

Chapter 21**Contents**

21 Contract Plan Development & Drafting.....	21-1
21.1 General.....	21-1
21.2 General Drafting Requirements.....	21-2
21.3 General Plan Sheet Content Requirements	21-3
21.4 MicroStation Traffic Signal Workflow	21-5
21.5 Grooming Reference Files	21-8
21.6 Projects Without Reference Files/Survey Data.....	21-8
21.7 Traffic Signal Style Drafting – Basic Layout and Information.....	21-9
21.7.1 Plan Sheet Titles, Size, and Scale.....	21-9
21.7.2 Order of Traffic Signal Plan Sheets.....	21-10
21.7.3 Title Block - Traffic Signal Specific Information	21-11
21.7.4 Digital Signatures	21-12
21.7.5 Accompanied by Dwgs. Box.....	21-12
21.7.6 Upper Right Corner Title Information	21-13
21.7.7 North Arrow, Street Names, & Lane Use Arrows.....	21-15
21.7.8 Centerline Station or Scale Bar	21-16
21.7.9 Right-of-Way.....	21-17
21.7.10 New Roadway & Pavement Markings.....	21-18
21.7.11 Break Lines and Match Lines.....	21-19
21.7.12 Blow-up Views	21-22
21.7.13 Cross References.....	21-24
21.8 Traffic Signal Style Drafting – Specific Design Features	21-25
21.8.1 New vs. Existing Symbology	21-25
21.8.2 Showing Conduit Runs	21-26
21.8.3 Pole (and Pedestal) Numbering	21-27
21.8.4 Controller Cabinet Orientation	21-29
21.9 Bubble Notes.....	21-30
21.9.1 Filling Out Bubble Note Variable Correctly	21-32

Traffic Signal Design Manual – Contract Plan Development & Drafting

21.9.2 Leader Line Information	21-33
21.9.3 Creating and Reading Bubble Note Strings.....	21-34
21.9.4 Reference Bubble Notes.....	21-36
21.9.5 Miscellaneous Customizable Bubble Note	21-37
21.9.6 Use of "EX" Bubble Notes.....	21-38
21.9.7 Use of "RX", "RR", and "RI" Bubble Notes	21-40
21.9.8 Updating Type 3L to Type 3LCF Signal Heads	21-41
21.10 Specific Plan Sheet Content Requirements.....	21-42
21.10.1 Legend Plan Sheet	21-42
21.10.2 Removal Plan	21-45
21.10.3 Signal Plan.....	21-49
21.10.4 Detector Plan.....	21-53
21.10.5 Interconnect Plan.....	21-57
21.10.6 Railroad Preemption Plan.....	21-59
21.10.7 Existing Utilities Plan.....	21-63
21.10.8 Details Plan	21-65
21.10.9 Temporary Signal, Detector, Ramp Meter Plan	21-68
21.10.10 Flashing Beacon Plan	21-72
21.10.11 Ramp Meter Plan.....	21-77
21.11 MicroStation File Archiving	21-79
21.12 Plan Sheet (PDF) Archiving.....	21-80
21.13 Revised Plans	21-81
21.14 As-Constructed Plans	21-83
21.15 Final Design/Drafting Checklist.....	21-85
21.16 Standard Bubble Note List.....	21-86

21 Contract Plan Development & Drafting

21.1 General

This chapter contains information about drafting standards, nomenclature, and MicroStation tools specific to creating contract plan sheets for traffic signal work. General information (that is not specific to traffic signal work) is contained in the [ODOT CAD Manual, ODOT Roadway CAD Manual](#), or the [ODOT Contract Plans Development Guide](#) and includes the following topics:

1. Seed files
2. Using separate files for design work and for plan sheet detailing work (allows for proper use of annotation scale)
 - a. Setting up the signal base map file
 - b. Setting up the signal plan sheet file
3. File naming conventions
4. Use of files in ProjectWise
5. Title block
6. Digital signatures
7. Order of plan sheet disciplines in the contract plans
8. Numbering the contract plan sheets according to the discipline specific series letter (this is different from the unique TRS drawing number/unit file code that is assigned by traffic engineering section as per chapter 2.)
9. Using print organizer

General information about MicroStation workspace and workflows can be found in the [ODOT Engineering Applications Support Team \(EAST Team\) MicroStation Users Guide](#):

1. Discipline ribbon workflow and standard symbologies
2. Using annotation scale
3. Using models in your design files
4. Setting up the signal plan sheet files for printing (allows for proper use of the print organizer)

This chapter assumes the user is comfortable using the MicroStation platform and is moderately proficient in its use. Parts of this chapter will also be of value to AutoCAD users.

21.2 General Drafting Requirements

The following bullet points list the basic requirements for plans submitted to ODOT. This includes projects to be let and administered by ODOT as well as projects produced for ODOT by cities, counties, or private developers.

- Plans must be legible, in black and white, and meet all design and drafting criteria in this manual and the [ODOT CAD Manual](#), [ODOT Roadway CAD Manual](#), or the [ODOT Contract Plans Development Guide](#).
 - Features/text/bubble notes shall not be obscured.
 - Levels/features that aren't necessary for the work and only add clutter to the plan sheet shall not be visible.
- Plans must be drafted and submitted in MicroStation Connect format. AutoCAD files are not acceptable.
- Plans must be submitted an 11x17 PDF for plan review submittals.
- Final plans must be submitted in an 11x17 PDF with each sheet digitally signed by the engineer of record. See chapter 2 for more information.
- Final plans must be approved and digitally signed by ODOT traffic signal standards. See chapter 2 for more information.

Uniformity for drafting is very important as it creates a language that is used to efficiently communicate. Uniformity of drafting leads to less errors and quick comprehension. It also helps custom notes and unique work stand-out better. However, it is understood that drafting style will vary slightly from drafter to drafter, and this will result in subtle differences in how the plan sheets look and convey information. This is normal and acceptable as long as the drafter is in substantial conformance of this chapter and the plans are clean, legible, and easy to follow. The state traffic signal engineer will make comments on any drafting issues that require correction during the design approval process.

21.3 General Plan Sheet Content Requirements

All traffic signal work shall be shown and detailed on the proper traffic signal plan sheets of the M series in the contract plans set. The M series has been designated as the traffic signal discipline as per the ODOT CAD Manual. Other disciplines are assigned different letters which are alphabetically arranged in the contract plan set (e.g., workzone plans are assigned to the E series, therefore workzone plan sheets will always precede traffic signal plan sheets).

Traffic signal work may be shown and referenced on other discipline plan sheets but shall only be shown and detailed on the M series plan sheets. Other discipline's work may be shown and referenced on the M series plan sheets but shall not be shown and detailed on the M series plan sheets. Always coordinate with the other discipline's designer when referencing work. See Figure 21-1 and Figure 21-2 for examples. Showing and detailing the work for each discipline on the proper plan sheet is very important for the following reasons:

- All contractors working on the project have an expectation of where to look to find the proper information. This results in increased efficiency and less risk of work being missed (e.g., contractors that perform traffic signal work know to look in the M series plan sheets. They do not expect to find this type of work in other discipline's plan sheets).
- Payment for the work performed needs to be very clear. When traffic signal work is shown and detailed on another discipline's plan sheet (or vise-versa) it introduces confusion on which bid item should be used and makes contract administration more difficult. It can also result in higher bid items prices (e.g., contractor covers the payment of that work in multiple incorrect bid items instead of using the correct bid item).
- The engineer of record (EOR) should only be stamping plan sheets detailing work that is within their expertise. When the detailed work is outside of EOR's area of expertise, they may not be aware of all applicable policies/guidelines/procedures associated with the work which can result in incomplete plan sheet detail and poor construction support.
- Archiving the work is important for future maintenance and design needs. When traffic signal work is shown and detailed on another discipline's plan sheet (or vise-versa) it will not be properly archived and accessible to those that will need it in the future (e.g., roadway plans are archived via the V-file number and traffic signal plans are archived via the unit file code. Staff doing the archiving work do not look at plan sheet contents and will not archive in both locations). Unless someone has past knowledge that some traffic signal work was shown on a different discipline's plan sheet, it will be virtually impossible to efficiently search and find that information in another discipline's archive system.

If the scope of work and number of plan sheets in the contract plan set is extremely limited (e.g., project has only 1 to 2 plans sheets total), combining the work of multiple disciplines (showing and detailing) on a single plan sheet may be allowed at the discretion of the state traffic signal

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

engineer. Even on projects this small, though it may feel excessive to produce discipline specific plan sheets, it immensely helps with contract administration and archiving.

Figure 21-1 | Work Shown and Detailed Example

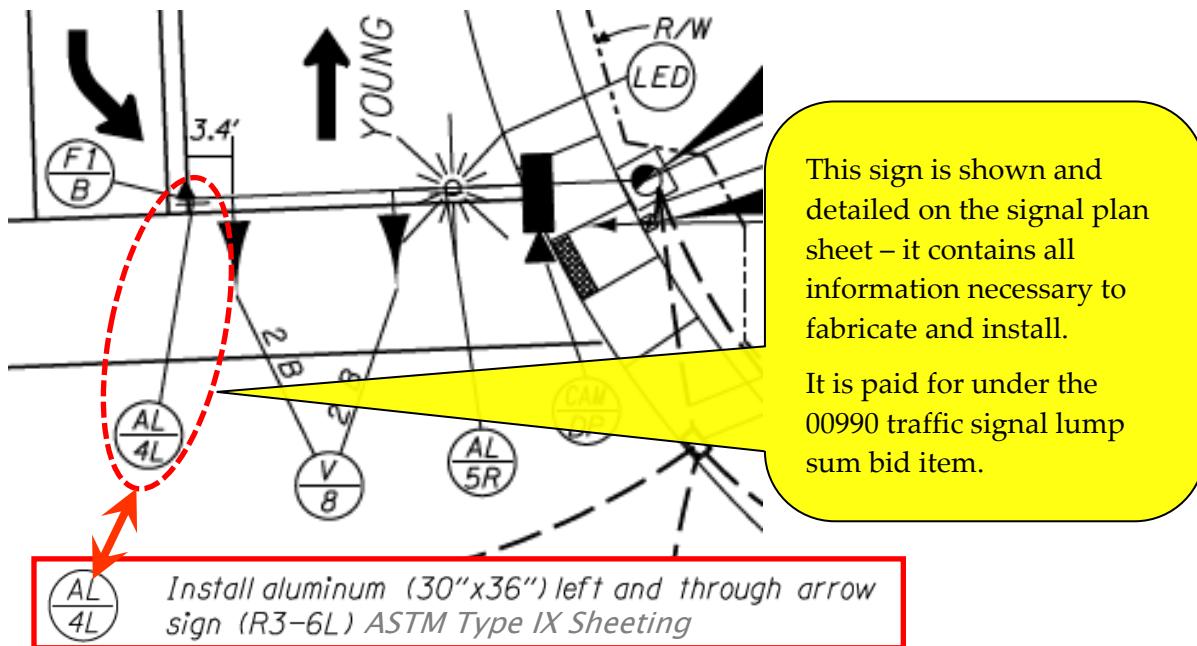
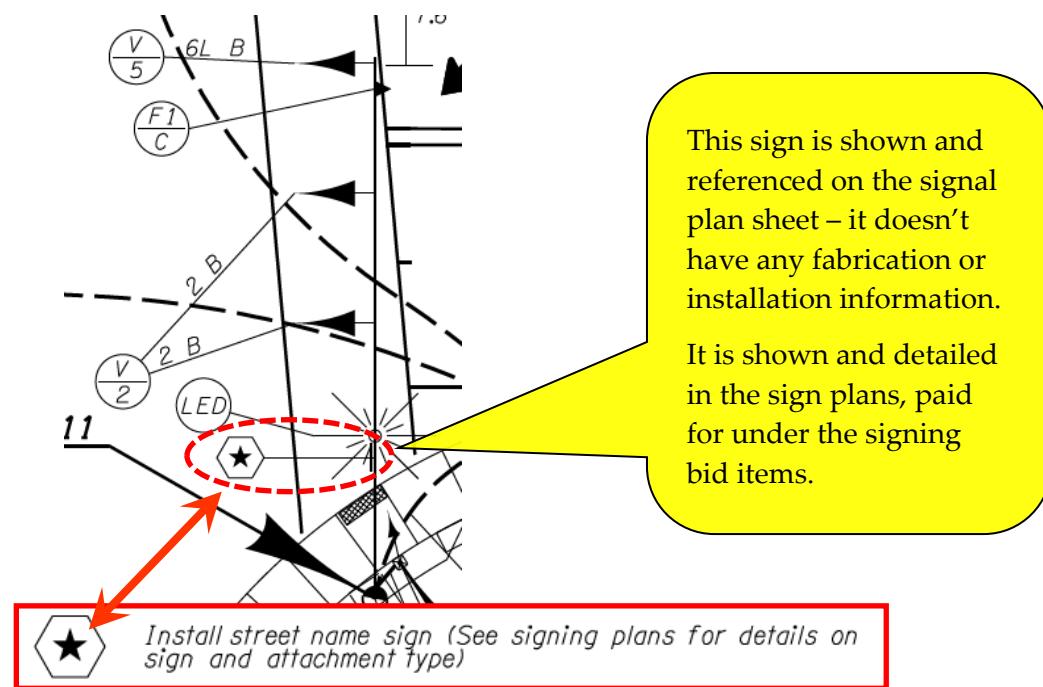


Figure 21-2 | Work Shown and Referenced Example



21.4 MicroStation Traffic Signal Workflow

The MicroStation workspace has a workflow for each specific engineering discipline. The traffic signal workflow contains the typical features and symbology that are used on traffic signal plans (e.g., scale, line weight, line style, color, level, wording of notes, font, etc.) and greatly reduces the need to create custom symbology/notes.

The symbology and scaleable features in the workflow are all labeled according to what they are and how they should be used. They have been created to work with the annotation scale of the plan sheets and/or the actual dimensions of the feature when placed at a scale of 1:1. Critical features that may affect right-of-way, affect placement of other features, and/or require very precise placement display the actual dimensions (e.g., pole and pedestal foundations, mast arm lengths, wheelchair design vehicle, junction boxes, etc.). Non-critical features do not display the actual size but instead provide good visibility of the feature at the plan sheet scale used (e.g., conduits, signal heads, pedestrian heads, etc.).

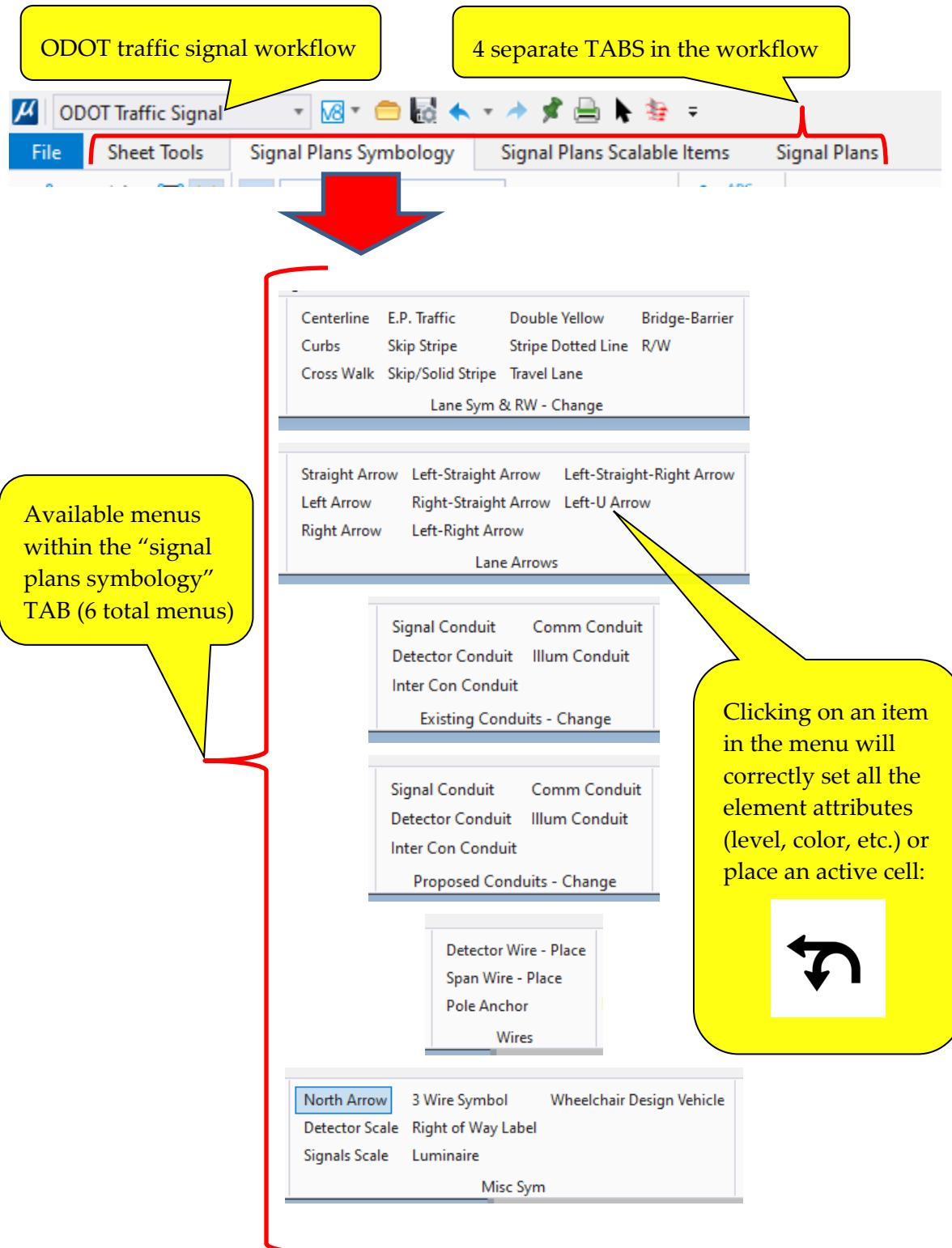
The traffic signal plans shall use the standard symbology contained within the traffic signal workflow. General information about the MicroStation workspace and how to access them is contained in section 21.1. See Figure 21-3 for how the traffic signal workflow is configured. In the situations where custom symbology/notes may be needed, contact the state traffic signal engineer for guidance.

Updates to the workflow may occur at any time, typically due to changes to standards, correcting errors/oversights, and making improvements for the drafter and/or plan reader. Updates should be automatic for ODOT personnel when opening MicroStation and the user should also get an e-mail from the ODOT EAST team summarizing the updates. For non-ODOT personnel, it the user's responsibility to ensure the workspace is the latest version before and during design of all signal projects.

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-3 | MicroStation Traffic Signal Workflow

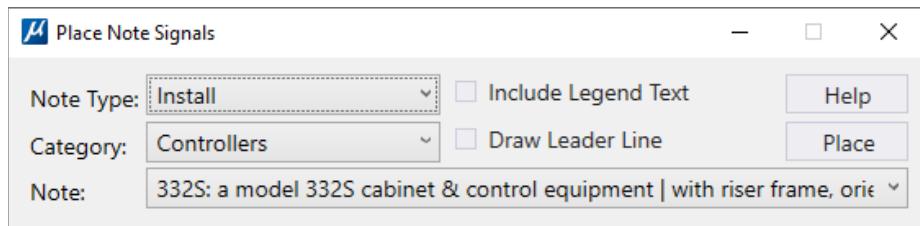


Traffic Signal Design Manual – Contract Plan Development & Drafting

The workflow contains a bubble note “place note signals” tool that contains all the standard bubble notes and makes placing them for the legend and in plan sheets quick and easy. See Figure 21-4. It can be found in either workflow detailed below:

- “ODOT” workflow
 - “Bubble Note Tools”
 - “Signals”
- “ODOT Traffic Signal” workflow
 - “sheet tools”
 - “notes & symbols”
 - “signal note tool”

Figure 21-4 | Bubble Note “Place Note Signals” Tool



A list of the standard bubble notes contained in the MicroStation workspace is provided at the end of this chapter for easy reference when creating and reviewing plan sheets.

Custom or modified bubble notes may be necessary if the bubble notes in the “place note signals” tool do not adequately or clearly address unique site-specific needs. For example, the EX/1 bubble note for the power source, “retain and protect existing power pole (power source)” is found only under the category “poles” because that is the most typical location for the power source. However, the power source could be ground mounted and not on a pole. In this case, the EX/1 bubble note should still be used, but the accompanying legend text should be modified to reflect the site-specific condition as follows, “retain and protect existing power cabinet (power source)”.

The workflow should contain all the standard drafting elements discussed in this chapter. If items are missing or not working/displaying correctly, or something should be added, contact the traffic engineering section so it can be fixed. Your feedback is important to maintain the workflow.

Custom/modified bubble notes and symbology should be avoided but is sometimes necessary on a project. Work with the state traffic signal engineer. If the custom/modified feature has the potential for wider use or improves upon the existing element, it will likely be included in a future update to the MicroStation workspace.

21.5 Grooming Reference Files

Each referenced base map file (e.g., roadway, striping, etc.) should be groomed. This is done because signal plan sheets are produced at a different scale and must emphasize different design features than plan sheets produced for other disciplines. Grooming includes turning off any levels with extraneous information/features not needed for the signal design and modifying the design features to conform to the traffic signal drafting standards as per the MicroStation workflow. Common elements that require grooming include:

- Turning off levels:
 - Signs
 - Landscaping, trees and brush
 - Buildings
 - Pavement markings for lane use
- Modifying design features to traffic signal drafting standard symbology:
 - Curbs
 - Crosswalks
 - Centerline
 - Various lane lines (e.g., converting striping line styles with raised pavement markers to striping line styles without raised pavement markers).
 - Edge of travel lanes/edge of pavement
 - R/W lines
 - Survey symbols of existing features (e.g., junction boxes, poles, conduit, etc.)

Grooming reference files and incorporating them into the traffic signal plan sheets can be done in various ways. Regardless of the method used, it is critical that the signal designer uses the correct reference files and monitors the reference files for changes throughout the design process. Good communication with the designer that is responsible for each reference file is key.

21.6 Projects Without Reference Files/Survey Data

Small scale projects that don't involve any roadway construction (such as state force work) may not have any survey data or other reference files. When a project won't have any reference files, the plan view features of the intersection (lane lines, edge of pavement, curbs, ramps, lane lines, etc.) will need to be created from the most current data available. This can include google earth images, original plans, or as-built plans (from FileNet) that are brought into MicroStation and then re-traced using the MicroStation workflow. This method requires the information to be field verified to ensure it is accurate. Another option for getting the necessary existing features includes requesting a base map from the data collected by the ODOT mobile lidar. Lidar data is collected on all state highways on a reoccurring schedule. Contact the [geometronics unit: remote sensing and UAS program surveyor](#) for assistance in getting a base map from lidar data. This method provides more accurate information, but it can take a little longer to get and could be slightly out-of-date (depending on when the lidar data was collected).

21.7 Traffic Signal Style Drafting – Basic Layout and Information

The following subsections provide guidance on the drafting style for basic layout and information that is shown on the M series for a typical project.

21.7.1 Plan Sheet Titles, Size, and Scale

All final contract plans are printed to an 11x17 PDF. Scales of each plan sheet title are shown in Figure 21-5.

Figure 21-5 | Plan Sheet Title Scale

Scale	Signal Plan Sheet Title
20:1	Signal Plan (may also be at 30:1 if necessary) *
	Temporary Signal Plan (may also be at 30:1 if necessary) *
	Railroad Preemption Plan
	Flashing Beacon Plan
	Fire Signal Plan
	Pedestrian Signal Plan
	Red Light Enforcement Plan
	Existing Utilities (may also be at 40:1 if necessary) *
	Automatic Traffic Recorder Plan
40:1	Detector Plan
	Temporary Detector Plan
	Ramp Meter Plan
	Temporary Ramp Meter Plan (may also be at 30:1 or 20:1 if necessary) *
	Removal Plan
80:1	Interconnect Plan
100:1	Legend
	Details
	Miscellaneous

*Occasionally, it may be necessary to use a modified scale to get acceptable clarity of the work/features or to avoid creating multiple sheets or awkward break lines. If the scale MUST be modified, always use the largest scale possible to maximize the legibility of the finished plan sheet.

21.7.2 Order of Traffic Signal Plan Sheets

The plan sheet titles shown in the previous subsection are always arranged in a specific order in the contract plans. See Figure 21-6 for the basic order.

Figure 21-6 | Basic Order of Traffic Signal Plan Sheets

1	Legend
2	Removal Plan
3	Temporary Signal Plan or Temporary Ramp Meter Plan
4	Temporary Detector Plan
5	Signal Plan, or Ramp Meter Plan, or Flashing Beacon Plan, or Fire Signal Plan, or Pedestrian Signal Plan, or Red Light Enforcement Plan (insert the type of plan you are designing here)
6	Detector Plan
7	Existing Utilities
8	Interconnect Plan
9	Details (one or more sheets)

When multiple intersections or multiple types of installation are on a project, the plans shall be arranged so the that the signal plan sheets follow the same order as the roadway plan sheets. Roadway stationing should be followed if available. If stationing is not available, follow milepoints from lowest to highest. See Figure 21-7 for an example of arranging multiple intersections/installations.

Figure 21-7 | Multiple Intersections/Installations Order of Traffic Signal Plan Sheets Example

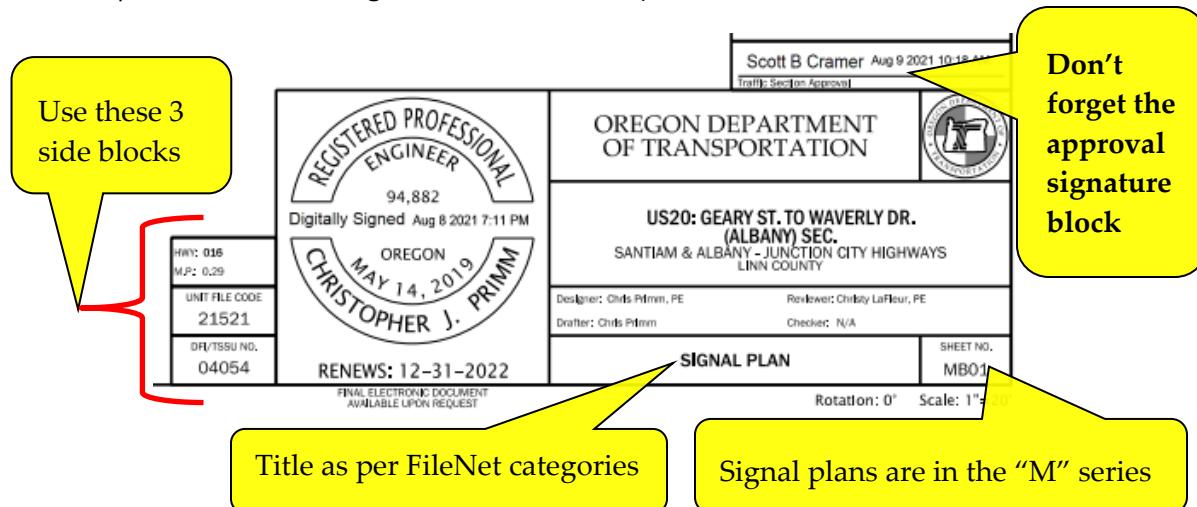
1	Legend	All intersections
2	Removal Plan	
3	Temporary Signal Plan	
4	Signal Plan	1 st intersection
5	Detector Plan	
6	Existing Utilities	
7	Removal Plan	
8	Fire Signal Plan	2 nd intersection
9	Existing Utilities	
10	Flashing Beacon Plan	3 rd intersection
11	Existing Utilities	
13	Interconnect Plan(s)	
14	Details (pole entrance chart)	
15	Details (miscellaneous)	All intersections

21.7.3 Title Block - Traffic Signal Specific Information

Use the standard title block and standard floating boxes (additional information and how to access them is contained in Section 21.1) and fill out the traffic signal specific information according to following list. See Figure 21-8 for an example of a completed title block.

- Hwy and MP: Input the ODOT hwy number (NOT ROUTE NUMBER) and milepoint of the intersection. This can be found in TransGIS or in the operational approval.
- Unit file code: Input the unique plan sheet number assigned by the traffic engineering section. See chapter 2 for more info.
- TSSU No.: Input the identification number of controller cabinet/asset. See chapter 2 for more info.
- **Traffic section approval signature block.** Place this standard title block add-on adjacent to the title block.
- Fill out the “designer”, “reviewer”, and “drafter” (“checker” is typically N/A or blank)
- Input the sheet number for the contract plan set (will be in the M series for traffic signals). See section 21.1 for more information on discipline specific sheet numbering.
- Input the title of the sheet. It shall be as per the designated categories listed in FileNet:
 - Automated Traffic Recorder Plan
 - Details
 - Detector Plan
 - Existing Utilities
 - Fire Signal Plan
 - Flashing Beacon Plan
 - Interconnect Plan
 - Legend
 - Miscellaneous
 - Pedestrian Signal Plan
 - Railroad Preemption Plan
 - Ramp Meter Plan
 - Red Light Enforcement Plan
 - Removal Plan
 - Signal Plan
 - Temporary Detector Plan
 - Temporary Ramp Meter Plan
 - Temporary Signal Plan

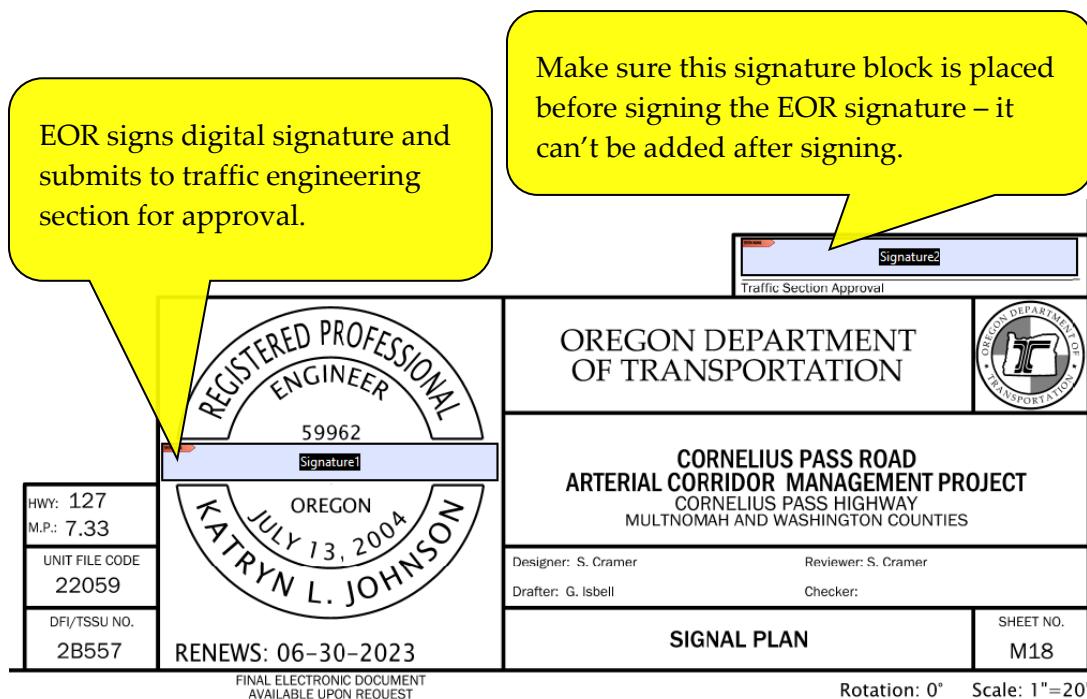
Figure 21-8 | Standard Traffic Signal Title Block Example



21.7.4 Digital Signatures

Digital signature blocks for both the EOR and traffic engineering section approval are required and placed on the PDF file when ready to finalize the plan sheet. See Figure 21-9.

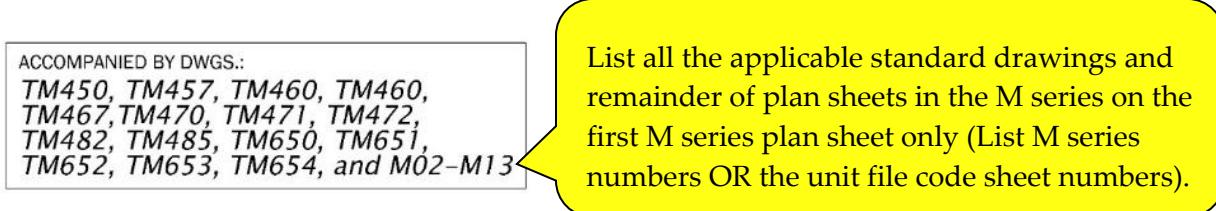
Figure 21-9 | Digital Signature Blocks on Plan Sheets



21.7.5 Accompanied by Dwgs. Box

The first plan sheet of the M series shall have the “Accompanied by Dwgs.” Box (plan sheet title block floating boxes in the ODOT CAD Manual) placed near the title block. It shall list all applicable standard drawings needed for the M series, typically drawings in the TM400 series and TM600 series. Occasionally the TM200 series or RD series are necessary. It shall also list the remainder of plans sheets in the plan set (either the M series numbers, or the unit file code numbers is acceptable to list). See Figure 21-10.

Figure 21-10 | Accompanied by Dwgs. Box Example



21.7.6 Upper Right Corner Title Information

Each traffic signal plan sheet shall have at least four lines of intersection identifying information as shown in Figure 21-11. V-numbers are not used or shown on traffic signal plan sheets.

On certain plan sheets (e.g., the legend, details, and interconnect plan sheets), it will be necessary to modify the standard four lines of identifying information. For example, providing a range distance for the interconnect sheet(s) or adding multiple intersections to the legend sheet. See Figure 21-13 and Figure 21-12 for examples.

Figure 21-11 | Upper Right Corner Title Information Example

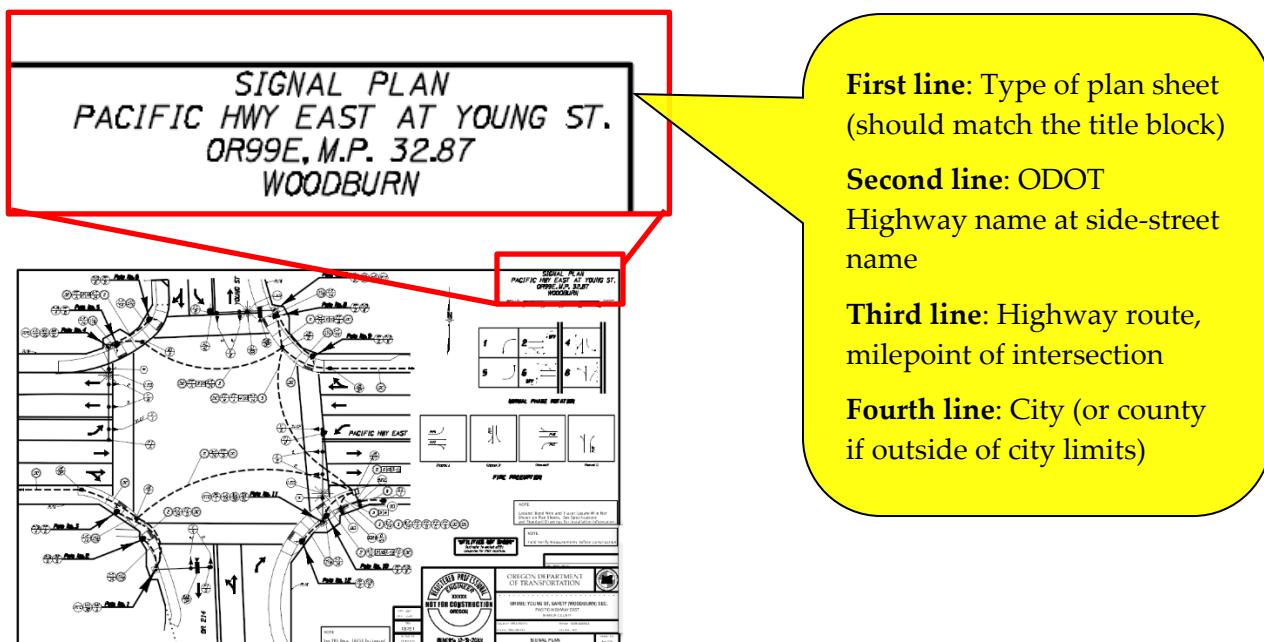
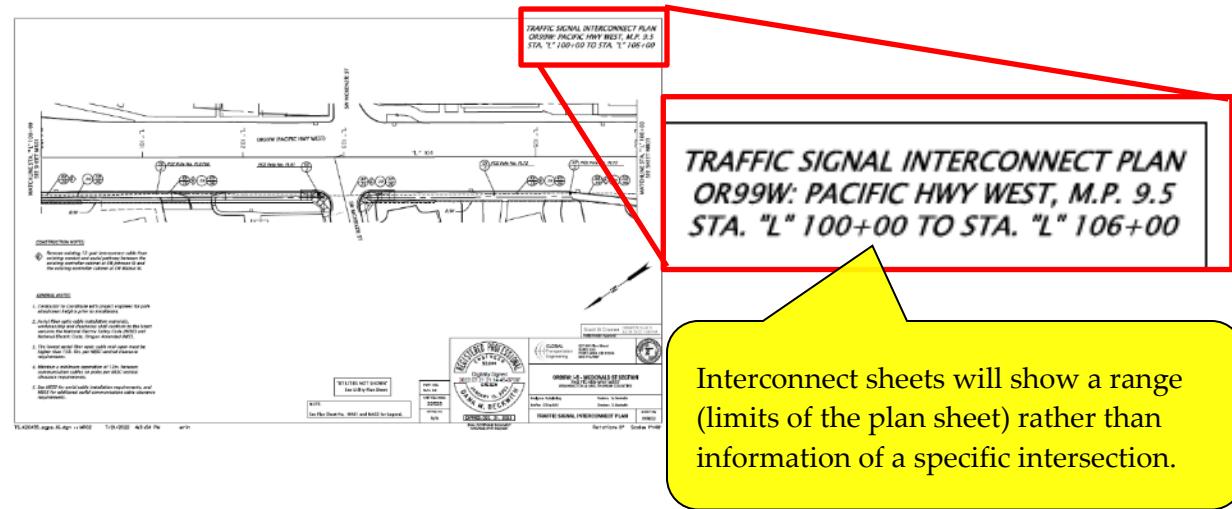
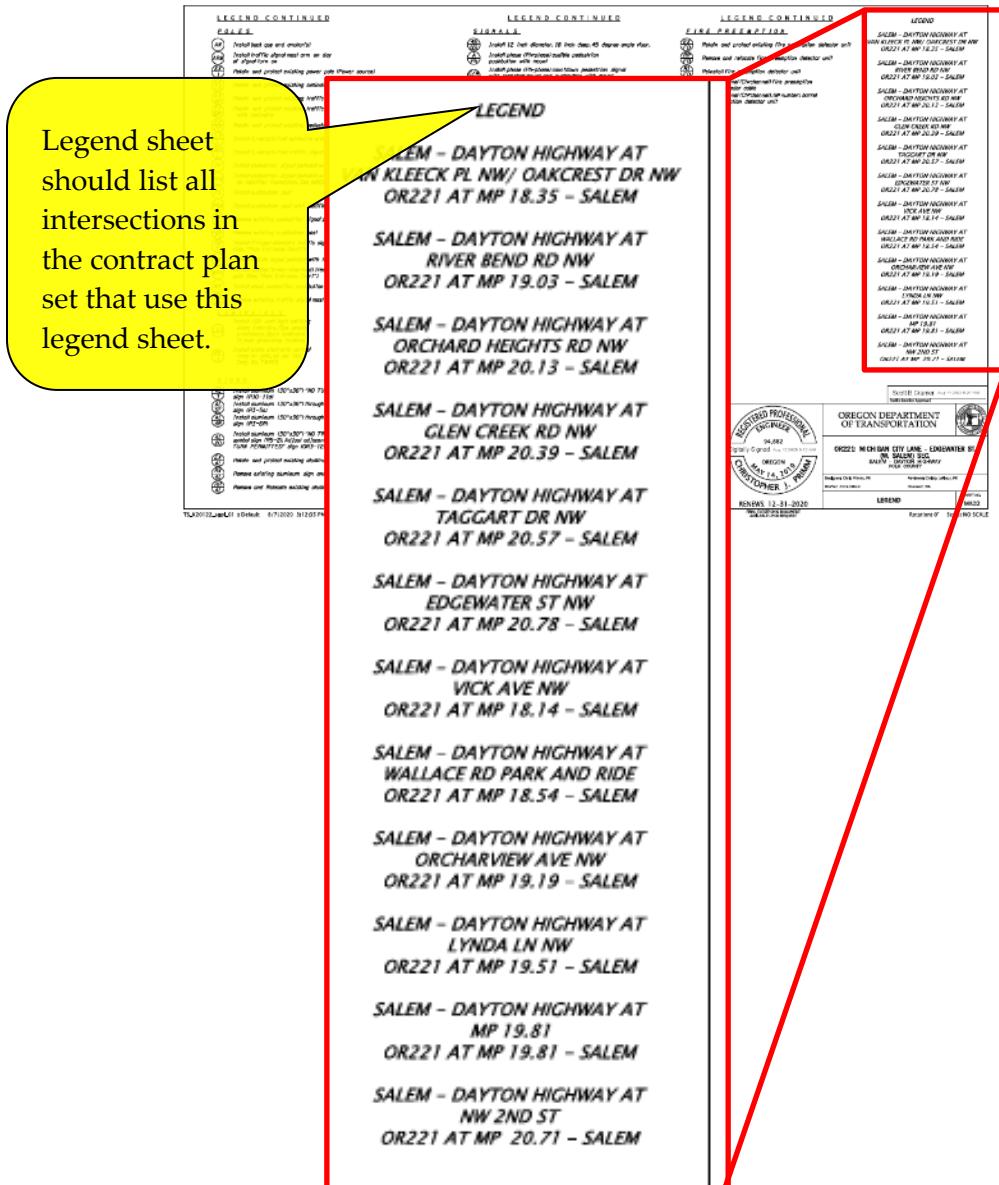


Figure 21-12 | Upper Right Corner Title Information – Modified for Interconnect Plan Sheet



Traffic Signal Design Manual – Contract Plan Development & Drafting

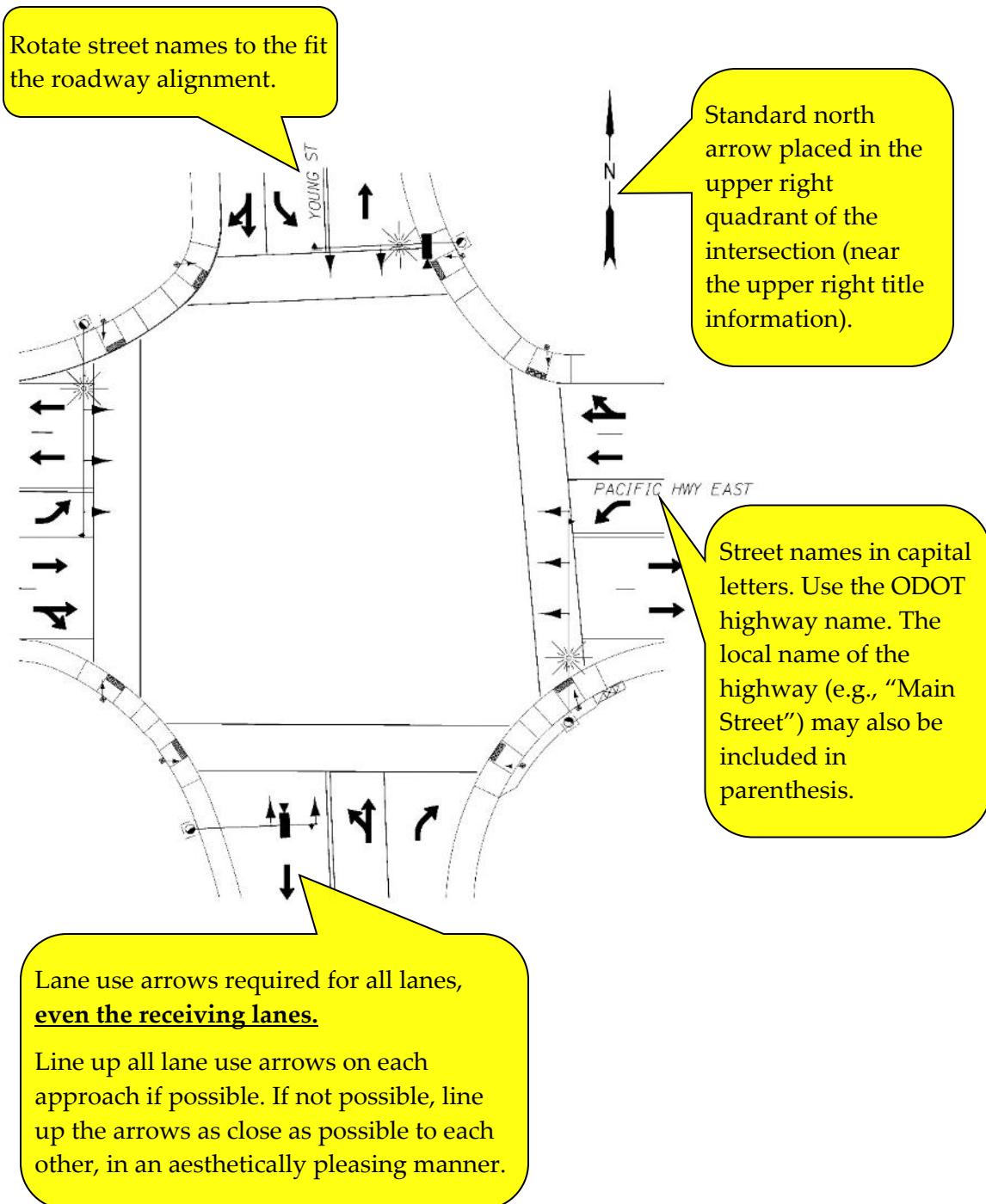
Figure 21-13 | Upper Right Corner Title Information – Modified for Legend Sheet



21.7.7 North Arrow, Street Names, & Lane Use Arrows

A north arrow, street name text, and lane use arrow shall be used as shown in Figure 21-14.

Figure 21-14 | Lane Use Arrow in All Lanes, Street Names, and North Arrow Example



21.7.8 Centerline Station or Scale Bar

The centerline alignment shall be shown with at least two stations labeled. See Figure 21-15. If an alignment is not present, use a scale bar instead. See Figure 21-16.

Figure 21-15 | Centerline Alignment with Two Stations Example

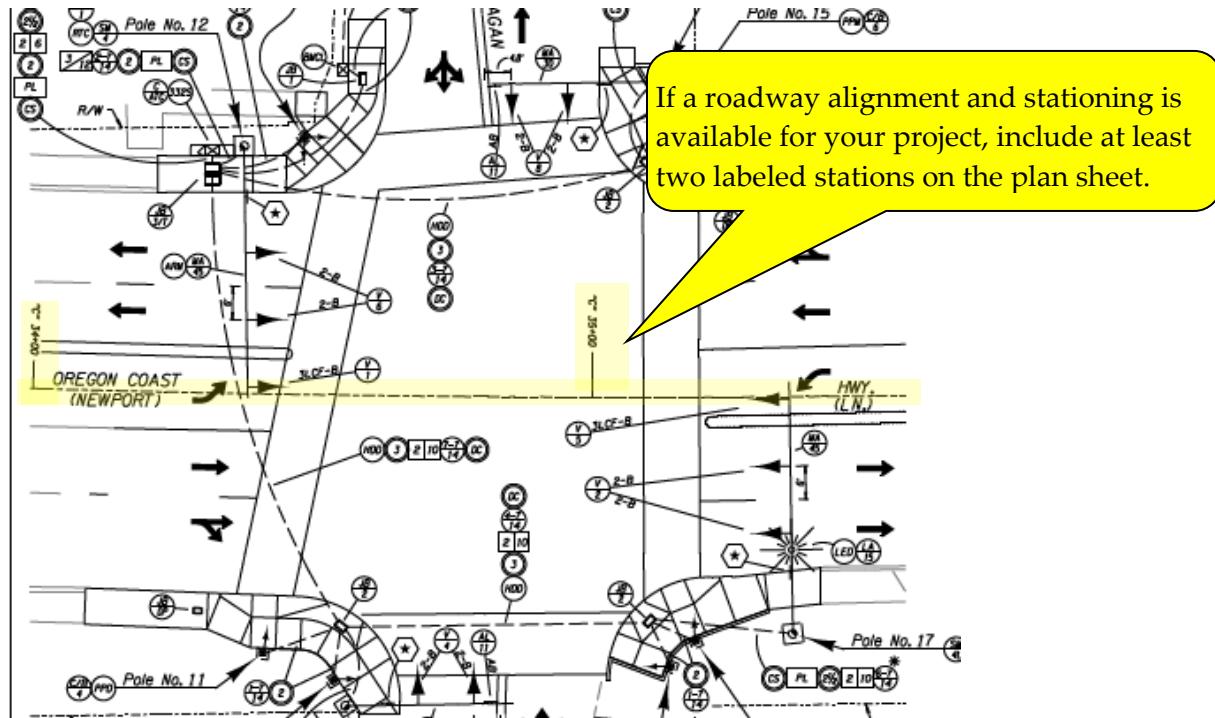
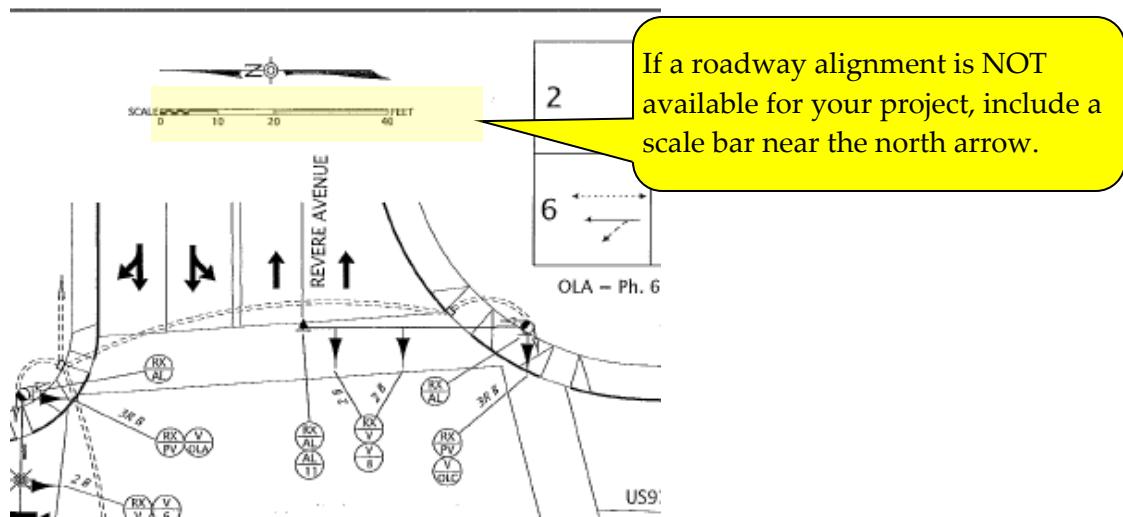


Figure 21-16 | Scale Bar Example



21.7.9 Right-of-Way

It is important to show and label the right-of-way lines, permanent and easements, on the plan sheets when the work involves installing new equipment that requires moving soil to ensure that all equipment is placed within right-of-way (e.g., mast arm poles, pedestals, service cabinet, controller cabinets, junction boxes, conduits, etc.). See Figure 21-17. In some cases, the right-of-way is beyond the plan sheet scale (e.g., interchange terminals) and should be noted as such on the plan sheets. See Figure 21-18.

Figure 21-17 | Right-of-Way Shown and Labeled

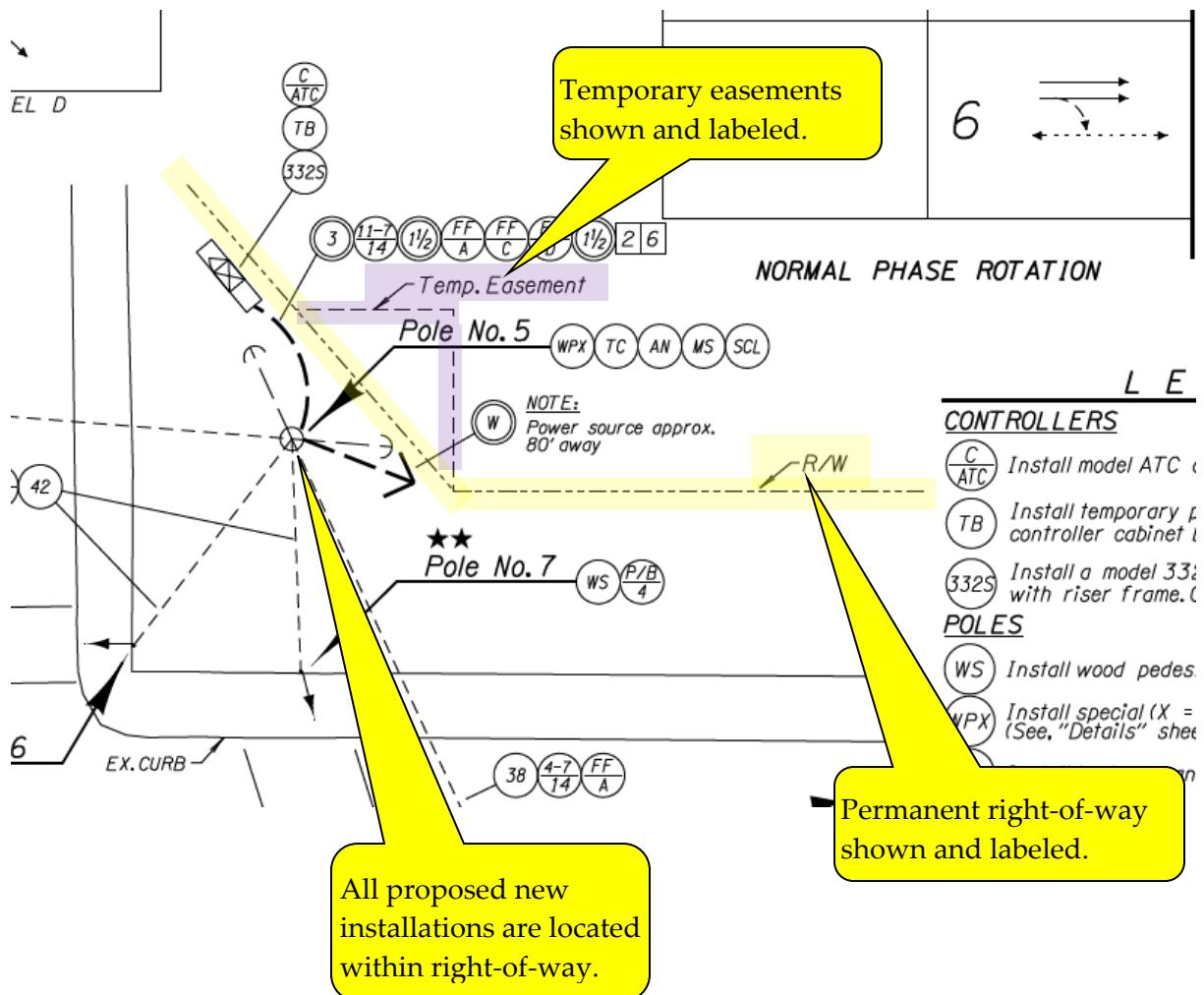
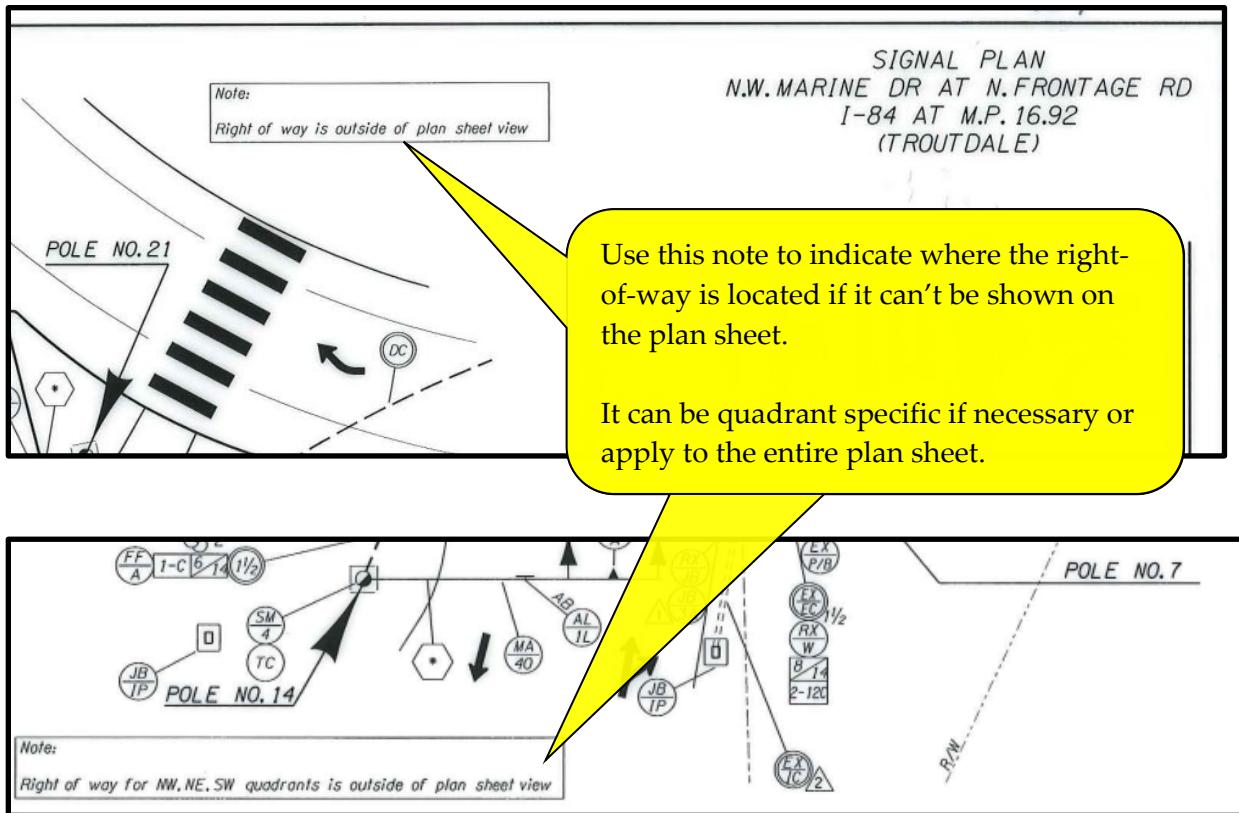


Figure 21-18 | Right-of-Way Outside of Plan Sheet View Note Examples



21.7.10 New Roadway & Pavement Markings

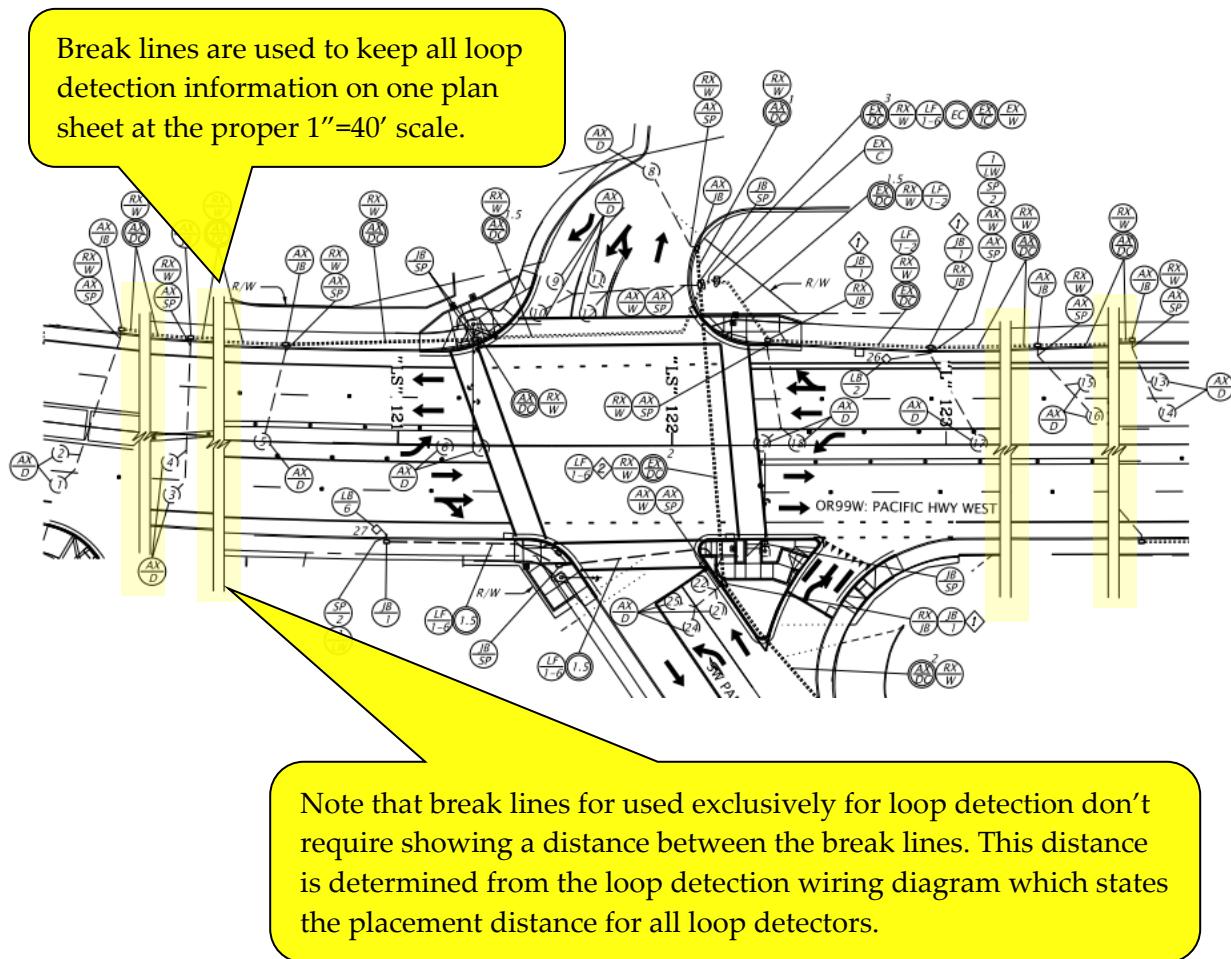
The new roadway (edge or pavement, curb, sidewalk, ramps, driveways, etc.) with new lane line striping, crosswalks, stop bars, and bike lane stencils shall be shown with the correct symbology for traffic signal plans as per the MicroStation workflow. Turn-off the levels for all other pavement markings.

Existing roadway/pavement marking feature symbology is typically not shown on the plan sheets for new signals or complete signal rebuilds. However, existing feature symbology with proper detailing may be necessary for certain projects to clearly show the intended work (e.g., partial signal modifications).

21.7.11 Break Lines and Match Lines

Break lines are typically required for detection plans (where loops are shown) and can be useful for other plan sheets (e.g., interconnect plan, railroad preemption plan, ramp meter plan, ATR plan, and removal plan) to keep all necessary information on one plan sheet at the proper scale or to reduce the number of plan sheets in the plan set. See Figure 21-19 and Figure 21-20 for examples.

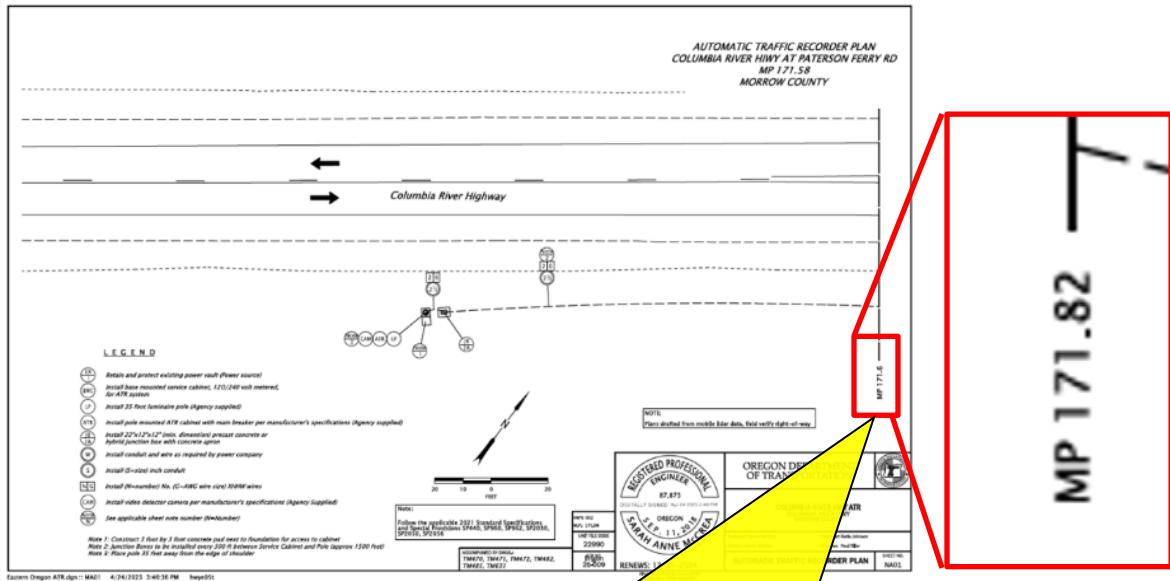
Figure 21-19 | Break Line Example 1: Keep Info on One Page (Detector Plan Sheet)



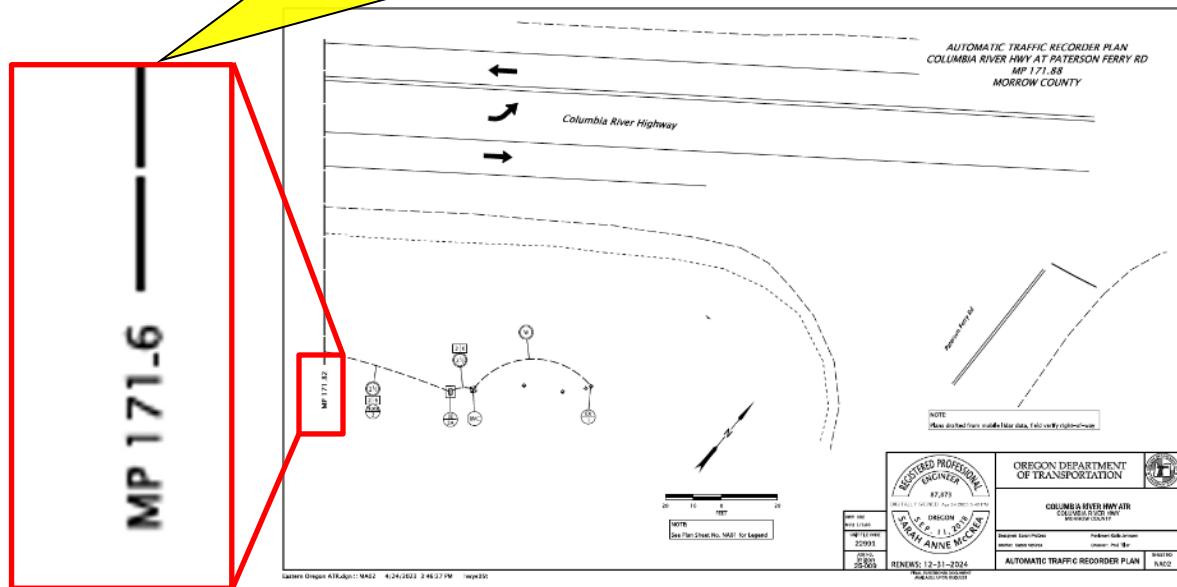
Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-20 | Break Line Example 2: Reduce Number of Plan Sheets (ATR Plan Sheet)



Alignment stationing is not used on this project so break lines with milepoint data are used to convey the distance between the two plan sheets.

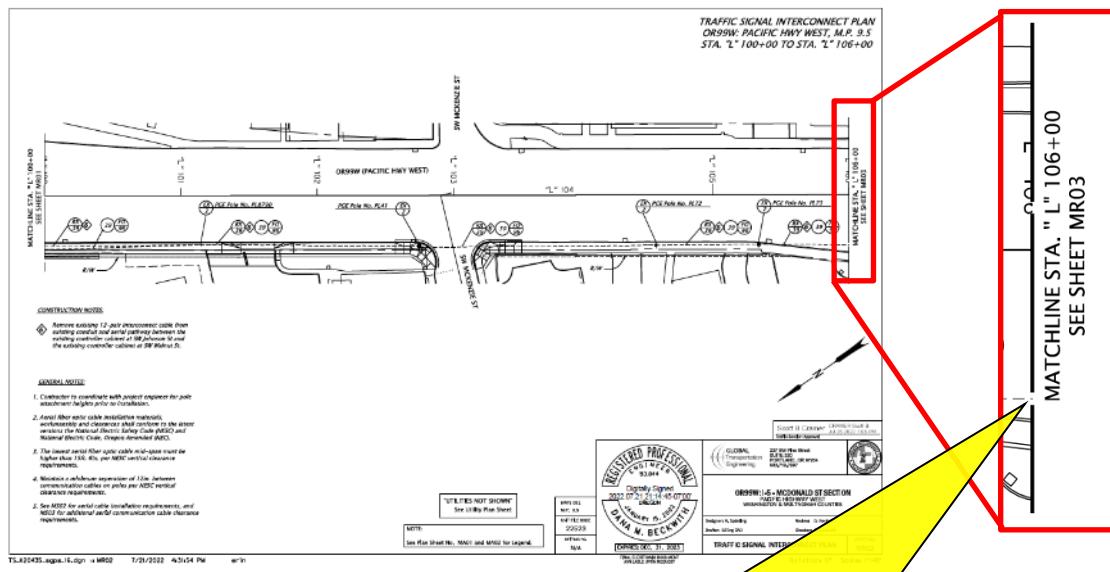


Traffic Engineering Section

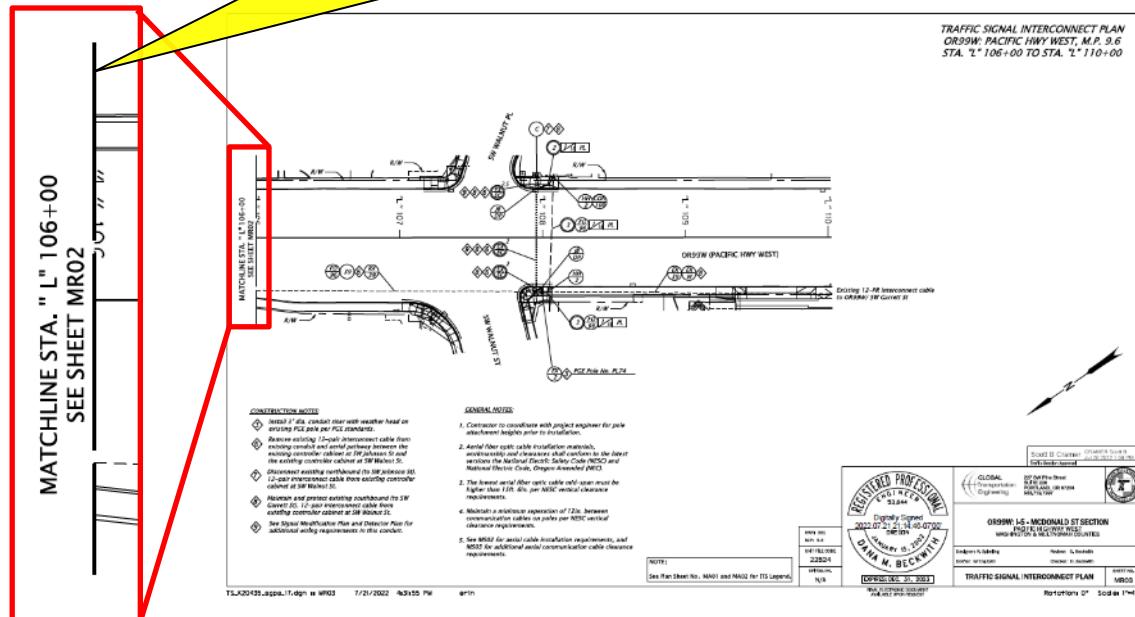
Traffic Signal Design Manual – Contract Plan Development & Drafting

Match lines are used for certain project alignment configurations (as per the guidance in the manuals listed in section 21.1) and to easily reference appropriate plan sheets. See Figure 21-21 for an example.

Figure 21-21 | Match Line Example



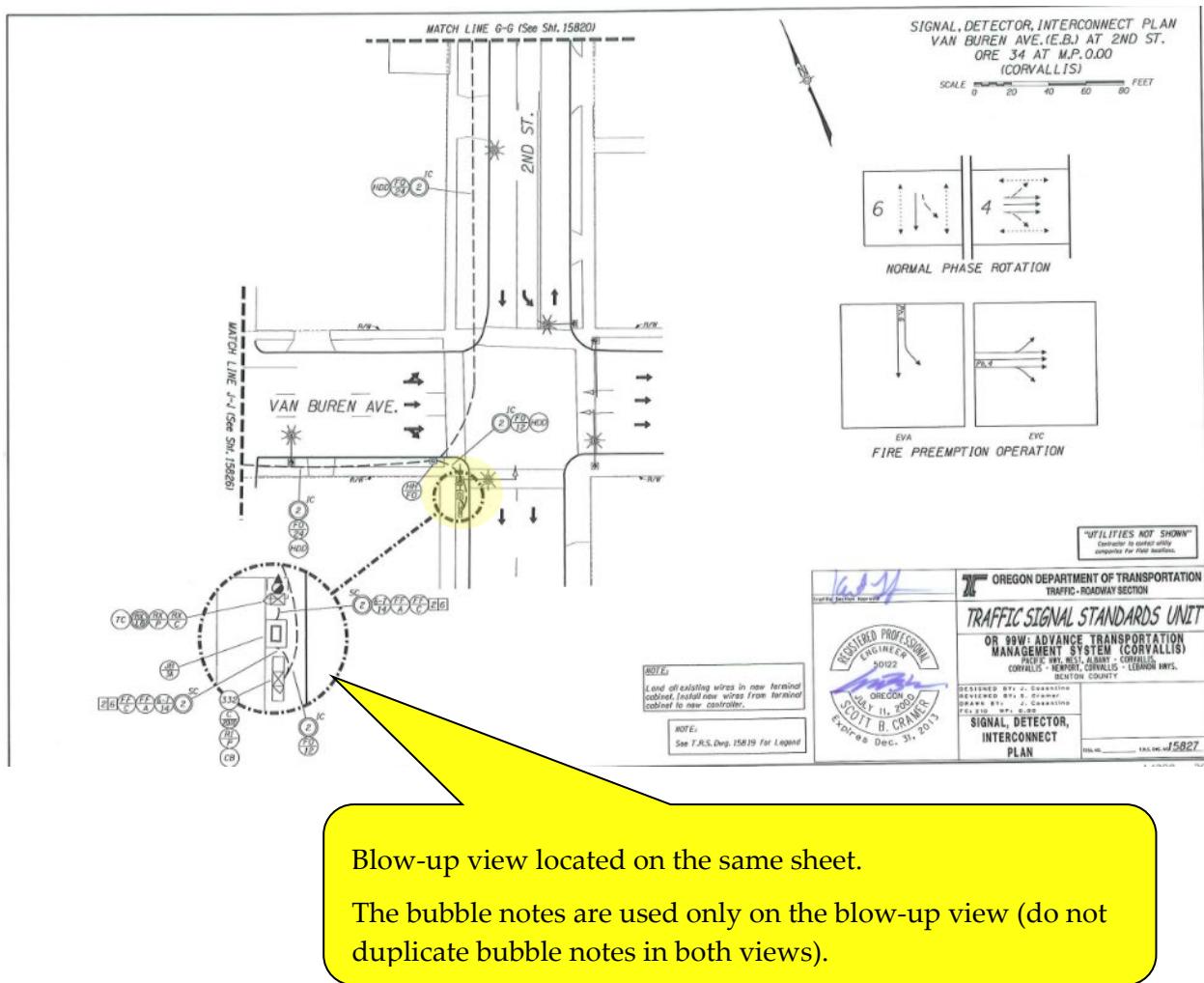
Alignment stationing used on project for match line with reference to the appropriate sheet number.



21.7.12 Blow-up Views

Occasionally it will be necessary to use a different scale for certain areas of work. These areas often have a lot of details in a small space which makes clearly showing the work a challenge at the standard plan sheet scale. If this is the case, use a blow-up view at an appropriate scale to clearly show the work. The blow-up view should be clearly labeled and shown on the same plan sheet if possible. See Figure 21-22. However, the blow-up view may also be placed on a separate plan sheet if there is not enough room to fit it on the same sheet. See Figure 21-23.

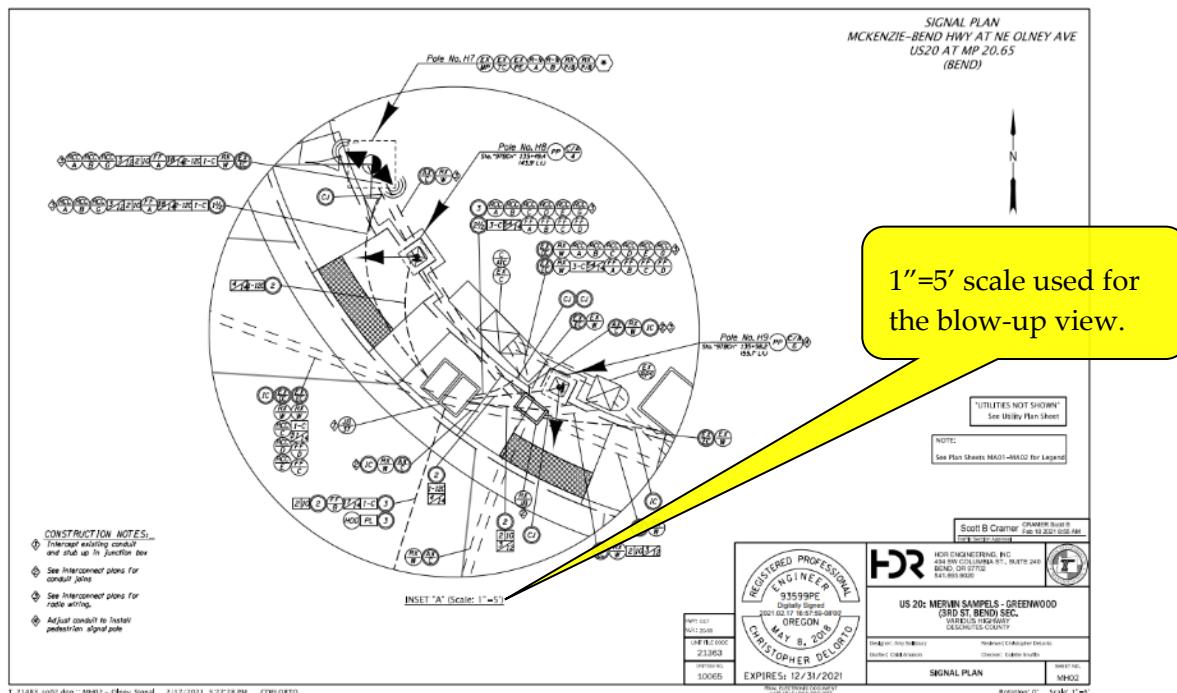
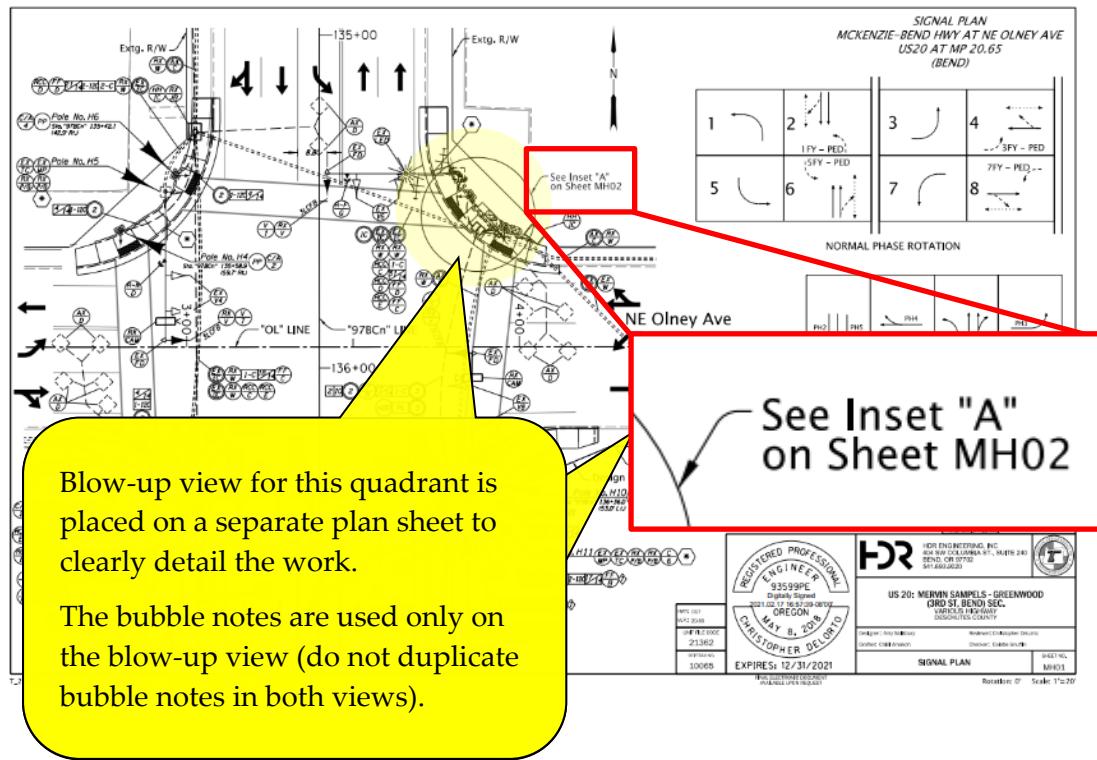
Figure 21-22 | Blow-up View Example 1 (Shown on Same Plan Sheet)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-23 | Blow-up View Example 2 (Shown on a Separate Plan Sheet)



21.7.13 Cross References

Cross reference to other plan sheets as necessary using a text note box, such as the cross reference to the legend sheet. See Figure 21-24. Bubble note cross referencing is discussed in section 21.9.4.

Figure 21-24 | Cross Reference Text Note Box Example

NOTE:
See T.R.S. Dwg. 17481 for Legend

21.8 Traffic Signal Style Drafting – Specific Design Features

The following subsections provide guidance on the drafting style for specific traffic signal design features that are shown on the M series for a typical project.

21.8.1 New vs. Existing Symbology

Certain features (e.g., conduit, signal heads, pedestrian signals, etc.) have slightly different symbology depending on if the feature is being installed new vs. if the feature is existing (retain and protect). In Figure 21-25 two examples of this are shown:

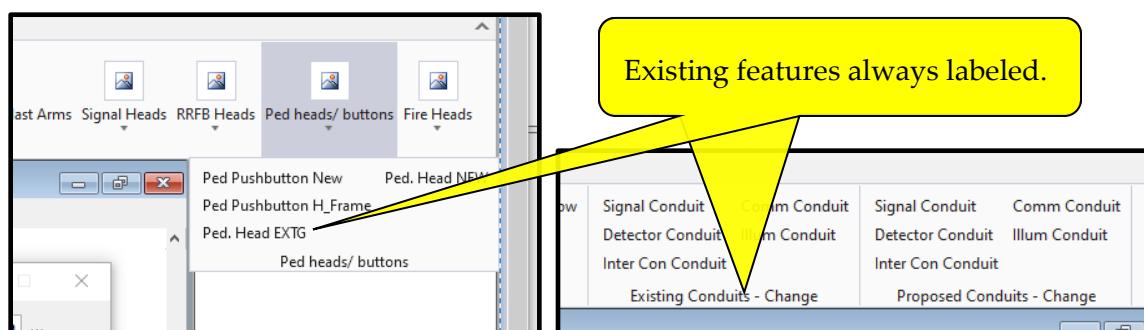
- A new signal head is shown as a solid arrow and an existing signal head is shown as a hollow arrow
- A new conduit is shown with a different line style than existing conduit

Figure 21-25 | Two Examples of Symbology for New vs. Existing

Feature	Proposed/New Symbology (Typically solid and/or bold)	Existing Symbology (Typically hollow and/or lighter)
Signal Head		
Conduit		

Not all features use a different symbology for existing (e.g., junction boxes, controller cabinets, etc.). When a feature does have a different symbology for new and existing, they will be together in the same area of the workflow with the existing feature always labeled “extg.” or “existing”. See Figure 21-26 for example.

Figure 21-26 | Existing Features Labeled in the Workflow

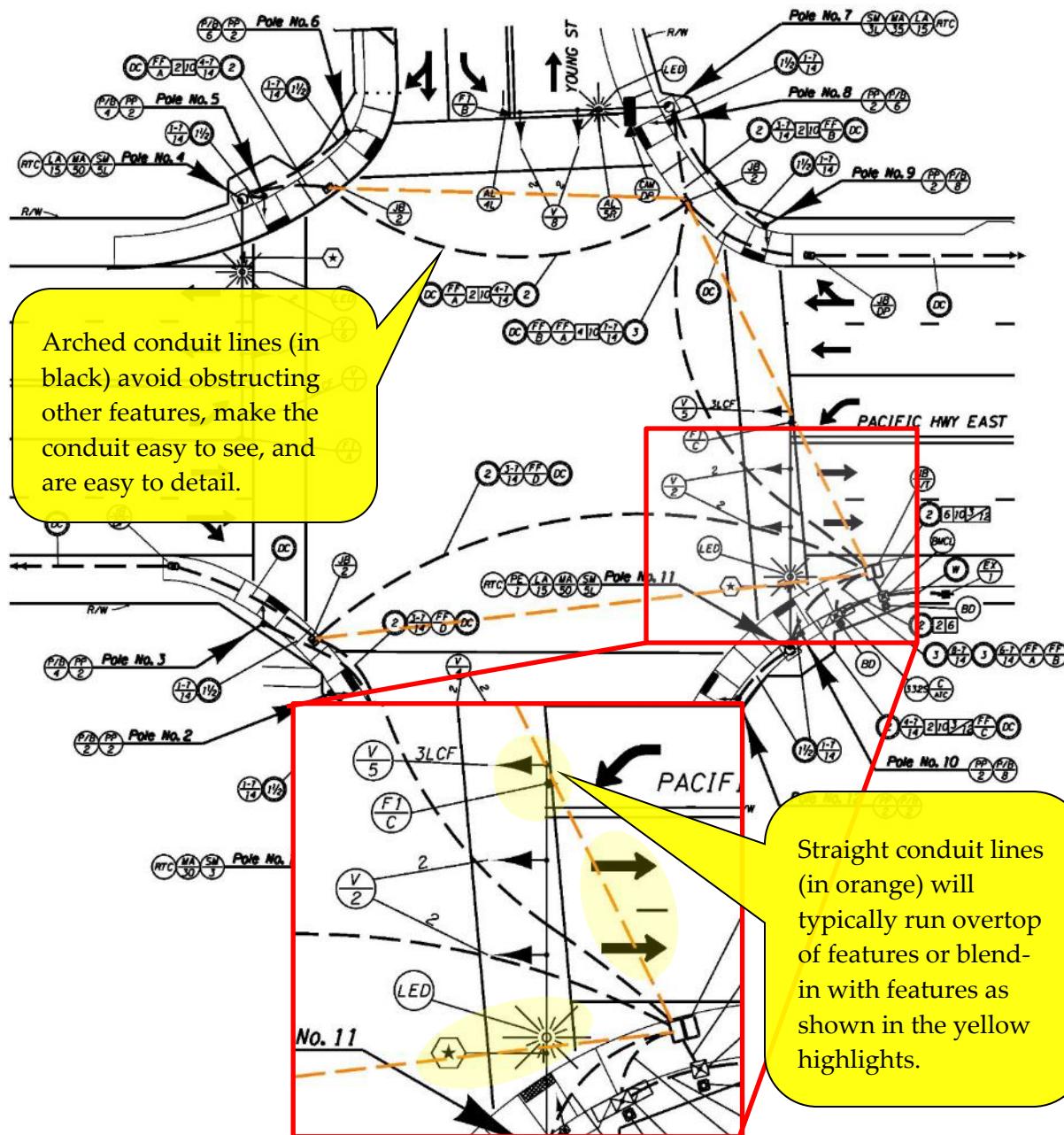


When detailing existing features, always verify if an existing symbology is applicable.

21.8.2 Showing Conduit Runs

It is important to show the conduit runs in a way that is readable and doesn't obscure or clutter other features. This is typically done by arching long conduit runs. The contractor will install the conduit as straight as possible between the beginning and ending point as per the standard drawing TM471 (which states that conduit runs shown on plans are for bidding purposes only and locations may be changed to avoid obstructions), but the arching makes the plan sheet much more readable. See Figure 21-27 for example.

Figure 21-27 | Arching Conduit Runs Example



21.8.3 Pole (and Pedestal) Numbering

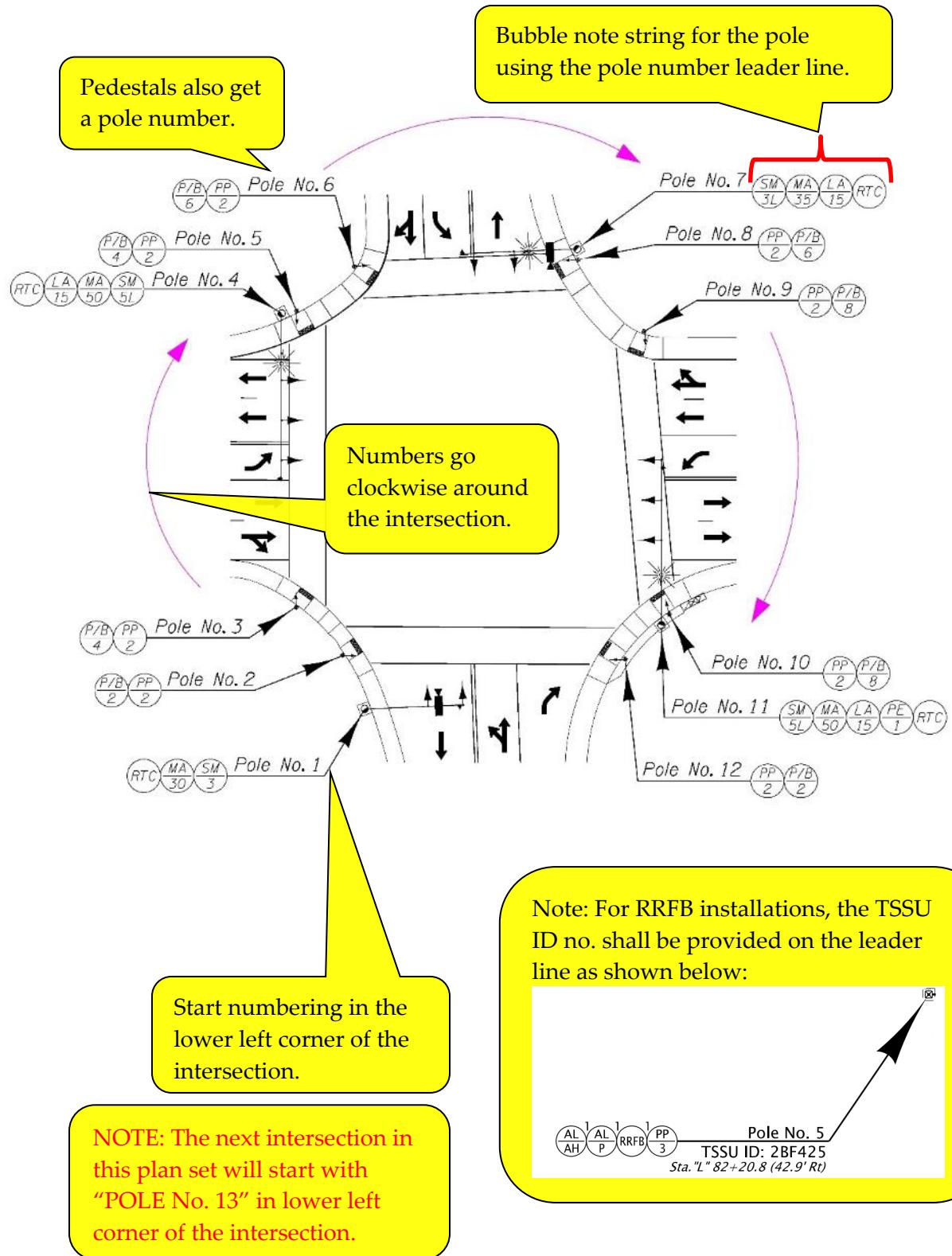
All poles and all pedestals (including all temporary) are numbered starting from the lower left corner of the intersection in a clockwise direction. Plans having poles at more than one intersection shall have the poles numbered consecutively starting with the first intersection shown in the plan set and ending with the last intersection shown in the plan set. It is important that each pole and pedestal in the plan set has a unique number as it lessens the chance for error. For example, if there is only one pole number 3 on the project, there is no confusion about what pole you are referencing. If there are three poles labeled number 3 in the same plan set (e.g., pole no. 3 at Main Ave. @ 1st St, pole no. 3 at Main Ave. @ 2nd St., and pole no. 3 at Main Ave. @ 3rd Street) extra info is needed to identify which pole is being referenced and design information for each of those poles can easily get mixed up. For this reason, using letters in conjunction with the number (e.g., 3A, 3B, 3C, etc.) should also be avoided, but may be used if a pole/pedestal needs to be added to the project **during the construction phase**. If a pole needs to be added late in the design phase, the poles should be re-numbered accordingly.

Only the existing poles and pedestals that have work on them (e.g., replacing signal heads or pedestrian pushbuttons) are required to be numbered as it is necessary to include information about the work on these poles in the pole entrance chart. However, existing poles and pedestals without work on them may also be numbered if it helps with clarity.

A large arrow with the pole number along the leader line is used for each pole and pedestal. For RRFB installations, the TSSU ID number shall be provided on the leader line. Additional information about the pole location can also be provided on the leader line as necessary (e.g., station and offset, reference to ADA curb ramp plan sheets, etc.), however, this information is typically not necessary to include as the signal design CADD files (which are coordinate correct) are used during the construction process to verify equipment location based on survey data. The leader line for the pole numbering should also be used for the bubble note string associated with the pole, rather than using a separate bubble note leader line.

See Figure 21-28 for an example of pole numbering and bubble note strings.

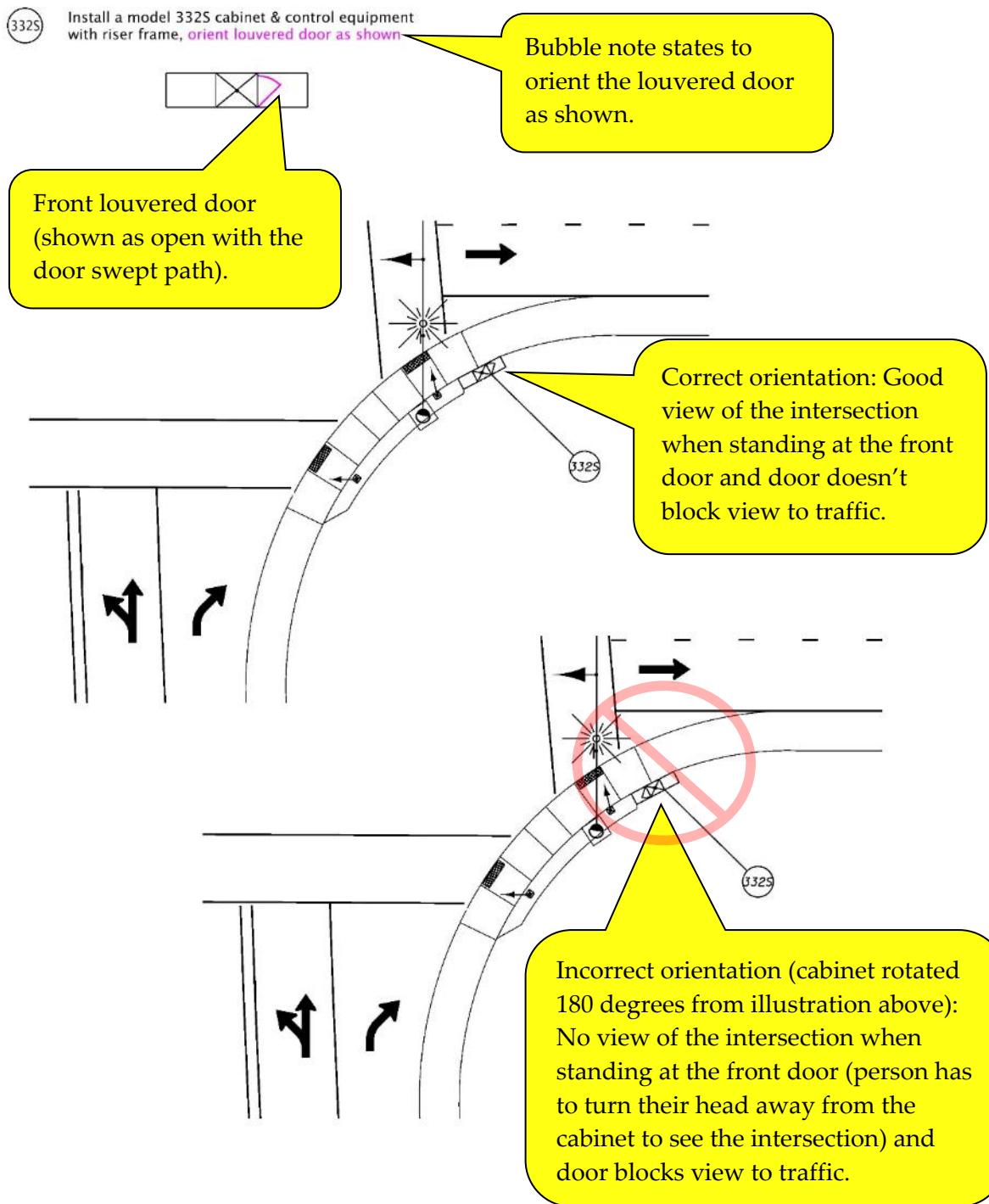
Figure 21-28 | Pole Numbering and Bubble Note Strings



21.8.4 Controller Cabinet Orientation

The controller cabinet symbology and associated bubble have a specific orientation that needs to be shown correctly on the plan sheets as per the guidance in chapter 5. See Figure 21-29.

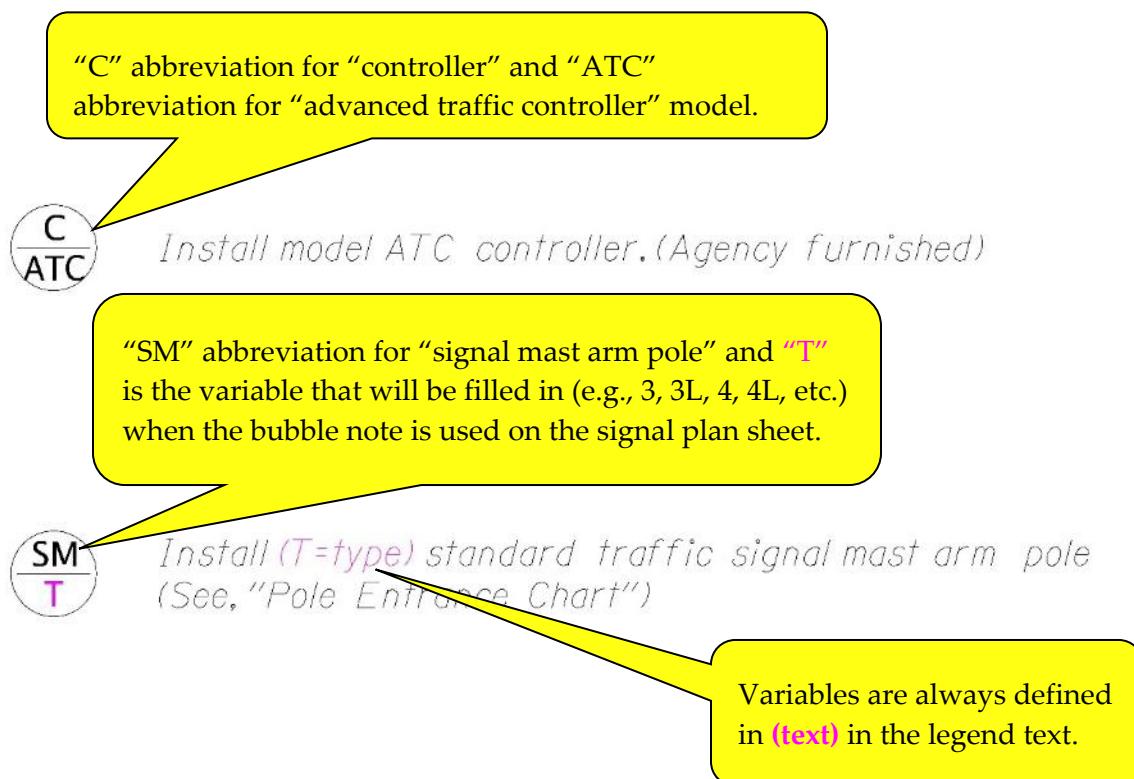
Figure 21-29 | Controller Cabinet Symbology



21.9 Bubble Notes

Bubble notes are used in conjunction with the standard drafting symbology to provide specific information about the work to be done. The bubble notes have been designed to be “intelligent” using abbreviations and variables, such that an experienced user will be able to read the signal plan sheets without much assistance from the bubble note legend text. See Figure 21-30 for basic bubble note structure of proposed/new items.

Figure 21-30 | Basic Bubble Note Structure for Proposed/New Features

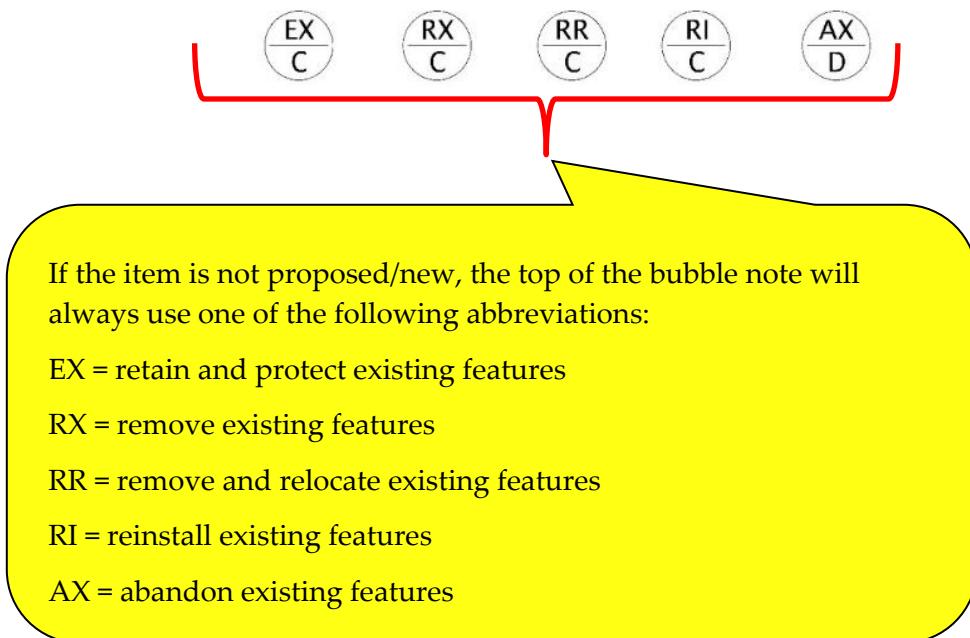


Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

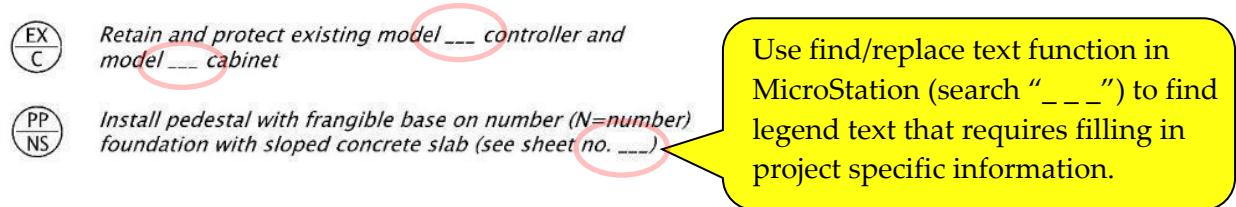
Bubble notes also have a specific structure when used for items that are not proposed/new, such as existing (retain and protect), remove, remove & relocate, reinstall, and abandon. See Figure 21-31. Note that these bubble note categories may only have a few standard options in the workflow. For example, the only standard abandon bubble notes are for loop detectors and conduits. This is intentional; typically, these are the only traffic signal features that have been deemed appropriate to abandon as per the design guidance contained within this manual.

Figure 21-31 | Basic Bubble Note Structure for Features that are not Proposed/New



Certain bubble notes have a location in the legend text that will need to be filled out. These are easily found by using the find/replace text function in MicroStation and searching for three underscores (no spaces): “___”. See Figure 21-32.

Figure 21-32 | Bubble Note Text Examples That Requires Filling in Project Specific Information



Only modify the standard bubble notes and legend text (found in the workflow) when absolutely necessary, as modifications can be easy for others to overlook. In cases where modification of a bubble note is necessary, using a brand-new custom note may be a better solution to highlight the unique work. The state traffic signal engineer will approve any custom bubble notes.

21.9.1 Filling Out Bubble Note Variable Correctly

For most bubble note variables, it is obvious how they should be filled out. However, the phase “PH” variable is not as intuitive, especially for complicated signal phasing. The following list provides guidance for properly filing out this variable for specific situations (see Figure 21-33):

- Two-phase vehicle signal heads (Type 4L, type 5, and type 7) require listing both phases in “V/PH” bubble note. Note: while flashing yellow arrow signal head types (Type 3LBF, 3LCF, 3RCF, and 6L) may technically be considered a two-phase signal head, only the protected left turn phase is listed in the bubble note.
- Overlap phases for vehicle signal heads shall use “OLA”, “OLB”, “OLC”, etc. as the variable in the “V/PH” bubble note.
- Overlap phases of pedestrian signal heads/pushbuttons shall use “A”, “B”, “C”, etc. as the variable in the pedestrian signal/pushbutton bubble note series.

Figure 21-33 | “PH” Phase Bubble Note Variable Examples



Install phase (Ph=phase) vehicle signal with 2" fluorescent yellow reflective sheeting on backboard



Two-phase signal head bubble note filled out correctly for type 7 head



Overlap B signal head bubble note filled out correctly

The phase “PH” variable has some unique specific requirements (shown in pink).



Install phase (Ph=phase) pedestrian signal with clamshell mount and audible pedestrian pushbutton with mount (sign R10-3).



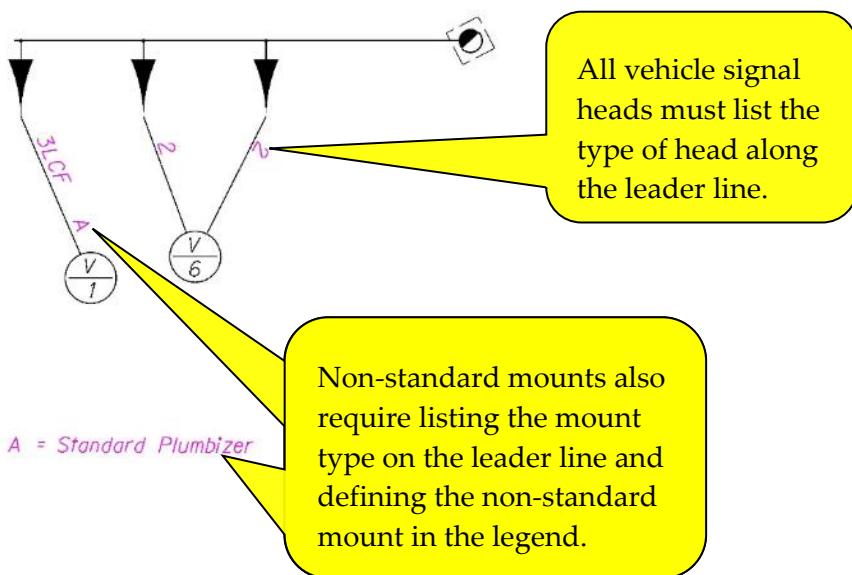
Ped overlap A signal head/pushbutton bubble note filled out correctly

21.9.2 Leader Line Information

Certain bubble notes require providing additional information along the leader line. See the following list and Figure 21-34.

- The signal head type shall be placed on the leader line for the “V/PH” bubble note.
- If a non-standard mount is used for equipment on the signal pole, mast arm, or pedestal (e.g., standard plumbizer, elevator plumbizer, pipe bracket, etc.), the mount type shall be placed on the leader line of the appropriate bubble note. The non-standard mount abbreviation will need to be defined in the legend sheet. DO NOT list standard mounts on the leader line (e.g., spanwire hanger, vehicle signal bracket, sign bracket, clamshell, etc.).

Figure 21-34 | Standard Leader Line Information



Leader line information for equipment that will be removed and relocated (e.g., temporary traffic signal with several construction stages) can be very helpful and should be used if it adds clarity. See section 21.9.7 and Figure 21-41 for an example.

21.9.3 Creating and Reading Bubble Note Strings

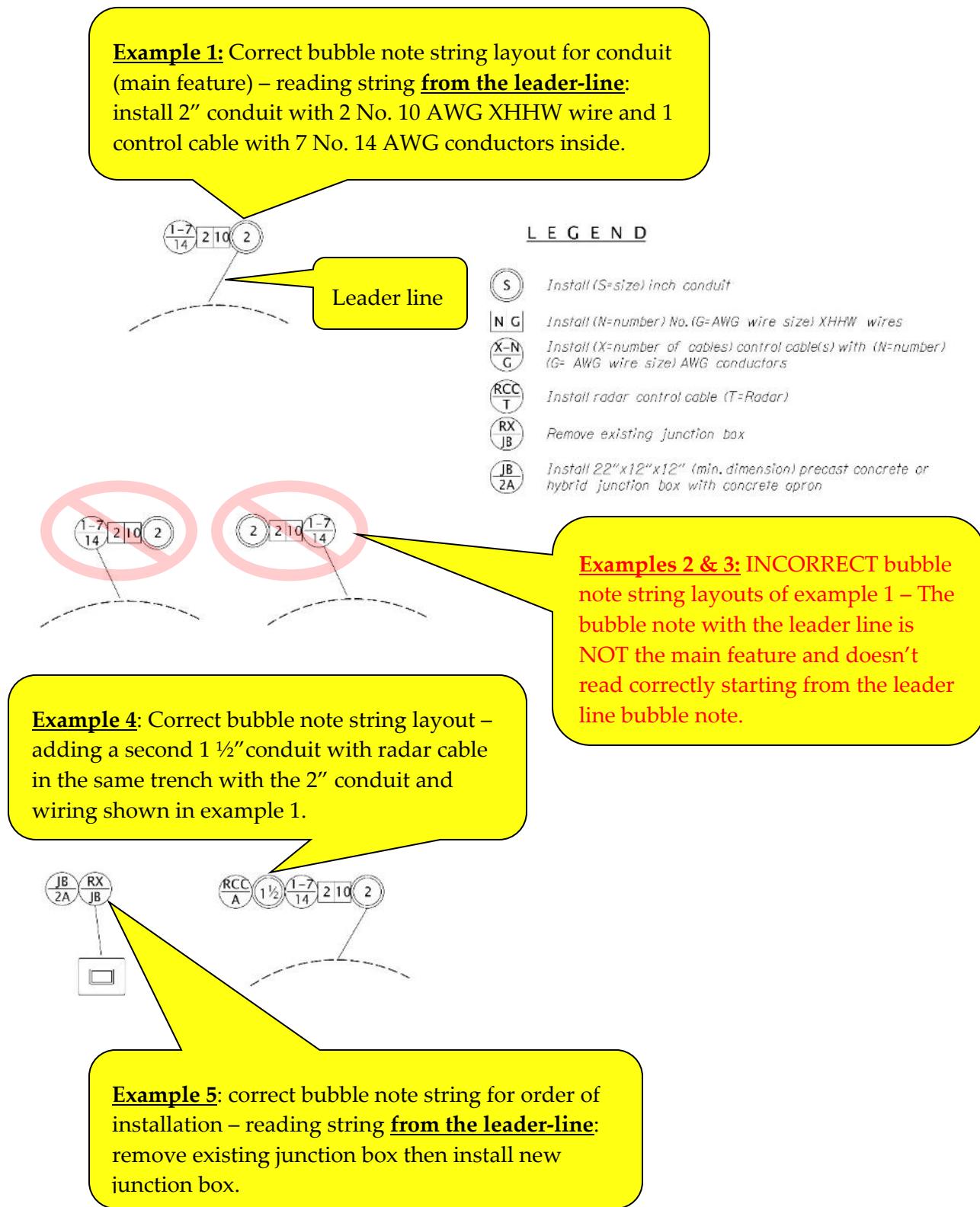
Bubble notes are placed with a leader line that points to the applicable feature. Certain features require multiple bubble notes, with each subsequent bubble note attached to the previous bubble note. This is called a bubble note string. The order of the bubble notes in the bubble string is also important and conveys information. The bubble note with the leader line attached to it is the starting bubble note and will identify the main feature and/or the order of installation. The subsequent bubble notes in the bubble note string will identify the other features either attached to or installed inside of the main feature and the logical order for installation. For example:

- The bubble note for a new conduit (main feature) will be followed by bubble notes for the wire/cables contained within that conduit. Additional conduits in the same trench are added on in the same manner (conduit note first, followed by notes for wires installed inside of that conduit)
- The bubble note for a mast arm pole (main feature) will be followed by the bubble notes for the mast arm, the pedestrian signal indications, recessed terminal cabinet, and luminaire arm that are attached to it.
- The bubble note for removal of a junction box (main feature) may be followed by the bubble note for installation of a new junction box to indicate the logical installation sequence.

Unlike reading text which starts from left and goes to right, when reading bubble note strings, always start **from** the leader line and read going towards the end of the bubble note string.

See Figure 21-35 for examples of creating and reading bubble note strings.

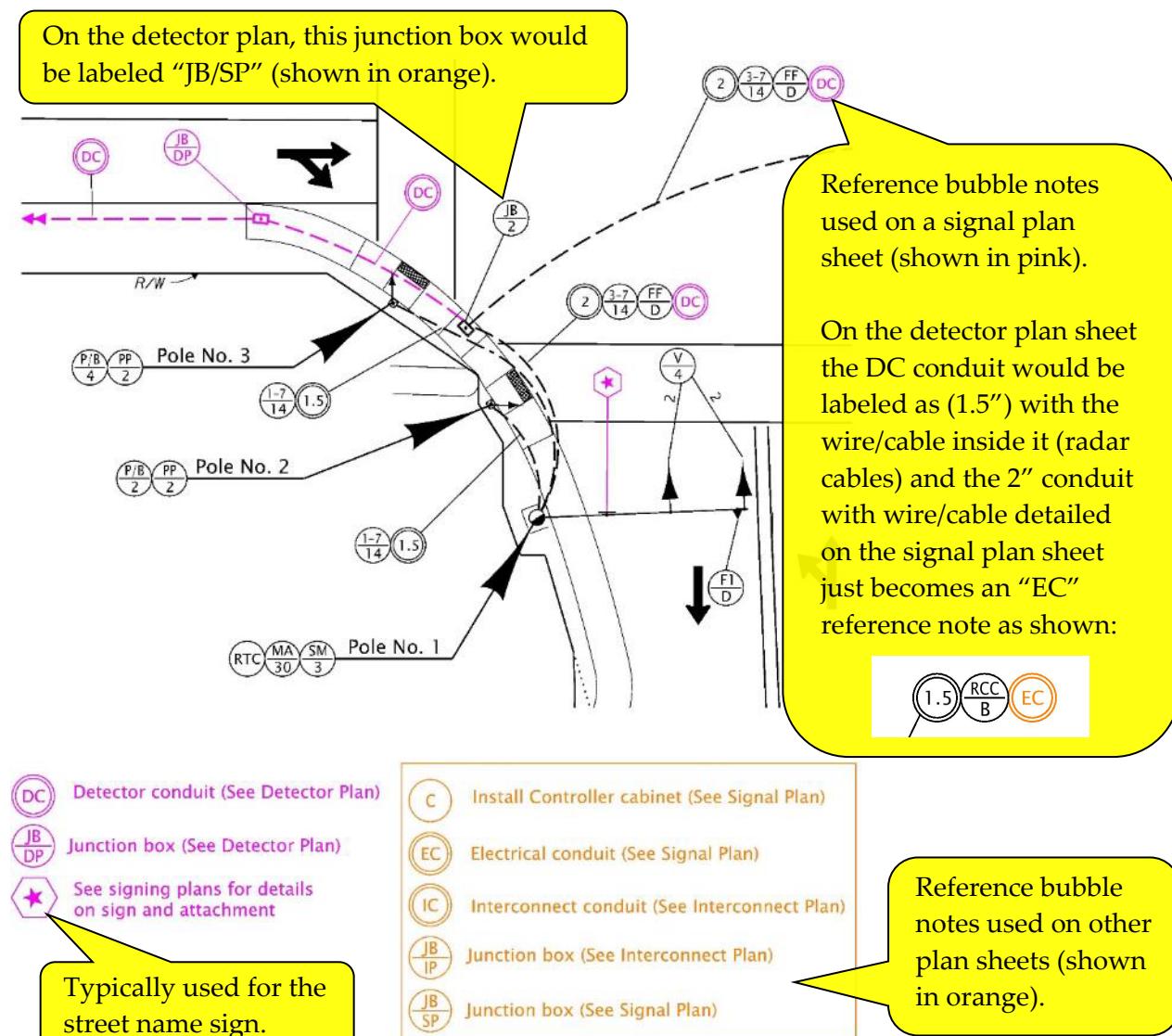
Figure 21-35 | Creating and Reading Bubble Note Strings



21.9.4 Reference Bubble Notes

Reference bubble notes are used in traffic signal plans as some of the features installed on one plan sheet will also be used or shown on another plan sheet (typically applies to conduits, junction boxes, controller cabinets, and certain signs). For example, junction boxes installed for the signal installation (on the signal plan) that are also used for the interconnect system (on the interconnect plan sheet). If the junction box on signal plan sheet uses an “install” note and that same junction box is also labeled with a “install” note on the interconnect plan sheet, it can get confusing how that one junction box is paid for (is it under the traffic signal bid item or the interconnect system bid item?) or if two separate junction boxes in the same area should be installed. Using reference bubble notes makes the design intent and payment very clear. See Figure 21-36 for example.

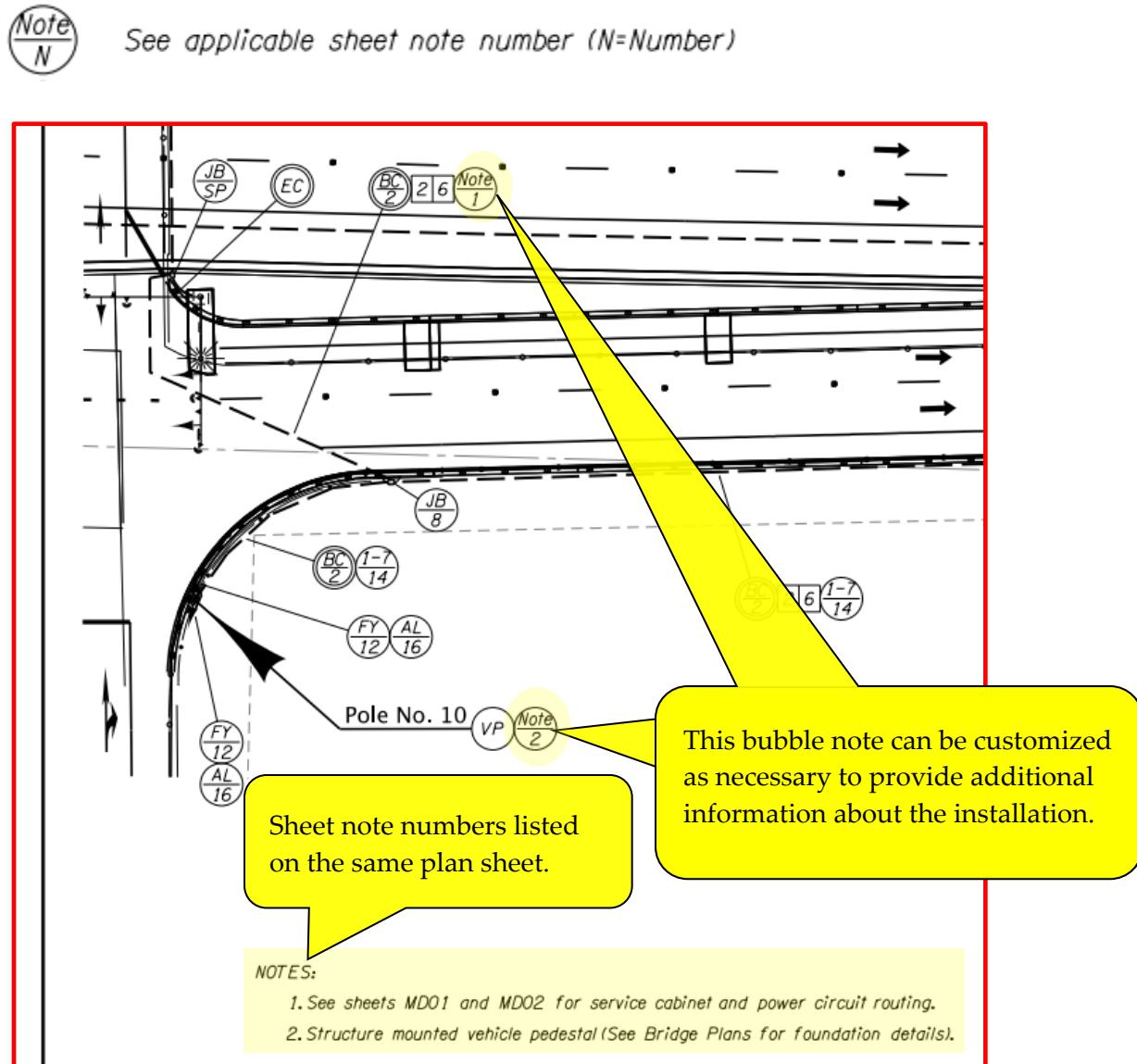
Figure 21-36 | Signal Plan Reference Bubble Note Example



21.9.5 Miscellaneous Customizable Bubble Note

When project specific information needs to be conveyed on a plan sheet, a miscellaneous customizable bubble note should be used. See Figure 21-37 for an example.

Figure 21-37 | Miscellaneous Customizable Bubble Note Example



21.9.6 Use of “EX” Bubble Notes

Plan sheets should only detail the work to be done and just show the symbology for the other signal equipment that is not impacted by the work. Place a reference to the prior plan sheets so that finding information on the signal equipment that is just shown symbolically is easier and it also makes it clear that any items not detailed on the plan sheet are to be retained and protected. See Figure 21-38 for example note referencing prior plan sheets. This simplifies the plan sheet and makes it much easier to see what work needs to be done. See Figure 21-39 for an example of properly detailed work and symbology for all other existing equipment.

Figure 21-38 | Referencing Prior Plan Sheets

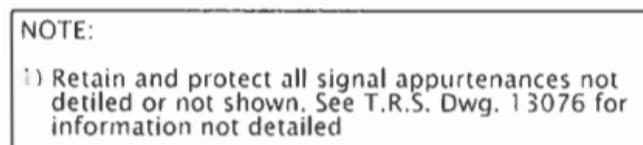
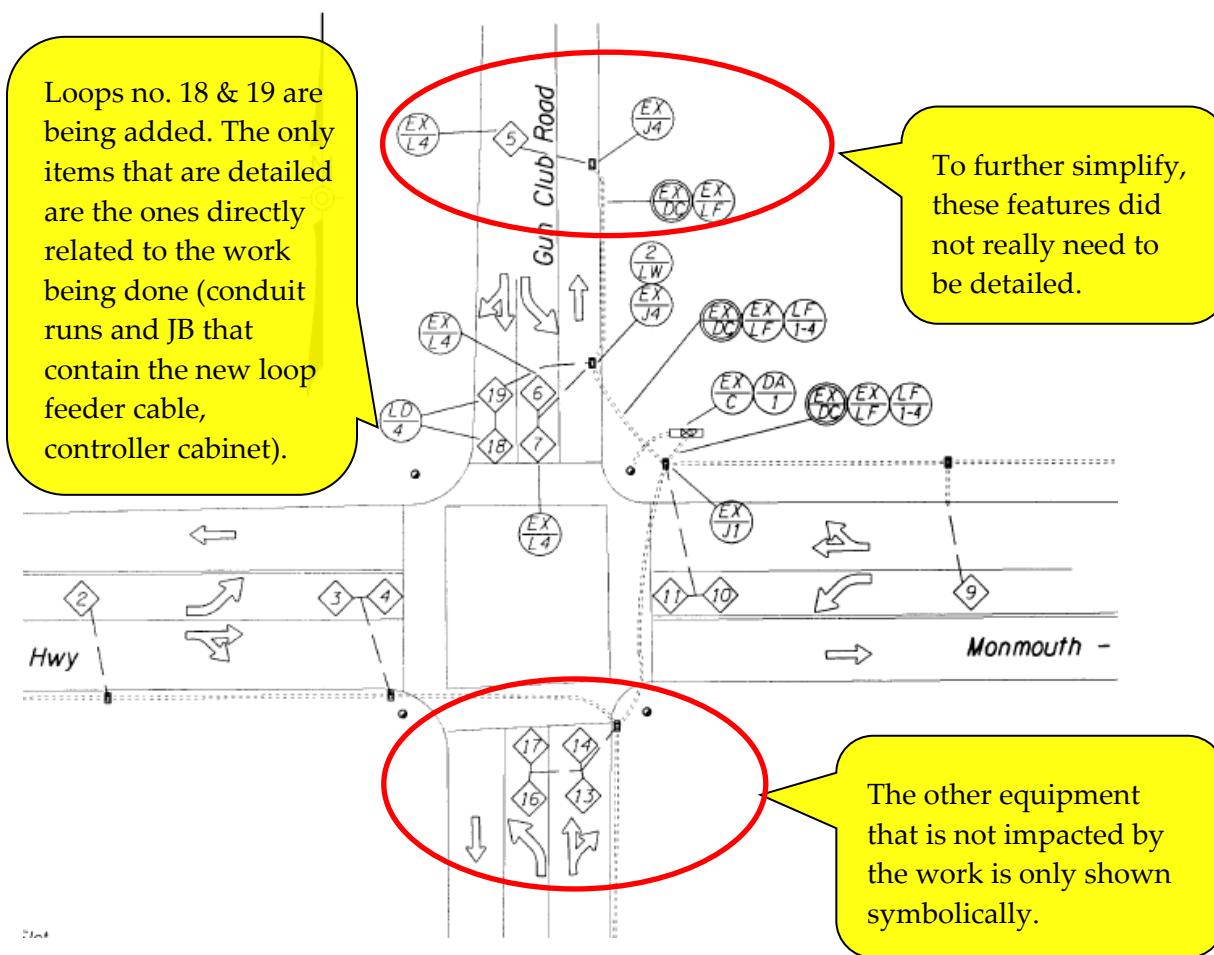


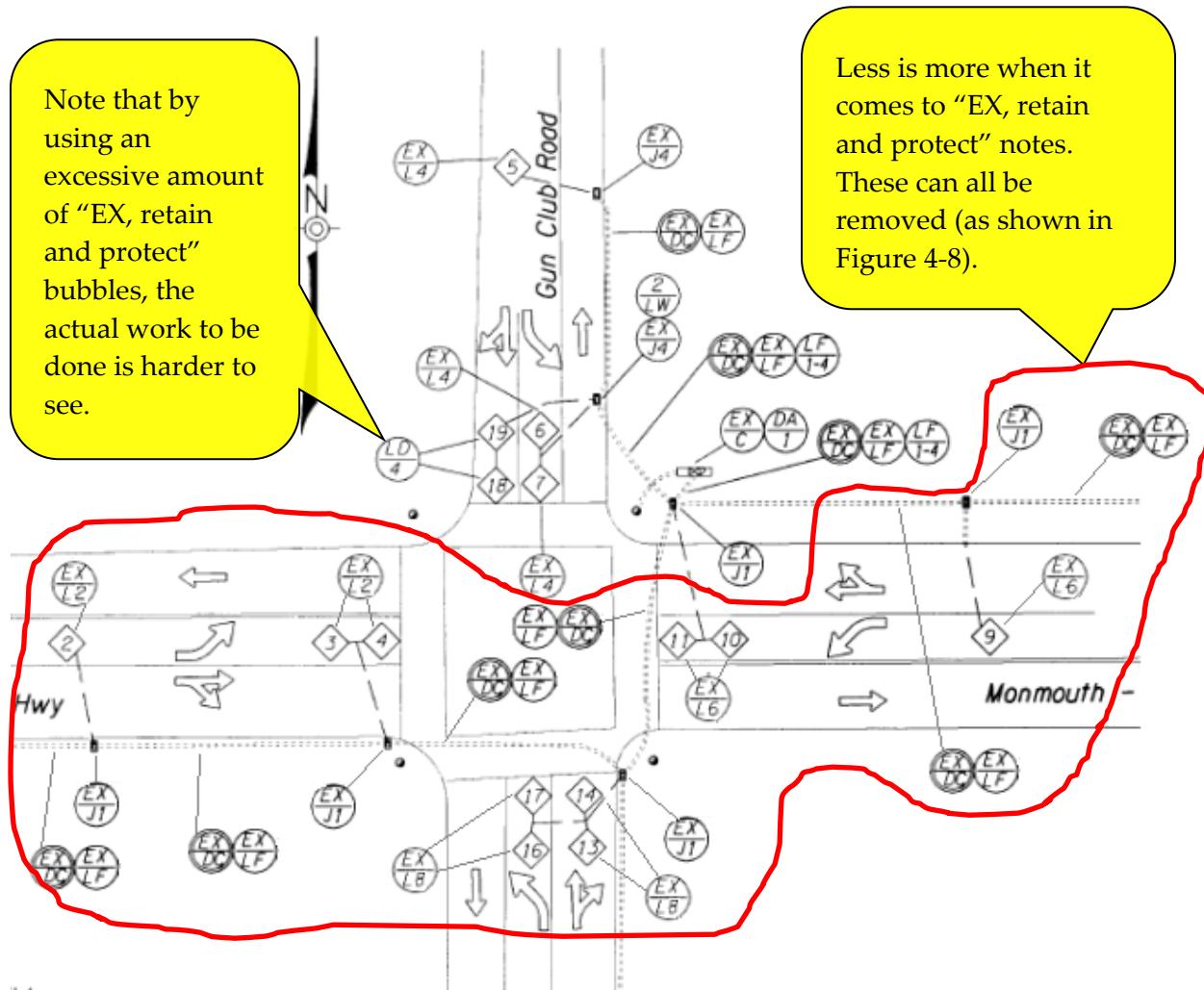
Figure 21-39 | Only Detailing Work to be Done (Preferred Method)



Traffic Signal Design Manual – Contract Plan Development & Drafting

Avoid detailing any equipment that is not impacted by the work to be done (e.g., placing a large amount of "EX, retain and protect" bubble notes). This tends to add little value and instead clutters the drawing making it easier to miss what work needs to be done. See Figure 21-40 for an example of excessive use of "EX, retain and protect" bubble notes.

Figure 21-40 | Detailing Equipment Not Impacted by the Work (Avoid this Method)

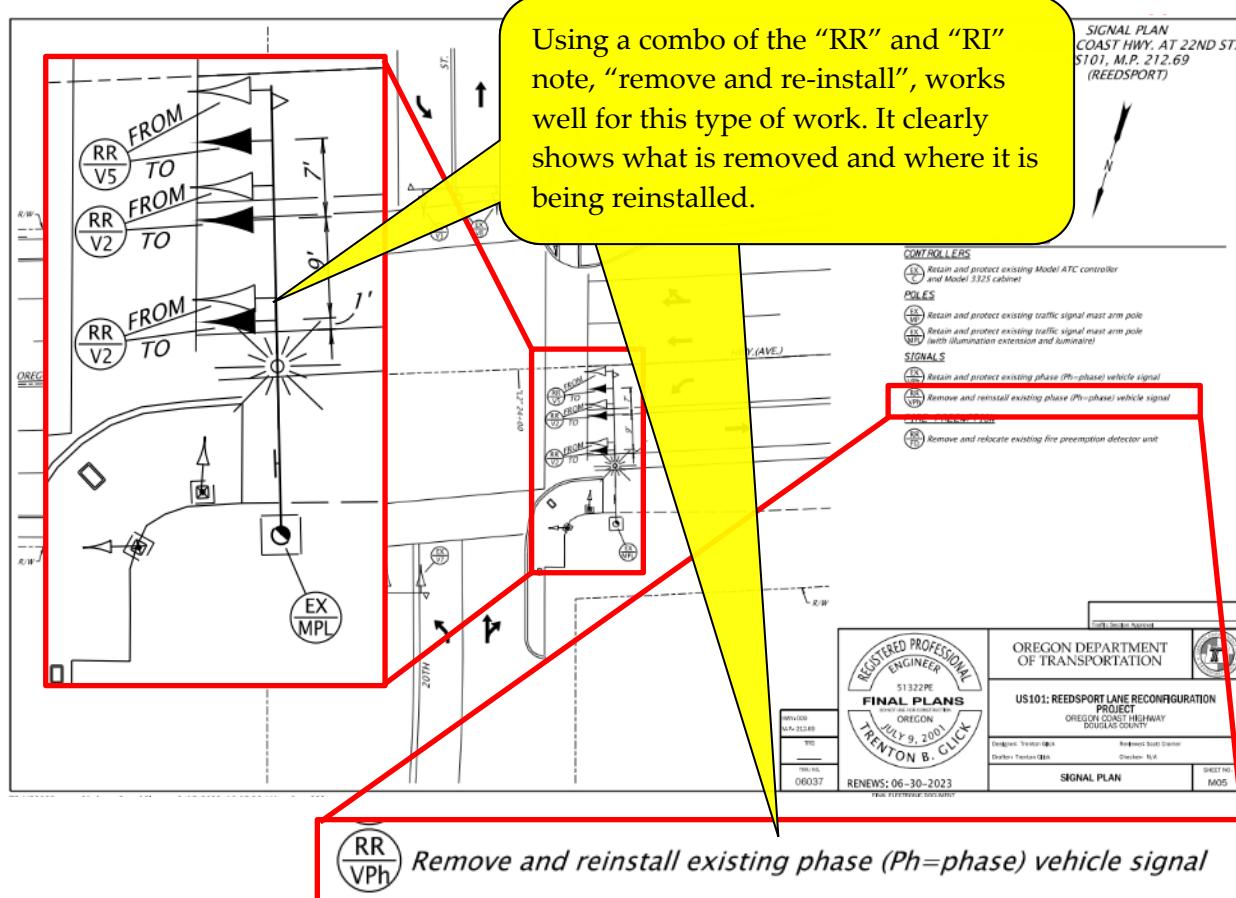


21.9.7 Use of “RX”, “RR”, and “RI” Bubble Notes

The remove & relocate and reinstall bubble notes are not frequently used as it is usually desirable and more cost effective to just remove the existing equipment and install all new equipment for a project. The equipment that was removed can still be salvaged if it is still in good condition and the electrical crew wants it. However, there will be cases where removing/relocating/reinstalling equipment makes the most sense (e.g., state force work and temporary signal work).

Note the remove and relocate bubble notes (“RR”) or reinstall (“RI”) may be combined into a “remove and reinstall” bubble note with use of “TO” and “FROM” on the leader line to show where the equipment is being removed *from* and where it is being reinstalled *to*. This works very well for certain types of work (e.g., adjusting signal head locations on the same mast arm) See Figure 21-41. If the equipment being removed is located too far away from where it will be reinstalled (or shown a different plan sheet), the standard “RR” and “RI” bubble notes are the only option.

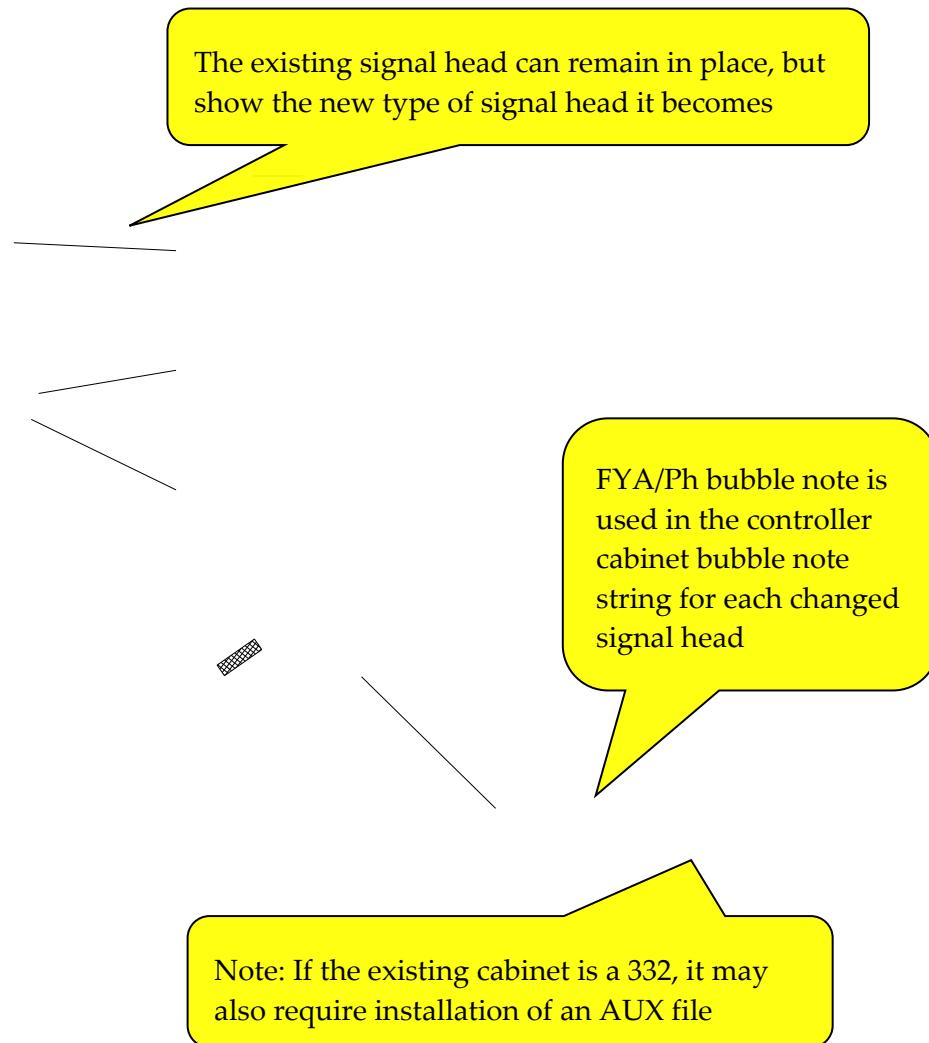
Figure 21-41 | Remove and Reinstall Combined Bubble Note



21.9.8 Updating Type 3L to Type 3LCF Signal Heads

When type 3L signal heads are converted to type 3LCF signal heads, there is a specific way to show this unique work on the signal plan sheet. See Figure 21-42.

Figure 21-42 | Updating Type 3L to Type 3LCF Signal Heads



21.10 Specific Plan Sheet Content Requirements

This section of the manual lists the required content and some good examples for each specific title of plan sheet. The state traffic signal engineer may allow exceptions based on a case-by-case basis.

21.10.1 Legend Plan Sheet

The legend plan sheet shall include the following:

- List all bubble notes that are used on the project. Projects that have a lot of bubble notes should be categorized under the correct sub-heading heading (e.g., “poles”, “conduits”, “controllers”, etc.)
- Show all vehicle signal head types used on the project
- Show cross-reference to all other plan sheets in the signal plan set that are using this legend sheet via the upper right corner title information.
- Show all the applicable standard drawings (typ. TM400 series and TM600 series) that will be needed for the project in the “accompanied by” box in the MicroStation workspace. This box is only used once, always on the first sheet of M series (which is typically the legend sheet).

The legend plan sheet may also include other information as necessary (for example, the normal phase rotation diagram and fire preemption diagram if there is not enough room to place it on the signal plan sheet).

Note that a separate legend sheet may not be necessary if the legend information can fit on the actual plan sheet(s). This is advantageous for smaller scopes of work. It also makes reading the plan sheets a little easier as all necessary information is contained on a single plan sheet. A separate legend sheet is advantageous for large projects (only drafting one list of bubble notes vs. drafting multiple lists of bubble notes for each sheet) and may be the only option if space on the actual plan sheet(s) is tight. See Figure 21-43 for an example of a separate legend sheet and Figure 21-44 for an example of the legend information shown on the actual plan sheet.

Legend plan sheet specific MicroStation workflow items to aid in drafting:

- Sheet Tools → Legends 1 Column
- Sheet Tools → Legends 1 Column Cont.
- Sheet Tools → Legend 2 Column
- Sheet Tools → Accompanied By (box)
- Sheet Tools → Signal/Sign Mount Opt (heading list)
- Sheet Tools → Signal Note Tool (contains the legend sub-headings, signal head types, and all standard bubble notes)

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

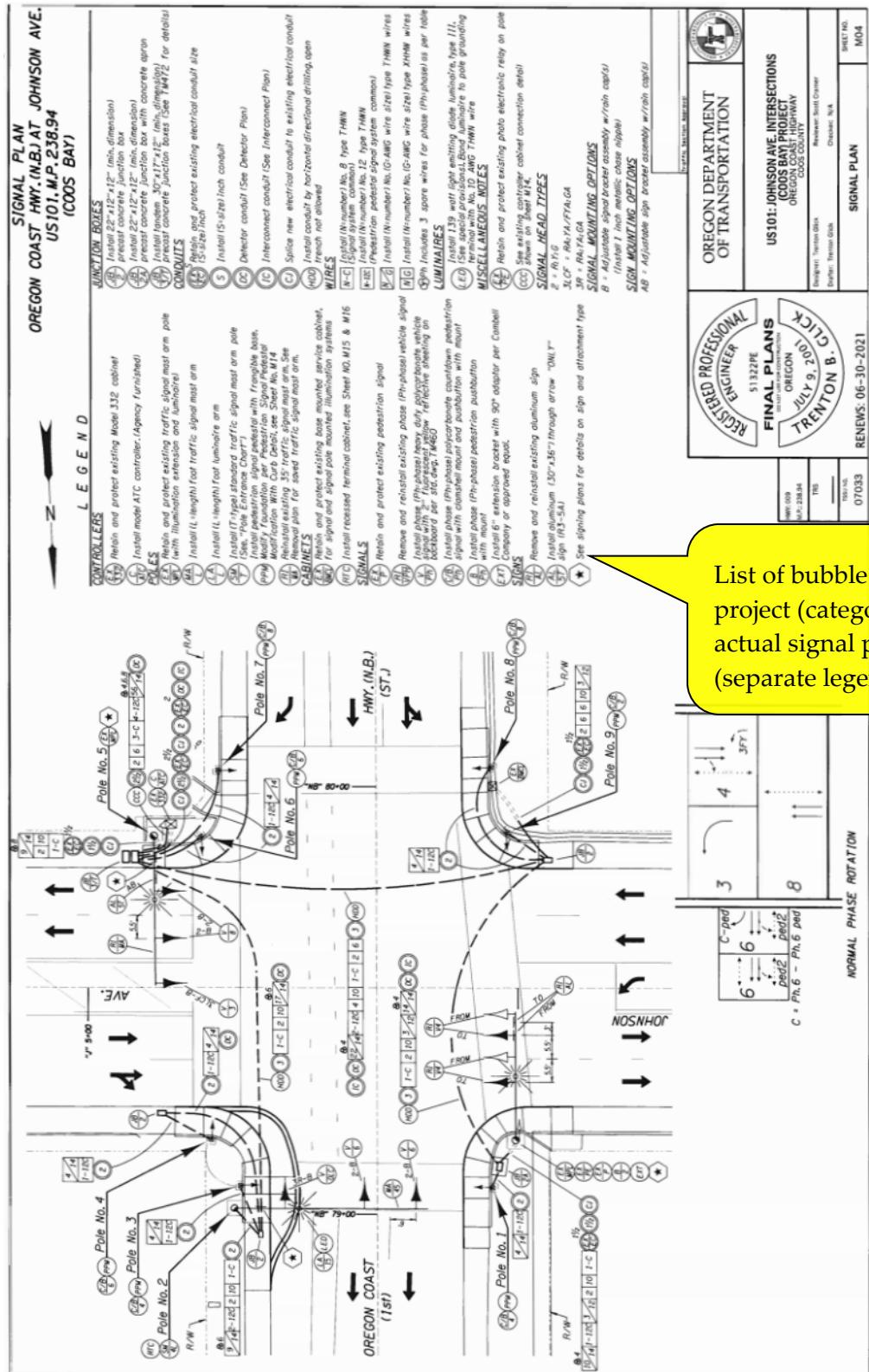
Figure 21-43 | Legend Plan Sheet Example

"Accompanied by" box listing standard drawings & all other plan sheets in the M series (this box is ONLY on the first sheet of the M series).

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-44 | Legend Information Shown on the Plan Sheet (No Separate Legend Sheet)



List of bubble notes used on the project (categorized) on the actual signal plan sheet (separate legend not necessary).

21.10.2 Removal Plan

The removal plan shall include the following:

- Existing feature symbology (e.g., poles, wires, vehicle signals, pedestrian signals, overhead signs, controller cabinet, service cabinet, etc.)
- Proper detailing: bubble note(s) with leader lines to each feature that is removed or abandoned under the 00950 removal bid items (see chapter 19).

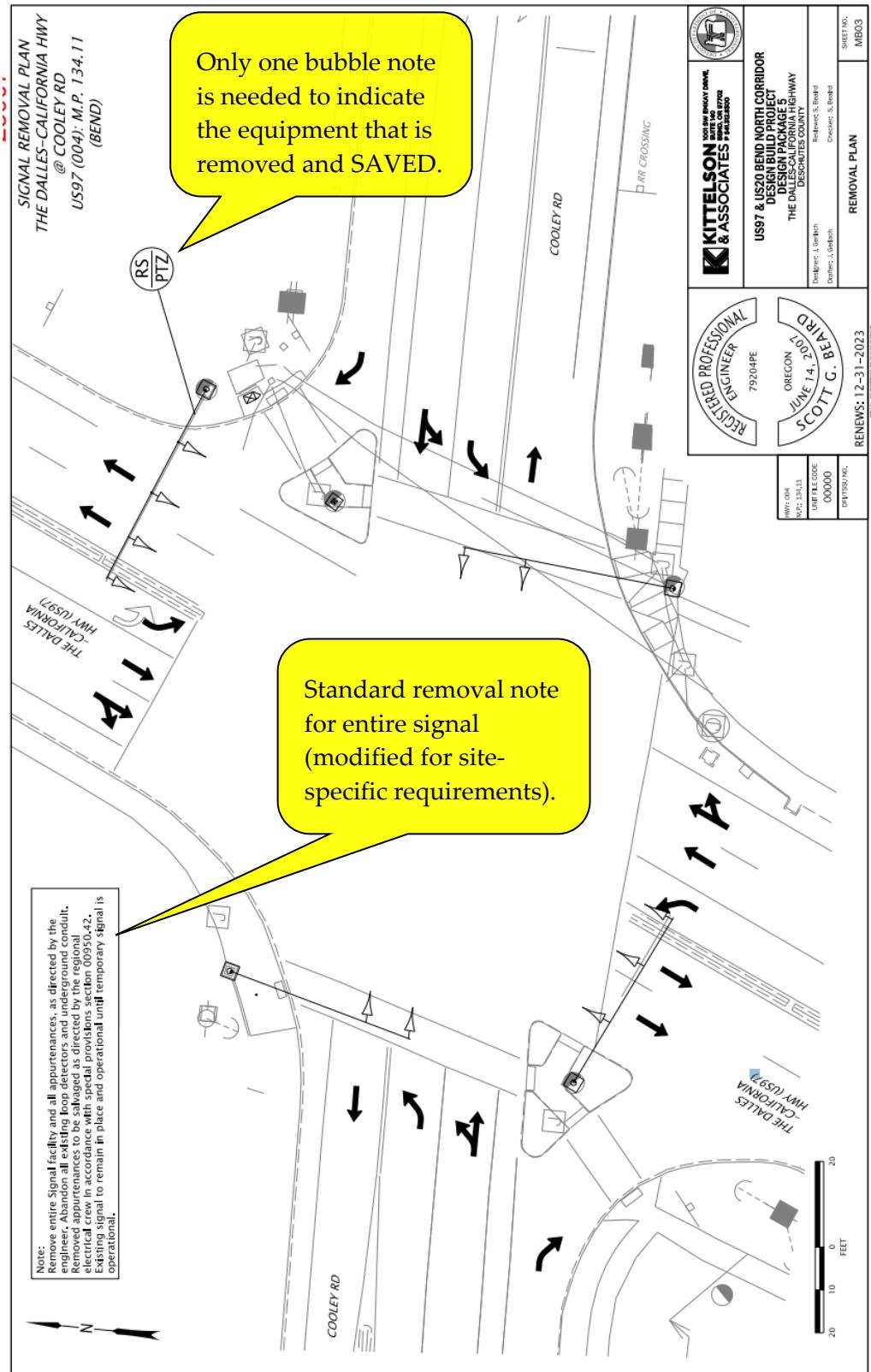
If the project requires a *complete* removal/abandon of all appurtenances at a traffic signal, the removal plan may just show the standard removal note (modified as necessary) with the plan view symbology of the existing traffic signal symbology vs. using detailing out all of the existing equipment with "RX" and "AX" bubble notes. See Figure 21-45 for example of using the removal note. For some installations where it may not be clear what comprises the "entire system" to be removed or there are multiple systems that need to be removed at the same intersection, detailing with the appropriate "RX" and "AX" bubble notes may be more appropriate. See Figure 21-46.

A separate removal plan sheet may not be necessary if the information can be fit and be shown clearly on the actual plan sheet(s). This is generally advantageous for small or partial removal work. See Figure 21-47 for example of the removal information shown on the actual plan sheet.

Removal plan sheet specific MicroStation workflow items to aid in drafting:

- Sheet Tools → Remove Entire Signal (note)

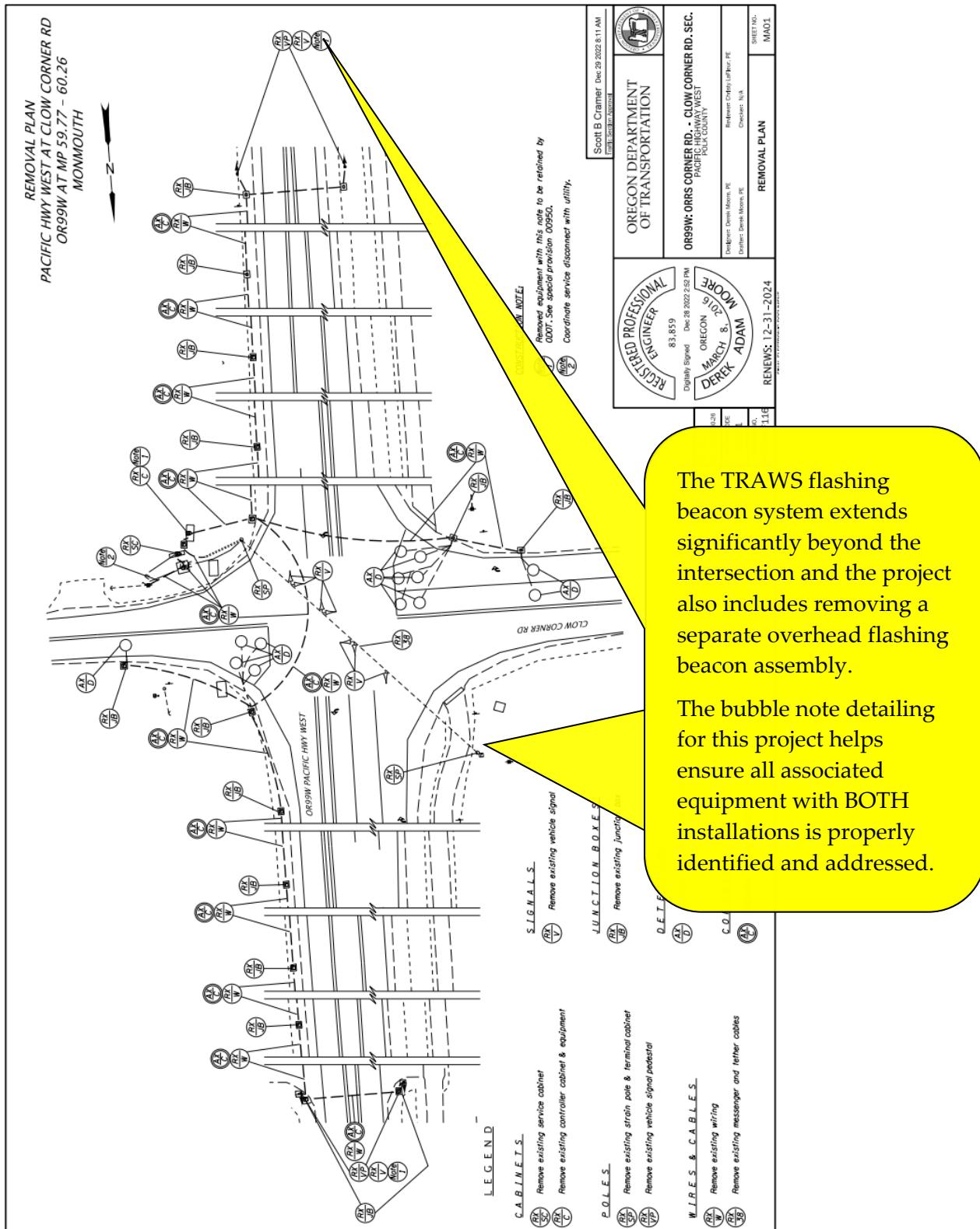
Figure 21-45 | Removal Plan Example – Standard Removal Note for Entire Traffic Signal



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

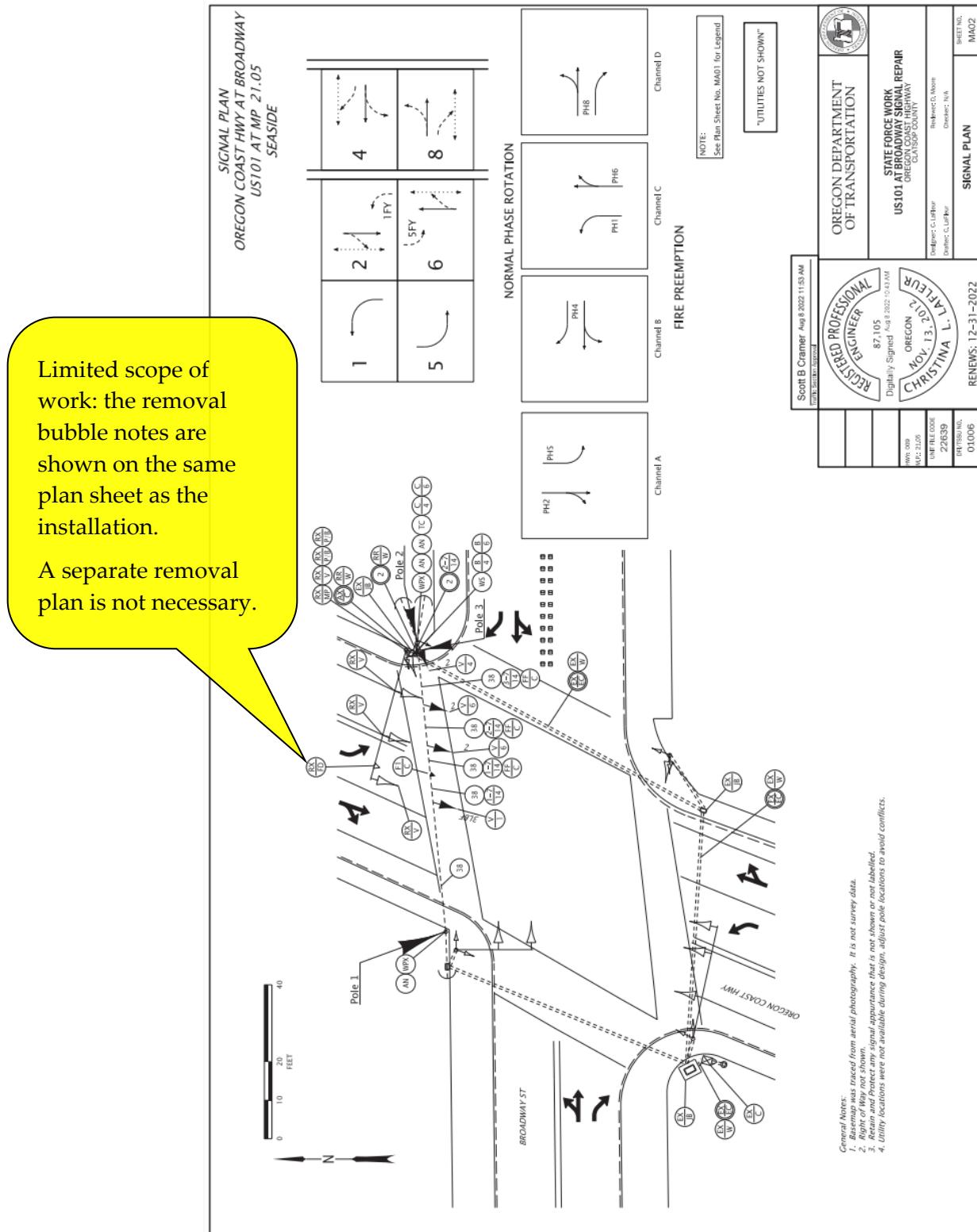
Figure 21-46 | Removal Plan Example – Detailing With “RX” and “AX” Bubble Notes



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-47 | No Separate Removal Plan - Removal Information Shown on the Installation Plan



Limited scope of work: the removal bubble notes are shown on the same plan sheet as the installation.

A separate removal plan is not necessary.

21.10.3 Signal Plan

The signal plan shall include the following as applicable for the scope of work (see Figure 21-48 through Figure 21-50 for good examples):

- Normal phase rotation diagram (may be shown on the legend sheet if there is not enough room for it on the signal plan sheet)
- Fire preemption phase diagram (may be shown on the legend sheet if there is not enough room for it on the signal plan sheet)
- Proposed/new feature symbology:
 - Power source (existing or new)
 - Controller cabinet
 - Service cabinet
 - Mast arm poles and pedestals – labeled with pole numbers (See section 21.8.3)
 - Illumination equipment that is part of the traffic signal installation
 - Vehicle and pedestrian signal heads
 - Pedestrian pushbuttons
 - Signs mounted on mast arm/mast arm pole (e.g., street name signs, lane use signs, PTR signs)
 - Fire preemption devices
 - Crosswalk closed supports
 - Junction boxes, conduit, and wires/cables for the signal system
 - Non-invasive detection equipment and wires/cables (as per chapter 6). Detection zones are NOT shown on plan sheets (shown on cabinet print as per chapter 20)
 - Railroad specific: Railroad bungalow, junction boxes, conduit, and wiring (as per chapter 16)
- Proper detailing: bubble note(s) with leader lines to each feature that will be installed as part of the 00990 traffic signal bid items (See chapter 19).
- Use appropriate reference bubble notes:
 - “DC” and “IC” bubble notes reference detector and interconnect plans for conduit respectively
 - The hex star bubble note references signing plans for street name signs, crosswalk closure supports, etc.

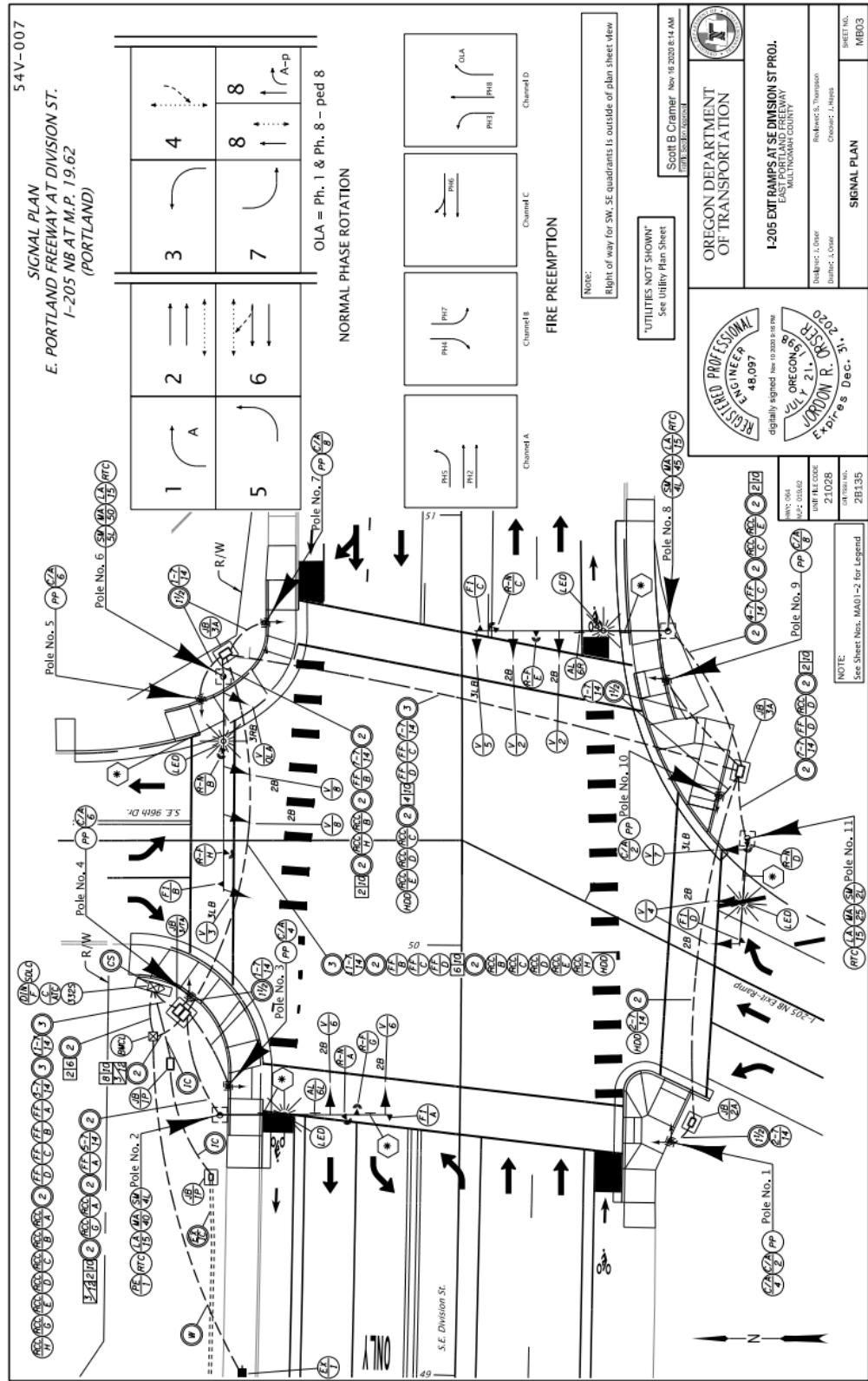
Signal plan sheet specific MicroStation workflow items to aid in drafting:

- Sheet Tools → Pole Number Tx
- Sheet Tools → Pole Arrow
- Sheet Tools → Utilities Not Shown (text box)
- Sheet Tools → Legend Cross Ref (text box)
- Sheet Tools → Right of Way (text box)
- Signal Plans Symbology → Wheelchair Design Vehicle
- Signal Plans → Phase Rotation Dia
- Signal Plans → Fire Preemption

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

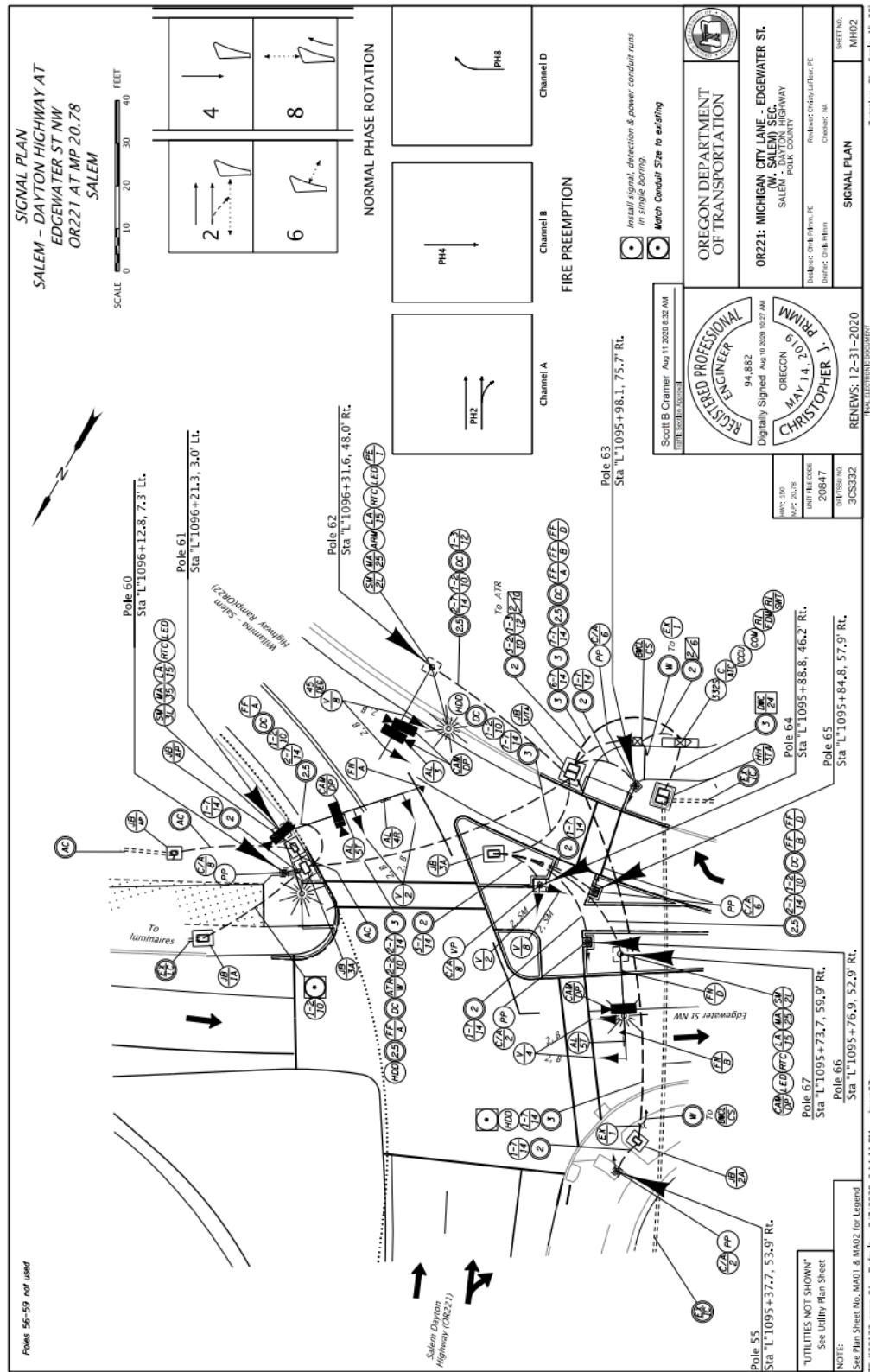
Figure 21-48 | Signal Plan Sheet Example 1 (New Signal)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

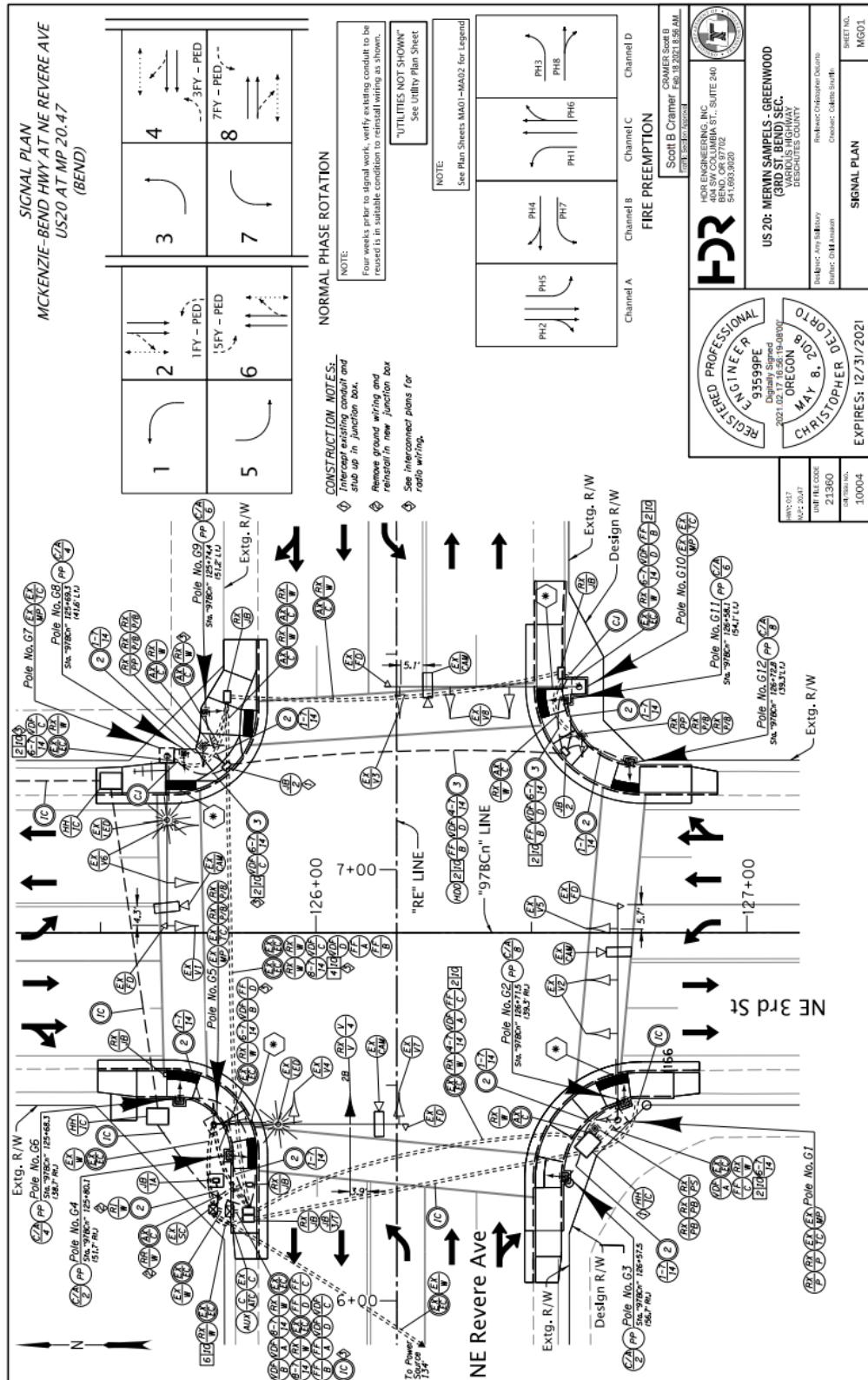
Figure 21-49 | Signal Plan Sheet Example 2 (New Signal)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-50 | Signal Plan Sheet Example 3 (Existing Signal Modification)



21.10.4 Detector Plan

The detector plan sheet is no longer necessary if the entire intersection has non-invasive detection as per chapter 6. 100% non-invasive detection will be shown on the signal plan sheet for new or completely rebuilt signals. If the project has any loop detection (typically not allowed for new construction) or the only work to be done is adding non-invasive detection to an existing signal, a detector plan sheet will be necessary, and it shall include the following as applicable for the scope of work (See Figure 21-51 through Figure 21-53 for good examples):

- Proposed/new feature symbology:
 - Loop detection – labeled with numbers.
 - Loop wire entrance
 - Junction boxes, conduit, and wires/cables for the loop detection system
 - Controller cabinet
- Loop detector wiring diagram, properly filled-out
- Non-invasive detection equipment and wires/cables (as per chapter 6). Detection zones are NOT shown on plan sheets (shown on cabinet print as per chapter 20).
- Use break lines to compress the plan into one plan sheet when possible.
- Proper detailing: bubble note(s) with leader lines to each feature that will be installed as part of the 00990 traffic signal bid items (See chapter 19).
- Use appropriate reference bubble notes:
 - “EC” and “IC” bubble notes reference signal and interconnect plans for conduit respectively
 - “C” bubble note references the signal plan for the controller
 - “JB/SP” bubble note references the signal plan for junction boxes

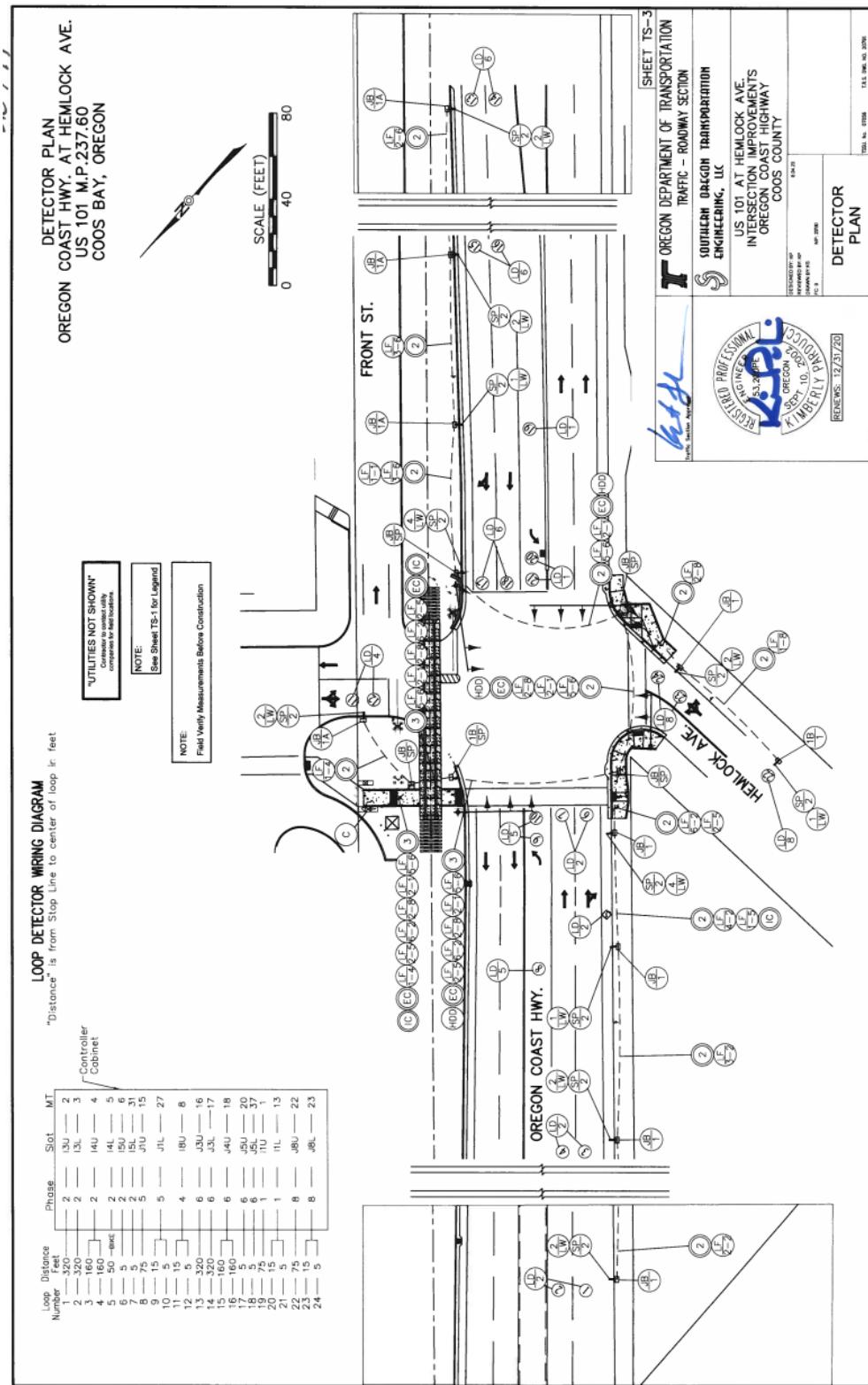
Detector plan sheet specific MicroStation workflow items to aid in drafting:

- Signal Plans → Loop Wiring Diagrams
- Sheet Tools → Break Line
- Sheet Tools → Rewire Loops (text box)

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

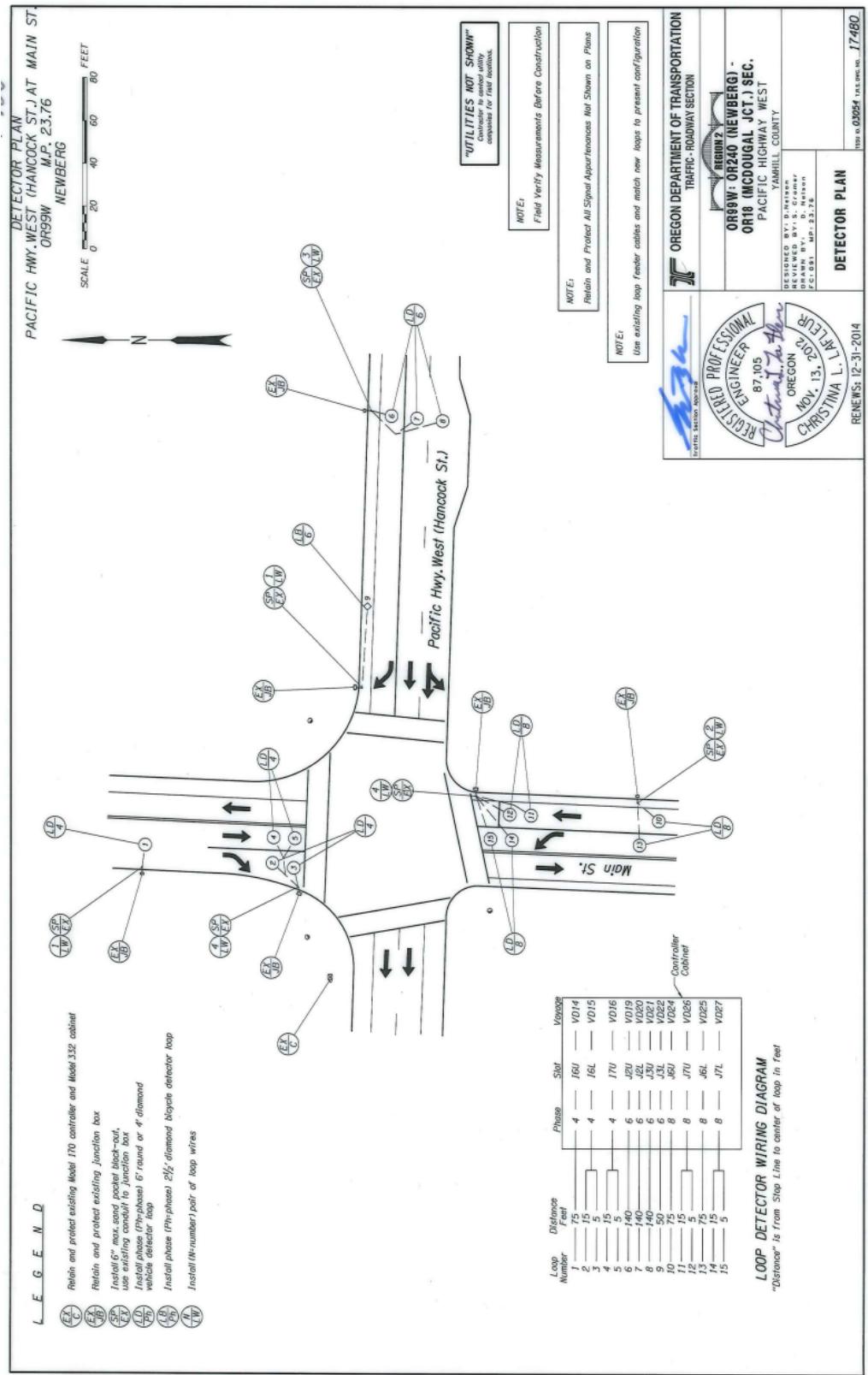
Figure 21-51 | Detector Plan Sheet Example 1 (New Loop Detection – Not Allowed for New Construction)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

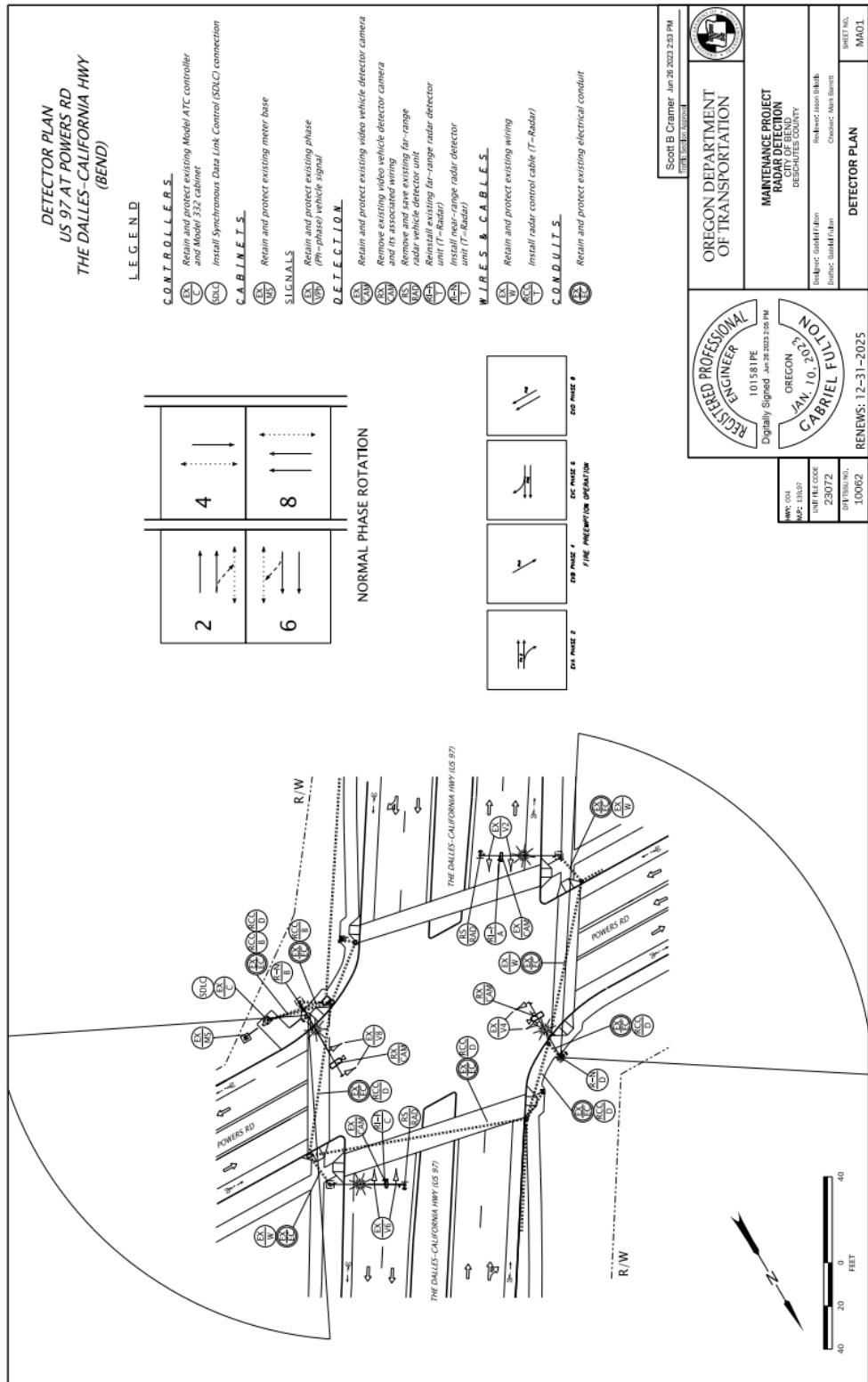
Figure 21-52 | Detector Plan Sheet Example 2 (Replacing Loop Detection at Existing Signal)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-53 | Detector Plan Sheet Example 3 (Adding Non-invasive Detection Only to Existing Signal)



21.10.5 Interconnect Plan

The interconnect plan shall include the following as applicable for the scope of work (see Figure 21-54 for a good example):

- Proposed/new feature symbology:
 - Junction boxes, conduit, wires/cables associated with the interconnect installation.
- Details as necessary as per the ITS unit (e.g., fiber optic splice, radio mount, etc.)
- Use break lines to compress the plan into one sheet when possible (or to reduce the number of sheets needed).
- Proper detailing: bubble note(s) with leader lines to each feature that will be installed as part of the 00990 interconnect bid item (See chapter 19).
- Use appropriate reference bubble notes:
 - “EC” and “DC” bubble notes reference signal and detector plans for conduit respectively
 - “C” bubble note references the signal plan for the controller
 - “JB/SP” and “JB/DP” bubble notes reference the signal and detector plans for junction boxes respectively

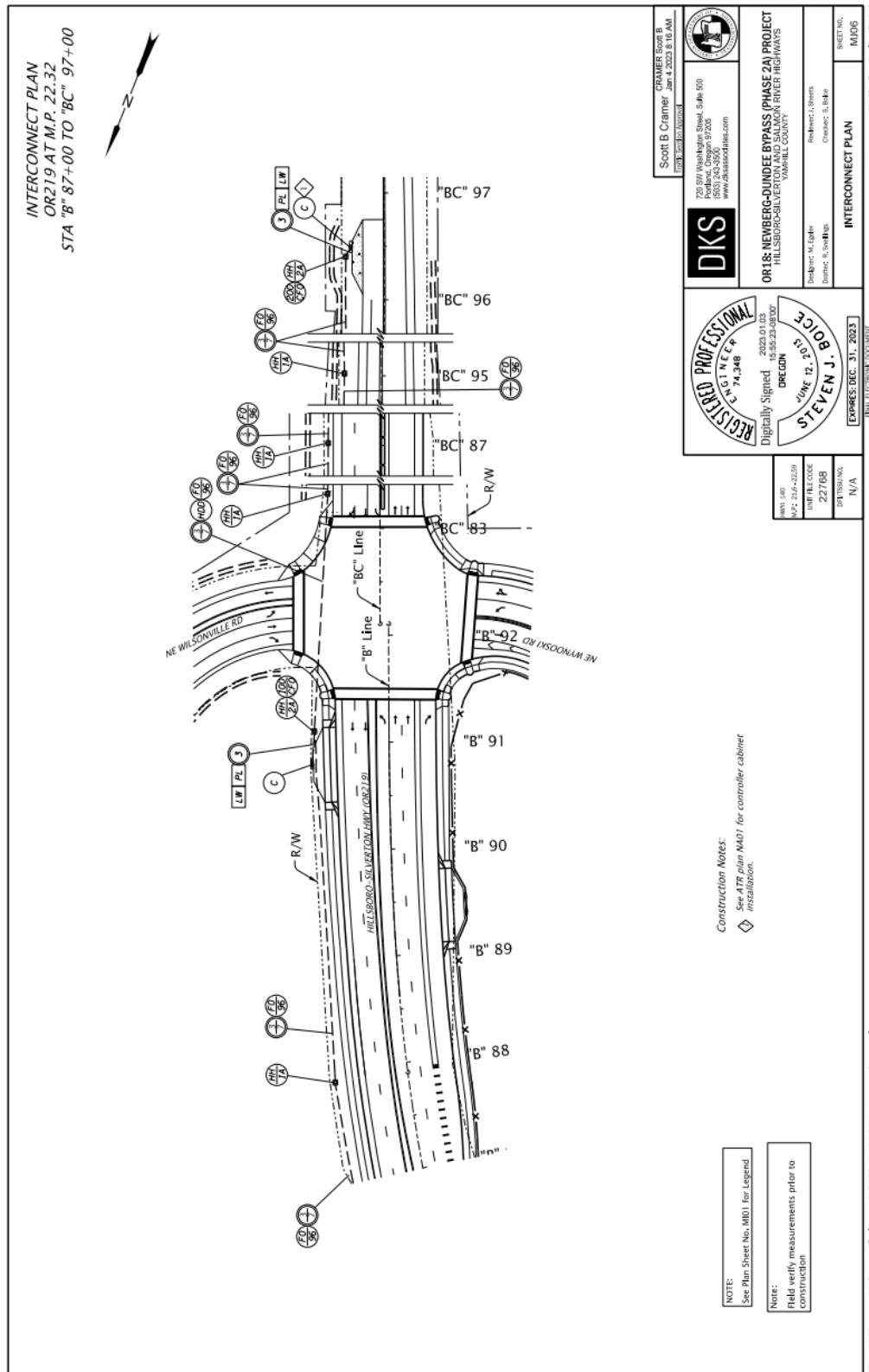
Interconnect plan sheet specific MicroStation workflow items to aid in drafting:

- Sheet Tools → Break Line

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-54 | Interconnect Plan Sheet Example



21.10.6 Railroad Preemption Plan

The railroad preemption plan is included in the rail crossing order, not the contract plans. It shall include the following (See Figure 21-55 through Figure 21-57 for good examples. Also refer to the [Railroad Final Drawings Manual](#) for additional information on producing plan sheets specifically for the crossing order):

- Standard preemption operation text template (3 options available) as per chapter 16, filled out as per the instructions. Unique operations may require unique text. Any unique text will be provided by the traffic engineering section.
- Normal phase rotation diagram
- Proposed/new feature symbology:
 - Railroad tracks
 - Poles, mast arms, and pedestals
 - Vehicle signal heads
 - Pedestrian signal heads
 - PTR signs
 - Signs (ground mounted or overhead) that directly relate to the preemption operation:
 - STOP HERE ON RED
 - NO TURN ON RED
- Proper detailing: **Bubble notes are NOT used on the railroad preemption plan.** Instead, the following items are labeled with text (with a leader line, or within the item itself):
 - USDOT crossing number, ODOT crossing number, and railroad milepoint adjacent to the railroad tracks
 - PTR sign(s). Use a leader line and state the PTR sign message, typically NO RIGHT TURN.
 - Signs that directly relate to the preemption operation. Use a leader line and state the sign message.
 - Type 7 vehicle signal head. Use a leader line.
 - Vehicle phases in each travel lane.
 - Pedestrian phases in each crosswalk.
- Other features that MAY be included, but are not required:
 - Railroad bungalow
 - Railroad equipment (e.g., gate arms, flashers, cantilevers, etc.)
 - Controller cabinet and service cabinet
 - Stationing
 - Right-of-way

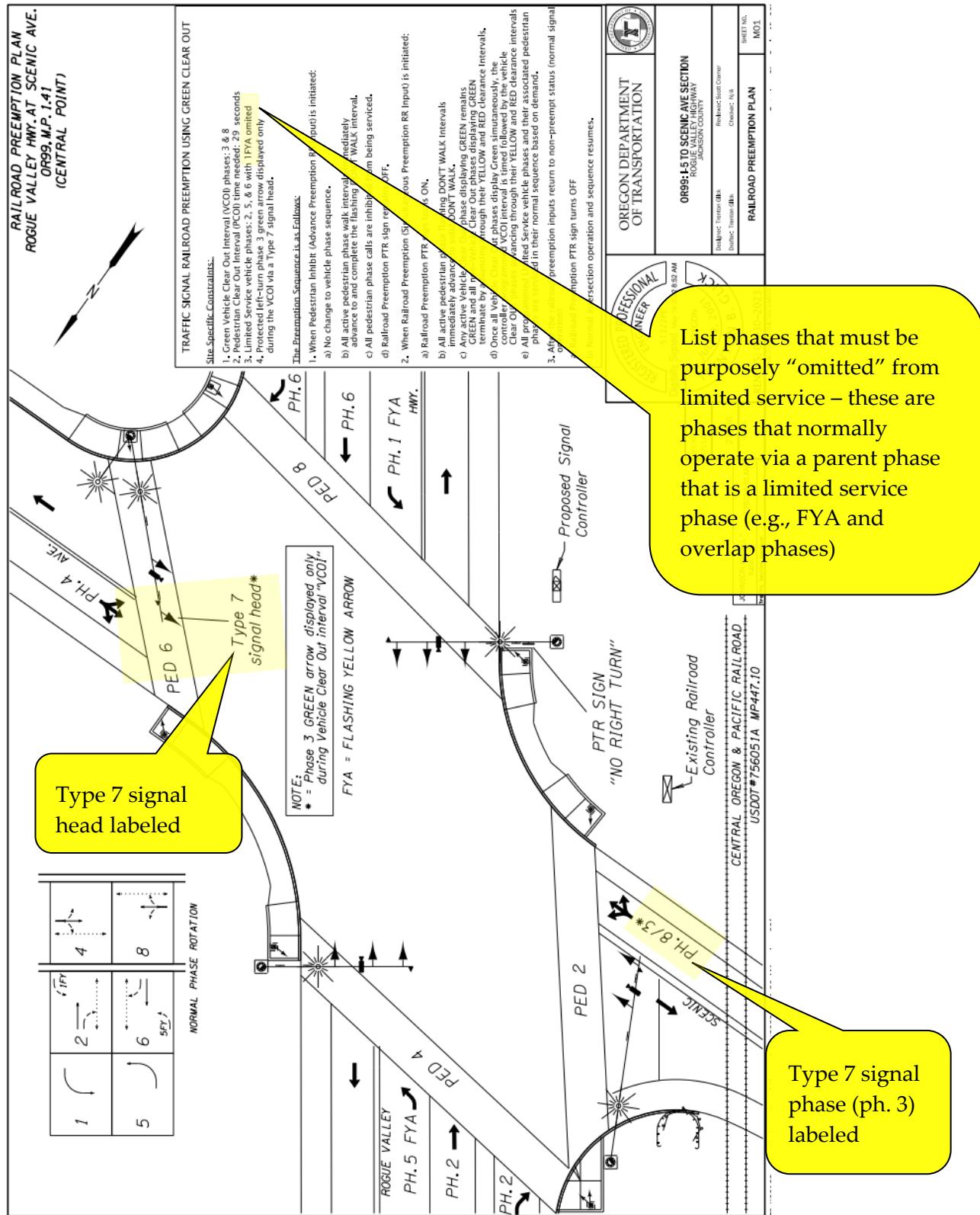
Railroad preemption plan sheet specific MicroStation workflow items to aid in drafting:

- Signal Plans → Rail Matrix (three standard text operation templates with instructions for using them and filling them out)
- Signal Plans → Phase Rotation Dia

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

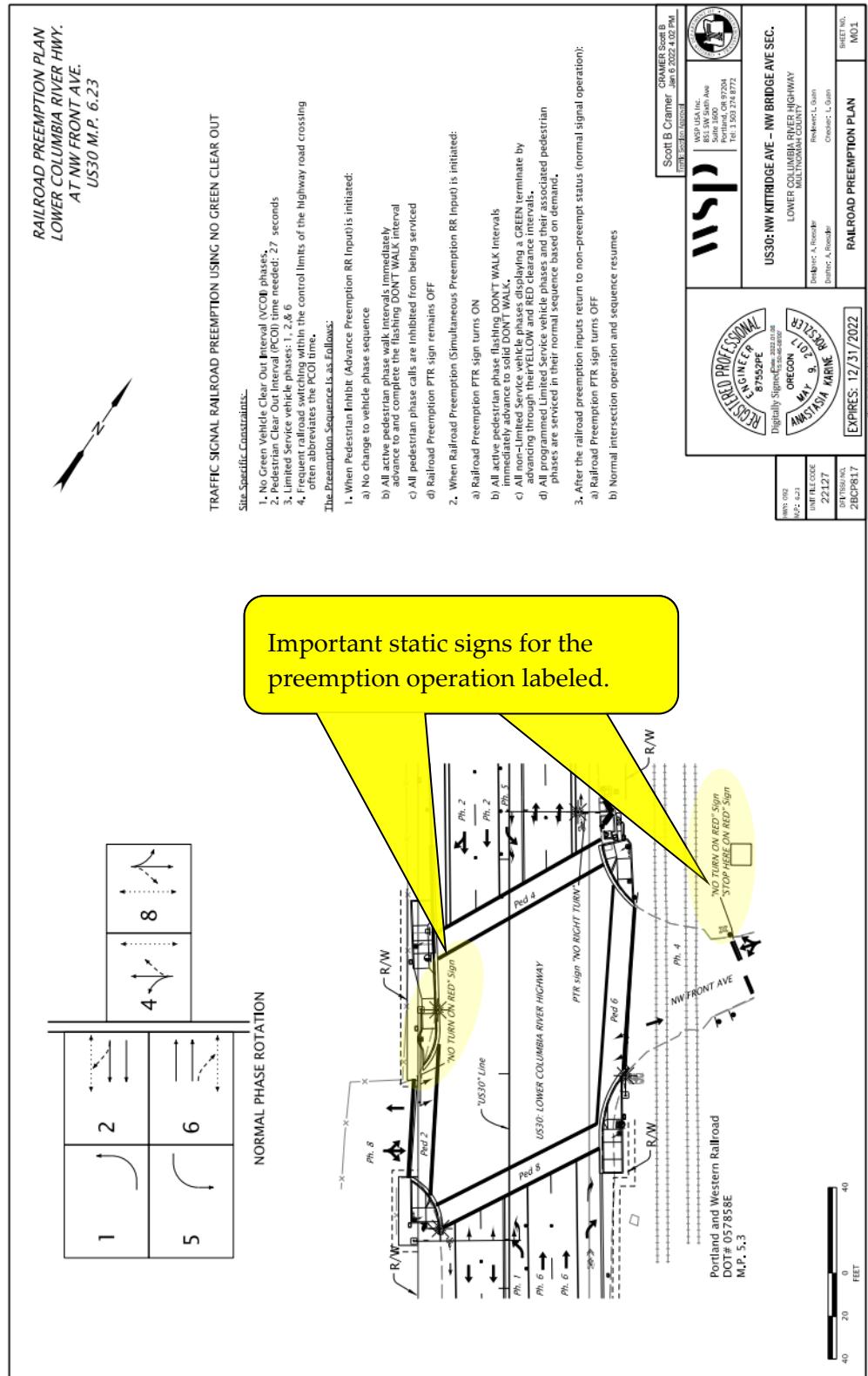
Figure 21-55 | Railroad Preemption Plan Sheet Example 1 (Default Standard Template Text)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

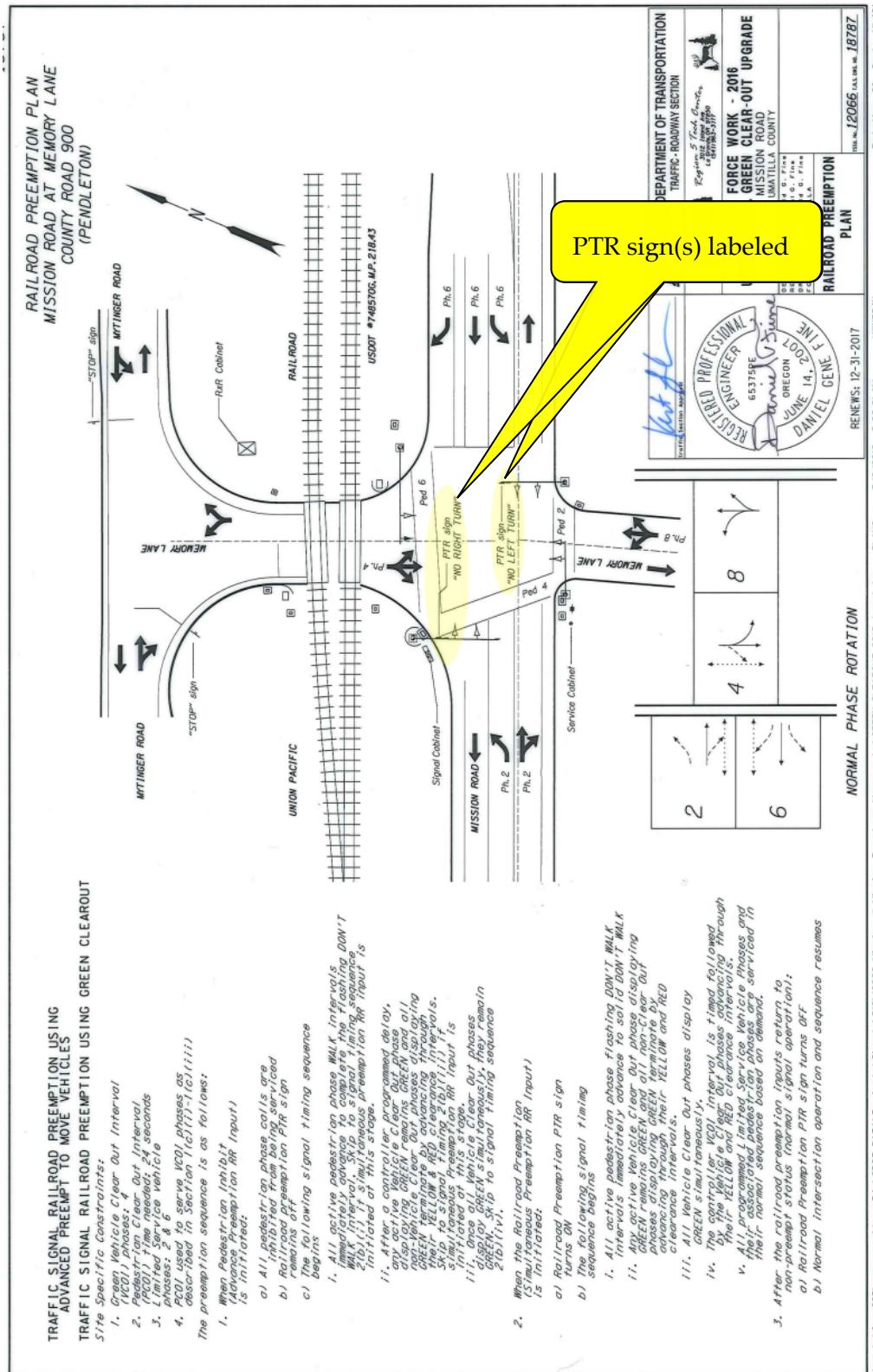
Figure 21-56 | Railroad Preemption Plan Sheet Example 2 (No VCOI Template Text)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-57 | Railroad Preemption Plan Sheet Example 3 (Advanced Template Text)



21.10.7 Existing Utilities Plan

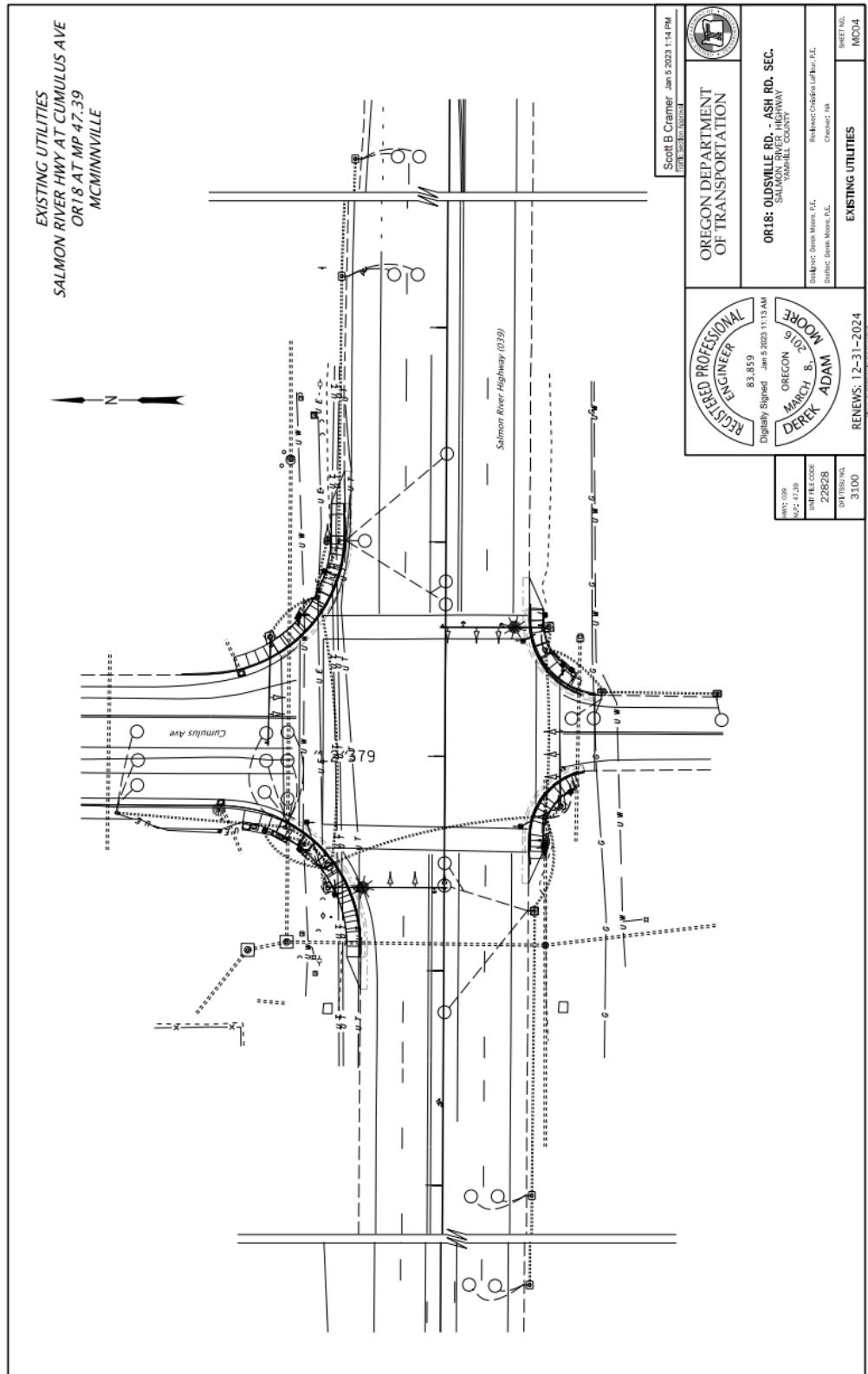
The existing utilities plan sheet shall include the following (see Figure 21-58 for a good example):

- Proposed/new feature symbology:
 - All signal features (e.g., poles, pedestals, mast arms, cabinets, conduit, junction boxes, signal heads, etc. that will be installed per the contract plan sheets)
 - All overhead and underground utilities (e.g., telephone, power, natural gas, water, sewer, storm sewer, etc.)
 - Other features that may impact the construction of the signal features.
- All existing signal feature symbology that will be retained and protected per the contract plan sheets.
- **Detailing (bubble notes) is NOT used on the existing utilities plan.** However, if deemed necessary, text notes can label or identify critical features/areas.
- Other features that may be included but are NOT required:
 - Noting any anticipated moves of existing utilities. Often utilities aren't moved before the contract is let, so the exact location of the relocated utility cannot be shown.
 - Noting any utilities that are very close to signal features and providing dimensions/ instructions for installation of these signal features if deemed necessary.

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-58 | Existing Utilities Plan Sheet Example



21.10.8 Details Plan

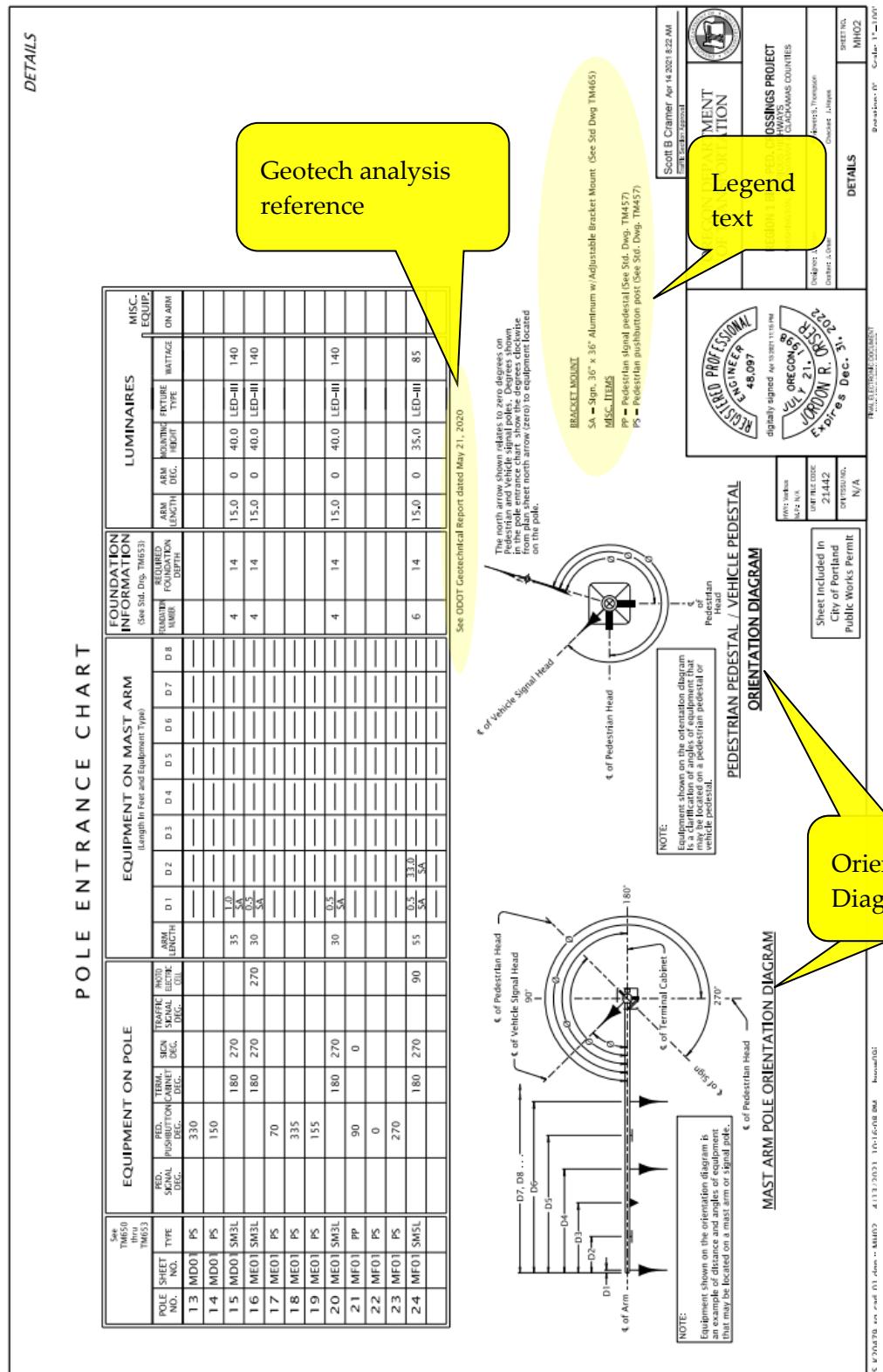
The details plan sheet will typically consist of the pole entrance chart, but other site-specific details should be added as necessary for the project. The details plan sheet shall include the following as applicable for the scope of work (see Figure 21-59 and Figure 21-60 for good examples):

- The pole entrance chart correctly filled out with all necessary information including adding additional columns as necessary based on the site-specific project needs. Columns may also be deleted if they aren't applicable to the project (e.g., no mast arm poles, no luminaires, etc.). See chapter 9.
 - Geotech analysis reference
 - The mast arm pole orientation diagram and the pedestal orientation diagram
 - Legend text for brackets and equipment detailed in the pole entrance chart
- Any standard details needed, modified for the project specific work (see chapter 9)
- **Detailing (bubble notes) is NOT typically used in the details plan.**

Details plan sheet specific MicroStation workflow items to aid in drafting:

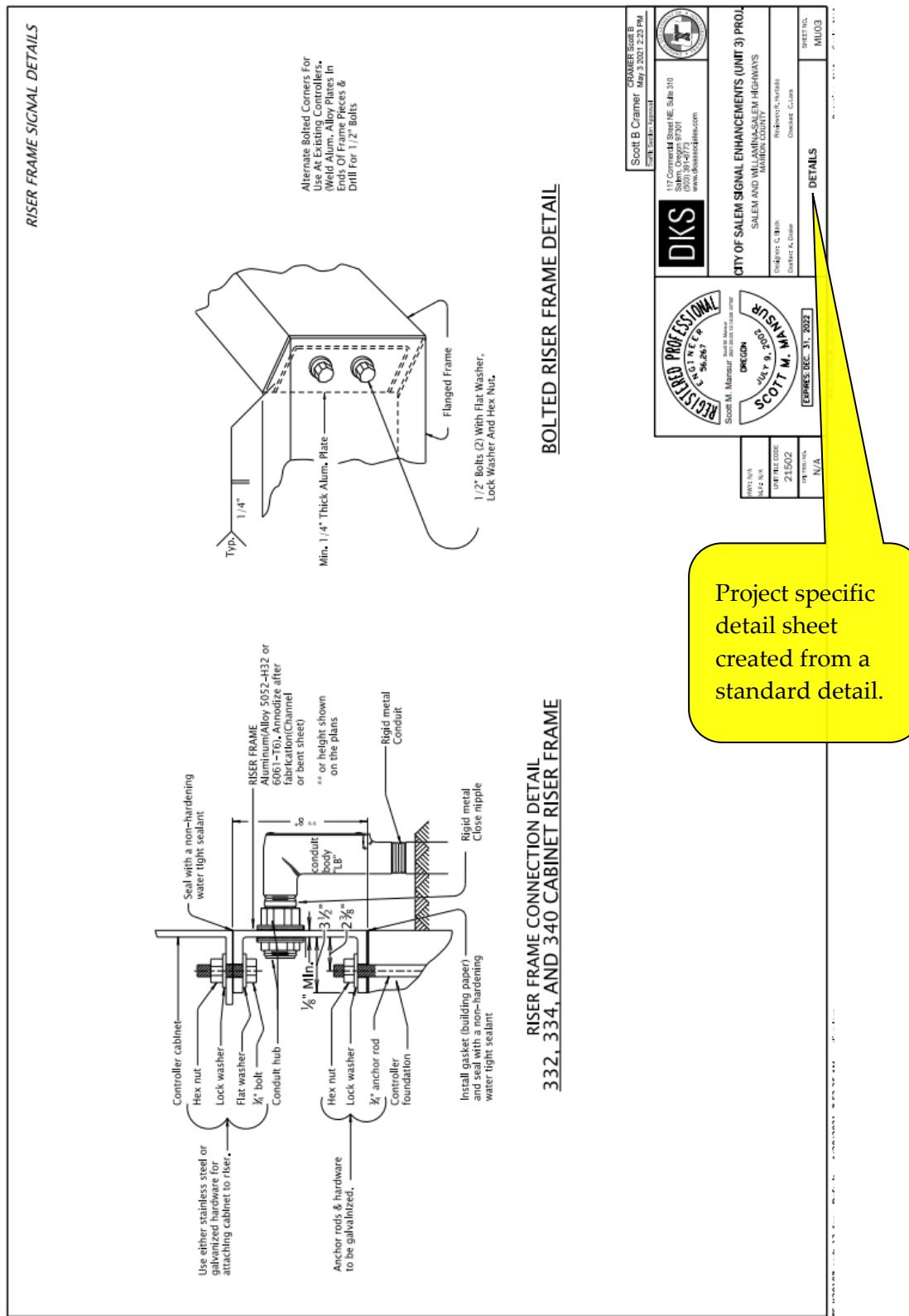
- Signal Plans → Pole Ent Chart (lots of tools to properly draft and detail)

Figure 21-59 | Details Plan Sheet Example 1 (Pole Entrance Chart)



Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-60 | Details Plan Sheet Example 2 (Project Specific Work Details)



Project specific detail sheet created from a standard detail.

21.10.9 Temporary Signal, Detector, Ramp Meter Plan

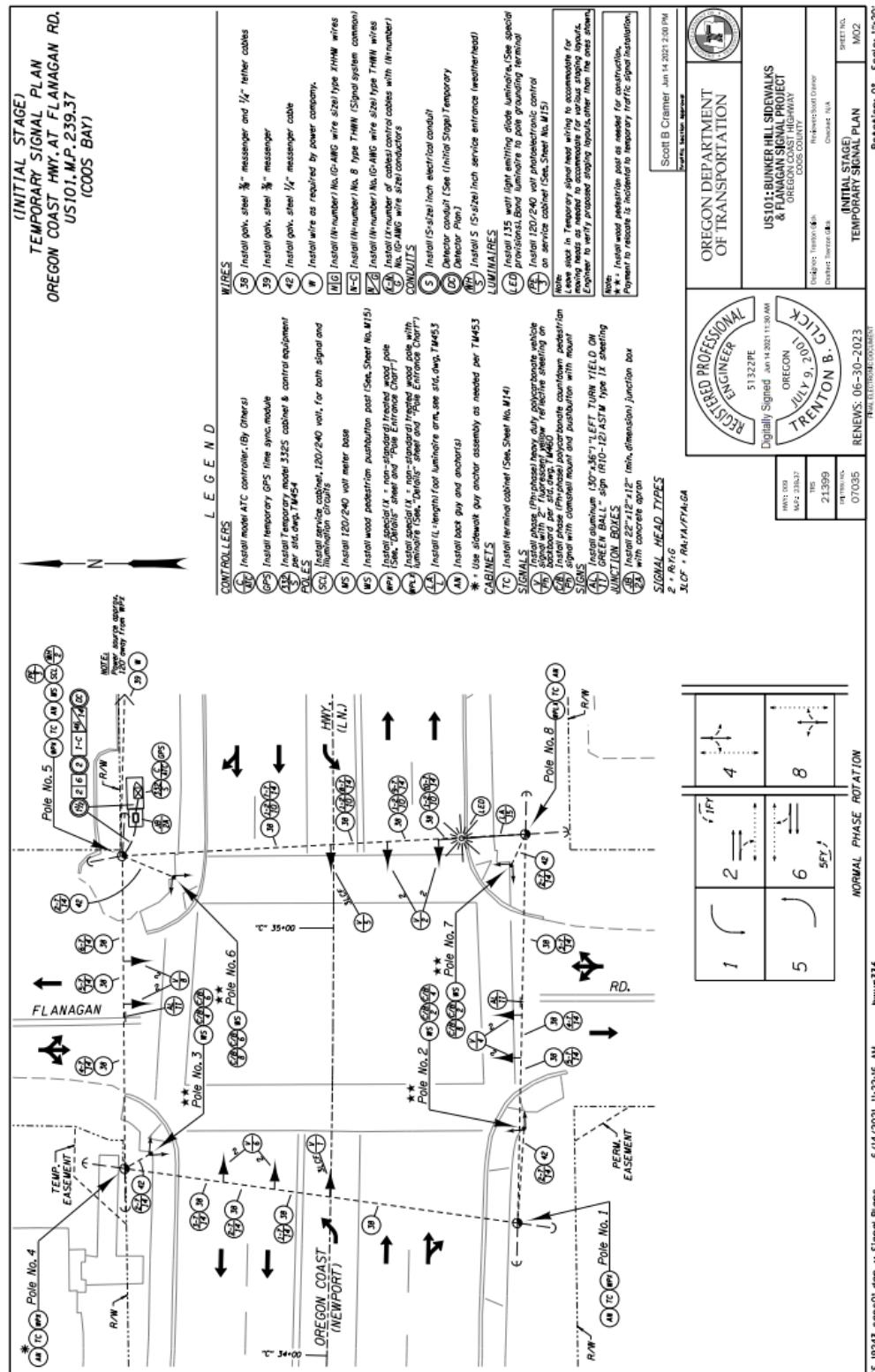
The temporary signal, detector, or ramp meter plan shall include all the items described in the permanent signal plan (see section 21.10.3), detector plan (see section 21.10.4), or ramp meter plan (see section 21.10.11) with the following items that are unique to temporary signals (see Figure 21-61 through Figure 21-63 for good examples):

- Wood poles and span wires
- Plans sheets as necessary for each stage/phase. The first stage for a temporary signal will detail ALL the equipment just like a regular signal/detector/ramp meter plan sheet. Each following stage will only detail the modification(s) needed for that particular stage. All equipment installed in the previous stage(s) is to be retained and protected unless otherwise detailed.
- The temporary signal, detector, or ramp meter plan shall match the staging shown in the temporary traffic control plans. Show the work zone stage/phase in the upper right corner of the plan sheet.
- Proper detailing: bubble note(s) with leader lines to each feature that will be installed as part of the 00227 temporary traffic signal bid items (See chapter 19).
- Use appropriate reference bubble notes:
 - For each stage following the initial temporary construction, use appropriate "EX", "RX", "RR" bubble notes to show work needed. See section 21.9.7 and chapter 11.
 - Reference workzone plans as needed for clarity.

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

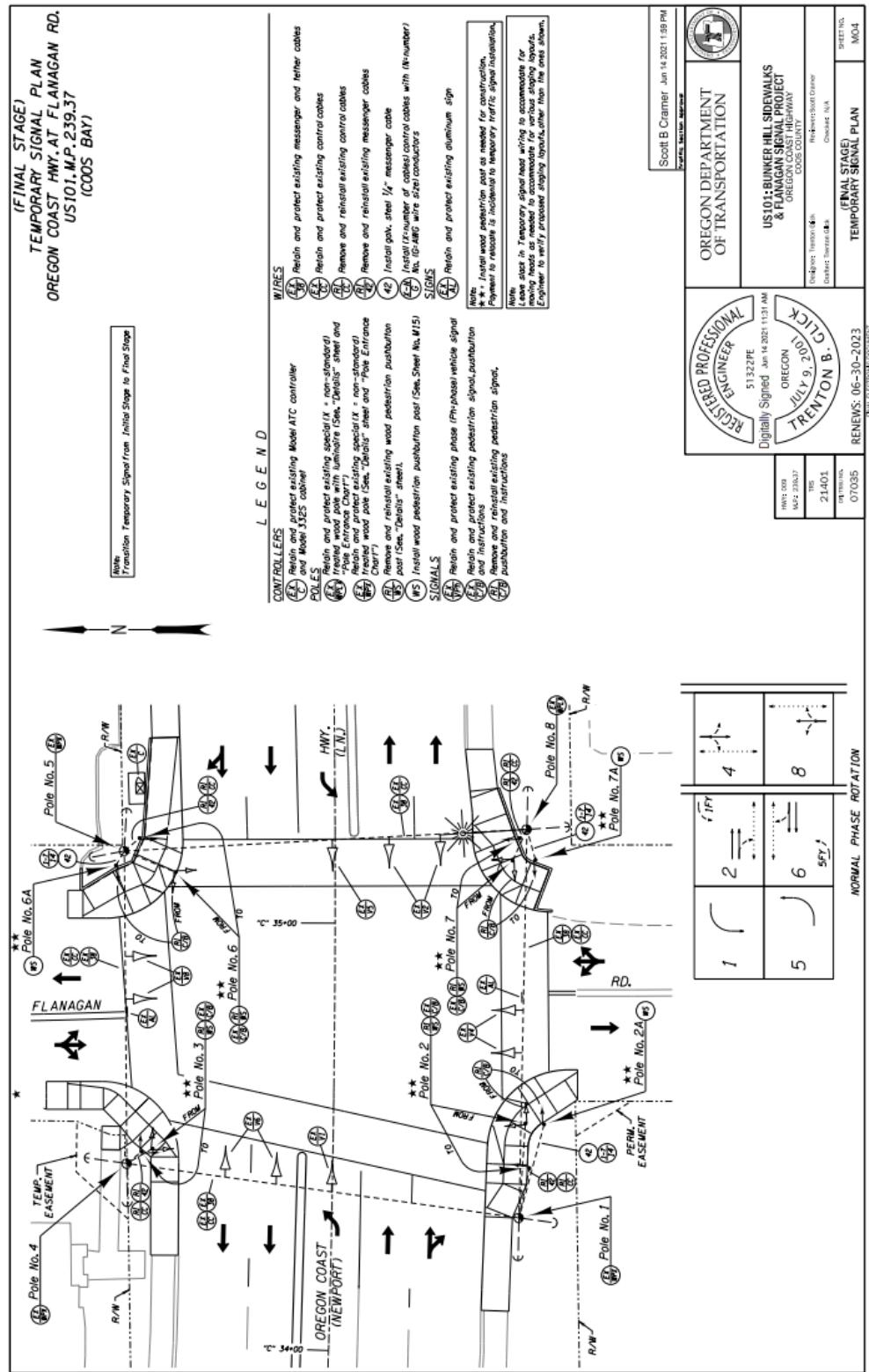
Figure 21-61 | Temporary Signal Plan Sheet Example 1 (First Stage – Show ALL Equipment Installation)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

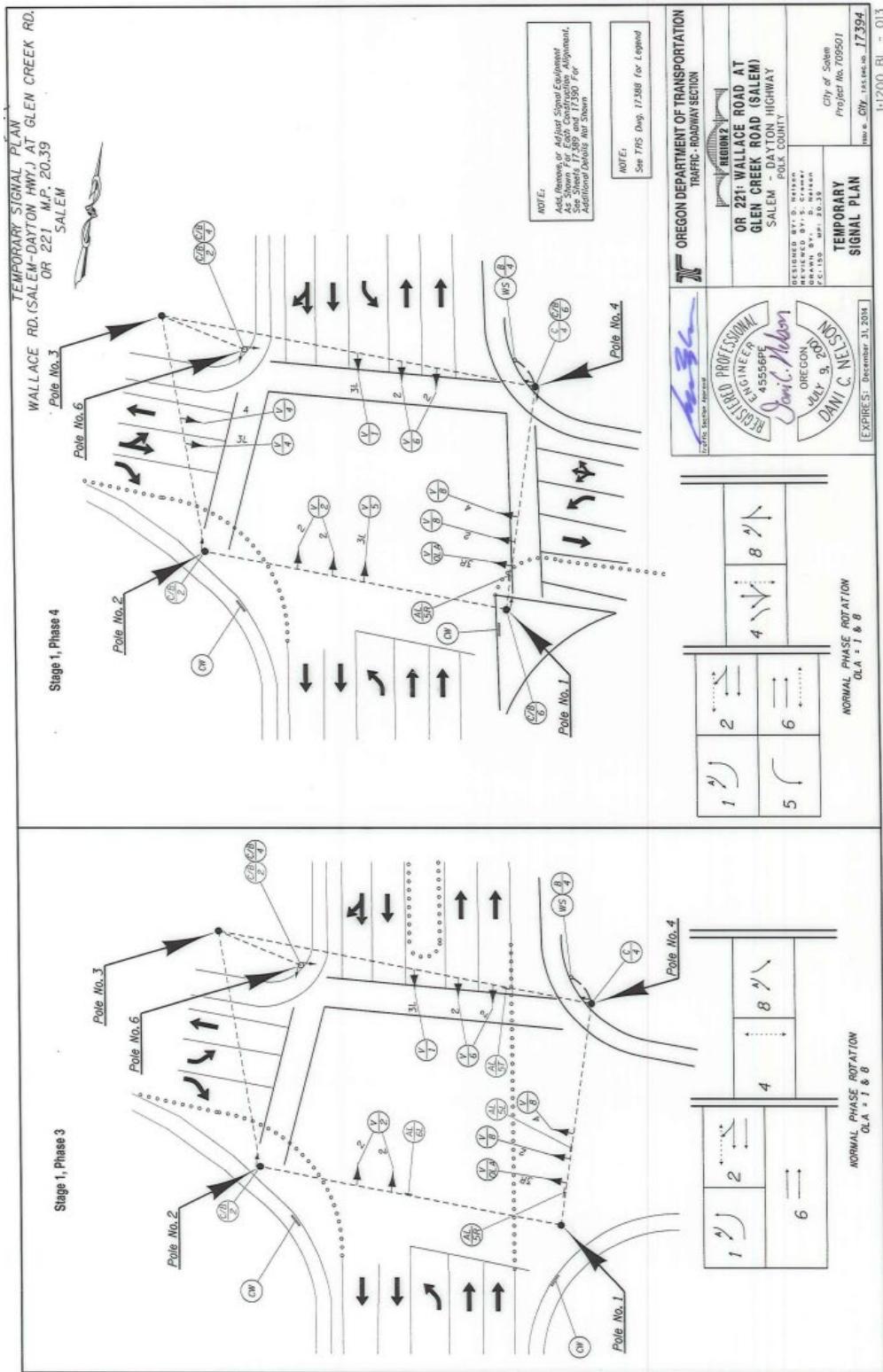
Figure 21-62 | Temporary Signal Plan Sheet Example 2 (Final Stage of Example 1 – Only Show Modifications)



Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-63 | Temporary Signal Plan Sheet Example 3 (Multiple Stages – Only Show Modifications)



21.10.10 Flashing Beacon Plan

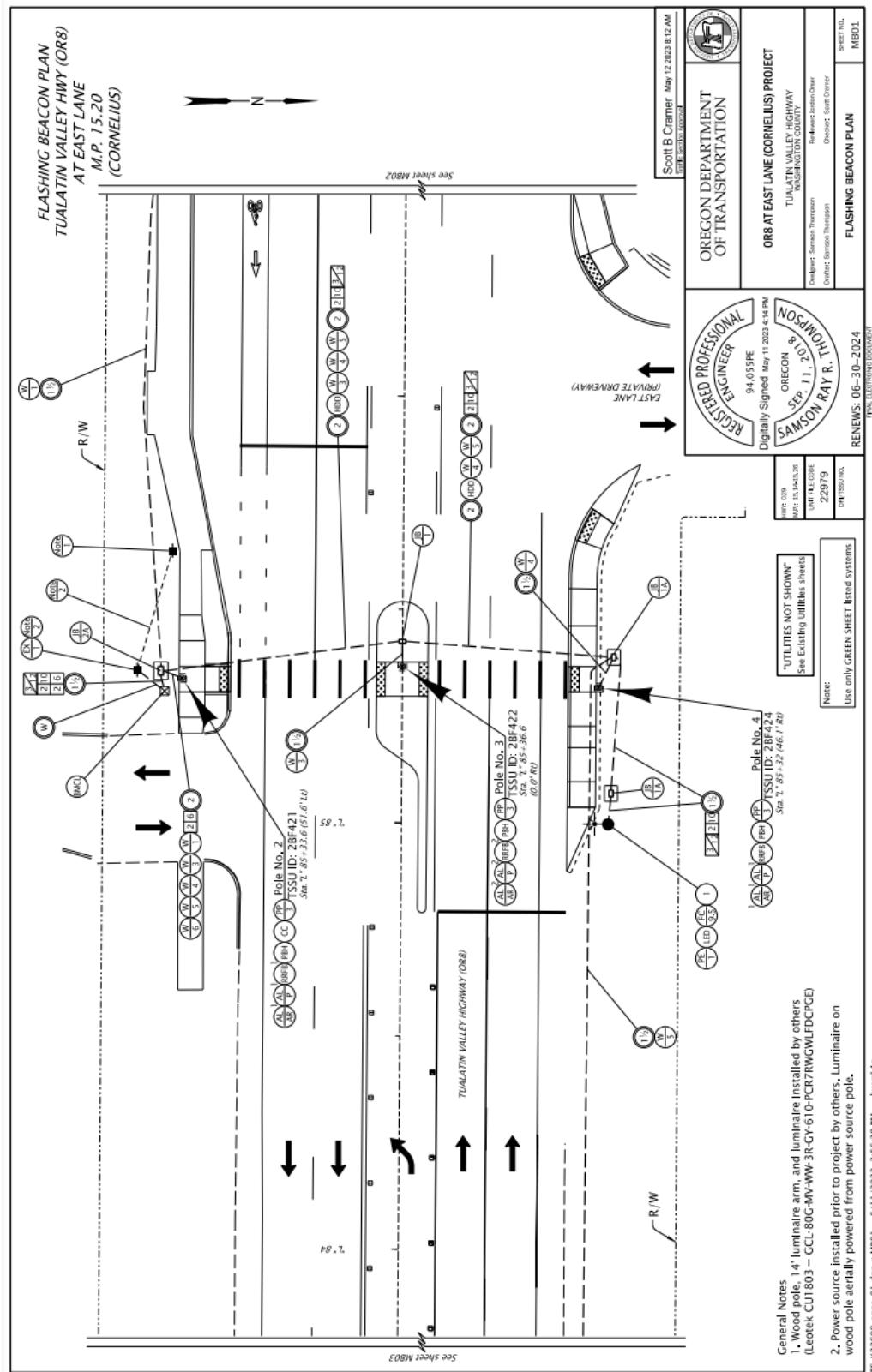
The flashing beacon plan sheet shall include the following as applicable for the scope of work (see Figure 21-64 through Figure 21-67 for good examples):

- Proposed/new feature symbology:
 - Power source (existing or new)
 - Controller cabinet
 - Service cabinet
 - Signs
 - Vehicle signal heads/flashing beacons
 - Pushbuttons
 - Junction boxes, conduit, and wires/cables for the signal system
 - Non-invasive detection equipment and wires/cables (as per chapter 6). Detection zones are NOT shown on plan sheets (shown on cabinet print as per chapter 20).
- Proper detailing: bubble note(s) with leader lines to each feature that will be installed as part of the 00990 flashing beacon bid item (See chapter 19).
- Use appropriate reference bubble notes:
 - The hex star bubble note references signing plans for any signs not paid for under the 00990 flashing beacon bid item.

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

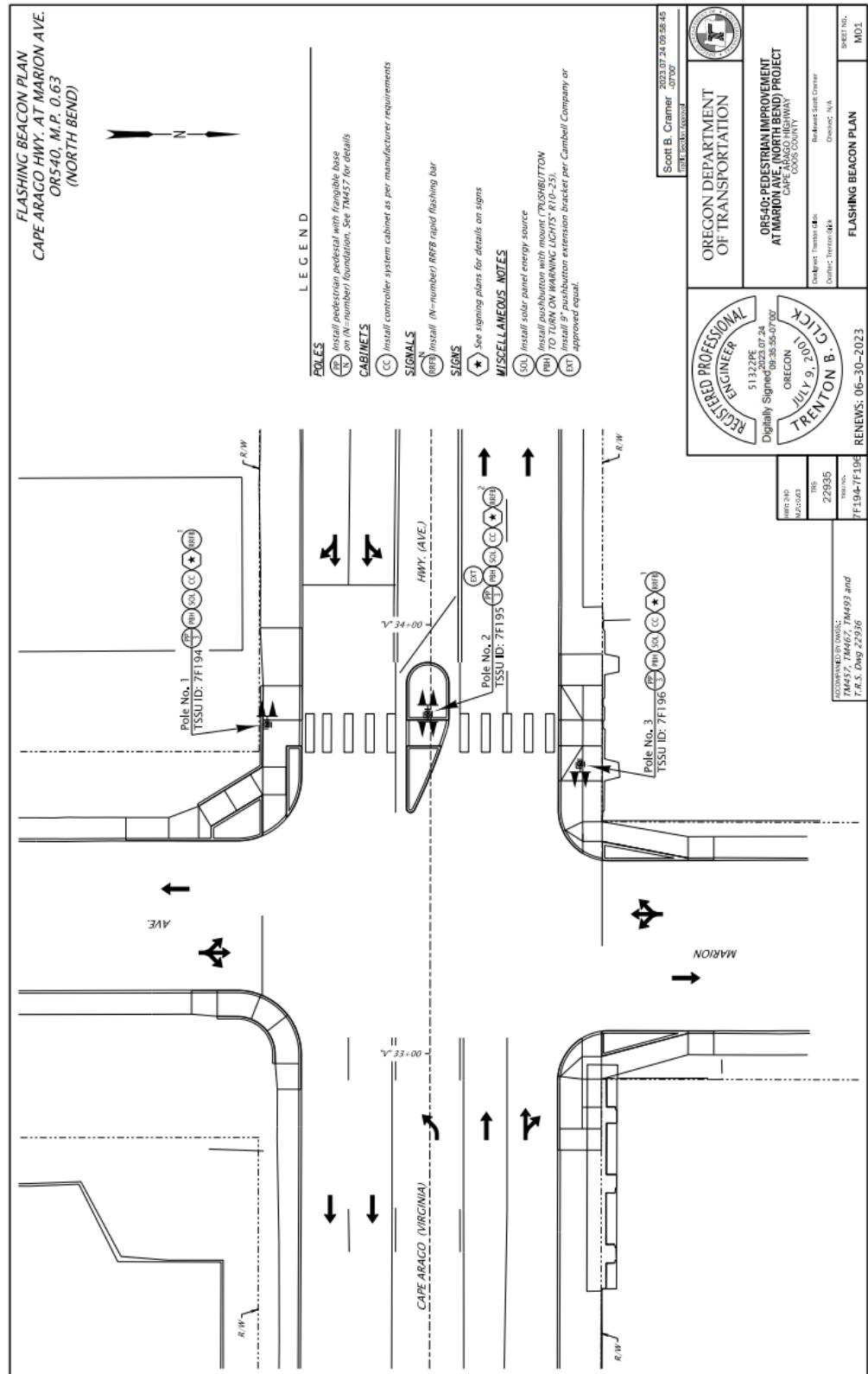
Figure 21-64 | Flashing Beacon Plan Sheet Example 1 (RRFB Hardwire)



Traffic Engineering Section

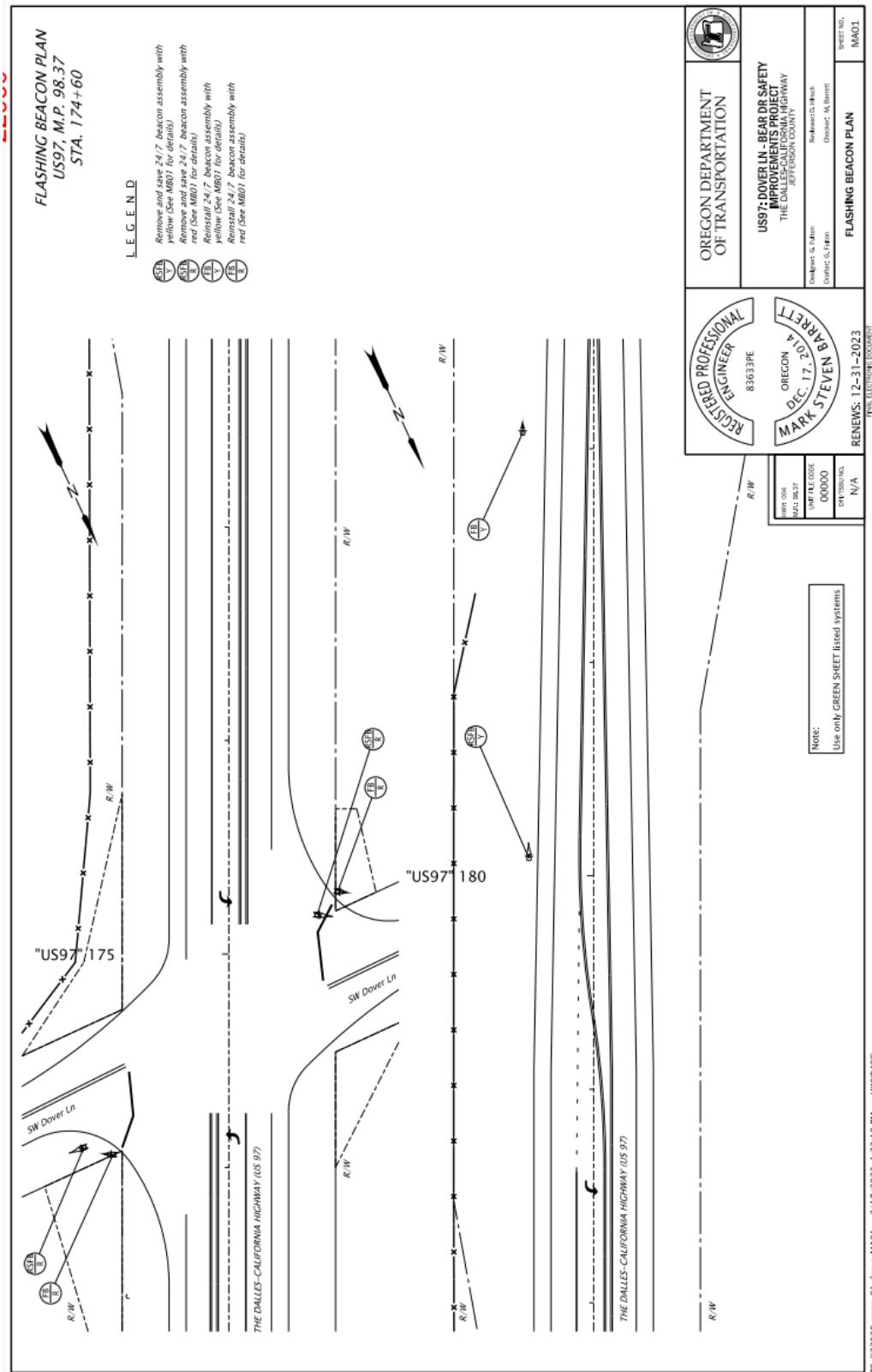
Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-65 | Flashing Beacon Plan Sheet Example 2 (RRFB Solar)



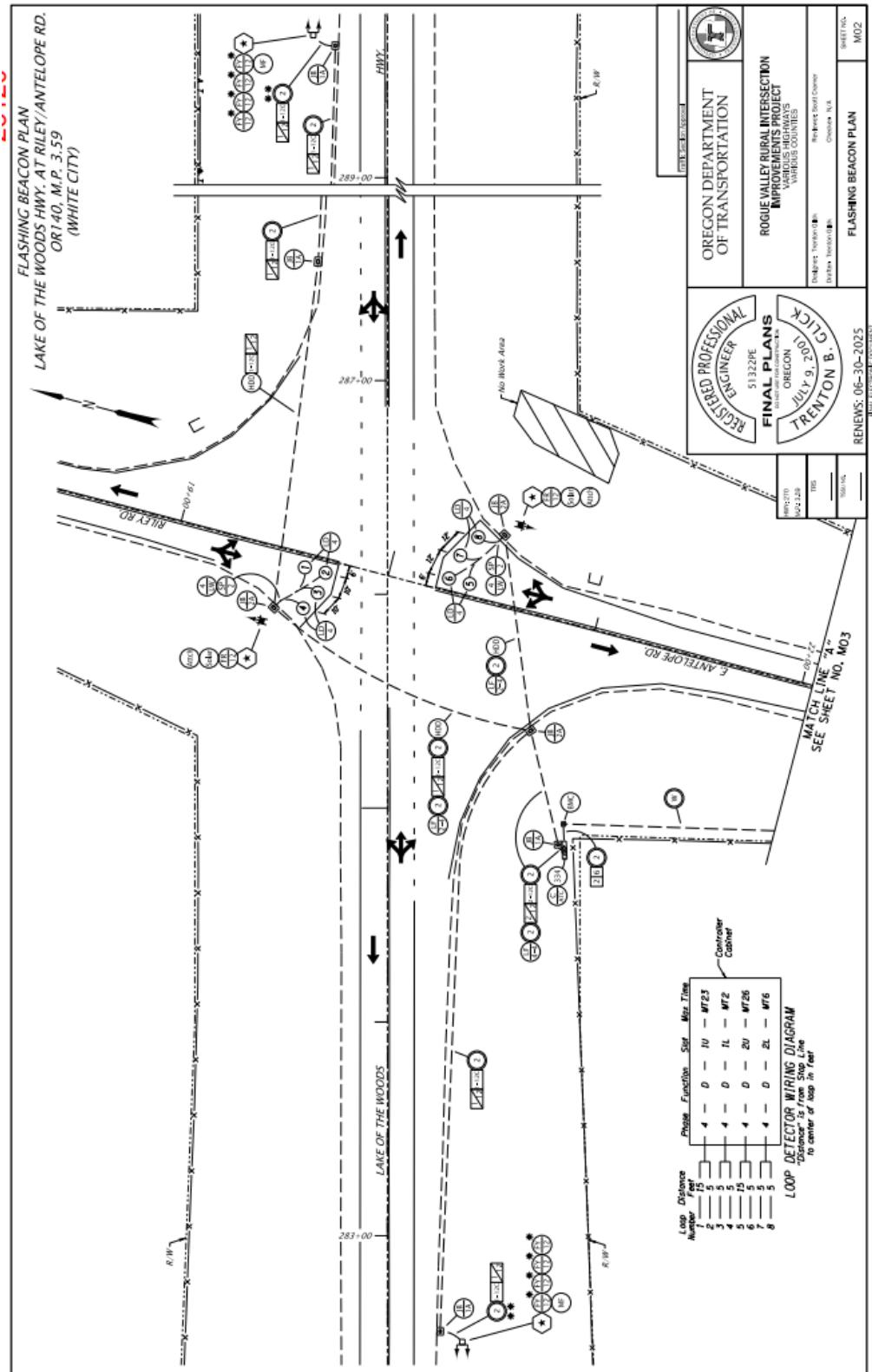
Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-66 | Flashing Beacon Plan Sheet Example 2 (24/7 Solar Flashing Beacons)



Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-67 | Flashing Beacon Plan Sheet Example 3 (TRAWS)



21.10.11 Ramp Meter Plan

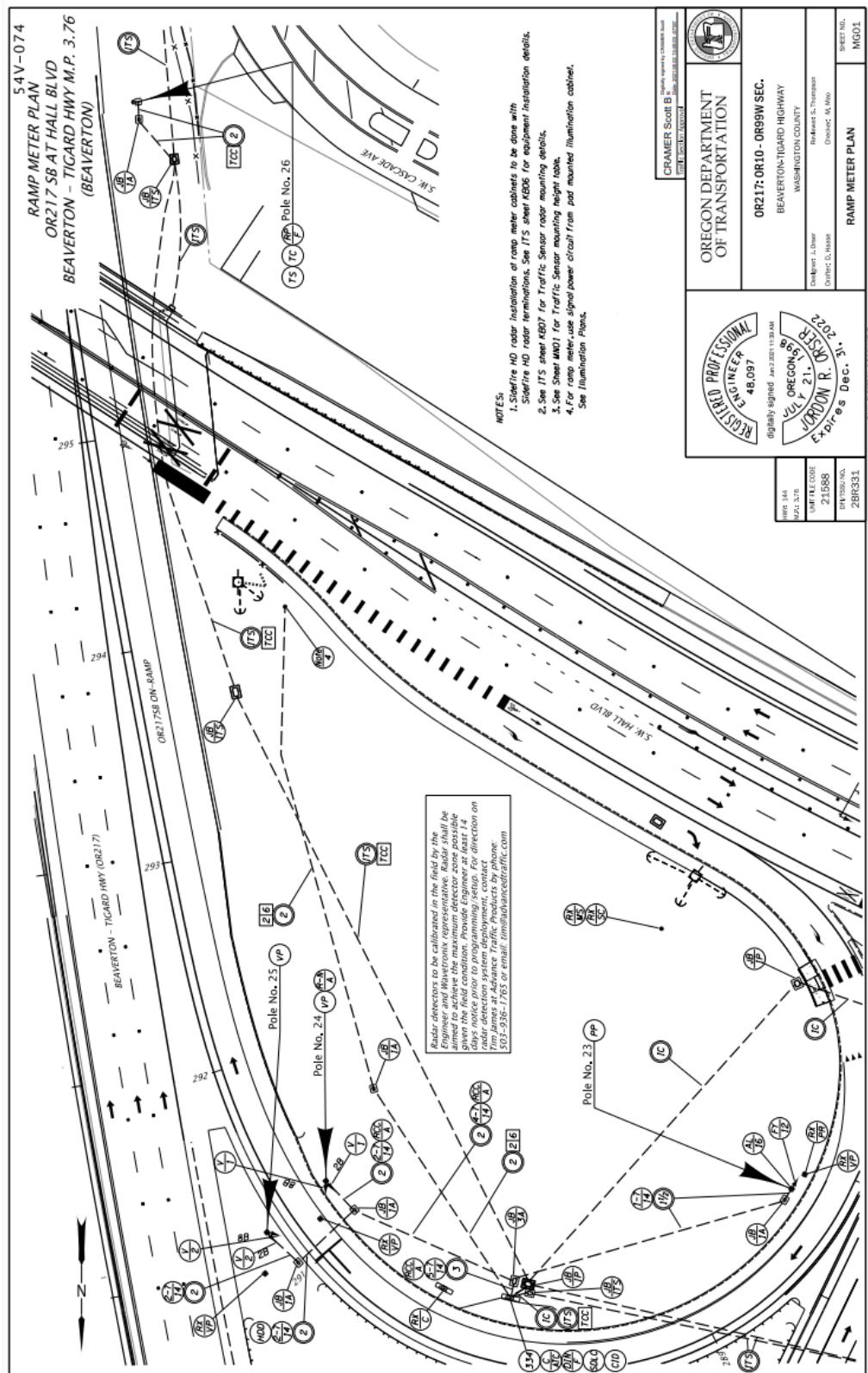
The ramp meter plan sheet shall include the following as applicable for scope of work (see Figure 21-68 for a good example):

- Proposed/new feature symbology:
 - Power source (existing or new)
 - Controller cabinet
 - Service cabinet
 - Ramp meter signs with flashing beacons as per chapter 13
 - Ramp meter assemblies or mast arm pole installation
 - Junction boxes, conduit, and wire/cables
 - Non-invasive detection equipment and wires/cables (as per chapter 6). Detection zones are NOT shown on plan sheets (shown on cabinet print as per chapter 20).
- Proper detailing: bubble note(s) with leader lines to each feature that will be installed as part of the 00990 ramp meter signal bid item (See chapter 19).
- Use appropriate reference bubble notes:
 - The hex star bubble note references signing plans for any signs not paid for under the 00990 ramp meter signal bid item. See chapter 13.

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-68 | Ramp Meter Plan Sheet Example



21.11 MicroStation File Archiving

When using ProjectWise, all MicroStation files will be automatically archived. Follow the guidance contained in the [ProjectWise Standards Folder](#) for properly using ProjectWise system.

For projects that aren't required to use ProjectWise (e.g., developer project by permit, local agency project, etc.) archive all MicroStation files using the [ODOT EAST engineering archive website instructions](#).

ODOT employees can search either ProjectWise (for newer projects) or the [ODOT EAST engineering archive](#) (for older projects or projects not required to use ProjectWise). Non-ODOT employees can request help in searching either location by contacting the ODOT EAST team via e-mail: odot.east@odot.oregon.gov

21.12 Plan Sheet (PDF) Archiving

Contract plans (PDFs) that are submitted to the traffic engineering section for drawing numbers or final approval (see chapter 2) are archived by the traffic engineering section in FileNet. Multiple versions of same drawing number may be available, with the most current version noted. See Figure 21-69 for example of how to access the versions.

Revised plans (see section 21.13) require a traffic engineering section review and approval block signature. When that PDF is submitted to traffic engineering section, it will be archived in FileNet.

As-construct plans (see section 21.14) do not require a traffic engineering section review or any digital signatures, but the PDF should be submitted to traffic engineering section to allow for archiving in FileNet.

Figure 21-69 | FileNet Versions Available

The screenshot shows a FileNet search results page and a detailed view of a document's versions. The search results page at the top shows a table with columns: Drawing Number, Discipline, Drawing Type, Project Title, Work Area, Route Number, City, County, Drawing Year, Highway Number - Name, and Milepoints. One row is highlighted for '20472' with a red arrow pointing to the Discipline column. A red circle highlights the 'Current Version' column in the detailed view below, which shows four versions of the document. The 'Current Version' is marked with a 'Y'.

Drawing Number	Discipline	Drawing Type	Project Title	Work Area	Route Number	City	County	Drawing Year	Highway Number - Name	Milepoints
20472	Signal	RAILROAD PREEMPTION PLAN	SW Eggert Way to SW Alexander Street	Tualatin Valley Hwy at 209th Ave	OR 8	HILLSBORO	WASHINGTON	2019	029 - TUALATIN VALLEY	7.8 - 7.8

Document Versions					
Version Number	File Name	Size	File Type	Date Created	Current Version
4	20472.pdf	1.94 MiB	application/pdf	06-15-2020	Y
3	20472.pdf	126.55 KiB	application/pdf	11-14-2019	N
2	20472.pdf	178.74 KiB	application/pdf	11-07-2019	N
1	Not Available	0 B	Not Available	11-04-2019	N

21.13 Revised Plans

Plans may need to be revised during the bidding phase. The revision process described in this section is typically only done during this time frame. Plans that are in the preliminary, advanced, or final plans stage do NOT follow the revision process (no need to document or draw attention to revisions that are made in these stages).

The plan revision process may also be used during the construction phase as deemed necessary to document and provide installation information for contract change orders (CCOs). Work with the resident engineer's office to determine if the revision process is necessary or if the CCO form with the changes to the plan sheet(s) documented at the end of the project in the as constructed plans will be adequate.

The revision process includes the following (see Figure 21-70 for an example):

- Add numbered revision triangle(s) for all revised content, near the actual revision (typically at the applicable bubble note(s)).
- Place a revision block just above title block and fill out the date, revision summary, and revision maker initials for each revision triangle used. If the revision block cannot fit above the title block, it should be placed as close as possible to the title block.
- Submit the sealed, revised plan to traffic engineering section for review and approval.
- **The use of “cloud” lines around the revised work are no longer used.**

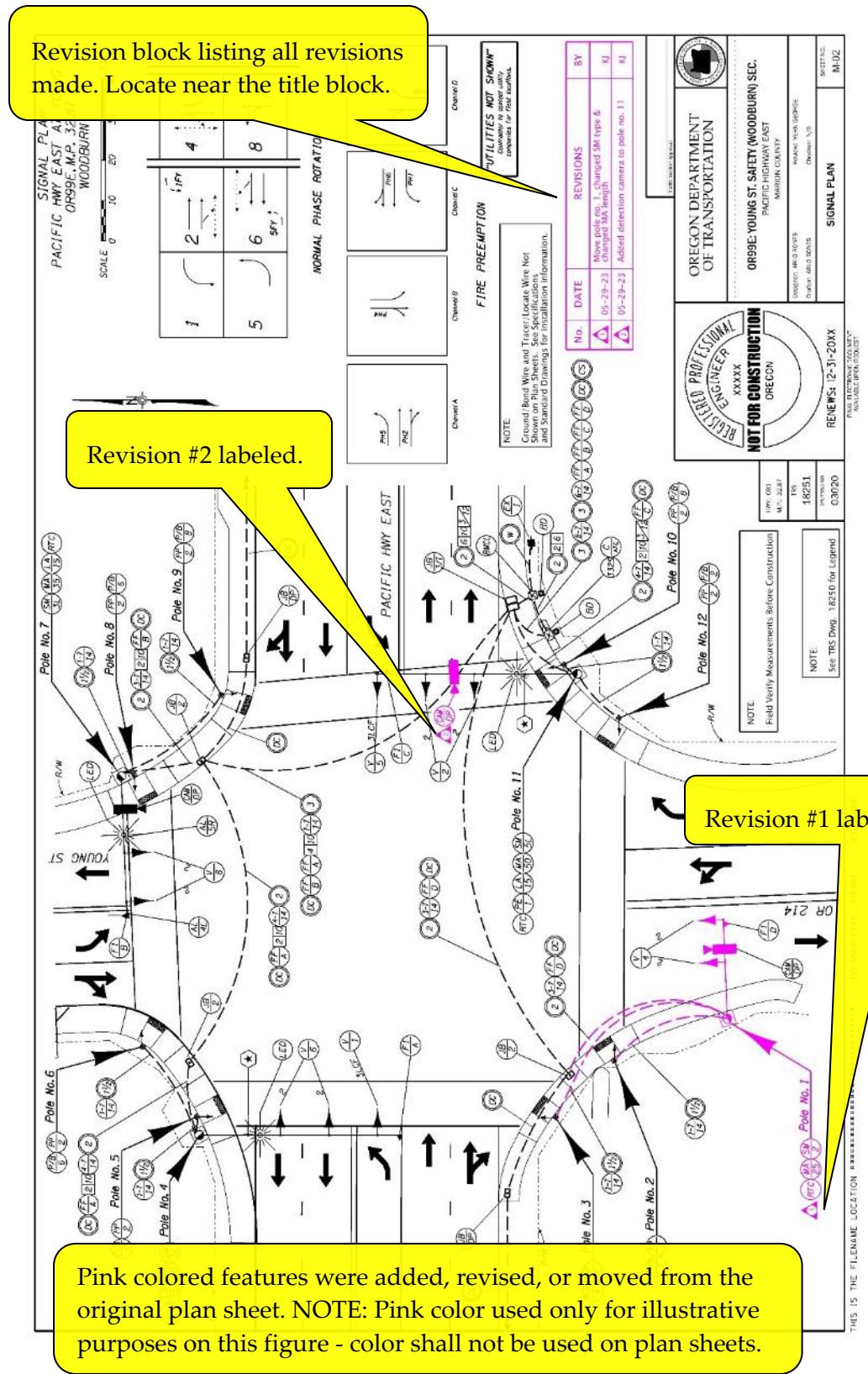
Revised plan sheet specific MicroStation workflow items to aid in drafting:

- Sheet Tools → Revision Block

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-70 | Revision Process (During Bidding/Construction Only)



21.14 As-Constructed Plans

The purpose of producing as-constructed plans is to accurately reflect the actual project as it was constructed in the field. As-constructed plans are important to agency electricians for maintenance and also to signal designers for use in future design work.

Red-lined plans are made by the contractor and submitted to the resident engineer's office (see specification 00960.71). These plans are reviewed by the resident engineer's office and then follow the process described in [technical bulletin RD22-01\(B\)](#). The signal designer will have an opportunity to review these as constructed plans before they are archived. For projects produced by a consultant, developer, or local agency, an electronic copy of the as-constructed traffic signal plans should be submitted to the state traffic signal engineer within 60 working days after completion of the contract work.

While not required, it is preferred that the signal designer or drafter update the MicroStation file(s) and produce a new, clean electronic version of the hard copy red-line mark-ups to archive instead of the hand drawn red-lines. Typically, the changes are minimal from the original plan sheet, so creating a new as-constructed plan sheet is not excessively time consuming.

As-constructed plans shall include (see Figure 21-71 for an example):

- An “original signed by” stamp on the engineer seal
- An “as const plans mm/yy” stamp with the date filled out placed on the traffic section approval box.
- Incorporating all red-lines into the drawing and deleting any original plan sheet information that conflicts with the red-lines (e.g., no need to highlight the change(s) from the original plans as per section 21.13).

As-constructed plan sheet specific MicroStation workflow items to aid in drafting:

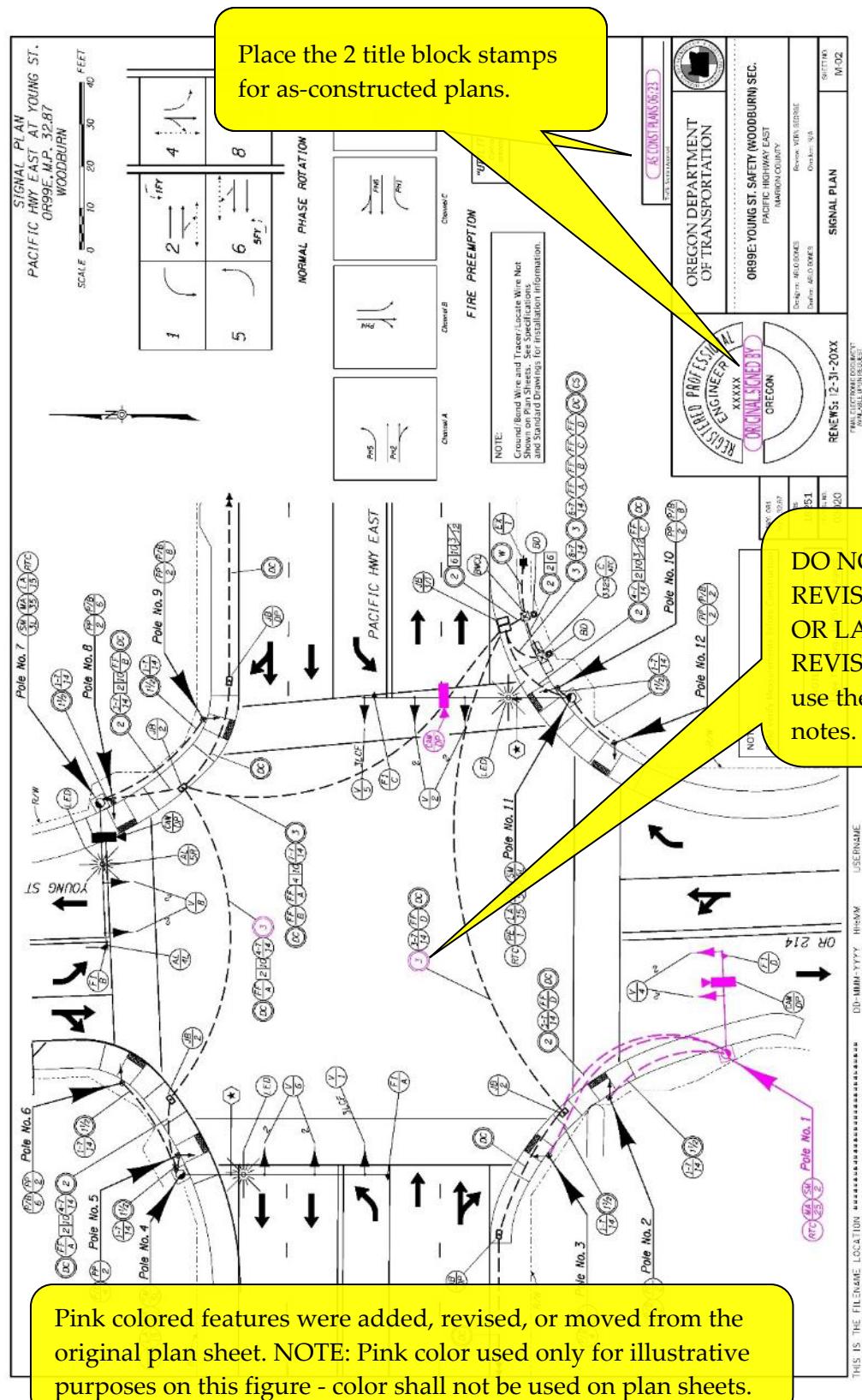
- Sheet Tools → Stamps

The electronic as-constructed plan sheets for all traffic signal work should be sent to the traffic engineering section (in pdf form) where they will be archived in FileNet.

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-71 | Completed As-Constructed Plans Example



21.15 Final Design/Drafting Checklist

Before submitting plans for design review/approval (see chapter 2), use the following checklist.

Signal Design/Drafting Checklist		For Information See:
APPROVALS		
1	RTE/STE Operational approval(s) complete & plans match PSOD (phasing, crosswalk closures, fire preemption, etc.)	Section 3.1 and 5.7
2	Loop detection is approved by the state traffic signal engineer and correctly detailed	Section 6.1.1
3	LPIF documentation complete	Section 19.4
COORDINATION WITH OTHERS		
4	Coordination with ITS unit on interconnect/communication plan is complete	Chapter 7
5	Coordination with workzone designer is complete (temporary features, staggering a signal turn-on to avoid obstructing the view of existing signal indications, etc.)	Chapter 11
6	Coordination with sign designer is complete (custom signs, determining bid items)	Section 5.3 & 5.3.2
7	Coordination with geotech designer is complete (pole foundations)	Section 9.3.4
8	Coordination with roadway designer and striping designer is complete (ADA ramps, turning templates, accesses, lane shifts, raised medians, stop bars, crosswalks, crosswalk closures, walkways for controller cabinet and BMCL as per TM482, etc.)	Section 5.1, 5.4, & 5.10.1
9	Coordination with illumination designer is complete	Section 5.6
10	Coordination with region utility specialist and utility is complete	Section 5.5.4
11	Coordination with region mobility liaison is complete (overhead vertical clearance)	Section 5.5.2
12	Coordination with region electrical crew maintaining the installation is complete	Section 2.9
13	Coordination with region signal timer is complete (detection zone needs)	Chapter 6 & Chapter 20
BASIC DRAFTING – LAYOUT AND INFORMATION		
14	M series plan sheets in correct order	Section 21.7.2
15	All sheets are clear and easy to read (no inappropriate overlapping of features/bubble notes, unnecessary layers turned off, clutter minimized, etc.)	Chapter 21.2
16	All sheets meet basic drafting layout and info requirements (sheet scale, upper right title info, sheet title, north arrow, stationing/scale bar, lane use arrows, street names, striping, right-of-way, etc.)	Multiple subsections in Section 21.7
17	Current, standard symbology and bubble notes as per MicroStation workflow are used. Customization is limited to only what is necessary	Sections 21.4, 21.8.1, & 21.9
18	All bubble note variables have been filled out correctly on the plan sheets	Section 21.9.1
19	Reference bubble notes (EC, DC, IC, JB/SP, JB/DP, JB/IP, C, etc.) and cross reference text (see sheet MXX for legend) are used when necessary	Sections 21.3, 21.7.13 & 21.9.4
20	All title block information is complete	Section 21.7.3
21	List of applicable standard drawings is complete ("accompanied by dwgs. box")	Section 21.7.5
22	All digital signature blocks for EOR and traffic engineering section approval are complete	Section 21.7.4
23	Specifications, bid items, and cost estimate complete	Chapter 19
PLAN SHEET AND DESIGN ELEMENT SPECIFIC DRAFTING		
24	Statewide goals, priority and implementation have been incorporated into project	Section 4.1.2
25	All bubble notes used in the plan sheets are listed in the legend	Section 21.10.1
26	All Phase rotation diagrams and fire preemption diagrams complete	Sections 3.3 & 3.4
27	All poles and pedestals numbered	Section 21.8.3
28	All illumination equipment location and detailing correct	Section 5.6
29	All signal head type, phase, location, and detailing correct	Sections 5.2, 21.9.1 & 21.9.2
30	All pedestrian signal heads and pushbutton location, phase and detailing correct	Section 5.4*
31	All sign size, message, location, and detailing correct	Section 5.3
32	All fire preemption equipment location and detailing correct	Section 5.7
33	All non-invasive detection equipment location, type, mount and detailing is correct	Chapter 6
34	Pole entrance chart complete	Section 21.10.8 & Chapter 9
35	All service cabinet locations and detailing correct	Sections 5.8 & 5.11
36	All controller cabinet location, orientation, and detailing correct	Section 5.10
37	All Cabinet prints are complete (detection zones shown, etc.)	Chapter 20
38	All Junction box location, size and detailing correct	Section 5.12*
39	All Conduit routing, size, future/spare, and detailing is correct	Sections 5.13* & 21.8.2
40	All wire/cable number, type, gauge and detailing is correct for ALL equipment	Section 5.14*
41	Existing utility plan sheet complete	Section 21.10.7
42	Railroad preemption plan sheet complete	Section 21.10.6 & Chapter 16
43	All standard details necessary for project are incorporated into a DETAIL sheet	Section 9.5

*Also see application specific sections of the manual such as fire preemption, railroad, PTR signs, RRFB, etc.

21.16 Standard Bubble Note List

This section contains all the standard bubble notes in the MicroStation workspace. See It is current at the date this manual is web posted in January, however, changes to the MicroStation workspace can occur at any time during the year as necessary. Therefore, the MicroStation workspace is the official location for the most up-to-date content. See Figure 21-72 through Figure 21-87.

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-72 | Standard Bubble Notes - Controllers

CATEGORY	CONTROLLERS
INSTALL NOTES	<p> <i>Install a model 332S cabinet & control equipment with riser frame, orient louvered door as shown</i></p> <p> <i>Install a model 332 cabinet & control equipment with riser frame, orient louvered door as shown</i></p> <p> <i>Install model ATC controller (Agency furnished & installed)</i></p> <p> <i>Install a model 334 cabinet & control equipment with riser frame, as shown (ramp meter)</i></p> <p> <i>Install controller cabinet (see signal plan)</i></p> <p> <i>Install solid and flashing from yellow arrow section of type 3L signal head for phase (Ph = phase) (Agency installed)</i></p> <p> <i>Install synchronous data link control (SDLC) connection (Agency installed)</i></p> <p> <i>Install GPS time sync. module</i></p> <p> <i>Install new output file (Agency furnished & installed)</i></p> <p> <i>Install new auxiliary file (Agency furnished & installed)</i></p> <p> <i>Install communications bracket for copper. Use only green sheet listed systems.</i></p> <p> <i>Install communications bracket for fiber. Use only green sheet listed systems.</i></p> <p> <i>Install (N=number) loop detector amplifier(s) in existing controller cabinet (Agency installed)</i></p> <p> <i>Install (N=number) load switch(s) in existing controller cabinet (Agency installed)</i></p> <p> <i>Install bolted riser frame under controller cabinet</i></p> <p> <i>Install temporary (332) traffic signal controller cabinet base</i></p>
RETAIN & PROTECT NOTES (EX)	<p> <i>Retain and protect existing model ___ controller and model ___ cabinet</i></p>
REMOVE NOTES (RX)	<p> <i>Remove existing controller cabinet & equipment</i></p> <p> <i>Remove existing signal cabinet (see removal plan)</i></p> <p> <i>Remove existing output file (completed by Agency)</i></p>
REMOVE & RELOCATE NOTES (RR)	<p> <i>Remove and relocate existing controller</i></p>
REINSTALL NOTES (RI)	<p> <i>Reinstall existing controller</i></p>
ABANDON NOTES (AX)	<i>NONE – NOT APPLICABLE</i>

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-73 | Standard Bubble Notes – Fiber Optic

CATEGORY	FIBER OPTIC
INSTALL NOTES	 <i>Install fiber optic cable with (N=number) fiber strands</i>  <i>Install fiber optic connection patch panel with SC connectors</i>  <i>Install coil (L=length) feet of each fiber optic cable</i>
RETAIN & PROTECT NOTES (EX)	
REMOVE NOTES (RX)	
REMOVE & RELOCATE NOTES (RR)	<i>NONE</i>
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-74 | Standard Bubble Notes – Poles

CATEGORY	POLES
INSTALL NOTES	 <i>Install (T=type) standard traffic signal mast arm pole (see pole entrance chart)</i>  <i>Install special (X = non-standard) traffic signal mast arm pole (see pole entrance chart)</i>  <i>Install (L=length) foot traffic signal mast arm</i>  <i>Install traffic signal mast arm on day of signal turn on</i>  <i>Install (L=length) foot luminaire arm</i>  <i>Install special (X=non-standard) treated wood pole (see pole entrance chart)</i>  <i>Install luminaire pole (see metal light pole table)</i>  <i>Install metal pole barrier (see sheet no. ____)</i>  <i>Install back guy and anchor(s)</i>  <i>Install wood pedestrian post</i>  <i>Install pedestal with frangible base on number (N=number) foundation</i>  <i>Install pedestal with frangible base on number (N=number) foundation with sloped concrete slab (see sheet no. ____)</i>
RETAIN & PROTECT NOTES (EX)	 <i>Retain and protect existing power pole (power source)</i>  <i>Retain and protect existing utility pole</i>  <i>Retain and protect existing strain pole</i>  <i>Retain and protect existing traffic signal mast arm pole</i>  <i>Retain and protect existing pedestrian signal pedestal</i>  <i>Retain and protect existing vehicle signal pedestal</i>  <i>Retain and protect existing luminaire pole</i>  <i>Retain and protect existing wood pole</i>
REMOVE NOTES (RX)	 <i>Remove existing strain pole & terminal cabinet</i>  <i>Remove existing traffic signal mast arm pole & terminal cabinet</i>  <i>Remove existing pedestrian signal pedestal</i>  <i>Remove existing vehicle signal pedestal</i>  <i>Remove existing luminaire pole</i>  <i>Remove existing wood pole</i>  <i>Remove existing signal pole (see removal plan)</i>
REMOVE & RELOCATE NOTES (RR)	 <i>Remove and relocate existing pedestrian signal pedestal</i>
REINSTALL NOTES (RI)	 <i>Reinstall existing pedestrian signal pedestal</i>
ABANDON NOTES (AX)	<i>NONE – NOT APPLICABLE</i>

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-75 | Standard Bubble Notes – RRFB

CATEGORY	RRFB
INSTALL NOTES	 <i>Install (N=number) aluminum (36"x36") pedestrian crossing sign (W11-2) ASTM type IX sheeting</i>  <i>Install (N=number) aluminum (36"x36") trail crossing sign (W11-15) ASTM type IX sheeting</i>  <i>Install (N=number) aluminum (36"x36") school crossing sign (S1-1) ASTM type IX sheeting</i>  <i>Install (N=number) aluminum (18x30") diagonal downward pointing arrow plaque (W16-7P) ASTM type IX sheeting</i>  <i>Install (N=number) aluminum (18x30") "AHEAD" plaque (W16-9P) ASTM type IX sheeting</i>  <i>Install actuated beacon system controller cabinet</i>  <i>Install pushbutton with mount & instruction sign R10-25</i>  <i>Install audible pushbutton with mount & instruction sign R10-25</i>  <i>Install audible pushbutton with bidirectional arrow with mount & instruction sign R10-25</i>  <i>Install (S=size) inch long pushbutton adaptor/extension</i>  <i>Install 90 degree extension bracket adaptor</i>  <i>Install (N=number) RRFB rapid flashing bar</i>  <i>Install solar panel energy source</i>
RETAIN & PROTECT NOTES (EX)	
REMOVE NOTES (RX)	
REMOVE & RELOCATE NOTES (RR)	NONE
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-76 | Standard Bubble Notes – Beacons

CATEGORY	BEACONS
INSTALL NOTES	 <i>Install 24/7 flashing beacon assembly for obstruction (see sheet no. ____)</i>  <i>Install 24/7 flashing beacon assembly with yellow & speed feedback (see sheet no. ____)</i>  <i>Install 24/7 beacon assembly with yellow (see sheet no. ____)</i>  <i>Install 24/7 beacon assembly with red (see sheet no. ____)</i>  <i>Install actuated flashing beacon assembly with ped/bike (see sheet no. ____)</i>  <i>Install actuated flashing beacon assembly with EV (see sheet no. ____)</i>  <i>Install actuated flashing beacon assembly for "BE PREPARED TO STOP" sign (see sheet no. ____)</i>  <i>Install actuated flashing beacon assembly w/school & (N=number) backside vehicle signal (see sheet no. ____)</i>  <i>Install actuated flashing beacon assembly w/school, speed feedback, & (N=number) backside vehicle signal (see sheet no. ____)</i>  <i>Install unintegrated speed feedback assembly (see sheet no. ____)</i>
RETAIN & PROTECT NOTES (EX)	
REMOVE NOTES (RX)	
REMOVE & RELOCATE NOTES (RR)	NONE
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-77 | Standard Bubble Notes – Signals

CATEGORY	SIGNALS
INSTALL NOTES	<p> <i>Install phase (Ph=phase) vehicle signal with 2" fluorescent yellow reflective sheeting on backboard</i></p> <p> <i>Install phase (Ph=phase) polycarbonate vehicle signal with 2" fluorescent yellow reflective sheeting on backboard</i></p> <p> <i>Install geometrically programmed louvers. Pelco model GL-1010 with ___ degree view cut-off or approved equal</i></p> <p> <i>Install 12" diameter, 18" deep, 45 degree angle visor</i></p> <p> <i>Install tattletale (white) LED light wired directly to the red vehicle signal indication. Coordinate aiming of light with Engineer.</i></p> <p> <i>Install 12" diameter flashing red beacon</i></p> <p> <i>Install 12" diameter flashing yellow beacon</i></p> <p> <i>Install phase (Ph=phase) audible pedestrian pushbutton with mount & instruction sign R10-3</i></p> <p> <i>Install phase (Ph=phase) pushbutton with mount & instruction sign R10-3</i></p> <p> <i>Install phase (Ph=phase) pedestrian signal with pedestrian signal mount and pushbutton with mount & instruction sign R10-3</i></p> <p> <i>Install phase (Ph=phase) pedestrian signal with pedestrian signal mount and audible pushbutton with mount & instruction sign R10-3</i></p> <p> <i>Install phase (Ph=phase) pedestrian signal with pedestrian signal mount</i></p> <p> <i>Install (S=size) inch long pushbutton adaptor/extension</i></p> <p> <i>Install 90 degree extension bracket adaptor</i></p> <p> <i>Install phase (Ph=phase) audible pushbutton with mount & instruction sign R10-3 with bidirectional arrow</i></p> <p> <i>Install phase (Ph=phase) pushbutton with mount & instruction sign R10-3 with bidirectional arrow</i></p> <p> <i>Install phase (Ph=phase) pedestrian signal with pedestrian signal mount and pushbutton with mount & instruction sign R10-3 with bidirectional arrow</i></p> <p> <i>Install phase (Ph=phase) pedestrian signal with pedestrian signal mount and audible pushbutton with mount & instruction sign R10-3 with bidirectional arrow</i></p>
RETAIN & PROTECT NOTES (EX)	<p> <i>Retain and protect existing phase (Ph=phase) vehicle signal</i></p> <p> <i>Retain and protect existing pedestrian signal, pushbutton & instruction sign</i></p> <p> <i>Retain and protect existing pedestrian pushbutton & instruction sign</i></p> <p> <i>Retain and protect existing pedestrian signal</i></p>
REMOVE NOTES (RX)	<p> <i>Remove existing vehicle signal</i></p> <p> <i>Remove existing pedestrian signal</i></p> <p> <i>Remove existing pedestrian signal, pushbutton & instruction sign</i></p> <p> <i>Remove existing pedestrian pushbutton & instruction sign</i></p>
REMOVE & RELOCATE NOTES (RR)	<p> <i>Remove and relocate existing vehicle signal</i></p>
REINSTALL NOTES (RI)	<p> <i>Reinstall existing phase (Ph=phase) vehicle signal</i></p>
ABANDON NOTES (AX)	<i>NONE – NOT APPLICABLE</i>

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-78 | Standard Bubble Notes – Cabinets

CATEGORY	CABINETS
INSTALL NOTES	<p> <i>Install terminal cabinet</i></p> <p> <i>Install recessed terminal cabinet</i></p> <p> <i>Install base mounted service cabinet, 120/240 volt metered for signal system</i></p> <p> <i>Install base mounted service cabinet, 120/240 volt metered for signal & illumination system</i></p> <p> <i>Install base mounted service cabinet, 120/240 volt metered for signal & flashing beacon system</i></p> <p> <i>Install base mounted service cabinet, 120/240 volt metered for signal, flashing beacon, & illumination system</i></p> <p> <i>Install service cabinet, 120/240 volt for signal system</i></p> <p> <i>Install service cabinet, 120/240 volt for signal & illumination system</i></p> <p> <i>Install 120/240 volt meter base</i></p> <p> <i>Install meter socket jumper cover required for flat rate billing (factory installed)</i></p>
RETAIN & PROTECT NOTES (EX)	<p> <i>Retain and protect existing terminal cabinet</i></p> <p> <i>Retain and protect existing recessed terminal cabinet</i></p> <p> <i>Retain and protect existing service cabinet</i></p> <p> <i>Retain and protect existing meter base</i></p>
REMOVE NOTES (RX)	<p> <i>Remove existing service cabinet</i></p> <p> <i>Remove existing meter base</i></p>
REMOVE & RELOCATE NOTES (RR)	
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-79 | Standard Bubble Notes – Signs (Aluminum)

CATEGORY	S I G N S (aluminium)
INSTALL NOTES	<p> <i>Install aluminum (30"x36") "ONE WAY" left arrow sign (R6-2L) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") "ONE WAY" right arrow sign (R6-2R) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") "NO TURN ON RED" sign (R10-11a) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") "U TURN PERMITTED" sign (OR3-12) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") left and right arrow sign (OR3-5TD) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") left and through arrow sign (R3-6L) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") through and right arrow sign (R3-6R) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") left, through, and right arrow sign (OR3-5TT) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") left arrow "ONLY" sign (R3-5L) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") right arrow "ONLY" sign (R3-5R) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") through arrow "ONLY" sign (R3-5a) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (36"x36") "NO TURNS" sign (R3-3) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (36"x36") no left turn symbol sign (R3-2) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (36"x36") no right turn symbol sign (R3-1) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (36"x36") "DO NOT ENTER" sign (R5-1) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (24"x30") "ONE VEHICLE PER GREEN" sign (R10-28) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (24"x12") "ONE VEHICLE PER GREEN" sign (OR20-1) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (24"x36") "STOP HERE ON RED" sign (R10-6) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x36") "LEFT TURN YIELD ON GREEN" ball symbol sign (R10-12) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (30"x30") "TURNING VEHICLES STOP FOR PEDS" sign (R10-15a) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (36"x36") "RAMP METERED WHEN FLASHING" sign (W3-8) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (24"x30") "FORM 2 LANES WHEN METERED" sign (OR20-5) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (36"x36") "BE PREPARED TO STOP" sign (W3-4) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (24"x18") "WHEN FLASHING" sign (W16-13P) ASTM type IX sheeting</i></p> <p> <i>Install aluminum (24"x12") "EXCEPT BUSES" sign (R3-7a) ASTM type IX sheeting</i></p>
RETAIN & PROTECT NOTES (EX)	 <i>Retain and protect existing aluminum sign and mount</i>
REMOVE NOTES (RX)	 <i>Remove existing aluminum sign and mount</i>
REMOVE & RELOCATE NOTES (RR)	 <i>Remove and relocate existing aluminum sign and mount</i>
REINSTALL NOTES (RI)	 <i>Reinstall existing aluminum sign and mount</i>
ABANDON NOTES (AX)	<i>NONE – NOT APPLICABLE</i>

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-80 | Standard Bubble Notes – Signs (PTR, Interior Illuminated, and Other)

CATEGORY	SIGNS (PTR)
INSTALL NOTES	 <i>Install (36"x36") no left turn symbol part time restriction sign (R3-2)</i>  <i>Install (36"x36") no right turn symbol part time restriction sign (R3-1)</i>
RETAIN & PROTECT NOTES (EX)	 <i>Retain and protect existing part time restriction sign</i>
REMOVE NOTES (RX)	 <i>Remove existing part time restriction sign</i>
REMOVE & RELOCATE NOTES (RR)	 <i>Remove and relocate existing part time restriction sign</i>
REINSTALL NOTES (RI)	 <i>Reinstall existing part time restriction sign</i>
ABANDON NOTES (AX)	<i>NONE – NOT APPLICABLE</i>

CATEGORY	SIGNS (Interior Illuminated)
INSTALL NOTES	<i>NONE</i>
RETAIN & PROTECT NOTES (EX)	 <i>Retain and protect existing interior illuminated sign</i>
REMOVE NOTES (RX)	 <i>Remove existing interior illuminated sign</i>
REMOVE & RELOCATE NOTES (RR)	
REINSTALL NOTES (RI)	<i>NONE – NOT APPLICABLE</i>
ABANDON NOTES (AX)	

CATEGORY	SIGNS (other)
INSTALL NOTES	 <i>See signing plans for details on sign and attachment</i>
RETAIN & PROTECT NOTES (EX)	
REMOVE NOTES (RX)	
REMOVE & RELOCATE NOTES (RR)	<i>NONE</i>
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-81 | Standard Bubble Notes – Junction Boxes

CATEGORY	JUNCTION BOXES
	<p> <i>Install 17"x10"x12" (min. dimension) precast concrete or hybrid junction box</i></p> <p> <i>Install 22"x12"x12" (min. dimension) precast concrete or hybrid junction box</i></p> <p> <i>Install 30"x17"x12" (min. dimension) precast concrete or hybrid junction box</i></p> <p> <i>Install tandem 30"x17"x12" (min. dimension) precast concrete or hybrid junction boxes</i></p>
INSTALL NOTES	<p> <i>Junction box (see signal plan)</i></p> <p> <i>Junction box (see detector plan)</i></p> <p> <i>Junction box (see interconnect plan)</i></p> <p> <i>Install ___"X___"X___" (min. dimension) galv. cast iron junction box with gasketed galv. steel cover</i></p> <p> <i>Install 6" max. sand pocket block-out with (S=size) inch conduit to junction box</i></p> <p> <i>Install 24"x30"x24" fiber optic hand hole</i></p> <p> <i>Install 30"x48"x24" fiber optic hand hole</i></p> <p> <i>Install 30"x48"x36" fiber optic hand hole</i></p>
RETAIN & PROTECT NOTES (EX)	<p> <i>Retain and protect existing junction box</i></p> <p> <i>Retain and protect existing fiber optic hand hole</i></p>
REMOVE NOTES (RX)	<p> <i>Remove existing junction box</i></p> <p> <i>Remove existing junction box (see removal plan)</i></p> <p> <i>Remove existing fiber optic hand hole</i></p>
REMOVE & RELOCATE NOTES (RR)	
REINSTALL NOTES (RI)	<i>NONE – NOT APPLICABLE</i>
ABANDON NOTES (AX)	

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-82 | Standard Bubble Notes – Detection

CATEGORY	DETECTION
INSTALL NOTES	<p> <i>Install 6' round or 4' diamond ramp meter detector loop with (F=function) function</i> <i>D = Demand</i> <i>C = Count</i> <i>P = Passage</i> <i>Q = Queue</i></p> <p> <i>Install phase (Ph=phase) 6' round or 4' diamond vehicle detector loop</i></p> <p> <i>Install 6' round or 4' diamond vehicle count loop</i></p> <p> <i>Install phase (Ph=phase) 2 1/2' diamond bicycle detector loop</i></p> <p> <i>Install phase (Ph=phase) 4' diamond preformed vehicle detector loop</i></p> <p> <i>Install phase (Ph=phase) 6' square preformed vehicle detector loop</i></p> <p> <i>Install phase (Ph=phase) parallelogram bicycle detector loop</i></p> <p> <i>Install (X=number of cables) phase (Ph=phase) loop feeder cable(s)</i></p> <p> <i>Install (X=number of cables) phase (Ph=phase) no. 18 AWG loop feeder cable(s)</i></p> <p> <i>Install (X=number of cables) function (F=function) loop feeder cable(s)</i></p> <p> <i>Install (N=number) pair of loop wires</i></p> <p> <i>Install video detector camera (T=camera)</i></p> <p> <i>Video detector camera (see detector plan)</i></p> <p> <i>Install side fire, dual beam radar detector unit (T=radar)</i></p> <p> <i>Install far-range radar detector unit (T=radar)</i></p> <p> <i>Install near-range radar detector unit (T=radar)</i></p> <p> <i>Install hybrid video/radar detector (T = hybrid detector)</i></p> <p><i>See next page for EX, RX, RR, RI, and AX information</i></p>

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-83 | Standard Bubble Notes – Detection, Continued

CATEGORY	DETECTION (continued)
RETAIN & PROTECT NOTES (EX)	 Retain and protect existing video detector camera  Retain and protect existing radar detector unit  Retain and protect existing phase (Ph=phase) detector loop  Retain and protect existing phase (Ph=phase) loop feeder cable(s)  Retain and protect existing ramp meter (F=function) detector loop  Retain and protect existing ramp meter (F=function) loop feeder cable(s)
REMOVE NOTES (RX)	 Remove existing phase (Ph=phase) loop feeder cable(s)  Remove existing ramp meter (F=function) loop feeder cable(s)  Remove existing video detector camera  Remove existing radar detector unit
REMOVE & RELOCATE NOTES (RR)	 Remove and relocate existing video detector camera  Remove and relocate existing radar detector unit
REINSTALL NOTES (RI)	 Reinstall existing video detector camera  Reinstall existing radar detector unit
ABANDON NOTES (AX)	 Abandon existing detector loop

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-84 | Standard Bubble Notes – Wires and Cables

CATEGORY	WIRES & CABLES
INSTALL NOTES	<p>N-C <i>Install (N=number) no. 8 AWG THWN wire(s) for signal system common</i></p> <p>N-12C <i>Install (N=number) no. 12 AWG THWN wire(s) for pedestal common</i></p> <p>N/G <i>Install (N=number) no. (G=wire size) AWG THWN wire(s)</i></p> <p>N/G <i>Install (N=number) no. (G=wire size) AWG XHHW wire(s)</i></p> <p>X-N G <i>Install (X=number of cables) control cable(s) with (N=number) no. (G=wire size) AWG conductors</i></p> <p>W P <i>Install wiring to serve pole (P = pole number) as required by the manufacturer</i></p> <p>PL <i>Install poly pull line</i></p> <p>VDF T <i>Install video detection coaxial and power cable for camera (T=camera)</i></p> <p>VDF T <i>Install combo video/radar detection coaxial and power cable for camera (T=camera)</i></p> <p>RCC T <i>Install radar control cable (T=radar)</i></p> <p>38 <i>Install galv. steel 3/8" messenger and 1/4" tether cables</i></p> <p>39 <i>Install 3/8" galv. steel messenger cable</i></p> <p>41 <i>Install 1/4" galv. steel stabilizer cable and bars</i></p> <p>42 <i>Install 1/4" galvanized steel messenger cable</i></p> <p>Ph <i>Includes 3 spare wires for phase (Ph=phase) as per table</i></p>
RETAIN & PROTECT NOTES (EX)	<p>EX W <i>Retain and protect existing wiring</i></p> <p>EX CC <i>Retain and protect existing control cables</i></p> <p>EX 38 <i>Retain and protect existing messenger and tether cables</i></p> <p>EX 39 <i>Retain and protect existing messenger cable</i></p> <p>EX 40 <i>Retain and protect existing tether cable</i></p>
REMOVE NOTES (RX)	<p>RX W <i>Remove existing wiring</i></p> <p>RX CC <i>Remove existing control cables</i></p> <p>RX 38 <i>Remove existing messenger and tether cables</i></p> <p>RX 39 <i>Remove existing messenger cable</i></p> <p>RX 40 <i>Remove existing tether cable</i></p>
REMOVE & RELOCATE NOTES (RR)	
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	
	<i>NONE</i>

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-85 | Standard Bubble Notes – Conduits

CATEGORY	CONDUITS
INSTALL NOTES	<ul style="list-style-type: none">  <i>Install (S=size) inch conduit</i>  <i>Install 2" conduit stub (for future use, cap ends)</i>  <i>Detector conduit (see detector plan)</i>  <i>Electrical conduit (see signal plan)</i>  <i>Install conduit by horizontal directional drilling, open trench not allowed</i>  <i>Interconnect conduit (see interconnect plan)</i>  <i>Install (S=size) inch rigid metallic conduit, conduit bodies, expansion fittings, and surface mounted metallic junction boxes as required. Submit proposed method of attachment to the bridge for approval.</i>  <i>Splice new electrical conduit to existing electrical conduit</i>  <i>Install conduit and wire as required by power company</i>
RETAIN & PROTECT NOTES (EX)	<ul style="list-style-type: none">  <i>Retain and protect existing electrical conduit</i>  <i>Retain and protect existing detector conduit</i>  <i>Retain and protect existing interconnect conduit</i>  <i>Retain and protect existing conduit stub</i>  <i>Retain and protect existing (S=size) inch conduit</i>  <i>Retain and protect existing (S=size) inch conduit</i>
REMOVE NOTES (RX)	<ul style="list-style-type: none">  <i>Remove existing electrical conduit</i>  <i>Remove existing detector conduit</i>  <i>Remove existing interconnect conduit</i>  <i>Remove existing electrical conduit (see removal plan)</i>
REMOVE & RELOCATE NOTES (RR)	<i>NONE - NOT APPLICABLE</i>
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	 <i>Abandon existing conduit</i>

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-86 | Standard Bubble Notes – Luminaires and Fire Preemption

CATEGORY	LUMINAIRES
INSTALL NOTES	 <i>Install ___ watt light emitting diode luminaire (see special provisions). Bond luminaire to pole grounding terminal.</i>  <i>Install photocontrol electronic relay on pole</i>  <i>Install photocontrol electronic relay on luminaire head</i>  <i>Install luminaire (see illumination plans)</i>
RETAIN & PROTECT NOTES (EX)	
REMOVE NOTES (RX)	
REMOVE & RELOCATE NOTES (RR)	NONE
REINSTALL NOTES (RI)	
ABANDON NOTES (AX)	

CATEGORY	FIRE PREEMPTION
INSTALL NOTES	 <i>Install fire preemption interface in controller cabinet (Agency installed)</i>  <i>Install channel (Ch=channel), (N=number) barrel fire preemption detector unit</i>  <i>Install channel (Ch=channel) fire preemption detector feeder cable</i>
RETAIN & PROTECT NOTES (EX)	 <i>Retain and protect existing fire preemption detector unit</i>  <i>Retain and protect existing fire preemption feeder cable</i>
REMOVE NOTES (RX)	 <i>Remove existing fire preemption detector unit</i>  <i>Remove existing fire preemption feeder cable</i>
REMOVE & RELOCATE NOTES (RR)	 <i>Remove and relocate existing fire preemption detector unit</i>
REINSTALL NOTES (RI)	 <i>Reinstall existing fire preemption detector unit</i>
ABANDON NOTES (AX)	NONE – NOT APPLICABLE

Traffic Engineering Section

Traffic Signal Design Manual – Contract Plan Development & Drafting

Figure 21-87 | Standard Bubble Notes – Miscellaneous and Heads & Brackets

CATEGORY	MISCELLANEOUS
INSTALL NOTES	 <i>Install crosswalk closure support with signs (both sides of support)</i>  <i>See sheet note number (N=Number)</i>
RETAIN & PROTECT NOTES (EX)	<i>NONE</i>
REMOVE NOTES (RX)	 <i>Remove existing crosswalk closure support with sign(s)</i>
REMOVE & RELOCATE NOTES (RR)	
REINSTALL NOTES (RI)	<i>NONE</i>
ABANDON NOTES (AX)	

CATEGORY	HEADS & BRACKETS	CAMERA TYPES
NON-INVASIVE DETECTOR UNIT MOUNTS	<p><i>VL = Video detection camera bracket, cable mount, 1-piece with 23" tube (Pelco part no. AS-0175 or approved equal) Mount camera on luminaire arm. Mount camera on flat part of luminaire arm or as directed by engineer.</i></p> <p><i>VM = Video detection camera bracket, cable mount, 1-piece with 74" tube (Pelco part no. AS-0175 or approved equal) Mount camera on mast arm.</i></p> <p><i>VRM = Video/ Radar detection camera bracket, cable mount, 1-piece with 74" tube (Pelco part no. AS-0175 or approved equal) Mount Video/Radar unit on mast arm per manufacturers recommendations.</i></p> <p><i>VP = Video detection camera bracket, 1-piece with 11" tube (Pelco part no. SH-0527 or approved equal) Mount camera on verticle pole.</i></p>	
NON-INVASIVE DETECTOR UNIT TYPES	<p><i>20 = Black and white video detector camera</i></p> <p><i>21 = Color video detector camera</i></p> <p><i>22 = Thermal imaging detector camera</i></p> <p><i>23 = Radar detector</i></p> <p><i>24 = Combo Video/ Radar detector</i></p>	
SIGNAL HEAD TYPE ABBREVIATIONS	<p><i>1Y = FY</i></p> <p><i>1R = FR</i></p> <p><i>2 = R:Y:G</i></p> <p><i>3L = RA:YA:GA</i></p> <p><i>3LCF = RA:YA/FYA:GA</i></p> <p><i>3R = RA:YA:GA</i></p> <p><i>3RCF = RA:YA/FYA:GA</i></p>	<p><i>4 = R:Y:G:GA</i></p> <p><i>7 = R:Y:G:GA</i></p> <p><i>8 = R:G</i></p> <p><i>9 = R:Y:GA:GA</i></p> <p><i>12 = RB:YB:GB</i></p> <p><i>12M = RB:YB:GB</i></p>