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# Layout Design for Operations

Steve Davis

Tom Vanden Bosch

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# What IS Model RR “Operations”?

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**OUR Opinion: A model railroad designed for Operations is designed to replicate the look, feel, purpose and tasks of actual railroad operations.**



# So what does that mean?

- **Basic rules of journalism apply to model railroading as well:**
  - Who? What railroad or railroads are we modeling? Real or fictional?

## Prototype Railroads



## Proto-Lance



Who? What?  
When?  
Where?  
Why?

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  - What? What does the railroad basically do? Haul coal? Passenger service? Granger service? Bridge line? Branch line? Single industry?



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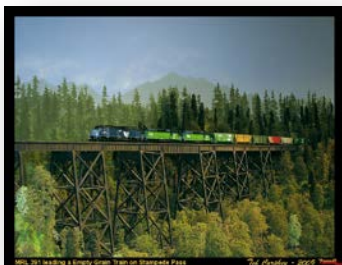
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  - **When? Era – steam, transition, modern, etc.**



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- What? What do we do? Haul coal? Passenger service? Bridge line? Branch line? Single industry?
- When? Era – steam, modern, etc.
- **Where? General setting if not an actual geographic location: coastal/harbor, mountain, plains, eastern, western, midwest, urban or rural?**



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  - Where? General setting if not an actual geographic location: coastal/harbor, mountain, plains, eastern, western, midwest, urban or rural?
  - **Why? Why is the railroad there? (West Bay story as example)**



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  - When? Era – steam, transition, modern, etc.
  - Where? General setting if not an actual geographic location: coastal/harbor, mountain, plains, eastern, western, midwest, urban or rural?
  - Why? Why is the railroad there? (see ‘what’?)
  - **How? How does the railroad serve it’s customers?**
    - Operating scheme, motive power, rolling stock.



# Remember: PEOPLE will operate the RR!

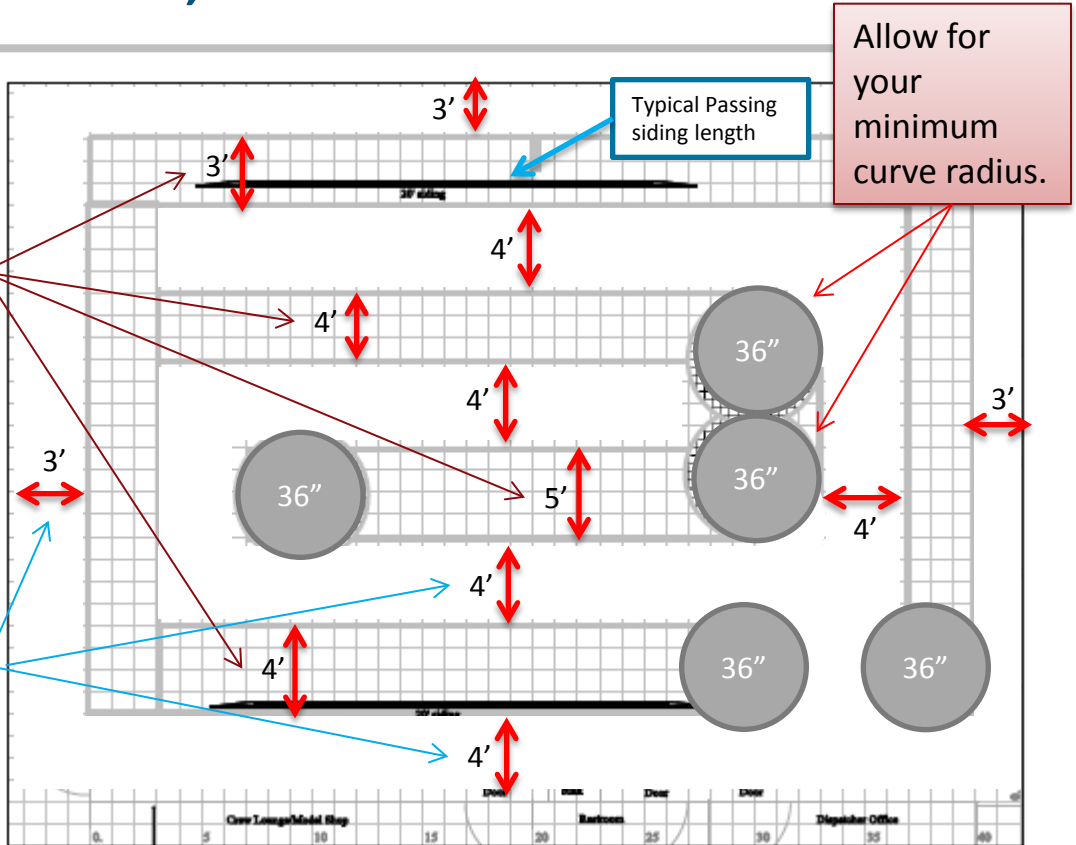
- **BEFORE** plotting a track plan, consider general layout and creature comforts:
  - Aisle Widths
  - Duckunders/access
  - How will operators follow trains?
  - Scene depth
  - Restroom?
  - Lounge?



# Given the room, see what will fit

Scene depth is 22" on average. 2 scenes plus a 4" backdrop take up 48", or 4'.

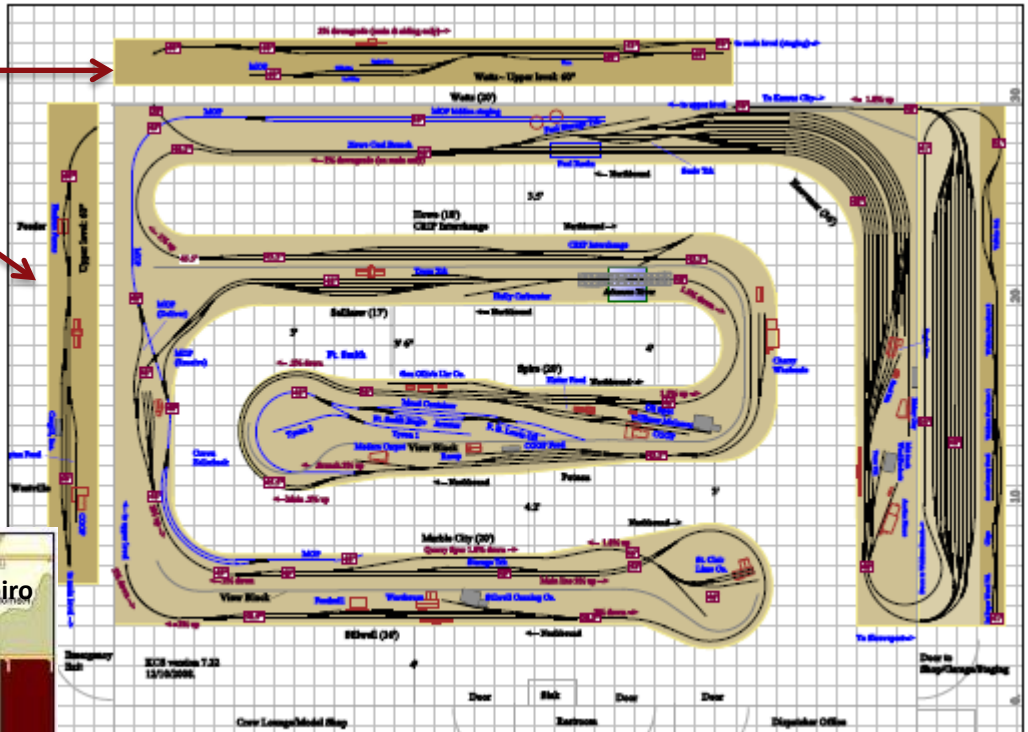
Aisle width varied from 4' in higher traffic areas, to 3' where fewer trains/people operate.



# Here's what we ended up with for the KCS

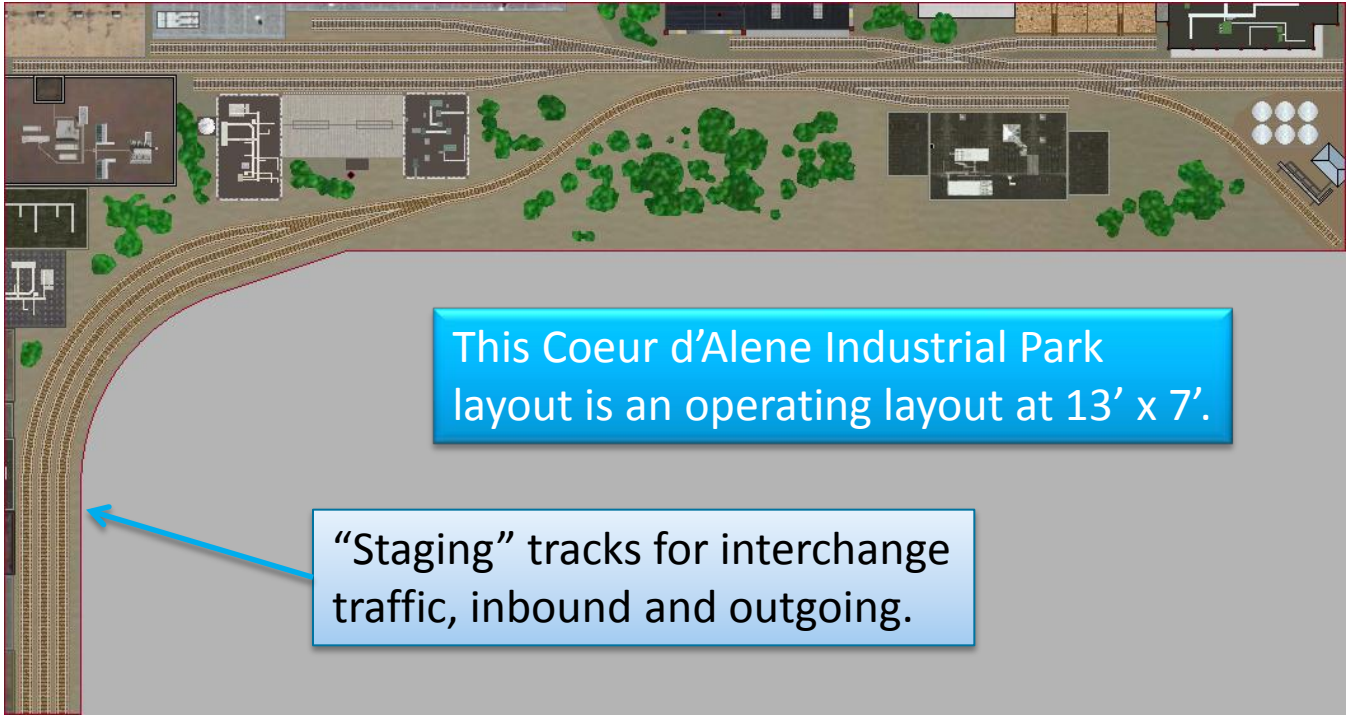
Mushroom / upper level.

"Mushroom" concept.

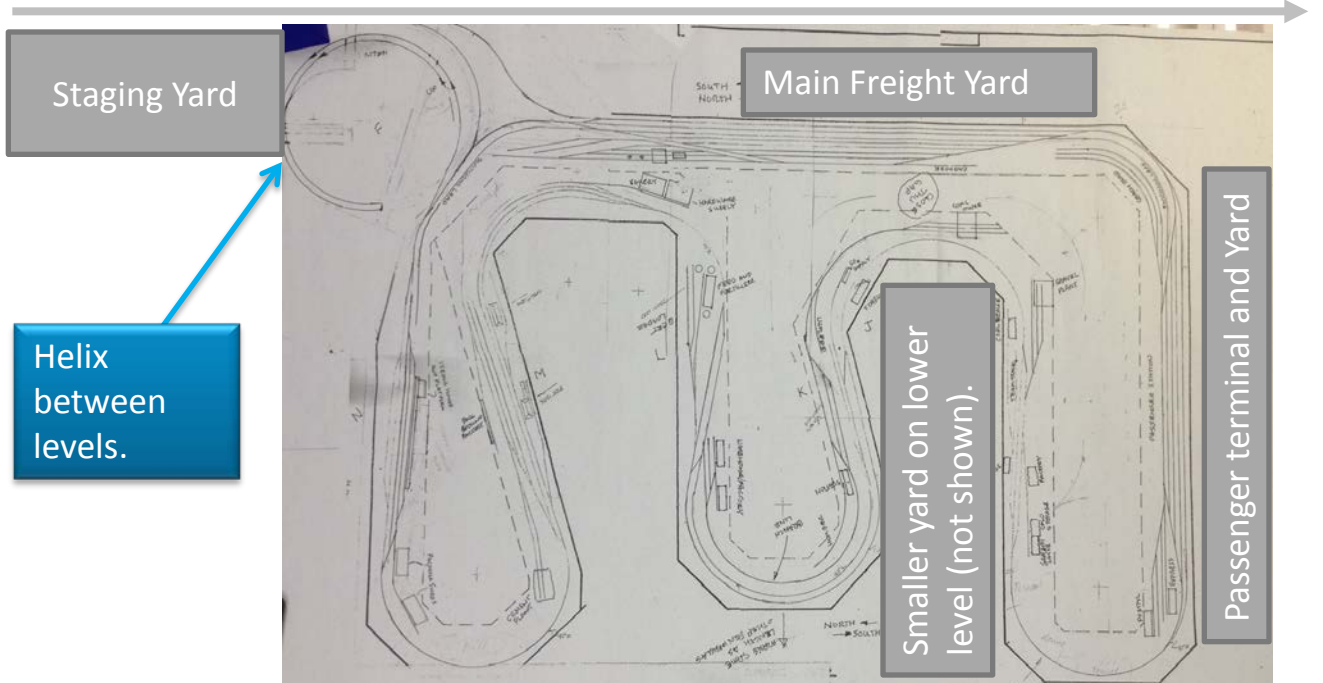


Single deck w/ mushroom, no helix in operating portion.

# It doesn't take a large space to operate



# West Bay Lines: Proto-Lanced, double-deck



The West Bay Lines is an independent North-South railroad located somewhere in the western United States. It is a single track railroad with passing sidings. The operation takes place circa 1950 to 1970, so steam power and diesel power (up to second generation diesels) are present. The portion modeled is a division somewhere in the middle of the railroad. Interchanges and run-through agreements exist with multiple western railroads operating in that era.

# What do these railroads have in common?

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- **Who**
  - They all have clear identities: KCS 3<sup>rd</sup>, Coeur d'Alene, Idaho industry switching, western north-south RR with bridge traffic.
- **What? (Purpose)**
  - Train(s) to run
  - Cars to deliver and pickup
  - Industries to service
- **Setting**
  - Different but all are believable
  - There is a “story”
  - There is a location
- **Why?**
  - Move freight and/or passengers
  - Serve on-line customers



# KCS 3<sup>rd</sup>



# Waldron Branch Switchlist

## Waldron Dodger

SWITCH CARS CAREFULLY AND SAFELY  
AVOID ROUGH HANDLING

Engine:  
KCS 799

Train:  
WD

Departs:  
11:20

Origin:  
Heavener

CREW:

RN	CAR INFO	TRACK
----	----------	-------

Manifest Leaving Heavener at: 11:20

### Waldron PICKUPS:

KCS	153294 Box Brown L	006 Furniture
GATX	91713 Tank Chem Black E	007 Furniture
ATSF	308205 Hop Cov-Food Tuscan L	009 Scott County Feed
KCS	310538 Hop Cov-Food Tuscan E	009 Scott County Feed
KCS	503045 Woodchip Brown E	011 Intl Paper
GATX	8184 Tank Food Gray E	005 ValMac
ACFX	88588 Tank Food Black E	005 ValMac
ATSF	300358 Hop Cov-Food Brown L	005 ValMac
AMCX	6809 Hop Cov-Chem Gray L	007 Furniture
KOTX	879 Tank Oil White E	010 Citgo

















### Waldron SETOUTS:

DRGW	15307 Hop Cov-Food Gray E	005 ValMac
KCS	308684 Hop Cov-Food Tuscan E	005 ValMac
CNW	490026 Hop Cov-Food Yellow L	005 ValMac
WP	4006 Box Brown L	006 Furniture
RAIX	6183 Tank Chem Blue E	007 Furniture
GATX	98934 Tank Chem White L	007 Furniture
SP	496668 Hop Cov-Food Gray L	009 Scott County Feed
SCLX	516 Tank Oil Orange E	010 Citgo



Note: this is a PARTIAL switchlist.

# Coeur d'Alene Industry Switchlist

Color	Action	Type	Car	To/At	Load	From	Image	Done
	Deliver	reefer	RS47	Denson Fruit	beef	Elm St Yard	 beef	
	Deliver	50ft box	XM7	Russet Potato...	potatoes	Elm St Yard	 potatoes	
	Send	50ft box	XM5	Team Track	Empty	Elm St Yard		
	Send	50ft box	XM11	Idaho Springs...	Empty	Elm St Yard		
	Send	50ft box	TM20	General Electric	Empty	Elm St Yard		
	Deliver	50ft box	SM29	Idaho Springs...	tinplate	Elm St Yard	 tinplate	
	Return	50ft box	XM8	Elm St Yard	appliances	General Electric	 appliances	
	Return	reefer	RS211	Elm St Yard	frozen foo...	Russet Potato...	 frozen foods	

*Switchlist and diagram from Train Player™ Software. This software, available at <http://www.trainplayer.com/> is a great tool for designing and then testing the operations on a model railroad, before committing to build it. The KCS 3<sup>rd</sup> Sub is included.*



# Walkaround operation and operators

- Consider a 'Sincere' layout

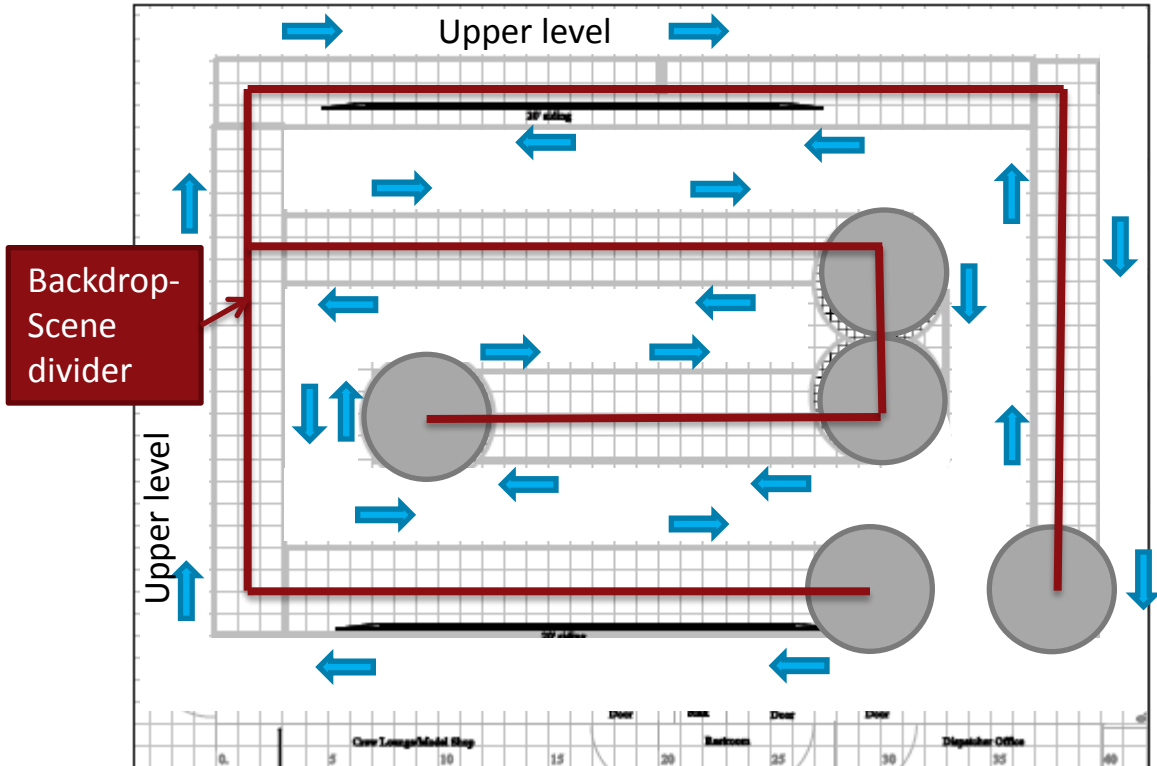
- This is a design in which the operator's left always represents the same compass direction no matter where the operator is on the layout (so the operator's right always represents the opposite direction) -- i.e. Left is North and Right is South (KCS) or left is west and right is east (C&S) etc.
  - Intuitive: helps new operators orient themselves and understand train orders and dispatcher instructions.
  - Makes it easier to follow trains across the layout

On the C&S, if you're looking at the track, you're looking North: West is to your left and East is to your right.

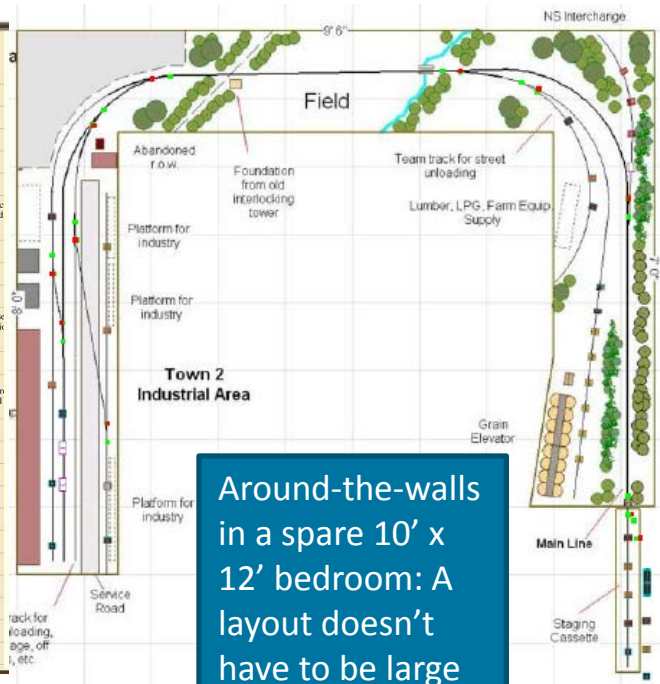
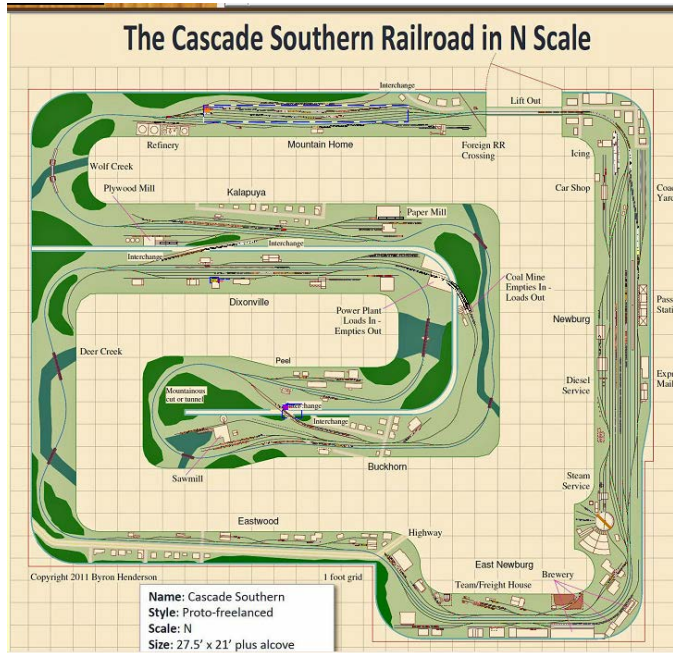


On the KCS 3<sup>rd</sup>, if you're looking at the track, you're looking East: North is to your left and South is to your right.

# How the KCS 3<sup>rd</sup> was designed to be “sincere”

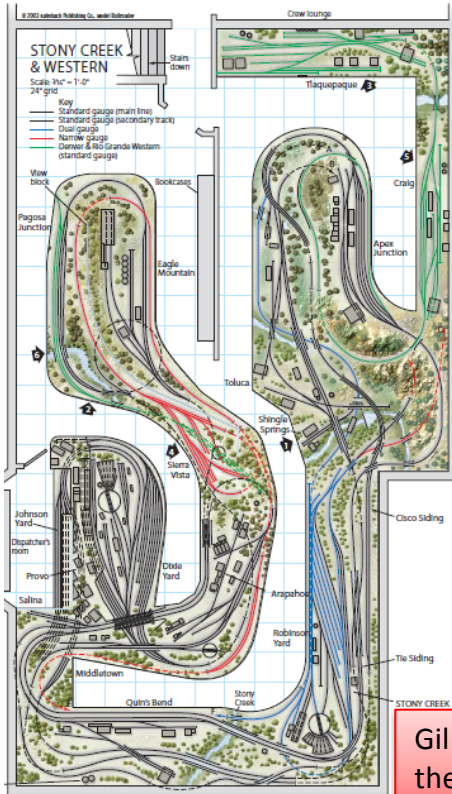


# Two more sincere layouts



Around-the-walls in a spare 10' x 12' bedroom: A layout doesn't have to be large to be 'sincere'.

# An operating layout need NOT be 'Sincere'

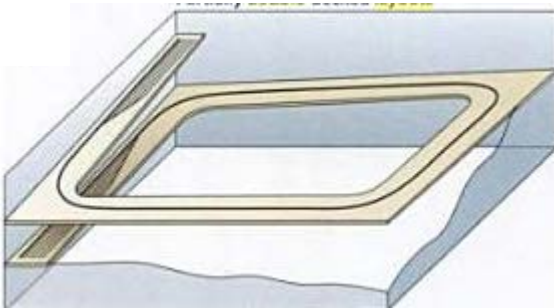
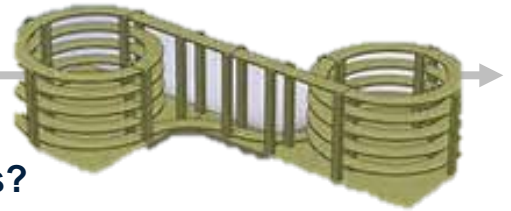


Gil Freitag's Stony Creek & Western is not 'sincere', but remains one of the finest operating model railroads in the world.

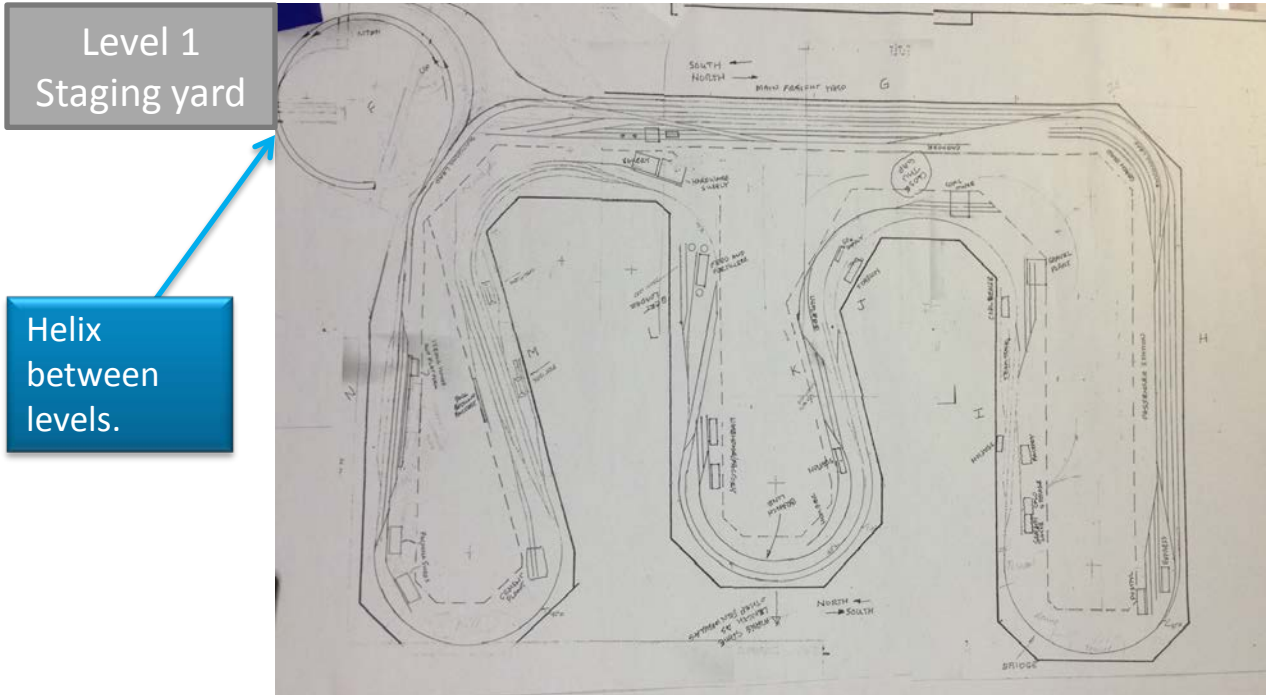
# Multi-deck?

- **Considerations include:**

- How much separation between levels?
- Lighting considerations, comfortable operating height for operators.
- 3<sup>rd</sup> level for staging?
- Helix? Where? Or constant-climb “No-lix” (i.e. Sammy Carlile’s ATSF Hereford sub and KCS 3<sup>rd</sup> to an extent)?
- Maintain, or reverse, compass directions at level change?



# West Bay Layout: Sincere “Per Level”

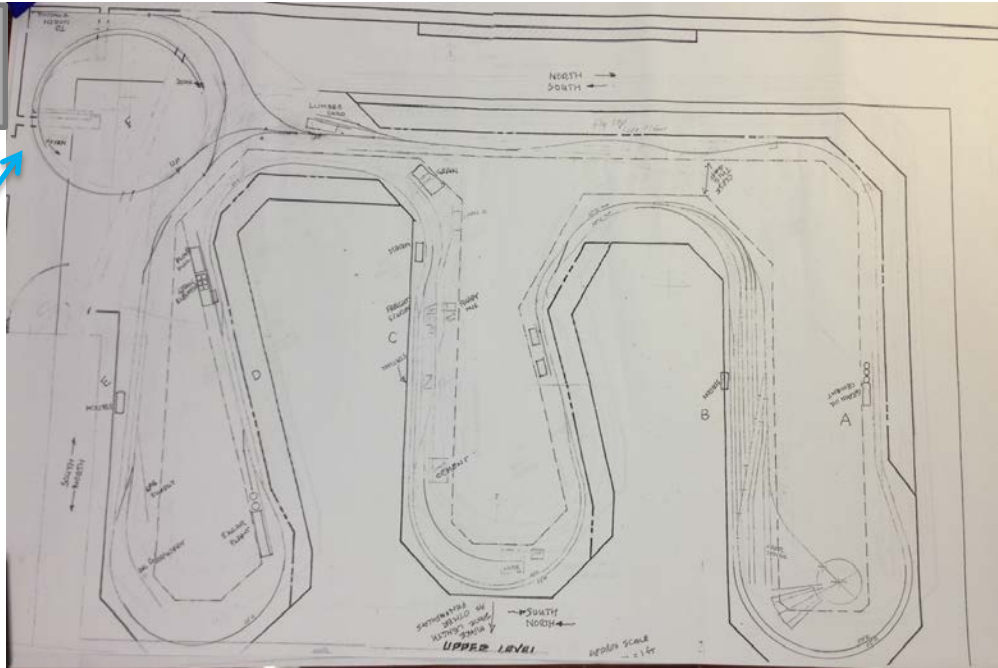


This layout is generally a walkaround, except you reverse directions at the helix, due to a track planning decision (mainline crossing the wye at the helix). This is fine as long as signage on each level makes this clear.

# West Bay Layout: Sincere “Per Level”

Level 2  
Staging yard

Helix  
between  
levels.



This design allows for continuous running on EACH LEVEL, without having to traverse the helix, for open house, etc.

# Location of Staging Yard(s)

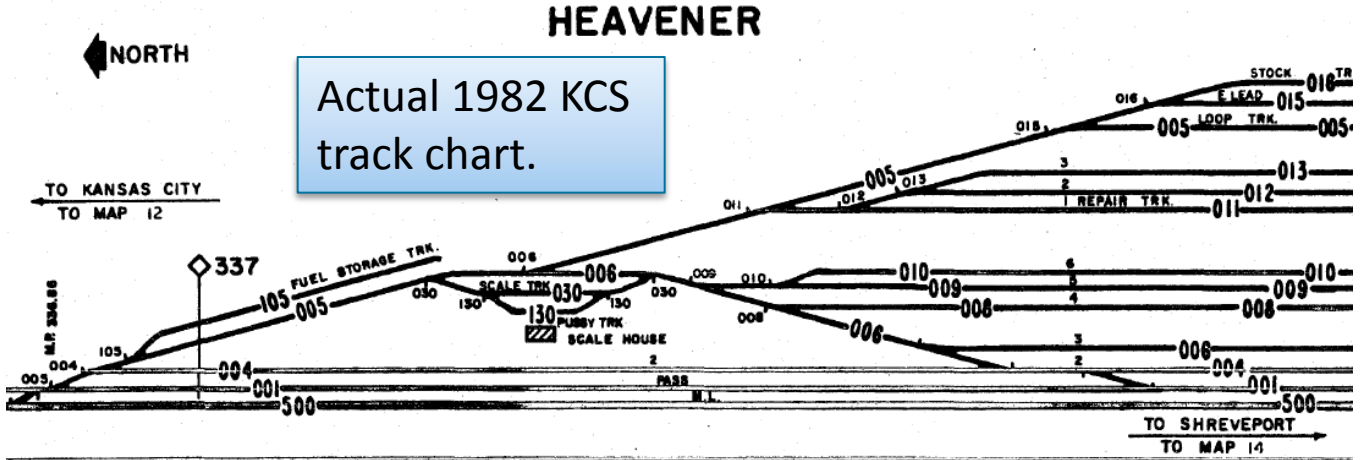
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- **Single staging yard connected to both ends (C&S, KCS 3<sup>rd</sup>)**
  - Provides for automatic restaging between sessions.
  - With a sincere layout, loaded coal trains always run one direction, empties the other, so no need to change out coal loads etc.
  - Can provide for continuous running (for an open house, etc.)
- **Staging yard at each end (West Bay, ATSF Panhandle)**
  - Provides room for more trains (nearly double if both are the same size.)
  - Harder to restage: need to turn trains or have a reverse loop, or run around locos and cabooses if used. May need to remove/replace loads in open cars.
- **No staging yard.**
  - Can use on-layout tracks like yard or interchange tracks that cars are pulled from or set-out to.
  - Off layout cartridge, “fiddle yard”, etc.
  - Ideal for smaller layouts, layouts that model a single industry like a steel mill or switching in a single town, etc.



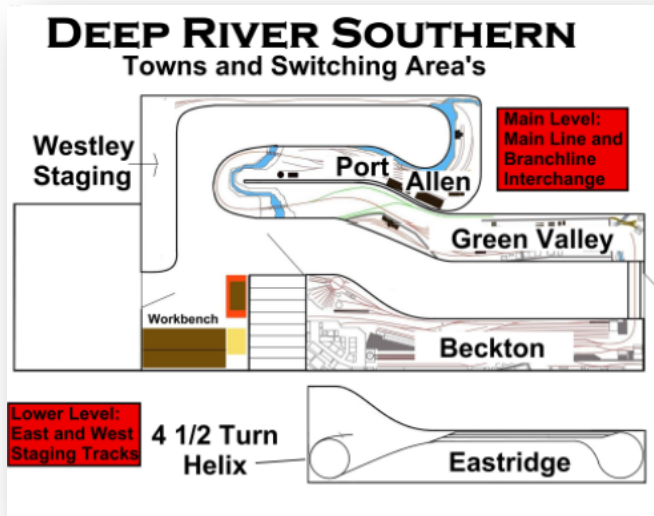
# Planning the layout

- Modeling a prototype can be easier: copy what the prototype had!
  - There are still decisions to be made in terms of “what to leave in, what to leave out” (“Against the Wind”, Bob Seger).
  - Where will the model start and end? Subdivision boundary? Major yard? Main terminal?



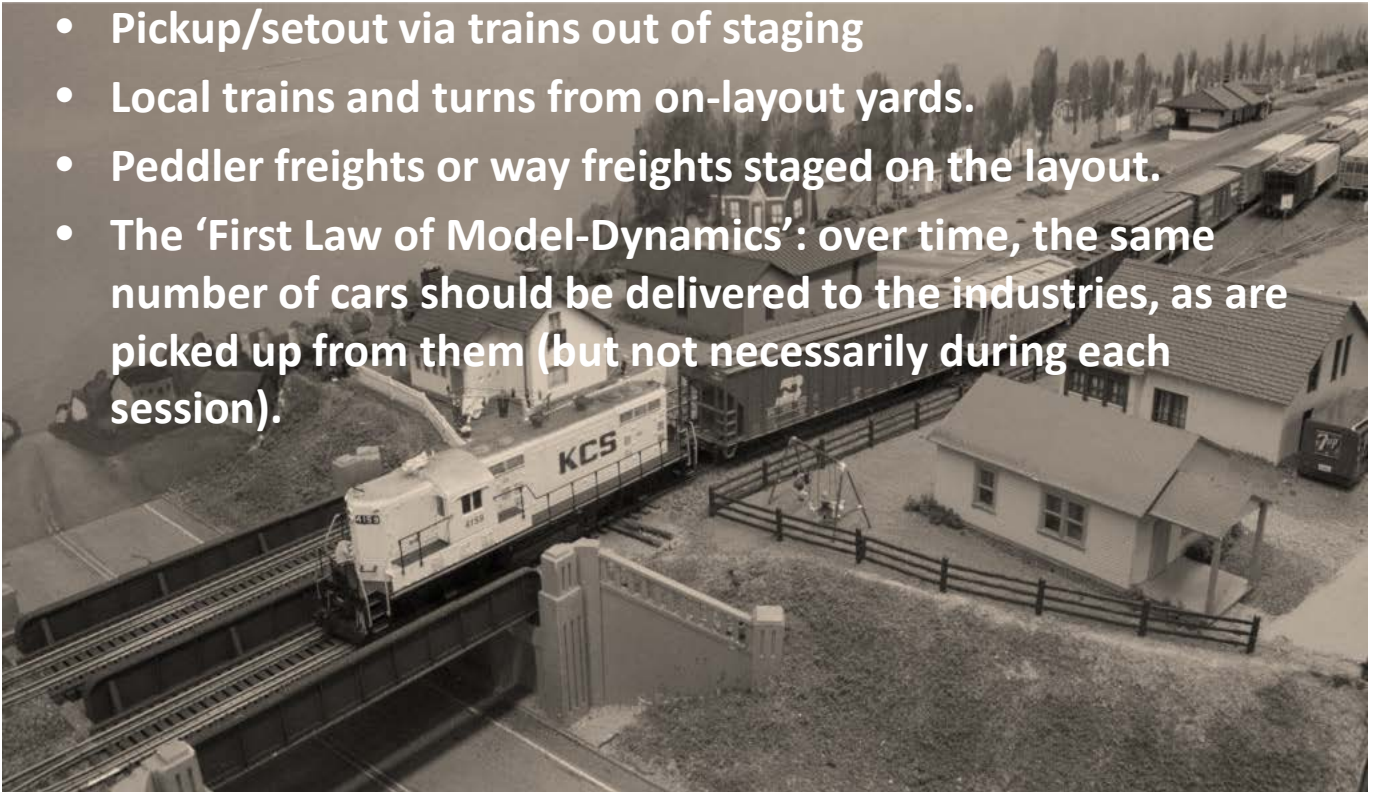
# Planning the layout

- “Proto-lance” and Freelance
  - More thought can be required as you have more of a “blank slate”.
  - Fewer restrictions – model your favorite industries & trains.
  - Yards and interchange points still impact operations



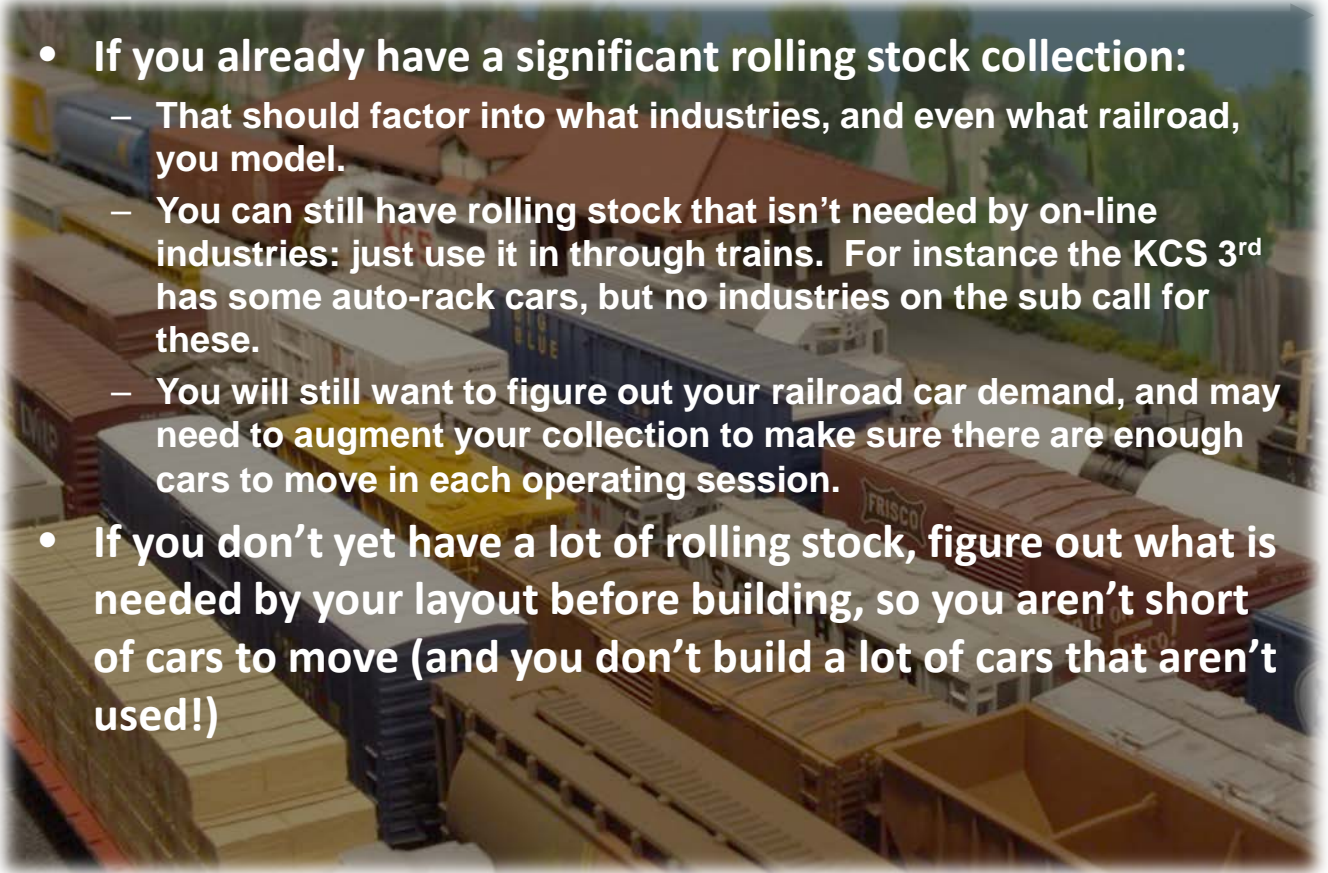
# Serving On-Line Industries

- Pickup/setout via trains out of staging
- Local trains and turns from on-layout yards.
- Peddler freights or way freights staged on the layout.
- The 'First Law of Model-Dynamics': over time, the same number of cars should be delivered to the industries, as are picked up from them (but not necessarily during each session).



# Rolling Stock Collection Considerations

- If you already have a significant rolling stock collection:
  - That should factor into what industries, and even what railroad, you model.
  - You can still have rolling stock that isn't needed by on-line industries: just use it in through trains. For instance the KCS 3<sup>rd</sup> has some auto-rack cars, but no industries on the sub call for these.
  - You will still want to figure out your railroad car demand, and may need to augment your collection to make sure there are enough cars to move in each operating session.
- If you don't yet have a lot of rolling stock, figure out what is needed by your layout before building, so you aren't short of cars to move (and you don't build a lot of cars that aren't used!)



# Rolling Stock Demand (sorry, math involved)

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- **Start with Industry Tracks**
  - Determine the car type(s) needed for each track (or ‘any’ if appropriate, i.e. for interchange tracks).
  - This is your **CAPACITY**. You may not want all spurs 100% full – we recommend 60% - 80% – that’s your “Utilization Percentage.”
  - Multiply the capacity by your Utilization Percentage to get your “Industry Demand” (you can do this for the total, or by industry if you prefer – for example you may want to assume interchange tracks are completely full (interchange job typically takes all)).
  - Make a chart of Industry Demand by type (Excel is great for this because you can use it to total up cars by type, calculate % etc.)
- **Count cars needed for trains in staging or pre-built.**
  - For any trains that will either directly service your industries, or drop cars in yards to service your industries, those car types need to match your Industry Demand.
  - The total of these (whether servicing industries or just running through) is your “Additional Demand”.

# Yard Basics

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- **Purpose**
  - Prototype yards generally exist to sort and route cars.
  - Some are used to store cars until needed.
- **Yard capacity**
  - If trains will be built at the beginning of the ops session, there must be room for all cars needed to make up outbound trains.
  - If trains are built “just in time”, (after arrival of trains with inbound cars) room is only needed for the number of cars that will be dropped.
- **Operation**
  - Switched by passing or originating crews
  - Dedicated Yard crew
- **Configuration**
  - Single-ended
  - Double-ended

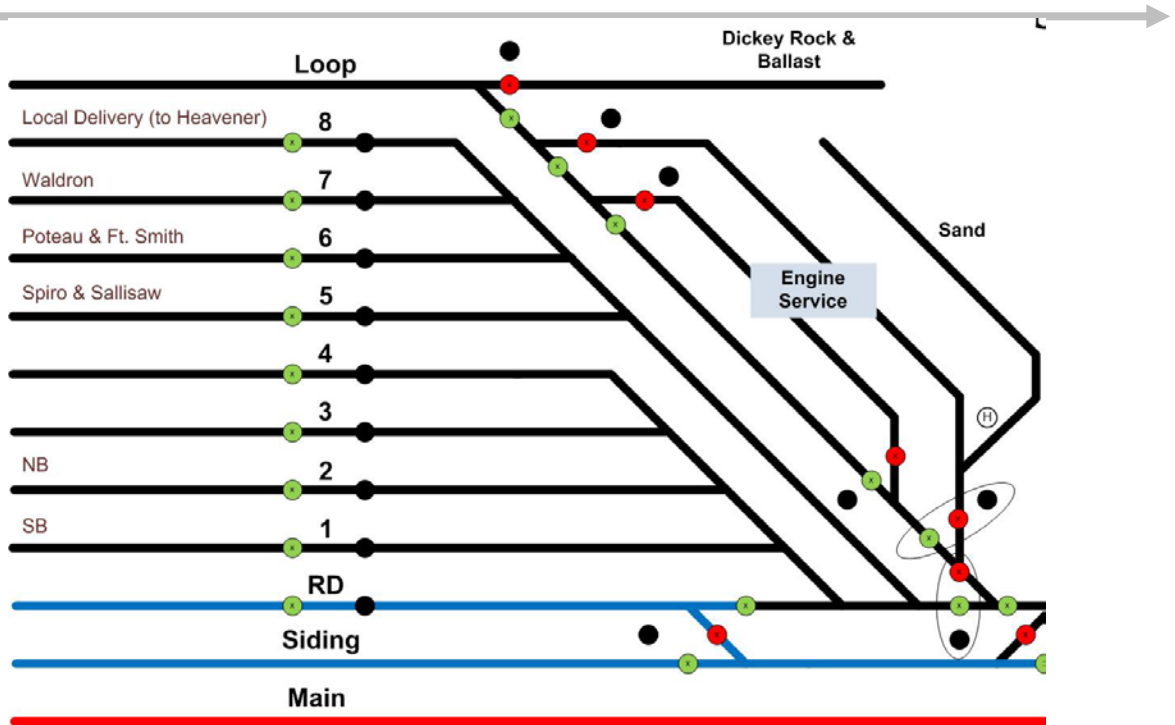


# Yards: Classification

- **Track usage** (If trains passing through will drop cars intended for multiple destinations, and/or only pick up cars intended for a specific destination or train)
  - Ideally, there should be a track dedicated to each major town or destination, or for each outbound train.
  - Can be based on prototype if you have sufficient information on how the prototype operated, and sufficient room for the required tracks.
- If space is lacking, tracks can be shared for multiple destinations, but, there should be a way to indicate the destination so cars are easily marshalled for outbound trains or trains exchanging cars.



# Example: KCS Heavener Yard (Drill/South end)



Example: train 82, a northbound manifest, will pick up cars from the NB track, and set out to tracks 5 – 8. So 5-8 fill up while the NB track empties out. NB won't fill back up until at least one of the locals returns, generally halfway through the session or later.



# Traffic Flow

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- **Staging to Staging**
  - Pick-up and drop off cars on the layout, including yards: peddler, interchange, block swap.
  - Run-through trains with no pickups or setouts: through manifests, coal and other unit trains, passenger trains, etc.)
- **On-layout yard(s) or interchange tracks, etc.**
  - Trains can originate and terminate there (cars classified)
  - Trains out of staging drop and pickup enroute (block-swaps).



# Math needed for traffic flow too ...

These are PLANNING rules of thumb, NOT set in stone. Not needed for every train/track or even every session.

## • Staging to Staging



- Trains out of staging should pick up no more cars than they drop off (*you can break this rule if there is excess capacity in staging, but over time this must be managed or staging will overflow*).

## • On-layout yard(s)

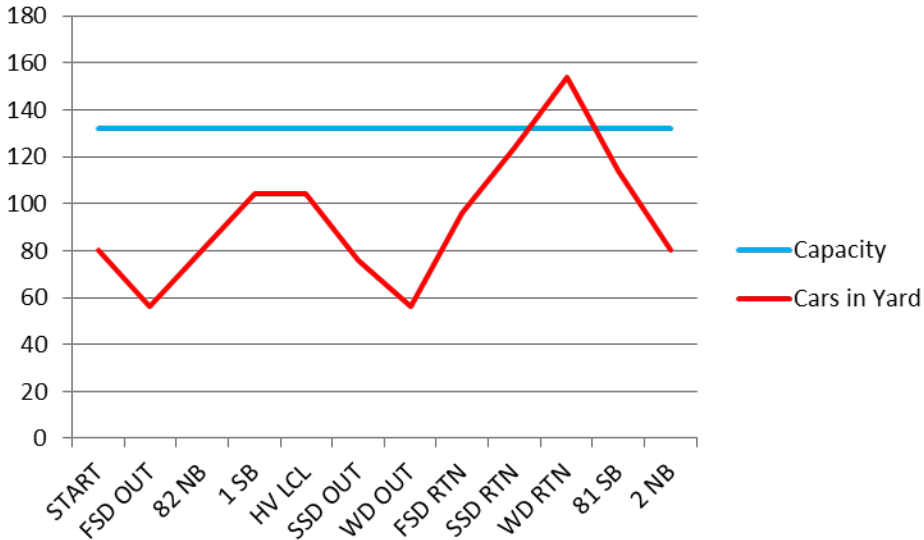
- The number of cars dropped by trains passing through or terminating should not exceed the number of cars going out on trains, or the yard will overflow. *Even if the yard has excess capacity, this needs to be observed over time.*

Siding	Length	Car capy	Count at Start	Pickups	Setouts	FSD OUT			82 NB			1 SB			HV LOCAL			
						PU	SO	On Trk	PU	SO	On Trk	PU	SO	On Trk	PU	SO	On Trk	
NB	1200	24	20	20	20			20	10		10			10			4	14
SB	1200	24	20	20	20			20			20	10		10			4	14
SSD	1200	24	10	10	10			10		3	13		3	16				16
FSD	1200	24	12	12	12	12		0		3	3		3	6				6
WD	1200	24	10	10	10			10		2	12		2	14				14
Local	600	12	8	8	8			8		2	10		2	12			8	4
<b>Total Heavener Cars</b>	6600	132	80	80	80	12	0	68	10	10	68	10	10	68	8	8	68	

60 % at start:

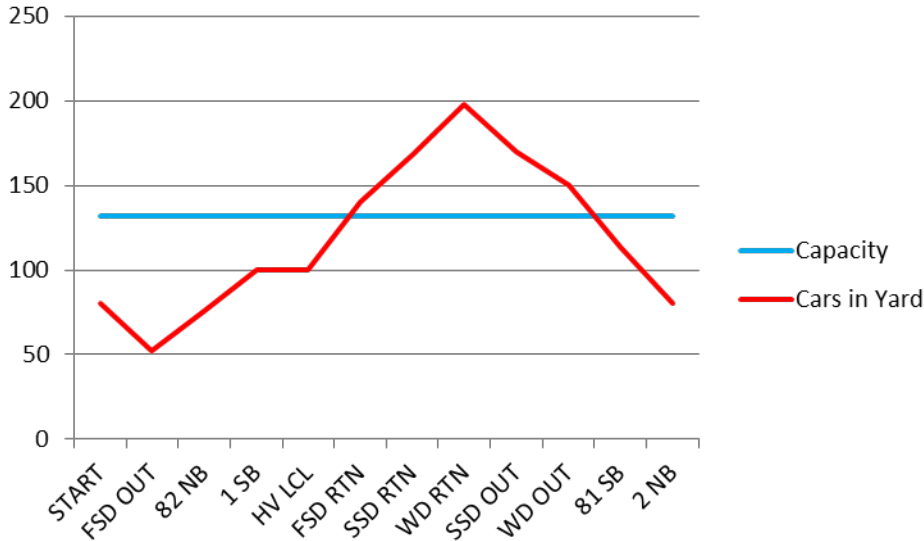
# Ebb and Flow in Heavener Yard

- Assuming 60% full at start, if just one train arrives out of order, we have a slight overflow at one point:



# Ebb and Flow in Heavener Yard (worst case)

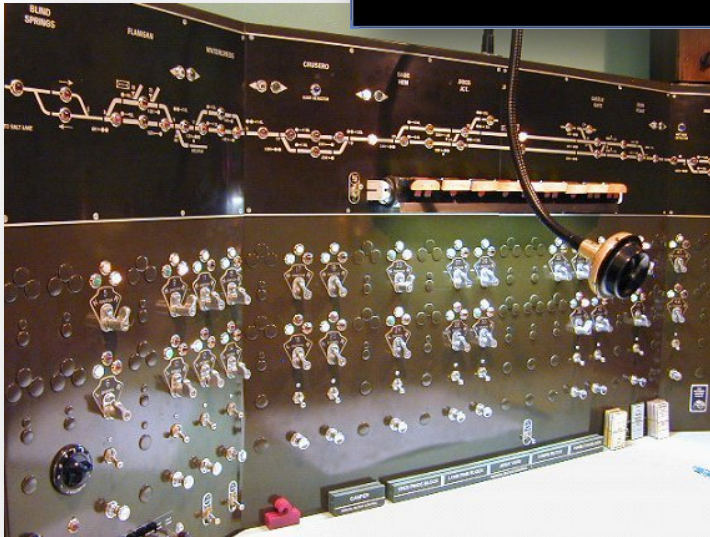
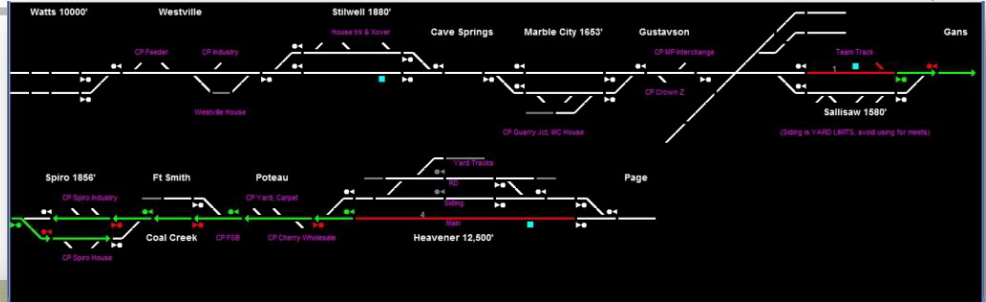
- Assuming 60% full at start, if multiple trains arrive out of order, there can be a significant overload:



Admittedly, this is a worst case scenario, but it IS a possibility.

# Train Routing and Dispatching

- CTC
  - CTC Panels
  - PC-based




A NB holds at Marble City, while the coming SB will see a “Diverging Approach.”


# Train Traffic Management/Dispatching

- Track Warrant Control
- Timetable and Train Order
- Pseudo CTC (magnet or dry-erase board etc.)
- Yard Limits rules.

Signals etc. can be added later but it is best to plan for this at the design stage.



**TRACK WARRANT**  
FOURTH DISTRICT, VALLEY DIVISION



No: \_\_\_\_\_ : 19 \_\_\_\_\_  
 To: \_\_\_\_\_ At: \_\_\_\_\_

Mark "X" in box for each item instructed

1.  Track warrant No. \_\_\_\_\_ is void
2.  Proceed from \_\_\_\_\_ to \_\_\_\_\_ on \_\_\_\_\_ Track
3.  Proceed from \_\_\_\_\_ to \_\_\_\_\_ on \_\_\_\_\_ Track
4.  Work between \_\_\_\_\_ and \_\_\_\_\_ on \_\_\_\_\_ Track
5.  Work between \_\_\_\_\_ and \_\_\_\_\_ on \_\_\_\_\_ Track
6.  Hold \_\_\_\_\_ Main track at \_\_\_\_\_
7.  Take siding at \_\_\_\_\_
8.  Not in effect until after arrival of \_\_\_\_\_ at \_\_\_\_\_
9.  This authority expires at \_\_\_\_\_ M
10.  Other instructions \_\_\_\_\_

OK \_\_\_\_\_ M Dispatcher \_\_\_\_\_  
 Reported clear at \_\_\_\_\_ M by \_\_\_\_\_

Form TW310771

**DRY PRONG, BENTLEY & GULF LINES**

Train Order No: *12*      Date: *February 22, 2010*

To: <i>EXTRA MP 626</i> <i>SOUTH</i>	At: <i>ALEXANDRIA</i>

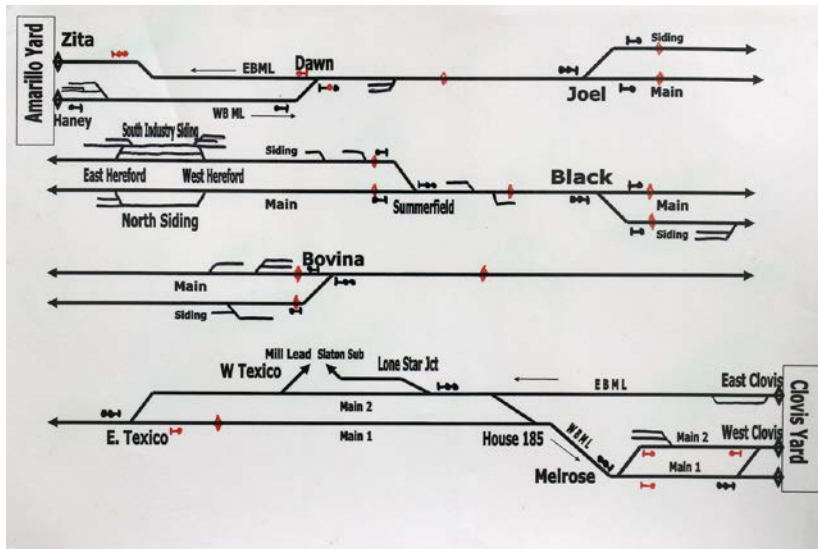
<i>No.</i>	<i>1</i>	<i>No.</i>	<i>3</i>	<i>No.</i>	<i>No.</i>	<i>No.</i>
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**TT&TO: Train Order example.**

	<i>GWS</i>
Made Complete	<i>7:05 PM</i>
Conductor and Engineer must each have a copy of this order	

# Train Traffic Management/Dispatching

- Track Warrant Control
- Timetable and Train Order
- **Pseudo CTC (magnet or dry-erase board etc.)**
- Yard Limits rules.



Sammy's ATSF Hereford Sub was dispatched by dry-erase board, until we added CTC. The signals on the layout were unlit models.

# Industries, Interchanges, Stations Served

- Easy if modeling a prototype: just pick the industries that the railroad actually served.
- If proto-lance, industries should be of the type found in the geographic area and era being modeled.
- If freelance, you might want to use “Layout Design Elements” (LDEs) as publicized in Model Railroader™ Magazine.





# What trains run, and why?

- **Through trains**
  - Home railroad trains
  - Haulage and trackage rights trains from other railroads, bridge traffic.
- **Local/switch jobs.**
- **Interchange trains/jobs.**
- **Branch line and other operations.**



# Trains on the KCS 3<sup>rd</sup> Sub



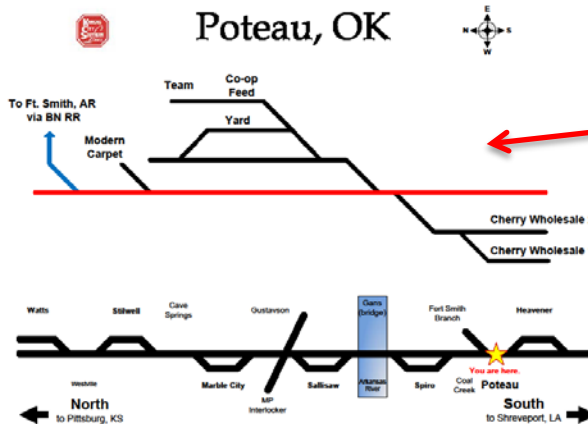
North and South bound run-through manifests	No stops on the 3 <sup>rd</sup> sub
North and South bound block swap manifests	Stop at yards to exchange cars (perform block swaps)
North and South bound through passenger trains	Only stop at major stations
Local freight trains (aka “Dodgers” in KCS parlance)	Run from yards to service industries
Yard jobs	Make and break trains in yards
Special train(s)	Officers’/Shipper’s Special, MOW trains.

# Operator Orientation

- Clear town/location names
  - Consistent format and placement helps



- Track plan posted or distributed.
- Maps of siding/spur locations posted at each station/town point.



Town schematic

Schematic of full layout, including "you are here."

# Ergonomics/People Considerations

- Shelves, supplies, clipboard hangers (if clipboards are used)



- Drink holders, shelves for track cleaners and paperwork, etc.
- Lounge or sitting/waiting area nearby or accessible
  - Availability/place for drinks and refreshments, especially water.
- Restroom nearby or accessible.