use of the Company's property almost always requires a formal agreement with the Company.

Roads Crossing Industry Tracks

Private at-grade road crossings and roads parallel to Industry tracks located beyond the Company's Division of Ownership and Maintenance point in the track shall meet or exceed Company standards and will only be permitted under the terms of the Industry Track Agreement.

Crossing surface types for private at-grade crossings are at the discretion of the Industry but shall be built in accordance with Company standards. Attached *NSRC Plans 7-5, 7-5a, and 7-5b* govern timber and rubber rail seal crossings while *NSRC Plans 7-6 and 7-6A* govern concrete crossings.

Safety of rubber tired vehicular traffic around railroad tracks inside Industry facilities is the responsibility of the Industry. Design of proper side clearances to tracks from adjacent roads, site distances at grade crossings, and proper signage shall be in accordance with Company standards.

6.13 AT-GRADE TRACK CROSSINGS

Rail crossings should be used as little as possible. All rail crossings shall be approved by the Company. The angle of the rail crossing shall be that shown on the approved plans and/or as further defined as staked in the field. Detailed manufacturer's plans and specifications shall be furnished for approval by the Company.

VII. INDUSTRY PLAN SUBMITTAL

7.01 GENERAL

Sample agreement and sidetrack design plans are shown in the attachments for reference.

The Industry submitted plans will be utilized by the Company for internal review and approval. This process ensures compliance with engineering and safety standards and verifies the feasibility of the proposal from an operational stand point. A clear, well labeled plan is essential for a successful submittal and prompt review.

The plans will also be utilized as attachments in track usage agreements between the Industry and the Company. As such, clear reference to ownership and parties to the sidetrack agreement should be included on the plan.

In addition to Industry submitted sidetrack design plans, a separate agreement plan *shall* be provided for final review and approval by the Company, unless deemed unnecessary by the Company. The agreement plan should be as shown in the attachments and not include construction related details such as contours, erosion control devices, etc...

It is the Company's desire to be a cooperative partner in progressing projects owned by Industry; however the safety of Company employees and the equipment it operates is of paramount importance. Plans provided shall clearly define all existing and proposed conditions and allow for sound decisions to be made by the Company in its approval process.

When overhead and under track structures, utilities and retaining walls are involved, submitted plans for these structures shall bear the seal of a current Registered Licensed Professional Engineer in the state of the project.

Plans produced and submitted by Industry or its contractor shall be provided to the appropriate Company Industrial Development Manager's office in MicroStation (.dgn) or other equivalent and compatible format. A PDF version of the completed plans shall also be attached.

Plans submitted shall be drawn to scale and show all essential features affecting the track layout. The preferred scale for drawings is 1"=100'. Smaller projects may utilize a scale of 1"=50' and larger projects may utilize a scale of 1"=200'. No other scales will be accepted. The agreement plan should use one of the preferred scales and be sized to have all track fit on one plan sheet.

All tracks depicted on the drawings shall be shown as CENTER LINE of track. Tracks showing crossties and rails, or two lines representing rails are not acceptable. Existing track center lines shall be shown as light weight (thin) and solid lines. Proposed track center lines shall be shown as a heavy weight (thick) with a dashed line. Tracks to be relocated or removed shall be shown light weight and with a dashed line style distinctly

different than the style used for proposed track. Tracks in relocated position shall be shown heavy weight and with a dashed line style distinctly different than the style used for proposed track. See the attached sample plans for examples.

Any questions regarding design specifications not answered in these specifications should be directed to the assigned Company Design and Construction engineer assigned to the Industry project.

7.02 REQUIRED PLAN SIZES

The Company allows 6 different standard plan sizes. The sizes are:

- AA – 8.5" x 11" (ANSI A)
- AB – 11" x 17" (ANSI B)
- AC – 17" X 22" (ANSI C)
- AD – 22" x 34" (ANSI D)
- ARN – 11" X >34"
- ARM – 22" X >34"

AB and AD plans are the preferred size subject to layout requirements and should be utilized when possible for ease of reproduction. When possible a single sheet including both site plan and profile drawing should be submitted. Cross-sections, grading and drainage details are required for work on Company right-of-way. Typically, grading details and cross sections beyond Company right-of-way are not required but may be requested on a case by case basis.

All drawings shall leave a 3" vertical by 5" horizontal clear area in the lower right hand corner (within inner border) of all plan sheets for insertion of a drawing identification label by Company.

7.03 TITLE BLOCK

Completed plan drawings submitted to Company for review and approval shall include the following title block information for the Industry:

- Facility owner
- Facility address
- Drawing title
- Drawing number or file reference.
- Date
- Firm responsible for production of drawing including contact information

7.04 SITE AND TRACK PLAN

Sidetrack Design Plan shall include the following as applicable:

- English units, engineering format (decimal)
- Centerline stationing for all track
- Point of Switch (PS) with stationing, turnout size, whether right hand (RHTO) or left hand (LHTO) turnout, and whether switch is hand throw or power operated
- Point of Curve (PC) or Point of Tangent to Spiral (TS) with stationing
- Point of Tangency (PT) or Point of Spiral to Tangent (ST) with stationing
- Curve data for all curves based on the chord definition including delta, degree of curvature, radius, tangent, and length of curve
- Track clearance points (CP) with stationing
- Door/dock clearances with stationing for door centers and dock ends
- Track centers or minimum track centers
- Derails / Division of Ownership & Maintenance with stationing
- Track capacities in number of cars and stationing limits
- Existing tracks with description (i.e. Main Track, Industry Track, etc...)
- Proposed tracks with description (i.e. Main Track, Industry Track, etc...)
- Show vertical & horizontal clearance for all structures within 15 feet of center line of proposed or existing track with stationing
- North arrow
- Drainage structures, both proposed and existing
- Utilities with horizontal and vertical clearances to proposed / existing track centerline
- Fiber optic cables with line identification
- Signals, signal equipment and shelters
- Direction to and name of the nearest city located along railway tracks
- Distance between the proposed point of switch and the nearest railway milepost with a directional arrow towards the milepost
- Distance to the nearest major land mark in each direction if not shown on the plan (i.e. road crossing, bridge, mile post, etc...)
- County in which the project is located, shown in upper right corner of plan
- Location map
- Location of Railway right-of-way (R/W) lines, with dimensions to track center line
- Location of property lines, other than Railway R/W, where possible
- End of track device (both existing and proposed) with stationing
- Level (0%) grades for all loading / unloading areas
- Spill containment devices and systems with stationing
- Coordinate table for all survey control points (point #, Northing, Easting, Elevation, and Description)
- The proposed point of switch shall be tied to the local State Plane coordinate system
- The State Plane coordinates for the proposed point of switch, derail and end of track(s) shall be shown on the plan either at the location shown, or in a

table. In addition, Lat/Long coordinates *shall* be included on the agreement plan for the proposed Division of O&M, Begin Track Lease and End of Track Lease.

- Detailed plans and calculations for proposed unloading pits and scales shall bear the seal of a current Registered Licensed Professional Engineer. These plans shall be approved by the Norfolk Southern Bridges and Structures Department prior to the commencement of any site work involving the track.
- Safety buffer with stationing
- Grade crossing length and stationing at each end
- Track lease and stationing

7.05 TRACK PROFILE

The Sidetrack Design Plan Profile shall include the following items as applicable:

- Point of Switch (PS) with stationing
- Derails with stationing
- Stationing in the same direction as the proposed track alignment and displayed on the same scale as the plan view
- Average grade of existing and proposed tracks
- Profiles of the existing track, proposed track, and proposed sub-grade
- Points of Vertical Curvature (PVC) with stationing
- Points of Vertical Tangency (PVT) with stationing
- Vertical curve lengths and “r” (rate of change) value
- Top of rail elevations for the proposed track every 100 feet
- Storage capacity in number of cars in loading/unloading zones and station limits
- Dock height and elevation
- End of track device with stationing
- At-grade road crossings with stationing at each end of crossing
- Unloading pits and loading structures with stationing
- Overhead and underground utilities with stationing and elevations
- Existing and proposed culverts with stationing, elevations and depth of cover
- Safety buffer with stationing
- Top-of-rail to top-of-subgrade measurement

7.06 ADDITIONAL PLAN REQUIREMENTS

Additionally, all sidetrack design plans shall include the following as applicable:

- A typical roadbed cross-section of the track showing the depth of the sub-ballast, ballast, and design of the sub-grade in compliance with Norfolk Southern standards
- Cross-sections at locations of overhead and underground utility and culvert crossings, including labelling inverts, diameter and cover

- Legend clearly defining all line types
- An applicable clearance diagram in compliance with Norfolk Southern standards
- Turnout Pad Plan 1-22A
- Typical section and detail for any grade crossings
- Typical section and/or detail plan for any unloading pit, or loading/unloading apparatus
- Detail of end of track device
- Detail and typical section for spill containment devices and systems
- Chart or table listing car type and length, commodity, unloading/loading method, and method of operations i.e. switching by Company, Industry or both
- Land lease area with both acreage and square footage shown. Include dimensions to proposed and existing tracks.
- A master plan view of the entire industrial site as a separate attachment
- A full set of cross-sections are to be submitted for review. Cross-sections shall include existing surfaces and tracks, proposed surfaces and tracks, including NS mainline tracks, drainage crossings and other special cases as needed. Cross-sections shall be fully annotated with slopes, elevations and offsets, track centerline offsets and top of rail elevations, and in a scale that is legible. The Company Design & Construction engineer will advise if this submittal will be required.
- A complete set of construction plans for the entire industrial site are to be submitted for review. The Company Design & Construction engineer will advise if this submittal will be required.

7.07 AGREEMENT PLAN REQUIREMENTS

A separate agreement plan shall be included in the plan submittal. Requirements for information to be presented on the agreement plan are shown on the agreement plan checklist and sample agreement plan in the attachments.

7.08 SUBMITTAL TO STATE AGENCIES

Where required by state law, the industry is responsible for submitting sidetrack design plans to the appropriate state agency for review and approval prior to performing site and track work.

VIII. SITE WORK

8.01 CLEARING AND GRUBBING

Clearing and grubbing includes the removal of all trees, brush, logs, debris and other undesirable materials from locations where new construction is to occur.

The Industry shall be responsible for the clearing and grubbing of that portion of the Company's right-of-way affected by new construction. All material removed from the Company's right-of-way, excepting that reserved by the Company, shall be disposed of by the Industry. The Industry shall be responsible for the identification and protection of overhead and underground utility easements, including fiber optic cable easements, within the Company's right-of-way.

Prior to the commencement of clearing and grubbing on Company right-of-way, the Company's Division Engineer and Division Superintendent's office shall be contacted in order to schedule the clearing and grubbing operation so as not to interfere with train operations.

8.02 GRADING

The Industry shall construct or cause to be constructed all grading necessary for the installation of the track. This includes all grading required for that portion of the track located on the Company's right-of-way. The requirement for a wider roadbed to provide a proper walkway in the area of all turnouts is of particular concern. This additional roadbed width shall be graded as shown on attached *NSRC Plan 1 – 22A* and shall continue along the diverging track until it transitions back to the diverging track's standard roadbed section.

The Industry shall be responsible for compliance with all local, state, and/or Federal regulations governing site construction including, but not limited to erosion control, grading, and storm water runoff.

Fills and subgrades shall be compacted to a minimum of 90 percent Modified Procter based on American Association of State Highway and Transportation Officials (AASHTO) Designation T-180, or 95 percent Standard Procter based on AASHTO Designation T-99.

Moisture content of soil should be controlled as necessary to obtain specified densities, based on the moisture-density relationship developed by AASHTO tests.

All topsoil shall be removed from the area of the proposed roadbed. Slopes of all cuts shall be true and straight and all loose stones and boulders removed. Slopes of all fills shall be carefully formed and trimmed as they are compacted. Where a fill is placed on sloping ground or on the side of an existing fill, the surface shall be deeply plowed or stepped and the new material thoroughly mixed and embodied with the old material as the new fill is constructed.

The finished subgrade shall conform to such elevations as shown or otherwise noted on the plans, within a tolerance of ± 0.1 foot.

8.03 DITCHES

The Industry shall provide temporary or permanent ditches in order to maintain the Company's existing drainage of the tracks. No ponding of water against the Company's existing roadbed shall be allowed. Ditches draining Company tracks shall be designed to carry the expected runoff of a storm with a 100-year recurrence interval.

No drainage is to be diverted to railroad ditches without the specific notification and written approval of the Company.

8.04 SEEDING

A seed and fertilizer mixture, adhering to local, county or state DOT specifications shall be applied so as to provide adequate slope protection. Creeping grasses shall not be used.

8.05 DRAINAGE CULVERTS AND STRUCTURES

Except as otherwise specified hereafter, the current AREMA Chapter 1, Part 4 applies to all work under this section. This Section applies to under track culverts conveying storm water run-off only. Closed pipeline systems for roadway stormwater management shall be designed in accordance with the NSCE-8, Section 4. A "Closed pipeline system" is defined as a system that conveys stormwater entirely across the right-of-way. If the drainage system empties onto the NS right-of-way, then the under track culvert requirements apply.

The Industry shall be responsible for constructing at its own expense all drainage structures for the proposed track including that portion on the Company's right-of-way. The Industry shall ensure that post-development storm water runoff rate / volume towards Company right-of-way does not exceed pre-development conditions. The Industry shall be liable for all damage claims arising from adverse effects caused by Industry alteration of pre-development drainage patterns.

Any required changes or additions to existing drainage structures under Company track(s) due to Industry track, shall be the responsibility of the Industry. The Industry shall furnish to the Company, for review and approval, plans, specifications and computations for proposed drainage structures and drainage modifications involving the Company's right-of-way prior to start of construction. In no case shall the hydraulic capacity of a Company drainage structure be reduced. In addition, ponding of water on Company right-of-way shall not be allowed.

Culverts shall be designed for Cooper's E-80 Live Loading and the 100 year storm event. The proposed design shall be approved by the Chief Engineer – Bridges and Structures. Maximum headwater build up (for Q 100) for inlet control conditions shall be limited to an HW/D= 1.5 provided the roadbed fill is of sufficient height to maintain the high water elevation below the toe of ballast and the fill material is capable of resisting water infiltration for short durations. With the approval of the Chief Engineer – Bridges and Structures, the HW/D limit may be adjusted for special field conditions.

All plans and calculations for work impacting drainage structures under the Company's tracks shall bear the seal of a current registered licensed professional engineer in the state of the project.

Culverts shall be sized based on the actual drainage basin. The minimum culvert size shall be 36 inches in diameter for all culverts on NS right-of-way unless otherwise approved by the Chief Engineer – Bridges and Structures. The "Rational Method" shall be used for drainage areas less than 200 Acres. For drainage areas greater than 200 Acres, one of the following methods should be considered and may provide more realistic runoff estimates provided data is available:

- a. Soil Conservation Service (Unit Hydrograph Theory Method) SCS
- b. Frequency Regression Theory

8.05.01 CULVERT OPTIONS

The following requirements shall be met for all culverts placed under Company tracks or tracks that will be owned by the Company in the future.

All culverts shall be installed to the line, grade, and elevations and be of the size as shown on plans approved by the Company. All culverts shall be installed for the full width of the section, properly bedded as per the attached *'Installation Instructions Corrugated Metal Pipe Culverts'* detail and shall be backfilled with select material and carefully compacted.

Corrugated metal with various coatings, corrugations, shape, and manufacturing processes, smooth wall steel pipes and concrete, both pre-cast and cast-in-place, HDPE, SDPE, and Schedule 80 PVC can be considered. Polymer coated pipe requires special care to avoid damage during handling and installation.

Corrugated metal, galvanized and asphalt coated circular pipes will be our basic design with variations permitted with the approval of the Engineer Structures.

1. Aluminized Type 2 uncoated or Bituminous coated galvanized steel pipe - may be used for a PH range of 5-8. Suggested uses are runoff from non-industrial rural areas.
2. Fiber Bonded Bituminous coated pipe or Polymer coated pipe - may be used where soil and water conditions warrant such as Midwest farm fields (high concentrations of fertilizer runoff), coal fields (acidic runoff), salt water marsh areas, and in areas where high soil concentrations of heavy metals are present.
3. Pipe Arch - may be considered for special cases where physical constraints and opening requirements warrant.
4. Corrugated metal culverts of 42" or larger diameter shall be formed to a specified 5 percent vertical elongation with tension wires or turnbuckle rods at horizontal axis. These tension wires are to be removed when grading is complete.
5. At no time shall the corrugated metal pipe gage exceed 12. See attached *'Corrugated Metal Culvert Gage Selection and Installation'* detail.

High Density Polyethylene (HDPE) pipe is approved for non-main track under track applications. See *NSRC Plans DR-HDPE-1 and DR-HDPE-2* for material and installation requirements for HDPE pipe.

Smooth Wall Casing pipe will be our basic design for culverts where jack and bore method of installation is required due to traffic condition or fill height greater than 10 feet. Liner Plate installed by Tunneling method may be required when diameter, length, presence of rock or other unusual site conditions exist. Refer to Table 1 – SMOOTH WALL CASING PIPE MINIMUM WALL THICKNESS and Table 2 – MINIMUM LINER PLATE GAGE TABLE shown on Page 30.

Except as approved by the Chief Engineer – Bridges and Structures, concrete pipe culverts or pre-cast concrete culverts may not be used under Company owned tracks or tracks to be owned by the Company due to the risk for differential settlement and joint separation. Concrete pipe culverts or pre-cast concrete culverts may be used under industry tracks where NS has no maintenance responsibilities. Concrete culverts shall be of adequate cross section to provide the proper drainage opening conforming to ASTM C-76 Class V, reinforced Wall B.

The use of pre-cast concrete box culverts is acceptable. Boxes shall be designed and fabricated in accordance with the current AREMA Manual for Railway Engineering, Chapter 8, for Cooper's E-80 Live Loading. Cast-in-place concrete structures may be used where appropriate.

Structural Plate pipes and pipe arches are to be used where size and conditions dictate (generally considered culverts greater than 72-inch diameter). The coating to be either bituminous coated or fiber bonded depending on soil and runoff water condition (PH range).

Tunnel Liner shall be used when the culvert diameter exceeds pipe sizes economically installed by the jack and bore method (culverts generally larger than 60-inch diameter). All tunnel liner pipe shall be bituminous coated and have paved inverts. Grouting of voids between the pipe and adjacent soil at regular intervals, not to exceed once daily, is required.

8.05.02 PAVED INVERTS AND END TREATMENTS FOR BCCMP

Paved inverts shall be used in corrugated metal pipes where water velocities are medium to high (above 10 f.p.s.) or the possibility of excessive wear from sand and gravel is likely.

1. Corrugated metal culverts shall have bituminous or asphalt paved inverts where needed due to high water velocities or the possibility of excessive wear from sand and gravel is likely.
2. Concrete or Asphalt paved inverts shall be used in structural plate, tunnel liner and pipe arches that are field assembled. If concrete is used, a minimum concrete compressive strength shall be 3000 p.s.i. after 28 days. The bottom 25% of culvert periphery shall be covered with concrete (or asphalt) to a depth of 1 inch above the crest of the corrugations for circular pipes and 40% of the periphery for pipe arches. The concrete pavement shall be reinforced with 6 x 6 (W2.9 x W2.9) welded wire fabric. This wire shall be attached to the pipe by either directly welding to the pipe or by mechanical attachment to the bolts.

Preformed bituminous coated end sections may be used in place of headwalls when erosion at the inlet is expected, and shall conform to AASHTO M218 requirements. Headwalls and/or End Sections should be considered on both ends of all culverts greater than or equal to 60-inch diameter.

8.05.03 CONNECTING BANDS FOR BCCMP

Connecting bands for annular bituminous coated corrugated metal pipe shall consist of a single piece 24" wide, one gage thinner, with the same corrugations and same cover treatment as the drainage pipe. Connecting bands for drainage pipe 48" and larger diameter shall be fully bolted with a minimum of four - 0.5 inch diameter rods and silo-type lugs. Dimpled bands are not acceptable.

8.05.04 STEEL CASING PIPE AND TUNNEL LINER PLATE SIZE CHARTS

TABLE 1 -SMOOTH WALL CASING PIPE MINIMUM WALL THICKNESS

Nominal Size (Inches)	Minimum Wall Thickness (Inches)
12	0.250
18	0.312
24	0.375
30	0.469
36	0.532
42	0.625
48	0.688
54	0.781
60	0.844
66	0.938
72	1.000

TABLE 2 - MINIMUM LINER PLATE GAGE TABLE

Diameter (feet)	2 Flange		4 Flange	
	Gage	Cover (feet)	Gage	Cover (feet)
4	12	4 to 50	12	4 to 50
5	12	4 to 50	12	4 to 50
6	12	4 to 50	10	4 to 50
7	12	6 to 50	10	4 to 50
7	10	4 to 50	--	--
8	10	4 to 50	8	6 to 50
9	10	4 to 50	8	8 to 50
10	8	4 to 32	5	8 to 50
10	7	34 to 50	--	--

Notes: The above Minimum Liner Plate Gage Table was developed using 1992 AREMA Specifications Chapter 1, Part 4.

The following factors of safety are used:

Joint Strength = 3.0

Minimum Stiffness = ("3.0" for 2-Flange and "1.5" for 4-Flange)

Critical buckling = 2.0.

The effects of high corrosive environments may be compensated for by adding one (1) gage to the above Liner Plate Gage Table values.

8.06 BLASTING

Use of explosives on and adjacent to railroad property and right of way is subject to strict provisions and safety precautions. If use of explosives during grading is anticipated, the Industry shall contact the Company for a copy of **Guidelines for Use of Explosives on Norfolk Southern Corporation Property**. This publication outlines insurance requirements, safety, method, and procedures. Failure to plan ahead with regard to these requirements can cause significant delays to the construction process; the Industry should fully investigate ahead of time if blasting will be necessary.

IX. TRACK MATERIALS & CONSTRUCTION

9.01 SUB-BALLAST

Sub-ballast shall be crusher-run dense graded aggregate, preferably limestone or granite material, and shall meet the requirements as set out in Chapter 1, Part 2, Section 2.11, "Sub-ballast Specifications" of the AREMA Manual.

Gradation as follows:

Sieve Size	2"	1"	3/8"	No. 10	No. 40	No. 200
% Passing Size (optimum)	100	95	67	38	21	7
Permissible Range % Passing	100	90-100	50-84	26-50	12-30	0-10

Sub-ballast shall be spread on a graded roadbed as a base, with sufficient width to accommodate the desired number of tracks (see *NSRC Plans 1-21* and *1-22*). The sub-ballast shall be compacted to 95 percent of its maximum dry density and have a minimum depth of 6 inches.

For sub-ballast quantity estimates, placement of 6 inches of compacted sub-ballast on a single track industry roadbed requires approximately 0.84 ton of sub-ballast per foot of track construction.

9.02 BALLAST

Material for ballast used on Industry tracks shall be clean crushed stone with a minimum depth of 9 inches for lead tracks and 6 inches for spur tracks between bottom of tie and top of sub-ballast (see *NSRC Plans 1-21* and *1-22*). Cribs between adjacent ties shall be filled with ballast and be level with the top of the ties.

Stone for use as ballast on tracks, or portions of tracks, to be owned by the Company, shall be furnished by a Company approved quarry and shall be granite crushed stone conforming to the requirements of Company Specification No. 702 (2009).

Subject to approval of the Company's Chief Engineer, limestone ballast conforming to Company Specification No. 702 (2009) may be used on tracks not owned by the Company. If material meeting this specification is not available, limestone ballast meeting AREMA Specifications may be used on tracks not owned by the Company if approved by the Company's Chief Engineer.

#3 Modified ballast shall be used under all main tracks, lead tracks, and switching tracks parallel to a main track on the Company side of the division of ownership and maintenance.

Yard tracks and turnouts, spur tracks, switching tracks (where a #3 Modified ballast is not required), and runaround tracks may use either a #3 Modified or #5 ballast.

Gradation shall conform to the following table:

Sieve Designation	Sieve Opening	#3 Modified Ballast % Passing Sieve	#5 Ballast % Passing Sieve
2 ½"	2.5"	100	-
2"	2"	95-100	-
1 ½"	1.5"	30-65	100
1"	1"	0-15	90-100
¾"	0.75"	-	40-75
½"	0.5"	0-5	15-35
3/8"	0.375"	-	0-15
No. 4	0.187"	-	0-5
No. 200	0.0029"	0.5 Max	0.5 Max

9.03 RAIL

Rail shall be new or relay of good quality, with minimum section of 100 pounds/yard, 115 pounds/yard for loop tracks. Relay rail should be free from local bends, kinks, battered ends, excessive engine burns and surface corrugations. Rail should be furnished in lengths not less than 31 feet and should be drilled to accept the proper size joint bars for the section of rail being used.

Based on planned track usage and/or tonnage a heavier rail section (continuous welded rail) should be considered. If welded rail is used, the type of welding should have approval of the Company's Chief Engineer or his representative.

Existing industry track with a rail section of less than 100 pounds/yard that is out of service or inactive may be subject to rail replacement as determined by NS MW&S track inspection, and/or track geometry, type of commodity, traffic volume, and operations.

Rails should be laid one at a time. The bottom of the rail and the bearing surface of the tie plate should be cleaned of all debris before the rail is laid. Joints in opposite rails shall be staggered not less than 8 feet and not more than 14 feet apart, except as close joints may be required at insulated joints or turnouts. To minimize the cutting of full length rails, short rails of not less than 15 feet may be used in adjusting for proper spacing of joints. Proper allowance for expansion should be provided at rail joints by installing rail expansion shims conforming to the section of rail being used.

When necessary to cut and/or drill a rail, it should be cut with an approved rail saw, and drilled with an approved rail drill. Flame cutting of rail will not be permitted.

9.04 TURNOUTS

Turnouts shall be new or relay of good quality of the same or greater rail section as the parent track. The turnouts shall be the size and shape as called for on the plans and shall meet all requirements in accordance with an approved design, AREMA, or equal. The turnout material shall be complete in every respect to construct the needed turnouts ready to receive train traffic. Package switches shall be of an approved design, AREMA, or equal, equipped with standard reinforced points and of correct length for the size of turnout of which they are a part. Frogs shall be of an appropriate design, AREMA or equal, equipped with plates of the proper size and type to fit the designed track layout. Frogs shall be of the same or heavier rail section as that of the parent track. Where the

Company has plans to upgrade the parent track, then the rail and frog section shall be as required by the Company. Turnouts to be used in tracks to be owned by the Company shall conform to the Company's standard turnout plans, not AREMA turnout plans. Reference *NSRC Plan 2-17* for turnout geometry.

9.05 TIES

TIMBER

Ties shall be new and conform to the Company's Quality Assurance Specifications for Ties and Timbers, Section No. 2, NS Specifications for Wooden Industrial Grade Crossties, Revised May 1, 2017.

Ties used in tracks to be owned by the Company shall be purchased from a Company approved supplier. Certification of the ties must be furnished to Company from the contractor and/or supplier based on Company specifications.

Ties shall be placed on the prepared sub-ballast at right angles or normal to the centerline of the track. Ties shall be spaced 20 inches, center to center (60 ties per 100 feet) with the ends of the ties along one side of the centerline on tangent track and along the inside on curved track being placed 1' 10 3/4" from the gage of the nearest rail.

STEEL

The use of steel ties on lead and switching tracks (or similar) to be owned and/or maintained by the Company requires approval of the Company's Chief Engineer. The Industry may elect to use steel ties on industry owned tracks.

Steel ties shall meet the requirements listed in the most current version of Chapter 30, Part 6 of the AREMA Manual. Ties shall be new North American Railway Steel Tie Corporation (NARSTCO) Type M10 or equivalent. Rail fastening clips and hook-in-shoulders shall meet manufacturer's specifications for the ties used.

Ties shall be placed on the prepared sub-ballast at right angles or normal to the centerline of the track. Ties shall be spaced 24" center to center in tangent track and 20" center to center in curved track and installed per the manufacturer's specifications, including ballast depth.

It is essential for surfacing and lining of track constructed with steel ties to be performed properly to ensure proper tie support and prevent track settlement.

Steel ties shall be installed as described in the most current version of Chapter 30, Part 6 of the AREMA Manual. It is of utmost importance to ensure the tamping machine used for surfacing is equipped with traversing vibratory work heads with 16 tamping tools in good condition and with depth properly adjusted for steel tie track surfacing.

9.06 SWITCH TIES

TIMBER

Switch ties shall be new oak and mixed hardwood ties of 7" x 9" in cross section and in 12" length increments as required for the turnout being used. All switch ties shall be air-dried and treated per the Company's Quality Assurance Specifications for Ties and

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Timbers, Section No. 2, NS Specifications for Wooden Industrial Grade Crossties, Revised May 1, 2017. No second hand switch ties may be used.

Switch ties used in turnouts to be owned by the Company shall be purchased from a Company approved supplier. Certification of the ties must be furnished to the Company from the contractor and/or supplier based on Company specifications.

Switch ties shall be placed on finished sub-ballast and spaced according to the Company's Standard Plan for the turnout being used.

STEEL

The use of steel switch ties in turnouts on lead and switching tracks (or similar) to be owned and/or maintained by the Company requires approval of the Company's Chief Engineer. The Industry may elect to use steel switch ties in turnouts on industry owned tracks.

Steel switch ties shall meet the requirements listed in the most current version of Chapter 30, Part 6 of the AREMA Manual. Switch ties shall be new North American Railway Steel Tie Corporation (NARSTCO) or equivalent. All OTM shall meet manufacturer's specifications for the ties used.

It is essential for surfacing and lining of track constructed with steel ties to be performed properly to ensure proper tie support and prevent track settlement.

Steel switch ties shall be installed as described in the most current version of Chapter 30, Part 6 of the AREMA Manual. It is of utmost importance to ensure the tamping machine used for surfacing is equipped with traversing vibratory work heads with 16 tamping tools in good condition and with depth properly adjusted for steel tie track surfacing.

9.07 TIE PLATES

Tie plates should be new or second hand, of good quality and of an approved design for the weight of rail to be used. Two tie plates per tie, under the base of rail, must be used. Also, tie plates shall be used on all switch ties not protected by switch plates, frog plates, or guard rail plates.

The tie plates shall be double shouldered and have a minimum size of 7 ½" x 11" with proper punching to fit the base of the rail being used. The down slope (1:40 cant) of the tie plate shall be directly over and parallel with the centerline of the crosstie. The tie plate shall be set so that the outside shoulder of the tie plate shall bear squarely against the base of the rail, having a full bearing for the rail and at the same time, a full bearing on the crosstie.

9.08 RAIL JOINTS

Joint bars should be either new or second hand, of good quality and of the size, drilling, and hole spacing to fit the rail being used. Joint bars should be properly installed with the full number of and the correct size of bolts, nuts and spring washers. Bolts shall be placed with nuts alternately on inside and outside of rail and shall be drawn tight before spiking. Bolts shall be tightened by the use of approved track wrenches or track bolt machines.

Rail joints should be kept out of grade crossings.

When different size rails are to be connected, forged compromise joint bars shall be used. The above mentioned recommendation for rail joints should apply to compromise joints.

Any field fabrication of compromise joints shall be strictly prohibited, that is, the cutting down of larger standard joints to fit smaller rail shall not be allowed.

9.09 BOLTS AND NUTS

Bolts and nuts for the track and turnouts should be new or approved relay and of the correct diameter and length to fit the rail and joints being used. Bolts and nuts must conform to the latest AREMA Specifications.

9.10 LOCK WASHERS

Lock washers should be new and of correct diameter to fit the bolts being used. Each track bolt should be equipped with a spring lock washer, conforming to the most current AREMA Specifications for Spring Washers.

9.11 RAIL ANCHORS

Rail anchors should be new or relay of good quality and should be the correct size and of approved design for the rail used. Rail anchors to be used on tracks to be owned by the Company shall conform to Company's Specifications and be purchased from a Company approved supplier.

The anchor pattern for tracks should be in accordance with *NSRC Plan 7-4*. Rail anchors should be installed through the turnouts in accordance with the Company's Standard Plan for the turnout being used.

9.12 TRACK SPIKES

Only standard, new 5/8" x 6" track spikes shall be used and shall conform to current AREMA Specifications for Low Carbon Steel Track Spikes. A minimum of two spikes per tie plate is required on tangent track. Spikes through the turnout should be applied in the number and location required in accordance with the Company's Standard Plan for the turnout being installed. Track spikes to be used on tracks owned by the Company shall conform to Company's Specifications and be purchased from a Company approved supplier.

The spiking pattern for curves shall be in accordance with *NSRC Plan 7-3A*.

9.13 DRIVE SCREW SPIKES

New 7/8" x 7" drive screw spikes shall be used for turnouts in accordance with the Company's Standard Plan for the turnout being used.

New drive screw spikes of appropriate size shall be used for grade crossings in accordance with *NSRC Plans 7-05, 7-05A, 7-05B* and *1-3*.

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9.14 DERAILS

Derails should be new or approved relay and must be the type indicated on the approved plans at the designated location. Where double switch point derails are required they shall be installed in accordance with the Company's Standard Plan for Derails. The standard double switch point derail is 43 feet long. Derails other than double switch point derails shall be Hayes Sliding Derail, Model HB or approved equal. They shall be sized to fit the rail and thrown with an operating stand per Section 9.18. Operating stands shall be furnished with targets. Care shall be taken when installing derails to insure that they are installed in the proper direction to derail cars away from the main track.

Derails are to be painted international orange. Glass beads should be sprinkled on after painting while paint is still wet to increase night time visibility (*NSRC MW&S Standard Procedure 100*).

9.15 EARTH MOUNDS AND BUMPING POSTS

Earth Mounds should be of an approved design sufficient to stop a moving car and should be protected against erosion.

Bumping posts should be either new or second-hand, of good quality and approved design.

9.16 SWITCH POINT PROTECTORS

Depending upon volume of traffic anticipated through turnouts and/or location of turnouts, switch point protectors may be required. Where required, these protectors should be new or second hand, of good quality and compatible with the size and type of switch point being used. The design for switch point protectors to be used on turnouts owned by the Company shall be approved by the Company.

9.17 FROG GUARD RAILS

Guard rails shall be installed for all frogs except self guarded frogs. They should be new or second hand, of good quality, of an approved design (AREMA or equal), and equipped with proper plates.

9.18 SWITCH STANDS

Switch stands shall be installed for each turnout and derail. Switch stands should be New Century Model 51-A or equivalent equipped with an ergonomic bow handle by G&B Specialties, Inc. or equivalent. All switch stands shall be complete in every respect and throw rods adjusted for proper throw, including grinding of stock rails if necessary for positive closure of switch point against stock rail.

Switch stands and latches shall be securely fastened to head block ties using 5/8" bolts, or standard cut spikes as specified by the Company. Switch stand cranks shall be made of forged steel.

X. GENERAL CONSTRUCTION

10.01 ROADBED

Roadbed width, ditches and slopes shall conform to the current Company standard roadbed section for the proposed track type. State or local regulations may require increased width of roadbed for walkway or other purposes. The controlling entity will always be the most restrictive.

Note: *The State of Tennessee requires a walkway width extending for a distance of 10 feet from the centerline of track on both sides. The walkway is to be level with the top of tie for a distance of 6 inches, and thereafter descending away from the centerline at no greater than an 8 to 1 slope. The walkway, or fill – in ballast is typically comprised of yard ballast with an AREMA gradation #5. Questions regarding the State of Tennessee regulations should be directed to:*

**Tennessee Department of Transportation
Rail Regulatory Section
505 Deadrick Street, Suite 400
Nashville, TN 37243
615-253-1045**

10.02 GAGE

Tracks shall be constructed with a gage of four feet eight and one half inches (4' – 8 ½") on tangents and curves.

10.03 CONSTRUCTION

All tracks shall be constructed to the alignment and grade as shown on approved plans and profiles.

Please note that final approval of the track for service is the prerogative of the Company and that close contact with the Company is desirable. No work is to be performed on Company track by contract forces, or in such proximity to Company track as to interfere with the Company track or roadbed without explicit permission of the Company.

No track or turnout should be laid, and no track or turnout should be placed on the roadbed, until the finished subballast has been approved. All track and turnout materials should be handled in such a manner to protect materials from being damaged. The alignment of the centerline of the track and the locations of turnouts should conform to that shown on the approved plans and further defined by an on-the-ground staked location. The final step for construction of track or turnouts should be the removing of all waste and rubbish from the track project site. The track project should not be considered complete and the final payment made until this clean up of the work site is accomplished.

XI. CROSSINGS

11.01 GRADE CROSSINGS

Where indicated on the plans and/or by the Engineer, grade crossings shall be installed. Each grade crossing shall have either rubber flange way inserts or creosoted hardwood guard timbers on both sides of the rail. Grade crossings owned and maintained by the Company shall be asphalt paved with rubber flange way or other approved crossing material.

The rubber flange way inserts shall be installed in accordance with *NSRC Plan 7-05B*.

The treated timbers for a timber crossing shall be 8 or 10 inches wide and of sufficient length to provide safe crossing for the roadway width by the appropriate depth in accordance with the *NSRC Plans 7-05 or 7-05A*. Drive screw spikes of appropriate length shall be used to install guard timber as per the Company's Standard Crossing Plans attached.

Asphalt paving shall be used between the rails and for a minimum distance of 10 feet on both sides of the centerline of the track. This asphalt paving shall be hot mix and shall meet the requirements of the governmental agency having jurisdiction.

If the governmental agency having jurisdiction requires that automatic warning devices be installed at the crossing, before Industry purchases and installs said devices, it shall be necessary that the plans for installation of such control apparatus and equipment be submitted to the Company for review and approval. Engineering plans for installation of the grade crossing warning devices shall also be reviewed and approved by the governmental agency prior to installation. This level of involvement may vary depending on the type of Company owned track involved, i.e. main line vs. lead track serving an industrial park.

The Industry shall submit complete plans to the Company for approval and preparation of agreements to permit construction of grade crossings or roads parallel to existing Company tracks on Company property.

Private grade crossings or roadways parallel to Industry tracks shall meet or exceed Company standards and will only be permitted under the terms of the Industry Track Agreement. The edge of parallel roadways shall be no closer than 9 feet to the centerline of track in tangent track and greater in track curves and at switch stands as per *NSRC Plan 7-1*.

11.02 PIPELINE

All pipelines located under Company track(s) or on Company right-of-way parallel with Company track(s) shall comply with current American Railway Engineering and Maintenance-of-Way Association (AREMA) specifications for conveying flammable and non-flammable substances, Chapter 1, Part 5, Section 5.1 through Section 5.2.7 and the Specifications for Pipeline Occupancy of Norfolk Southern Property (NSCE-8). All pipeline crossings and parallel right-of-way encroachments shall be approved by the Company's Chief Engineer before installation may be permitted.

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For pipeline crossings concerning tracks owned and maintained by the Company, the Industry shall submit complete plans for the proposed crossings to the Company for approval and handling for preparation of an agreement to cover such crossing or encroachment. Pipeline crossings shall not be attached to or located closer than fifty (50) feet to a bridge, culvert, or other major railroad structure. Reinforced concrete pipe will not be allowed except as a carrier pipe when the pipeline is operated under gravity flow and a casing pipe is provided. The jack and bore method of installation is preferred for pipelines crossing under Company tracks.

For pipeline crossings concerning tracks owned and maintained by the Industry, but to be operated over by the Company, the Industry shall submit complete plans for the proposed crossing for approval.

All plans and computations associated with the work under the pipeline agreement shall be prepared by, and bear the seal of, a licensed Professional Engineer in the state where the work will take place.

Specifications (NSCE – 8) and application for the pipeline occupancy can be found at the following URL:

<http://www.nscorp.com/content/nscorp/en/real-estate/norfolk-southern-services/wire-pipeline-fiber-optic-projects.html>

If the Industry is working with the Company's Design and Construction Department in conjunction with a proposed track project, then the application should be completed and submitted directly to Design and Construction personnel assigned to the project for further handling.

No work shall be performed where crossing existing Company tracks until the Company has been notified of the proposed work schedule and a representative of the Company is available to be at the work site during the time the work is performed.

11.03 WIRE LINE

All overhead and underground cable and/or wire lines crossing Company tracks or encroaching on the Company's right-of-way shall have approved plans prior to the commencement of the work and shall comply with Specifications for Wire, Conduit and Cable Occupations of Norfolk Southern Property (NSCE-4).

Specifications (NSCE – 4) and application for the occupancy can be found at the following URL:

<http://www.nscorp.com/content/nscorp/en/real-estate/norfolk-southern-services/wire-pipeline-fiber-optic-projects.html>

If the industry is working with the Company's Design and Construction Department in conjunction with a proposed track project, then the application should be completed and submitted directly to Design and Construction personnel assigned to the project for further handling.

All overhead and underground cable and/or wire lines crossing tracks owned and maintained by the Industry but operated over by the Company shall have approved plans ***prior*** to commencement of work.

All plans and computations associated with the work under the wire line agreement shall be prepared by, and bear the seal of, a licensed Professional Engineer in the state where the work will take place.

No work shall be performed where crossing existing Company tracks until the Company has been notified of the proposed work schedule and a representative of the Company is available to be at the project site during the time the work is performed.

See attachment SP-1621 for clearance requirements for cable and wire crossings over railroads.

XII. BRIDGES, TRESTLES, BOX CULVERTS AND UNLOADING PITS

12.01 GENERAL

All proposed bridges, trestles, box culverts, unloading pits and structures over which the Company's equipment will operate shall be designed in accordance with American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering, Chapters 7 (Timber), 8 (Concrete), and 15 (Steel Structures), for E-80 Live Loading and appropriate Impact. Prior to the beginning construction, the proposed design shall be approved by the Company's Chief Engineer - Bridges and Structures. Sufficient time should be allowed for proper review and approval.

Drawings covering temporary sheeting and bulkheads to protect railway tracks during adjacent structure construction shall be approved by Chief Engineer - Bridges and Structures.

Clearances and drainage requirements will be furnished upon request to the Chief Engineer - Bridges and Structures.

All plans and calculations shall bear the seal of a current registered licensed professional engineer in the state of the project.

12.02 UNLOADING PITS

The following guidelines shall be used when designing all unloading pits.

There shall be no rail joints in the running rail over the pit. Welding or torch cutting of running rail shall not be permitted.

The top of the pit shall be equipped with a removable cover which will be kept in place when the pit is not in use and which shall be designed in accordance with AREMA Chapter 15, Section 8.5.3.2.

Minimum distance from centerline of any adjacent track to nearest edge of pit walls is to be 15 feet. Closer clearances require special approval and indemnity if permitted.

Minimum horizontal distance from centerline of pit track to adjacent obstructions above the top of the pit is to be 9 feet, see *NSRC Plan 7-1*.

Pit cover and top of pit are to extend a minimum of 10 feet from the centerline of pit track on open side of pit. Embankment side slopes should not be steeper than 2 to 1.

Applicant is to furnish the distance and direction from centerline of pit to nearest switchpoint and to the switchpoint at the mainline. Application, plans, and details of each pit are to be submitted to the Company and are to be approved before construction begins.

12.02.01 SINGLE SPAN UNLOADING PITS WITH A SPAN LENGTH OF 15 FEET OR LESS

Live Load: Cooper's E-80 with 28 percent impact.

Design specifications and workmanship shall be in accordance with current AREMA Specification, Chapters 7 (Timber), 8 (Concrete) and 15 (Steel Structures).

General pit details can be referenced from Figures 8-5, 8-6, and 8-7 in the AREMA Manual Chapter 15, Section 8. However, Norfolk Southern requires that the top of pit to extend a minimum of 10 feet from the centerline of the pit track, not the eight feet shown by AREMA in Figure 8-5.

12.02.02 SINGLE SPAN UNLOADING PITS WITH A SPAN LENGTH GREATER THAN 15 FEET OR MULTI-SPAN PITS

GENERAL

All portions of the unloading structure that are subjected to train or equipment loading shall be designed as a bridge in accordance with the AREMA Manual (current edition). All plan submittals for proposed unloading structures shall include design calculations stamped by a registered professional engineer certifying that the design is in accordance with AREMA requirements. If computer programs are utilized in the design, the submittal shall include a complete summary of the input data used and all design assumptions. Additional manual calculations may be required to document compliance with AREMA requirements. Thirty days should be allowed in scheduling for the Company's review of unloading structure plans and calculations.

STEEL SUPERSTRUCTURE

Span Type: All spans shall be designed as simple spans. The use of side plates, bolted to beam webs, will be permitted as a means to stabilize or maintain alignment between adjacent spans. All beam ends shall have bearing stiffeners and shall bear directly on pit walls, floorbeams or columns. Attachment of ends of floorbeams to vertical steel plates, embedded in pit wall, is prohibited.

Loadings: All steel super-structure shall be designed for Cooper's E-80 live loading and appropriate impact. All loads outlined in Section 1.3 of AREMA Chapter 15 must be considered in the design. A reduction in wind load (Section 1.3.7) may be considered where justified by local conditions. To the extent possible, hoppers and mechanical features of the unloading structure should be supported independent of the superstructure carrying train loading.

Fatigue: By AREMA definition, all rail support beams and floorbeams are fracture critical members and must be so designated on the plans. The steel superstructure shall be designed to include fatigue consideration for 2,000,000 cycles and allowable stresses reduced, based on the fabrication and connection details used. All material specifications, including notch toughness requirements, shall be shown on plans. All non-destructive testing requirements shall be shown on the plans. When requested to do so, the Industry or its designated representative shall furnish the Company with copies

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of material certifications and test results, as well as copies of results of testing required during fabrication.

Erection: The steel superstructure supporting train loading shall be shipped, handled and erected in such manner as to avoid injurious bends, nicks or gouges to the steel. Field welding may be used only for minor connections, not subject to train live load force, as outlined in Section 1.5.10 of AREMA Chapter 15.

CONCRETE SUBSTRUCTURE

All concrete portions of undertrack unloading structures that are subjected to train loading shall be designed in accordance with Chapter 8 of the AREMA Manual. Pit end walls shall be designed for the effects of vertical load from rail support beams and live load surcharge from train on ground track adjacent to the pit. Surcharge from adjacent parallel tracks, roadways and buildings shall be considered in the design of pit side walls. Calculation and application of train surcharge loadings shall be as outlined in AREMA Chapter 8.

Foundations: Submittal of unloading structure plans shall include a geotechnical report defining the characteristics of the soils at the site and their suitability for supporting the design loads. All foundations for unloading structures shall be designed in accordance with the requirements in AREMA Chapter 8.

Approach Walls: If approaches to the main pit span, or spans, are to be constructed of parallel reinforced concrete walls, with the rails attached directly to the top of the walls, the approach walls shall be designed in accord with AREMA Chapter 8, Concrete Structures and Foundations. The two parallel walls shall have a single footing supporting both walls. Where necessary to obtain safe bearing capacity, the approach walls shall extend to the same depth as the pit walls. The rails shall be attached to the walls using standard Pandrol plates and clips, unless other attachment is approved by the Chief Engineer - Bridges and Structures. Pandrol plates and clips shall be spaced at 2'-0" maximum.

12.03 RETAINING WALLS

All proposed retaining walls that will support both Company and Industry tracks and roadbeds shall be designed in accordance with AREMA Chapters 7 and 8. The design shall be approved by the Company's Chief Engineer - Bridges and Structures.

All plans and calculations shall bear the seal of a current registered licensed professional engineer in the state of the project.

XIII. SCALES

13.01 GENERAL

All proposed scales over which the Company's equipment will operate shall be designed in accordance with **Section XII**. Furthermore, if the scale will be used for certified weights/commercial purposes then the scale shall also be in compliance with:

- Association of American Railroads (ARR) Scale Handbook
- National Institute of Standards & Technology (NIST) Handbook – 44
- Any additional requirements mandated by local, state and federal agencies.

Proposed design plans shall be approved by Company prior to the beginning of any construction.

Plans shall include, at a minimum, the following:

- Site plan showing scale and instrument building location with track elevations and distances to point of curvature.
- Geotechnical report that includes pertinent recommendations of compliance with Section 2.22.19 Bearing Pressures Under Foundations of the AAR Scale Handbook.
- Complete structural detail with design calculations.
- Plans shall be stamped by a current registered licensed professional engineer.
- The Industry name and location.
- National Type Evaluation Program (NTEP) Certificates of Conformance (COC) for Load Cells, Instrumentation and Weight Bridge.

XIV. HAZARDOUS COMMODITIES

14.01 GENERAL

Rules and regulations governing the location of new loading, unloading and storage facilities for flammable liquids, combustible liquids, pyrophoric liquids, compressed gases and other hazardous commodities on System Lines will be considered on an individual basis upon application by Industry to the Company.

14.02 APPLICATION PROCEDURE

Applications for location or relocation of facilities for loading, unloading or storage of flammable liquids, combustible liquids, pyrophoric liquids, compressed gases or other hazardous commodities, shall be submitted to the Company.

To expedite handling of such applications, it is essential that all available facts be contained in the application and accompanied by a detailed print. Bear in mind these regulations are the minimum. Safety is foremost. Each application shall be considered on its merits and factors, such as exposures to high valued property and density of traffic adjacent to unloading and storage points.

**See Association of American
Railroads Circular NO. OT-55,
latest revision,
Recommended Railroad
Operating Practices for
Transportation of Hazardous
Materials**

In no case will hazardous materials or contaminants be allowed to drain onto Company property or be carried in Company drainage systems. The Industry shall be responsible for researching and complying with all federal, state, and local regulations concerning the safe handling and accidental release containment for the particular material being handled. The Industry shall submit the final state approved spill containment plan to the Company for review and approval.

14.03 STORAGE OF HAZARDOUS MATERIALS

Table 14.03.1 Separation Distance for New Facilities
Loaded Tank Cars and Storage Tanks from Mainline Class 2 Track or Higher

ACTIVITY	PIH (ZONE A, B, C OR D), CLASS 3, DIVISION 2.1, DIVISION 2.2 AND ALL OTHER HAZARD CLASSES	COMBUSTABLE LIQUIDS, CLASS 8, AND CLASS 9
LOADING AND UNLOADING	100 FEET	50 FEET
LOADED TANK CAR STORAGE	50 FEET	25 FEET
STORAGE IN TANKS	100 FEET	50 FEET

NOTE: Above distances are centerline of rail to centerline of rail and/or closest part of structure.

Definitions:

- ORM- Oxidized and Radioactive Material
- PIH- Poisonous Inhalation Hazard

With regard to existing facilities, maximum reasonable effort shall be made to conform to this standard taking into consideration cost, physical and legal constraints.

The requirements apply to storage on Company property and on Industry property located close to railroad mainline.

14.04 PROTECTION FROM STRAY ELECTRIC CURRENTS

Industry spurs used for loading or unloading of oil, gas, or other flammable or explosive commodities shall be protected from stray electric currents. See *SP-701*, attached to these guidelines, for proper placement of insulated joints, jumpers, grounding, and cross-bonds, etc.

14.05 DOUBLE SWITCH POINT DERAIL

A double switch point derail (*See Section 6.08*) shall be installed at the clear point on *any* track that handles hazardous materials (*NSRC MW&S Standard Procedure 100*).

14.06 SPILL CONTAINMENT SYSTEM



Spill containment devices and systems shall be shown on the design plans and include plan views with proper stationing, typical sections, details and catalog cuts as needed.

XV. ATTACHMENTS

Document:	Agreement and Sidetrack Design Plan Check Lists
PLAN NO. 1-3	Spikes
PLAN NO. 1-3A	Rectangular Head Timber Screw Spike
PLAN NO. 1-21	Roadbed Section for Heavy Tonnage Tracks Other Than Main Tracks
PLAN NO. 1-22	Roadbed Section for Industrial Tracks
PLAN NO. 1-22A	Turnout Pad for No. 10 Industry Turnouts
PLAN NO. 1-23	Roadbed Section for New Siding Parallel to Single Main Line
PLAN NO. 2-4	No. 8 Turnout
PLAN NO. 2-6	No. 10 Turnout (SMSG Frog)
PLAN NO. 2-8	No. 10 Turnout (Spring Frog)
PLAN NO. 2-17	Data on Turnouts and Crossovers
PLAN NO. 3-36	Bow Handle for New Century 51-A & 51-B Switch Stands
PLAN NO. 6-14	Close Clearance Sign
PLAN NO. 7-1	Clearance Diagram
PLAN NO. 7-3A	Industrial Track Spiking Pattern
PLAN NO. 7-4	Rail Anchoring Pattern
PLAN NO. 7-5	Highway Grade Crossing Asphalt Paving
PLAN NO. 7-5A	Highway Grade Crossing Treated Lumber
PLAN NO. 7-5B	Highway Grade Crossing Asphalt Paving w/Rubber Flange Way
PLAN NO. 7-6	Precast Concrete Crossing Shunt Resistant Steel Clad (1 of 2)
PLAN NO. 7-6A	Curved Concrete Panels (2 of 2)
PLAN NO. 7-9	Switch Point Derail
PLAN NO. SP-701	Oil Siding Protection from Stray Electric Current
PLAN NO. SP-1621	Clearance Requirements for Cable and Wire Crossings
NS QA Specs	QA Specifications for Ties and Timbers, Sec. 2, Wooden Industrial Grade Crossties (Rev. 05/01/17)
Detail:	Curve Reduction Table
Detail:	Earth Mound
Detail:	Placement of Industry Turnouts
Detail:	Turnout Design Schematic
Detail:	Sample Agreement Plan
Detail:	Sample Sidetrack Design Plan
Detail:	DR – HDPE – 01
Detail:	DR – HDPE – 02
Detail:	Corrugated Metal Culvert Gage Selection and Installation
Detail:	Installation Instructions Corrugated Metal Pipe Culverts
Detail:	Non – Shunting Track Survey Bar
Detail:	Shoring Design Guide – Shoring Requirements
Detail:	Shoring Design Guide – Lateral Pressures from Train Loads



INDUSTRY SUBMITTED AGREEMENT PLAN PLAN PRESENTATION CHECKLIST

Sheet 1 of 1

				N/A
PLAN VIEW				
7.01	Preferred plan scale is 1" = 100'. Smaller projects may use 1"=50', larger projects may use 1"=200' or other as approved to be able to fit all track on one sheet.			
7.02 & 7.03	3" x 5" space in lower right hand corner for NS Title block. All drawings will have an NS Title block.			
7.02	Add A to drawing number (AD-2016-58A) for agreement plan.			
7.04	City, County and State and Location Map if required.			
7.04	TO Nearest Major Rail Station with arrow in each direction along mainline.			
7.04	Industry & Consultant Company names and contact information, including phone and e-mail.			
7.04	North Arrow.			
7.04	Legend with all line styles and symbols.			
7.01 & 7.04	Centerlines of existing track(s) with labels showing ownership as well as stationing and labels at event points (PS, Derail, Div. O&M, 15' Clear Point, End of Track, Loading/Unloading Structure, Grade Crossing, Gate, Loading Dock, Rail Door, and both Horizontal and Vertical Close Clearances).			
7.01 & 7.04	Centerlines of proposed track(s) with labels showing ownership as well as stationing and labels at event points (PS, Derail, Div. O&M, 15' Clear Point, End of Track, Loading/Unloading Structure, Grade Crossing, Gate, Loading Dock, Rail Door, and both Horizontal and Vertical Close Clearances).			
7.01 & 7.04	Centerlines of track(s) to be removed.			
7.04	Latitude/Longitude for only the Division of O&M, Begin Track Lease and End of Track Lease.			
7.01 & 7.04	Sidetrack Agreement Table per sample Agreement Plan.			
7.04	Extent of track lease with stationing <u>and</u> a Track Lease Table showing information per sample Agreement Plan.			
7.04	Label NS Right-of-Way and dimension from center of main track.			
7.04	Land lease area <u>and</u> a Land Lease Table showing acreage per sample Agreement Plan.			
7.04 & 7.05	Horizontal and vertical close clearances to structures and overhead utilities.			
DRAFTING				
7.01	Thick Dashed Red Line for ALL Proposed Railroad Owned Tracks.			
7.01	Thick Dashed Orange Line for ALL Proposed Industry Owned Tracks.			
7.01	Thin Solid Black Line for ALL Existing Railroad Owned Tracks.			
7.01	Thin Solid Cyan Line for ALL Existing Industry Owned Tracks.			
7.01	Dotted Green Line for ALL Tracks to be Removed.			



INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN - ENGINEERING CHECKLIST

Sheet 1 of 4

				N/A
HORIZONTAL ALIGNMENT				
6.02	Curves Defined by Chord Definition			
6.02	Maximum degree of curvature 12 degrees (10 degrees for tracks serving cars with total length of 73' or more)			
6.02	100' between PT and PC of reverse curves (70' minimum with NS approval)			
6.05	30' or half car length, whichever is greater, between the end of loading/unloading area and the beginning of an end of track device.			
6.06	Minimum 15' Track Centers between NS and Industry Tracks			
6.06	Minimum 14' Track Centers between industry owned Tracks			
VERTICAL ALIGNMENT				
6.03	Vertical Curve at all breaks of grade in profile of track			
6.03	Vertical Curve calculations based on "r"			
6.03	For Lead Tracks maximum r = 1.0 for summits and sags			
6.03	For Spur Tracks over 1,500' in length maximum r = 2.5 for summits and maximum r = 2.0 for sags			
6.03	For Spur Tracks less than 1,500' in length maximum r = 3.0 for summits and maximum r = 2.5 for sags			
6.04	Lead tracks grade maximum 2.0% compensated			
6.04	Spur Track grade maximum 3.0% compensated			
6.05	Loading and Unloading Area for Railcars to have 0.00% grade			
6.05	30' or half car length, whichever is greater, between end of vertical curve and loading/unloading area			
TURNOUTS				
6.07	Proposed Turnout(s) in Tangent Track Only			
Detail	Proposed Turnout(s) located in accordance with Placement of Industry Turnouts in attached details			
6.07	Entire length of turnout located outside of vertical curves			
6.07	Turnout located at least 100' from road at grade crossing			
6.07	Turnout located at least 100' from back wall of railroad bridge			
6.07	Turnout not located underneath a bridge			
Detail	Turnout Return Curve per PLAN 2-17			
Detail	Turnout Layout in Yard and Ladder Tracks per PLAN 2-17			
DERAILS				
6.08	Derail placed at 15' Clear Point			
6.08	Double Switch Point Derail used when Industry Track descends towards NS Track or Placarded Hazardous Materials are handled.			
6.08	DSPD not located in horizontal or vertical curve			



INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN - ENGINEERING CHECKLIST

Sheet 2 of 4

				N/A
CLEARANCES				
6.10	Clearances of all structures to all proposed and existing tracks is in accordance with Plan 7-1			
6.12	Clearances to edge of roads			
6.12	Clearances from end of rail car to grade crossings			
6.1 & 11.03	Clearances between overhead and electric wires in accordance with SP-1621 & NSCE-4			
14.03	Side Clearances for storage of rail cars and storage tanks of Hazardous Materials			
GRADE CROSSINGS				
6.12 & 11.01	Grade crossing surface and flageways meet NS specs			
6.12 & 11.01	Grade crossing has proper warning devices			
CULVERTS				
8.05	Culvert constructed of approved material			
8.05	Proper Cover from T/R to top of culvert per NSCE-8 and Standard Detail			
OVERHEAD AND UNDERGROUND UTILITIES				
11.02-11.03	All overhead and underground utilities which cross track or are adjacent to track to meet NSCE-4 & NSCE-8 with plans stamped by PE			
LOADING/UNLOADING STRUCTURES, BRIDGES & RETAINING WALLS				
12.01-12.03	Detailed construction plans stamped by PE for review by NS Bridge Department			

INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN PLAN PRESENTATION CHECKLIST



Sheet 3 of 4

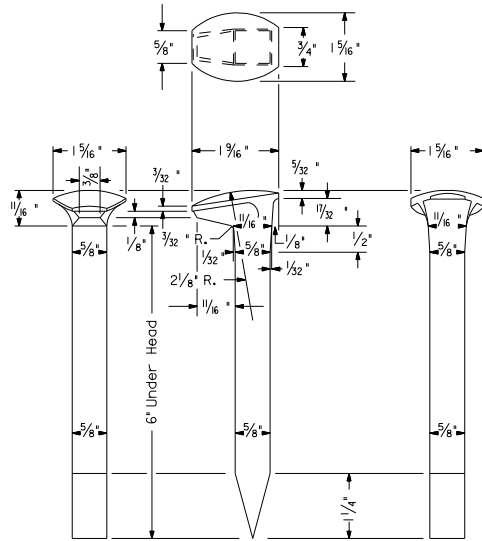
				N/A
ALL DRAWING SHEETS				
7.01	Preferred plan scale is 1" = 100'. Smaller projects may use 1"=50', larger projects may use 1"=200'. NO OTHER SCALES ARE ACCEPTABLE.			
7.02 & 7.03	3" x 5" space in lower right hand corner for NS Title block. All drawings will have an NS Title block			
7.04	City, County and State and Location Map if required.			
7.04	TO Nearest Major Rail Station with arrow in each direction along mainline.			
7.04	Industry & Consultant Company names and contact information, including phone and e-mail.			
7.04	North Arrow			
7.04	Legend with all line styles and symbols			
PLAN VIEW				
7.04	Centerlines of existing track(s) with labels showing ownership as well as stationing and labels at event points (PS, PC, PT, DSPD, Clear Point, Div. O&M etc...) for length of project			
7.04	Centerlines of Proposed track(s) with labels showing ownership as well as stationing and labels at event points (PS, PC, PT, DSPD, Clear Point, Div. O&M, Car Spot End Points, Car Lengths, etc...)			
7.04	Stationing should be provided for every existing or proposed feature along a given track: PS, PI, Derail, Clear Point, Div. O&M, PC, PT, Rail Door, Loading or Unloading Structure, Grade Crossing, gate, Safety Buffers, Car Spots, Culverts, Utilities, End of Track Device, etc...			
7.04	Note for centerline of proposed track(s) with the clear length and railcar capacity plus safety buffer			
7.04	State Plane Coordinates and Latitude/Longitude for all proposed Point of Switches in NS track as well as distance to nearest mainline milepost.			
7.04	Horizontal Curve Data for each proposed horizontal curve including: Δ, Degree of Curvature, Chord Length, and Radius. All Curve Data shall be based on the Chord Definition.			
7.04	Existing and proposed utilities which shall be shown on plan view, profile and cross sections. Clearances should be shown between the utility and centerline of track or top/rail as appropriate. Horizontal clearance shall be based on centerline of track. Vertical clearance shall be based on Top of Rail elevation.			
7.04	Existing and proposed structures shall be shown and side (within 20') and overhead clearances labeled. If necessary include a dimensioned section view. Horizontal clearance shall be based on centerline of track. Vertical clearance shall be based on Top of Rail elevation.			

INDUSTRY SUBMITTED SIDETRACK DESIGN PLAN

PLAN PRESENTATION CHECKLIST

Sheet 4 of 4

				N/A
PLAN VIEW				
7.04	Label NS Right-of-Way and dimension from center of main track. Show adjacent property lines and easements with bearings.			
7.04	Location, size, type and orientation of all existing and proposed culverts and pipes.			
7.04	Table with Horizontal and Vertical Control Data, include control points with descriptions in plan view			
7.04	Table containing proposed track usage, number of cars, commodity (identify if TIH/Hazmat), car type and length, loading/unloading method, switching plan and/or operational narrative.			
PROFILE				
7.05	Profile scale shall be 1"=10' vertical, 1"=100 horizontal. (1=5v,1=50h and 1=20v,1=200h shall be acceptable when the plan view has the corresponding scale)			
7.05	Profile Stationing should begin at -1+00 to show grade leading to proposed PS			
7.05	Profile should include existing track, proposed track, existing ground, proposed subgrade, overhead wires, underground utilities, derails, culverts, pipes, grade crossings,safety buffer, end of track device, loading/unloading structures, etc... All features should be properly stationed and labeled.			
7.05	For all tracks the grades shall be labeled as well as vertical curves with PVC, PVT, PVI, vertical curve length, and r value.			
7.05	Dimensions shall be given between top of rail and top of culverts, pipes, and other underground structures.			
7.05	Dimensions shall be given between top of rail and all overhead structures, wires, pipes, etc...			
7.05	Loading/Unloading Area shall be labeled and stationed with car capacity and track grade shown.			
DETAILS				
7.06	Show Typical Track Roadbed Section			
7.06	Show Turnout Pad Plan 1-22A			
7.06	Show unloading/loading section and details			
7.06	Show NS Standard Clearance Plan 7-1			
7.06	Show End of Track Device detail			
7.06	Show grade crossing section and detail			
DRAFTING				
7.01	Thick Dashed Red Line for ALL Proposed Railroad Owned Tracks.			
7.01	Thick Dashed Orange Line for ALL Proposed Industry Owned Tracks.			
7.01	Thin Solid Black Line for ALL Existing Railroad Owned Tracks.			
7.01	Thin Solid Cyan Line for ALL Existing Industry Owned Tracks.			
7.01	Dotted Green Line for ALL Tracks to be Removed.			
7.06	Applicable Standard Notes included on plan			



5/8" X 6" CUT TRACK SPIKE
AREMA STANDARD
640-903705

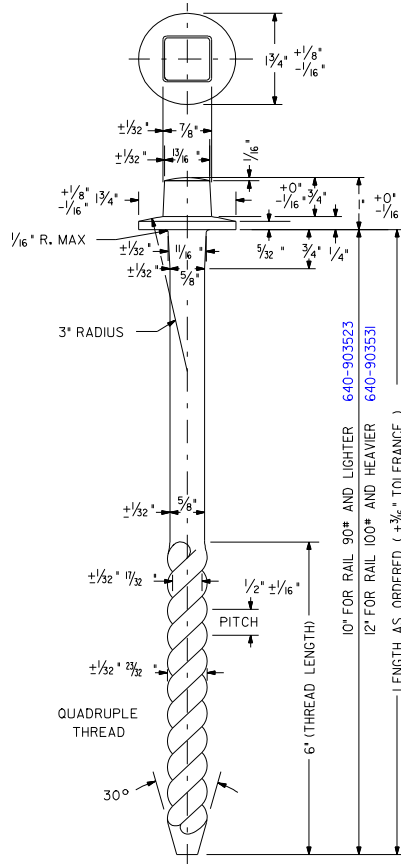
Material and workmanship to be in accordance with current AREMA manual requirements for soft steel track spikes.

Permissible shank straightness variation measured in either plane, shall not exceed 0.0313".

Manufacturer's I.D. shall be pressed on the head of each spike while being formed.

Weight = approximately 0.83-lbs each

24 Spikes per 200-lb keg



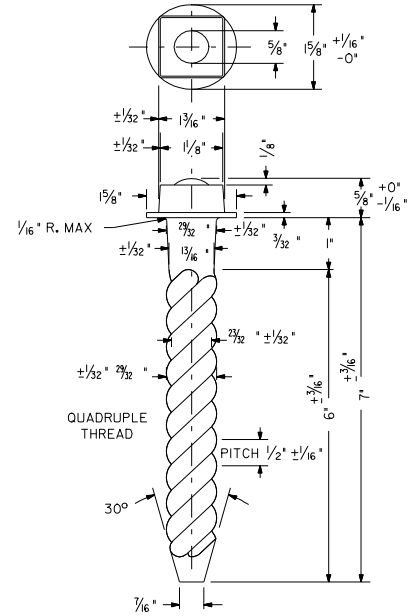
5/8" GALVANIZED DRIVE SCREW SPIKE
AREMA STANDARD
PLAN 2M-63

For fastening crossing timbers.

Drill 1/2" pilot hole in cross-ties.

10" Length for use in rail 90RA and lighter.
125 Spikes per 200-lb keg

12" Length for use in rail 100RE and heavier.
100 Spikes per 200-lb keg



7/8" X 7" GALVANIZED DRIVE SCREW SPIKE
AREMA STANDARD
640-903565

For use where specified in turnouts.

Drill 1/2" pilot hole.

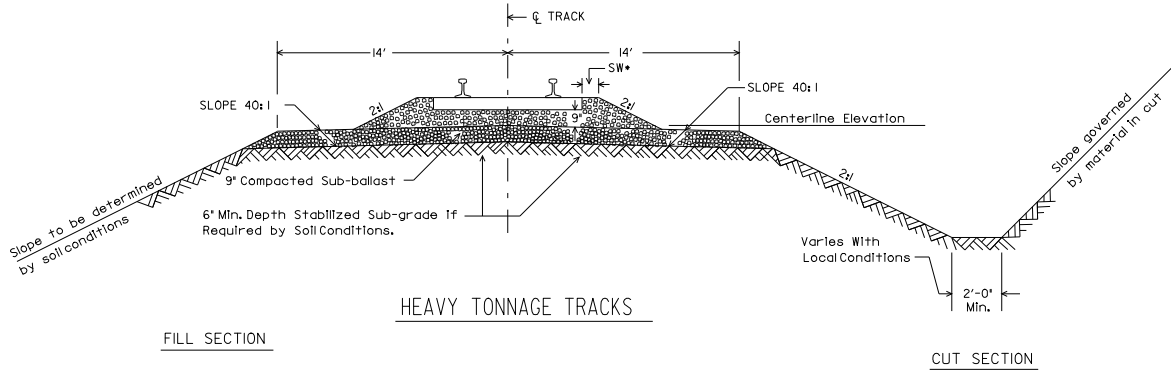
150 Spikes per 200-lb keg

NORFOLK SOUTHERN RAILWAY COMPANY

SPIKES

APRIL 1991
Atlanta, Georgia

REVISION	
DATE	
12-5-05	TRACK SPIKE SPECIFICATIONS



SHOULDER WIDTH (SW) *

BALLAST WIDTH FROM END OF TIE TO EDGE OF SLOPE

	<u>Jointed Rail</u>	<u>Welded Rail</u>
SW (Inside of Curve)	0"	6"
SW (Outside of Curve)	6"	12"
SW (Tangent both sides)	0"	6"

- (1) Sub-grade may be stabilized with lime, lime-fly ash, cement or stone.
- (2) Tamping of ballast must not disturb compacted sub-ballast.
- (3) Top of sub-grade is to be crowned.

NORFOLK SOUTHERN RAILWAY COMPANY

ROADBED SECTION

FOR HEAVY TONNAGE TRACKS
OTHER THAN MAIN TRACKS

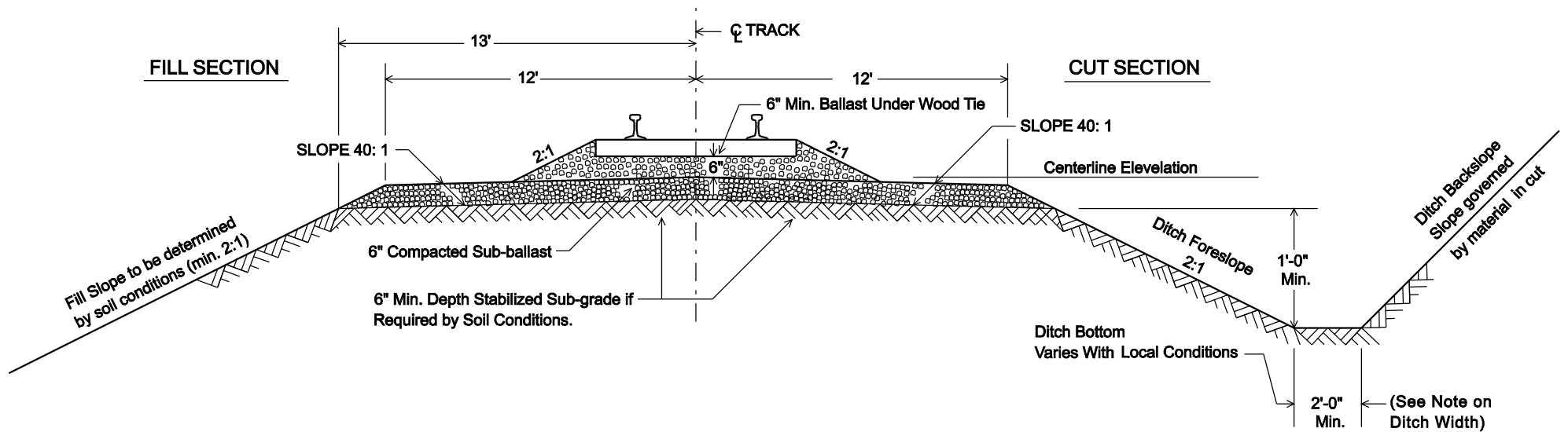
JANUARY 1989

Atlanta, Georgia

REVISION	
DATE	

INDUSTRIAL TRACKS

PLAN NOT TO SCALE



GENERAL NOTES

- (1) Sub-grade may be stabilized with lime, lime-fly ash, cement or stone.
- (2) Tamping of ballast must not disturb compacted sub-ballast.
- (3) Top of sub-grade is to be crowned.

DITCH WIDTH NOTES

- (1) On NORFOLK SOUTHERN right-of-way, minimum ditch width should be calculated to carry volume of water for a 100 year storm event, or be at a minimum 5' wide, whichever is greater.
- (2) Where ditch back slopes on NORFOLK SOUTHERN right-of-way are in cut sections greater than 25' in height, ditch width should be increased to a minimum of 10' wide.

NOTE:

Roadbed Sections Proposed Near Structures And/Or In Pavement Locations Will Need To Be Designed And Submitted For Review And Approval.

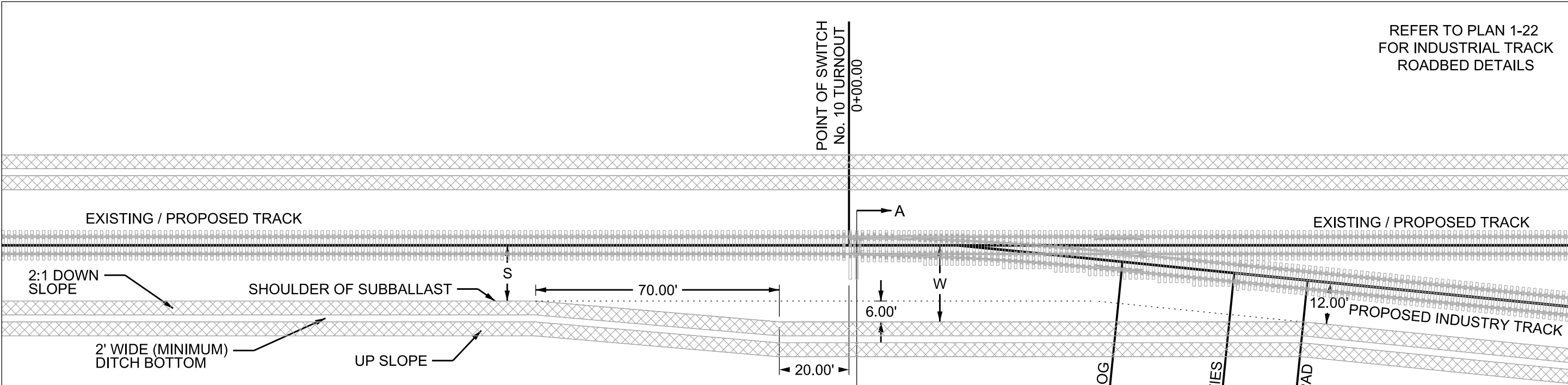
DATE	REVISION
11/06	ADDED CUT SECTION NOTES
03/10	ADD NOTE & 1' TO DITCH BOTTOM

NORFOLK SOUTHERN RAILWAY COMPANY

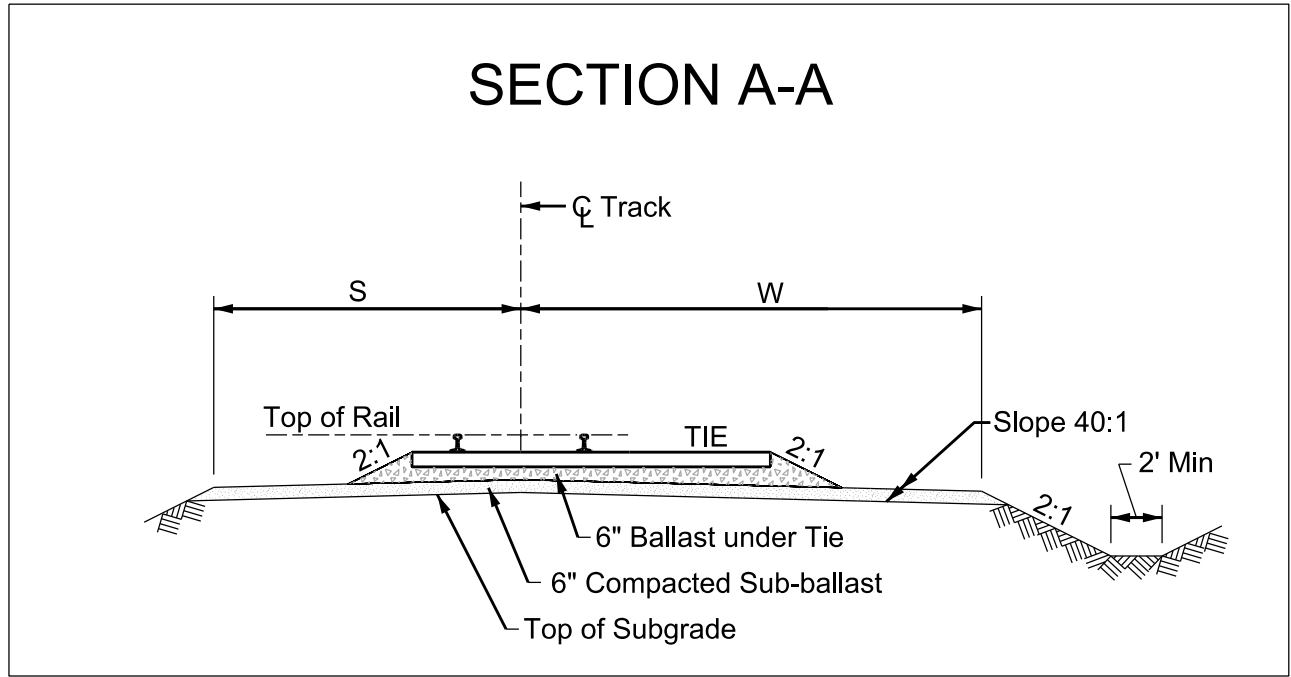
ROADBED SECTION FOR INDUSTRIAL TRACKS

JANUARY 1989
Atlanta, Georgia

REFER TO PLAN 1-22
FOR INDUSTRIAL TRACK
ROADBED DETAILS



SECTION A-A



	SUBBALLAST WIDTH FROM C/L	WALKWAY WIDTH FROM C/L	APPROXIMATE END STATION OF TURNOUT PAD
	S	W	
MAIN TRACK	14 FT	20 FT	1+12
LEAD TRACK	14 FT	20 FT	1+12
INDUSTRY TRACK	12 FT	18 FT	0+92

NORFOLK SOUTHERN RAILWAY COMPANY

TURNOUT PAD

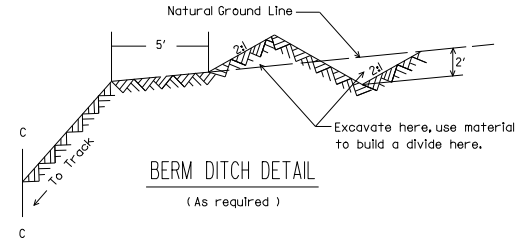
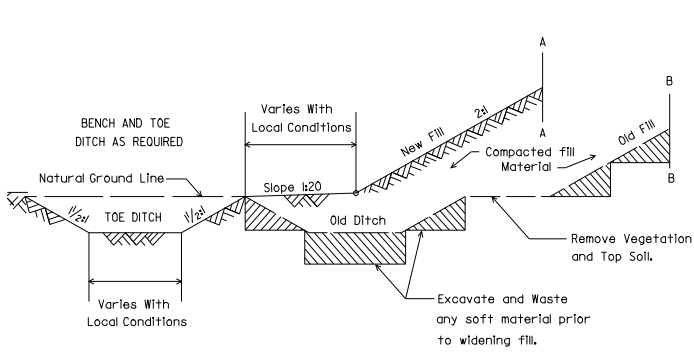
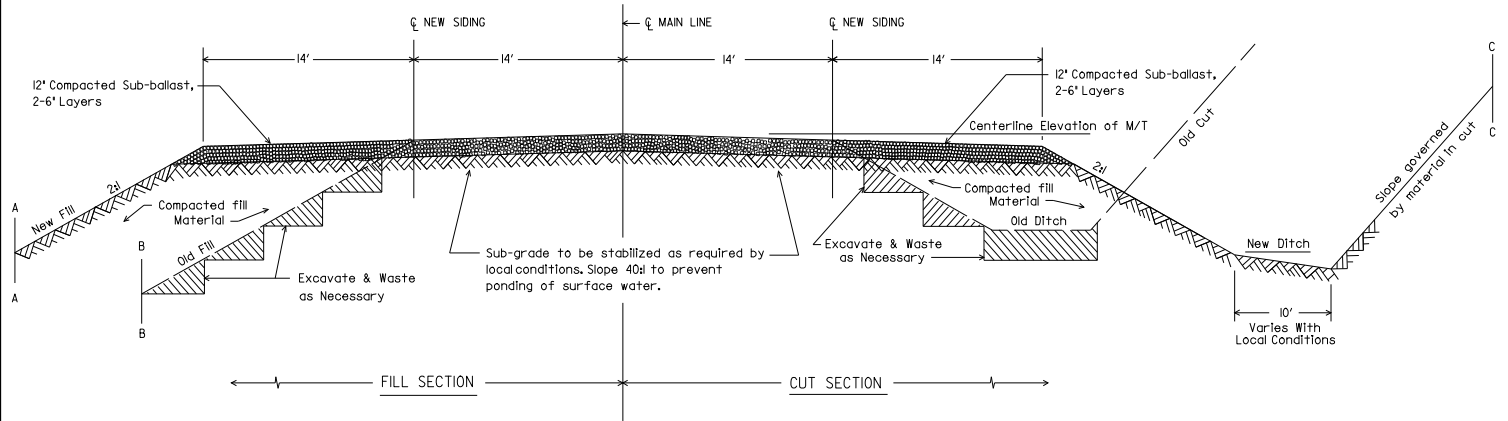
FOR No. 10 INDUSTRY TURNOUTS

MAY 2010

ATLANTA, GA

REVISION	REVISED DISTANCES / ADDED PROP. TRACK
DATE	5/7/15

REFER TO PLAN 1-22
FOR TRACK DETAILS



METHOD OF WIDENING TOE OF FILL

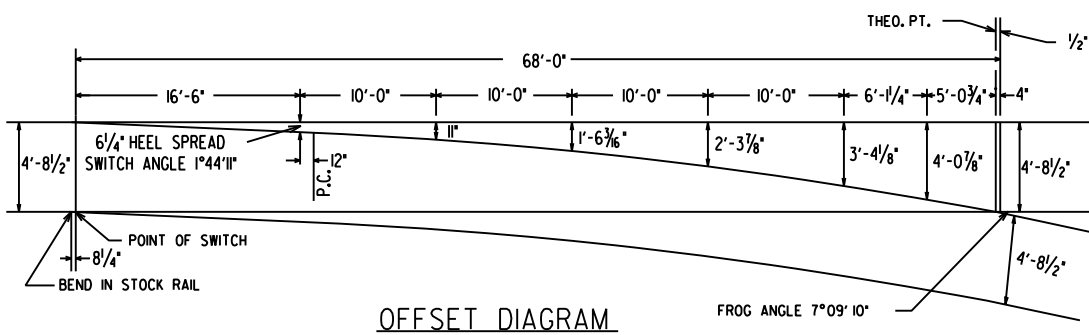
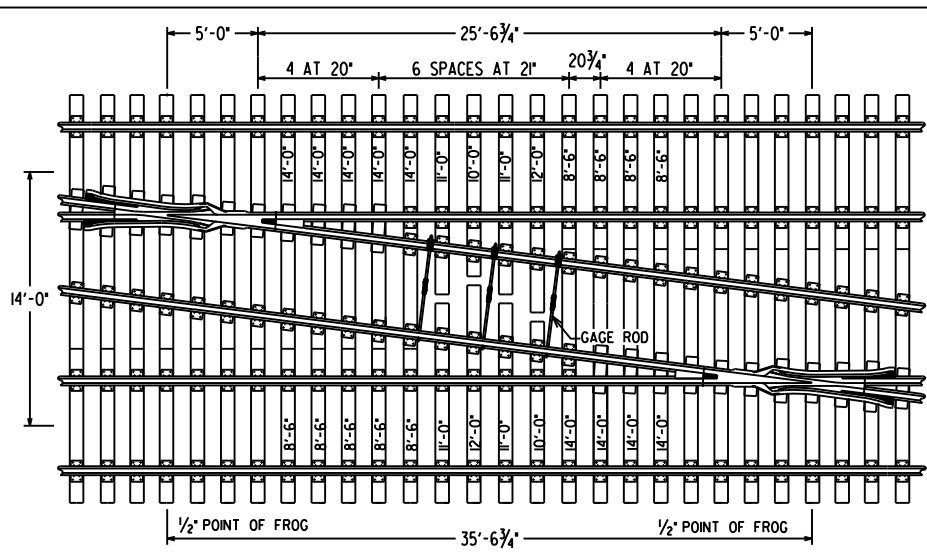
NORFOLK SOUTHERN RAILWAY COMPANY

ROADBED SECTION

NEW SIDING PARALLEL TO
EXISTING SINGLE MAIN LINE
JANUARY 1989

Atlanta, Georgia

REVISION	
DATE	

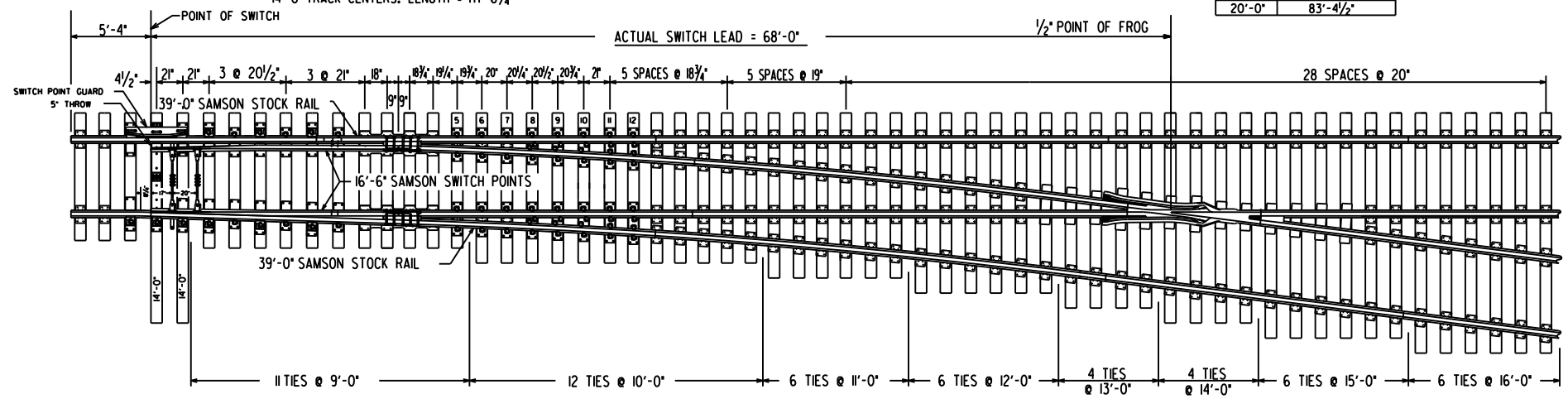


BILL OF SWITCH TIES-7' X 9' TURNOUT	
NO. OF PCS.	LENGTH
11	9'-0"
12	10'-0"
6	11'-0"
6	12'-0"
4	13'-0"
6	14'-0"
6	15'-0"
6	16'-0"
TOTAL NO. PCS.	57
TOTAL LIN. FT.	679
TOTAL F.B.M.	3,564.75

CROSSOVER DATA FOR TANGENT TRACK	
TRACK CENTERS	DISTANCE BETWEEN 1/2" POINTS
13'-0"	27'-7 1/8"
14'-0"	35'-6 3/4"
15'-0"	43'-6 3/8"
16'-0"	51'-6"
17'-0"	59'-5 5/8"
18'-0"	67'-5 1/4"
19'-0"	75'-4 1/8"
20'-0"	83'-4 1/2"

NOTE : FOR EACH 1" OVER OR UNDER 14'-0" TRACK CENTERS ADD OR SUBTRACT 8" TO DISTANCE BETWEEN 1/2" POINT OF FROGS IN CROSSOVER.

CROSSOVER
 14'-0" TRACK CENTERS: LENGTH = 171'-6 3/4"

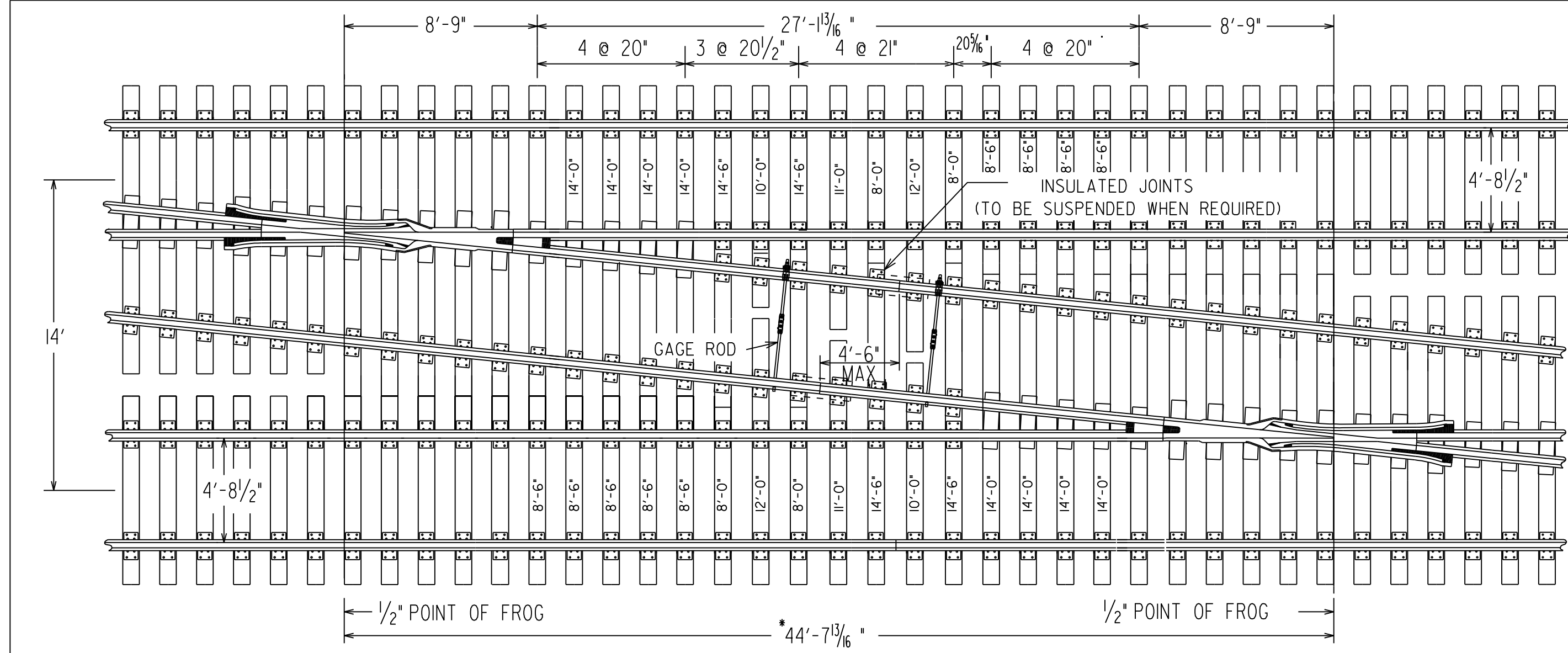


NO. 8 TURNOUT

- SEE PLAN
- 1-4 BOLTS USED IN TRACKWORK
 - 3-6 16'-6" SWITCH
 - 3-15 SWITCH HEEL BLOCK
 - 3-16 SWITCH HEEL BASE PLATE
 - 3-19 SWITCH LUGS (CLIPS)
 - 3-20 SWITCH RODS
 - 3-21 SWITCH PLATES
 - 3-22 ADJUSTABLE PLATES & BRACES
 - 3-22 1" GAUGE PLATES
 - 3-34 & 3-35 SWITCH STANDS
 - 4-10 S.M.S.G. FROGS
 - 4-11 FROG PLATES FOR SMSG FROGS

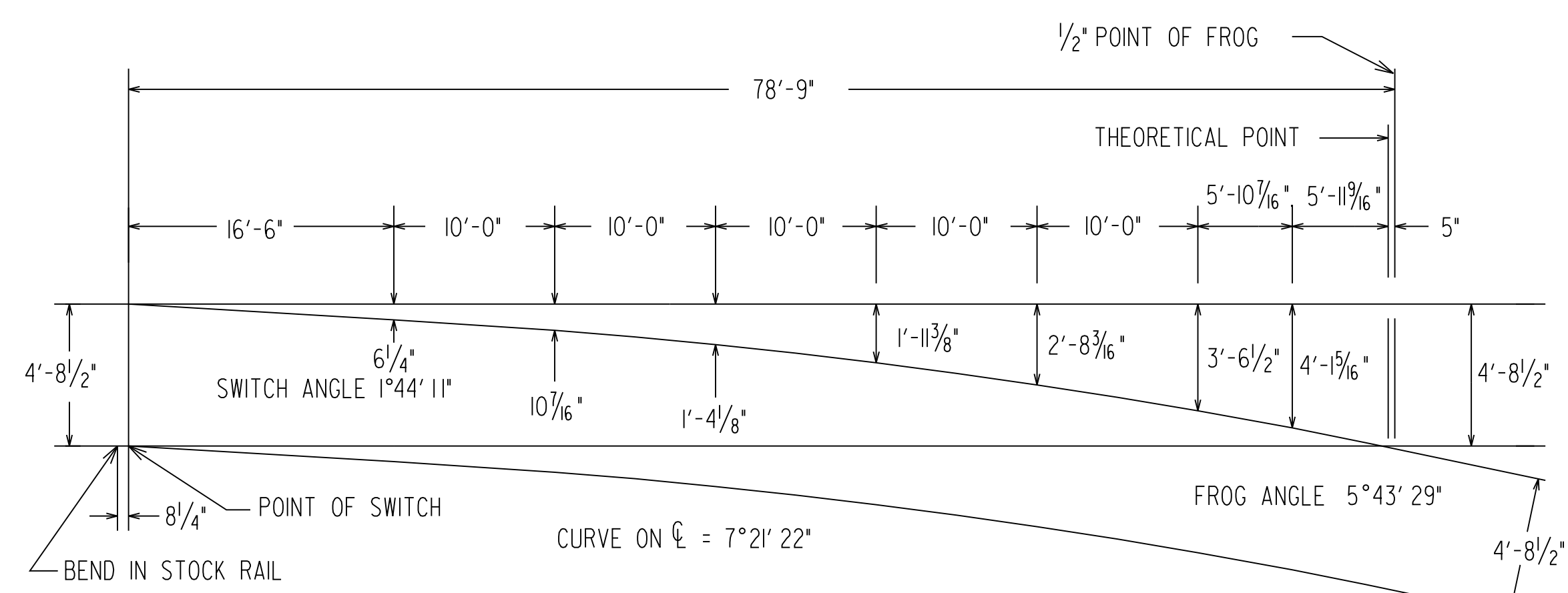
NORFOLK SOUTHERN RAILWAY COMPANY
NO. 8 132/136R TURNOUT
 WITH 16'-6" SWITCH, S.M.S.G.
 FROG AND SWITCH POINT GUARD
 SEPTEMBER 1996
 Atlanta, Georgia

DATE	REVISION
7-24-07	REVISE PLAN REFERENCES
3-16-10	REVISE CROSSOVER LENGTH



• FOR EACH 1" OVER OR UNDER 14'-0" TRACK CENTERS ADD OR SUBTRACT 9 3/32" * TO DISTANCE BETWEEN 1/2" POINT OF FROGS IN CROSSOVER.

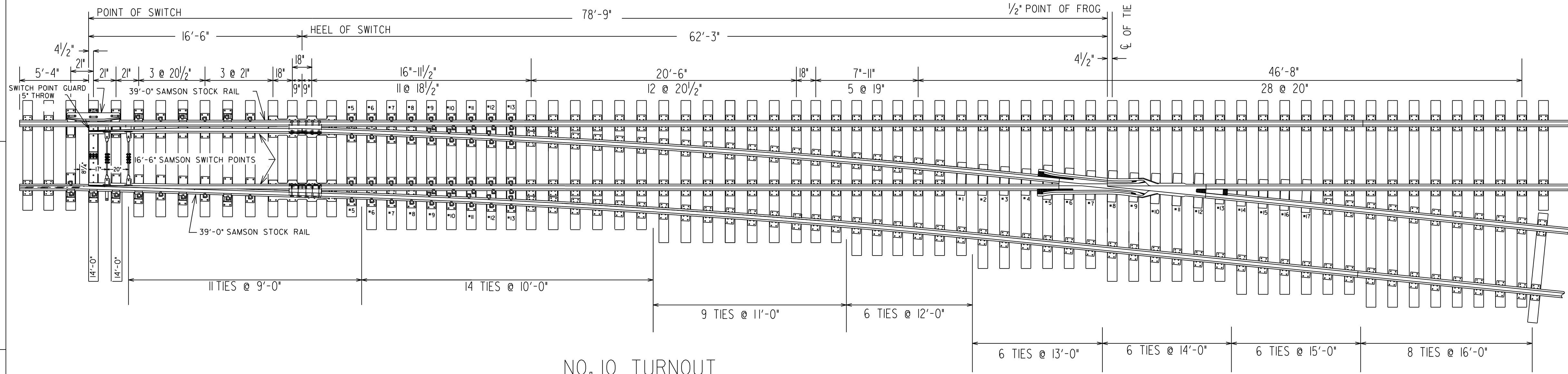
CROSSOVER



OFFSET DIAGRAM

BILL OF SWITCH TIES-7" X 9" TURNOUT	
NO. OF PCS.	LENGTH
11	9'-0"
14	10'-0"
9	11'-0"
6	12'-0"
6	13'-0"
8	14'-0"
6	15'-0"
8	16'-0"
TOTAL NO. PCS.	68
TOTAL LIN. FT.	818
TOTAL F.B.M.	4,294.5

CROSSOVER DATA FOR TANGENT TRACK	
TRACK CENTERS	DISTANCE BETWEEN 1/2" POINTS
13'-0"	34'-8 1/8"
14'-0"	44'-7 1/16"
15'-0"	54'-7 1/2"
16'-0"	64'-7 1/8"
17'-0"	74'-6 1/8"
18'-0"	84'-6 1/16"
19'-0"	94'-6 1/4"
20'-0"	104'-5 3/8"

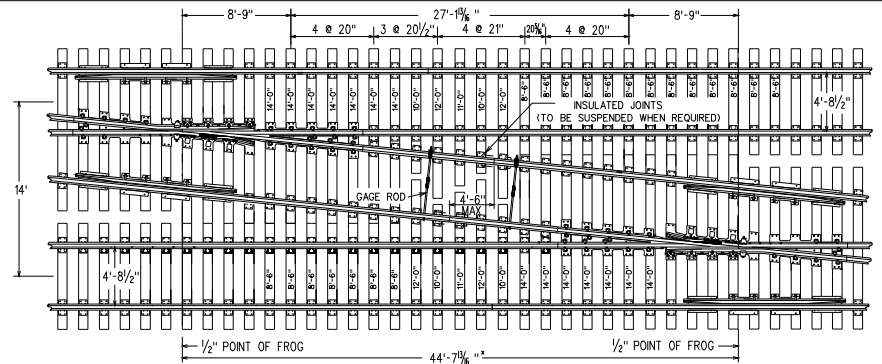


NO. 10 TURNOUT

SEE PLAN 1-4 FOR BOLTS USED IN TRACK CONSTRUCTION
 PLAN 3-19 FOR SWITCH LUGS (CLIPS)
 PLAN 3-20 FOR SWITCH RODS
 PLAN 3-21 FOR SWITCH PLATE DETAILS
 PLAN 3-22 FOR ADJUSTABLE BRACE PLATE DETAILS
 PLAN 3-32 TO 3-35 FOR SWITCH STANDS
 PLAN 3-7 FOR 16'-6" WELDED SWITCH
 PLAN 4-10 FOR SOLID MANGANESE SELF GUARDED FROG
 PLAN 4-11 FOR FROG PLATE DETAILS

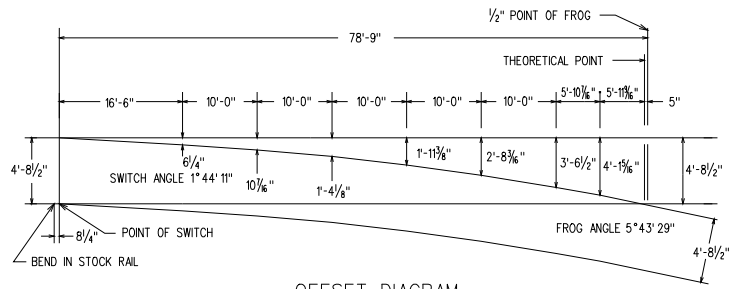
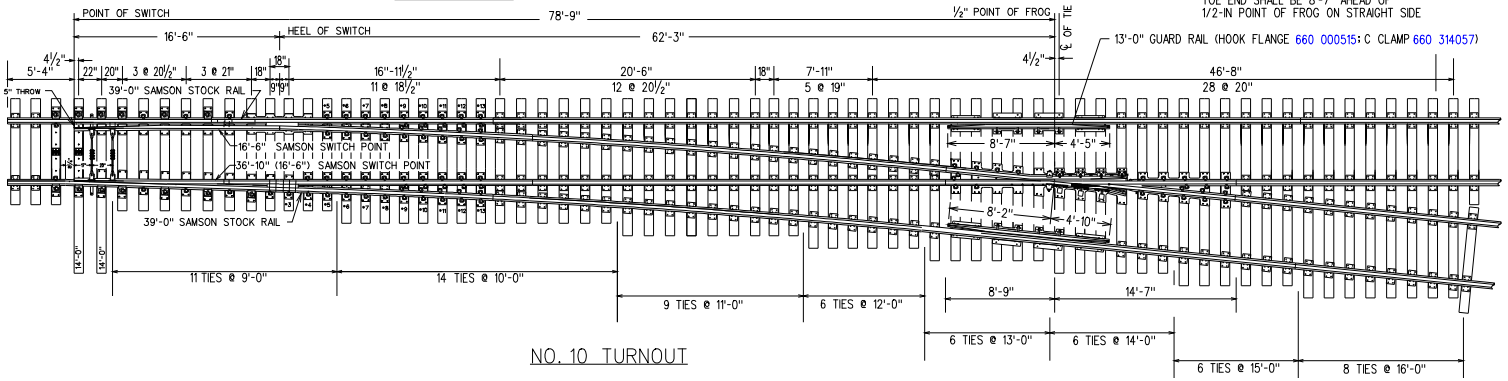
NORFOLK SOUTHERN RAILWAY COMPANY
NO. 10 132/136RE TURNOUT
 WITH 16'-6" SWITCH AND
 SOLID MANGANESE SELF GUARDED FROG
 FOR YARDS
 SEPTEMBER 1996
 Atlanta, Georgia

DATE	REVISION
6-8-99	CHANGE TIMBER LENGTH IN CROSSOVER



* FOR EACH 1" OVER OR UNDER 14'-0" TRACK CENTERS ADD OR SUBTRACT 9 3/8" TO DISTANCE BETWEEN 1/2" POINT OF FROGS IN CROSSOVER.

CROSSOVER



OFFSET DIAGRAM

NOTE: IF 16'-6" GUARD RAIL IS REQUIRED
(HOOK FLANGE 660 697544; C CLAMP 660 585324)
TOE END SHALL BE 8'-7" AHEAD OF
1/2-IN POINT OF FROG ON STRAIGHT SIDE

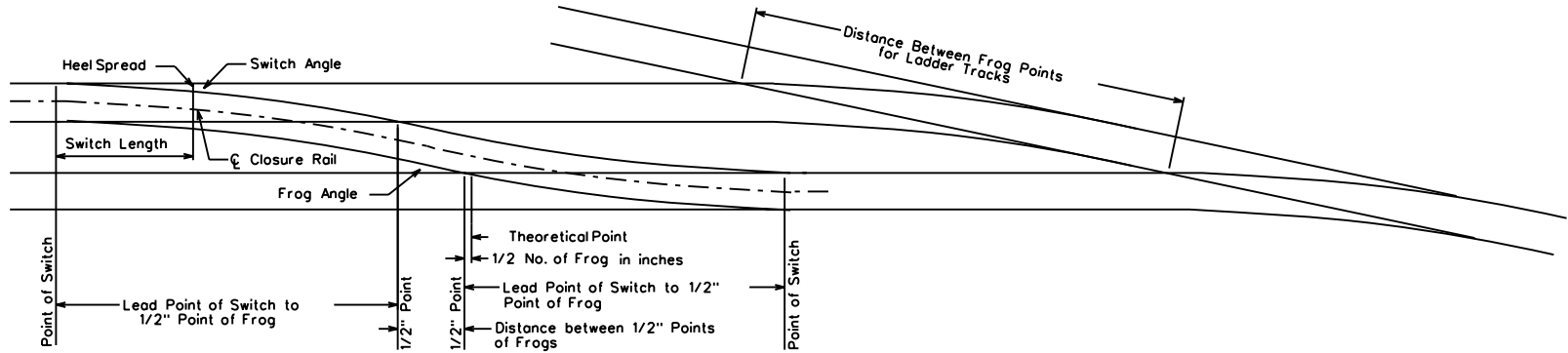
BILL OF SWITCH TIES-7" X 9" TURNOUT	
NO. OF PCS.	LENGTH
11	9'-0"
14	10'-0"
9	11'-0"
6	12'-0"
6	13'-0"
8	14'-0"
6	15'-0"
8	16'-0"
TOTAL NO. PCS. 68	
TOTAL LIN. FT. 818	
TOTAL F.B.M. 4,294.5	

CROSSOVER DATA	
FOR TANGENT TRACK	
TRACK CENTERS	DISTANCE BETWEEN 1/2" POINTS
13'-0"	34'-8 1/4"
14'-0"	44'-7 1/4"
15'-0"	54'-7 1/2"
16'-0"	64'-7 3/4"
17'-0"	74'-6 1/4"
18'-0"	84'-6 3/4"
19'-0"	94'-6 1/4"
20'-0"	104'-5 3/4"

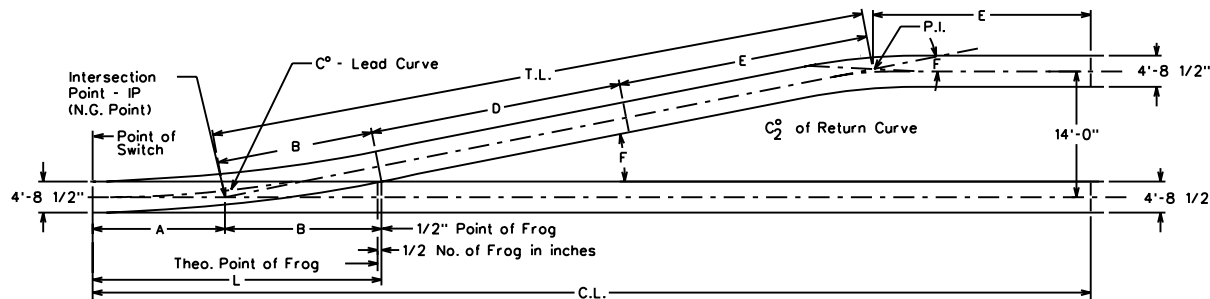
- SEE PLAN 1-4 FOR BOLTS USED IN TRACK CONSTRUCTION
- PLAN 3-19 FOR SWITCH LUGS (CLIPS)
- PLAN 3-20 FOR SWITCH RODS
- PLAN 3-21 FOR SWITCH PLATE DETAILS
- PLAN 3-22 FOR ADJUSTABLE BRACE PLATE DETAILS
- PLAN 3-32 TO 3-35 FOR SWITCH STANDS
- PLAN 3-7 FOR 16'-6" WELDED SWITCH
- PLAN 4-6 FOR SPRING FROG
- PLAN 4-7 THRU 4-8 FOR SPRING FROG DETAILS

NORFOLK SOUTHERN RAILWAY COMPANY
NO. 10 132/136RE TURNOUT
 WITH
16'-6" SWITCH AND SPRING FROG
 SEPTEMBER 1996
 Atlanta, Georgia

DATE	REVISION	GUARD RAIL NOTE
11-21-96		



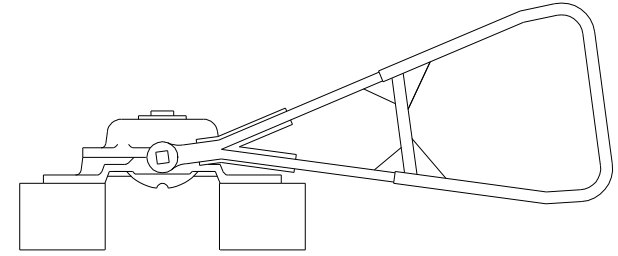
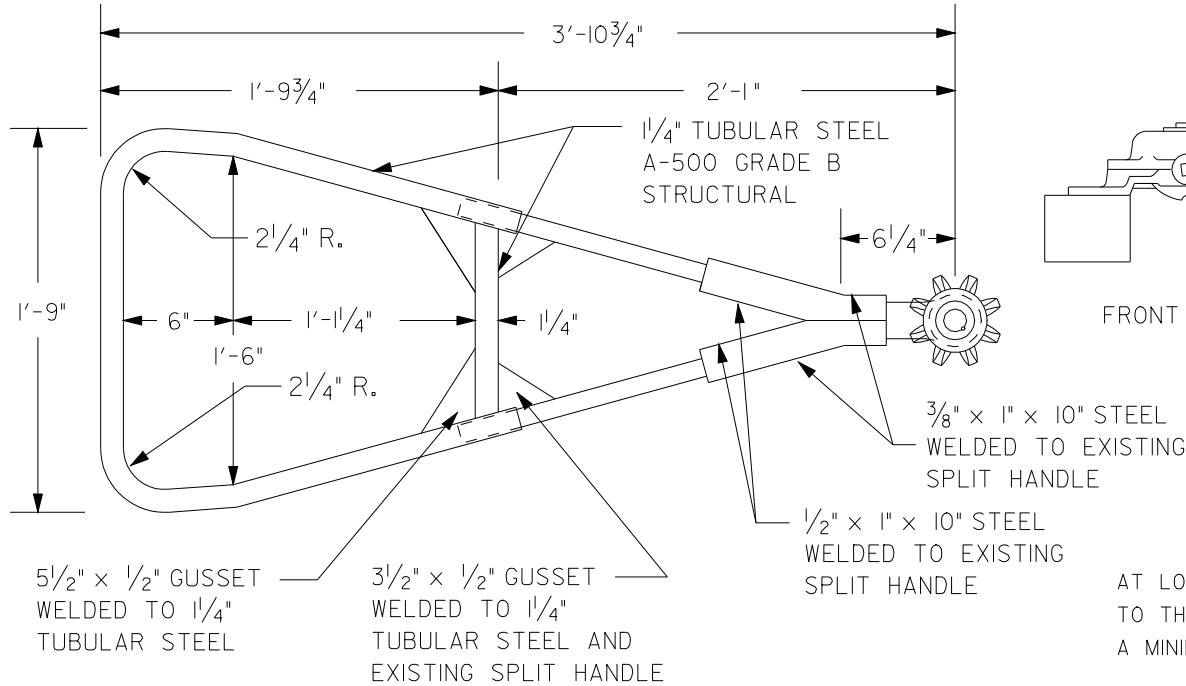
FROG NO.	L POINT OF SWITCH TO 1/2" POINT OF FROG	C° DEGREE OF CURVE CLOSURE RAILS	TURNOUT PLAN NO.	FROG		SWITCH			A P.S. TO INT. PT.	B I.P. TO 1/2" PT FROG	D 1/2" P.F. P.C. RET. CURVE	E TANG. RET. CURVE TO INT. PT.	T.L. I.P. TO P.I. RET. CURVE 14'-0" T.C.	C° ₂ DEGREE RET. CURVE	C.L. CLEAR LENGTH 14'-0" T.C.	C.L. CLEAR LENGTH 15'-0" T.C.	P.S. TO 16'-0" LAST TIMBER	CROSSOVER		LADDER TRACKS		FROG NO.
				F FROG ANGLE	FROG PLAN NO.	LENGTH	ANGLE	HEEL SPREAD										1/2" POINT OF FROG		1/2" POINT OF FROG		
																		TRACK CENTERS	TRACK CENTERS	TRACK CENTERS	TRACK CENTERS	
				14'-0"	15'-0"	14'-0"	15'-0"															
7	62'-1"	16° 31' 26"	2-2	8° 10' 16"	4-10	16'-6"	∠ 44' 11"	6 1/4"	28.83'	33.25'	39.59'	25.66'	98.50'	16° 00'	152.00'	158.96'	93'	30.99'	37.96'	98.50'	105.54'	7
8	58'-11 1/8"	10° 25' 03"	2-3	7° 09' 10"	4-10	curved 13'-0"	2° 54' 0"	6 1/4"	20.93'	38.00'	38.58'	35.86'	112.44'	10° 00'	168.35'	176.34'	84'	35.56'	43.53'	112.44'	120.47'	8
8	68'-0"	11° 58' 03"	2-4	7° 09' 10"	4-13	16'-6"	∠ 44' 11"	6 1/4"	30.00'	38.00'	44.54'	29.90'	112.44'	12° 00'	171.46'	179.43'	93'	35.56'	43.53'	112.44'	120.47'	8
9	72'-3 1/2"	9° 43' 14"	2-5	6° 21' 35"	4-10	16'-6"	∠ 44' 11"	6 1/4"	29.54'	42.75'	50.10'	33.55'	126.39'	9° 30'	188.70'	197.67'	100'	40.11'	49.08'	126.39'	135.41'	9
10	78'-9"	7° 21' 22"	2-7	5° 43' 29"	4-14	16'-6"	∠ 44' 11"	6 1/4"	31.25'	47.50'	54.63'	38.23'	140.35'	7° 30'	209.13'	219.10'	111'	44.65'	54.63'	140.35'	150.38'	10
12	95'-4"	5° 11' 20"	2-9	4° 46' 19"	4-15	22'-0"	∠ 18' 08"	6 1/4"	38.33'	57.00'	63.53'	47.76'	168.29'	5° 00'	253.80'	265.78'	129'	53.71'	65.69'	168.29'	180.31'	12
14	106'-0"	3° 51' 39"	2-10	4° 05' 27"	4-16	22'-0"	∠ 18' 08"	6 1/4"	39.50'	66.50'	78.58'	51.17'	196.25'	3° 45'	286.42'	300.40'	152'	62.76'	76.74'	196.25'	210.27'	14
15	111'-2 3/4"	3° 05' 30"	2-12	3° 49' 06"	4-17	26'-0"	0° 44' 47"	6 1/4"	39.98'	71.25'	70.53'	68.46'	210.23'	2° 48'	318.20'	333.22'	161'	67.27'	82.27'	210.23'	225.25'	15
15	126'-4 1/2"	3° 19' 48"	2-11	3° 49' 06"	4-17	30'-0"	0° 57' 18"	6 1/4"	55.13'	71.25'	75.31'	63.67'	210.23'	3° 15'	328.56'	343.54'	172'	67.27'	82.27'	210.23'	225.25'	15
20	156'-0 1/2"	∠ 43' 15"	2-15	2° 51' 51"	4-18	curved 39'-0"	∠ 04' 30"	6 1/4"	61.04'	95.00'	89.68'	95.50'	280.18'	∠ 30'	436.36'	456.35'	220'	89.82'	109.81'	280.18'	283.47'	20



NORFOLK SOUTHERN RAILWAY COMPANY
**DATA ON TURNOUTS
 AND CROSSOVERS**
 RETURN CURVES AND LADDERS

JULY 1997
 Atlanta, Georgia

REVISION	DATE
8-14-03 ADD NO. 15 TURNOUT WITH 26'-0" POINTS	
3-15-06 REMOVE NO. 6 TURNOUT	
3-24-08 CORRECT "E" ON NO. 14 & "TL" ON 15	



FRONT VIEW

AT LOCATIONS WHERE A TRACK IS ADJACENT TO THE HANDLE, THE TRACK CENTERS MUST BE A MINIMUM OF 13'-0" APART.

FOR USE WITH THE 5 1/2" CRANK 640 737525 AND SAFETY PLATE 640 760676.

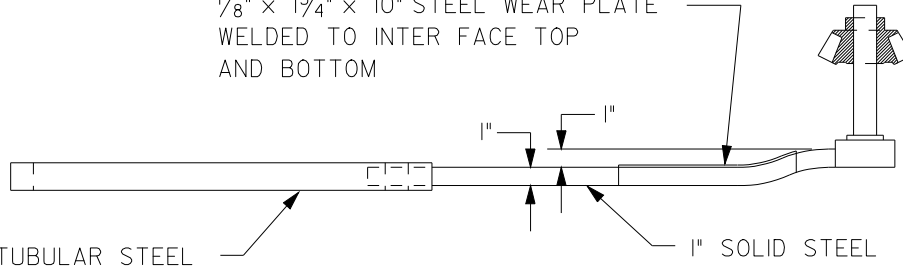
640 139380

NORFOLK SOUTHERN RAILWAY COMPANY
**BOW HANDLE FOR
NEW CENTURY 51-A & 51-B
SWITCH STANDS**

SEPTEMBER 2005
Atlanta, Georgia

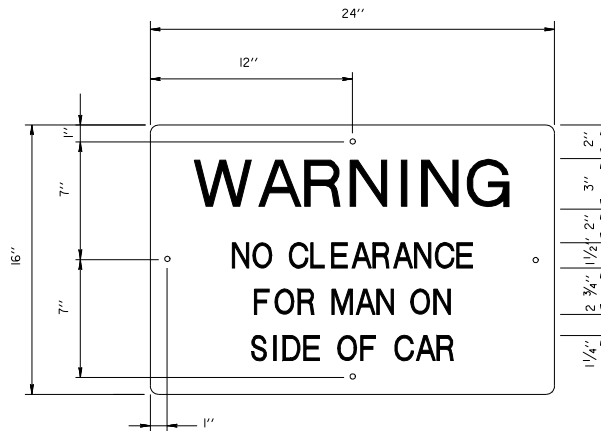
REVISION	
DATE	

1/8" x 1 3/4" x 10" STEEL WEAR PLATE
WELDED TO INTER FACE TOP
AND BOTTOM

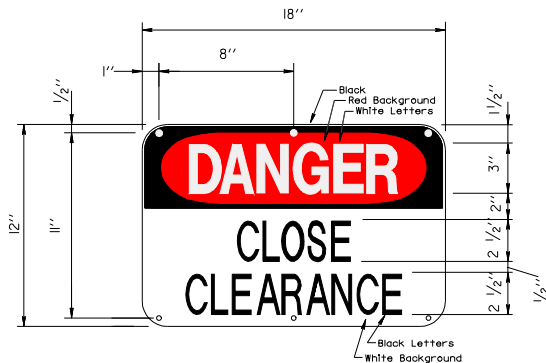




CLEARANCE SIGN (ILLINOIS)
 (Black Screened Letters On White Background)
 360 001699



CLEARANCE SIGN (INDIANA)
 (Black Screened Letters On White Background)
 360 001706



CLEARANCE SIGN (ALL OTHER STATES)
 (Screened Letters On Indicated Color Background)
 360 001714

NOTES:

ALL LETTERS TO BE SERIES C IN ACCORDANCE WITH CURRENT US DOT-FHWA STANDARDS.

SIGNS: 0.080 ALUMINUM.
 ALL HOLES SHALL BE 3/8" DIA. UNLESS NOTED.

FACING: ENGINEER GRADE REFLECTIVE SHEETING, COLOR AS SHOWN.

LETTERS: AS NOTED.

POSTS: STANDARD SIGN POST. SEE PLAN 6-20.

LOCATION:

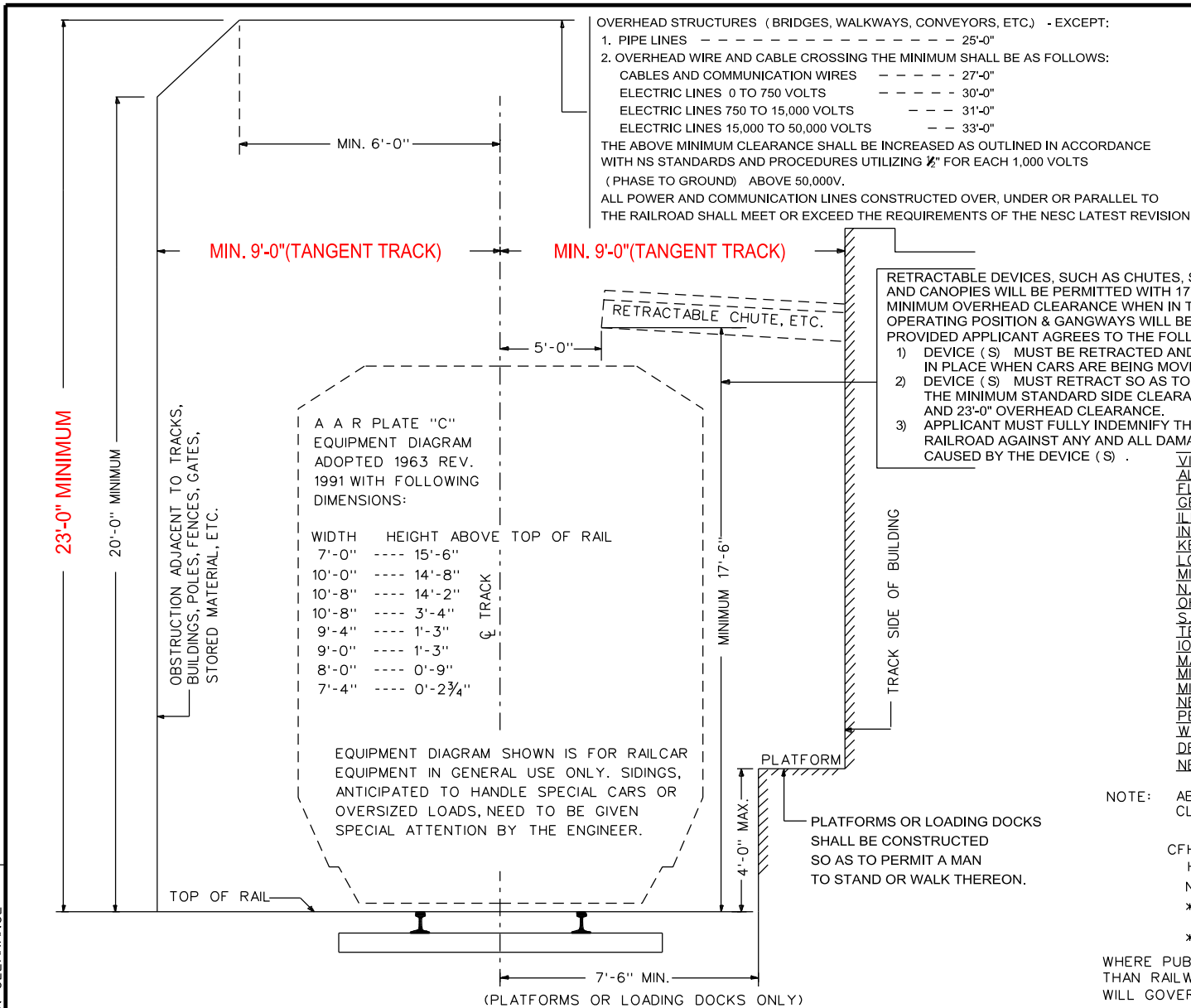
SIGNS SHALL BE PLACED AT RIGHT ANGLE TO TRACK AND A MINIMUM OF 12'-0" FROM CENTERLINE OF TRACK THAT HAS SUB-STANDARD CLEARANCE. ON TRACKS CONNECTED AT BOTH ENDS, SIGNS SHALL BE PLACED ON BOTH SIDES OF STRUCTURE, AT OR NEAR THE CLEARANCE POINT OF TURNOUT NEAREST THE STRUCTURE. IF THERE IS NO ROOM FOR POST, SIGN SHALL BE MOUNTED ON THE STRUCTURE. SIGNS ARE TO BE USED ON INDUSTRY OR LEAD TRACKS ONLY AS DIRECTED BY THE DIVISION SUPERINTENDENT.

NORFOLK SOUTHERN RAILWAY COMPANY
CLOSE CLEARANCE SIGN

JANUARY 1989
 Atlanta, Georgia

REVISION	
DATE	

DATE	REVISION
1-26-09	REVISE NOTES
5-28-14	REVISE NOTES
6-4-14	RETRACTABLE CHUTE, ETC.
7-20-18	REVISE OVERHEAD MIN CLEARANCE



ADDED SIDE CLEARANCES, REQUIRED FOR STRAIGHT TRACK AT END OF CURVE

DISTANCE FROM ADJACENT OBSTRUCTION TO NEAR END OF CURVED TRACK	INCREASE IN SIDE CLEARANCE PER DEGREE OF CURVATURE
0 - 22 FT.	1 1/2 INCHES
23 - 45 FT.	1 INCH
46 - 68 FT.	1/2 INCH
69 - 90 FT.	1/4 INCH

TABLE OF CURRENT STATE LEGAL CLEARANCE REQUIREMENTS

STATE	CLEARANCE									
	TRACK CENTERS		VERTICAL		HORIZONTAL					
	BETWEEN MAIN & INDUSTRIAL TRACK	INDUSTRIAL TRACK	GENERAL	BUILDING DOORS	BUILDING DOORS	POLES	GENERAL	GENERAL	GENERAL	GENERAL
VIRGINIA	N	N	N	N	N	N	N	N	N	N
ALABAMA	N	N	N	N	N	N	N	N	N	N
FLORIDA	13'-6"	13'-6"	22'	17'	8'	5'-9"	CFH	8'	10'	8'
GEORGIA	N	N	N	N	N	N	N	N	N	N
ILLINOIS	13'-6"	15'	23'-0"	H	7'	6'-2"	CFH	8'	9'	8'
INDIANA	N	N	22'	22'	8'	*	N	8'	8'	8'
KENTUCKY	N	N	N	N	N	N	N	N	N	N
LOUISIANA	N	N	N	N	N	N	N	N	N	N
MISSISSIPPI	N	N	N	N	N	N	N	N	N	N
N. CAROLINA	N	N	N	N	N	N	N	N	N	N
OHIO	14'	15'	21'	21'	8'	*	N	8'	8'	8'
S. CAROLINA	N	N	N	N	N	N	N	N	N	N
TENNESSEE	13'	14'	22'	17'	8'	7'-6"	4'	8'	8'	8'
IOWA	N	N	N	N	N	N	N	N	N	N
MARYLAND	13'-6"	15'	22'	18'	8'	5'-7"	4'	8'-6"	8'-6"	8'-6"
MICHIGAN	14'	14'	22'-6"	22'-6"	8'-6"	N	N	8'-6"	9'-0"	8'-6"
MISSOURI	14'	14'	22'	22'	8'-6"	5'-9"	CFH	8'-6"	8'-6"	8'-6"
NEW YORK	13'-6"	15'	22'	18'	8'	8'-6"	4'	8'-6"	8'-6"	8'-6"
PENNSYLVANIA	13'-6"	15'	22'	18'	8'	8'-6"	4'	12'	12'	12'
W. VIRGINIA	14'	15'	22'	22'	8'	6'-4"	4'	8'	10'	8'
DELAWARE	*	*	*	*	*	*	*	*	*	*
NEW JERSEY	N	N	N	N	N	N	N	N	N	N

- NOTE:
- CLEARANCES APPLY BOTH TO STUB END TRACK AND TRACK CONNECTED AT BOTH ENDS.
 - CLEARANCES APPLY BOTH TO OUTSIDE AND INSIDE OF BUILDING.
 - DOORWAY FOR TRACK ENTERING BUILDING MUST HAVE 8'-0" SIDE CLEARANCE AND 22'-0" OVERHEAD CLEARANCE.
 - SIGN MUST BE PLACED ON EACH SIDE OF DOORWAY TO WARN OF CLOSE SIDE CLEARANCE.
 - INDUSTRY TRACK MUST BE NOT LESS THAN 15'-0" CENTER TO CENTER WITH MAIN AND RUNNING TRACK OF RAILWAY COMPANY. MINIMUM DISTANCE, CENTER TO CENTER, FOR ALL OTHER TRACKS TO BE 14'-0".
 - WHERE THE TRACK IS CURVED ALL SIDE CLEARANCES TO AN ADJACENT OBSTRUCTION MUST BE INCREASED 1/2 INCHES FOR EACH DEGREE OF TRACK CURVATURE.
 - WHERE THE TRACK IS CURVED WITHIN 90 FEET OF AN ADJACENT OBSTRUCTION, THE SIDE CLEARANCES MUST BE INCREASED AS PER THE TABLE IN THE UPPER RIGHT HAND CORNER.
 - FOR ANY STRUCTURE CROSSING OR PROJECTING OVER TRACK, INDUSTRY MUST SUBMIT PLANS BEARING THE SEAL OF A REGISTERED PROFESSIONAL ENGINEER TO THE DIVISION SUPERINTENDENT FOR FORWARDING TO THE CHIEF ENGINEER BRIDGES AND STRUCTURES FOR APPROVAL.

NOTE: ABOVE EXCERPTED FROM AREMA CHART SHOWING LEGAL CLEARANCE REQUIREMENTS LAST REVISED 2004

+ - NO CURRENT REGULATIONS
 CFH - CAR FLOOR HEIGHT
 H - HEIGHT OF CAR GOVERNS
 N - NO REGULATION GIVEN
 * - MUST APPLY TO STATE PUBLIC SERVICE COMMISSION FOR LESS THAN 8'-0" LATERAL CLEARANCE TO PLATFORMS.
 ** - AREMA STANDARDS APPLY

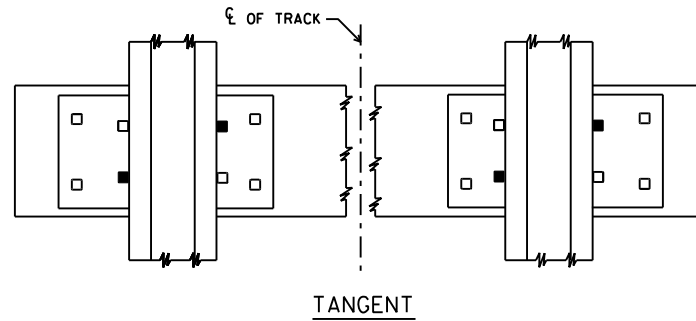
WHERE PUBLIC LAW OR REGULATION REQUIRES CLEARANCE GREATER THAN RAILWAY COMPANY STANDARD, SUCH LAWS AND REGULATIONS WILL GOVERN. SEE ABOVE TABLE.

WHERE NORFOLK SOUTHERN STANDARDS SPECIFY CLEARANCES GREATER THAN STATE STANDARDS, NORFOLK SOUTHERN CLEARANCE SHALL APPLY.

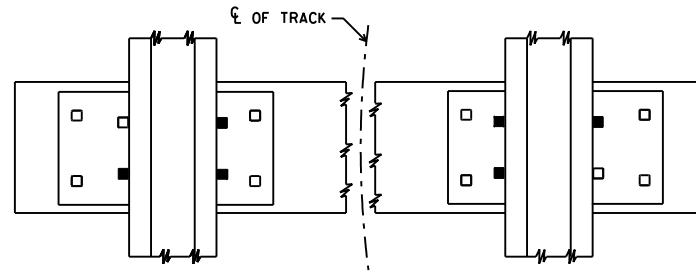
NORFOLK SOUTHERN RAILWAY COMPANY

CLEARANCES FOR TRACKS LOCATED ON INDUSTRY PROPERTY

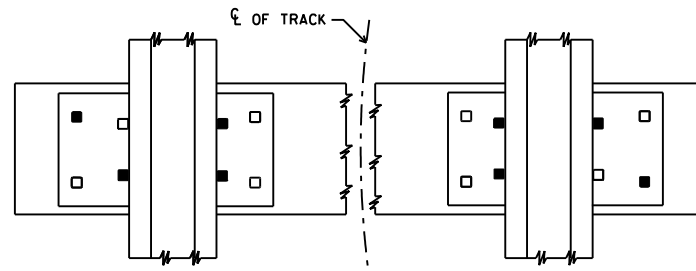
MARCH 1994
 Atlanta, Georgia



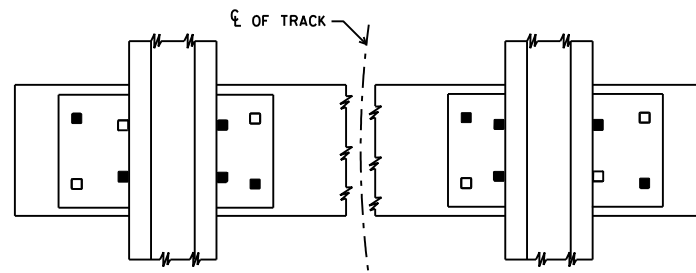
TANGENT



CURVES 2 DEGREES AND OVER



CURVES 4 DEGREES AND OVER



CURVES 13 DEGREES AND OVER

GENERAL NOTES

THE SPIKING PATTERN SHOWN APPLIES TO TRACKS CONSTRUCTED FOR INDUSTRIAL TRACKS; THE SPIKING PATTERN ON CURVES WILL BEGIN AT THE TANGENT AND THE SPIKING PATTERN WILL BE UNIFORM THROUGHOUT THE TOTAL LENGTH OF THE CURVE. THE SPIKING PATTERN ON COMPOUND CURVES WILL BE BASED ON THE HIGHEST DEGREE OF CURVE AND WILL BE USED FOR THE ENTIRE LENGTH OF THE CURVE.

ALL TRACKS WITH TIMBER TIES ARE TO HAVE THE RAILS SPIKED WITH AT LEAST ONE RAIL HOLDING SPIKE ON THE GAGE SIDE AND ONE RAIL HOLDING SPIKE ON THE FIELD SIDE.

STANDARD TRACK SPIKES ARE 5/8"x6" CUT SPIKE SHOWN ON STANDARD PLAN I-3.

OTHER RAIL AND/OR PLATE HOLDING DEVICES MAY BE USED WHEN AUTHORIZED BY AVP MAINTENANCE.

WHEN ANY RE-SPIKING IS PERFORMED, OLD SPIKE HOLES MUST BE PLUGGED WITH WOOD.

SPIKES MAY BE DRIVEN WITH A STANDARD SPIKE MAUL OR WITH A MACHINE. SPIKES MUST BE STARTED AND DRIVEN VERTICALLY AND SQUARE TO THE TIE TO PROVIDE A FULL BEARING AT THE BASE OF RAIL.

RAIL HOLDING SPIKES AT EPOXY INSULATED JOINTS MUST BE REVERSED SO THAT THE TOE OF SPIKE WILL NOT CONTACT JOINT BAR. IF SPIKE IS UNDER THE BOLT, THE TIE MUST BE RE-SPACED.

ADDITIONAL SPIKES MAY BE USED WHERE NECESSARY TO MAINTAIN PROPER GAGE.

■ = SPIKE

NORFOLK SOUTHERN RAILWAY COMPANY

**INDUSTRIAL TRACK
SPIKING PATTERN**

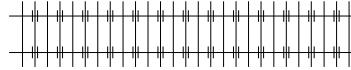
SEPTEMBER, 2009

Atlanta, Georgia

DATE	
REVISION	

ANCHORING PROCEDURE

CONTINUOUS WELDED RAIL TERRITORY



FULLY ANCHOR EVERY OTHER TIE EXCEPT AS INDICATED IN NOTES FOR ANCHORING WELDED RAIL

CONVENTIONAL BOLTED RAIL TERRITORY



OVER 4 MILLION GROSS TONS ANNUALLY
16 ANCHORS PER 39 FT. RAIL LENGTH



LESS THAN 4 MILLION GROSS TONS ANNUALLY
10 ANCHORS PER 39 FT. RAIL LENGTH

GENERAL NOTES

THE ANCHOR STANDARDS ON THIS PLAN SHOULD BE CONSIDERED AS MINIMUM REQUIREMENTS. ADDITIONAL ANCHORS MAY BE AUTHORIZED BY THE DIVISION ENGINEERS TO PREVENT RAIL MOVEMENT IN LOCATIONS SUCH AS HEAVY GRADES, DIPS, RAILROAD CROSSINGS OR SIMILAR LOCATIONS WHERE THE STANDARD ANCHOR PATTERN DOES NOT ADEQUATELY RESTRAIN RAIL MOVEMENT.

ANCHORS MUST BE APPLIED ON THE SAME SIDE OF THE TIE OF BOTH RAILS WITH A FULL BEARING AGAINST THE SIDE OF THE TIE. ANCHORS INSTALLED SHOULD BE SPACED UNIFORMLY THROUGHOUT THE RAIL LENGTH AND NOT BE GROUPED IN ONE AREA OF THE RAIL. ANCHORS THAT ARE APPLIED EITHER BY MACHINE OR BY HAND, MUST NOT BE OVERDRIVEN OR OVER APPLIED.

ANCHORS MUST NOT BE APPLIED WHERE THEY WILL INTERFERE WITH SIGNAL OR OTHER TRACK APPLIANCES, ON THE RAIL OPPOSITE A JOINT OR WHERE THEY ARE INACCESSIBLE FOR ADJUSTMENT OR INSPECTION.

ANCHORS THAT ARE REMOVED FROM THE RAIL MUST BE REAPPLIED IN THE REQUIRED PATTERN.

RELAY (FIT) ANCHORS MAY BE USED IN WELDED RAIL LOCATIONS AS DIRECTED BY THE CHIEF ENGINEER LINE MAINTENANCE OR CHIEF ENGINEER PROGRAM MAINTENANCE.

RAIL ACROSS BALLAST DECK BRIDGES IS TO BE ANCHORED IN THE SAME PATTERN AS THE ADJACENT GROUND TRACK.

RAIL ON OPEN DECK BRIDGES IS NOT TO BE ANCHORED UNLESS SPECIFICALLY AUTHORIZED BY THE CHIEF ENGINEER BRIDGES AND STRUCTURES.

ANCHORS FROM DIFFERENT MANUFACTURERS ARE NOT TO BE INTERMIXED IN TRACK.

ANY MAIN TRACK NOT ANCHORED AS REQUIRED BY THIS PLAN IS CONSIDERED DEFICIENT AND MUST BE SLOW ORDERED. (EXCEPTION: SEE PREFACE MW&S STANDARD PROCEDURE 005.) WHEN RAIL HAS BEEN LAID OR REPLACED, SLOW ORDER MAY NOT BE REMOVED UNTIL RAIL IS PROPERLY ANCHORED AND TIE CRIB FILLED.

IF THE TYPE RAIL OR TONNAGE CHANGES, THEN THE ANCHORING PATTERN SHOULD BE CHANGED TO THE NEW REQUIRED PATTERN.

ANCHORING WELDED RAIL

TANGENT TRACK: BOX ANCHOR EVERY OTHER TIE.

CURVES LESS THAN 3 DEGREES: BOX ANCHOR EVERY OTHER TIE.

CURVES 3 DEGREES AND OVER: BOX ANCHOR EVERY TIE.

JOINTS: BOX ANCHOR EVERY TIE FOR SIX 39 FOOT RAIL LENGTHS (234 FEET) ON EACH SIDE OF JOINT.

WELDED TO JOINTED: WHEN WELDED RAIL CONNECTS TO JOINTED RAIL THE FIRST SIX 39 FOOT RAIL LENGTHS OF JOINTED RAIL ARE TO BE BOX ANCHORED FOR EVERY TIE EXCEPT AT AND OPPOSITE JOINTS. THE NEXT SIX RAIL LENGTHS OF JOINTED RAIL ARE TO BE ANCHORED WITH A TRANSITION PATTERN BETWEEN THE WELDED PATTERN AND THE JOINTED RAIL PATTERN.

OPEN DECK BRIDGES: GROUND TRACK IS TO BE BOX ANCHORED EVERY CROSS TIE FOR SIX 39 FOOT RAIL LENGTHS (234 FEET) FROM EACH BRIDGE END.

WHERE EXPANSION JOINTS ARE LOCATED ON THE GROUND, TRACK IS TO BE BOX ANCHORED EVERY CROSS TIE FOR SIX RAIL LENGTHS (234 FEET) FROM THE EXPANSION JOINT AWAY FROM THE BRIDGE. THERE ARE TO BE NO ANCHORS AND NO TRACK JOINTS BETWEEN THE EXPANSION JOINT AND THE BRIDGE.

ANCHORING JOINTED RAIL

LOCATIONS WHERE TONNAGE IS GREATER THAN 4 MILLION GROSS TONS ANNUALLY: BOX ANCHOR 8 TIES PER 39 FOOT RAIL.

SIDINGS WITH LESS THAN 25 M.P.H. TIMETABLE SPEED, YARDS, LEADS, BRANCH LINES AND LOCATIONS WITH LESS THAN 4 MILLION GROSS TONS ANNUALLY: BOX ANCHOR 5 TIES PER 39 FOOT RAIL.

ANCHORING TURNOUTS

MAIN TRACK TURNOUTS AND TURNOUTS IN WELDED RAIL TERRITORY: TURNOUTS ARE TO BE BOX ANCHORED EVERY CROSS TIE FOR THREE 39 FOOT RAIL LENGTHS (117 FEET) IN EACH DIRECTION FROM THE TURNOUT INCLUDING THE TURNOUT SIDE. ALL SWITCH TIES ARE TO BE BOX ANCHORED, WHERE POSSIBLE.

OTHER THAN MAIN TRACK TURNOUTS AND TURNOUTS IN JOINTED RAIL TERRITORY: TURNOUTS ARE TO BE BOX ANCHORED EVERY OTHER CROSS TIE FOR THREE 39 FOOT RAIL LENGTHS (117 FEET) IN EACH DIRECTION FROM THE TURNOUT INCLUDING THE TURNOUT SIDE. EVERY OTHER SWITCH TIE TO BE BOX ANCHORED, WHERE POSSIBLE.

IF THE TURNOUT IS IN WELDED RAIL TERRITORY WITH A JOINT, THEN THE PROCEDURE FOR ANCHORING JOINTS IN WELDED RAIL APPLIES.

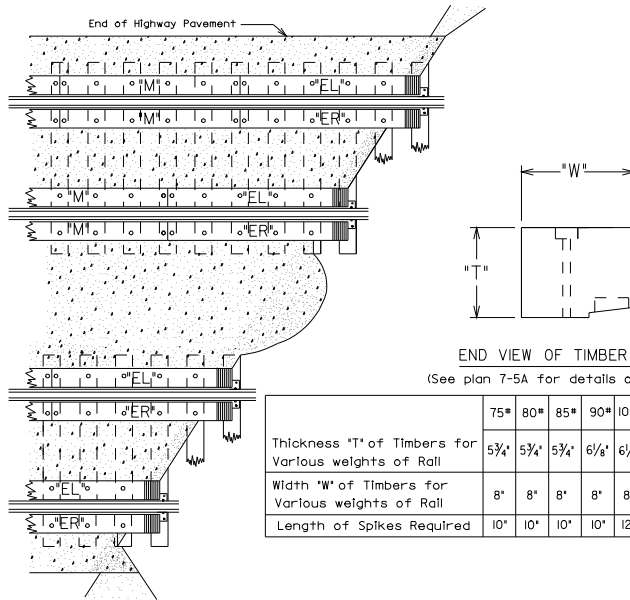
NORFOLK SOUTHERN RAILWAY COMPANY

**RAIL ANCHORING
PATTERN**

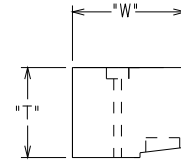
APRIL 1991

Atlanta, Georgia

REVISION		
DATE		

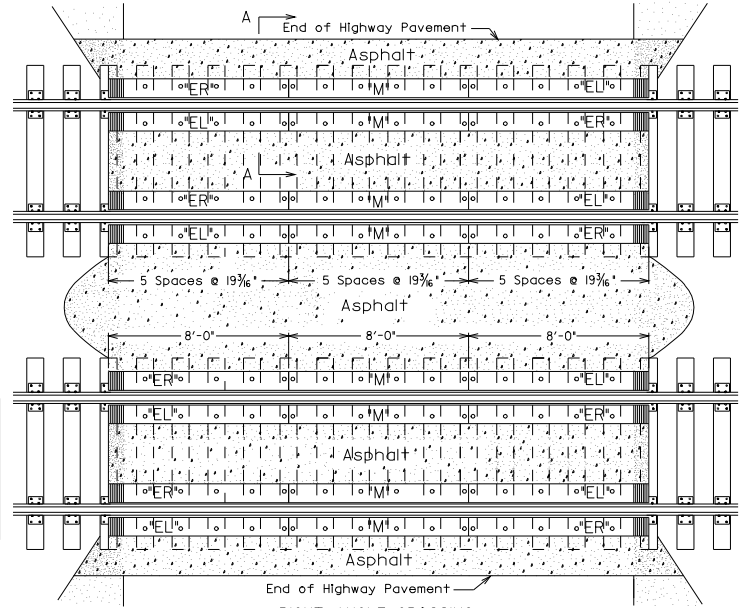


ACUTE ANGLE CROSSING



END VIEW OF TIMBER
(See plan 7-5A for details of timber)

	75*	80*	85*	90*	100*	110*	112* 115*	132*
Thickness 'T' of Timbers for Various weights of Rail	5 3/4"	5 3/4"	5 3/4"	6 1/8"	6 1/2"	7"	7 1/2"	8"
Width 'W' of Timbers for Various weights of Rail	8"	8"	8"	8"	8"	10"	10"	10"
Length of Spikes Required	10"	10"	10"	10"	12"	12"	12"	12"



RIGHT ANGLE CROSSING

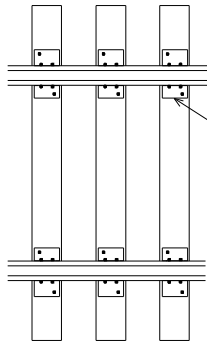
NOTES

- Timbers to be shaped and bored prior to creosote treatment.
- Pavement to be full depth asphalt, except lightly used private crossings and farm crossings. These type crossings are to have compacted NS standard sub-ballast with 4" maximum asphalt.
- Where highway or street have separate sidewalks, the entire width of crossing to the outside edge of sidewalk, will be paved, where practical.
- When necessary provide drainage between tracks.
- To allow for compaction of paving under vehicular traffic, the surface of the asphalt paving shall be raised 3/8" above the top of the crossing timbers for the width of the roadway.
- To increase width of crossing use additional 'M' timbers.
- Standard tie plates to be used for 6" base rail are 7 3/4" x 14 3/4".
- Worn plates must be replaced when crossing is renewed.

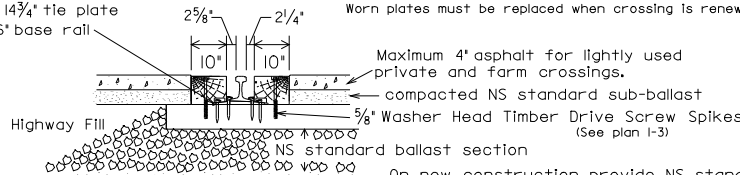
SPIKING PATTERN

All spikes for 110" thru 132" timbers shall be driven in holes as shown at left in order to match the preframed timber.

For 75" thru 100" timbers drive 4 rail spikes per tie plate.



7 3/4" x 14 3/4" tie plate with 6" base rail



SECTION A-A

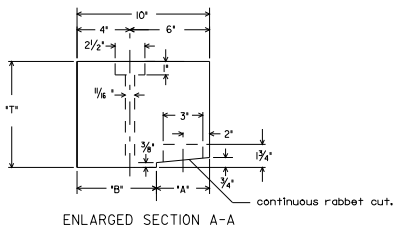
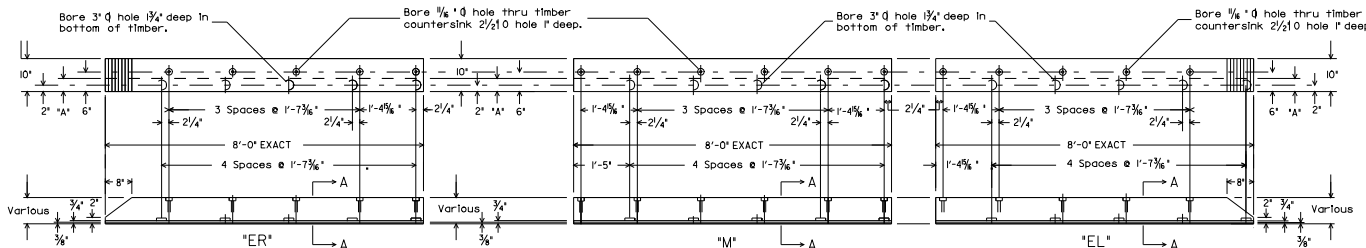
On new construction provide NS standard sub-ballast 6" thick, under full width and length of crossing.

NORFOLK SOUTHERN RAILWAY COMPANY
**HIGHWAY GRADE CROSSING
ASPHALT PAVING**

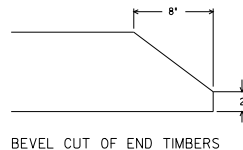
JANUARY 1995

Atlanta, Georgia

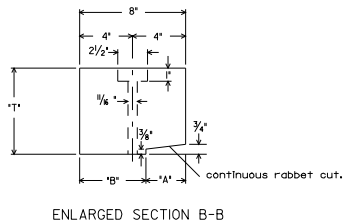
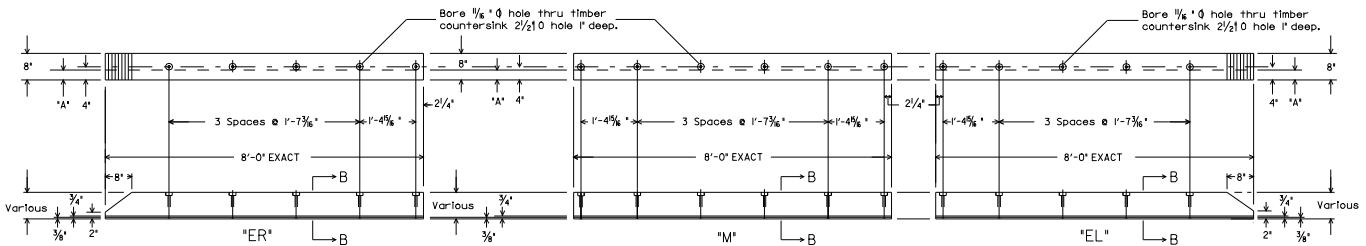
DATE	REVISION
1-6-95	Added notes NS standard sub-ballast
1-10-95	Added rail spikes 100" thru 132" timber
8-7-02	Added tie plate designation



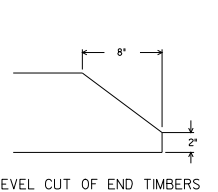
110# THRU 132# TIMBER



Weight of Roll	75*	80*	85*	90*	100*	110*	122*	132*
Thickness ** of Timbers for Various weights of Roll	5 3/4"	5 3/4"	5 3/4"	6 1/4"	6 3/4"	7"	7 1/2"	8"
Width ** of Timbers for Various weights of Roll	8"	8"	8"	8"	8"	10"	10"	10"
Dap 'A' of Timbers for Various weights of Roll	3"	3"	3"	3"	3"	3"	3"	4"
Base 'B' of Timbers for Various weights of Roll	5"	5"	5"	5"	5"	7"	7"	6"
Length of Spikes Required	10"	10"	10"	10"	12"	12"	12"	12"



75# THRU 100# TIMBER

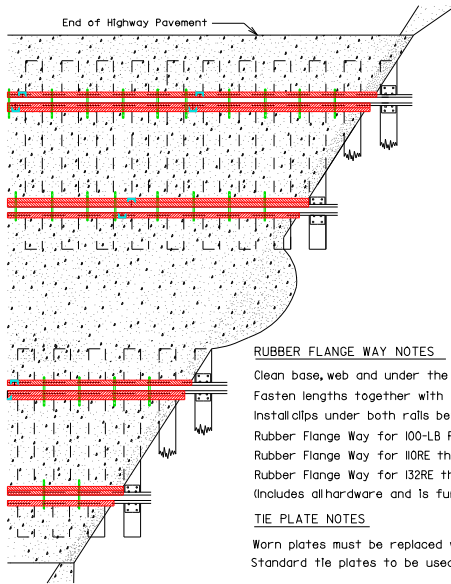


NOTES
 Timbers to be shaped and bored prior to creosote treatment.
 All daps will be cut into the bottom of the timber which is the wide surface closest to the heart.
 Tolerances: -1/8" overall thickness, width, and length.
 +/-1/4" on hole spacing and countersunk depth.
 +/-1/4" and -0" dap width.
 +/-1/8" and -0" dap thickness.

NORFOLK SOUTHERN RAILWAY COMPANY
HIGHWAY GRADE CROSSING
TREATED TIMBER

DECEMBER 1989
 Atlanta, Georgia

REVISION	
DATE	



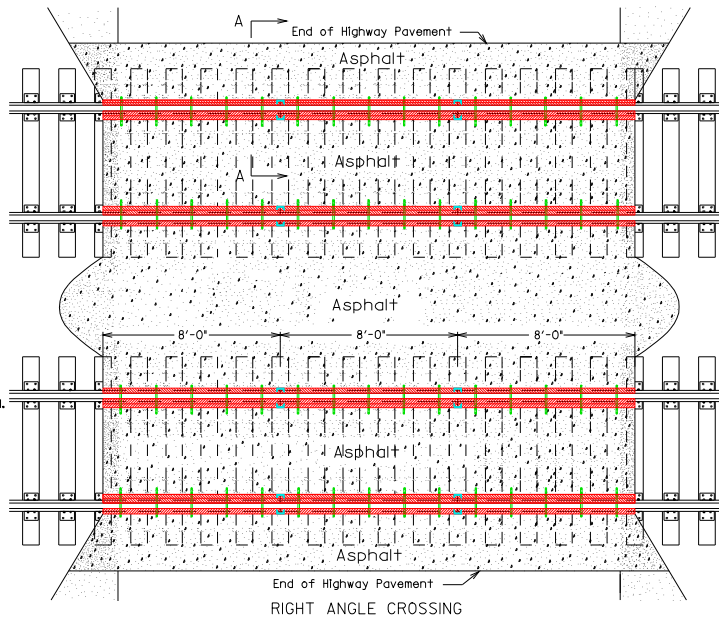
RUBBER FLANGE WAY NOTES

Clean base, web and under the head of the rail.
 Fasten lengths together with end clips and lay rubber against the rail.
 Install clips under both rails between every tie in the crossing.
 Rubber Flange Way for 100-LB Rail 270 99529I
 Rubber Flange Way for 110RE through 115RE Rail 270 991789
 Rubber Flange Way for 132RE through 141AB Rail 270 00879I
 (Includes all hardware and is furnished in 8 track foot sections.)

TIE PLATE NOTES

Worn plates must be replaced when crossing is renewed.
 Standard tie plates to be used for 6" base rail are 7 3/4" x 14 3/4".

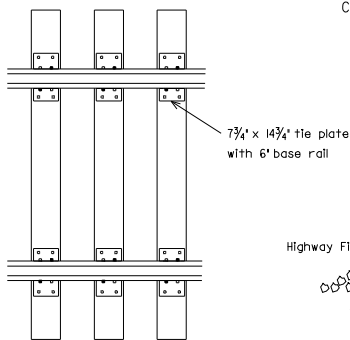
ACUTE ANGLE CROSSING



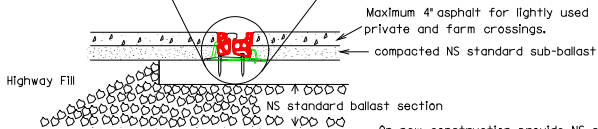
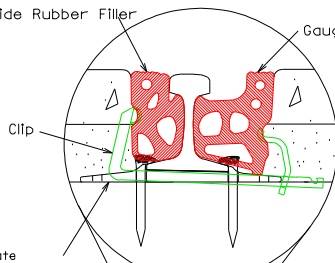
RIGHT ANGLE CROSSING

SPIKING PATTERN

All spikes for 110" thru 141" rail shall be driven in holes as shown below.



Field Side Rubber Filler Gauge Side Rubber Flange Way



SECTION A-A

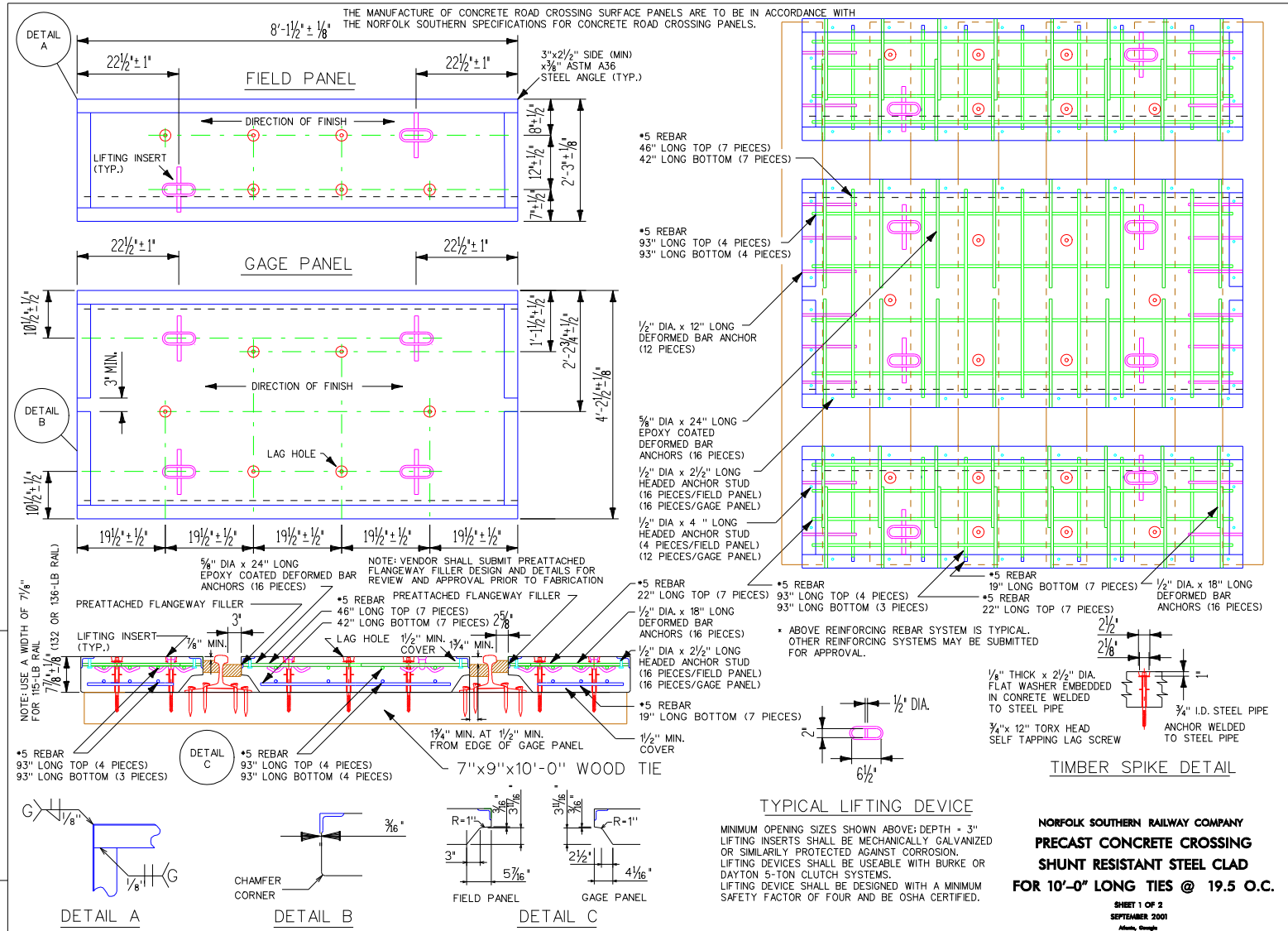
PAVING NOTES

Pavement to be full depth asphalt, except lightly used private crossings and farm crossings. These type crossings are to have compacted NS standard sub-ballast with 4" maximum asphalt.
 Where highway or street have separate sidewalks, the entire width of crossing to the outside edge of sidewalk, will be paved, where practical.
 When necessary provide drainage between tracks.
 To allow for compaction of paving under vehicular traffic, the surface of the asphalt paving shall be raised 3/8" above the top of the rubber flange ways for the width of the roadway.
 In full depth crossings, lay asphalt in two lifts.
 Jam stone or asphalt under rubber flange way between ties - both field and gauge sides. FILL ALL VOIDS.

NORFOLK SOUTHERN RAILWAY COMPANY
HIGHWAY GRADE CROSSING
ASPHALT PAVING
WITH RUBBER FLANGE WAY

OCTOBER 2003
 Atlanta, Georgia

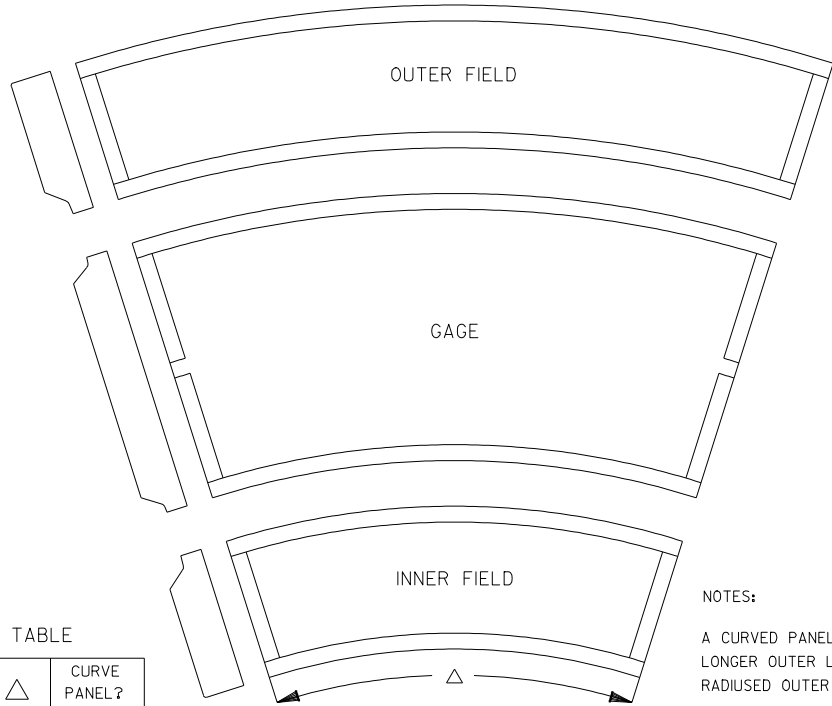
REVISION	ADD. CLASS & ITEM NUMBER FOR 100-LB RAIL
DATE	11-16-03



DATE	REVISION
8-23-04	PREATTACHED FLANGWAY FILLER
9-10-07	LAG SCREW DIAMETER

NORFOLK SOUTHERN RAILWAY COMPANY
PRECAST CONCRETE CROSSING SHUNT RESISTANT STEEL CLAD
FOR 10'-0" LONG TIES @ 19.5 O.C.

Sheet 1 of 2
 SEPTEMBER 2001
 Atlanta, Georgia



CURVATURE TABLE

DEGREE OF CURVE	RADIUS IN FEET	△	CURVE PANEL?
3° OR LESS	1,910	0.24°	NO
4°	1,433	0.32°	YES
5°	1,146	0.40°	YES
6°	955	0.48°	YES
7°	819	0.56°	YES
8°	717	0.66°	YES
9°	637	0.74°	YES
10 °	574	0.82°	YES
11 °	522	0.90°	YES
12 °	478	0.98°	YES
13 °	442	1.06°	YES
14 °	410	1.14 °	YES

(SEE PANEL CURVATURE TABLE)

NOTES:

A CURVED PANEL IS A PANEL THAT IS PIE SHAPED WITH A LONGER OUTER LENGTH THAN INNER LENGTH WITH A TRUE RADIUSUED OUTER AND INNER STEEL.

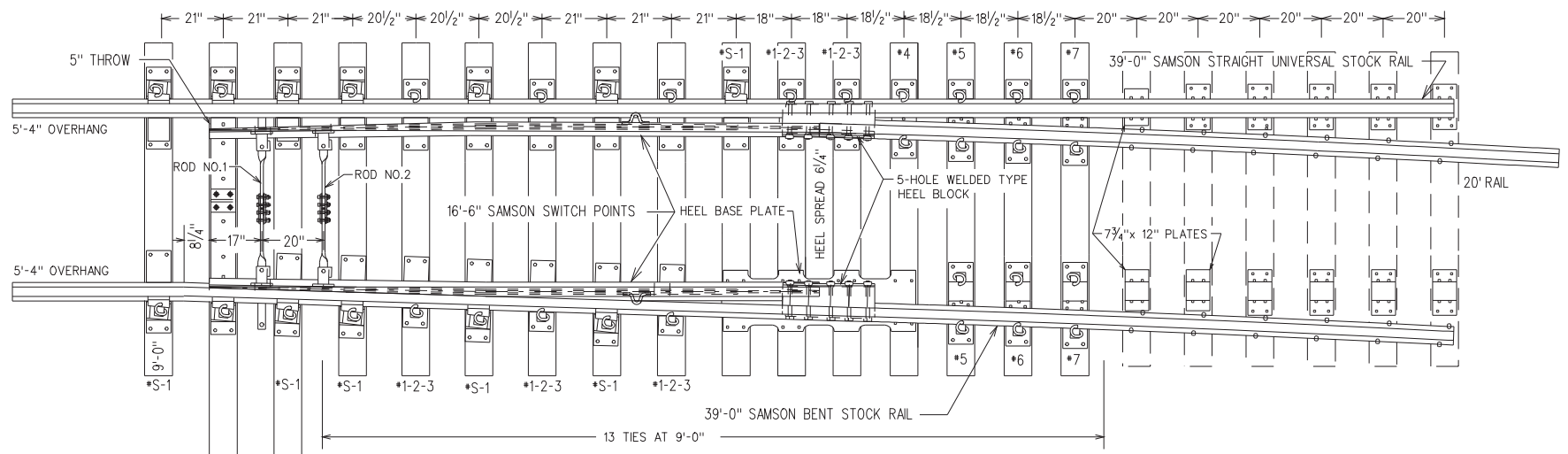
CURVED PANELS USE STANDARD REINFORCEMENT SIMILAR TO TANGENT PANEL STANDARD REINFORCEMENT.

LAG HOLES MUST LINE UP WITH THE CENTERLINE OF THE TIES.

NORFOLK SOUTHERN RAILWAY COMPANY
CURVED CONCRETE PANELS

SHEET 2 OF 2
 APRIL 2003
 Atlanta, Georgia

REVISION	
DATE	



PLAN OF RIGHT HAND SWITCH POINT DERAIL

NOTES

- RAIL SECTION - FULLY HEAT TREATED
- 1/4" SAMSON POINTS, 6/4" HEEL SPREADS
- RAIL ENDS BEVELED PER AREMA PLAN 1005-40
- GAGE - 4'-8 1/2" THRU SWITCH

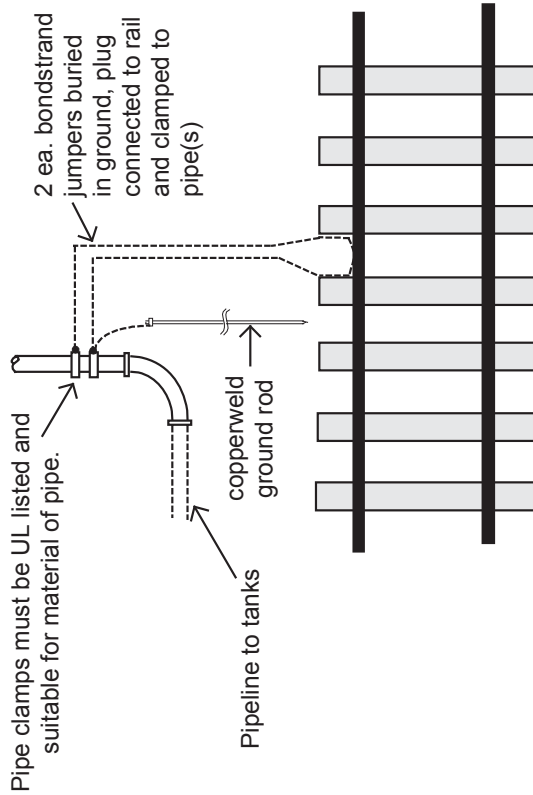
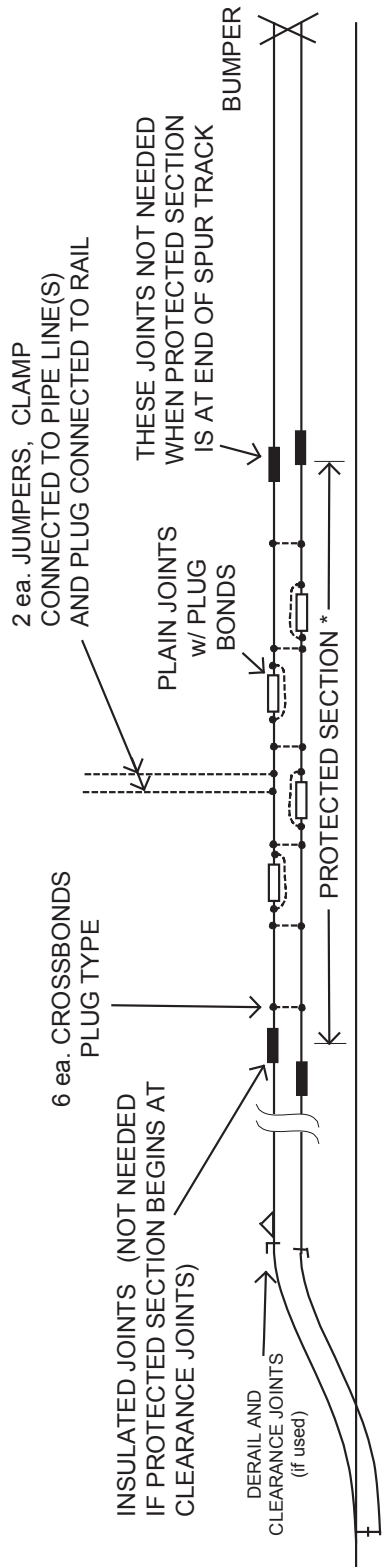
SWITCH DERAIL MINI PACKAGE: 640 301365
 DERAIL PANELIZED TURNOUT: 640 696018

NORFOLK SOUTHERN RAILWAY COMPANY
132RE SWITCH POINT DERAIL

JUNE 2003
 Atlanta, Georgia

REVISION	DATE

STANDARDS AND PROCEDURES
OIL, GAS or OTHER FLAMMABLES
LOADING / UNLOADING SPURS
PROTECTION FROM STRAY ELECTRIC CURRENTS
 Initial date 4/19/93 – Revised 3/18/03



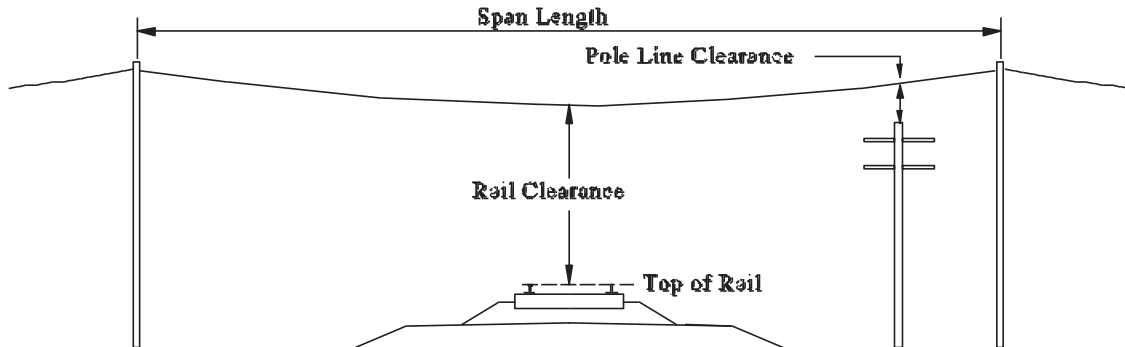
- NOTES:**
1. * Protected Section - To be of sufficient length to hold car(s) connected to tanks for loading/unloading. Cars spotted for loading/unloading must not bridge insulated joints or be coupled to cars outside of protected section during loading/unloading operations.
 2. Protected Section insulated joints must be of approved type and must be painted with yellow paint.
 3. No connections or bonding using any welding process permitted in Protected Section due to fire hazard.
 4. Holes for web bond connections must be at least 8" horizontally from any thermite web weld.
 5. Loading/unloading pipe to be connected to rails as shown in drawing to right. Ground clamps to be UL listed type and suitable for material that pipe is made from.

STANDARDS AND PROCEDURES CLEARANCE REQUIREMENTS FOR CABLE AND WIRE CROSSINGS

Initial date 9/1/93 - Revised 3/24/06

Note: All power and communication lines constructed over, under or parallel to the railroad shall meet or exceed the requirements of the National Electric Safety Code (NESC), latest revision.

OVERHEAD CLEARANCE



In no case shall crossings have less vertical clearance than the following at a final unloaded sag at 60° F, or for span lengths greater than the standard span lengths for the appropriate geographic loading district, at the maximum conductor temperature for which the supply line is designed to operate.

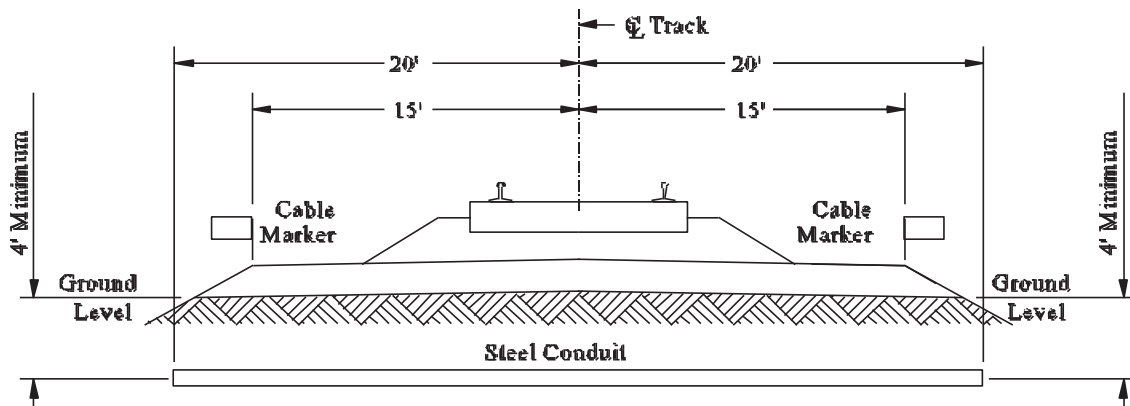
Distance Above	Guys, Messenger, and Communications Spans	Open Supply Line or any Neutral (phase to ground voltage)		
		0 to 750 V	over 750 V to 15 KV	over 15 KV to 50 KV *
Rail	27 feet	30 feet	31 feet	33 feet
Pole Line	2 feet	2 feet	4 feet	6 feet

* Add 1/2 inch for each 1000 volts (phase to ground) above 50 KV.

Loading District	Standard Span Lengths
Heavy	175 feet
Medium	250 feet
Light	350 feet

Note - The applicant will furnish line design final sag data.

UNDERGROUND CLEARANCE



Power and communications underground wire and cable crossings must be buried a minimum 5 1/2 feet below base of rail and 4 feet below ground level for entire width of right-of-way and must be installed in steel conduit beneath the track, extending a minimum of 20 feet from the centerline of nearest track. Cable marker signs must be installed 15 feet from centerline of nearest track on both sides of right-of-way entry/exit. Signs must indicate cable owner, depth buried and voltage.



Quality Assurance Specifications for Ties and Timbers

Revised

May 1, 2017

2.0 NORFOLK SOUTHERN SPECIFICATIONS FOR WOODEN INDUSTRIAL GRADE CROSSTIES

SCOPE

This specification cancels and supersedes all previous specifications for Norfolk Southern Corporation covering the purchase of solid wooden industrial grade crossties.

GENERAL

Industrial grade crossties are standard crossties that do not meet all of the requirements of grade ties, but are suitable for industrial leads, yards, sidings, and other low-impact tracks. Only the following defects are considered acceptable for ties down-graded to industrial grade: splits, checks, shake, twist, bow, and failed end-plates.

No green, dry, or treated industrial grade crossties shall be bought unless explicitly specified by an NS purchase order. If a purchase order is issued, then this specification will detail the classifications and defect limitations.

Normally industrial grade crossties will accumulate in the Norfolk Southern inventory only after degrading in the air-drying or treating processes at a plant where NS owns the dry tie or the treated tie. Full service plants will absorb all degraded ties into their inventories and ship only grade crossties to NS; unless storage time limitations for treated crossties are approved.

2.1 Species of Acceptable Woods

Mixed oak and mixed hardwoods are acceptable. Poplar, cottonwood, willow and basswood are not acceptable.

2.2 Classification and Design

The following sizes, lengths, and minimum faces are allowed in industrial grade crossties:

- 6" IG 6" x 8" x 8'0" - 8'7" 6" face on top or bottom
- 7" IG 7" x 8" x 8'0" - 8'7" 6" face on top or bottom
- 7" IG 7" x 9" x 8'0" - 8'7" 6" face on top or bottom.

The above minimum face requirements apply to the rail-bearing areas, which are the areas between 20" and 40" from the middle (11"-31" from the end) of the industrial grade crosstie. Outside the rail-bearing areas, wane will be limited to half the face width on the top or bottom of the tie. The grade of each tie shall be determined at the point of most wane, on the top or bottom, within the rail-bearing areas. The top is defined as the wide face farthest from the pith center.

Dry or treated ties may be 1" narrower or 1/2" thinner than the specified sizes. Thickness and width may not vary more than 1" from end to end. The tie body may be out of square by no more than 1" throughout the length. Tie length may vary from 8'-0" to 8'-6".

End squareness should be reasonably flat to accept end plates.

2.3 Definitions of Defects

- 2.3.1 Wane: Wane is defined as bark or the lack of wood (see Section 2.2 for allowance).
- 2.3.2 Bark Seam: Bark seams will not be acceptable if more than 2" deep or more than 10" long anywhere in the industrial grade crosstie.
- 2.3.3 Decay: A decayed knot greater than 3/4" in diameter will be rejected within the rail-bearing area. Also, slight incipient decay may be allowed outside the rail-bearing area, if the decayed area does not exceed 2" in diameter. Ties with decay appearing in both ends will be rejected.
- 2.3.4 Splits: A split is a separation of the wood extending from one surface to an opposite or adjacent surface --not counting the end as a surface. Seasoned or treated ties with a split greater than 1/2" wide or 15" long will be rejected with or without an end-plate.
- 2.3.5 Check: A check is a separation of wood due to seasoning which appears on one surface only - not counting the end as a surface. Season checks greater than 2" deep or 3/4" wide shall be rejected.
- 2.3.6 Shakes: Industrial grade crossties with shakes (ring separations) having a width on the cross-section greater than 4" or extending to more than one surface shall be rejected.
- 2.3.7 Holes: Ties having holes on any surface within the rail-bearing areas that are greater than 1" in diameter or greater than 3" deep will be rejected. Ties having holes on any surface outside the rail-bearing areas which are greater than 3" in diameter or deeper than 4" will be rejected.

- 2.3.8 Knots: A knot greater than 4" in diameter will not be permitted in industrial grade crossties.
- 2.3.9 Cross or Spiral Grain: Except in species with interlocking grain, ties having cross, slant, or spiral grain greater than 2" in 15" of length will be rejected.
- 2.3.10 Manufacturing Defects: All ties must be straight and have top and bottom parallel. Ties will be rejected for any of the following:
- Lack of Straightness - A straight line from a point on one end to a corresponding point on the other end is no more than 2" from the surface at any point.
 - Not Well-Sawn - Surfaces are cut with score marks more than 1" deep.
 - Out of Parallelism - If any difference in width or thick at the sides or ends exceeds 1".

2.4 Seasoning and Conditioning

- 2.4.1 Air Seasoning - Prior to air seasoning, ties shall be incised, separated by size and species, and stacked promptly upon receipt at the treating plant. Hickory shall be air stacked with the oaks.

Each completed run of green industrial grade crossties will be dated on the front of the run, conforming to the fiscal or status month in which it was completed. No longer than 30 days will be allowed for the construction, completion, and dating of any given run of ties. Each completed run of ties will be scheduled for treatment when moisture contents fall to specified levels.

For air-dried runs, 7 of the 20 borings required for moisture assessment shall be taken from the hacks on the ends of the runs. Sufficient runs must be sampled to yield a representative moisture content that will allow proper creosote penetration in all of the ties that finished drying that month. A solid 3" boring shall be taken midway between the ends and midway from top to bottom of each tie sampled. All species within a run should be included in the moisture content determination.

The whole 3" borings shall be dried, and the finished moisture content percentage shall not exceed the following limits:

- Oak-hickory 50% moisture content
- Mixed hardwood 40% moisture content.

Use the stacking method that normally produces the best results for your particular locality. However, regardless of stacking method, all stacks must be supported on treated, or non-decaying sills. The first layer of ties shall be off the ground 12" or more. Space between stacks or runs shall be dictated by site and climate. Horizontal and vertical alignment of ties within a stack or run must be equal to provide for good air circulation within and between stacks or runs of ties. When stickers are used for air-drying, they must be treated and at least 1 1/2" thick.

All air seasoning yards shall be so located and constructed to provide for free, unobstructed flow of prevailing air currents, and complete water drainage away from stacks of seasoning ties. Seasoning yards will be kept free and clear of grass, weeds, decayed wood, and other such objects that inhibit good seasoning.

- 2.4.2 Artificial Seasoning (Boultonizing) - Industrial grade crossties scheduled for Boultonizing shall be separated by size and species, incised, then sent to the tramming station and handled as outlined in Section 2.5 before the drying process begins. Hickory ties must be Boultonized with the oaks. Each layer of ties on the tram shall be separated with one 3/4" steel spacer placed on alternate ends as layers are built.

Moisture contents shall be determined in accordance with **current** AWPA procedures using twenty - 3" borings from each charge, prior to drying. Water removal is acceptable when target moisture content of 50% for oak-hickory charges and 40% for mixed hardwoods are obtained. A preheating period of 3 hours without any vacuum applied will be initiated after filling the cylinder and heating the oil to a minimum of **180°** F. This period must be shown on charge reports as "Heated in oil at **180-210°** F". After this heating period, the Boulton cycle is initiated as described below with temperatures of 170-210° F and vacuums sufficient to boil the water at the desired rate. The Boulton cycle will continue until the required amount of water is removed, or the minimum water flow rate is achieved. If a plant elects to control the Boulton vacuum times based on flow rates alone, then the above initial moisture content borings and water removal calculations are not required. If flow rates are used alone, then the target amount of gallons to be removed will be an amount equal to the cubic foot volume of ties in the cylinder, i.e. 3500 cubic feet would require a target amount of 3500 gallons of water be removed.

The Boulton cycle may be stopped before the calculated amount of water is removed, if the following conditions have all been met during the previous 2 out of 3 consecutive hours:

- The temperature of the oil bath was **180°**F or more.
- A vacuum of 20" or more mercury existed in the cylinder.
- Not more than 0.30 lbs. water/cubic ft. of wood in the cylinder was recovered.

Moisture content after treatment shall be taken on one charge per week and shall not exceed the following averages from 20 - 3" cores:

Oak-hickory 50% moisture content
Mixed hardwood 40% moisture content.

2.5 Processing and Handling

2.5.1 TSO Tie Orders

Prior to being loaded on trams for preservative treatment and/or Boultonizing, all ties shall be double end-trimmed square to 8'6" length, inspected, graded and end-branded with the letters 'NS', plant location, and year treated. Letters shall be a minimum of 1" high, 1/2" wide, and 1/8" deep. Letter designations for plant locations are as follows:

A – Koppers, Glenvar, VA	R – Stella-Jones, McAlisterville, PA
B – Stella-Jones, DuBois, PA	S – Koppers, Susquehanna, PA
C – Stella-Jones, Cordele, GA	V – Stella-Jones, Goshen, VA
G – Koppers, Guthrie, KY	W – Stella-Jones, Winslow, IN
K – Cahaba, Brierfield, AL	X – Stella-Jones, Montevallo, AL
M – Mellott, Needmore, PA	

2.5.2 Black Tie Orders

Prior to being loaded on trams for preservative treatment and/or Boultonizing, all ties shall be double end-trimmed square to 8'6" length, inspected, graded and end-branded/plated with an approved letter(s) to identify the plant location, and year treated. Letters shall be a minimum of 1" high, 1/2" wide, and 1/8" deep.

Inspection and grading shall consist of the examination of all four surfaces and both ends of the tie. Acceptance is based on the requirements of this specification.

2.5.3 Incisor heads must be well-maintained to assure an average penetration depth of 1/2" minimum for each tooth for the full length of the tie. A bar will be replaced when any two adjacent teeth are missing or damaged or more than three teeth are missing from the entire length of the bar.

2.6 Treatment and Preservatives

The methods, requirements, and specifications to insure proper handling, conditioning and treatment of ties shall be governed first by NS Specifications and supplemented secondly with current AWPAs Standards, with the following exceptions:

Treatment shall be by the empty cell method with a creosote/coal tar solution in accordance with AWPAs Standard P-2. The preservative solution shall be tested monthly according to current AWPAs Standard with a copy of the results maintained for a representative of Norfolk Southern Corp to review.

Net retention shall not be less than 8 lbs. / cubic ft. in oak-hickory and 10 lbs. / cubic ft. in mixed hardwoods by gauge or until refusal.

Net retention of creosote for creosote-borate dual treated ties shall not be less than 6 pcf in oak-hickory and 6 pcf in mixed hardwoods by gauge or until refusal, with a 0.28 pcf DOT of borate retention.

2.6.3 Air-Dry Treatment – All air-dried charges of ties shall be held in 180-210°F oil for a minimum of 6 hours. This time will be a combination of pressure and preheating in oil to achieve sterilization and deeper distribution of creosote in air-dried material. Preheating time will begin only after 180°F is attained. These preheats will have only the “initial air” pressure applied and will be 1 hour minimum for both oak-hickory and mixed hardwood. Pressure periods will include only the time at 200 psi or more, and will be sufficient to meet desired retentions. Each layer of ties on the tram shall be separated with one ¾” steel spacer placed on alternate ends as the layers are built.

2.6.2 Boulton Treatment -Pressure periods will include only the time at 200 psi or more, and will be sufficient to meet desired retentions. Each individual charge or “lot” of treated ties must have process records retained for review by Norfolk Southern Corp. representatives. These records shall be maintained for a minimum of 7 years.

All tie treatment facilities shall certify on invoices that treated ties meet the appropriate Norfolk Southern specifications and AWPA standard treating requirements.

2.7 Inspection After Treatment

Except as hereinafter provided, all after-treatment inspection tests shall be made in accordance with requirements stipulated in current AWPA Standards. Each treated charge of ties will be tested for penetration of preservative after removal from the treating cylinder or retort. This visual test shall consist of at least 20 borer cores taken randomly throughout the charge of material to be representative of the charge as a whole. All borings made for the penetration test shall be made on the 6” or 7” side of the tie midway between the ends and midway between the top and bottom to a minimum depth of 3 ½”. All holes made during boring shall be plugged with tight fitting, treated plugs. If 80% of the test cores in any charge meet the annual ring penetration requirements, that charge shall be accepted.

Minimum penetration requirements for DOT will be per current AWPA standards. Spray all dual treated borings with 2 part curcumin solution to visually check for borate penetration. These should be the same borings used for the visual determination of creosote penetration.

Dual treated crossties shall bear a 1/8” wide by 1/8” deep kerf mark across the top and bottom face of one end positioned approximately 9” from the end.

2.7.1 Minimum penetration requirements for oak-hickory charges are as follows:

White Oak 95% of sapwood annual rings

Red Oak 65% of annual rings in a 3 ½" test core
Hickory 90% of sapwood annual rings

Bore only the red oak and hickory to assess the penetration results of oak-hickory charges.

If the average red oak and hickory penetration of the 20 test cores meets the penetration requirements, the charge shall be accepted.

Charges of white oak with less penetration may be accepted, if the wood is conditioned properly, and treatment continued to refusal.

2.7.2 Minimum penetration requirements for mixed hardwoods are as follows:

Blackgum 2 ½" solid or 90% of sapwood rings
Mixed Hardwood 90% of sapwood rings

2.7.3 Assay extractions by zone (0-1", 1-2", 2-3") on a 3" core, as per AWPA A-6 shall be done weekly, or more often as required by any of the following; the supplier's Quality Assurance representative, treating supervisor or Norfolk Southern representative.

Only red oak and hickory ties shall be assayed to determine if adequate retention levels are being obtained in the oak – hickory charges, but any of the mixed hardwoods may be assayed. Assay results should be at least 70% of gauge retentions. Assays for DOT shall be done regularly as dictated by the dual-treatment section of this specification and the plants written procedure.

No charge shall be pulled from the cylinder for refusal with less than the specified amount of treating solution injected **absorbed in each of any two consecutive half-hours is not more than 2% of the amount already injected.**

All treated borings must be stored in sealed zip-loc plastic bags with the charge number, tie size, species, date, and retention clearly marked on the bag. These bags must be kept in date order until inspected by the NS representative.

Treatment to refusal does not, however, constitute an acceptable alternative to minimum penetration and/or retention requirements specified under results of treatment except as specifically listed.

2.8 Retreatment

Treated industrial grade ties not conforming to the minimum requirements for retention and/or penetration may be retreated and re-offered for acceptance in accordance with **current** AWPA Standards and the following conditions:

- Industrial Grade tie charges to be retreated will be heated in **180-210°F** oil for 3 hours before applying pressure. A pressure period of 2 hours at 200 psi will be required to improve penetration.
- When a charge is retreated, the total retention as a result of all treatments must be sufficient to satisfy the requirements for both net retention and penetration.

-Ties may not be retreated more than twice.

2.9 Inspection, Care and Handling after Treatment

Treated ties shall be inspected for all of the defects outlined in Section 2.4. Soft areas can be probed for soundness as well.

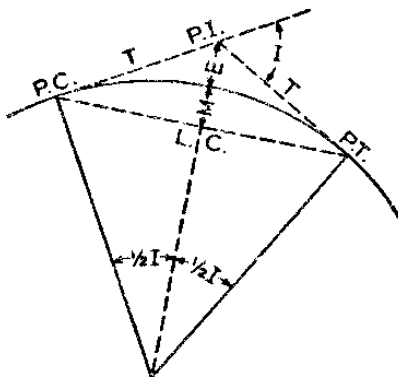
Ties that are to be plated, or re-worked in any way must be separated and marked for re-work. All rejects shall be separated and marked as rejects.

All treated ties not handled directly from tram to car must be carefully and neatly stored. Different size classifications must be kept separate, and all bundles or stacks must be marked with 'NS', grade, and treatment date. All ties must be stacked to ensure that tie straightness is not impaired during temporary storage. Treated stringers must be placed underneath all stacks of treated ties. No loose windrows of NS treated ties will be allowed. Shipments are to be made from the oldest stacks first. If any ties become excessively bleached during storage, they will be retreated or replaced by the vendor if not properly rotated. Yard drainage conditions must provide rapid drainage of water from beneath stacks of treated ties. Storage areas must be kept free of grass and weeds to aid in the free flow of air and to minimize the possibility of fire. The vendor shall be liable for all fire damage while NS crosstie inventory is located on the property of the vendor. Care must be exercised in the handling of NS crossties for storage or shipment to prevent damage which affects the utility of the crosstie in service.

For shipments already delivered, compliance with Section 2.4 of the specification shall be deemed satisfactory if no more than 5% of the ties in any given shipment are considered borderline compliant. This 5% allowance is only for subjective variation in the judgment of the inspectors. NS reserves the right to refuse any obvious rejects.

CURVE AND REDUCTION TABLES

Published by Eugene Dietzgen Co.



CURVE FORMULAS

1. Radius : $R = \frac{50}{\sin D/2}$
2. Degree of Curve: $D = 100 \frac{I}{L}$ Also, $\sin D/2 = \frac{50}{R}$
3. Tangent : $T = R \tan \frac{1}{2} I$. Also, $T = \frac{T \text{ for } 1^\circ \text{ curve}}{D} + C$.
4. Length of Curve: $L = 100 \frac{I}{D}$
5. Long Chord : $L. C. = 2R \sin \frac{1}{2} I$.
6. Middle Ordinate: $M = R (1 - \cos \frac{1}{2} I)$
7. External : $E = \frac{R}{\cos \frac{1}{2} I} - R$. Also, $E = T \tan \frac{1}{4} I$.

EXPLANATION AND USE OF TABLES

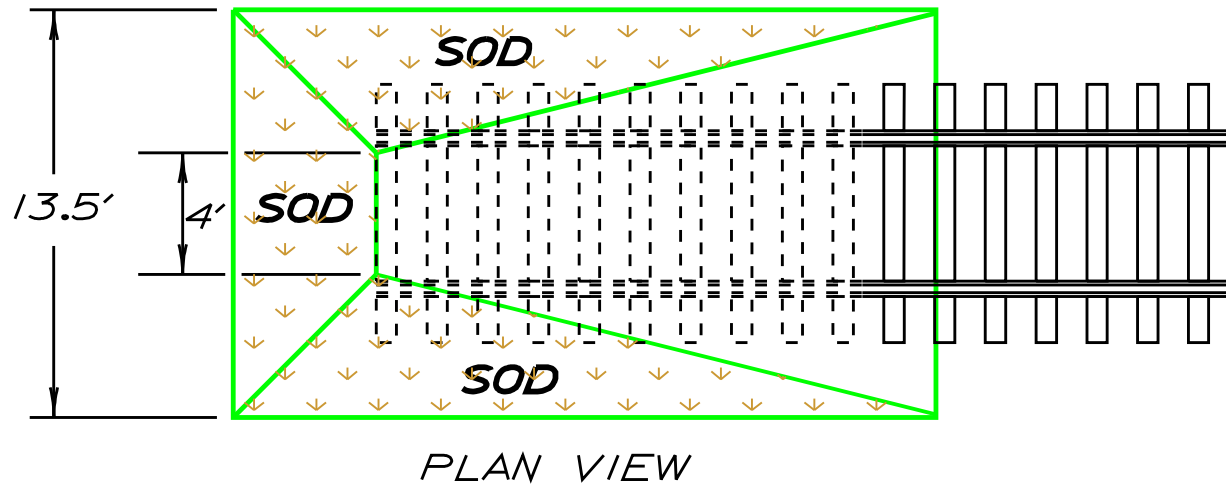
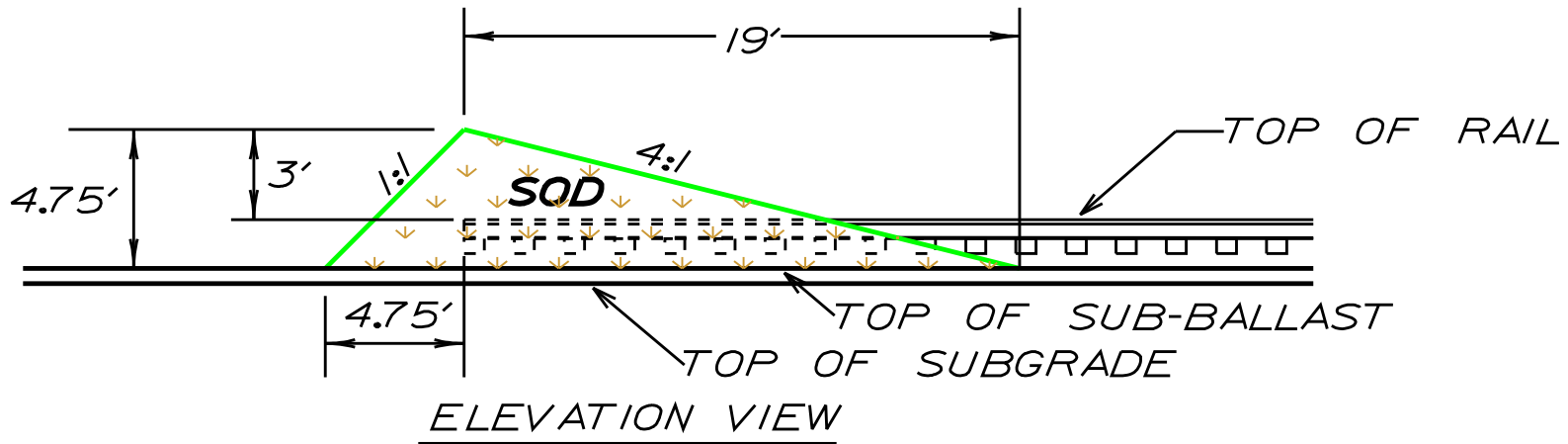
Given P.I. Sta. 83+40.7, $I = 45^\circ 20'$ and $D = 6^\circ 30'$ find:

Stations—P. C. = P. I. — T. $T = \frac{T \text{ for } 1^\circ \text{ Curve}}{D} + C$. From Tables V and VI
 $T = \frac{2392.8}{6.5} + .197 = 368.32 = 3 + 68.32$. Sta. P. C. = 83 + 40.7 — (3 + 68.32) = 79 + 72.38.
 P. T. = P. C. + L, and $L = 100 \frac{I}{D} = 100 \frac{45.33}{6.5} = 697.38$ Therefore, P. T. = (79 + 72.38) + (6 + 97.38) = 86 + 69.76.

Offsets—Tangent offsets vary (approximately) directly with D and with the square of the distance. From Table III Tangent Offset for 100 feet = 5.669 feet. Distance = 80 — Sta. P. C. = 27.62. Hence offset = $5.66 \times \left(\frac{27.62}{100}\right)^2 = .432$ ft. Also, square of any distance, divided by twice the radius equals (approximately) the distance from tangent to curve. Thus $(27.62)^2 \div (2 \times 881.95) = .432$ ft.

Deflections—Deflection angle = $\frac{1}{2} D$ for 100 ft., $\frac{1}{4} D$ for 50 ft., etc. For "X" ft., Deflection Angle (in minutes) = $.3 \times X \times D$. For Sta. 80 of above curve Deflection Angle = $.3 \times 27.62 \times 6.5 = 53.86'$. Also Deflection Angle = dfl. for 1 ft. from Table III $\times X = 1.95 \times 27.62 = 53.86'$. For Sta. 181 Deflection Angle = $53.86' + \frac{6^\circ 30'}{2} = 4^\circ 8.86'$.

Externals—From Table V for 1° curve, with central angle of $45^\circ 20'$, $E = 479.6$. Therefore, for $6^\circ 30'$ curve, $E = \frac{479.6}{6.5} +$ Correction from Table VI = $7.378 + .039 = 7.417$.



NORFOLK SOUTHERN RAILWAY COMPANY

EARTH MOUND DETAIL

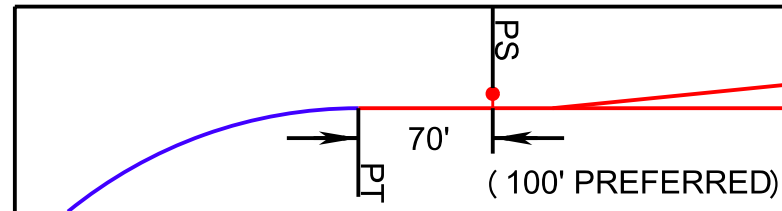
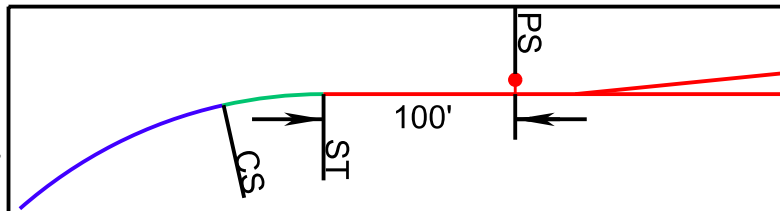
AUGUST 2000
Atlanta, Georgia

PLACEMENT OF INDUSTRY TURNOUTS

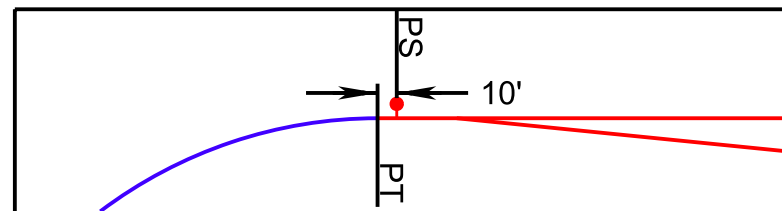
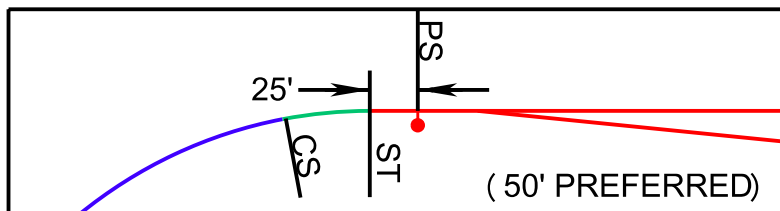
MAIN TRACKS

ALL OTHER TRACKS

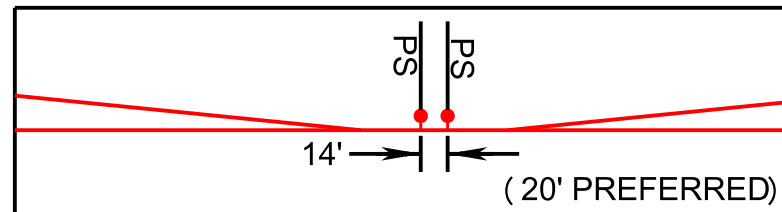
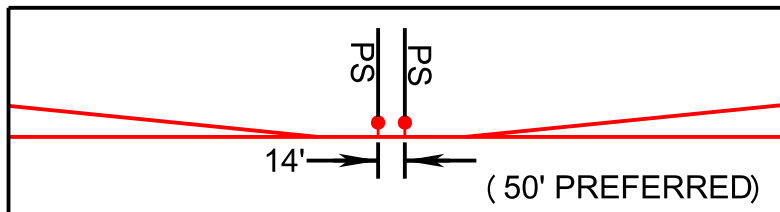
TURNOUT
ON OPPOSITE SIDE
OF PRECEDING CURVE



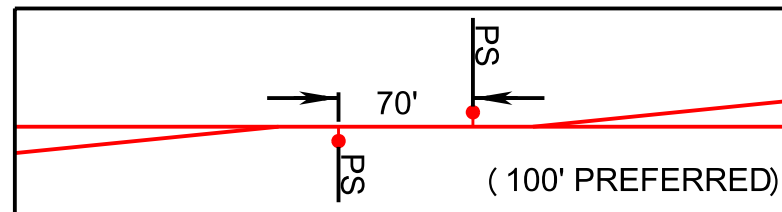
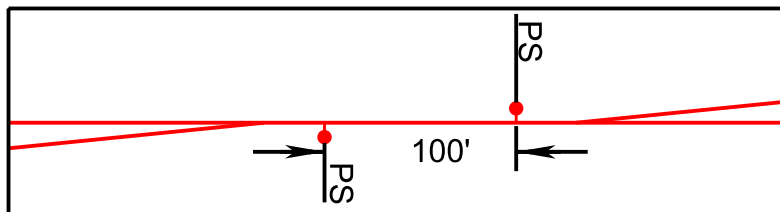
TURNOUT
ON SAME SIDE
AS PRECEDING CURVE



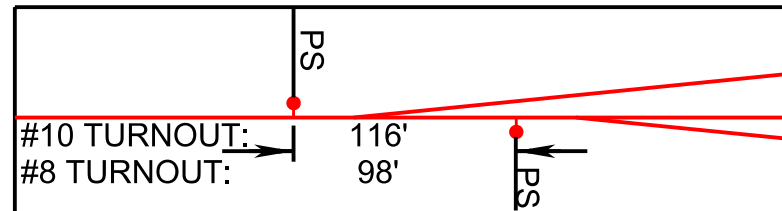
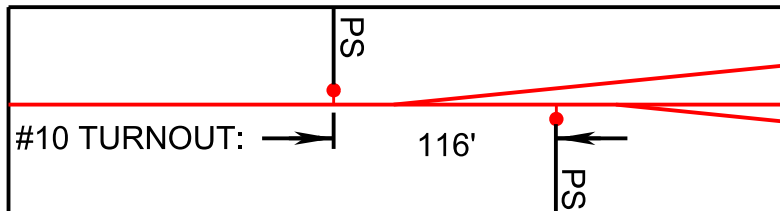
FACING TURNOUTS
ON THE SAME SIDE



FACING TURNOUTS
ON OPPOSITE SIDES



TURNOUTS ONE
BEHIND THE OTHER
OPPOSITE SIDE



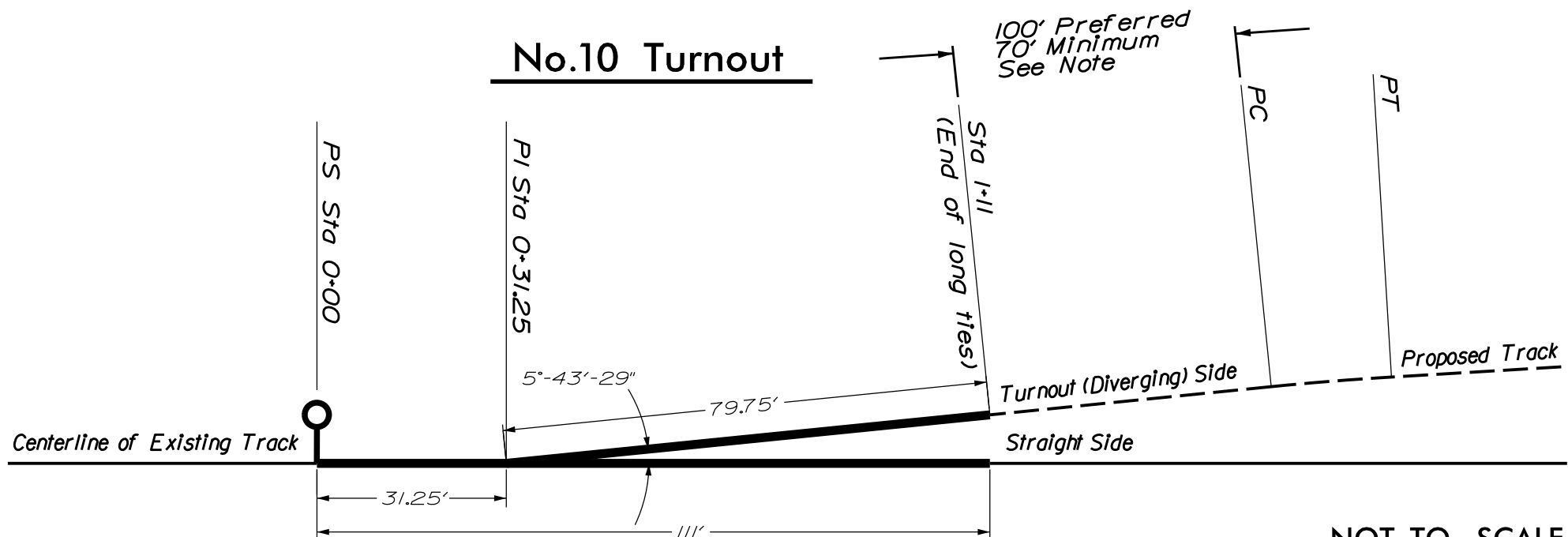
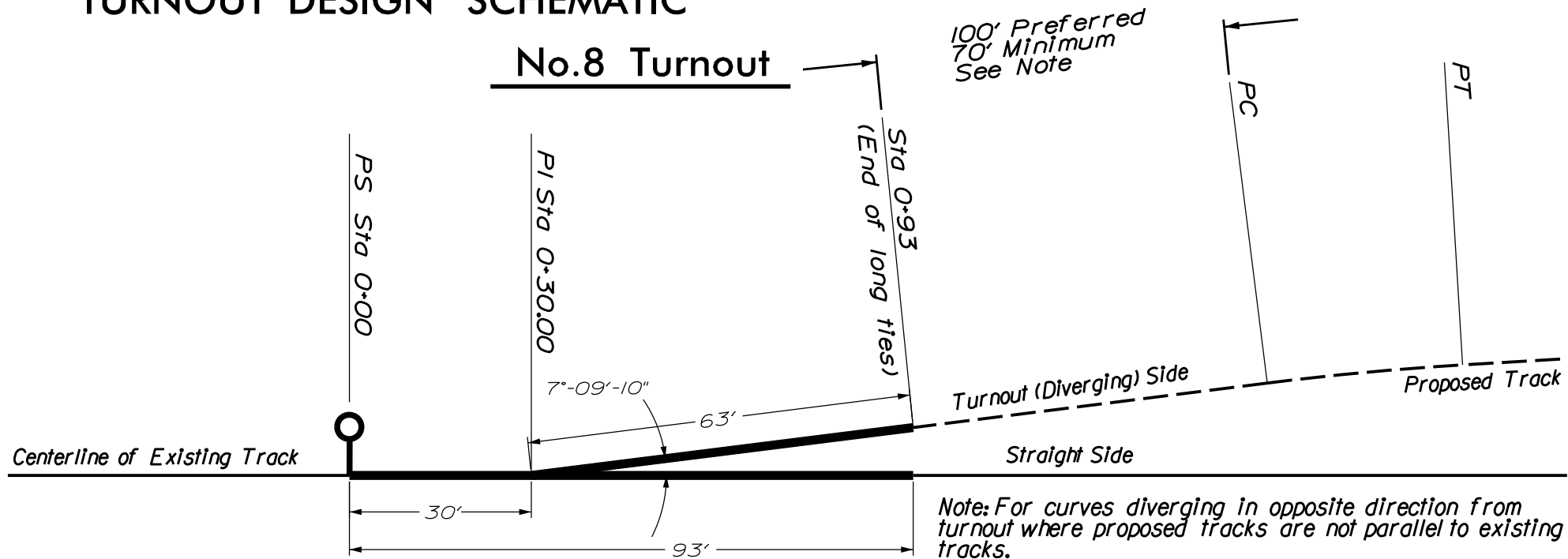
TURNOUTS ONE
BEHIND THE OTHER
SAME SIDE



NOTE: DISTANCES SHOWN ARE MINIMUMS

NORFOLK SOUTHERN RAILWAY CO. TURNOUT DESIGN SCHEMATIC

DETAIL



NOT TO SCALE

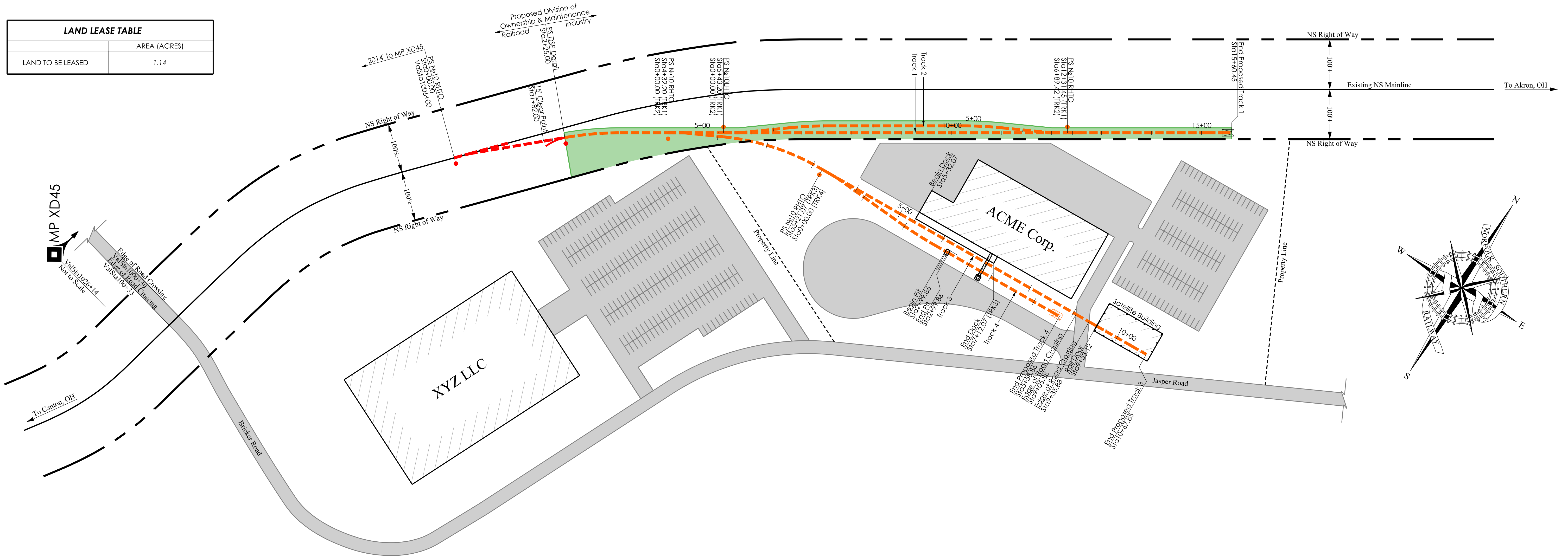
Legend

- Existing NS Track
- Existing Industry Track
- Proposed NS Track
- Proposed Industry Track
- Track to be Removed
- Ex. Property Line
- Ex. NS ROW
- Ex. Overhead Wire
- Ex. Fiber Optic Cable
- Ex. Pavement or Concrete
- Ex. Buildings
- Lease of ROW

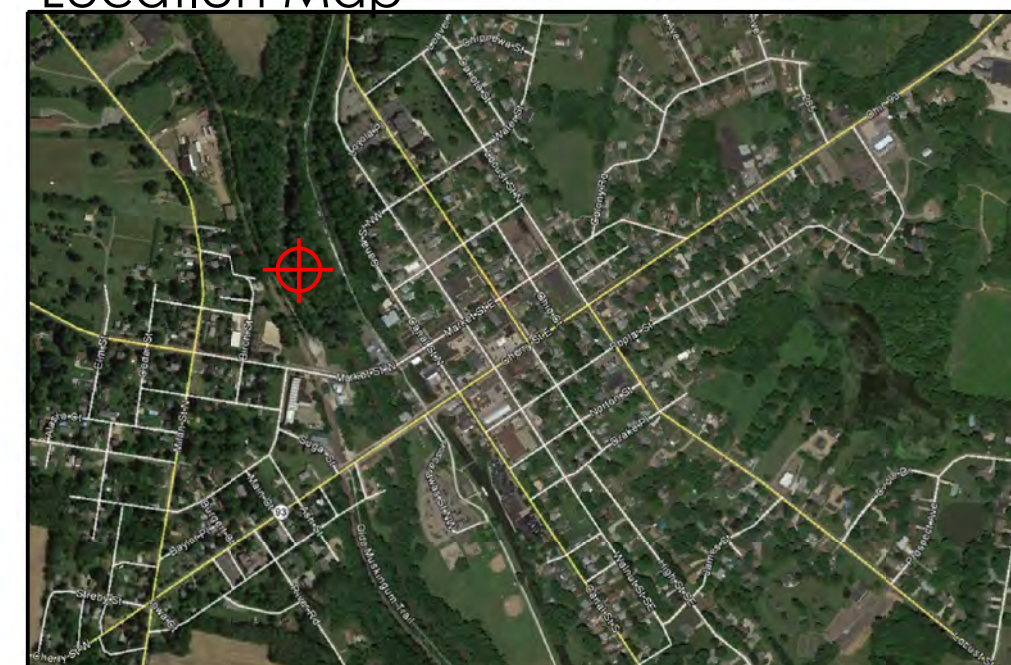
TRACK LEASE TABLE		COORDINATE SYSTEM = UTM83-17F / OH83 NF					
BEGIN LEASE	TRACK #1		TRACK #2		TRACK #3		LEASE SUMMARY
	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	
	N/A	N/A	N/A	N/A	N/A	N/A	
END LEASE	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	
	N/A	N/A	N/A	N/A	N/A	N/A	
LEASE LENGTH	N/A		N/A		N/A		N/A

SIDE TRACK AGREEMENT TABLE		COORDINATE SYSTEM = UTM83-17F / OH83 NF							
BEGIN TRACK	TRACK #1		TRACK #2		TRACK #3		TRACK #4		
	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	
	0+00				0+00			0+00	
DIVISION OF OWNERSHIP & MAINTENANCE	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	
	2+25	-81.602277, 40.895395							
END TRACK	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	STATION	COORDINATES	
	15+60.45		6+89.42		10+67.85		5+58.86		
CLEAR TRACK CAPACITY	550 TF		6+89.42		300 TF		240 TF		

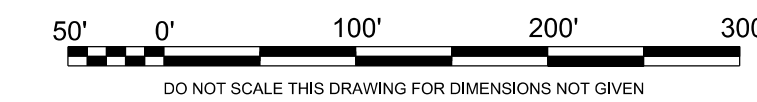
LAND LEASE TABLE	
LAND TO BE LEASED	AREA (ACRES)
	1.14



Location Map



SCALE: 1"=100'



1289 Brookwood Park Drive
Akron, Ohio 44322
The office of John Doe, PE
Drawing Number: 02387
Drawing Date: 05/15/2020
Customer: ACME Corp.
Project Location: Canal Fulton, OH

<input type="checkbox"/>	PLAN PREPARED BY OUTSIDE PARTY - SUBMITTED TO NS D&C FOR REVIEW.
<input type="checkbox"/>	PLAN PREPARED BY NS D&C USING INFORMATION PROVIDED BY OTHERS.
<input type="checkbox"/>	PRELIMINARY PLAN - APPROVED BY NS TRANSPORTATION ON: 04/01/2020
<input type="checkbox"/>	APPROVED PLAN - ACCEPTED FOR CONSTRUCTION BY NS D&C ON:

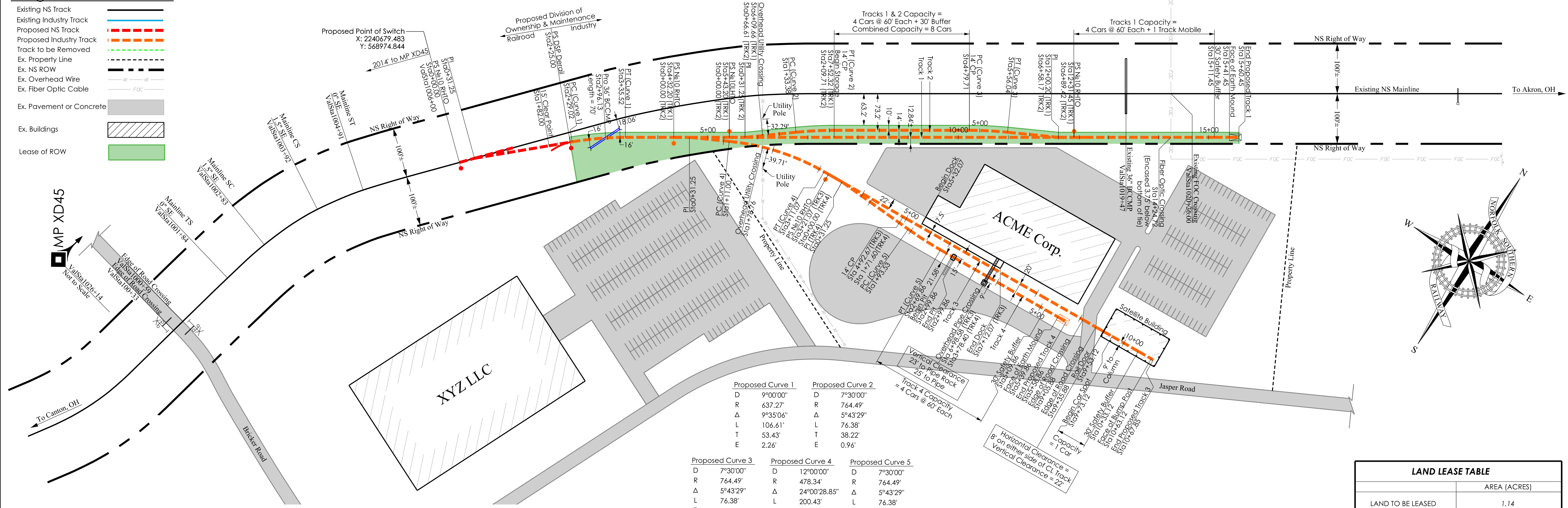
NS NORFOLK SOUTHERN
NORFOLK SOUTHERN RAILWAY CO.
DEARBORN DIVISION

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

REV	BY	DATE	DESCRIPTION
DESIGNED BY	TMH	LOCATION	CANAL FULTON, OH
PROJECT NO.	ID2463	TITLE	PROPOSED TRACK TO SERVE ACME CORP. AGREEMENT PLAN
DATE	17 OH / 23	FILE	TRK0103584
DATE	05/15/2020	DRAWING NUMBER	AD-2020-58A

Legend

- Existing NS Track
- Existing Industry Track
- Proposed NS Track
- Proposed Industry Track
- Track to be Removed
- Ex. Property Line
- Ex. NS ROW
- Ex. Overhead Wire
- Ex. Fiber Optic Cable
- Ex. Pavement or Concrete
- Ex. Buildings
- Lease of ROW

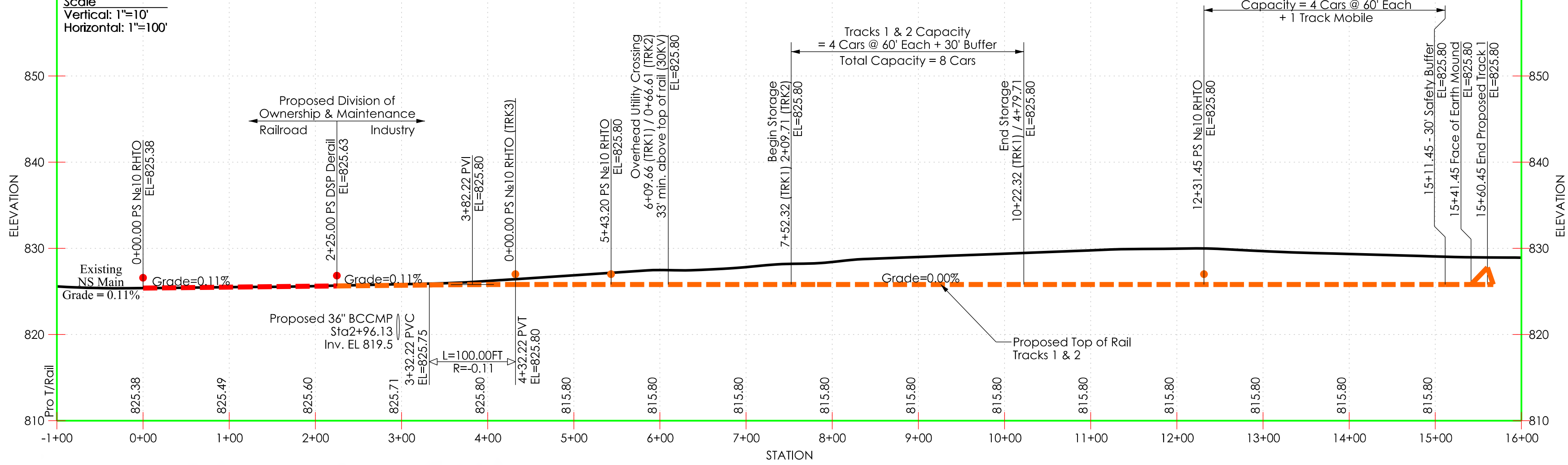


Proposed Curve 1		Proposed Curve 2		Proposed Curve 3		Proposed Curve 4		Proposed Curve 5	
D	9°00'00"	D	7°30'00"	D	7°30'00"	D	12°00'00"	D	7°30'00"
R	637.27'	R	764.49'	R	764.49'	R	478.34'	R	764.49'
Δ	9°35'06"	Δ	5°43'29"	Δ	5°43'29"	Δ	24°00'28.85"	Δ	5°43'29"
L	106.61'	L	76.38'	L	76.38'	L	200.43'	L	76.38'
T	53.43'	T	38.22'	T	38.22'	T	101.71'	T	38.22'
E	2.26'	E	0.96'	E	0.96'	E	10.69'	E	0.96'

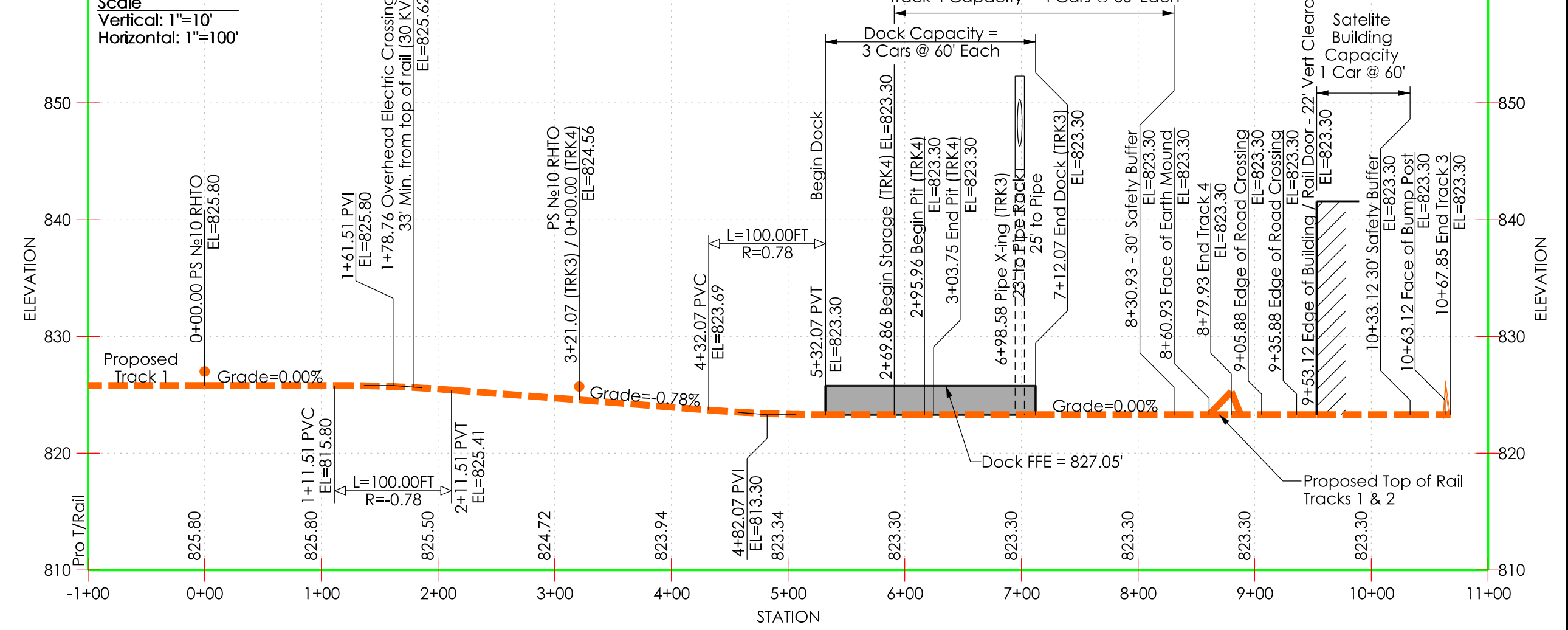
LAND LEASE TABLE

LAND TO BE LEASED	AREA (ACRES)
	1.14

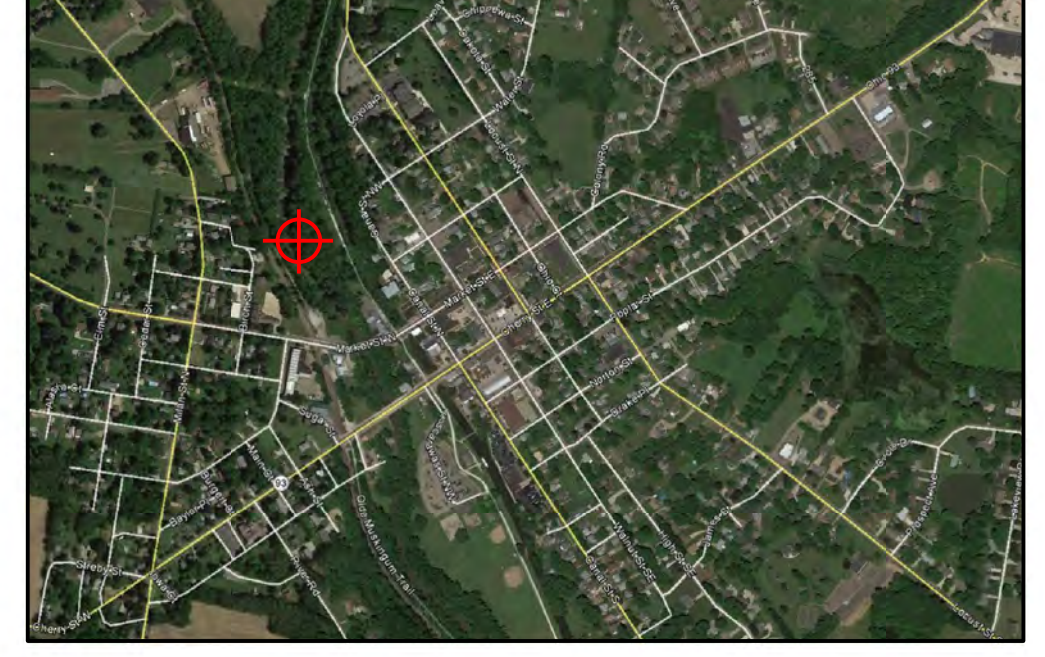
Profile - Proposed Tracks 1 & 2



Profile - Proposed Tracks 3 & 4



Location Map



Notes

- Grading, drainage and placement of sub-ballast for the entire project to be performed by the applicant at their expense.
- Proposed drainage structures to be extended and/or installed must meet A.R.E.M.A. Part 5 Specifications and be of sufficient length to comply with NS standards.
- Existing and/or proposed utilities are to be relocated, adjusted and/or protected by the applicant at their expense and must meet NS minimum clearance standards.
- Clearances to existing or proposed structures must adhere to NS standard plans 7-1 and SP-1621.
- Detail plans of the proposed loading and/or unloading facilities, including horizontal and vertical clearances, are to be approved by the industry before construction.
- All plans for unloading/loading structures, extensions of railway drainage structures, or retention ponds which empty into railway drainage structures must be approved by the NS Bridge and Structures Department prior to any construction.
- Bonding of tracks (if required) shall adhere to NS standard plan SP-701.
- A bow handled throw is required for all switches.
- This plan was not prepared or intended for use as a real estate title map.
- Valuation stationing based on existing NS Culvert (ValSta1019+47)
- Track plan based on Xenos Rail Consulting survey (January 14th, 2017)
- Tie and rail at clear points without a deraill are to be painted fluorescent green.

Critical PTC Coordinates

Location	Y (N)	X (E)	Latitude	Longitude
Mainline Switch	568974.844	2240679.483	40.895809	-81.602202
DSP Deraill	569125.449	2240846.465	40.895395	-81.602277
End Track 1	569834.478	2241977.663	40.894730	-81.601880
End Track 3	569340.566	2242065.179	40.895273	-81.603211
End Track 4	569366.933	2241877.158	40.893765	-81.602084

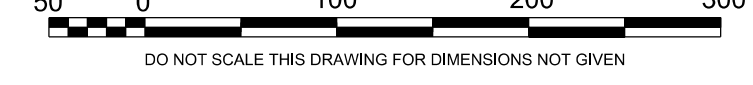
Operations

Car Type	Car Size	Commodity	Loading/Unloading
Box Car	60'	Food Products	NS will bring full cars and spot them directly on track 3, or store them on tracks 1 & 2 to later be switched by the industry. Dock and satellite building will be used to unload.
Hopper	60'	Grain	NS will bring full cars and spot them directly on Track 4, or store them on tracks 1 & 2 to later be switched by the industry. A rail pit will be used to unload.

Control Points (NAD83 OH N)

Point Number	Northing	Easting	Elevation	Description
1	568015.576	2241789.567	936.025	Rebar w/ cap
2	569304.326	2241365.784	938.158	PK Nail in file
3	567814.387	2240684.364	935.741	Rebar w/ cap
4	569457.628	2240876.124	929.189	Rebar w/ cap
5	56849.842	2240012.389	932.267	Rebar w/ cap
6	570841.856	2241361.589	940.325	Rebar w/ cap
159	571375.986	2240786.815	928.249	Monument Found

SCALE: 1"=100'



1289 Brookwood Park Drive
Akron, Ohio 44322
The office of John Doe, PE
Drawing Number: 02387
Drawing Date: 05/15/2020
Customer: ACME Corp.
Project Location: Canal Fulton, OH

PLAN PREPARED BY OUTSIDE PARTY - SUBMITTED TO NS D&C FOR REVIEW.
 PLAN PREPARED BY NS D&C USING INFORMATION PROVIDED BY OTHERS.
 PRELIMINARY PLAN - APPROVED BY NS TRANSPORTATION ON: 04/01/2020
 APPROVED PLAN - ACCEPTED FOR CONSTRUCTION BY NS D&C ON:

NS NORFOLK SOUTHERN
NORFOLK SOUTHERN RAILWAY CO.
DIVISION COMPANY

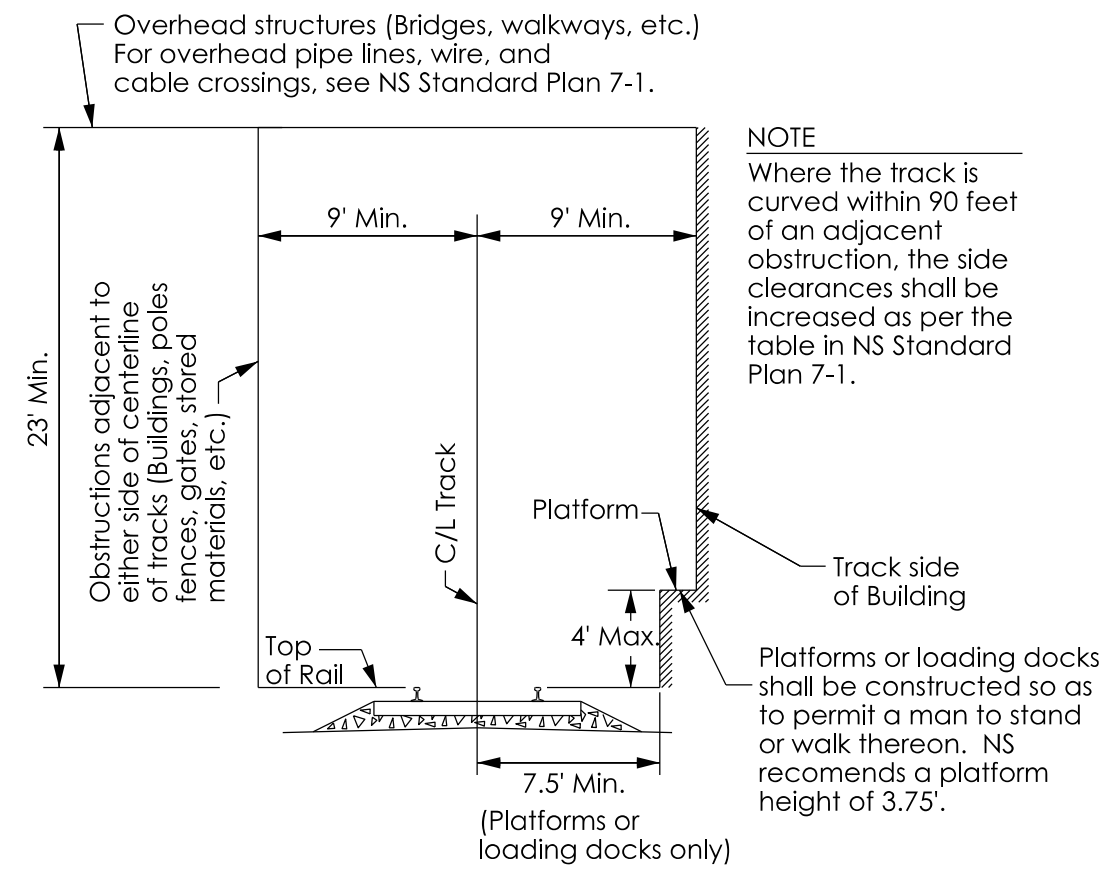
DEARBORN DIVISION

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

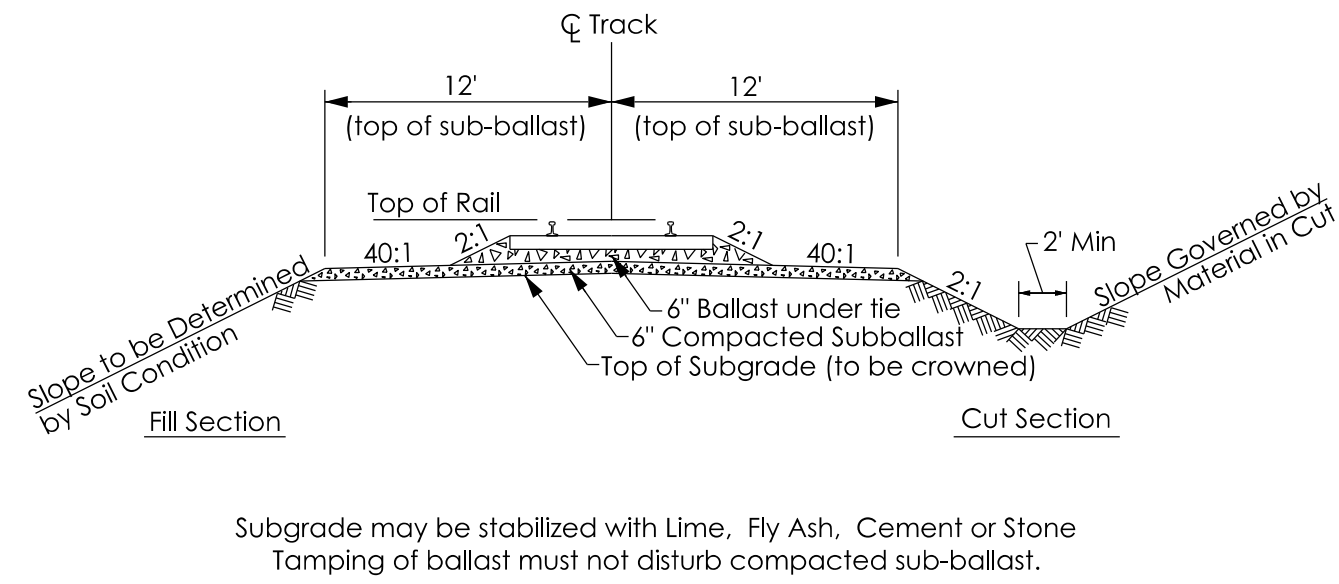
REV	BY	DATE	DESCRIPTION
1	TMH	05/15/2020	CANAL FULTON, OH

DRAWN BY: ID2463
 CHECKED BY: 10385
 FILE: TRK1013584
 DRAWING NUMBER: 02387
 PROJECT: PROPOSED TRACK TO SERVE ACME CORP. SIDETRACK DESIGN PLAN
 SCALE: 1"=100'
 DATE: 05/15/2020
 SHEET: 17 OH / 23
 FILE POST: XD45.38
 DRAWING NUMBER: TRK1013584
 DRAWING NUMBER: 02387
 SHEET: AD-2020-58

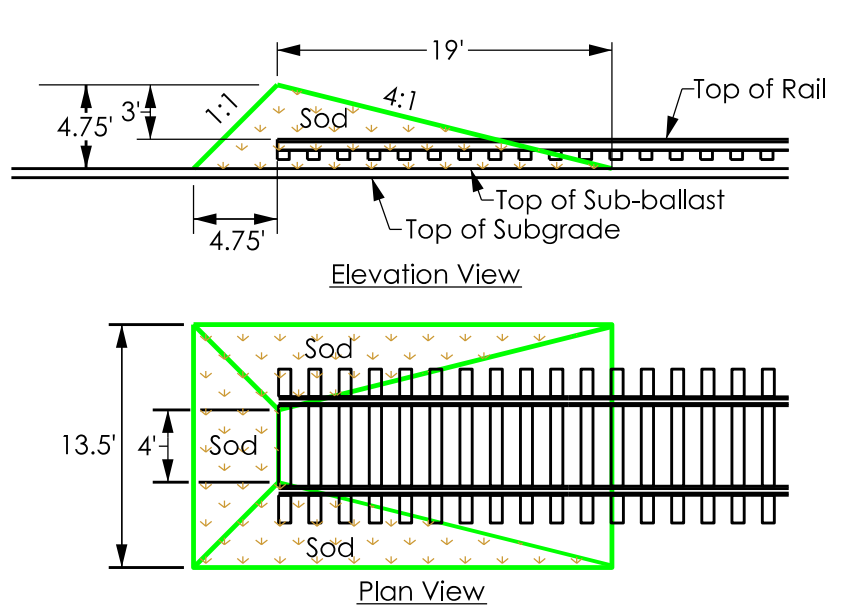
Typical Clearance Section NOT TO SCALE



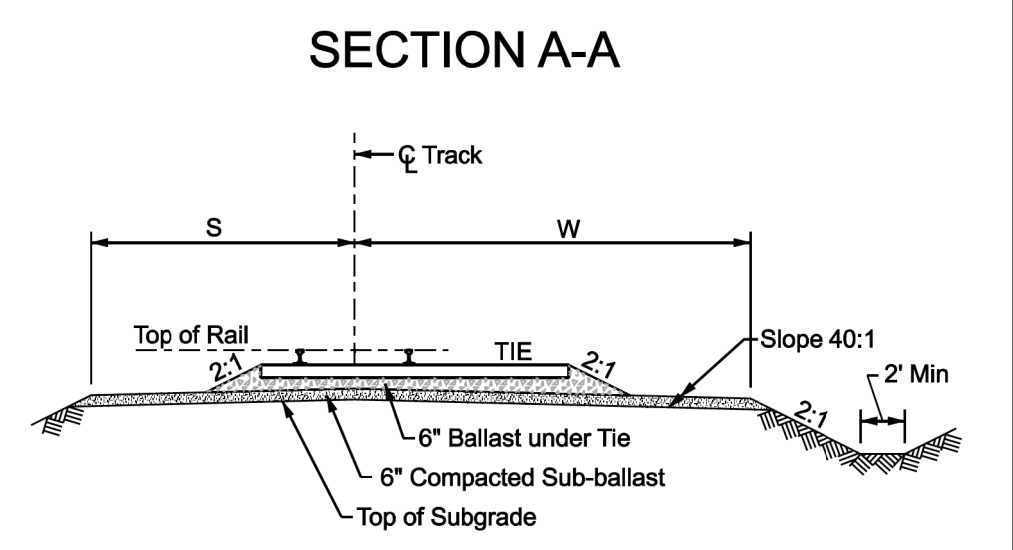
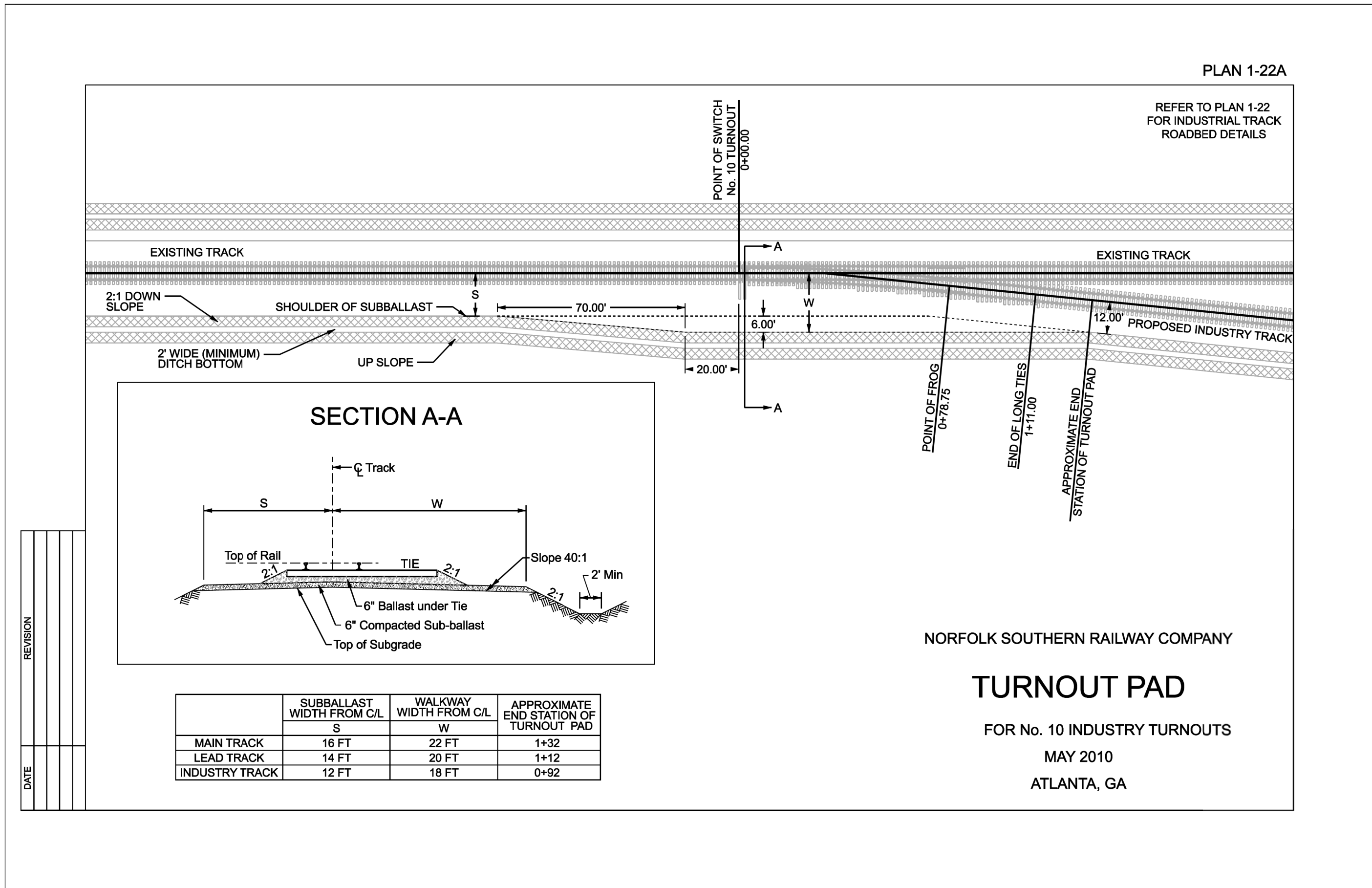
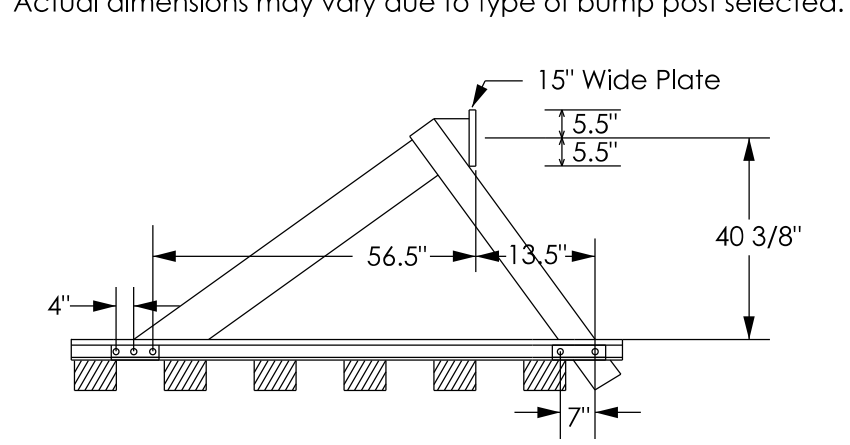
Roadbed Section - Industrial Track NOT TO SCALE



Earthmound Detail NOT TO SCALE



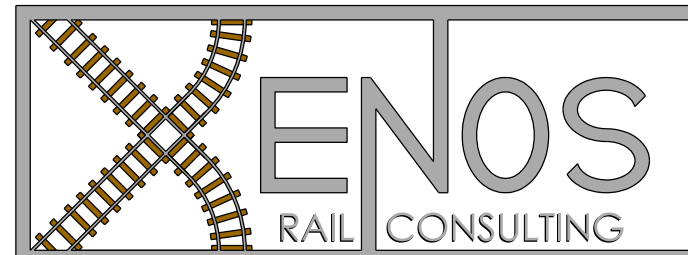
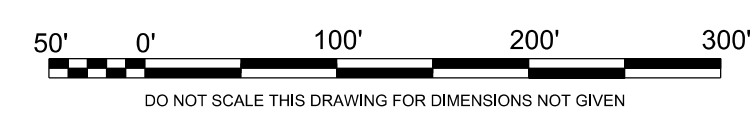
Bumping Post Detail NOT TO SCALE



	SUBBALLAST WIDTH FROM C/L	WALKWAY WIDTH FROM C/L	APPROXIMATE END STATION OF TURNOUT PAD
	S	W	
MAIN TRACK	16 FT	22 FT	1+32
LEAD TRACK	14 FT	20 FT	1+12
INDUSTRY TRACK	12 FT	18 FT	0+92

REVISION	DATE

SCALE: 1"=100'



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Drawing Number: 02387
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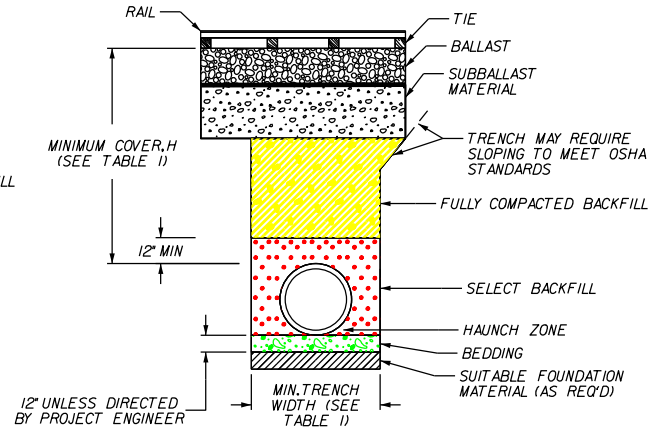
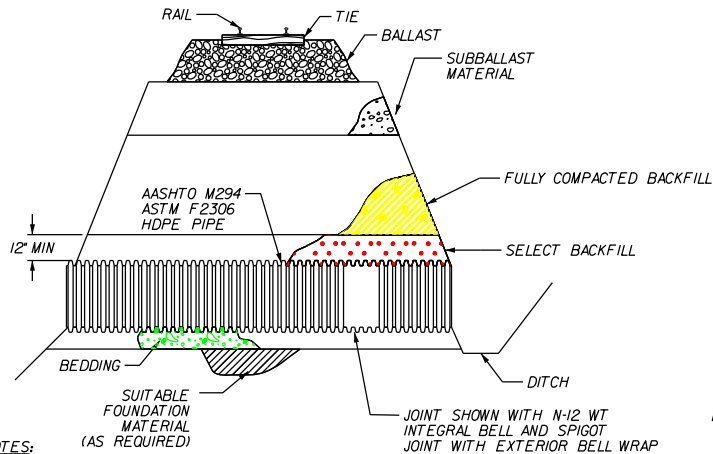
PLAN PREPARED BY OUTSIDE PARTY - SUBMITTED TO NS D&C FOR REVIEW.
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 APPROVED PLAN - ACCEPTED FOR CONSTRUCTION BY NS D&C ON:







NORFOLK SOUTHERN RAILWAY CO.
 DEARBORN DIVISION
 OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA

REV	BY	DATE	DESCRIPTION

RECEIVED BY: TMH LOCATION: CANAL FULTON, OH
 PD# ID2463 FILE PROPOSED TRACK TO SERVE ACME CORP.
 WRN 10385 FILE SIDETRACK DESIGN PLAN
 VAL SEC / MAP 17 OH / 23 FILE TRK0103584 DRAWING NUMBER
 FILE POST XD45.38 DATE 05/15/2020 AD-2020-58

UNDER PROPOSED TRACK



-  BALLAST
-  SUBBALLAST
-  BACKFILL
-  SELECT BACKFILL
-  BEDDING
-  FOUNDATION

NOTES:

1. ALL PIPE SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321, "STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PIPE FOR SEWERS AND OTHER GRAVITY FLOW APPLICATIONS", LATEST EDITION
2. MEASURES SHOULD BE TAKEN TO PREVENT MIGRATION OF NATIVE FINES INTO OPEN GRADED MATERIAL.
3. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE UNSUITABLE MATERIAL TO THE REQUIRED DEPTH AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE DESIGN ENGINEER. DEPTH OF FOUNDATION IMPROVEMENT MAY BE REDUCED BY USE OF GEOTEXTILE FABRIC AND GRID. REQUIRED TRENCH WIDTH MAY INCREASE WHEN FOUNDATION MATERIALS ARE MODIFIED.
4. BEDDING: BEDDING MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM BEDDING THICKNESS SHALL NOT BE LESS THAN 12 INCHES. THE MIDDLE THIRD OF THE BEDDING SHALL BE LOOSE AND UNIFORM IN DEPTH AND CONSISTENCY. AFTER PIPE IS IN PLACE, COMPACT BEDDING TO SELECT BACKFILL STANDARDS. BEDDING SHALL BE COMPACTED TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99.
5. SELECT BACKFILL: SELECT BACKFILL MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM COMPACTION SHALL BE TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99. BACKFILL MATERIAL SHALL BE PLACED ALONGSIDE THE PIPE IN UNIFORM LAYERS AND COMPACTED. WHEN VIBRATORY COMPACTION EQUIPMENT IS USED IN CONJUNCTION WITH OTHER METHODS OF COMPACTION, THE COMPACTED DEPTH OF A SINGLE LAYER OF BEDDING MATERIAL SHALL NOT EXCEED 6 INCHES (6-9 INCHES LOOSE). WHEN NO VIBRATORY COMPACTION EQUIPMENT IS USED, THE MAXIMUM COMPACTED THICKNESS OF ONE LAYER SHALL NOT EXCEED 3 INCHES (3-6 INCHES LOOSE). IF A HAND TAMPER IS USED, IT SHALL WEIGH NOT LESS THAN 20 POUNDS AND HAVE A TAMPING FACE NOT LESS THAN 6 INCHES X 6 INCHES.
6. THE CONTRACTOR SHOULD PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATIONS TO DESIGN ENGINEER, WHERE BACKFILL VERIFICATION IS NOT PROVIDED OR WHERE BACKFILL MAY BECOME SATURATED AFTER PLACEMENT, ONLY ASTM CLASS I OR II (CLEAN) BEDDING AND BACKFILL SHOULD BE USED.
7. BEDDING MATERIAL SHALL BE PLACED AND COMPACTED UNDER THE HAUNCHES OF THE PIPE EXTENDING FROM THE BOTTOM OF PIPE UP TO A DISTANCE EQUAL TO 1/3 OF THE PIPE'S DIAMETER UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

TABLE I
RECOMMENDED MINIMUM TRENCH WIDTHS,
MIN. COVER^{1,2,3,4,5} AND MAX. COVER^{1,2,3,4,5}

PIPE DIA.	MIN. TRENCH WIDTH	MINIMUM COVER	MAX. COVER CLASS I	MAX. COVER CLASS II
12"	30"	2'	25'	20'
15"	34"	2'	25'	20'
18"	39"	2'	25'	20'
24"	48"	2'	25'	20'
30"	56"	3'	25'	15'
36"	64"	3'	25'	15'
42"	72"	4'	25'	15'
48"	80"	4'	25'	15'
54"	88"	4'	25'	15'
60"	96"	4'	25'	15'

1. COVER IS MEASURED FROM TOP OF PIPE TO BOTTOM OF RAILWAY TIE.
2. LOADS GREATER THAN E-80 LOAD MAY REQUIRE ADDITIONAL COVER.
3. MINIMUM COVER MAY BE INCREASED TO PREVENT PIPE DAMAGE DUE TO ROUTINE TRACK MAINTENANCE.
4. MANUFACTURER NEEDS TO VERIFY ALLOWABLE FILL HEIGHTS PER DESIGN LOADS.
5. FILL HEIGHT CALCULATIONS DO NOT TAKE IN TO CONSIDERATION GROUND WATER, WHERE GROUND WATER IS ENCOUNTERED HAVE THE MANUFACTURER VERIFY FILL HEIGHTS.

SCALE: NTS

DO NOT SCALE THIS DRAWING FOR DIMENSIONS NOT GIVEN

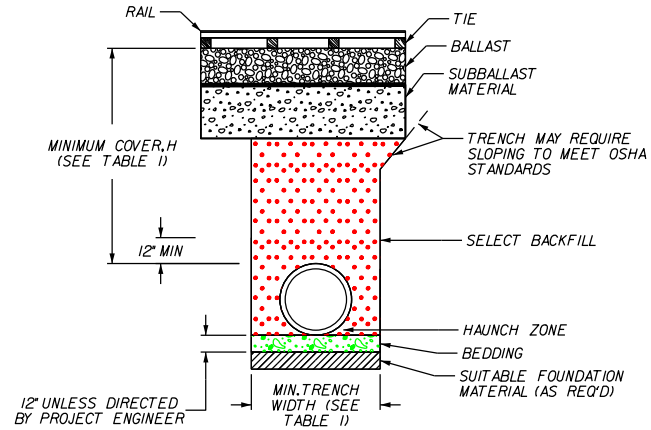
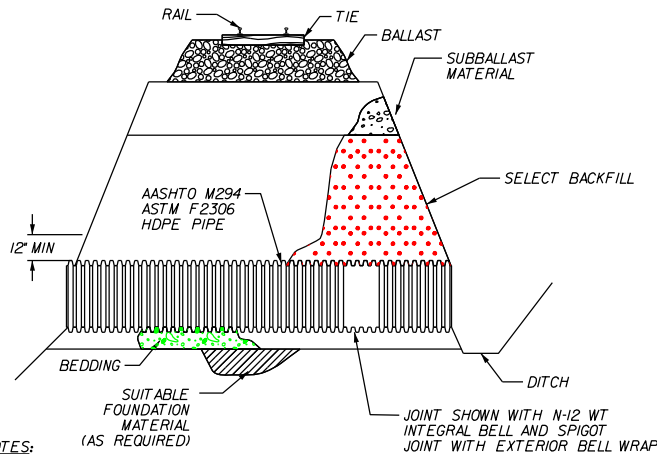


NORFOLK SOUTHERN RAILWAY COMPANY
OWNING COMPANY
SYSTEMWIDE
OPERATING DIVISION
OFFICE OF THE CHIEF ENGINEER - DESIGN AND CONSTRUCTION - ATLANTA, GA.






REV	BY	DATE	DESCRIPTION
LOCATION SYSTEMWIDE			
TITLE HDPE PIPE TYPICAL TRENCH DETAIL PROPOSED TRACK APPLICATIONS			
DGN	PID No.	VRN	MILE POST
DWN	FILE No.	DRAWING NUMBER	
CHK	DATE	DR-HDPE-1	
APRIL 18, 2017			

CADD FILE:

UNDER EXISTING TRACK



LEGEND

-  BALLAST
-  SUBBALLAST
-  SELECT BACKFILL
-  BEDDING
-  FOUNDATION

NOTES:

1. ALL PIPE SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ASTM D2321, "STANDARD PRACTICE FOR UNDERGROUND INSTALLATION OF THERMOPLASTIC PIPE FOR SEWERS AND OTHER GRAVITY FLOW APPLICATIONS", LATEST EDITION
2. MEASURES SHOULD BE TAKEN TO PREVENT MIGRATION OF NATIVE FINES INTO OPEN GRADED MATERIAL.
3. FOUNDATION: WHERE THE TRENCH BOTTOM IS UNSTABLE, THE CONTRACTOR SHALL EXCAVATE UNSUITABLE MATERIAL TO THE REQUIRED DEPTH AND REPLACE WITH SUITABLE MATERIAL AS SPECIFIED BY THE DESIGN ENGINEER. DEPTH OF FOUNDATION IMPROVEMENT MAY BE REDUCED BY USE OF GEOTEXTILE FABRIC AND GRID. REQUIRED TRENCH WIDTH MAY INCREASE WHEN FOUNDATION MATERIALS ARE MODIFIED.
4. BEDDING: BEDDING MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM BEDDING THICKNESS SHALL NOT BE LESS THAN 12 INCHES. THE MIDDLE THIRD OF THE BEDDING SHALL BE LOOSE AND UNIFORM IN DEPTH AND CONSISTENCY. AFTER PIPE IS IN PLACE, COMPACT BEDDING TO SELECT BACKFILL STANDARDS. BEDDING SHALL BE COMPACTED TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99.
5. SELECT BACKFILL: SELECT BACKFILL MATERIAL SHALL CONFORM TO CATEGORY B DENSE GRADED AGGREGATE IN ACCORDANCE WITH SECTION GA - GRADED AGGREGATE OF THE NS STANDARD SPECIFICATIONS UNLESS STATED OTHERWISE BY THE DESIGN ENGINEER OR PLANS. MINIMUM COMPACTION SHALL BE TO A DENSITY OF NOT LESS THAN 95 PERCENT IN ACCORDANCE WITH AASHTO T 99. BACKFILL MATERIAL SHALL BE PLACED ALONGSIDE THE PIPE IN UNIFORM LAYERS AND COMPACTED. WHEN VIBRATORY COMPACTION EQUIPMENT IS USED IN CONJUNCTION WITH OTHER METHODS OF COMPACTION, THE COMPACTED DEPTH OF A SINGLE LAYER OF BEDDING MATERIAL SHALL NOT EXCEED 6 INCHES (6-9 INCHES LOOSE). WHEN NO VIBRATORY COMPACTION EQUIPMENT IS USED, THE MAXIMUM COMPACTED THICKNESS OF ONE LAYER SHALL NOT EXCEED 3 INCHES (3-6 INCHES LOOSE). IF A HAND TAMPER IS USED, IT SHALL WEIGH NOT LESS THAN 20 POUNDS AND HAVE A TAMPING FACE NOT LESS THAN 6 INCHES X 6 INCHES.
6. THE CONTRACTOR SHOULD PROVIDE DOCUMENTATION FOR MATERIAL SPECIFICATIONS TO DESIGN ENGINEER, WHERE BACKFILL VERIFICATION IS NOT PROVIDED OR WHERE BACKFILL MAY BECOME SATURATED AFTER PLACEMENT, ONLY ASTM CLASS I OR II (CLEAN) BEDDING AND BACKFILL SHOULD BE USED.
7. BEDDING MATERIAL SHALL BE PLACED AND COMPACTED UNDER THE HAUNCHES OF THE PIPE EXTENDING FROM THE BOTTOM OF PIPE UP TO A DISTANCE EQUAL TO 1/3 OF THE PIPE'S DIAMETER UNLESS OTHERWISE DIRECTED BY THE ENGINEER.

TABLE I
RECOMMENDED MINIMUM TRENCH WIDTHS,
MIN. COVER^{1,2,3,4,5} AND MAX. COVER^{1,2,3,4,5}

PIPE DIA.	MIN. TRENCH WIDTH	MINIMUM COVER	MAX. COVER CLASS I	MAX. COVER CLASS II
12"	30"	2'	25'	20'
15"	34"	2'	25'	20'
18"	39"	2'	25'	20'
24"	48"	2'	25'	20'
30"	56"	3'	25'	15'
36"	64"	3'	25'	15'
42"	72"	4'	25'	15'
48"	80"	4'	25'	15'
54"	88"	4'	25'	15'
60"	96"	4'	25'	15'

1. COVER IS MEASURED FROM TOP OF PIPE TO BOTTOM OF RAILWAY TIE.
2. LOADS GREATER THAN E-80 LOAD MAY REQUIRE ADDITIONAL COVER.
3. MINIMUM COVER MAY BE INCREASED TO PREVENT PIPE DAMAGE DUE TO ROUTINE TRACK MAINTENANCE.
4. MANUFACTURER NEEDS TO VERIFY ALLOWABLE FILL HEIGHTS PER DESIGN LOADS.
5. FILL HEIGHT CALCULATIONS DO NOT TAKE IN TO CONSIDERATION GROUND WATER, WHERE GROUND WATER IS ENCOUNTERED HAVE THE MANUFACTURER VERIFY FILL HEIGHTS.

SCALE: NTS

DO NOT SCALE THIS DRAWING FOR DIMENSIONS NOT GIVEN



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

REV	BY	DATE	DESCRIPTION
LOCATION			
SYSTEMWIDE			
TITLE			
HDPE PIPE TYPICAL TRENCH DETAIL EXISTING TRACK APPLICATIONS			
DGN	PID No.	VRN	MILE POST
DWN	FILE No.	DRAWING NUMBER	
CHK	DATE	DR-HDPE-2	
APRIL 18, 2017			

CADD FILE:

CORRUGATED METAL CULVERT GAGE SELECTION AND INSTALLATION UNDER NS-OWNED TRACKS

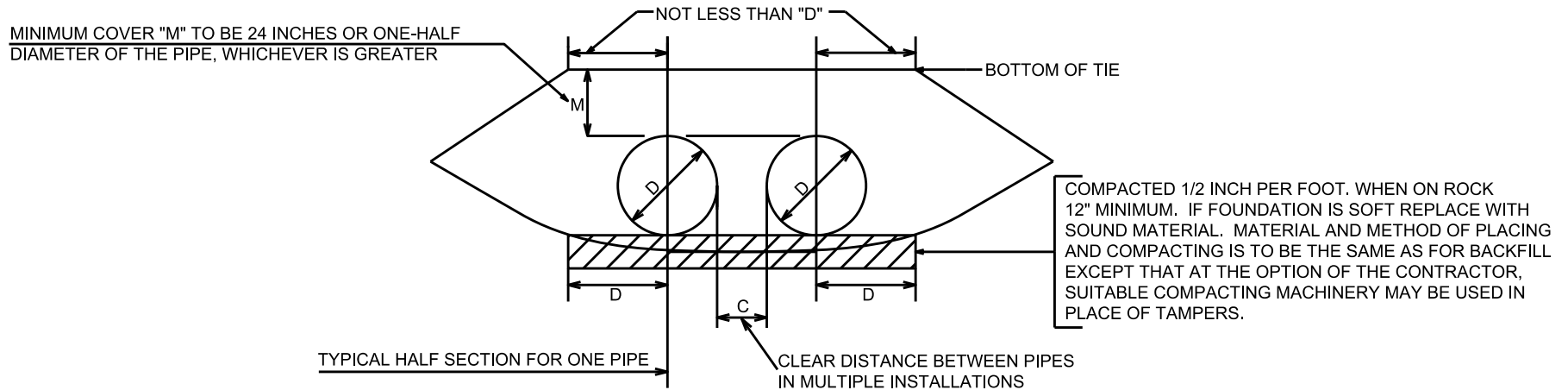
CORRUGATED METAL PIPE		GAGE TABLE FOR 2 2/3" X 1/2" CORRUGATIONS									
AREA (SQ.FT.)	DIA. (IN.)	HEIGHT OF COVER (FEET)									
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
1.8	18										
2.4	21									10	10
3.1	24							10	10	10	10
4.9	30					10	10	10	8	8	8
7.1	36			10	8	8	8	8	8	8	8
9.6	42			10	8	8					
12.6	48										
13.9	54	USE ELONGATED CORRUGATED METAL PIPE FOR THESE TABULAR VALUES									
19.6	60	USE ELONGATED CORRUGATED METAL PIPE FOR THESE TABULAR VALUES									
23.8	66	USE ELONGATED CORRUGATED METAL PIPE FOR THESE TABULAR VALUES									
28.3	72	USE ELONGATED CORRUGATED METAL PIPE FOR THESE TABULAR VALUES									

ELONGATED CORRUGATED METAL PIPE		GAGE TABLE FOR 2 2/3" X 1/2" CORRUGATIONS									
DIA. (IN.)		HEIGHT OF COVER (FEET)									
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
18		USE ROUND CORRUGATED METAL PIPE FOR THESE TABULAR VALUES									
21											
24											
30											
36											
42											
48	10	10	8	8	8	8	8	8	8	8	
54	8	8	8	8	8	8	8	8			
60	8	8	8	8	8						
66	8	8	8								
72	8	8									

NOTES

1. **MINIMUM DIAMETER** : TO BE 36" UNLESS APPROVED BY BRIDGE OFFICE.
2. **MATERIAL** : TO BE GALVANIZED STEEL, ASTM A760 TYPE 1 PIPE, WITH 2 2/3" X 1/2" ANNULAR CORRUGATION.
3. **COATING** : PIPE AND BANDS TO BE FULLY ASPHALT COATED, CONFORMING TO AASHTO M190 TYPE A.
4. **CONNECTING BANDS** : MAY BE ONE GAGE LIGHTER THAN CULVERT MATERIAL. ALL BANDS UNDER COMPANY OWNED TRACKS ARE TO BE ONE PIECE, TWO FEET WIDE. CULVERTS 48" DIAMETER AND LARGER TO USE TWO FOOT BAND WITH FOUR - 1/2" DIAMETER RODS AND SILO LUGS.
5. **INSTALLATION** : WHERE CULVERTS ARE INSTALLED IN OPEN CUT TO REPLACE FAILED CULVERTS, BEDDING AND BACKFILL TO BE DENSE GRADED AGGREGATE.
6. **ELONGATED PIPE** : SHALL NOT HAVE LESS THAN 5% VERTICAL ELONGATION. ELONGATED PIPE 42" IN DIAMETER AND LARGER SHALL BE SHOP WIRE STRUTTED.
7. **EXCEPTIONS** : THE GAGE TABLES ARE TO PROVIDE ADEQUATE STRENGTH. EXCEPTIONS MUST BE CLEARED BY BRIDGE OFFICE. WHERE KNOWN CONDITIONS WILL AFFECT THE SERVICE LIFE OF THE CULVERT, ADDITIONAL GAGE REQUIREMENTS WILL BE FURNISHED BY THE BRIDGE OFFICE.
8. **MINIMUM COVER** : SHALL BE 24" OR 1/2 PIPE DIAMETER, WHICHEVER IS GREATER, AS MEASURED BETWEEN BOTTOM OF TIE AND TOP OF PIPE. EXCEPTIONS TO THIS CRITERIA WILL BE CONSIDERED ON AN INDIVIDUAL BASIS.

PLACE MATERIAL (6" LAYERS ONLY) EVENLY ON EACH SIDE OF PIPE. STONES LARGER THAN 2" SHALL NOT BE USED



DETAILS FOR BEDDING AND BACKFILLING PIPE

INSTALLATION INSTRUCTIONS FOR CORRUGATED METAL DRAINAGE STRUCTURES

PROTECTION: A REASONABLE AMOUNT OF CARE MUST BE TAKEN IN HANDLING CORRUGATED METAL DRAINAGE PRODUCTS TO PROTECT AGAINST CRACKING OR BREAKING THE PIPE OR DAMAGING THE GALVANIZED AND/OR OTHER COATING. HEAVY CONSTRUCTION EQUIPMENT MUST NOT BE RUN DIRECTLY OVER STRUCTURE UNTIL IT HAS BEEN BACKFILLED AND EMBANKMENT PLACED TO THE MAXIMUM HEIGHT ABOVE TOP OF PIPE AS SHOWN ON THIS DRAWING.

STRUTTING: PIPES SHOWN TO BE SHOP STRUTTED WILL HAVE TWISTED WIRE OR ROD STRUTS. STRUTS SHALL BE HORIZONTAL WHEN PIPE IS PLACED.

CAMBER: UNDER HIGH FILLS, WHERE THE FOUNDATION IS SUBJECT TO SUBSIDENCE, THE GRADE LINE WILL BE CAMBERED TO PRODUCE A STRAIGHT GRADE AFTER SUSIDENCE.

HAND TAMPED: WHEN APPROVED BY THE ENGINEER, A HAND TAMPER SHALL WEIGH NOT LESS THAN TWENTY (20) POUNDS AND HAVE A TAMPING FACE NOT LESS THAN 6" X 6".

ASSEMBLY OF STRUCTURE: CORRUGATED METAL PIPES MUST BE PLACED WITH INSIDE CIRCUMFERENTIAL LAPS POINTING DOWNSTREAM. THE LONGITUDINAL LAPS SHOULD BE AT THE SIDES OR QUARTER POINTS BUT NOT IN THE BOTTOM. STRUCTURAL PLATE PIPES WILL BE ASSEMBLED FROM DETAILED ERECTION INSTRUCTIONS WHICH ACCOMPANY EACH PIPE WHEN SHIPPED.

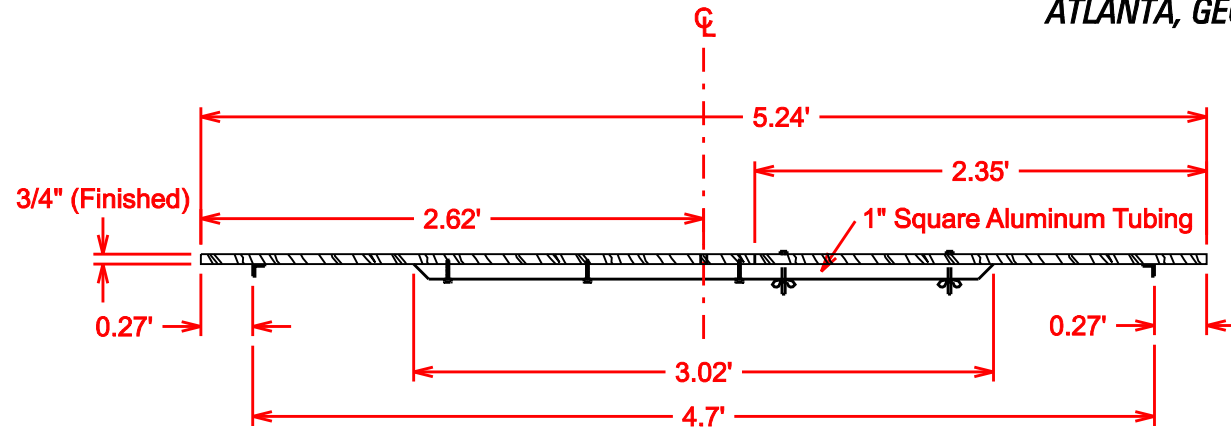
BEDDING AND BACKFILLING: BEDDING AND BACKFILL MATERIAL SHALL BE DENSE GRADED CRUSHED STONE MAXIMUM SIZE 2 INCHES TO DUST. BACKFILL IS TO BE PLACED IN LAYERS NOT LESS THAN 4" OR MORE THAN 6" AND COMPACTED WITH MECHANICAL TAMPERS TO NOT LESS THAN 95% MODIFIED PROCTOR. HEAVY EARTH COMPACTING EQUIPMENT SHALL NOT BE USED OVER THE PIPE UNTIL BACKFILL HAS BEEN COMPLETED AS SHOWN AND SPECIFIED ON THE PLAN. CARE MUST BE TAKEN NOT TO STRIKE THE PIPE WITH THE TAMPER.

MULTIPLE LINES OF PIPE: PIPE DIAMETERS MINIMUM CLEARANCE "C"
 UP TO 72" ONE HALF DIAMETER OF THE PIPE
 72" TO 180" 36"

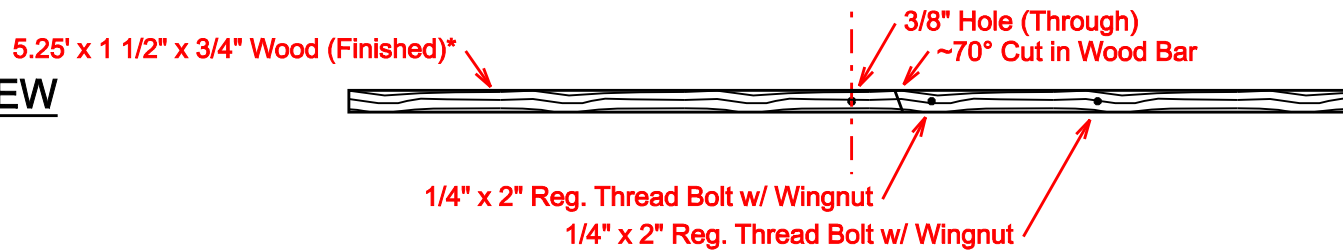
NORFOLK SOUTHERN RAILWAYS

INSTALLATION INSTRUCTIONS
 CORRUGATED METAL PIPE CULVERTS
 REVISED 5/2/2017

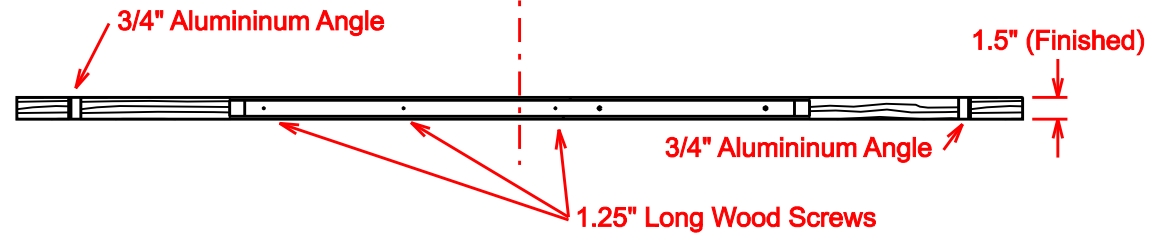
SIDE VIEW



TOP VIEW



BOTTOM VIEW



*Wood type selection - Experience has shown that pine is light, but Red Oak is more durable.

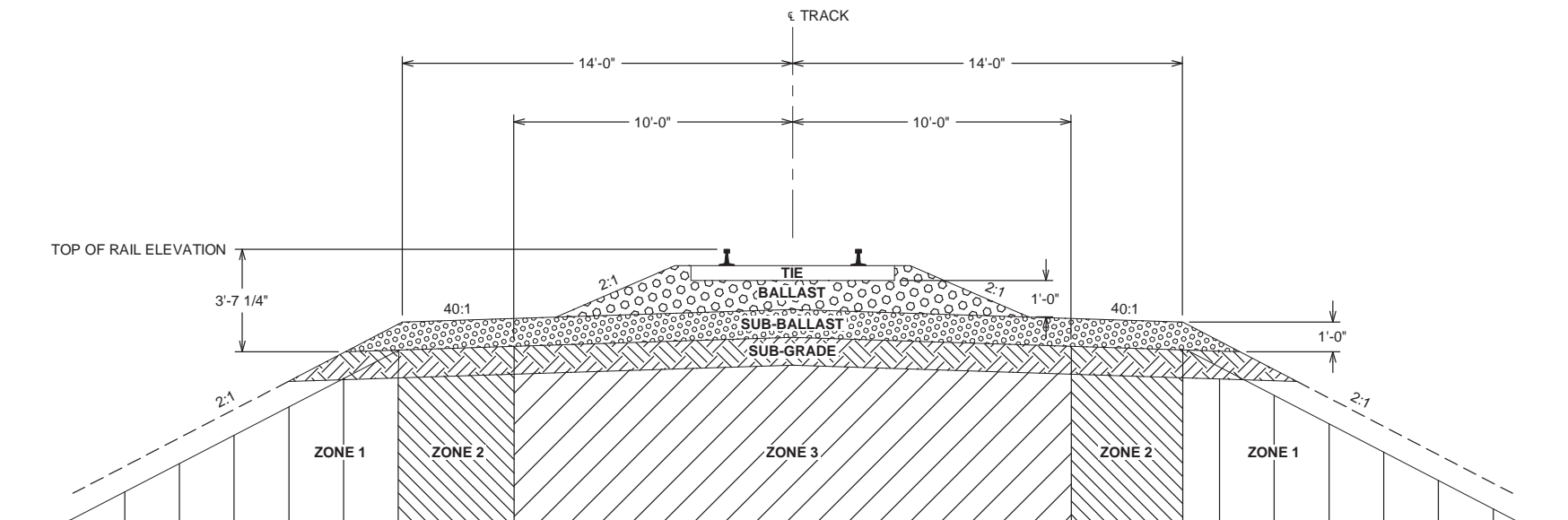
SCALE: NONE



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

REV	BY	DATE	DESCRIPTION	
1	JRT	3/28/05	ADDED DIMENSIONING AND MATERIAL TYPES	
LOCATION ATLANTA, GEORGIA				
TITLE NON-SHUNTING TRACK SURVEY BAR				
DGN	CJF	PTD No.	VAL MAP REC. No.	MILE POST
DWN	AD	FILE No.	DRAWING NUMBER	
CHK		DATE	NONE	
CADD FILE#				

Filename: P:\6260400 - TECHNICAL\433 - PUBLIC PROJECTS MANUAL\STANDARD DRAWINGS\4 SHORING DESIGN GUIDE - SHORING REQUIREMENTS.DWG




ROADBED PROFILE - SHORING REQUIREMENTS (NTS)

- ZONE 1 EXCAVATION WITHIN ZONE 1 WILL REQUIRE SHORING FOR THE PROTECTION OF THE RAILROAD
- ZONE 2 EXCAVATION WITHIN ZONE 2 WILL REQUIRE SHORING CONSISTING OF INTERLOCKING SHEETING FOR THE PROTECTION OF THE RAILROAD
- ZONE 3 NO EXCAVATIONS WILL BE ALLOWED IN ZONE 3

NOTES:

1. EXCAVATIONS OUTSIDE OF ZONE 1 MAY REQUIRE SHORING FOR SAFETY. LATERAL PRESSURES DUE TO TRAIN LOADINGS DO NOT AFFECT SHORING DESIGN OUTSIDE OF ZONE 1.
2. REFER TO PUBLIC PROJECTS MANUAL APPENDIX H, SECTION H.1.6.A. (OVERHEAD BRIDGE) OR SECTION H.2.8.A (UNDERPASS BRIDGE) AND APPENDIX H FOR ADDITIONAL SHORING LOCATION REQUIREMENTS.

REVISIONS		
DATE	LTR.	DESCRIPTION
9/23/2013	1	REVISE ZONE 2 DIMENSION AND AREA
1/1/15	2	REVISED NOTE 2



NORFOLK SOUTHERN
PUBLIC PROJECTS MANUAL
TYPICAL DRAWINGS

**SHORING DESIGN GUIDE
SHORING REQUIREMENTS**

REF. NO.: SEC 1 - OHB - 5 - SHT 4
DATE: AUGUST 1, 2015 DRAWING NO.: 4

LATERAL PRESSURES FROM COOPERS E-80 TRAIN LOADS

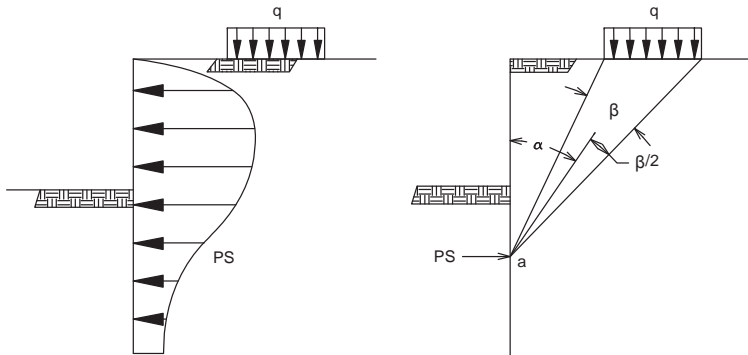
THE BOUSSINESQ EQUATION FOR STRIP LOADS IS SHOWN IN THE AREMA MANUAL FOR RAILWAY ENGINEERING, CHAPTER 8, SECTION 20.3.2.2

BOUSSINESQ EQUATION:

$$PS = (2q/\pi) * (\beta - (\sin(\beta) * \cos(2\alpha)))$$

WHERE:

- PS = ACTIVE PRESSURE FROM SURCHARGE LOADING
- β = $\text{ATAN}((\text{CLT} + \text{TL}/2) / \text{HS}) - \text{ATAN}((\text{CLT} - \text{TL}/2) / \text{HS})$ IN RADIANS
- α = $\beta/2 + \text{ATAN}((\text{CLT} - \text{TL}/2) / \text{HS})$ IN RADIANS
- q = UNIFORM SURCHARGE LOAD FROM TRAINS = 80 KIPS/ (5) (TL)
- CLT = DISTANCE FROM FACE OF RETAINING WALL TO CENTERLINE OF TRACK
- TL = TIE LENGTH = 8.5' STANDARD
- HS = DEPTH BELOW APPLIED SURCHARGE LOADING



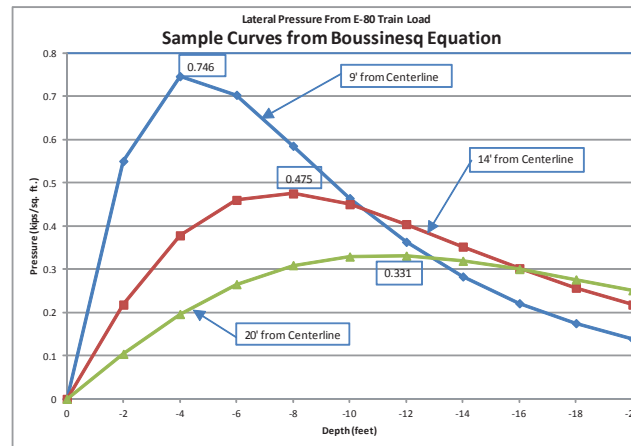
NOTES:

- TABLE 1 PROVIDES THE RESULTANT LATERAL PRESSURES FOR VARIOUS DEPTHS AND DISTANCES FROM THE CENTERLINE OF TRACK. THREE REPRESENTATIVE PRESSURE CURVES ARE ALSO SHOWN ON THE PROVIDED SAMPLE CURVES FROM BOUSSINESQ EQUATION.
- FOR A SIMPLIFIED ENGINEERING ANALYSIS, THE RAILROAD LOADING SURCHARGE PRESSURE MAY BE ASSUMED RECTANGULAR WITH WIDTH (P) EQUAL TO 0.8 OF THE MAXIMUM PRESSURE ORDINATE AS GIVEN BY THE APPROPRIATE RAILROAD CURVE.
- WORK THIS DRAWING WITH PUBLIC PROJECTS MANUAL APPENDIX H, SECTION H.1.6 (OVERHEAD BRIDGE) OR SECTION H.2.8 (UNDERPASS BRIDGE).

Table 1 - Lateral Pressure from E-80 Train Loads
(From Boussinesq Equation)

	Depth (Feet)										
	0	-2	-4	-6	-8	-10	-12	-14	-16	-18	-20
8	0	0.7	0.846	0.732	0.576	0.439	0.333	0.253	0.195	0.152	0.12
9	0	0.55	0.746	0.703	0.585	0.464	0.363	0.283	0.221	0.175	0.139
10	0	0.44	0.65	0.659	0.579	0.478	0.385	0.307	0.245	0.196	0.158
11	0	0.36	0.565	0.608	0.561	0.482	0.399	0.326	0.265	0.215	0.176
12	0	0.301	0.492	0.556	0.536	0.477	0.406	0.339	0.281	0.232	0.192
14	0	0.218	0.378	0.46	0.475	0.45	0.404	0.352	0.302	0.257	0.218
16	0	0.165	0.297	0.38	0.413	0.411	0.386	0.35	0.311	0.272	0.236
18	0	0.13	0.239	0.315	0.357	0.369	0.36	0.338	0.309	0.278	0.247
20	0	0.104	0.196	0.265	0.309	0.329	0.331	0.319	0.3	0.276	0.251
23	0	0.078	0.15	0.208	0.25	0.276	0.287	0.287	0.279	0.265	0.247
26	0	0.061	0.118	0.166	0.205	0.232	0.248	0.255	0.254	0.247	0.237
29	0	0.049	0.095	0.136	0.17	0.196	0.214	0.224	0.228	0.227	0.222
32	0	0.04	0.078	0.113	0.143	0.167	0.185	0.197	0.205	0.207	0.206
35	0	0.034	0.066	0.095	0.122	0.144	0.161	0.174	0.183	0.188	0.189
39	0	0.027	0.053	0.078	0.1	0.119	0.135	0.148	0.158	0.164	0.168
43	0	0.022	0.044	0.064	0.083	0.1	0.115	0.127	0.137	0.144	0.149
47	0	0.019	0.037	0.054	0.07	0.085	0.098	0.11	0.119	0.127	0.133
51	0	0.016	0.031	0.046	0.06	0.073	0.085	0.095	0.104	0.112	0.118
55	0	0.014	0.027	0.04	0.052	0.063	0.074	0.084	0.092	0.099	0.105

All pressures shown are in kips per sq. ft.
Boxed values represent the maximum pressure ordinate for each value of "CLT".



REVISIONS		
DATE	LTR.	DESCRIPTION

NORFOLK SOUTHERN
PUBLIC PROJECTS MANUAL
TYPICAL DRAWINGS

SHORING DESIGN GUIDE
LATERAL PRESSURES FROM
TRAIN LOADS

REF. NO.: SEC 3 - MISC 1
DATE: AUGUST 1, 2015 DRAWING NO.: 5