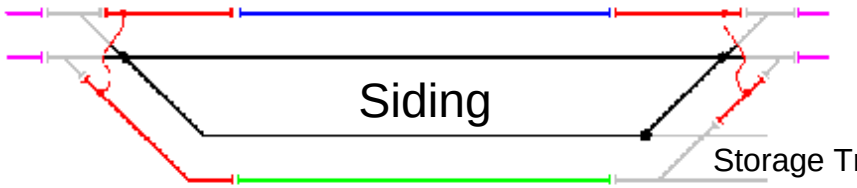
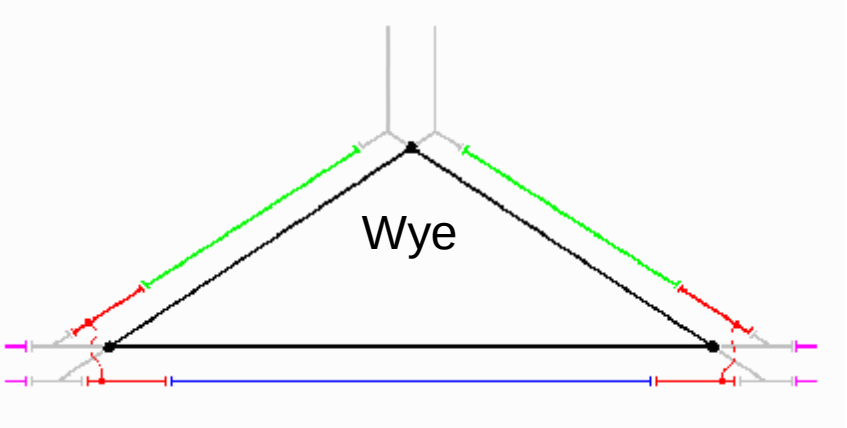
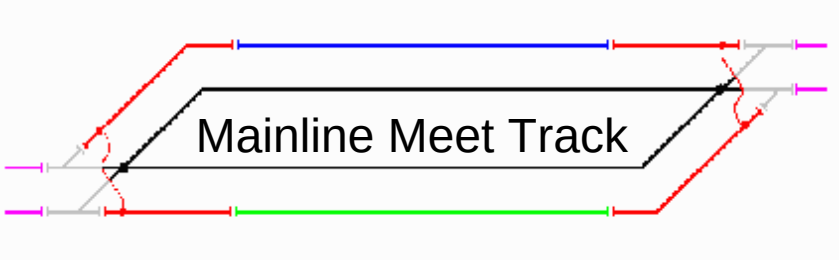
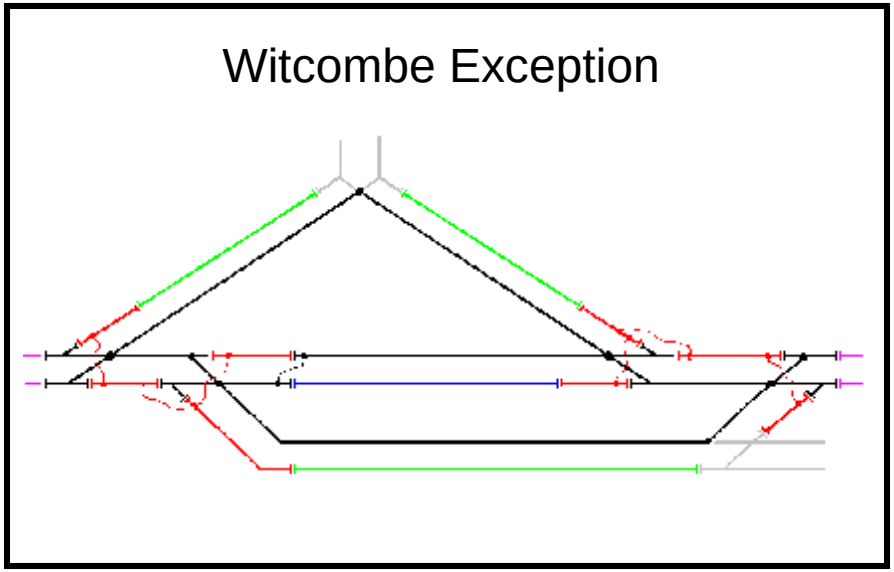
Basic Concepts

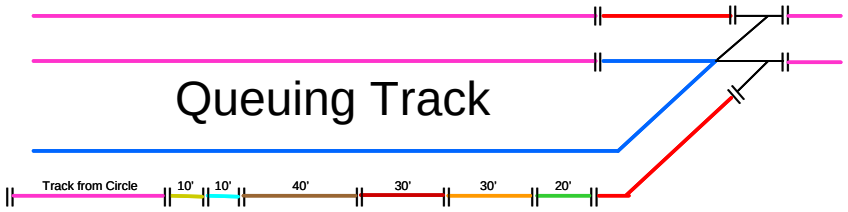
1. Basics - Four Basic Track Structures



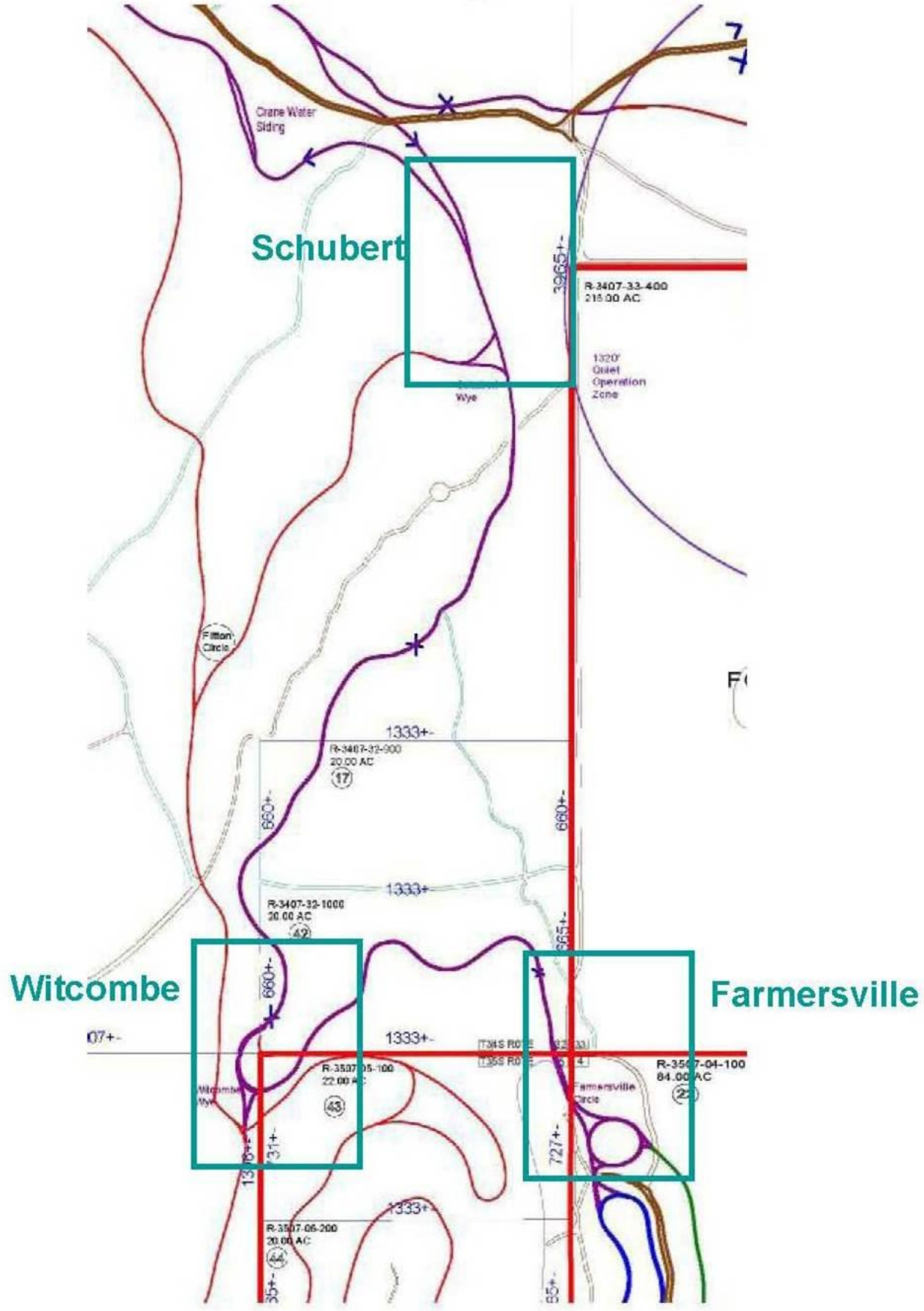




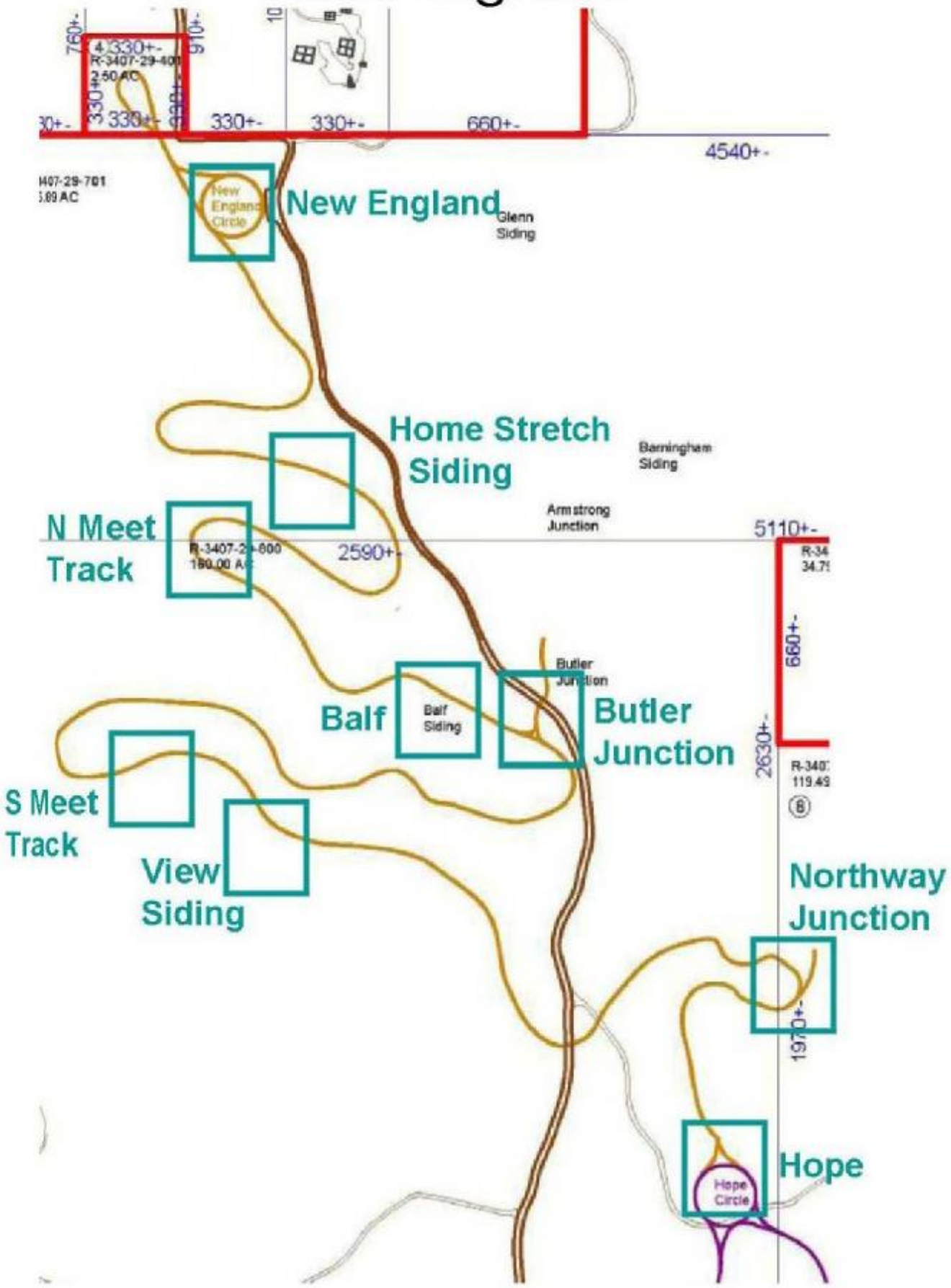




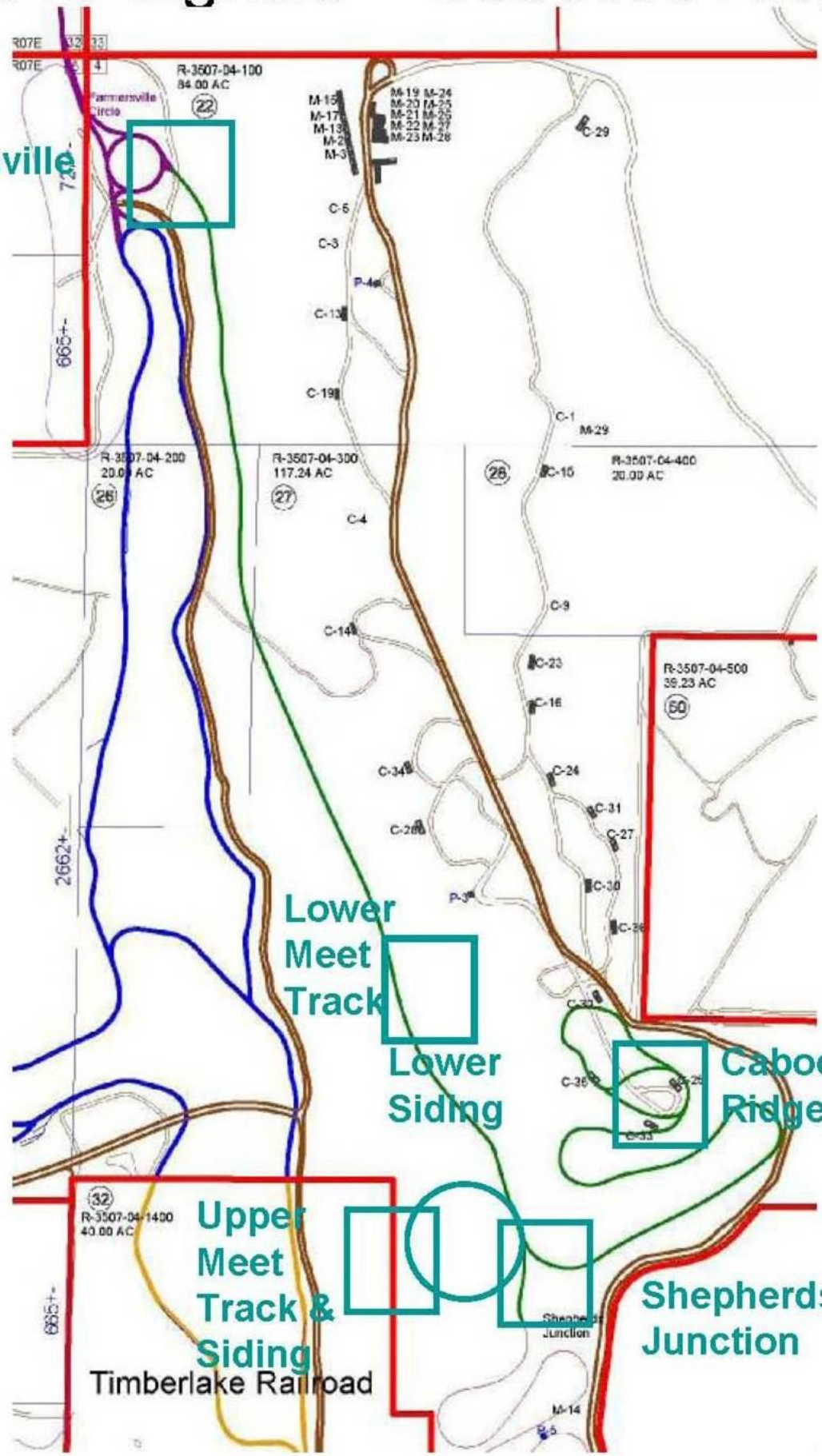
2008 Signals



2009 Signals



2010 Signals -- Caboose Ridge



Place Holder for Signals Handout
Page 1

Place Holder for Signals Handout Page 2

1. Basics - Standards

- **Mainline Meet Tracks** are where trains traveling in opposite directions on Bi-Directional Track can pass each other.

- **Mainline Meet Tracks** are always structured as in the above picture. They are part of the Mainline. You may not park on the Mainline. You are to proceed as soon as the signal allows you to.

- **Mainline Meet Tracks** shall be located approximately every 3000ft on Bi-Directional Track. Mainline Meet Tracks will be long enough to accommodate 140’ of train(s).

- **Signals, Entry to Bi-Directional Track** – Every entry to Bi-Directional track will have queuing siding that breaks groups of trains into aggregate lengths of no more than 140’ which is the length of the Mainline Meet Tracks and Sidings.

- **Signals, Sidings & Wyes ReEntry** – Every Re-Entry to Bi-Directional Mainline will be controlled by a signal to the right of the track. In Sidings that signal may be Left of the siding track, away from the Mainline. (New Standard)

- **Signals, Ready to leave Button** - A Push Button will alert the signal system that the train is ready to depart a Siding or Wye and ReEnter the Bi-Directional Mainline. The Push Button Stands may be of any design, provided that they do not protrude above tie level, within 24" of the center line of the track, and thereby not impede the operation of oversized snowplow and pine needle blower equipment. Push Button stands shall be forty feet from the Re-Entry Signal. If possible, Push Buttons shall be located on the right hand side of the track, but may be Left of a Siding, away from the Mainline. (New Standard)

- **Switch Stands** -- Switch Stands may be of any design, provided that they do not protrude above tie level, within 24" of the center line of the track, and thereby not impede the operation of oversized snowplow and pine needle blower equipment. Remote switch stands shall be forty feet from the points of the switch that they control and the edge of the remote switch shall be a minimum of 24" from the centerline of the track. If possible, remote switch stands shall be located on the right hand side of the track. (Existing Standard)

1. Basics - Standards continued

- **Signals, Intermediate** - Bi-Directional track is broken into Track segments of approximately 3000' by Mainline Meet Tracks. Track segments are broken into a maximum of 6 Blocks, approximately 600' long, by Intermediate Signals.

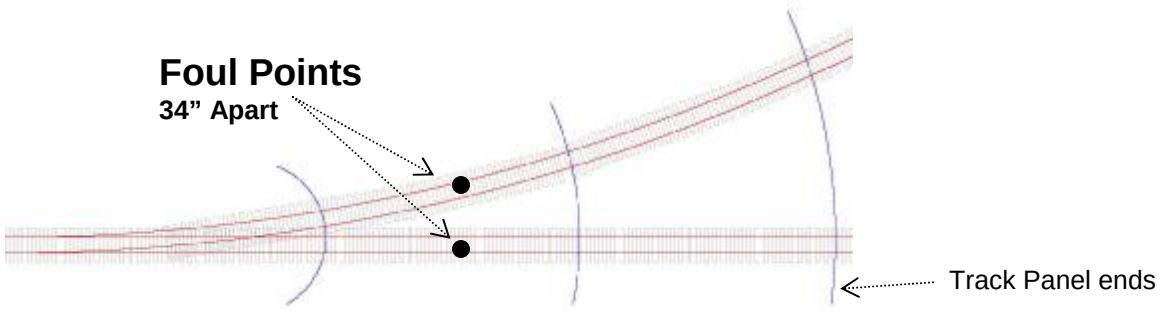
- **Signals, Head Colors** – The following 6 Lamp Colors will be used :
  - **Green** – Proceed the track ahead is clear
  - **Flashing Yellow** – Proceed. There is a reason to stop about 1200-1800' ahead. The next signal is solid yellow.
  - **Solid Yellow** – Proceed Cautiously. There is a reason to stop about 600-1200' ahead. The next signal is Solid Red, Flashing Red or a Yard entry with a Lunar White.
  - **Flashing Red** -- Proceed "on-your-own". There is a reason to stop ahead. Be prepared to stop.
  - **Solid Red** – STOP – Do not pass this signal.
  - **Lunar White** – Proceed "on-your-own", used for entering a yard.

- **Foul Points** – Foul Point is the point at which the centerlines of 2 converging tracks are 34" apart. Foul Points are marked with a 2" Fender Washer In the middle of the top of the Foul Point Ties on both Tracks. (Existing Standard)

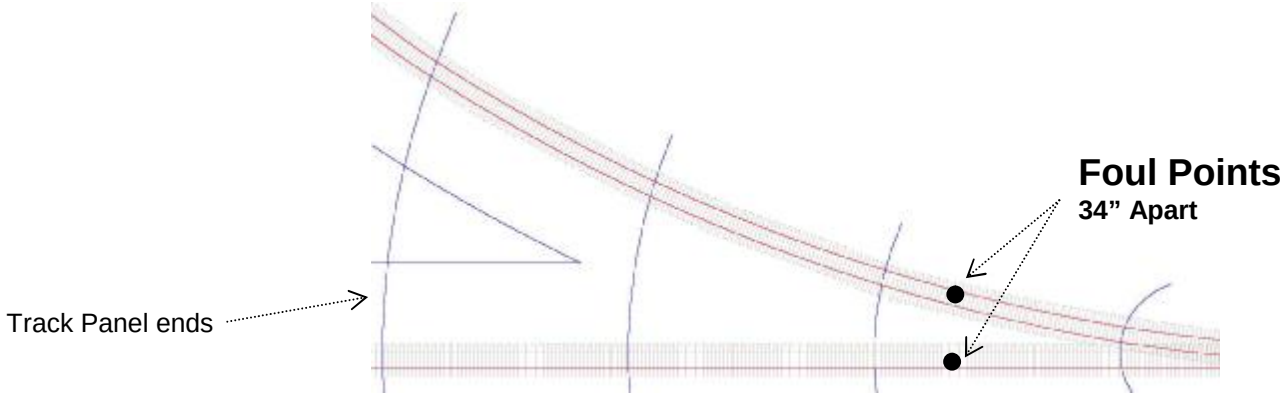
- **Signal Points** – Signal Points mark the location of Signals. On Sidings, Queuing Tracks, and Mainline Meet Tracks, on each track, find the end of the first Track Panel after the tracks begin to run parallel. The Track Panel end that is farthest from the point where the tracks began to run parallel is one Signal Point. The other Signal Point is directly across on the other track. On the leg of a Wye, the Signal point is at the first Track Panel end where the centerlines of the tracks are at least 9 feet apart. This allows the signal to be 4' from either track. Signal Points are marked with two 2" washers screwed to the middle of the Signal Point Ties on both tracks. On Sidings and Mainline Meet Tracks the distance between Signal Points must be 140' minimum. (New Standard)

1. Basics - Foul Points

- **Foul Points** – Foul Point is the point at which the centerlines of 2 converging tracks are 34” apart. Foul Points are marked with a 2” Fender Washer screwed to the middle of the Foul Point Ties on both tracks. (Existing Standard)

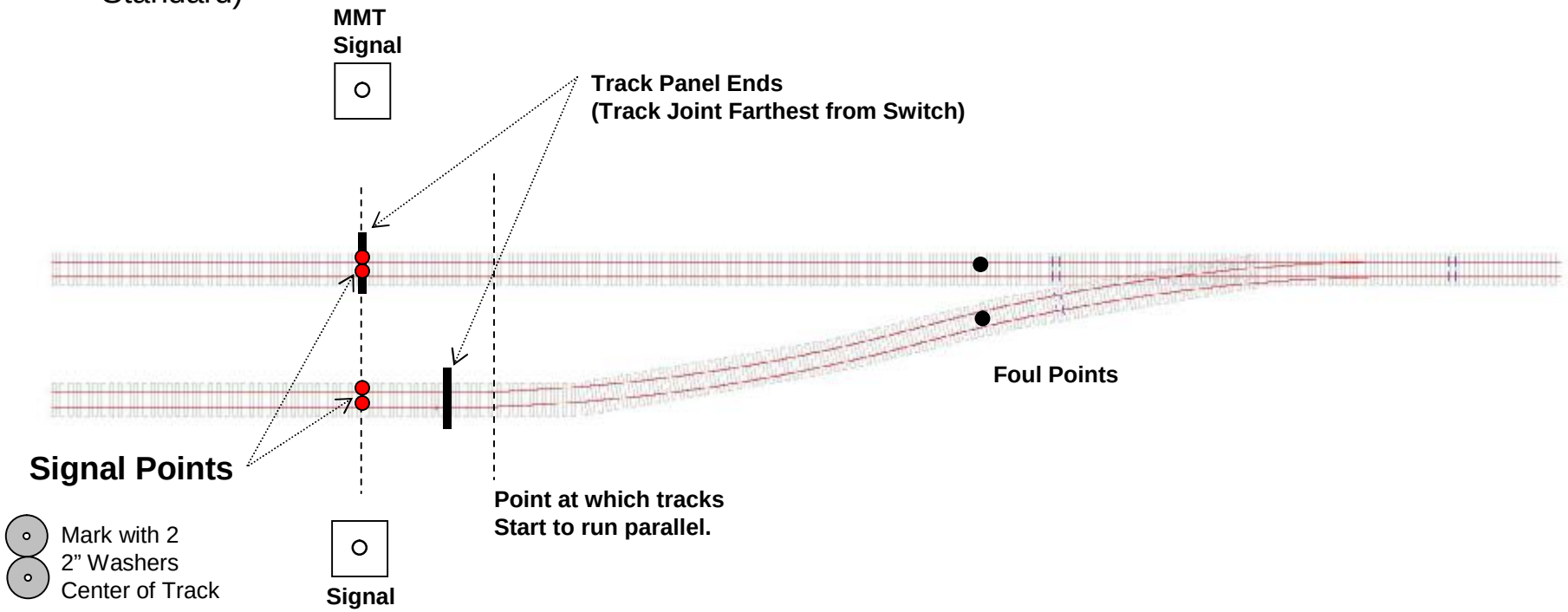


Mark Foul Point
With a 2” Washer
In the Middle of the Tie



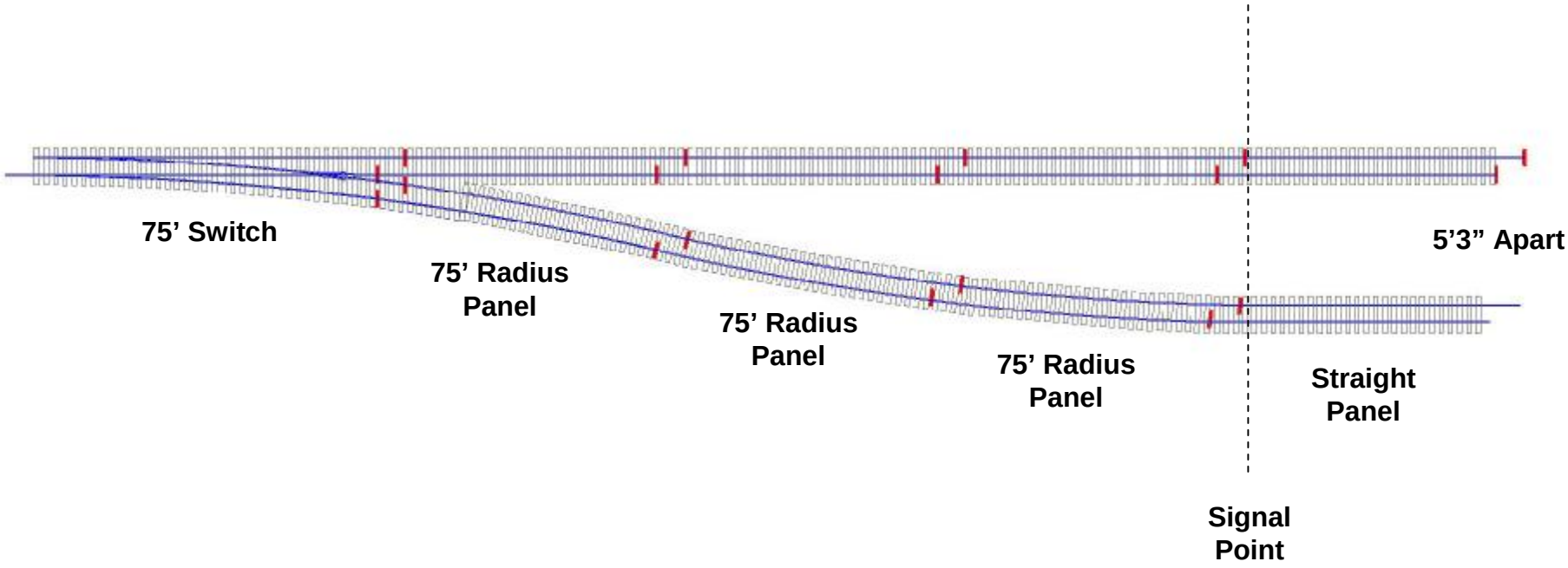
1. Basics - Signal Points on Sidings, Queuing Tracks & Mainline Meet Tracks

- **Signal Points** – Signal Points mark the location of Signals. On Sidings, Queuing Tracks, and Mainline Meet Tracks, on each track, find the end of the first Track Panel after the tracks begins to run parallel. The Track Panel end that is farthest from the point where the tracks began to run parallel is one Signal Point. The other Signal Point is directly across on the other track. Signal Points are marked with two 2" washers screwed to the middle of the Signal Point Ties on both tracks. On Sidings and Mainline Meet Tracks the distance between Signal Points must be 140' minimum. (New Standard)



2. Basics - Signal Point

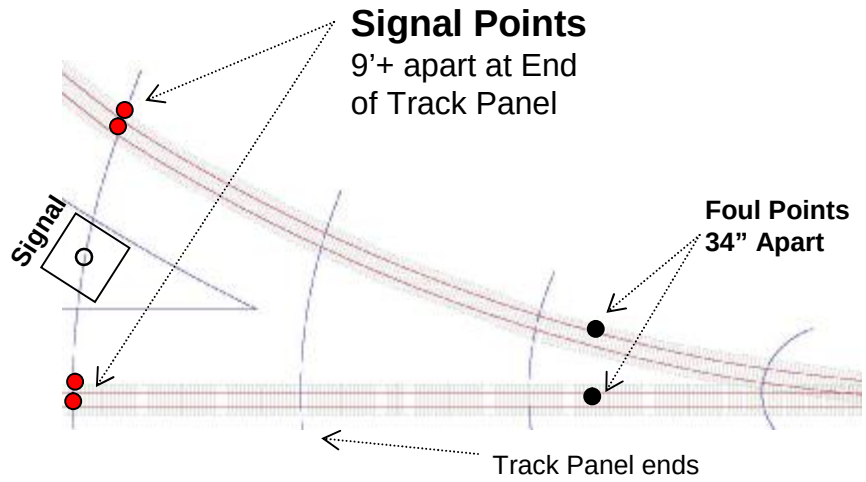
- **Standard Siding is 5’ of separation…. Center Line to Center Line… near 5’ is OK**

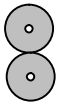


1. Basics - Signal Points on Wyes

- **Signal Points** – Signal Points mark the location of Signals. On the leg of a Wye, the Signal point is at the first Track Panel end where the centerlines of the tracks are at least 9 feet apart. This allows a signal between the tracks to be 4’ from either track. Signal Points are marked with two 2” washers screwed to the middle of the Signal Point Ties on both tracks. On Sidings and Mainline Meet Tracks the distance between Signal Points must be 140’ minimum. (New Standard)

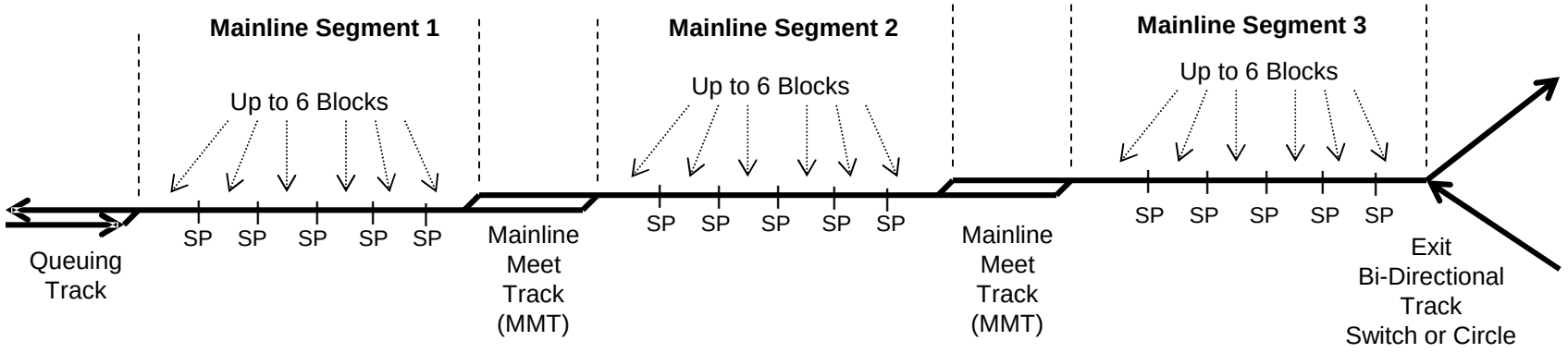
Signal Points where Signal is on inside of Wye




Mark with 2
2” Washers
Center of Track

1. Basics - Signal Points at Block Boundaries

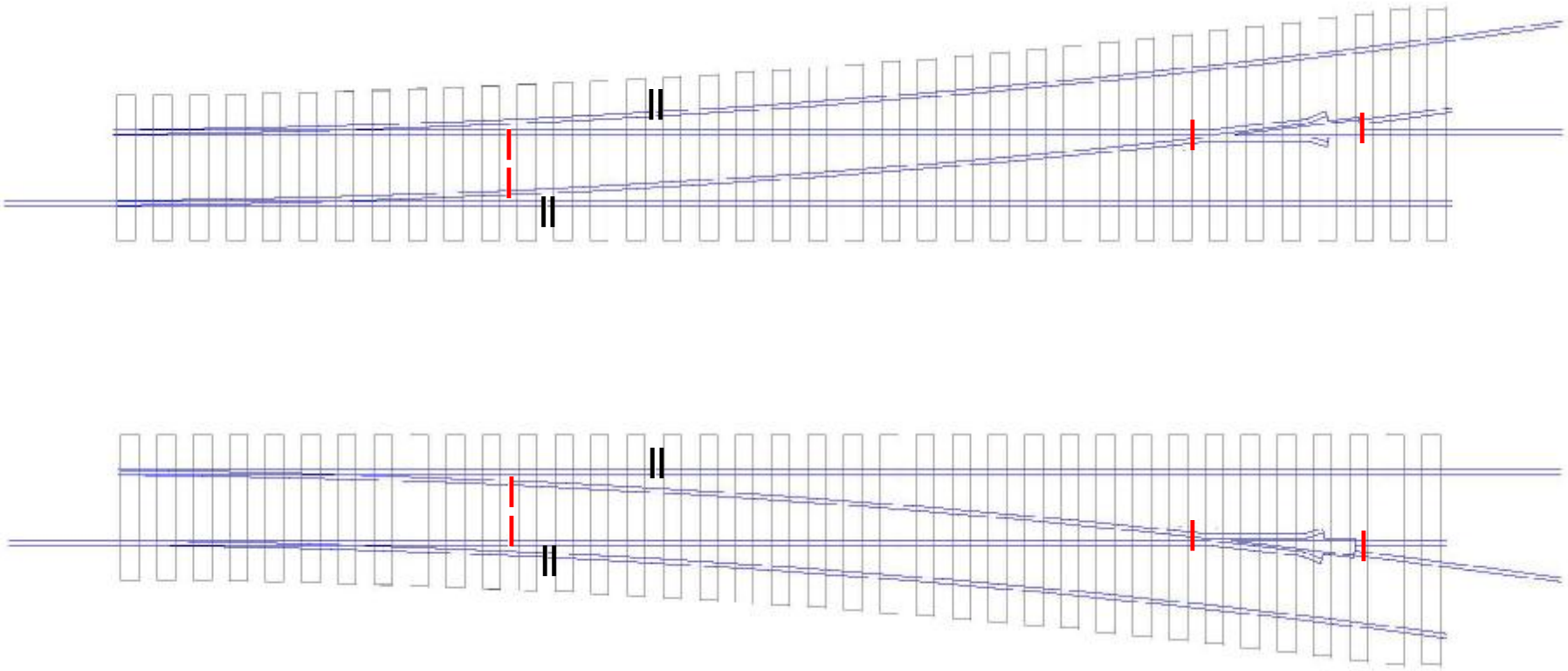
- Mainline Segments are approximately 3000 feet long, separated by Mainline Meet Tracks.
- Mainline Segments are divided into Blocks of Equal Size
  - The Signal Team will determine how many Blocks
  - Always 6 or less
  - Usually each block is roughly 600’ long
  - Farmersville to Witcombe MMT = 4 Blocks
  - Witcombe MMT to Bypass Switch = 6 Blocks
- Signal Points at Block Boundaries are marked with two 2” washers



1. Basics - Operating Rules

- Rules
  - Cell phones are required north of Farmersville Circle where FRS radios will not reach in an emergency.
  - No Trains over 140’ N of Farmersville
  - Metal wheels and uninsulated metal axles are required N of Farmersville
  - Trains may not reverse on Bidirectional track except to back up into a Wye at the Wye or to back up into a Siding at the Siding.
  - Trains must always back up into Wyes.
  - Trains cannot enter a Siding if there is already an opposing train in it…. Go to the far end and back up to get in the Siding.

1. Basics - Switch Architecture

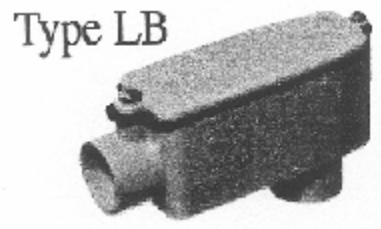


| = Possible Bonding Requirement

|| = Possible Insulator Location

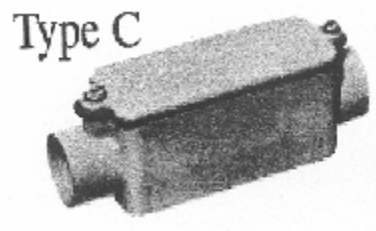
1. Basics - Track Boxes

These boxes go in the center of the track near an insulator.



18 Gauge wires connect to the track. Mostly these wires will be connected to Cat5 in a nearby signal head. Occasionally a 2”x4” Connection Box will be placed nearby to make the splice from Cat5 to 18 gauge wire.

Wires enter the Type LB or Type C box through the bottom to enforce a Drip Loop…. A low point in the wire where moisture falls off instead of flowing toward a connection.



Type C boxes get 1/4” holes drilled in their bottom for the wires to exit.

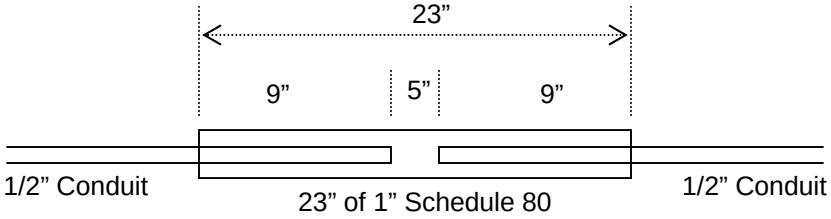
1. Basics - Conduit -- Keeping it Down

- **The big problem is keeping Conduit from coming up through the ballast.**

- Issues
  - At TM PVC conduit expands or contracts 1.5”-2.5” per 100’ each day
  - Dry conduit floats up
  - Ballast movement near the tracks appears to lift conduit

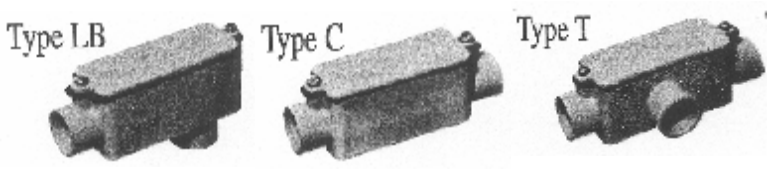
- Solutions
  - Expansion Joints every 20’
  - Let the conduit fill with water
  - Run conduit parallel to the track at 8-10” from ends of ties
    - Over 10” the gators destroy the conduit during ballasting
    - Less than 8” the track movement may lift the conduit

- Expansion Joints
  - Every 20’
  - Use 23” of 1” Schedule 80 PVC Conduit to connect or sleeve 2 pieces of ½” Conduit.
  - Leave 3” of space between the pieces of ½” conduit



1. Basics - Conduit Fittings & Tie Marking

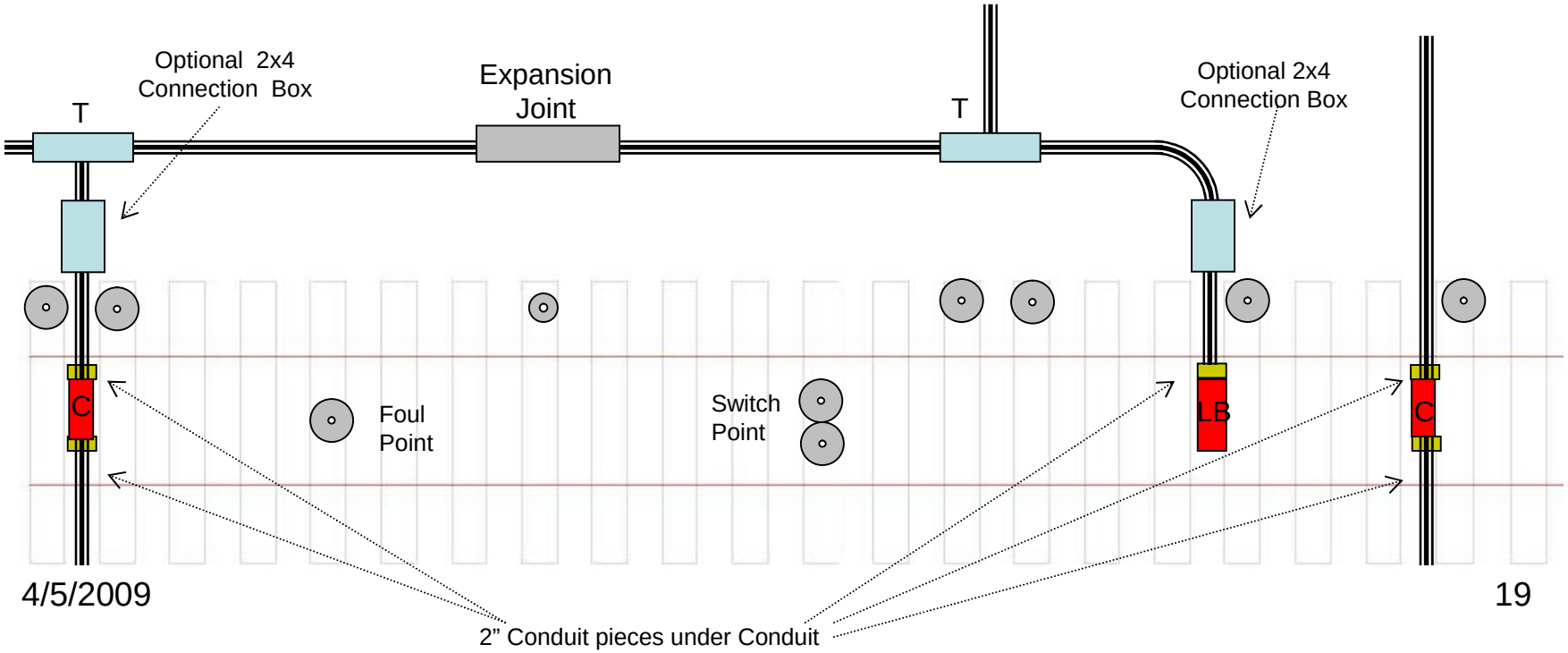
Conduit Boxes



- One 2” Fender Washer at Foul Point
- Two 2” Fender Washers at Switch Point

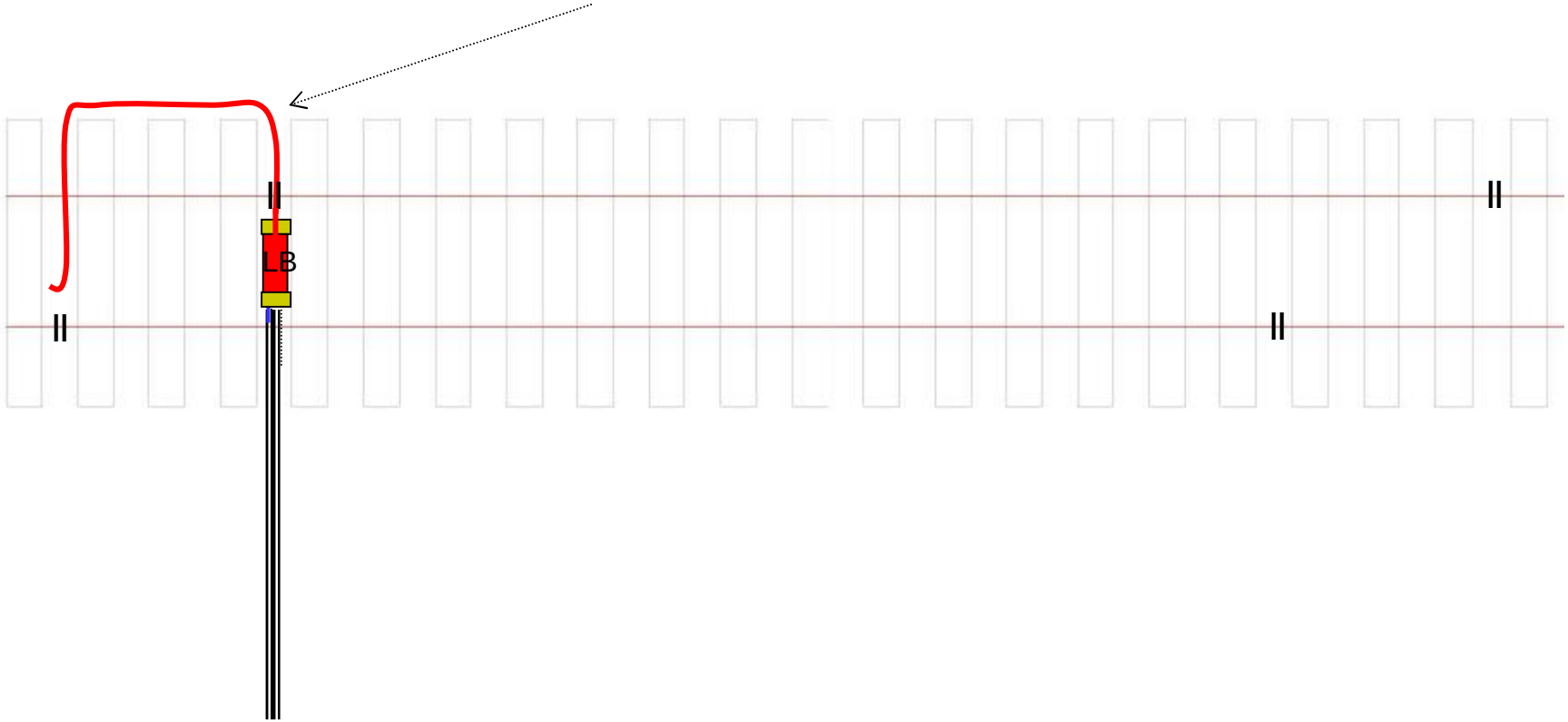
Washers Locate Boxes

- Two 2” Fender Washers means a Type T box is nearby.
- One 2” Fender Washer means a Type C or Type LB box between the tracks
- One 1” Washer means an Expansion Joint nearby



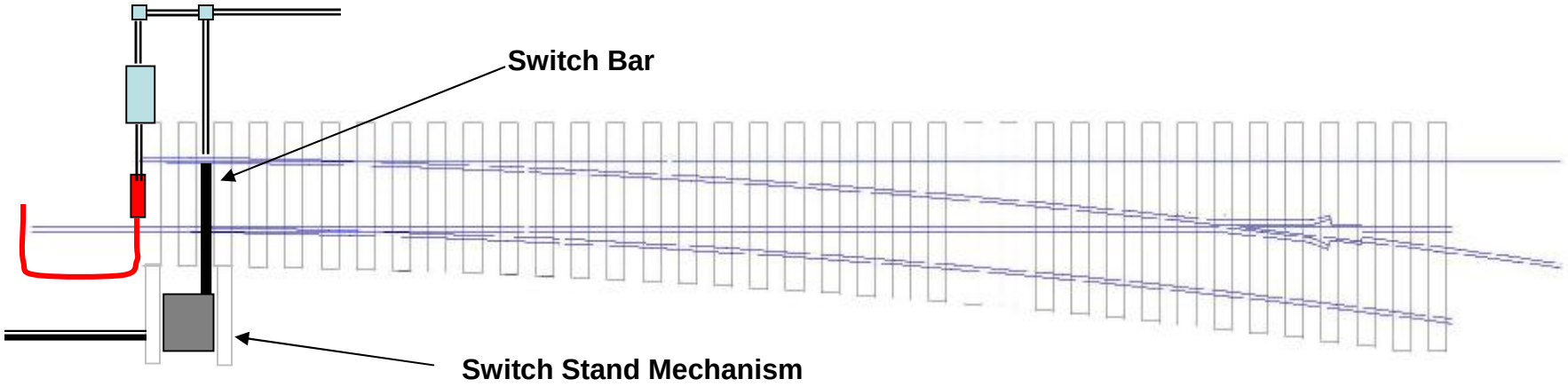
1. Basics - Flexible Conduit

We have a problem with rodents eating wire…. so
Wires to locations near an In-Track box should be protected by Flexible Metal Conduit



1. Basics - Switch Position Indicators

Every Mainline Switch to a Siding or Wye
gets Boxes for Future Switch Position Indicators



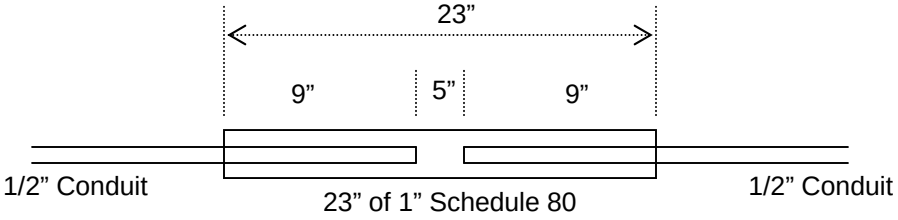
Type T Track Box

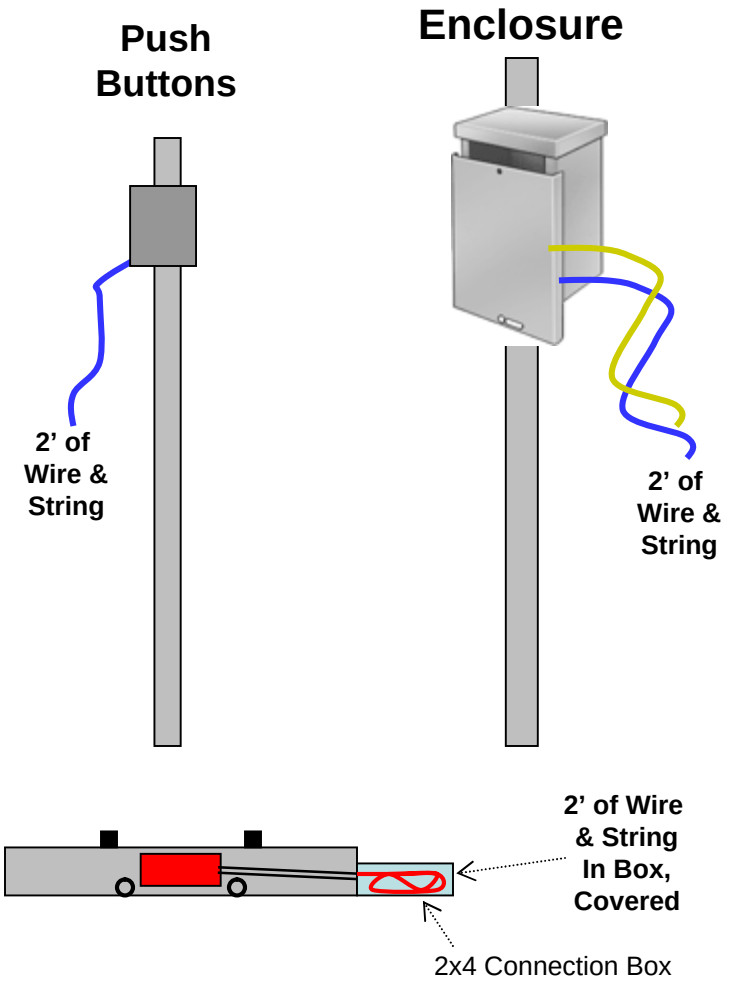
Type LB Track Box

2x4 Connection Box

1. Basics - Pulling Wire

- Track Team pulls all the Car5 wire runs that go through an Expansion Joint.
- Always Pull a String with the Wire
- **2' of Wire** at each end -- Never make us splice Cat5 in a ground level Box
- 3 Colors of Cat5 -- Never pull 2 Cat5 of the same color in a conduit
  - **Blue**
  - **Black**
  - **Other** (may be Yellow, White, or Grey)
- Straighten up conduit after wire pull. Be sure Expansion Joints properly adjusted





3 Teams

- Track Team
  - Does the minimum needed to be able to Ballast
  - Installs Insulators
  - Installs Solar/Enclosure Posts
  - Installs Conduit
  - Pulls all wire that goes through an expansion joint

- Bonding Team
  - Installs Bonding Wires

- Signals Team
  - Checks Bonding Wires, Insulators
  - Pulls small, short run wires
  - Makes all wire splices
  - Connects wires to track
  - Installs printed circuit boards and connects wires to them
  - Tests system