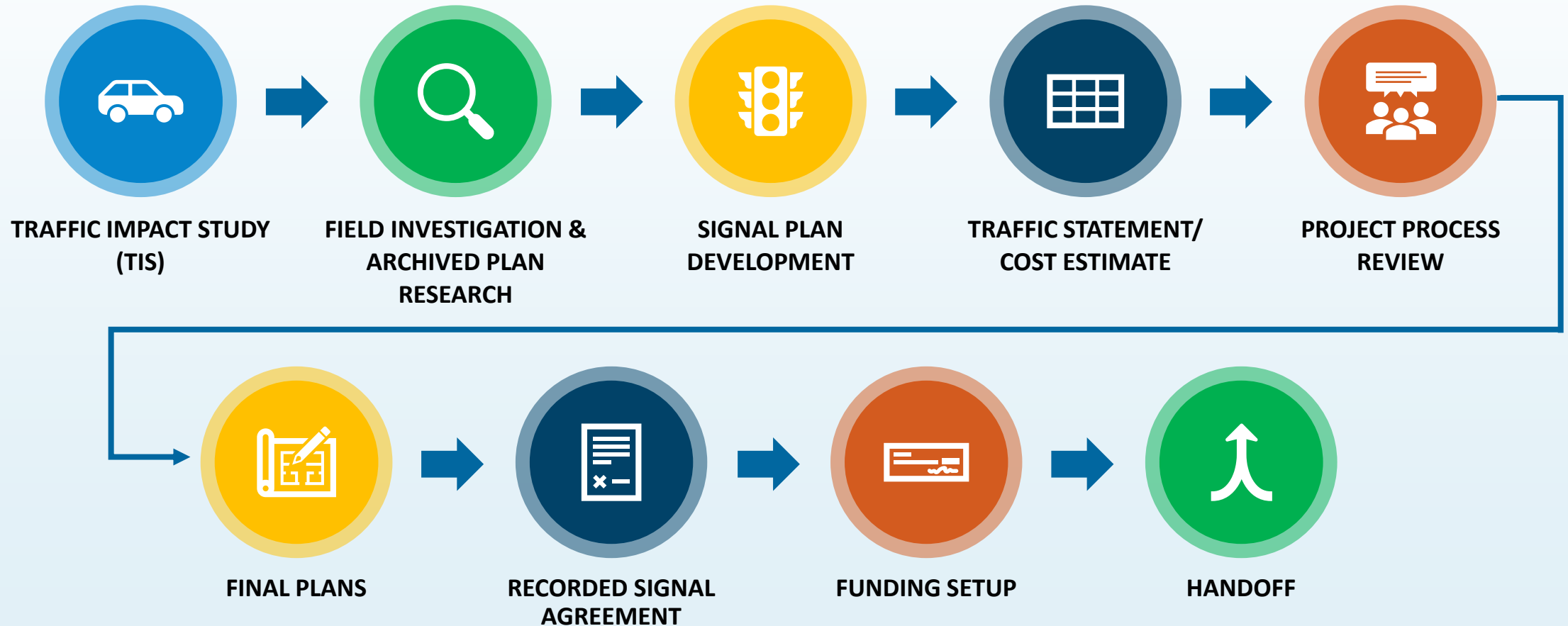




Signal Design Process & Common Errors

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Traffic Signal Design Process





TRAFFIC IMPACT STUDY (TIS)

- “A study conducted during the development approval process to determine the impacts that traffic generated by the proposed development will have on the surrounding street network and the improvement needed to the transportation system in order to mitigate those impacts.” *(Section 1.8, DCM).*
- A Final TIS or TOA Review Letter is created from the study which outlines the traffic impacts that may be caused by the construction or improvement of a development, and provides recommendations for development entrances including:
 - Lane configuration/assignments
 - Signal phasing/operations
 - Bicycle and pedestrian improvements
 - Scope of signal improvement work

Common Errors

- Forgetting to incorporate TIS recommendations
- Not providing justification for modifying or omitting TIS recommendations



FIELD INVESTIGATION & ARCHIVED PLAN RESEARCH

- Record existing intersection features that will impact signal design
 - Signal equipment placement, condition, etc.
 - Overhead and underground utilities
 - Signing and pavement markings
 - Pedestrian facilities
 - ITMS equipment
 - Right-of-way
- Measure approach slopes and take photos of approach speed limits for signal timesheet preparation



FIELD INVESTIGATION

Common Error

Overlooking major utility conflicts





SIGNAL PLAN DEVELOPMENT

- Determine and identify locations of existing signal equipment
- Propose new signal design considering right-of-way, clear zone, lateral offset, utility constraints, etc.
- Complete signal phasing diagram and applicable signal equipment schedules



SIGNAL PLAN DEVELOPMENT

Common Error

Not using the Signal Design Checklist

(found on the Development Coordination website, under Checklists)

- Provides designers with all basic elements needed for a complete signal plan
- Self-check to ensure no steps have been skipped

DelDOT - Subdivision Signal Design Checklist

Subdivision Name: _____

Intersection Name: _____

Project Id.: _____ Signal Permit #: _____ Date: _____

Effective: 12/01/2020

	Checklist Topic/Content	Item Addressed?	Justifications are Required if: N or N/A
SECTION 1: PLAN DEVELOPMENT			
1.1	If a new signal is being proposed, have the signal warrants been met? Coordinate with DelDOT Traffic Study section as necessary. If the project is within municipal limits, coordinate with the municipality, as needed.	▼	
1.2	Only pertinent levels (i.e. existing and proposed geometrics and utilities, drainage and clearzone) shown on the plans.	▼	
1.3	Base mapping shown.	▼	
1.4	All existing DelDOT equipment (i.e. poles, flashers, sign structures and lighting) shown on the plans.	▼	
1.5	North arrow shown and at correct orientation.	▼	
1.6	Signal legend shown and matches symbols on plan.	▼	
1.7	Plans shown at correct scale.	▼	
1.8	Existing and proposed right-of-way and easements shown.	▼	
1.9	All equipment within right-of-way. If needed, an Agreement 'C' or easement has been provided for any equipment outside of right-of-way.	▼	
1.10	Limit of construction shown on plans.	▼	
1.11	General signal notes shown.	▼	
1.12	Street names and route numbers shown.	▼	
1.13	Current border, signature block and revision block used.	▼	
1.14	Construction details provided, if required.	▼	
1.15	All proposed signal equipment is labeled correctly.	▼	
1.16	All existing signal equipment to remain is labeled correctly.	▼	
1.17	All existing signal equipment to be removed is labeled correctly.	▼	
1.18	Power source location coordinated with utility company.	▼	
1.19	Power source pole number and owner shown.	▼	
1.20	Service disconnect and meter placed 10' or less from the power source.	▼	
1.21	Additional service disconnect provided where the pedestal meter is across the roadway from the cabinet or where the cabinet is located more than 100' from the power source.	▼	
1.22	Signal controller cabinet placed with the door facing away from the road.	▼	
1.23	Signal controller cabinet placement permits safe access. Cabinet is protected, if needed.	▼	



SIGNAL PLAN DEVELOPMENT

Common Error

Forgetting to consider clear zone and lateral offset

- See [“Clear Zone & Lateral Offset Application Discussion”](#) on DeIDOT Design Resource Center for more information

Lateral Offset (or Horizontal Clearance)		
Speed Limit	≤ 45 mph	> 45 mph
Minimum lateral offset	2 ft	2ft
Desirable lateral offset	6 ft	10 ft

DeIDOT’s [Traffic Design Manual \(2015\)](#) – Chapter IV.C.1.c(1)

Clear Zone							
Table IV-3 Clear Zone Distances (in feet from edge of traveled way)							
Design Speed (MPH)	Design ADT	Backslopes			Foreslopes		
		1V:3H	1V:5H to 1V:4H	1V:6H or Flatter	1V:6H or Flatter	1V:5H to 1V:4H	1V:3H
40 or Less	Under 750	7 - 10	7 - 10	7 - 10	7 - 10	7 - 10	(2)
	750-1500	12 - 14	12 - 14	12 - 14	10 - 12	12 - 14	(2)
	1500-6000	14 - 16	14 - 16	14 - 16	12 - 14	14 - 16	(2)
	Over 6000	16 - 18	16 - 18	16 - 18	14 - 16	16 - 18	(2)
45 - 50	Under 750	8 - 10	8 - 10	10 - 12	10 - 12	12 - 14	(2)
	750-1500	10 - 12	12 - 14	14 - 16	14 - 16	16 - 20	(2)
	1500-6000	12 - 14	14 - 16	16 - 18	16 - 18	20 - 26	(2)
	Over 6000	14 - 16	18 - 20	20 - 22	20 - 22	24 - 28	(2)
55	Under 750	8 - 10	10 - 12	10 - 12	12 - 14	14 - 18	(2)
	750-1500	10 - 12	14 - 16	16 - 18	16 - 18	20 - 24	(2)
	1500-6000	14 - 16	16 - 18	20 - 22	20 - 22	24 - 30	(2)
	Over 6000	16 - 18	20 - 22	22 - 24	22 - 24	26 - 32 ⁽¹⁾	(2)
60	Under 750	10 - 12	12 - 14	14 - 16	16 - 18	20 - 24	(2)
	750-1500	12 - 14	16 - 18	20 - 22	20 - 24	26 - 32 ⁽¹⁾	(2)
	1500-6000	14 - 18	18 - 22	24 - 26	26 - 30	32 - 40 ⁽¹⁾	(2)
	Over 6000	20 - 22	24 - 26	26 - 28	30 - 32 ⁽¹⁾	36 - 44 ⁽¹⁾	(2)
65 - 70	Under 750	10 - 12	14 - 16	14 - 16	18 - 20	20 - 26	(2)
	750-1500	12 - 16	18 - 20	20 - 22	24 - 26	28 - 36 ⁽¹⁾	(2)
	1500-6000	16 - 20	22 - 24	26 - 28	28 - 32 ⁽¹⁾	34 - 42 ⁽¹⁾	(2)
	Over 6000	22 - 24	26 - 30	28 - 30	30 - 34 ⁽¹⁾	38 - 46 ⁽¹⁾	(2)



SIGNAL PLAN DEVELOPMENT

Common Error

Providing inadequate pedestrian facilities per DeIDOT's [*Traffic Design Directive 2019-1*](#)

- Provide crossings across all intersection approaches where appropriate
- Where crossings are deemed infeasible or undesirable, provide supporting documentation to DeIDOT's Traffic Section for review and approval





SIGNAL PLAN DEVELOPMENT

Other Common Errors

- Incorrect CADD standards
- Forgetting soil boring requests
- Failing to verify mast arm loading
- Incorrect signal head numbering
- Incorrect NEMA phasing
- Failing to address all review comments
- Forgetting to submit timesheet package with signal plans
- Attempting to submit items for review outside of PDCA
- Developing signal plans only for impacted approached, rather than entire intersection
- Forgetting to provide CADD files with final signal plan for signature



TRAFFIC STATEMENT/COST ESTIMATE

- MS Excel spreadsheet to be completed by the designer using a template, which is used to determine cost of proposed traffic signal and associated equipment
- The template includes a tab describing how each section is intended to be completed
- To be submitted with signal plan for review prior to approval of signal



TRAFFIC STATEMENT/COST ESTIMATE

Common Error

Placing signal items under incorrect sections

- Project Contractor Items – all **underground** equipment
- Traffic Contractor Items – all **aboveground** signal equipment, and associated cables
- Traffic Supply Items – all **900 section** items
 - Advance Order Items – all steel poles and mast arms (can only be ordered after execution of signal agreement and final plans)

SR 4 (W Newport Pike/Mitch Road) @ Stanton Road (N818)

LINE #	ITEM #	QTY	UDN	DESCRIPTION	UNIT COST	TOTAL COST
1	135	846001	1300	LF	Provide and install Loop Wire 1-Conductor #14 AWG Encased in 1/4" Flexible Tubing in A Loop Sewer	
2	140	846002	5	LF	Provide and install A-1-1/2 Inch Galvanized Rigid Metal Conduit Detector Sleeve With Loop Wire	
3	300	831245	20	LF	Provide and install 4" HDPE SDR-13.5 Conduit (Bore)	
4	325	831503	20	LF	Provide and install 2 1/2" Schedule 80 PVC Conduit (Open Cut)	
5	355	831514	45	LF	Provide and install 2 1/2" Schedule 80 PVC Conduit (Trench)	
6	350	831515	5	LF	Provide and install 3" Schedule 80 PVC Conduit (Trench)	
7	365	831516	35	LF	Provide and install 4" Schedule 80 PVC Conduit (Trench)	
8	650	830001	3	EA	Conduit Junction Well, Type 1, 20" x 20" Precast Concrete	
9	670	830008	3	EA	Adjust or Repair Existing Conduit Junction Well	
10	680	830011	2	EA	Provide and install Frame and Lid for Junction Well, Type 1	
11	685	830012	1	EA	Provide and install Frame and Lid for Junction Well, Type 4	
12	700	830001	7	EA	Realign and Graveling Existing Junction Well	
13	850	830008	5	EA	Pole Base, Type 1A	
14	850	830008	1	EA	Pole Base, Type 1A	

SR 4 (W Newport Pike/Mitch Road) @ Stanton Road (N818)

LINE #	ITEM #	QTY	UDN	DESCRIPTION	UNIT COST	TOTAL COST
1	7070	999476	1	EA	Post & Nohab, Night Work Over time	4,700.00
2	712	800000	2	LS	MOT (Lump Sum)	7000.00
3	90	832508	110	LF	Provide and install 2-Conductor #14 AWG Aluminum Shielded Cable	302.50
4	110	832507	335	LF	Provide and install 14/5 Traffic Control Cable	1,005.00
5	130	832505	45	LF	Provide and install #6 AWG Solid Copper Wire	112.50
6	885	836502	6	EA	Provide and install Pedestal Pole	6,300.00
7	985	837007	2	EA	Provide and install Signal Head Backplate	700.00
8	990	837011	1	EA	Realign or Slide Existing Signal Head	200.00
9	1000	837008	6	EA	Provide and install 16" LED Countdown Pedestrian Signal	625.00
10	1050	847407	17	EA	Installation and Removal of Traffic Pedestrian Signal Head Indication/H3 Module	3,000.00
11	1235	832075	415	LF	Removal of Cable from Conduit or Traffic/Lighting Pole	2.00
12	1250	836006	6	EA	Remove Pedestal Pole	1,200.00
13	1260	837500	1	EA	Removal of Signal or Pedestrian Head From Pole or Pedestal	70.00
14	1290	842500	12	EA	Installation or Removal of Pedestrian Button on Wood or Metal Pole	3,600.00
15						0.00

SR 4 (W Newport Pike/Mitch Road) @ Stanton Road (N818)

LINE #	ITEM #	QTY	UDN	DESCRIPTION	UNIT COST	TOTAL COST
1	7070	999476	1	EA	Complete P Cabinet w/3 Channel PAC Controller (includes Mounting Rack w/ tower	15,772.00
2	7070	999477	1	EA	Base Extension (split) Aluminum w/Natural Mill Finish	754.00
3	2105	999461	1	EA	Optical Receiver Card (Emergency Preemption)	2,751.00
4	2355	999527	3	EA	Set of Four, 2' x 90" (51mm x 2286mm) Anchor Bolts with Two Hex Nuts and Two Flat	2,934.00
5	2435	999601	8	EA	Rouleau Sign Brackets (2 per average sign, 3 per longer sign)	920.00
6	2490	999613	1	EA	Camera (Includes Lowering Device, Controller, and Video Encoder)	12,461.00
7	2495	999614	1	EA	Strain Pole Camera Mounting Adapter (Includes Cable Assembly)	741.00
8	2535	999622	1	EA	CDMA	1,200.00
9						
10						
11						
12						
13						
14						
15						

SR 4 (W Newport Pike/Mitch Road) @ Stanton Road (N818)

LINE #	ITEM #	QTY	UDN	DESCRIPTION	UNIT COST	TOTAL COST
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
TOTAL TRAFFIC SUPPLY ITEMS					→	37,483.00
TOTAL ADVANCE ORDER ITEMS					→	0.00
TOTAL PROJECT CONTRACTOR ITEMS					→	0.00
TOTAL TRAFFIC CONTRACTOR ITEMS					→	38,270.00
TOTAL TRAFFIC SUPPLY ITEMS					→	37,483.00
TOTAL ADVANCE ORDER ITEMS					→	0.00
CONTINGENCIES					→	7,575.20
TOTAL COST					→	83,328.20



TRAFFIC STATEMENT/COST ESTIMATE

Common Errors

- Using an outdated traffic statement template
 - Latest pricing needs to be verified to ensure accuracy of cost estimate
- Forgetting to include quotes for special order items with the final traffic statement, i.e., fisheye cameras, ITMS
- Not selecting highest cost contractor for final cost estimate



PROJECT PROCESS REVIEW

- A review period during which designers submit signal plans and cost estimate to DeIDOT for review by DeIDOT Signal Construction/Maintenance, Traffic Design/Safety/Studies, TMC, OIT, and other sections as needed
- Project Process review is a required step to ensure constructability, operational compliance, and maintenance feasibility prior to plan approval for installation by Chief of Traffic Engineering



PROJECT PROCESS REVIEW

Common Errors

- Overlooking Project Process review period in project schedule
- Not addressing all comments made during Project Process review
- Attempting to bypass Project Process review



FINAL SIGNAL PLANS

- The final form of signal plans which has incorporated or resolved all previous comments provided throughout the review process
- Plans must contain signature and seal before it can be approved for installation by Chief Traffic Engineer

Common Errors

- Forgetting to provide signature and seal on final plans
- Not submitting final traffic statement and updated timesheet package with final signal plans



RECORDED SIGNAL AGREEMENT

- An agreement allowing DeIDOT right of entry onto property to install, operate, and maintain new traffic signals and ITMS devices or modification of existing signal equipment
- Required to be executed in order to request funding

Common Error

- Overlooking TIS recommendation to enter into signal agreement
- Waiting until the last minute to start the process of drafting a signal agreement



FUNDING SETUP

- A draft concurrence letter is sent to Finance along with the final cost estimate and signal agreement to request funding from the developer for installation of the signal

Common Errors

- Forgetting to include all applicable traffic statement tabs in final cost estimate sent to Finance
- Excluding maintenance fee from final estimate
- Not realizing that it may take up to a month between reception of signed concurrence letter/check and issuance of a project number



HANDOFF

- The final step in the signal design process, in which finalized signal design documents are distributed to all appropriate parties for signal installation

Common Errors

- Failing to confirm funding approval prior to handing off project
- Forgetting to include all necessary parties in signal handoff email
- Forgetting to send all materials identified on Handoff Form



NEXT STEPS

- Prior to the start of construction, the developer's contractor shall contact signal construction to coordinate scheduling and installation of signal
- Field changes that occur during construction of signal require a redline plan outlining all intended modifications to the original approved signal plan

Wait...
Questions

