TRAFFIC SIGNAL LAYOUT AND CONDUCTOR TERMINATION

Presented By:
Keith Calais - HQ Traffic Office
Bob Hoover - HQ Traffic Office
INTERSECTION LAYOUT
STOP LINES
PEDESTRIAN CROSSINGS

• Make sure that everything needed to signalize the intersection is shown: pedestrian crossings, landings, ALL channelization, drainage, wetlands, utilities (above & below grade).
INTERSECTION LAYOUT - SERVICE AND CONTROLLER LOCATION

- Do not locate controller in wetland, ditch flow line or above buried utility.
- Make sure Maintenance has access, preferably access for vehicle also.
- Sight distance – try to locate controller on right side of minor leg.
PHASE DIAGRAM

01

02

03

04

05

06

07

08

LEFT TURN MOVEMENTS
THROUGH MOVEMENTS WITH PEDESTRIANS
LEFT TURN MOVEMENTS
THROUGH MOVEMENTS WITH PEDESTRIANS

VEHICLE MOVEMENT
PED MOVEMENT

Mainline

BARRIER

Minor
INTERSECTION LAYOUT

SIGNAL STANDARDS

• Determine which phases are needed; which ones may be eliminated.
• Place signal heads, emergency pre-emption detectors, pedestrian signal heads & pedestrian push buttons.
• Do you need auxiliary push buttons for ADA? (Americans with Disabilities Act)
STANDARD LOOP NUMBERING

NOTES:
1. Ø 2 & 6 shall be oriented with the mainline.
(Approach with higher volume.)
2. If SR runs N-S, Ø 2 shall be northbound.
3. If SR runs E-W, Ø 2 shall be eastbound.
4. Stop bar loops designated LX1A and LX1B shall have separate lead-in cables.
5. Stop bar loops designated LX2 shall be used in exclusive RT lanes.

LEGEND
LXXX INDUCTION LOOP
→ VEHICLE DISPLAY
# PEDESTRIAN DISPLAY
◯ POLE NUMBER
• Layout Phases. Phase 2 shall be NB or EB in the overall direction of the SR layout.
• Mainline phases add up to 7, minor phases add up to 11.
• Label signal heads and signal standards.
• Label emergency preempt detectors.
• Label pedestrian signal heads and push buttons.
**INTERSECTION LAYOUT**

**STOPLINE AND ADVANCE LOOPS**

- Dilemma Zone detection for approach with posted speed at or above 35 mph. Design Manual (DM) section 850.06(6).
- At times, advance detection is placed on approaches with posted speed under 35 mph in the range of 100’ – 150’ back from the stop bar. This provides about 2 seconds of travel time.

- Loops are standard plan items.
- In most cases the stop bar loop is 3 loops wired together and brought back to controller on 1 each 2C(shielded). All other loops are brought back to controller on 1 each 2C(shielded).
• Layout conduit- 2” diameter minimum on all legs. Use 3” diameter minimum for crossings.

• Layout conduit crossings - try to cross mainline only once. Try not to open cut mainline.

• Consolidate junction boxes around corners of intersection.

• Send the preliminary signal plan to HQ for review - per DM 850.06 (10), Page 850-14.
INTERSECTION LAYOUT

- Single pedestrian heads – 5C.
- Three section vehicle heads – 5C (except heads 21, 41, 61, 81 with permissive left turn).
- Five section vehicle heads – 7C.
- Double pedestrian heads on one shaft – 7C.
- Pedestrian push buttons and induction loops - 2C (shielded).
- Emergency pre-emption - 3C (shielded).

- Design a product for maintenance that they can maintain.
- Watch your conduit fill. Leave spares for future use.
- Run a 7C to heads 21, 41, 61 & 81 when running permissive left turns.
- Add tenons for future increased phase control.
- Send preliminary plan set to stakeholders for review.
## Field Wiring Chart

<table>
<thead>
<tr>
<th>Movement Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
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### Vehicle Head


#### Red

- AC+
- AC-

#### Yellow

- Control
- Coordination

#### Green

- Display
- Spare

#### Spare

- AC

#### Red Auxiliary

- AC

#### Yellow Auxiliary

- AC

#### Green Auxiliary

- AC

### Pedestrian Heads & Dets.

| Type                  | 711 721 731 741 751 761 771 781 791 | 712 722 732 742 752 762 772 782 792 | 713 723 733 743 753 763 773 783 793 | 714 724 734 744 754 764 774 784 794 | 715 725 735 745 755 765 775 785 795 | 716 726 736 746 756 766 776 786 796 | 717 727 737 747 757 767 777 787 797 | 718 728 738 748 758 768 778 788 798 | 719 729 739 749 759 769 779 789 799 |

- Hand
- Man
- AC
- Detection
- Common-Detection
- Spare
- Spare
- Spare
- Spare
Field Wiring Chart Continued:

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### Input File

**Input File Marking Detail**

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**INPUT FILE LAYOUT - PROGRAM WAPITI W4IKS**

- **MODULE**: XX-XX
- **INPUT NO.**: XX-XX
- **MODEL TYPE**: XXX
- **E** = EXTENSION
- **C** = CALL
332
CONTROLLER
CABINET
LAYOUT

Detector Test Panel
Controller
Document Drawer Assembly
Input File “I”
Input File “J”
Power Distribution Assembly
Conflict Monitor
Output File
Flash Transfer Relays
Auxiliary Output File
20
CONTROLLER CABINET LAYOUT DIAGRAM
VEHICLE AND PEDESTRIAN DETECTION DISCONNECT PANEL

Each Switch is 3 position:
Up – ON
Center – Off
Down – Test Momentary (spring loaded to off ((Center Position)))

The Indicator Light Is
Illuminated When Detector Is Occupied
REAR VIEW OF VEHICLE AND PEDESTRIAN DETECTION DISCONNECT PANEL
CONTROLLER ASSEMBLY
REAR VIEW OF CONTROLLER
DETECTION INPUT FILES

Two Channel Loop Detectors

Pedestrian Isolators
REAR VIEW OF DETECTION INPUT FILES

Input File Harness from side panel
LOOP
LEAD-IN
(FIELD WIRE)
TERMINATION
BLOCKS

Input File Harness

Lead In Cable Shield Drain
Conductor Termination
Each Odd Phase Has 3 Channels of Detection. Each Even Phase Has 6 Channels of Detection.

Each Odd Phase Has 1 Count Register per phase. Each Even Phase Has 2 Count Registers per phase.
WAPITI 170 VEHICLE DETECTION OPTIONS

• The vehicle detector term “Extend” (E) means that the loop detector will output to the controller during the green display. The term Call (C) means that the loop detector outputs to the controller during the yellow and red displays.

ODD PHASES (1, 3, 5, 7)

• Typically stop line detection Extension, Call (E, C) operation.
• Odd phases are generally left turn phases.
• There are three channels of vehicle detection for “Odd” phases.
• For phase 1 input file “I” slot No. 1 upper and lower channels and the upper channel of slot 9.
• For phase 3 input file “I” slot No. 5 upper and lower channels and the lower channel of slot 9.
• “Odd” (1, 3, 5, 7) phases have one count register each.
• Phases 5, 7, in the “J” FILE, operate identically to phases 1, 3.

OTHER DETECTION OPTIONS

• Delay - This option builds a time delay into the controller until the programmed time have elapsed, the delay is canceled during phase green.
• Carryover(stretch) - This option extends the detection by a programmed number of seconds during phase green.
• The extend, call operation is the same for even phases as for ODD phases.
• “EVEN” PHASES (2, 4, 6, 8)

• One of the options is programming either phases 2 & 6 or phases 4 & 8 even phases. It is possible to only operate a single phase to add additional time to the programmed minimum initial time, but this is not a practical type of operation. The stop line detection loops are connected to the Call (C) only positions. When this option is selected it is generally applied to the main street through phases, typically phases 2 & 6, or occasionally phases 4 & 8, if these are the main street phases.

• This operation adds time to the minimum initial timer, in settable increments of 1 to 3 seconds per increment.

• The desired goal is to add sufficient time to clear the queue that develops during yellow and red intervals of main street. It is important to set a maximum amount of added initial time, a failed detector could add 15 minutes to the minimum initial.

• The goal here is to clear the queue and achieve free flow traffic, with the green extended only by the advance detectors. This operation is difficult to achieve due to varying driver behavior.
• **MORE OPTIONS FOR “EVEN” PHASES (2, 4, 6, 8)**

- A second “Even” phase option is called TYPE detection. As in the above option the stop line loops are connected to the Call (C) positions. The following must be entered (programmed) into the controller (for phase 2, D+4+6, for phase 6, D +5+6, for phase 4, D+4+D, for phase 8, D+5+D.

- Normally only phases 2 & 6 or 4 & 8 will be programmed, not all “Even” phases. This programming will program the controller to use the stop line detection until there is an instant of time where there is no vehicle detecting the controller. At that instant the phase that this occurs on will no longer have stop line extension, the other “even phase will continue to operate until there is an instant where there is no vehicle detecting the controller present.
POWER DISTRIBUTION ASSEMBLY

Output file circuit breakers

Main circuit breaker

Intersection Flashers

Low voltage power supply
REAR VIEW OF POWER DISTRIBUTION ASSEMBLY

Incoming Power to Power Distribution Assembly

Low Voltage Power Supply to Input File

Controller unit receptacle

Power to Output File
OUTPUT FILE

Flash Transfer Relays

Phase Load Switches

PH1, PH2, PH2,P, PH3, PH4, PH4,P, PH5, PH6, PH6,P, PH7, PH8, PH8,P

PH = Phase *  PH * P = Pedestrian Phase

Red Monitor Program Cable

Conflict Monitor
Program Card
Conflict Monitor
REAR VIEW OF OUTPUT FILE

Flash Display Program Connectors (Red)

Field Wire Output Terminals

Red Monitor Program Board

Flash Display Program Connectors (Yellow)

Power from Power Distribution Panel
AUXILIARY OUTPUT FILE - TYPICALLY USED FOR OVERLAP OUTPUTS

Flash Transfer Relays

Load Switches

Overlap A  Overlap B  Overlap C  Overlap D
AUXILIARY OUTPUT FILE - TYPICALLY USED FOR OVERLAP OUTPUTS

Overlap D
Overlap C
Overlap B
Overlap A
332 Controller Cabinet

POLICE PANEL

SIGNALS

ON  OFF

AUTO  FLASH
Each Switch is 3 position:
Up – ON
Center – Off
Down – Test Momentary
(spring loaded to off ((Center Position)))

The Indicator Light Is Illuminated When Detector Is Occupied
NEMA Controller

MANUFACTURER PROVIDED SOFTWARE
MANUFACTURER DRIVEN SPECIFICATION
NEMA input files have additional connections to each loop detector. These connections make the following additional functions available:

- Detection stretch (extends call after vehicle leaves loops), delays waits a programmed amount of time before outputting call to controller.
- Red / green detection inhibit (inhibits call during red or green assigned phase).
Back NEMA Input File

Input File Harness
Loop Lead-In
(Field Wire)
Termination Blocks
NEMA External Logic Package

Stop Line Detection Disconnect

Terminates at the Input File

CONTRACT SPECIFIES OPERATION
NEMA Conflict Monitor

Conflict Monitor
Program Card

Input to Conflict monitor & Output from Conflict Monitor
Back view of NEMA cabinet

Rear view of input files

Rear view of output file
Manual Interior Control Panel

Display Panel

Detector Disconnect Panel
NEMA police panel

“AUTOMATIC” / “FLASH” SWITCH

SIGNAL “ON” / “OFF” SWITCH
INCOMING POWER

DIRECTS WHAT AND WHEN TO TURN ON

CONTROLLER

POWER DISTRIBUTION ASSEMBLY

FLASH TRANSFER RELAY

LOAD SWITCH

TERMINAL STRIP

DISPLAY

IF THERE IS A CONFLICT A SIGNAL IS SENT TO FLASH TRANSFER RELAY
Traffic Signal Timing Terms
• **Minimum green** - Is the first timed portion of the green interval, and is timed concurrently with passage timer and the maximum timer. The guaranteed minimum green time for the phase will be the greater of either minimum or passage time.

• **Passage time** – The maximum amount of time set between detector actuations, while in a green condition to not cause a gap out. *Passage starts timing at beginning of green unless sequential timing is active.*
• **Maximum 1**- Determines the amount of time that the phase will be green, with the presence of an opposing call. The timer starts at the beginning of the green interval. If there is no opposing call, it will not start timing. Exception: pedestrian time will override maximum time setting.

• **Maximum 2** – Will be used in place of maximum 1 when selected. Maximum 2 may be selected manually or by time clock.
• **Walk** - The time period of time controls the amount of that the “WALK” is displayed.

• **Flashing Don’t Walk** - This is pedestrian clearance time interval. It is calculated by measuring from the curb to the center of the furthest traveled lane, before opposing vehicles receive a green indication. The measured distance is then divided by 3.5 or 4 (walking speed in feet per second).
Yellow clearance - The amount of time a movement will be in the yellow condition.

Red clearance - Establishes the length of the red clearance interval following the yellow clearance interval. Generally considered to be equal (in seconds) to the width of the intersection (in feet) divided by the approach speed in feet per second.
This is the Fiber optic patch panel – with 6 fibers or 12 fibers.

120 VAC from power distribution assembly.

Use only one for each corridor of traffic signals (talk to ITS group).

One Ethernet switch needed at each traffic signal.

Fiber port for future camera operations at traffic signal.

Cat 5 (RJ-45) To 2070 traffic signal controller.

From 24 volt power supply.

these 2 fiber optic patch cables terminate at the patch panel above.
Ethernet switch
If you have any questions, please contact:

Keith Calais - Traffic Signal Engineer @ 360-705-6986

Bob Hoover-Traffic Signal Operations Engineer @ 360-705-7985