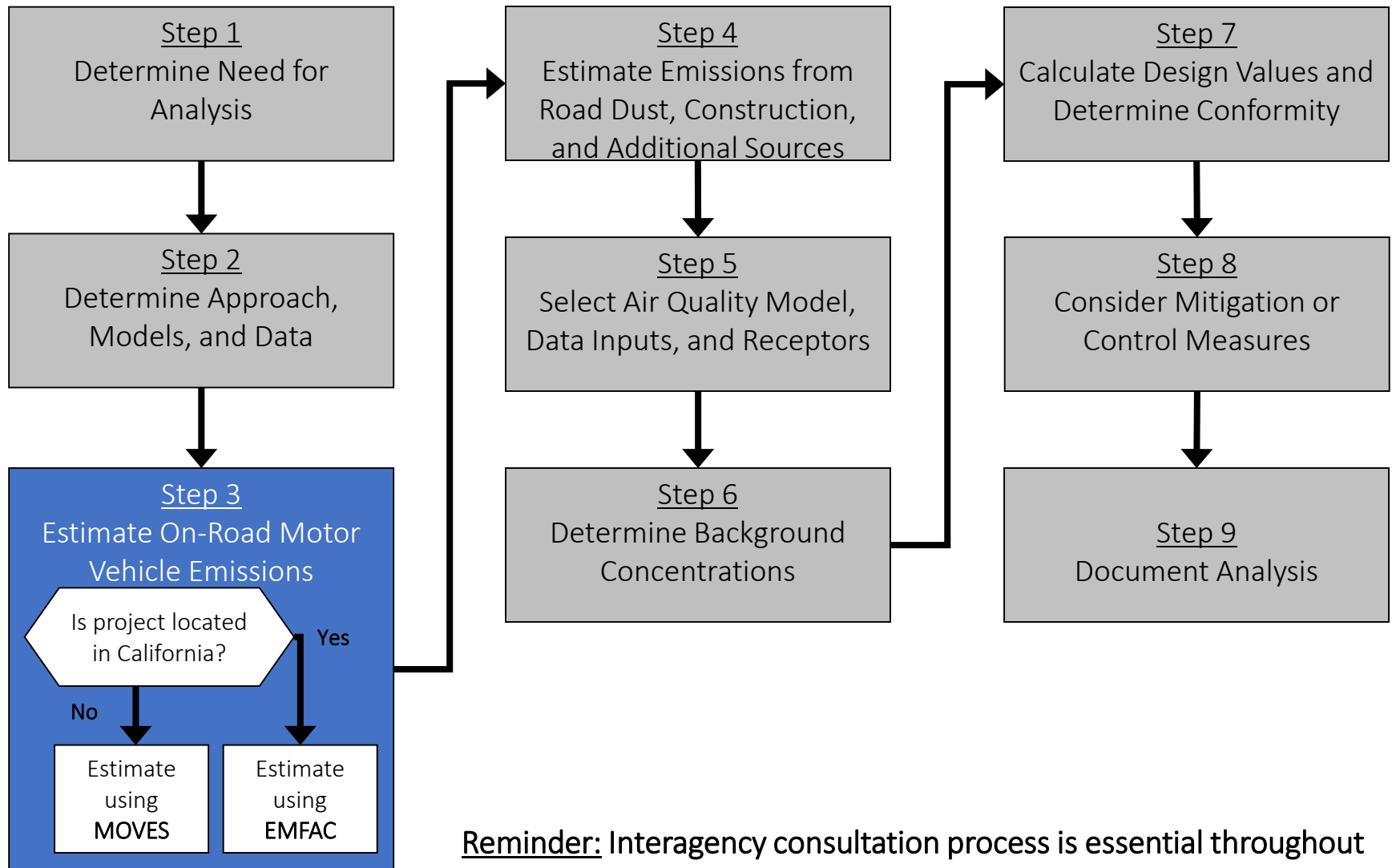


# Module 2

## Using MOVES for PM Hot-spot Analyses



# Completing a PM Hot-spot Analysis





# Module Overview

- Introduction to MOVES and Project-Scale Analyses
- Introduction to Links and Link Activity Information
- Modeling Highways and Intersections in MOVES
  - Links Exercise
- Modeling Terminals and Parking Lots
- Defining Activity
- Example Analysis
  - Running MOVES
- Reference: How Do I Develop Traffic Data for MOVES?



# Key References for this Module

- [PM Hot-spot Guidance](#), Section 4
- [Conformity rule](#) sections 93.105(c)(1)(i), 93.110 and 93.123(c)
- [MOVES2014a User Guide](#) and [supporting documentation](#)
- [EPA MOVES website](#)
- Receive MOVES updates through [Mobile News listserv](#)



# Introduction to MOVES and Project-Scale Analyses



# What is MOVES?

- The **MO**tor **V**ehicle **E**mission **S**imulator (**MOVES**) is a state-of-the-art modeling framework
- Designed to allow easier incorporation of large amounts of in-use data from a variety of sources to generate emissions inventories
- Includes a project scale of analysis
  - Allows detailed link-level analyses
- MOVES2014a is the latest version
  - A minor update to MOVES2014, which replaced MOVES2010/a/b



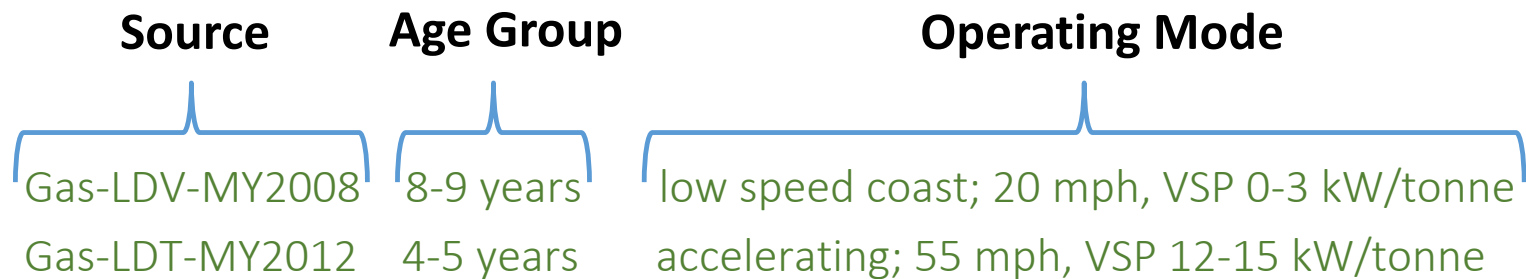
# MOVES at the Project Scale

- Conceptually, at the project scale we will use MOVES to estimate PM emissions from:
  - The **activity** of the vehicles that are expected in the analysis
    - The user indicates what vehicles types are expected; how many; how old they are; and what these vehicles are doing
  - On each of the **specific “links”** that make up the project – a link being a segment of the road or parking area
  - In a particular **hour**, of a particular month, of a particular year
    - Multiple time periods require multiple runs
- These concepts will be covered in depth in this module



# How Does MOVES Calculate Emissions?

- MOVES includes a different emission rate for each combination of...



- MOVES can calculate an emission inventory internally using fleet and activity inputs, **or** users can do this outside of MOVES by multiplying emission rates from MOVES by the appropriate corresponding activity factors (e.g., VMT of a given vehicle type and model year)



# Emissions Vary by Vehicle Type

MOVES “Source Types” Compared to HPMS Vehicle Types

HPMS Vehicle Types		MOVES	
Vehicle Type ID	Vehicle Type	Source Type ID	Source Types
10	Motorcycles	11	Motorcycle
25	Light Duty Vehicles	21	Passenger Car
		31	Passenger Truck
		32	Light Commercial Truck
40	Buses	41	Intercity Bus
		42	Transit Bus
		43	School Bus
50	Single Unit Trucks	51	Refuse Truck
		52	Single Unit Short-haul Truck
		53	Single Unit Long-haul Truck
		54	Motor Home
60	Combination Trucks	61	Combination Short-haul Truck
		62	Combination Long-haul Truck



# Emissions Vary by Vehicle Age

- Emission rates can vary by age as well as model year; activity also varies by age
- Users enter an age distribution of vehicles covering new (0 year old) vehicles to 30+ year old vehicles
- MOVES uses age groups to account for deterioration:
  - 0 to 3 years old
  - 4 or 5 years old
  - 6 or 7 years old
  - 8 or 9 years old
  - 10 to 14 years old
  - 15 to 19 years old
  - 20 or more years old



# Emissions Vary by Vehicle Activity

- In MOVES, vehicle activity is defined through **Operating Mode**:
  - Operating mode refers to what the vehicle is doing at a specific point in time
- Running activity operating modes
  - Include accelerating, braking, cruising, idling
  - Activity divided into categories that differentiate emissions (next slide)
- Start and hotelling operating modes
  - Used to define number of starts, soak-time distribution, and/or hotelling for “off-network” emissions
  - Off-network refers to an area of activity not occurring on a roadway (e.g., parking area, freight or bus terminal)



# Running Activity Operating Modes

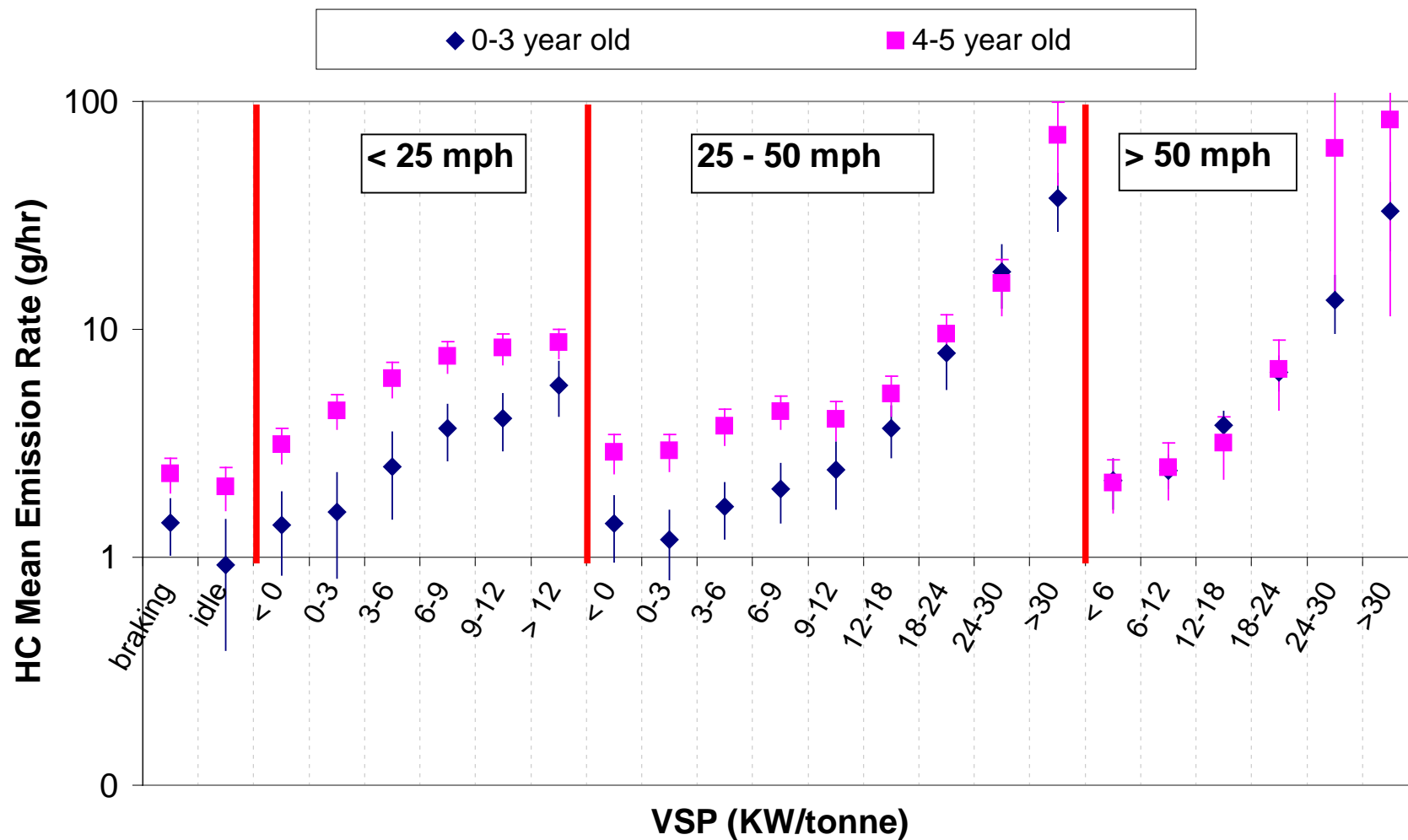
- Running activity operating modes are numbered 11-40
- Defined by **speed** and **Vehicle Specific Power (VSP)**
  - VSP is a measure of the energy the moving vehicle is using at a moment in time
- Activity of a running vehicle is described by an Operating Mode (Op Mode) distribution

		Speed Class (mph)		
		1-25	25-50	50+
VSP Class (kW/tonne)	30+	16	30	40
	27-30		29	39
	24-27			
	21-24		28	38
	18-21			
	15-18	15	27	37
	12-15			
	9-12		25	35
	6-9	14	24	
	3-6	13	23	33
	0-3	12	22	
	<0	11	21	



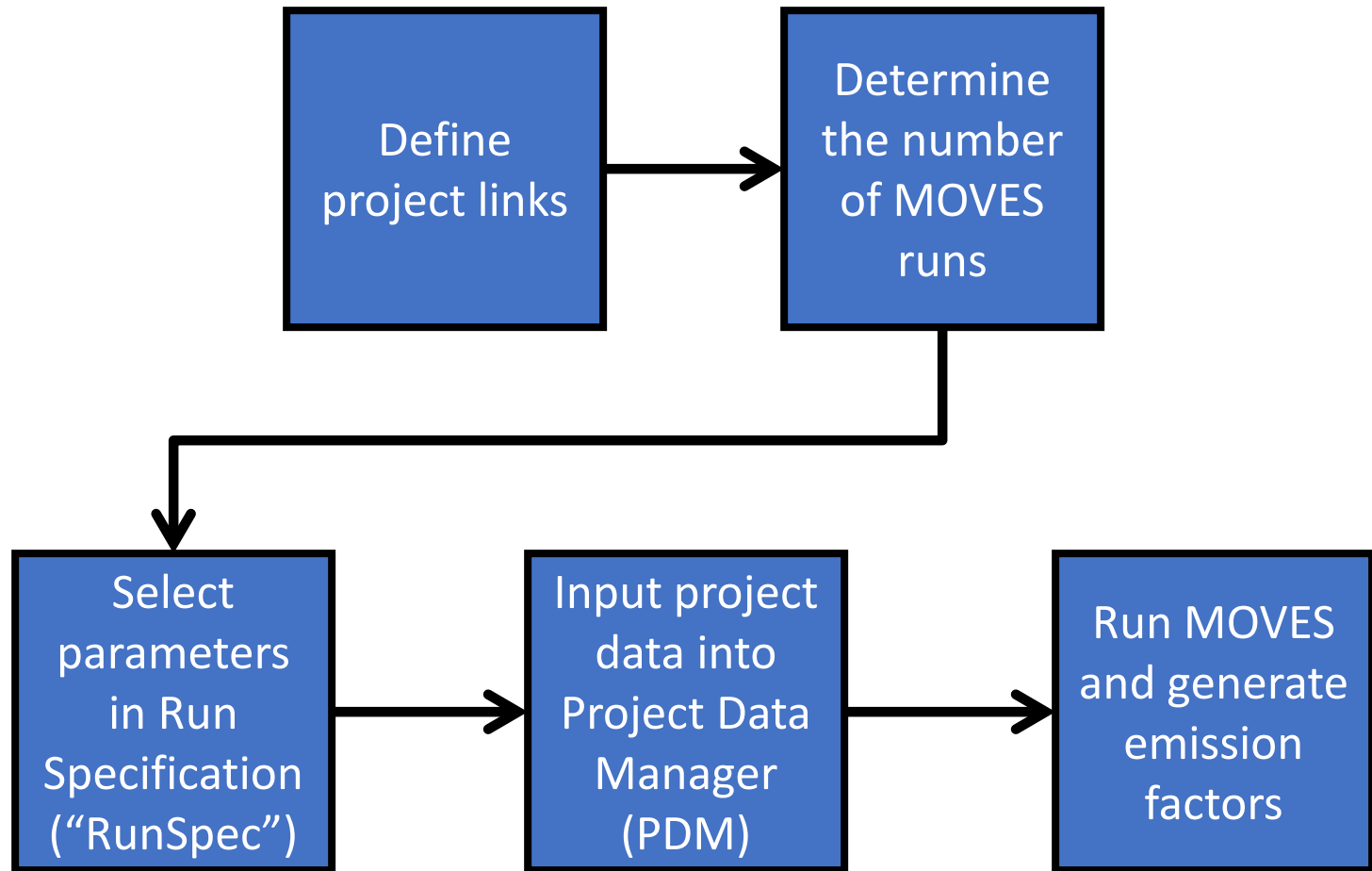
# Example Emission Rates by Speed, VSP, & Age

Source Bin: LDV Gasoline / 1996 MY





# Running MOVES at the Project Scale

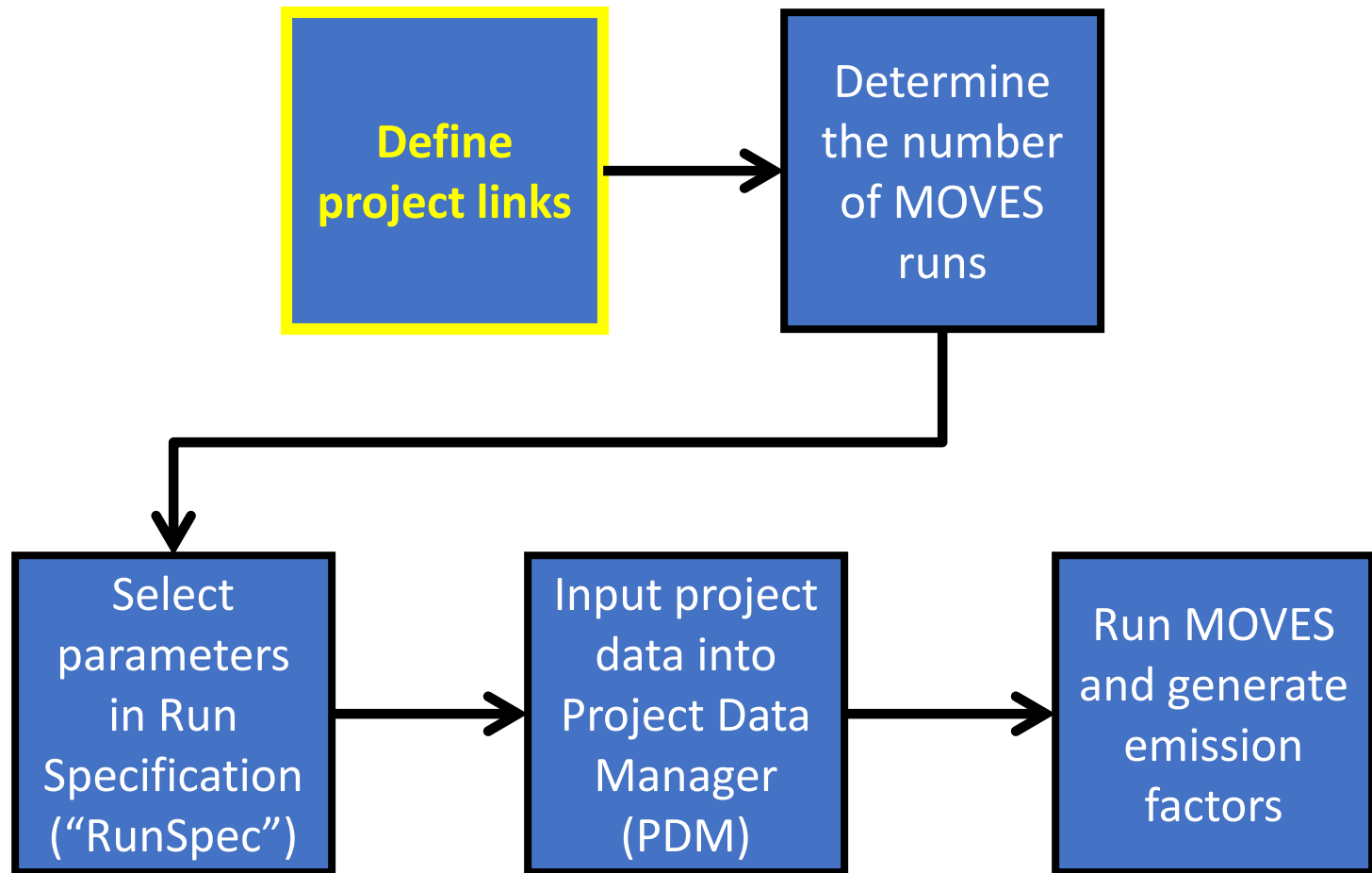




# Introduction to links and link activity information



# Running MOVES at the Project Scale





# What is a MOVES link?

- A link is a segment of road or an “off-network” location where a similar type of vehicle activity occurs
- There are two primary types of links:
  1. **Running links**
    - Used to describe driving activity: e.g., free-flow highways, ramps, arterials, intersections (cruise, deceleration, idle, and acceleration activity)
    - Running exhaust, crankcase, brake/tire wear emissions, and some evap processes
    - No limit on the number of running links in a run
  2. **Off-Network links**
    - Used to describe areas of start and hotelling activity: e.g., parking areas, truck or transit terminals
    - Only needed if a project contains vehicles starting or hotelling
    - Hotelling applies only to combination long-haul trucks, sourcetypeid 62
    - Only one off-network link can be defined per run



# Running Links

This is a simple example of two MOVES links. This example is a free-flowing highway section with no ramps or interchanges with consistent vehicle activity. The next example illustrates a more complex set of links.

**Link 1:  
Northbound**

**Link 2:  
Southbound**

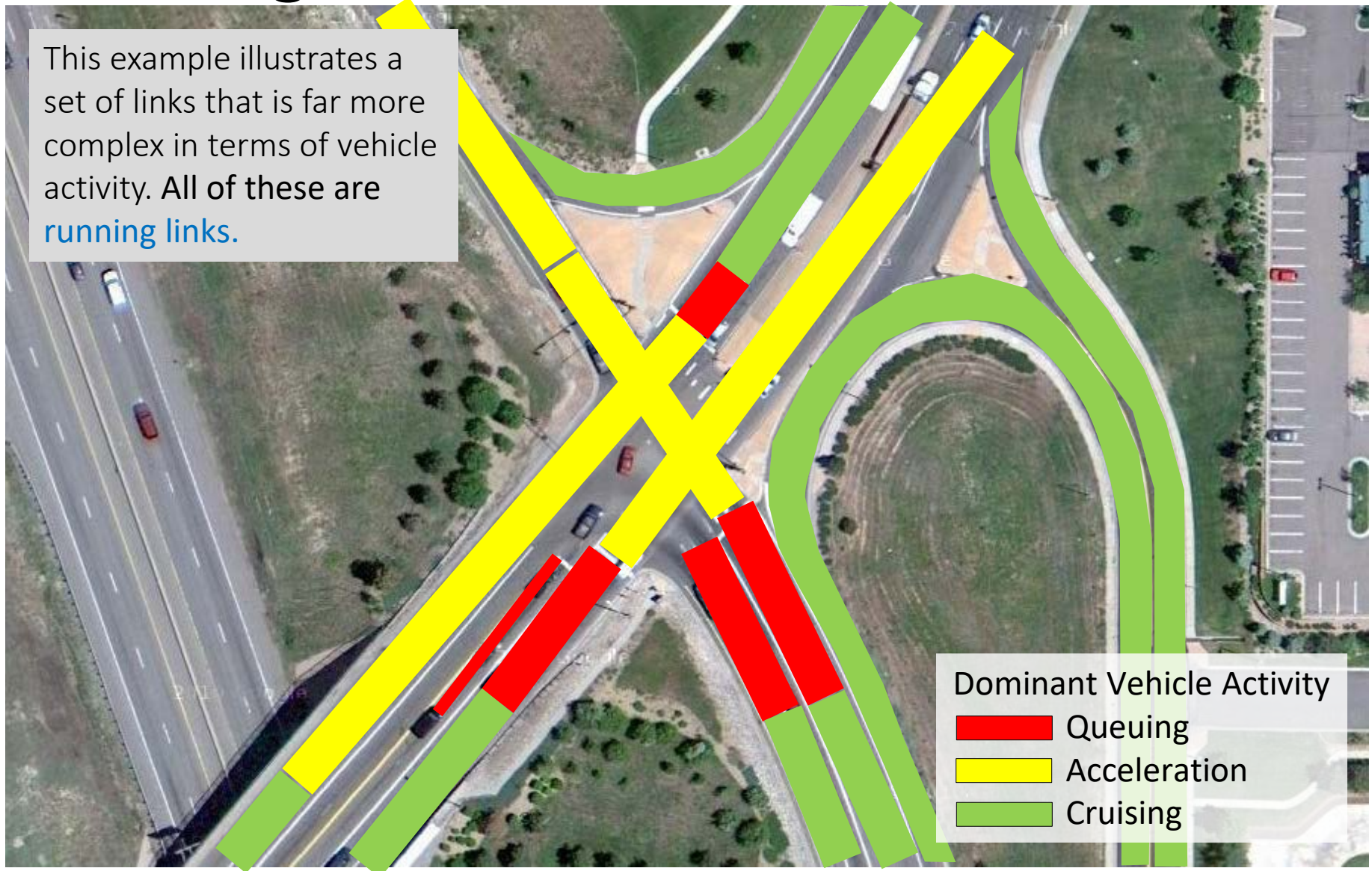
Dominant Vehicle Activity

-  Queuing
-  Acceleration
-  Cruising



# Running Links

This example illustrates a set of links that is far more complex in terms of vehicle activity. All of these are **running links**.





# Off-Network Links

Bus Terminal



Parking Lot



Truck Terminal



- **Off-network links** represent start and/or hotelling emissions only
  - Hotelling activity is done by “combination long-haul trucks” only
  - Starts and other off-network emissions processes (evaporative and refueling) apply to all vehicle types
- Any driving activity in the same area, including idling, should be represented with **running links**
  - E.g., buses idling at a bus terminal are not hotelling; their idling activity would be represented with a **running link**



# Primary Types of Projects

- Highway and intersection projects
  - Composed of **running links** (includes idling, accelerating, decelerating, and cruising at traffic signals)
    - Defined through MOVES Project Data Manager “**Links**” Input
    - Running exhaust, crankcase, brake/tire wear emissions are the focus
- Transit or other terminal projects
  - Include at least one **off-network link**
    - Defined through MOVES Project Data Manager “**Off-network**” Input (only one off-network link allowed per MOVES run – discussed later)
    - Used to calculate start and hotelling emissions
  - May also include running links
- Some projects involve both types of links



# General Guidance for All Projects

- Goal of defining a project's links in MOVES is to accurately estimate emissions where they occur
  - Which depend on vehicle types, volumes, and activity
- Should include segments with similar traffic/activity conditions and characteristics
- In general, the definition of a link (whether running or off-network) depends on vehicle activity
  - Running: acceleration, deceleration, cruise, or idle
  - Off-network: starts and hotelling



# General Guidance for All Projects

- EPA encourages the development of sufficient travel activity data to capture expected ranges of traffic conditions for build and no-build scenarios
- PM hot-spot analyses must be based on latest planning assumptions or data available when the analysis begins (40 CFR 93.110)
- Use interagency consultation process to select models, methods, and assumptions as described in local procedures (40 CFR 93.105(c)(1)(i))



# Modeling Highways and Intersections in MOVES



# Guidance for Highway and Intersection Links

- Divide project into separate MOVES links to allow sufficient resolution at different traffic and activity patterns
  - Local traffic data should be used to characterize each link sufficiently
- In general, density of links depends on project type:
  - Fewer links would be needed for free-flow highways
  - More links expected for intersections
- There is no limit on the number of running links in a MOVES run



# Highway Links

- For free-flow highway links (e.g., freeways) where vehicle behavior is fairly constant, the length of the MOVES link could be longer
  - **Note:** *Roadway curves or changes in road grade may necessitate a new link because of changes in vehicle operation*
- Free-flow highway links are assumed at steady-state flow
  - Relatively constant speed and minimal acceleration or deceleration
  - Expect free-flow speed if demand is below 1500 vehicles per hour per lane
- For highway ramps, multiple links may be needed to describe variation in vehicle activity
  - More details later



# Intersection Links

- Intersections need to be treated separately from free-flow MOVES links that connect to those intersections
  - Approaches and departures from intersections will likely involve acceleration, deceleration, and idling activity not present on free-flow links
- Definition of link length will depend on:
  - Geometry of intersection
  - How that geometry affects vehicle activity
  - The level of detail of available activity information
  - See Appendix D of PM hot-spot guidance for more details



# Defining Links

- New links should be defined when...
  - Speeds change (e.g., changes in activity over a highway ramp or intersection)
  - Volumes change (e.g., changes in volumes when vehicles use freeway exit ramps or turn at an intersection)
  - Fleets change (e.g., truck-only lane vs. all-purpose lane)
  - Facility purpose changes (e.g., a turn lane vs. a through lane of an intersection)
  - Road grade changes
- Details provided later on some of these examples



# Defining Vehicle Activity for Highways and Intersections

For each link, the user can choose one of three options to define activity:

1. Define a **link average speed** through the “Links” input
  - » MOVES has default OpMode distributions associated with average speed, based on typical driving cycles
  - » Different road types have different default OpMode distributions
2. Enter a **link specific drive cycle** through the “Link Drive Schedule” input
  - » MOVES calculates OpMode distribution from second-by-second speed/grade profile
  - » You could develop a drive cycle for a ramp link and use average speed for all other links
3. Directly enter a link specific **OpMode distribution** (not covered in this course) through the “Operating Mode Distribution” input
  - » Describes fraction of time spent in each OpMode bin on a link
  - » Not a direct output from current traffic models – but may be derived



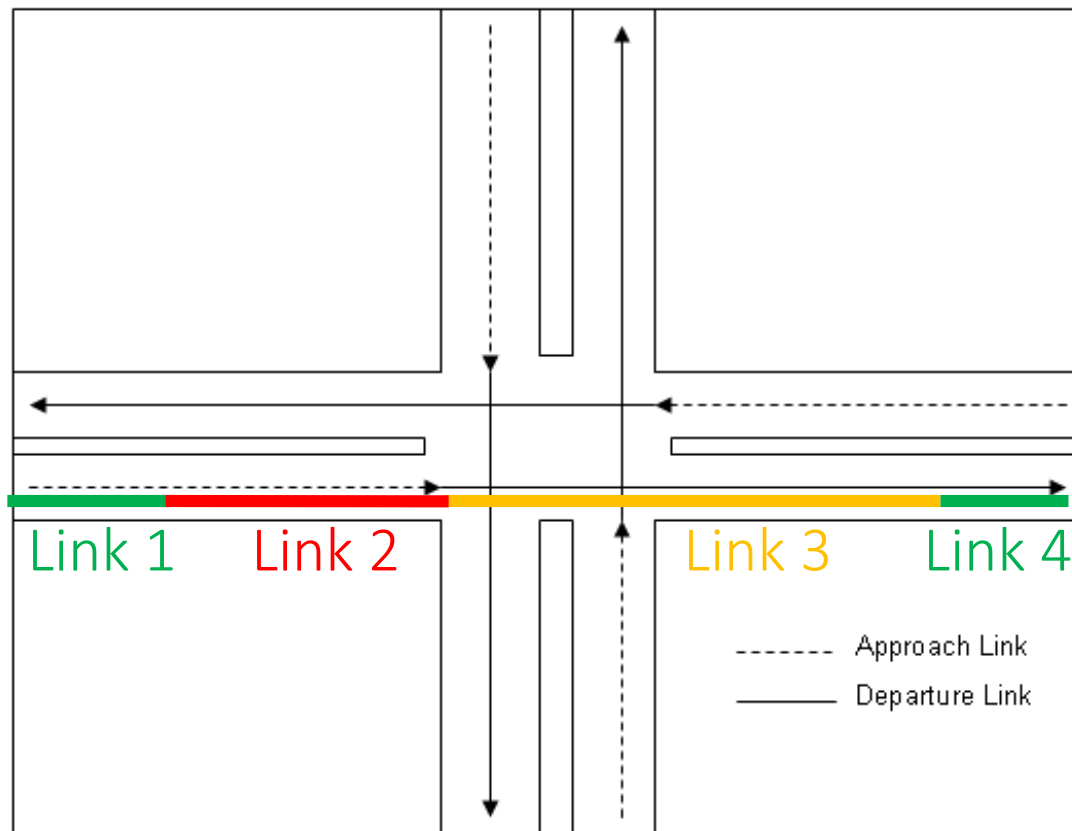
# Activity Option 1: Using Average Speed

- MOVES will use default drive cycles consistent with the average speed and vehicle type defined
- **Note:** *“Queue,” “Acceleration,” and “Cruise” links will include idle, cruise, acceleration, and deceleration activity in different proportions based on the link average speed*
- Other vehicle activity options may be preferred to more precisely define intersection activity (if data are available)



# Activity Option 1: Using Average Speed

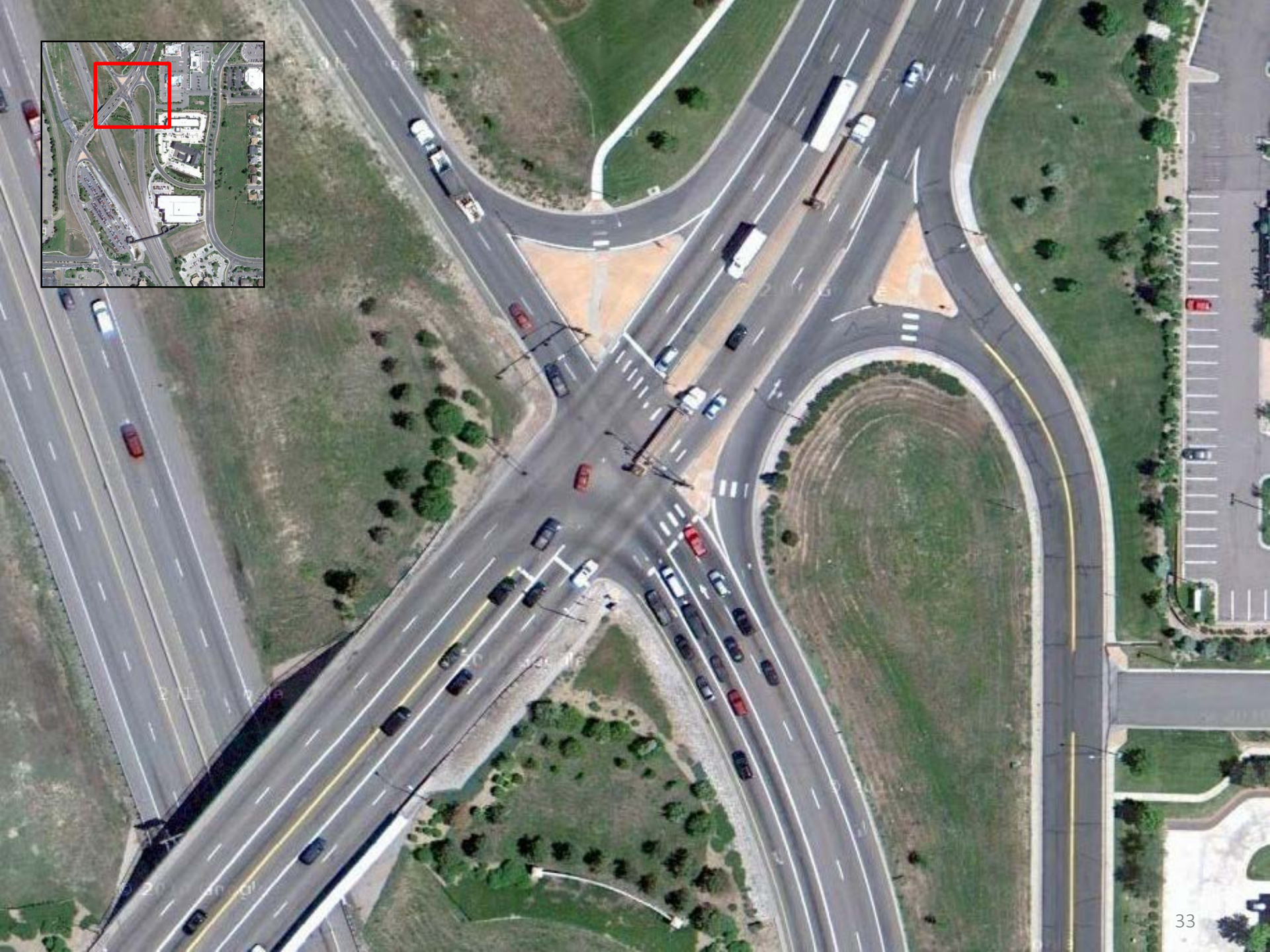
- In this example, links are defined to capture four unique areas of activity:
- **Link 1** – Cruise
- **Link 2** – “Queue” - Deceleration, Idle, and Acceleration (red light) also Cruise (green light)
- **Link 3** – Acceleration (red light) also Cruise (green light)
- **Link 4** - Cruise



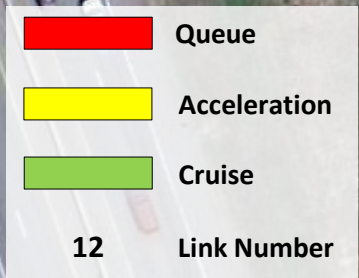


# Links Exercise Handout

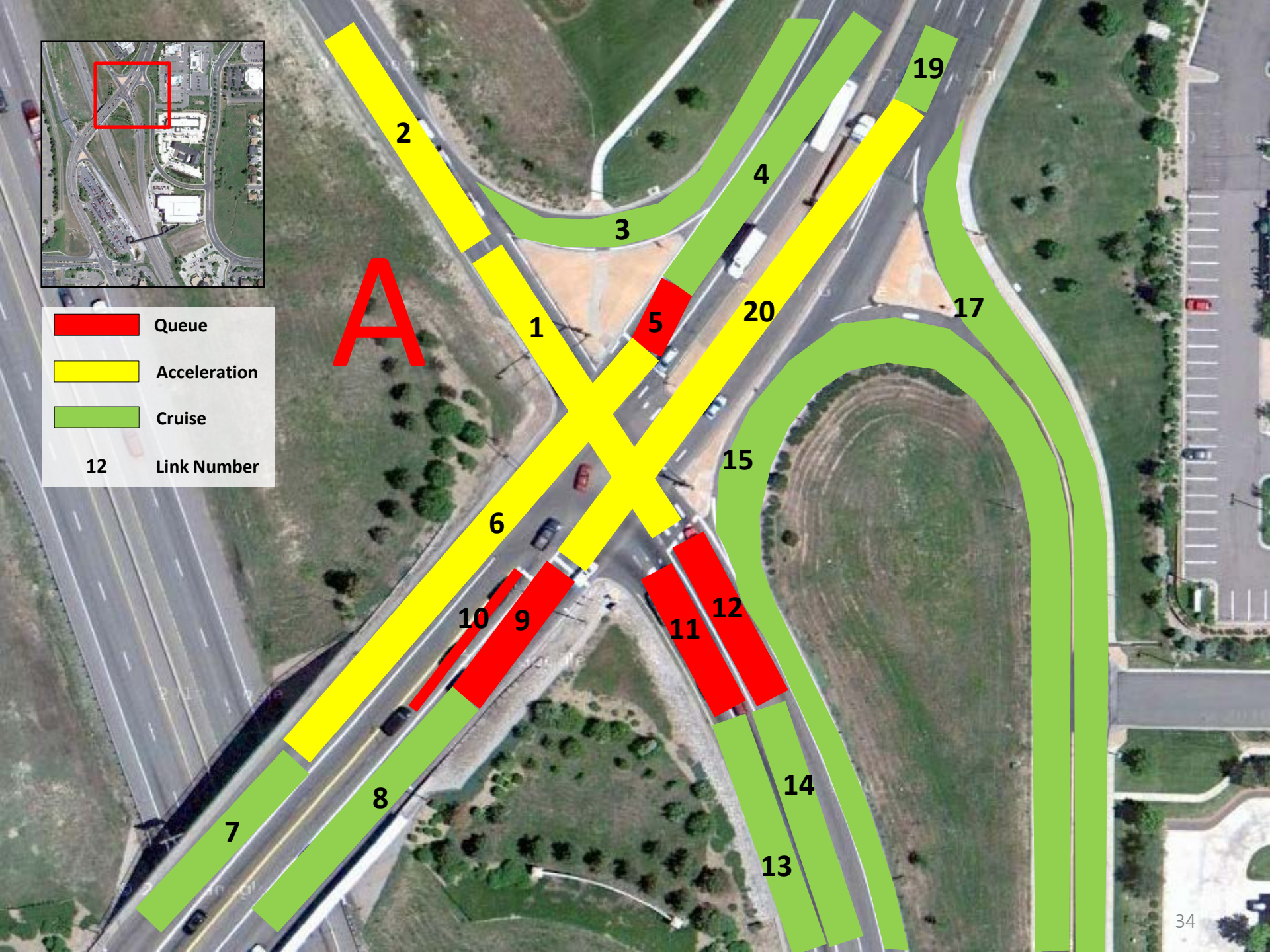








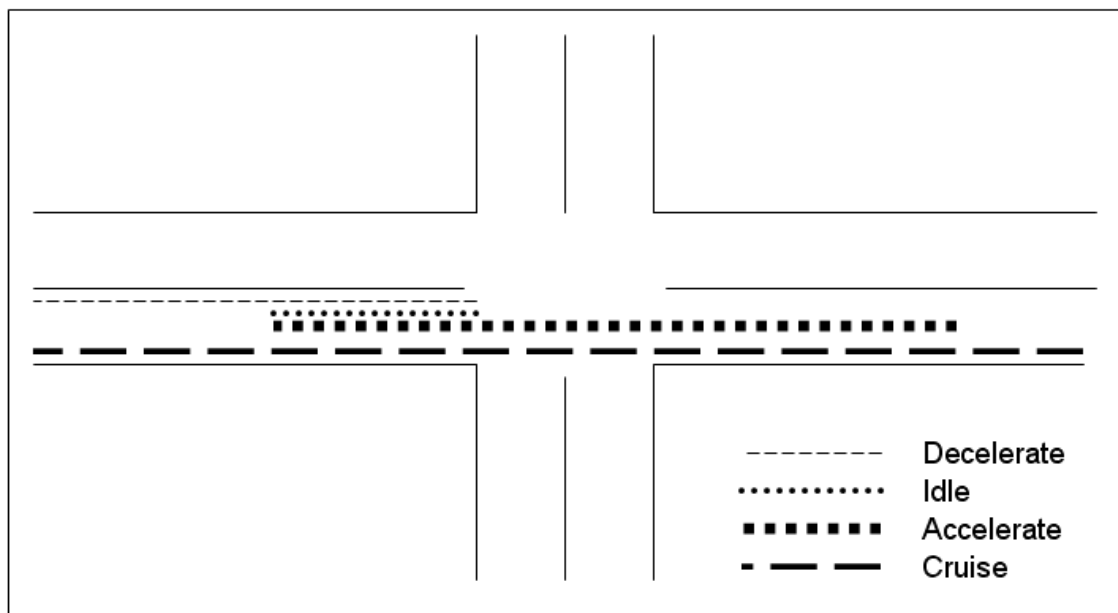
A





# Activity Option 2: Using Link Drive Schedules

- Each explicit type of activity can be considered a separate link (overlapping)
- Volumes defined on each type of link depend on signal timing
- Results can be modeled as individual (overlapping) links in air quality models



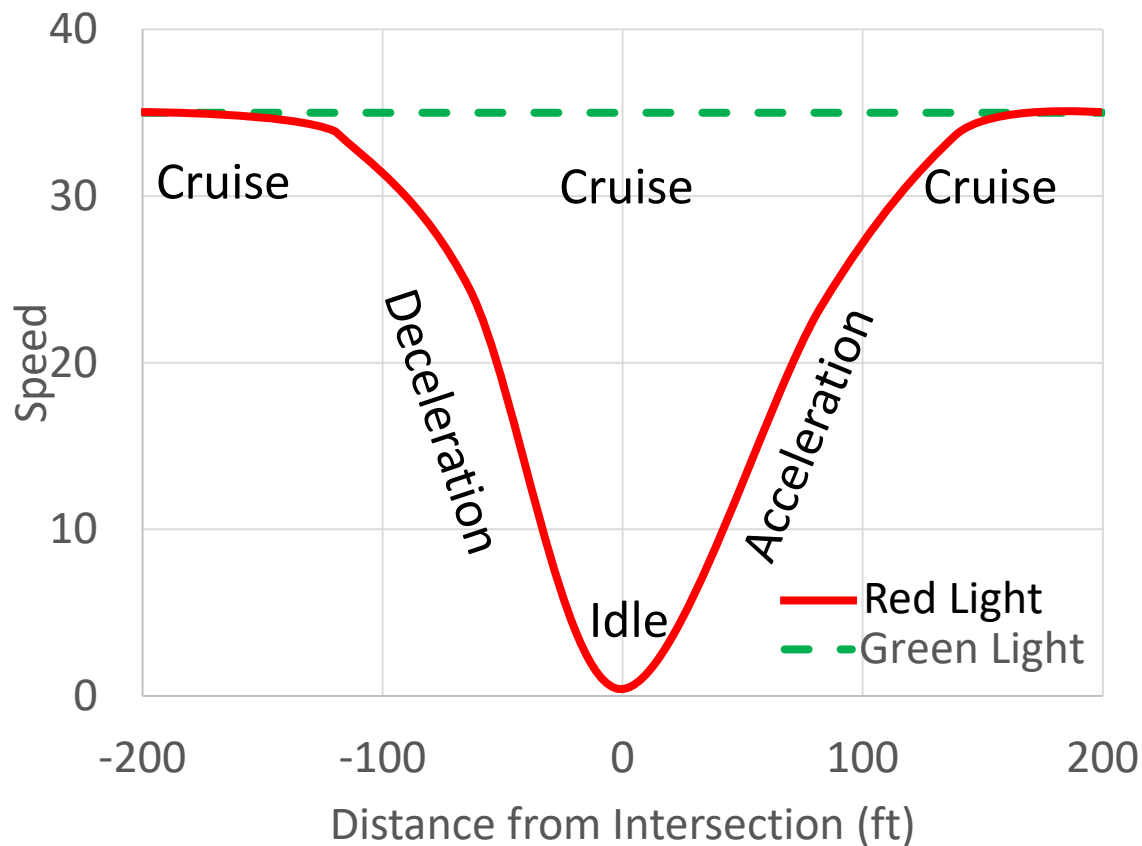
***Note:** Modeling activity using overlapping drive schedules requires some additional considerations not covered in this course*



# Activity Option 2: Using Link Drive Schedules

In an under-capacity situation, vehicles passing through intersections will use one of the following paths:

1. **Green light** cruise
2. **Red light** cruise → deceleration → idle → accelerate → cruise





# Activity Option 3: Using OpMode Distributions

- Users may define vehicle activity as the proportion of time spent in different modes of activity
- Determining the appropriate OpModeID for a given vehicle and type of activity:
  - Would require additional VSP calculation
  - Could be derived, but is not a direct output from current traffic models
  - May be done with available research tool - not covered in this course



# Typical Traffic Data

- What traffic data might be available for a project?
  - Network schematics with segment data:
    - Annual average daily traffic (AADT)
    - Peak-hour traffic volume (% of AADT)(k)
    - Directional split in peak-hour (D)
    - Truck percentage, daily or peak-hour (T)
    - Average speed (most likely for peak-hour)
- What additional traffic data might be needed?
  - Volumes, fleet mix, and speeds for additional time periods
  - Operational details (cruise, idle, deceleration, acceleration)
- See the “For Reference” section at the end of this module for additional information about defining links



# Modeling Terminals and Parking Lots



# Defining Links for Terminals and Parking Lots

- Most terminal and parking lot activity will be captured on one or more “off-network” links
  - Each link would describe an area with a certain number of vehicle starts per hour, and/or a certain number of trucks hotelling
  - **Only one off-network link allowed per MOVES run**
- Some terminal projects may have significant running emissions similar to highway and/or intersection projects
  - E.g., trucks arriving and leaving the loading area of freight terminal; buses idling at a bus terminal
  - Follow guidance for running links, as appropriate: Section 4.2.1 and Appendix D of PM Hot-spot Guidance
- Sources that are determined to be insignificant to project emissions (e.g., separate service drive, small employee parking lot) could be excluded



# Two Types of Idling Activity in MOVES

- MOVES defines two types of idling emissions:
  1. Hotelling: **Applies to long-haul combination trucks only**
    - Gives emission rates based on operating mode while trucks are hotelling
    - Treated in MOVES as an off-network input
    - Hotelling activity is described by 1 of 4 OpModeIDs in MOVES2014a:
      - OpMode ID 200 – Long Duration Idling
      - OpMode ID 201 – Auxillary Power Unit (APU) use
      - OpMode ID 203 – Battery (zero emissions)
      - OpMode ID 204 – Engine Off, Plug-in Electric Power (zero emissions)
  2. All other idling (e.g., from idling buses at a terminal)
    - Treated in MOVES as a running link with a speed of “0” mph
    - Not included as an off-network input
- MOVES produces emissions as if idling is occurring for the entire hour – if not, post processing of MOVES result will be needed
  - E.g., if idling is occurring for 20 minutes:  $\text{emissions} = \text{MOVES result} \times (1/3)$



# Off-Network Data for Terminals and Parking Lots

Emission Type	Applies to:	Off-Network Data Required
Starts	All source types	<ul style="list-style-type: none"><li>• Vehicle population</li><li>• Start fraction</li><li>• Soak time distribution</li></ul>
Hotelling	Long-haul combination trucks in hotelling operation <u>only</u>	<ul style="list-style-type: none"><li>• Vehicle population</li><li>• Hotelling fraction</li></ul>
All other Idling	All source types	None – not handled in MOVES as an off-network link. Treat as a running link with a speed of “0” mph

**Note:** How and where to enter the off-network data into MOVES is covered later in this module

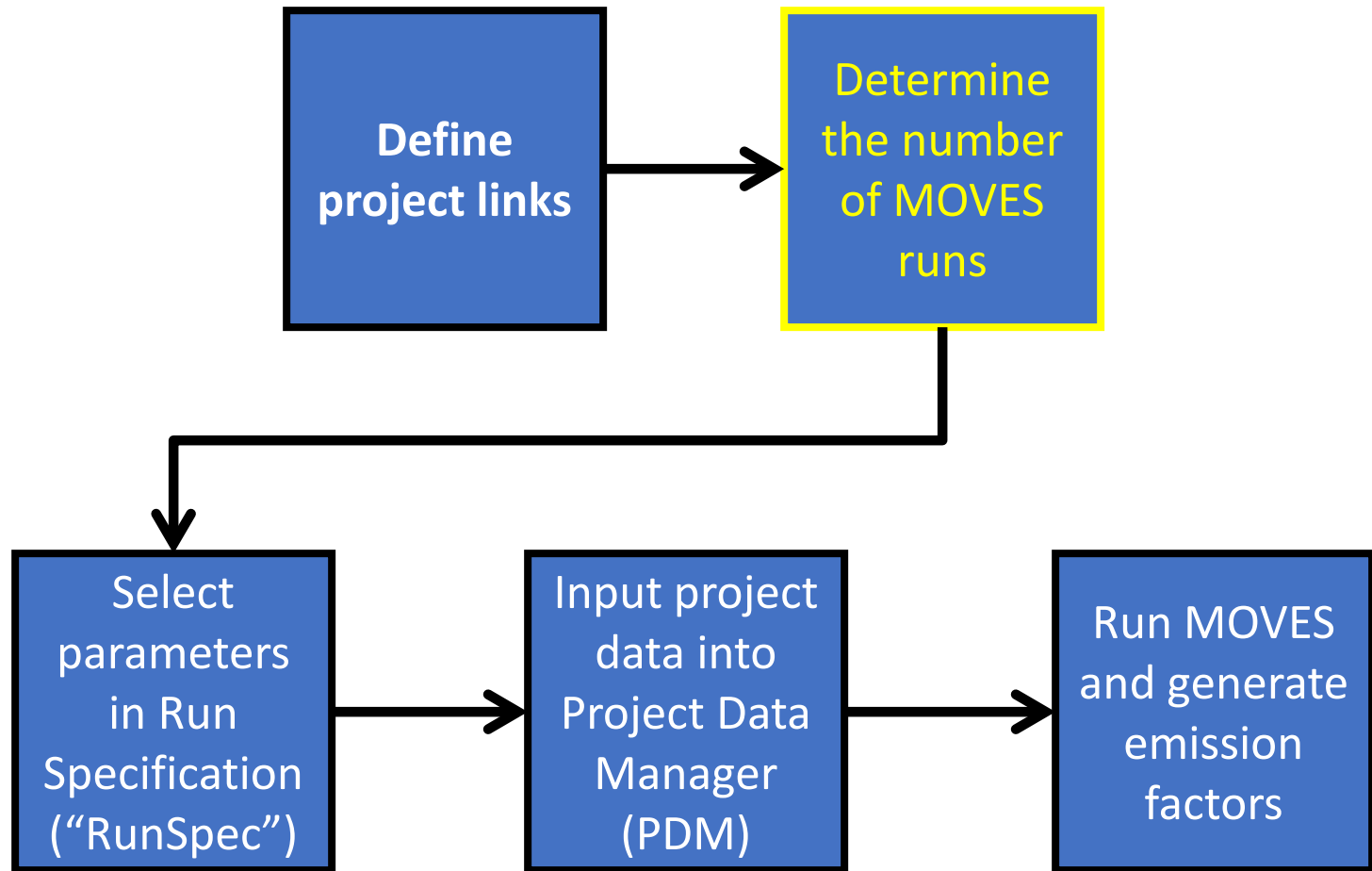


# Typical Terminal Data

- What data might be available for a project?
  - Fleet mix
  - Hourly estimates for starts and number of vehicles
    - Regular idling (e.g., bus idle) – idle dwell time
    - Hotelling (long-haul combination trucks only)
  - Running emissions in some cases
- What additional data might be needed?
  - Soak-time distribution (how long vehicles are parked before starting)
  - Operational details for running links (cruise, queue, deceleration, acceleration)



# Running MOVES at the Project Scale





# Guidance on Number of Runs

Minimum number of runs recommended:

Applicable NAAQS	Build Scenario	No-build Scenario
Annual PM <sub>2.5</sub> NAAQS only	16	16
24-hour PM <sub>2.5</sub> NAAQS only	16 (4 in certain cases)	16 (4 in certain cases)
24-hour PM <sub>10</sub> NAAQS only	16 (4 in certain cases)	16 (4 in certain cases)
Annual and 24-hour PM NAAQS	16	16

- 4 hours of a weekday x 4 seasons of a year = 16 runs per scenario
- Annual PM<sub>2.5</sub> NAAQS: **16 runs**
- 24-hour PM<sub>2.5</sub>, 24-hour PM<sub>10</sub> NAAQS: **16 runs**
  - Except where violations are expected to occur in only one season; can model with **4 runs** – use interagency consultation when deciding (see 40 CFR 93.105(c)(1) and PM Hot-spot Guidance Section 3.3.3)



# Why the Number of Runs Matters

- The recommended number of runs reflects the need to capture emissions variability across the day and year
- Emissions are based on:
  - Temperature
  - Vehicle Volumes
  - Vehicle Speeds
  - Fleet Mix
- Overall air quality is affected by the timing of emissions across the day and year



# Guidance for Highway/Intersection Projects

- Determine how many unique scenarios can sufficiently describe activity variation
- Number of runs should be based on the best available activity data and the PM NAAQS involved
  - 16 runs is a minimum (4 hours of a weekday x 4 seasons of a year), but you may have data for additional hours that you want to include
- Typical travel activity data involves annual average daily traffic (AADT) volumes, with an allocation factor for a daily peak-hour volume
  - The most reasonable methods in accordance with good practice should be used to obtain the peak-hour allocation factors and diurnal distribution of traffic
  - In accordance with interagency consultation procedures (40 CFR 93.105(c)(1)(i))



# Guidance for Highway/Intersection Projects

- 16 runs will capture emissions for:
  - 4 seasons:
    - January (Dec, Jan, Feb)
    - July (Jun, Jul, Aug)
    - April (Mar, Apr, May)
    - October (Sep, Oct, Nov)
  - 4 weekday time periods:
    - Morning peak (AM)
    - Evening peak (PM)
    - Midday (MD)
    - Overnight (ON)
    - Emission results for each of these 4 hours can be applied to the other hours of the day to cover the full day
- With typical travel activity data:
  - AM and PM peak periods can be represented by peak-hour traffic activity
  - MD and ON periods can be represented by off-peak activity
- With additional travel data:
  - If available, can use travel activity data that represents each of the 4 (or more) time periods



# Determining Representative Time Periods

A suggested approach for an analysis:

- Morning peak (AM) emissions based on traffic data and meteorology occurring between 6 a.m. and 9 a.m. (emissions from one hour/one MOVES run represent all three hours)
- Midday (MD) emissions based on data from 9 a.m. to 4 p.m.
- Evening peak (PM) emissions based on data from 4 p.m. to 7 p.m.
- Overnight (ON) emissions based on data from 7 p.m. to 6 a.m.

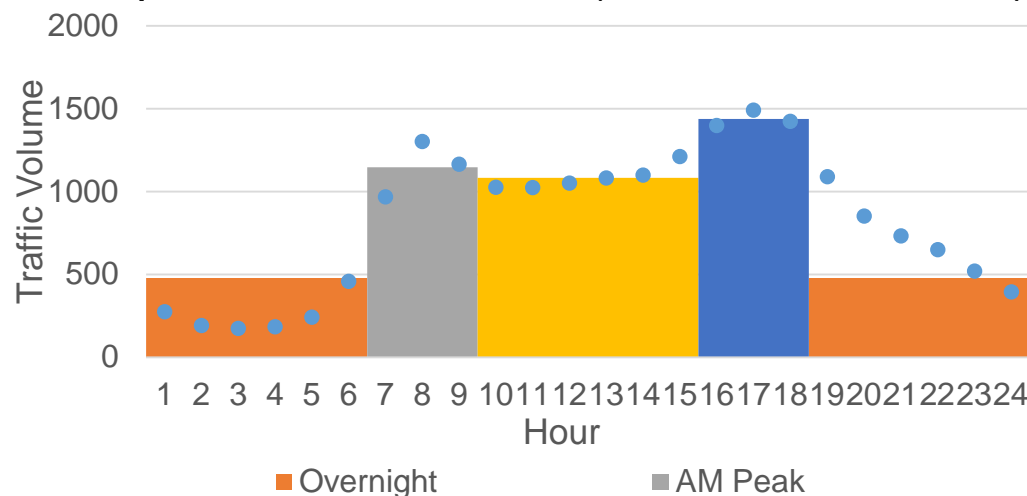
***Note:** Longer or shorter periods of time can be used if local or project-specific data supports; information should be documented in PM hot-spot analysis*



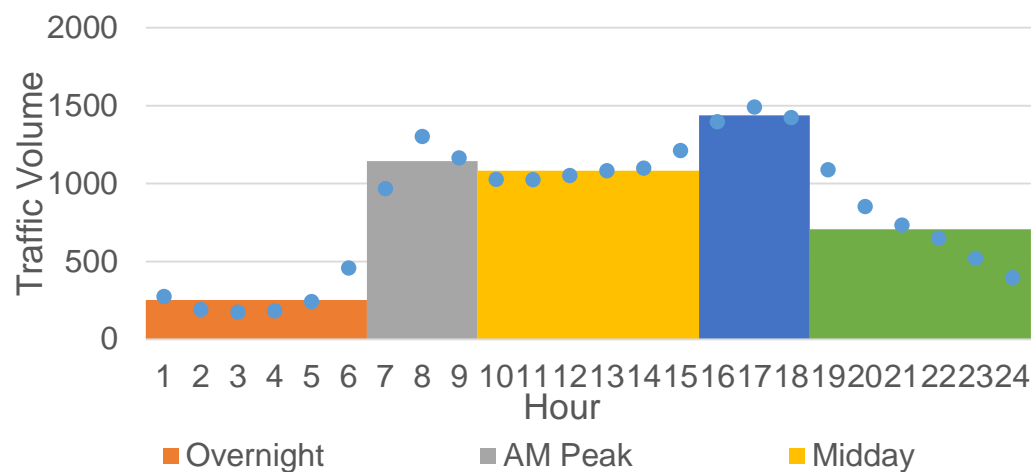
# Comparison of 4 vs. 5 Representative Time Periods

- Using traffic activity data from representative periods will better represent emissions
- In the example at right, using traffic volumes from 4 rep. periods would improve the estimate compared to using peak/off-peak volumes
- However, volume overestimated from Midnight-6 AM and underestimated 7-11 PM
- Splitting the “overnight” period so there are 5 representative periods improves the approximation to actual traffic volumes
- **Note:** Each additional representative period will result in 4 more MOVES runs

4 Representative Periods (min. recommended)



5 Representative Periods





# Determining Representative Time Periods

MOVES Run Scenario	Representative Period
January	December, January, February
April	March, April, May
July	June, July, August
October	September, October, November

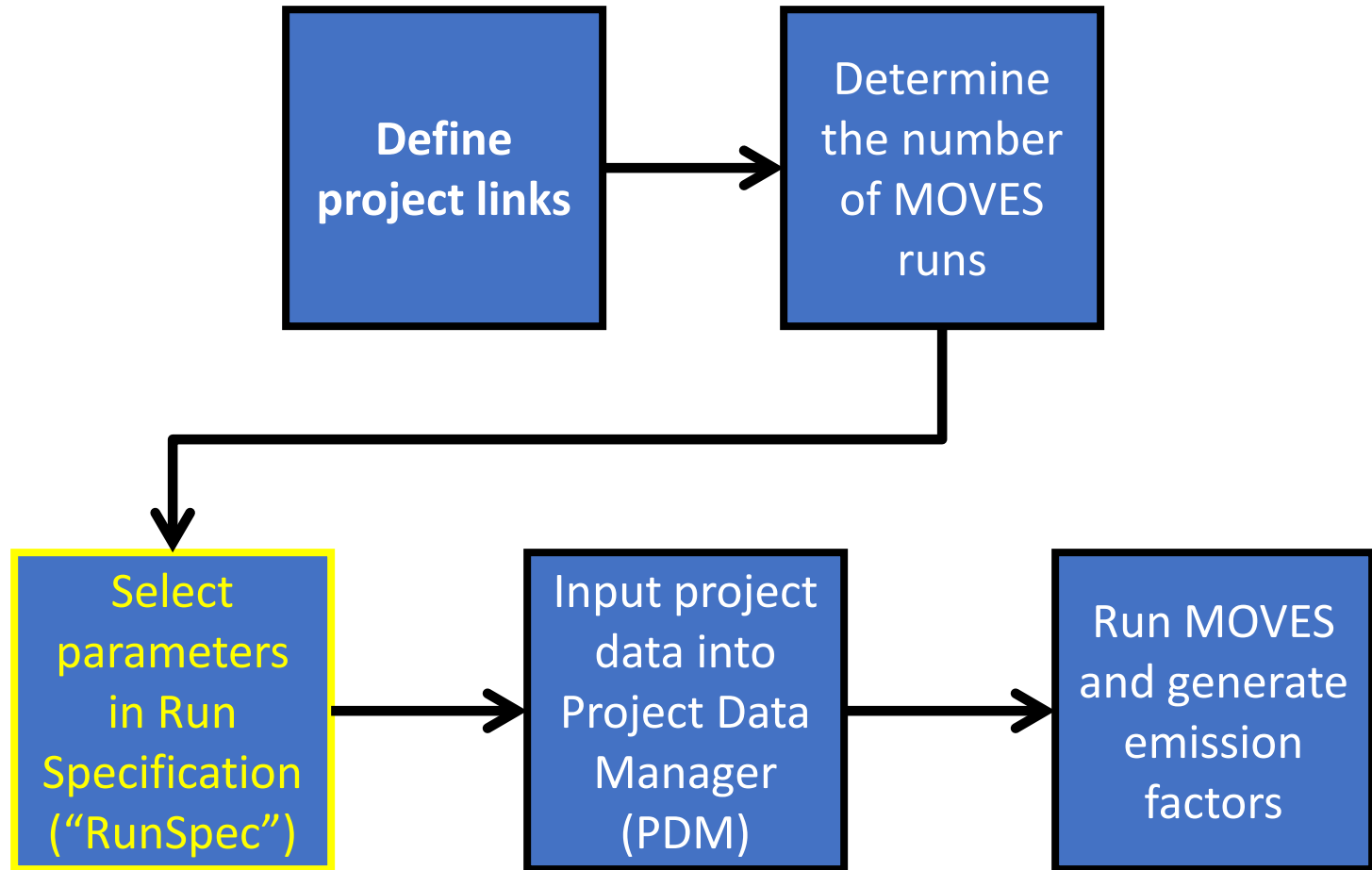


# Guidance for Terminals

- For transit or other terminal projects, it is likely that project sponsors will have more comprehensive activity data; possibly covering each hour of the day
- In these cases it may be appropriate to develop additional MOVES runs (beyond the recommended 16)
- The decision to model additional time periods should be made through interagency consultation and will depend on available data and whether using additional data would significantly impact emissions modeling results



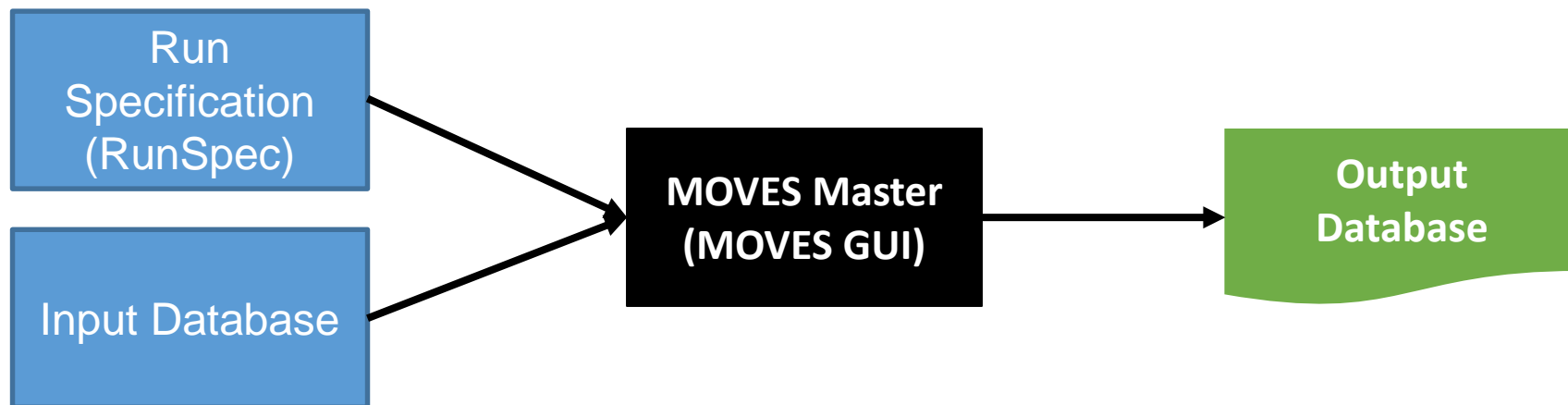
# Running MOVES at the Project Scale





# Setting Up a MOVES Run

- To run MOVES at the project scale, users must provide or create
  - A run specification, a.k.a. a “RunSpec” and
  - An input database
- When MOVES is run, it populates an output database





# Setting Up a RunSpec

- The MOVES GUI Navigation Panel is used to set up your RunSpec
- The RunSpec specifies the scale, location, time period, alternate data and output preferences of a MOVES run
- To setup a RunSpec, complete each item on the Navigation Panel by making selections on the sub-panels
  - Items marked with ≈ are optional but recommended
  - Items marked with ! are required
  - **Note:** All items on the Navigation Panel must show ✓ or ≈ to run MOVES.



# Setting Up a RunSpec

- Navigation Panel Items:
  - Description
  - Scale
  - Time Spans
  - Geographic Bounds
  - Vehicles/Equipment
  - Road Type
  - Pollutants and Processes
  - Manage Input Data Sets
  - Strategies
  - Output
  - Advanced Performance Features

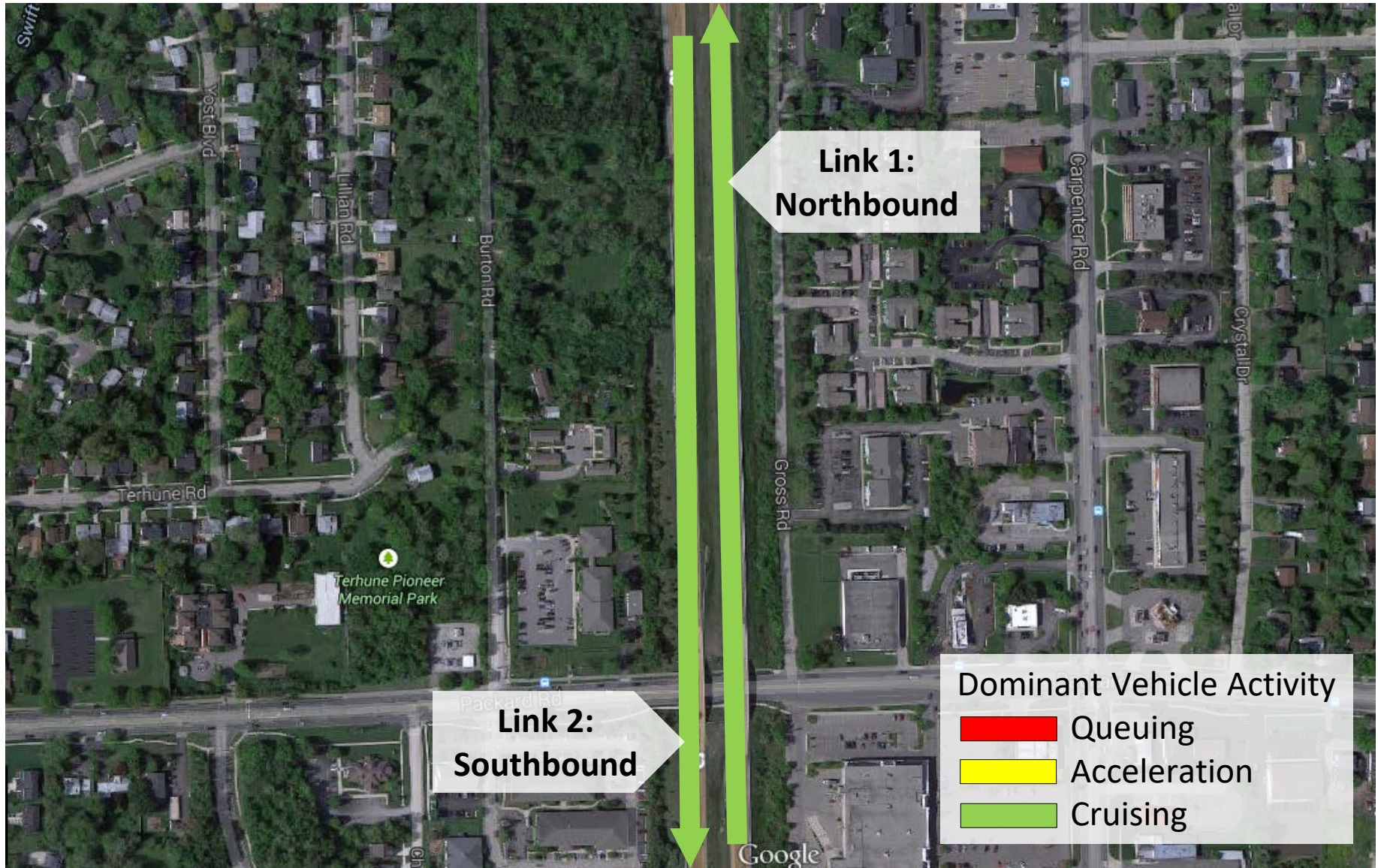


# MOVES Mini-Run

- Guidance will be explained as class walks through a very simple, hypothetical  $PM_{10}$  MOVES highway-only analysis
  - Example has been simplified for purpose of instruction
- MOVES Mini-Run Class Example (See Handout):
  - Project links consist of a 2-lane highway in Washtenaw County, MI
  - Analysis period is July 2016
  - 1-hour analysis (12:00 a.m.- 1:00 a.m.)
  - Evaluating long-haul trucks and passenger cars



# MOVES Mini-Run





# MOVES Mini-Run

- Two links:
  - Northbound – Link 1
    - 1.25 miles in length
    - 765 vehicles in analysis hour
    - 62.5 mph average speed
    - 95% gasoline passenger cars, 5% diesel combination long-haul diesel trucks
  - Southbound – Link 2
    - 1.25 miles in length
    - 690 vehicles in analysis hour
    - 61.0 mph average speed
    - 95% gasoline passenger cars, 5% diesel combination long-haul diesel trucks



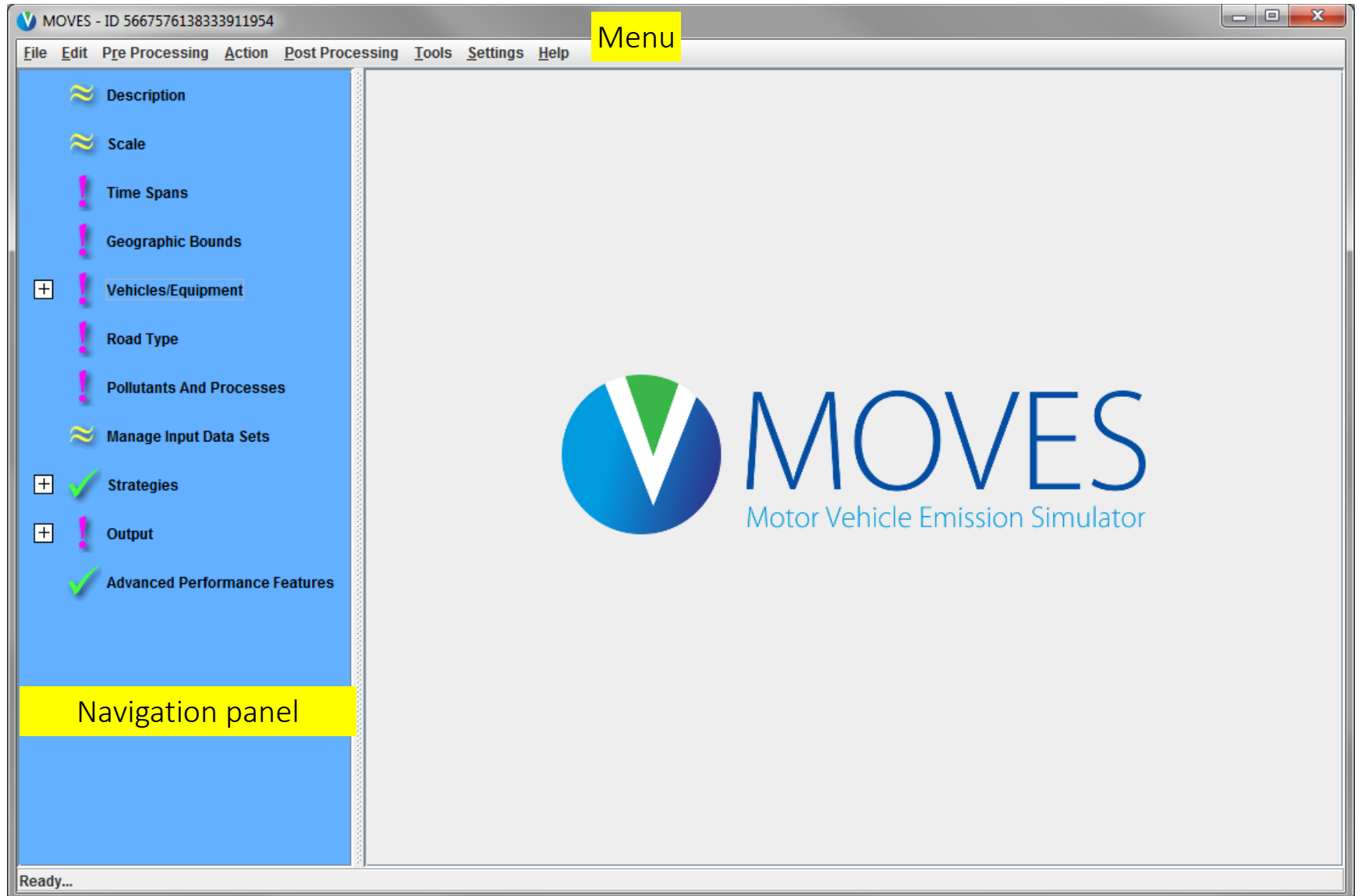
# Getting Started

- Begin by opening the latest version of MOVES2014
  - For example, *MOVES2014a* is the latest version at the time this module was developed
  - On your desktop, double-click the MOVES icon
  - If you have multiple versions of MOVES2014, use the latest version
- The MOVES Graphical User Interface will open





# MOVES Graphical User Interface (GUI)



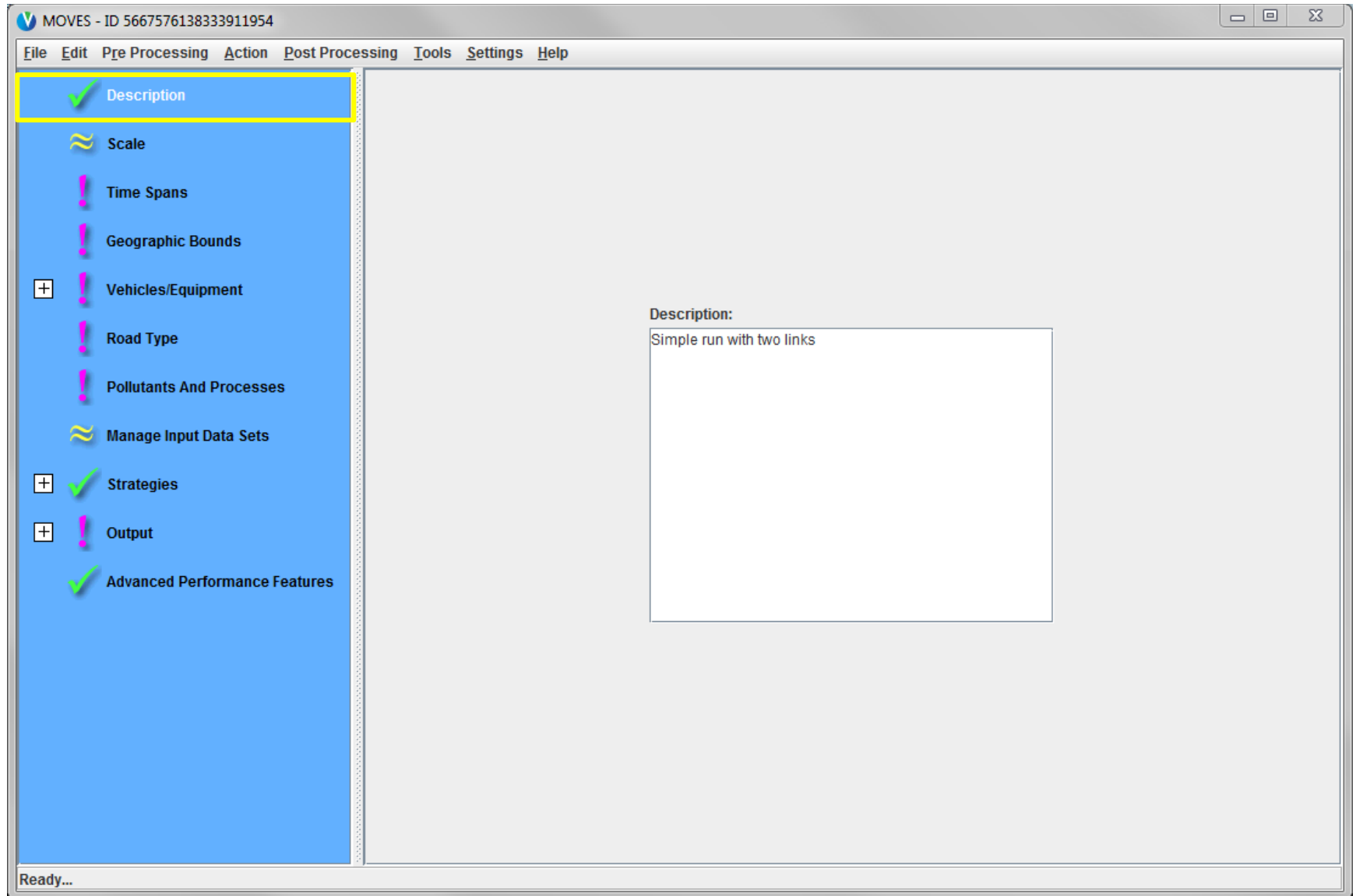


# Description Panel

- Allows the user to describe the RunSpec (what is being modeled)
  - Include details like location, time period, pollutant type, or whatever else is unique about the run
  - Up to 5,000 characters of text, but no quotation marks, ampersand or backslash characters allowed
  - Description appears in the MOVESRun table of the output database
  - Description is optional but useful to keep track of runs
- Instructions for the Mini-Run RunSpec:
  - Type, “Simple run with two links”



# Description Panel





# Scale and Calculation Type

- Scale should always be set to “Project” for hot-spot analyses
- Calculation Type can be specified as “Inventory” or “Emission Rates”
  - “Inventory” will produce aggregate emissions (e.g., grams, lbs, or tons per link)
  - “Emission Rates” will produce link specific emission factors:
    - grams/vehicle-mile
    - grams/vehicle-hour
    - grams/vehicle-start
- Instructions for the Mini-Run RunSpec:
  - For Model, select “Onroad”
  - For Domain/Scale, select “Project”



# Guidance on Calculation Type

- Either “Inventory” or “Emission Rates” can be selected as output, depending on the air quality model being used
- When using AERMOD, select “Inventory”
  - This will produce results for total emissions on each link, and since running MOVES at the project-scale produces results for only one hour, this is equivalent to a grams/hour emission factor needed by AERMOD
- When using CAL3QHCR, select “Emission Rates”
  - This will produce link emission factors needed by CAL3QHCR in
    - units of grams/vehicle-hour for link average speed of 0 mph, and
    - units of grams/vehicle-mile for link average speed greater than 0 mph
- Instructions for the Mini-Run RunSpec:
  - For Calculation Type, select “Inventory”



# Scale and Calculation Type

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

☒ Description

☒ Scale

☐ Time Spans

☐ Geographic Bounds

☐ Vehicles/Equipment

☐ Road Type

☐ Pollutants And Processes

☐ Manage Input Data Sets

☐ Strategies

☐ Output

☒ Advanced Performance Features


Model

☒ Onroad

☐ Nonroad

Domain/Scale

☐ National Use the default national database with default state and local allocation factors.

 Caution: Do not use this scale setting for SIP or conformity analyses. The allocation factors and other defaults applied at the state or county level have not been verified against specific state or county data and do not meet regulatory requirements for SIPs and conformity determinations.

☐ County Select or define a single county that is the entire domain.

Note: Use this scale setting for SIP and regional conformity analysis. Use of this scale setting requires user-supplied local data for most activity and fleet inputs.

☒ Project Use project domain inputs.


Note: Use this scale setting for project-level analysis for conformity, NEPA, or any other regulatory purpose. Use of this scale setting requires user-supplied data at the link level for activity and fleet inputs that describe a particular transportation project.

Calculation Type

☒ Inventory Mass and/or Energy within a region and time span.

☐ Emission Rates Mass and/or Energy per unit of activity.

MOVES ScenarioID:

 Caution: Changing these selections changes the contents of other input panels. These changes may include losing previous data contents.

Ready...



# Time Spans Panel

All sections on this panel must be completed for hot-spot analyses:

1. Time Aggregation Level: For Project-scale analyses, “Hour,” meaning no preaggregation, is the default selection
2. Only a single year can be selected
3. Only a single month can be selected
4. Only a single day type can be selected
5. Only a single hour can be selected

- Instructions for the Mini-Run RunSpec:

- For Year, select 2016;
- For Month, select July;
- For Days, select Weekdays;
- For Hours, select 00:00 - 00:59.



# Time Spans Panel

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

✓ Description  
✓ Scale  
✓ Time Spans  
! Geographic Bounds  
+ ! Vehicles/Equipment  
! Road Type  
! Pollutants And Processes  
Manage Input Data Sets  
+ ✓ Strategies  
+ ! Output  
✓ Advanced Performance Features

Time Aggregation Level  
☐ Year ☐ Month

Years  
Select Year: 2016 Add  
Years:  
2016 Remove

Days  
☐ Weekend  
☒ Weekdays  
Select All Clear All

Hours  
Start Hour: 00:00 - 00:59  
End Hour: 00:00 - 00:59  
Select All Clear All

☐ January ☒ July  
☐ February ☐ August  
☐ March ☐ September  
☐ April ☐ October  
☐ May ☐ November  
☐ June ☐ December  
Select All Clear All

Ready...

**Note:** Time Aggregation Level is set to “Hour” by default. Only one calendar year, month, day and hour can be selected



# Geographic Bounds Panel

- Once you have selected the Project scale, there are two choices available:
  - County: once this button selected, you would select a single county from the list, which allows access to the default data MOVES has for that county
  - Custom Domain: selected to represent a project spanning multiple counties, but no defaults are available
- On this panel, you also create/select an input database to store the project data (do this step after completing the RunSpec)



# Guidance on Selecting County or Custom Domain

- Users should select the actual county where the project is located
- If a project spans multiple counties, users have 3 options:
  1. If the fuel supply and age distribution of vehicles in the fleet are the same for all of the counties, select the county in which the majority of the project area is located;
  2. If not, separate the project into multiple parts (each of which is in a separate county) and do a separate MOVES run for each part; *or*
  3. Use the custom domain option to model multiple unique areas that share the same fuel and age distribution, but may have different meteorological data
- Instructions for the Mini-Run RunSpec:
  - Select County: MICHIGAN, MICHIGAN - Washtenaw, Click “Add”



# Geographic Bounds Panel

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

☒ Description

☒ Scale

☒ Time Spans

☒ **Geographic Bounds**

☐ Vehicles/Equipment

☐ Road Type

☐ Pollutants And Processes

☐ Manage Input Data Sets

☒ Strategies

☐ Output

☒ Advanced Performance Features

Region:

☐ Nation

☐ State

☒ County

☐ Zone & Link

☐ Custom Domain

States:

IOWA

KANSAS

KENTUCKY

LOUISIANA

MAINE

MARYLAND

MASSACHUSETTS

MICHIGAN

MINNESOTA

Counties:

MICHIGAN - Shiawassee County

MICHIGAN - St. Clair County

MICHIGAN - St. Joseph County

MICHIGAN - Tuscola County

MICHIGAN - Van Buren County

MICHIGAN - Washtenaw County

MICHIGAN - Wayne County

MICHIGAN - Wexford County

Selections:

MICHIGAN - Washtenaw County

Select All Add Delete

Domain Input Database

The Project domain scale requires a database of detailed data.

Server:

Database:

Refresh

Enter/Edit Data

Geographic Bounds Requirements

Please select a domain database.

Ready...



# Guidance on Selecting Vehicle Types

- For most analyses, select all vehicle and fuel types:
  - Diesel
  - Ethanol (E-85)
  - Compressed Natural Gas (CNG)
  - Gasoline
- **Note:** Some projects may have only one or a few vehicle types (e.g., a bus fleet running entirely on CNG)
  - Diesel fractions may still need to be adjusted through the “FuelType and Technology” input, regardless of what is selected here
  - Discussed later in example analysis
- **Instructions for the Mini-Run RunSpec:**
  - For Fuels, select Diesel Fuel, Ethanol (E-85), and Gasoline;
  - For Source Use Types, select Combination Long-haul Truck and Passenger Car, then, click “Add Fuel/Type Combinations”



# On Road Vehicle and Equipment Panel

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

☒ Description  
☒ Scale  
☒ Time Spans  
☐ Geographic Bounds  
☐ Vehicles/Equipment  
☒ On Road Vehicle Equipment  
☐ Road Type  
☐ Pollutants And Processes  
☐ Manage Input Data Sets  
☐ Strategies  
☐ Output  
☒ Advanced Performance Features

Fuels:

- Compressed Natural Gas (CNG)
- Diesel Fuel
- Electricity
- Ethanol (E-85)
- Gasoline

Source Use Types:

- Combination Long-haul Truck
- Combination Short-haul Truck
- Intercity Bus
- Light Commercial Truck
- Motor Home
- Motorcycle
- Passenger Car
- Passenger Truck
- Refuse Truck
- School Bus
- Single Unit Long-haul Truck
- Single Unit Short-haul Truck
- Transit Bus

Selections:

- Diesel Fuel - Combination Long-haul Truck
- Diesel Fuel - Passenger Car
- Ethanol (E-85) - Passenger Car
- Gasoline - Passenger Car

Select All Select All Delete

Add Fuel/Type Combinations

Ready...



# Road Types in MOVES

1. **Off-Network** – Any location where the predominant activity is vehicle starts and hotelling, i.e., parking lots, truck stops, rest areas, freight or bus terminals (roadtypeID = 1)
2. **Rural Restricted Access** – A rural highway that can be accessed only by an on-ramp (roadtypeID = 2)
3. **Rural Unrestricted Access** – All other rural roads, i.e., arterials, connectors, and local streets (roadtypeID = 3)
4. **Urban Restricted Access** – An urban highway that can be accessed only by an on-ramp (roadtypeID = 4)
5. **Urban Unrestricted Access** – All other urban roads, i.e., arterials, connectors, and local streets (roadtypeID = 5)



# HPMS Road Type Mapping

HPMS		MOVES	
f_system (functional system)	Description	RoadTypeID*	Description
1	Interstate	2 or 4	Urban or Rural restricted access
2	Principal Arterial - Other Freeways and Expressways	2 or 4	Urban or Rural restricted access
3	Principal Arterial - Other	3 or 5	Urban or Rural unrestricted access
4	Minor Arterial	3 or 5	Urban or Rural unrestricted access
5	Major Collector	3 or 5	Urban or Rural unrestricted access
6	Minor Collector	3 or 5	Urban or Rural unrestricted access
7	Local	3 or 5	Urban or Rural Unrestricted access

\*Urban or rural designation for MOVES roadtypeID is determined by HPMS urban\_code where 99999 or 99998 denote rural and all other values denote urban

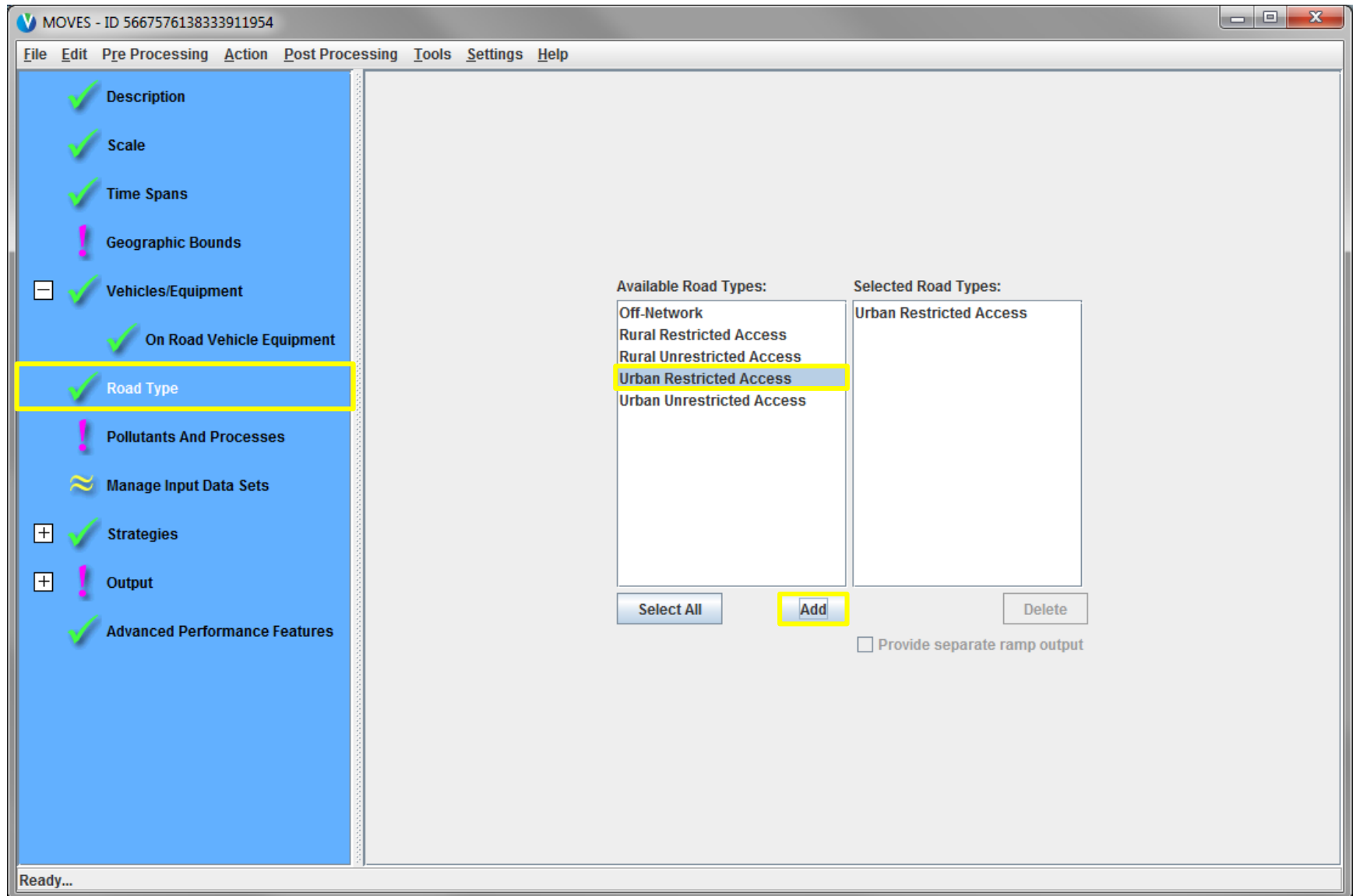


# Guidance on Selecting Road Types

- Select all road types that exist within the project
  - ***Note:** Do not select road types that do not exist in project*
  - MOVES Road type can be determined by HPMS classification
- Off-network road type should be selected only if an Off-Network link exists (i.e., the project has start or hotelling activity)
  - Used for parking lots, intermodal facilities, bus terminals, etc.
- Some pollutant-process selections automatically select certain road types
  - Ex: Selecting start emissions or extended idle emissions in the Pollutants and Processes panel will automatically select the “Off-network” road type
- [Instructions for the Mini-Run RunSpec:](#)
  - For Available Road Types, select “Urban Restricted Access”. Click “Add”.



# Road Type Panel





# Guidance on Selecting Pollutants & Processes

- To perform a PM Hot-spot analysis, you must select the following:\*

## Pollutants:

- Primary Exhaust PM – Total (Either PM<sub>10</sub> or PM<sub>2.5</sub>)
- Brake Wear Particulate (running links only)
- Tire Wear Particulate (running links only)

## Processes:

For running links:	For off-network links:
• Running Exhaust	• Start Exhaust
• Crankcase Running Exhaust	• Extended Idle Exhaust
• Brake Wear	• Crankcase Start Exhaust
• Tire Wear	• Crankcase Extended Idle Exhaust
	• Auxiliary Power Unit (APU) Use

\*Note: Some pollutants and processes are chained. For example, many PM<sub>2.5</sub> processes are chained to PM<sub>10</sub> processes.



# Guidance on Selecting Pollutants & Processes

- Instructions for the Mini-Run RunSpec:
  - For Pollutants, select:
    - Primary Exhaust PM10 - Total,
    - Primary PM10 - Brakewear Particulate, and
    - Primary PM10 - Tirewear Particulate,
    - Then click “Select Prerequisites”
      - Scroll to the right to review associated processes.
  - Be sure to unselect any off-network associated processes such as “Start Exhaust”, “Extended Idle Exhaust”, “Auxiliary Power Exhaust” etc.
    - **Note:** “Selecting Prerequisites” will include off-network associated automatically processes and will automatically select “Off-Network” on the Road Type panel. For our mini-run, **remove** the associated off-network processes and **manually delete** the “Off-Network” Road Type in the Road Type panel.



# Pollutants and Processes Panel

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

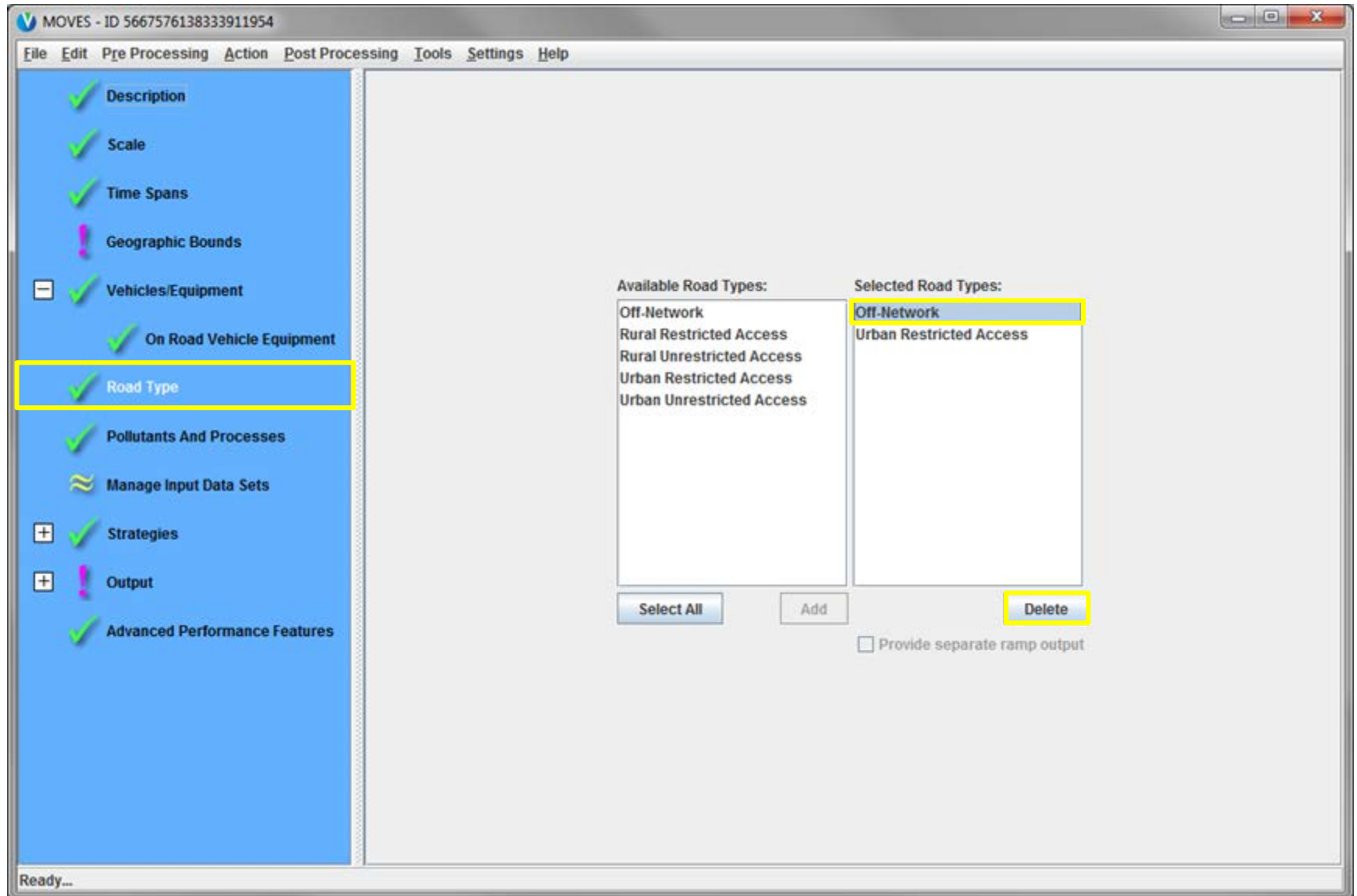
☒ Description  
☒ Scale  
☒ Time Spans  
☐ Geographic Bounds  
☐ Vehicles/Equipment  
☒ On Road Vehicle Equipment  
☒ Road Type  
☒ **Pollutants And Processes**  
☐ Manage Input Data Sets  
☐ Strategies  
☐ Output  
☒ Advanced Performance Features

	Running Exhaust	Start Exhaust	Brakewear	Tirewear	Evap Permeation	Evap Fuel Vapor <sup>1</sup>
<input type="checkbox"/> Total Gaseous Hydrocarbons	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Non-Methane Hydrocarbons	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Non-Methane Organic Gases	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Total Organic Gases	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Volatile Organic Compounds	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Methane (CH <sub>4</sub> )	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Carbon Monoxide (CO)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Oxides of Nitrogen (NO <sub>x</sub> )	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrogen Oxide (NO)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrogen Dioxide (NO <sub>2</sub> )	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrous Acid (HONO)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Ammonia (NH <sub>3</sub> )	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrous Oxide (N <sub>2</sub> O)	<input type="checkbox"/>	<input type="checkbox"/>				
<input checked="" type="checkbox"/> Primary Exhaust PM <sub>2.5</sub> - Total	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
<input checked="" type="checkbox"/> (+) Primary Exhaust PM <sub>2.5</sub> - Species	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
<input checked="" type="checkbox"/> Primary PM <sub>2.5</sub> - Brakewear Particulate			<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/> Primary PM <sub>2.5</sub> - Tirewear Particulate				<input checked="" type="checkbox"/>		
<input checked="" type="checkbox"/> Primary Exhaust PM <sub>10</sub> - Total	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
<input checked="" type="checkbox"/> Primary PM <sub>10</sub> - Brakewear Particulate			<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/> Primary PM <sub>10</sub> - Tirewear Particulate				<input checked="" type="checkbox"/>		
<input type="checkbox"/> Sulfur Dioxide (SO <sub>2</sub> )	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Total Energy Consumption	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Petroleum Energy Consumption	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Fossil Fuel Energy Consumption	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Atmospheric CO <sub>2</sub>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> CO <sub>2</sub> Equivalent	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Benzene	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Ethanol	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> MTBE	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>

Ready...



# Road Type Panel



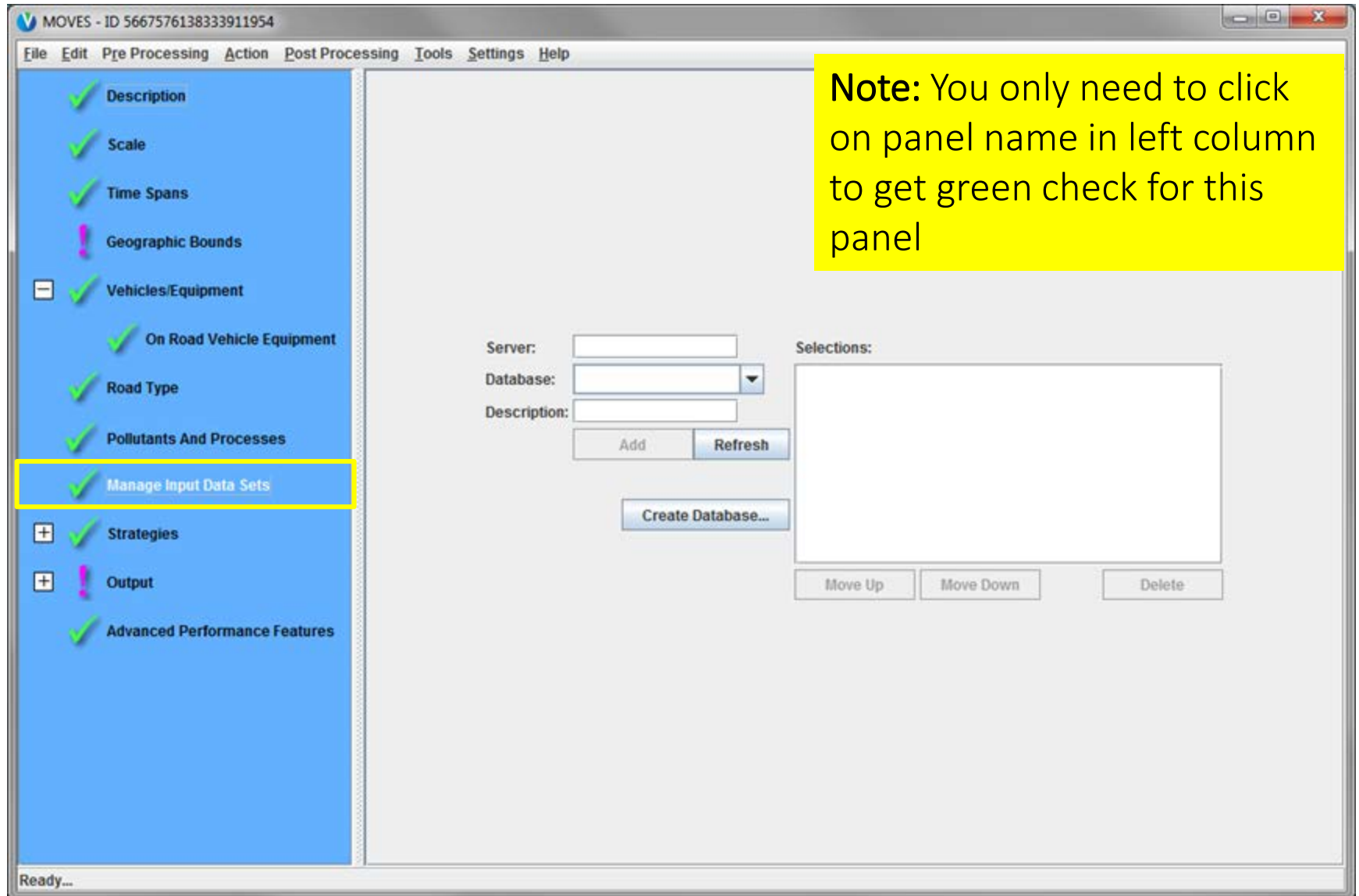


# Guidance on Manage Input Data Sets Panel

- Most PM hot-spot analyses will not use this panel
- Instead, the Project Data Manager (PDM) will be used to input project-specific data

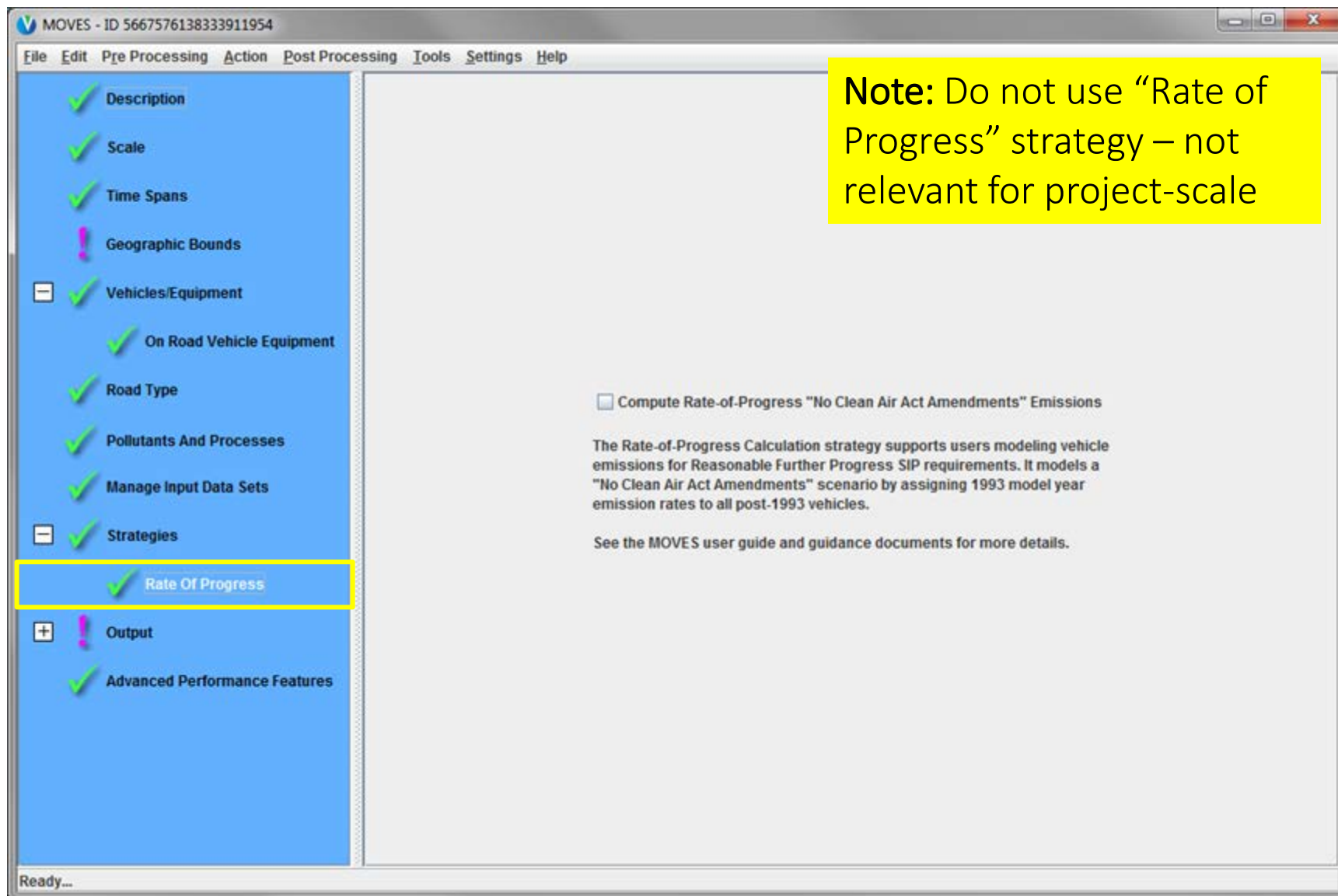


# Manage Input Data Sets Panel





# Strategies Panel – Rate Of Progress





# General Output Panel

- On this panel, name the output database
- Selecting Activity output is useful for diagnostic purposes
  - Will report what was input for different activity parameters
- “Distance Traveled” and “Population” should be selected
  - Selecting “Rates” calculation in the Scale panel will automatically select “Distance Traveled” and “Population”
  - Population will reflect vehicle population
- Selecting “Starts” and “Source Hours Idling” may also be helpful for confirmation that starts and idling you get from output is consistent with input



# Database Naming Recommendations

- Name the RunSpec file and databases for a specific run using the same name, but with different extensions
  - Examples:

RunSpec:	Simplerun. <b>mrs</b>
Input database:	Simplerun_ <b>in</b>
Output database:	Simplerun_ <b>out</b>
  - Identifies each part of the run file
  - Helps organize information



# General Output Panel

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ Road Type
  - ✓ Pollutants And Processes
  - ✓ Manage Input Data Sets
- [-] ✓ Strategies
  - ✓ Rate Of Progress
- [-] ! Output
  - ✓ General Output**
  - ! Output Emissions Detail
  - ✓ Advanced Performance Features

Output Database

Server:  Refresh

Database:  Create Database...

Units

Mass Units:

Energy Units:

Distance Units:

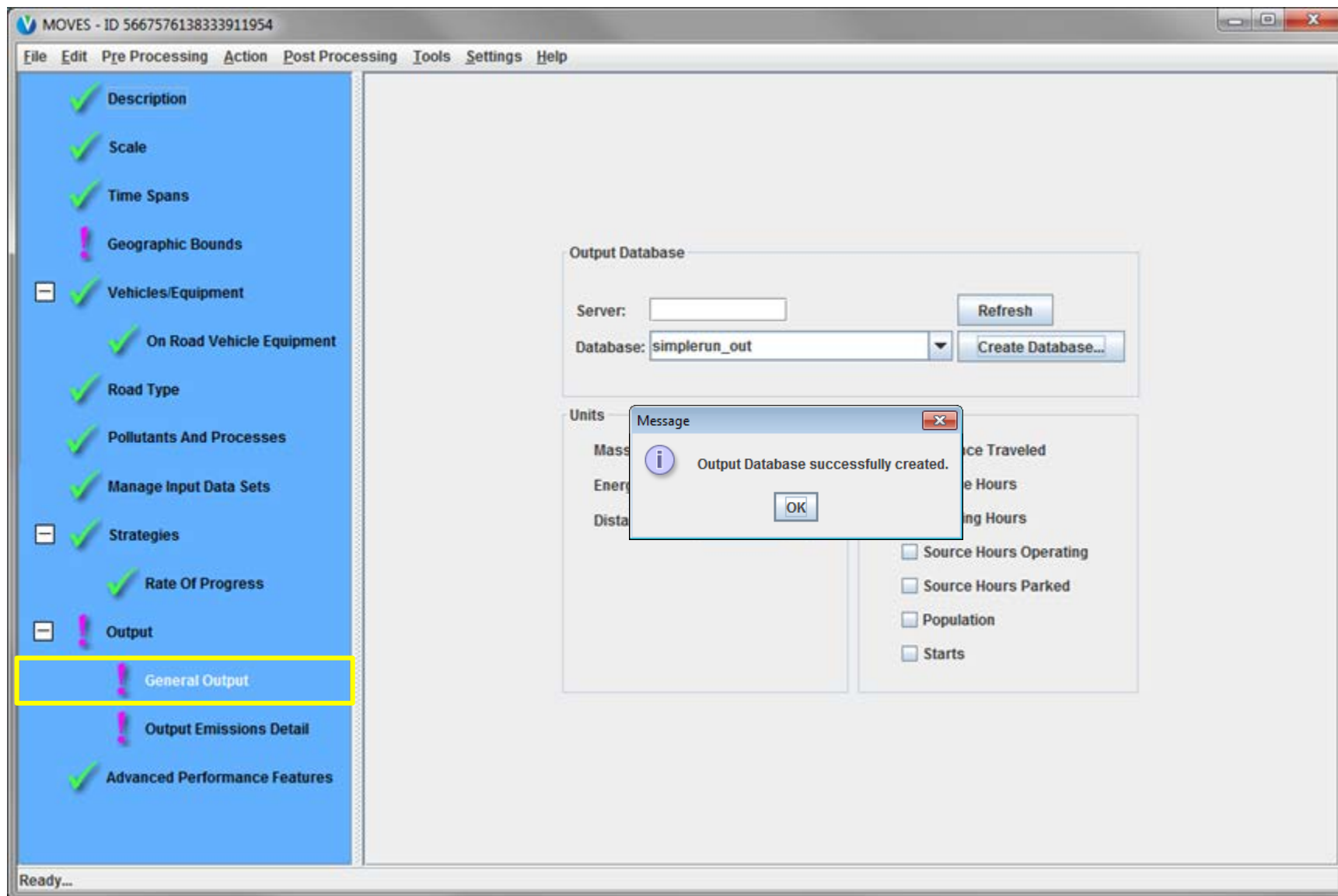
Activity

- ☒ Distance Traveled
- ☐ Source Hours
- ☐ Hotelling Hours
- ☐ Source Hours Operating
- ☐ Source Hours Parked
- ☒ Population
- ☐ Starts

Ready...



# General Output Panel





# Guidance on Output Emission Detail Panel

- The aggregation of the Time level is set to “Hour” and “Link” by default
- The “for All Vehicle/Equipment Categories” and “On Road” selections depend on the detail desired by the user
  - More selections means more detail
  - Differentiation by Emission Process and Source Type is likely most useful
- ***Note:** If “Rates” was selected in the Scale Panel, do not select output by Source Type, Model Year, or Fuel Type*



# Output Emission Detail Panel

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ Road Type
  - ✓ Pollutants And Processes
  - ✓ Manage Input Data Sets
- [-] ✓ Strategies
  - ✓ Rate Of Progress
- [-] ✓ Output
  - ✓ General Output
  - ✓ **Output Emissions Detail**
  - ✓ Advanced Performance Features

**Always**

- ☒ Time
- ☒ Location
- ☒ Pollutant

**for All Vehicle/Equipment Categories**

- ☐ Model Year
- ☐ Fuel Type ☐ Fuel Subtype
- ☒ **Emission Process**

☐ Estimate Uncertainty

**On Road/Off Road**

- ☒ On Road/Off Road
- On and Off Road**
  - ☐ Road Type
  - ☒ **Source Use Type**
  - ☐ SCC
  - ☐ Regulatory Class
- Off Road**
  - ☐ Sector
  - ☐ Engine Tech.
  - ☐ HP Class

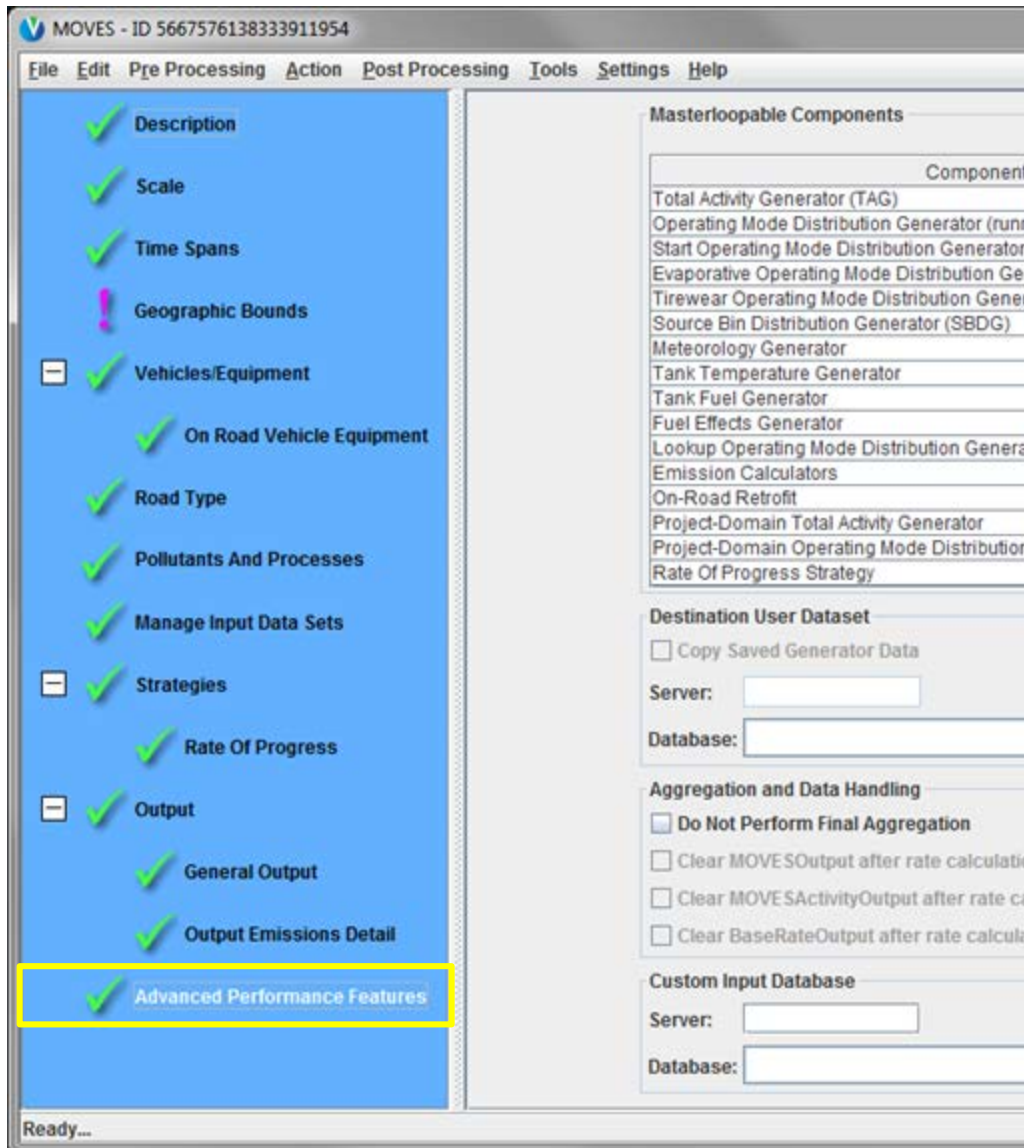
Number of iterations:

- ☐ Keep pseudo-randomly sampled input
- ☐ Keep output from each iteration

Ready...



# Advanced Performance Features Panel



The screenshot shows the MOVES software interface. The left sidebar contains a list of features, with 'Advanced Performance Features' highlighted in a yellow box. The main panel displays configuration options for various components, including a table of Masterloopable Components, sections for Destination User Dataset, Aggregation and Data Handling, and Custom Input Database.

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

☒ Description  
☒ Scale  
☒ Time Spans  
☒ Geographic Bounds  
☒ Vehicles/Equipment  
☒ On Road Vehicle Equipment  
☒ Road Type  
☒ Pollutants And Processes  
☒ Manage Input Data Sets  
☒ Strategies  
☒ Rate Of Progress  
☒ Output  
☒ General Output  
☒ Output Emissions Detail  
☒ **Advanced Performance Features**

Masterloopable Components

Component			
Total Activity Generator (TAG)			
Operating Mode Distribution Generator (runn			
Start Operating Mode Distribution Generator			
Evaporative Operating Mode Distribution Ger			
Tirewear Operating Mode Distribution Gener			
Source Bin Distribution Generator (SBDG)			
Meteorology Generator			
Tank Temperature Generator			
Tank Fuel Generator			
Fuel Effects Generator			
Lookup Operating Mode Distribution Generator			
Emission Calculators			
On-Road Retrofit			
Project-Domain Total Activity Generator			
Project-Domain Operating Mode Distribution Generator (running exhaust)			
Rate Of Progress Strategy			

Destination User Dataset

☐ Copy Saved Generator Data

Server:  Refresh

Database:  Create Database

Aggregation and Data Handling

☐ Do Not Perform Final Aggregation

☐ Clear MOVESOutput after rate calculations

☐ Clear MOVESActivityOutput after rate calculations

☐ Clear BaseRateOutput after rate calculations

Custom Input Database

Server:  Refresh

Database:  Create Database

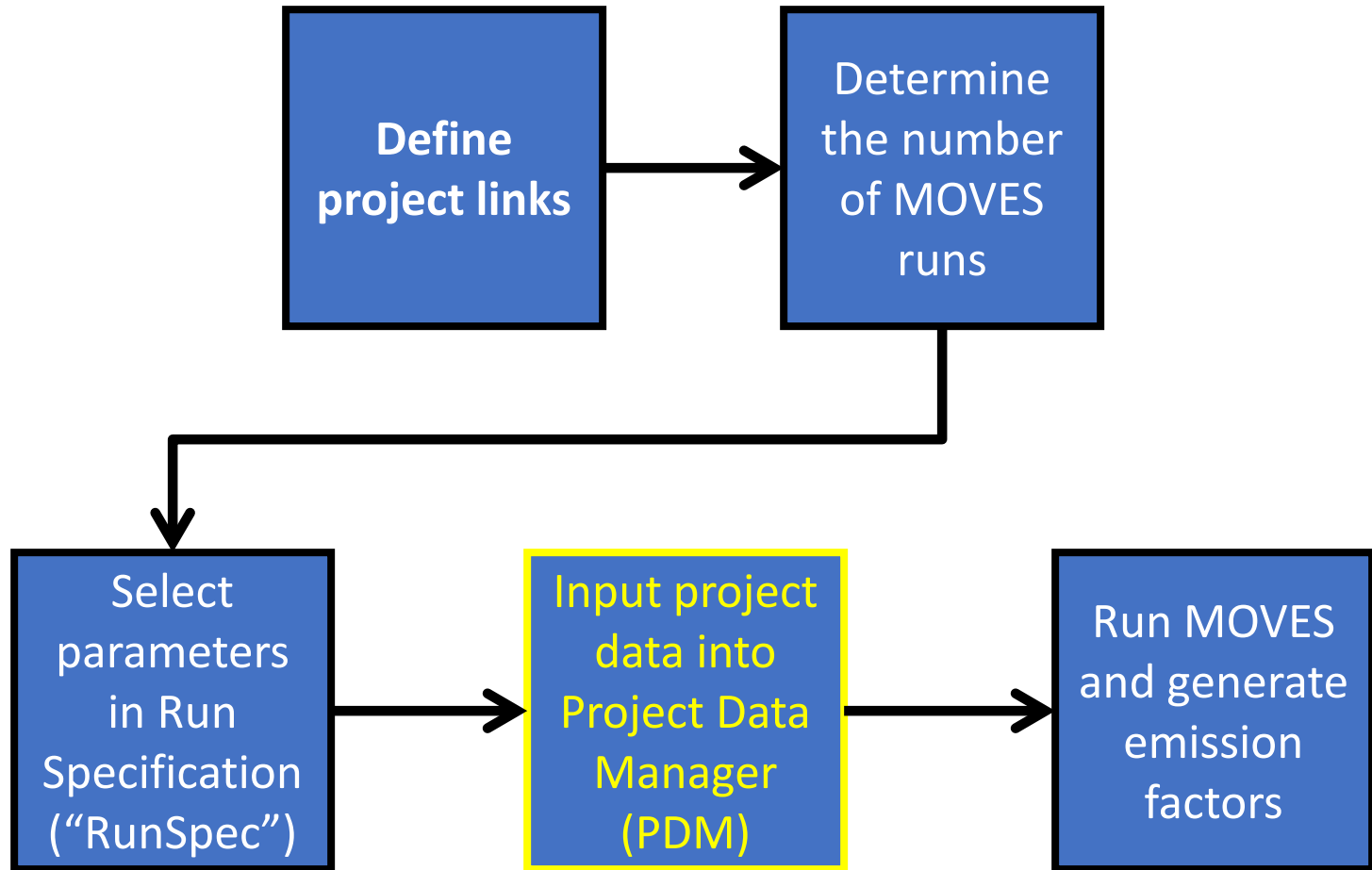
Ready...

Can skip - most analyses will not use this panel

- Used to invoke features that improve run time
- See MOVES User Guide for more information



# Running MOVES at the Project Scale





# PDM Section Overview

- Introduction
- Inputting data into the PDM, for the mini-run
- Off-network inputs



# What is the Project Data Manager?

- The Project Data Manager (PDM) is a tool that facilitates the process of entering data into a project input database
  - The data in the input database is used by MOVES when executing the run
  - A database is a set of tables
    - Databases are not “files” with an extension
    - User names them, but does not need to save them
    - Databases can be viewed and manipulated in MySQL; information can also be exported to another program (e.g., Excel)
- PDM takes the form of a separate Graphical User Interface (GUI) that is used in conjunction with the MOVES Master GUI
  - When the PDM is open, the MOVES Master GUI is frozen and no changes can be made to the RunSpec
  - Nothing done in the PDM will affect the selections in the RunSpec
  - ***Note:*** Always complete the RunSpec first, before adding information to the PDM



# Project Data Manager Functions

- Use the PDM to create an input database, an input at a time, by either:
  1. Creating a template of a table, in which you will enter local data, or
  2. Exporting default data (when available) to a table, in order to review and/or modify with local data
- Users manipulate data in Excel, then “Import” worksheets into the PDM
  - Data are not entered directly in the PDM
  - You can add descriptions in the PDM of data being imported to document data sources
- Using the PDM ensures the input tables are properly formatted, necessary for MOVES to run properly
- Imported data can be cleared for each tab or the entire database can be emptied
  - You should always clear previously-imported data before importing new data for the same input to prevent execution errors



# Opening the Project Data Manager

- Two ways to open the PDM:
  - “Enter/Edit Data” button on the Geographic Bounds panel; or
  - Use the “Pre Processing” pull-down menu
- If the input database you want to use already exists, it can be selected in the Domain Input Database drop-down list; otherwise, a new input database can be created in the PDM



# Accessing the Project Data Manager (PDM)

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- Geographic Bounds**
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ Road Type
  - ✓ Pollutants And Processes
  - ✓ Manage Input Data Sets
- [-] ✓ Strategies
  - ✓ Rate Of Progress
- [-] ✓ Output
  - ✓ General Output
  - ✓ Output Emissions Detail
  - ✓ Advanced Performance Features

Region:  
☐ Nation  
☐ State  
☒ County  
☐ Zone & Link  
☐ Custom Domain

States:  
IOWA  
KANSAS  
KENTUCKY  
LOUISIANA  
MAINE  
MARYLAND  
MASSACHUSETTS  
MICHIGAN  
MINNESOTA

Counties:

Selections:  
MICHIGAN - Washtenaw County

Select All Add Delete

Domain Input Database  
The Project domain scale requires a database of detailed data.

Server:

Database:

Refresh

**Enter/Edit Data**

Geographic Bounds Requirements  
Please select a domain database.

Ready...



# A Newly Opened PDM

MOVES Project Data Manager

Hotelling I/M Programs Retrofit Data Generic Tools  
Operating Mode Distribution Age Distribution Fuel Meteorology Data  
RunSpec Summary Database Links Link Source Types Link Drive Schedules Off-Network

Select or create a database to hold the imported data.

Server: localhost Refresh  
Database: Create Database  
Log: Clear All Imported Data

Database

Done



# Using the PDM: Database Tab

- Project input database is selected or created here
  - Existing project input databases can be selected from the drop-down menu
  - Or, user enters a name for the input database and clicks “Create Database”
- Once a project input database has been created or selected, the tables within it can be edited with the other PDM tabs
  - Inputs can be added in any order – i.e., you can start with any tab
  - All the tables in the database can be cleared of data with the “Clear All Imported Data” button
- The tab also displays a log of changes



# Database Tab

The screenshot shows the 'MOVES Project Data Manager' application window. The 'Database' tab is selected, and the 'Create Database' button is highlighted. A message box indicates that the database 'simplerun\_in' was successfully created.

Server: localhost

Database: simplerun\_in

Log:

Refresh

Create Database

Clear All Imported Data

Message

Database successfully created.

OK

Database


Done

The database "simplerun\_in" is created by entering the name and clicking "Create Database"




# PDM Inputs (each has a tab)

- Meteorology Data
- Age Distribution
- Fuel
- I/M
- Hotelling
- Retrofit Data
- Links
- Off-Network
- Link Source Types
- Operating Mode Distribution
- Link Drive Schedules







These inputs are common for both MOVES county scale and project scale analyses



These inputs are unique to the MOVES project scale

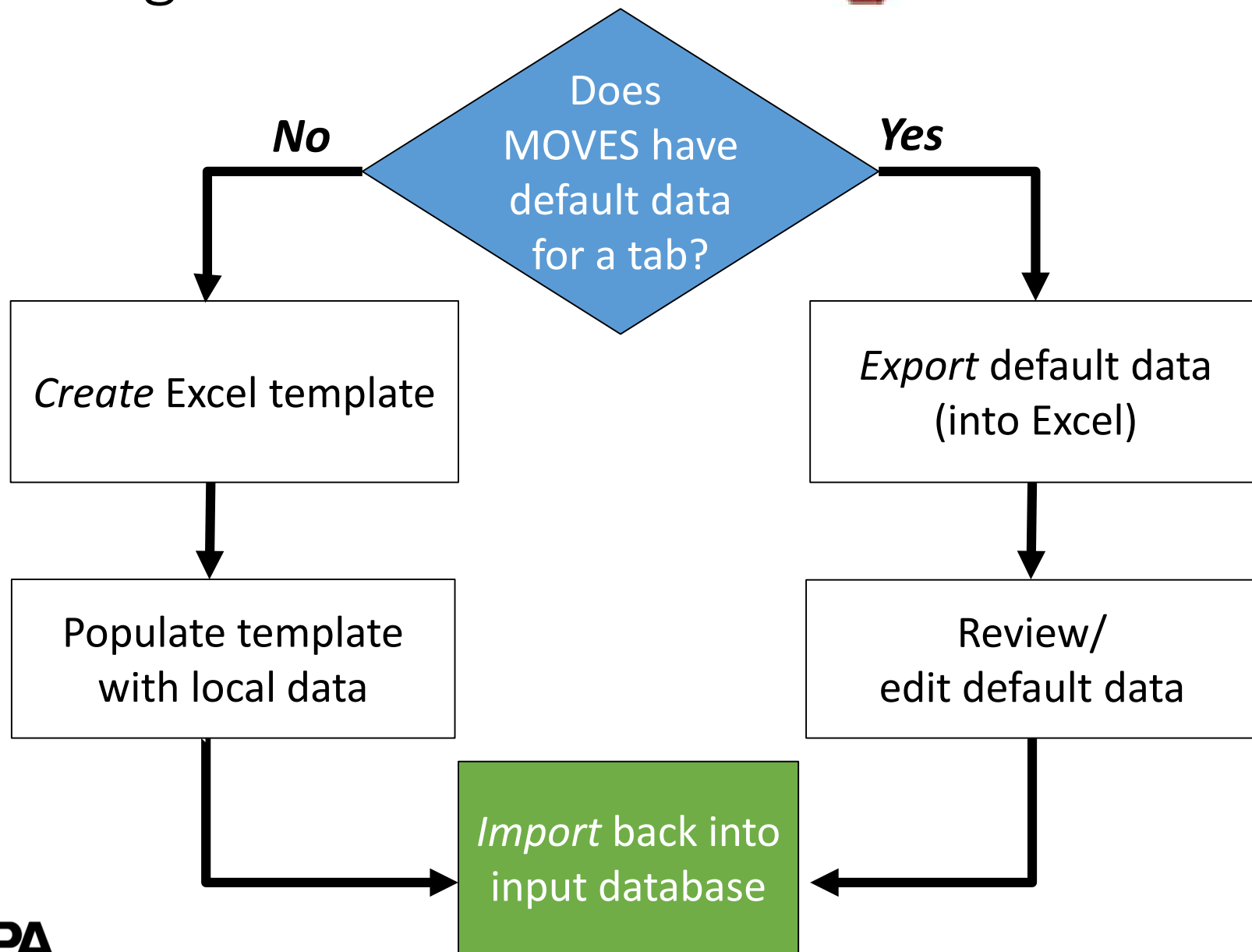


# Using the PDM: Tabs for Inputs

-  and  symbols for each tab are determined by the relationship between the selections made in the RunSpec and the data provided by the user
-  appears when the user has provided data that is sufficient and passes error checks for all parameters in the RunSpec
  - several tabs begin with a green check (optional inputs)
-  appears if the user has not provided enough information or if there is an error with the data provided



# Entering Data for Tabs with a:





# Using the PDM: Creating a Template

- *A//*PDM tabs provide the option of creating an Excel template spreadsheet of the appropriate MOVES table
  - Save as .xls extension to get a spreadsheet format
- Templates contain the proper fields/column headings, but have blank cells for user-specified data
- The template will be pre-populated with some data based on entries made in the RunSpec
  - This is why you should always complete all RunSpec panels first!
- Templates contain extra worksheets that will help you decipher MOVES codes

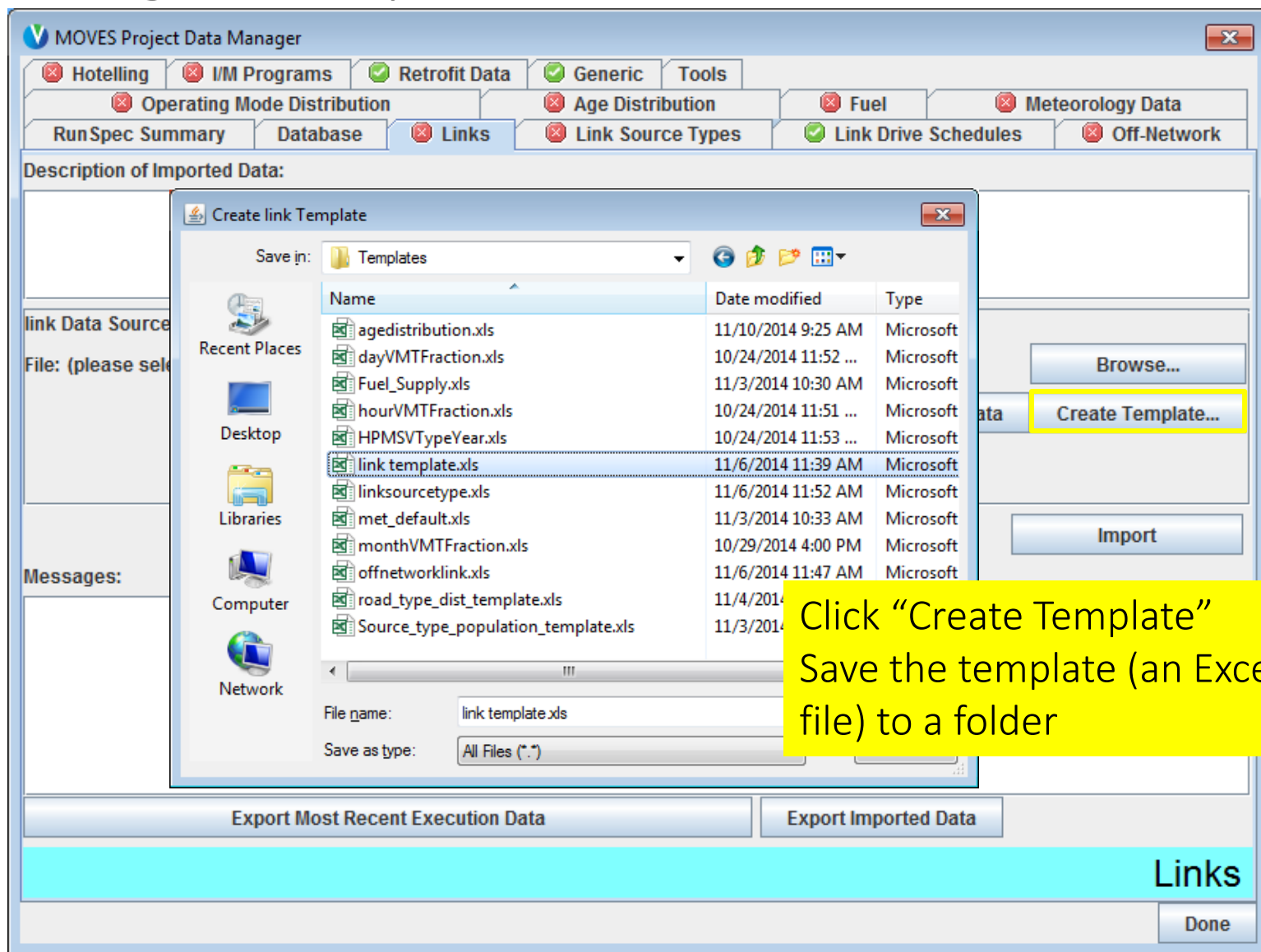


# Using the PDM: Exporting Default Data

- *Some* PDM tabs have default data available:
  - Meteorology Data
  - Fuel (Fuel Supply, Fuel Formulation, Fuel Usage, AVFT)
  - I/M Programs
- Tabs with default data will have “Export Default Data” option

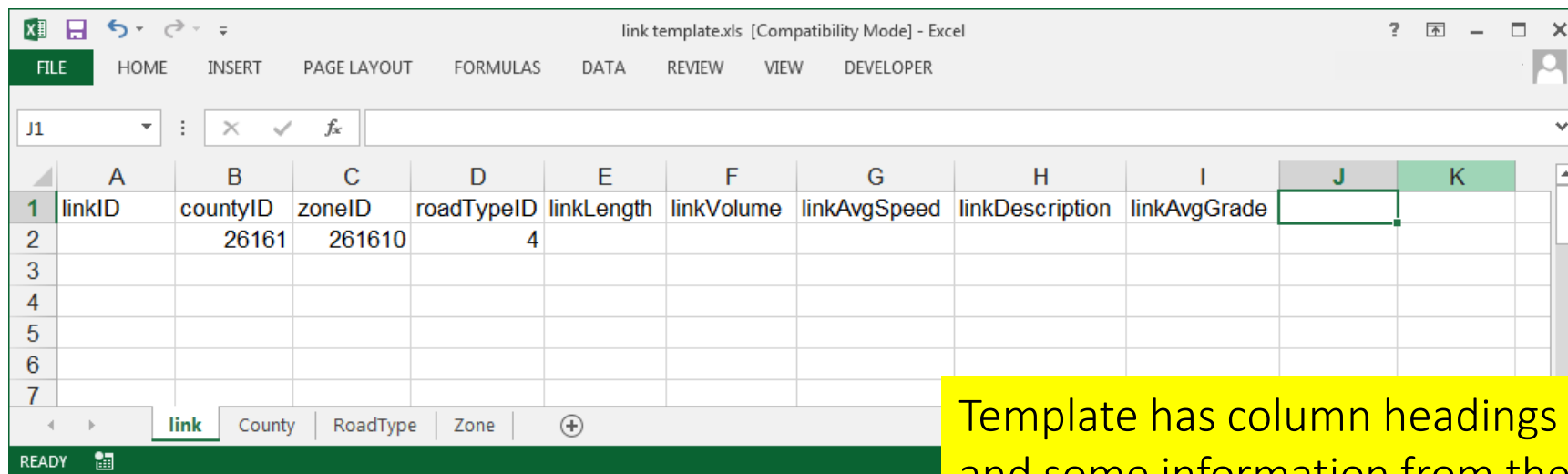


# Creating a Template





# Completing a Template

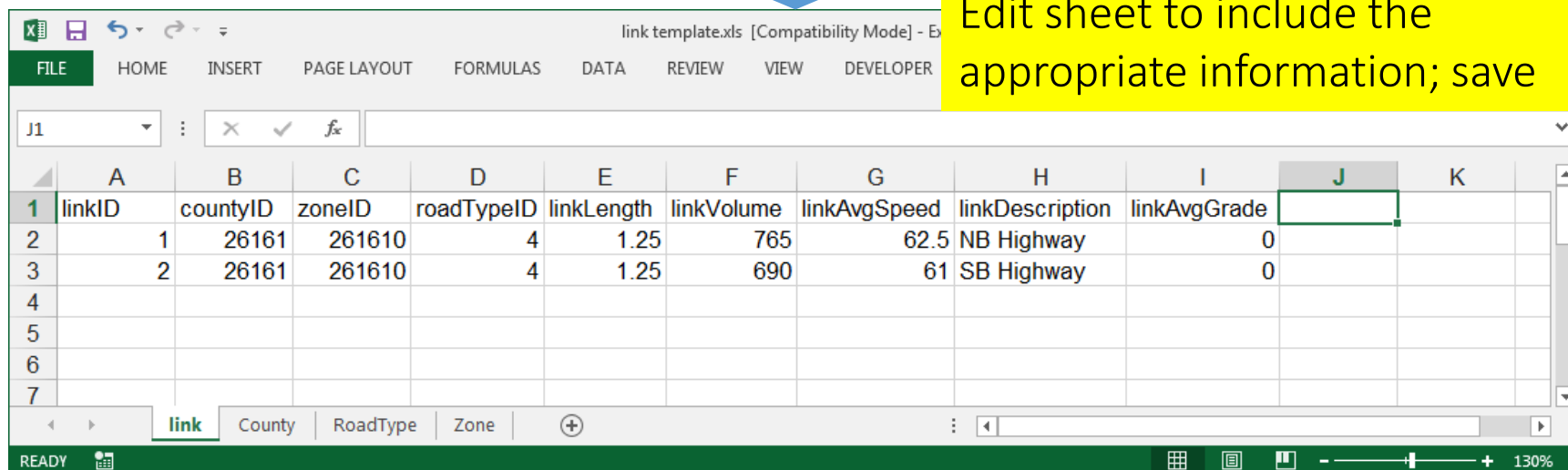


The screenshot shows an Excel spreadsheet titled 'link template.xls [Compatibility Mode]'. The spreadsheet has columns A through K. The first row (row 1) contains the following headers: linkID, countyID, zoneID, roadTypeID, linkLength, linkVolume, linkAvgSpeed, linkDescription, linkAvgGrade, and two empty columns (J and K). The second row (row 2) contains the following data: countyID is 26161, zoneID is 261610, roadTypeID is 4, and the rest of the row is empty. The third row (row 3) is empty. The fourth row (row 4) is empty. The fifth row (row 5) is empty. The sixth row (row 6) is empty. The seventh row (row 7) is empty. The bottom of the spreadsheet shows a tab labeled 'link' and a status bar with 'READY'.

	A	B	C	D	E	F	G	H	I	J	K
1	linkID	countyID	zoneID	roadTypeID	linkLength	linkVolume	linkAvgSpeed	linkDescription	linkAvgGrade		
2		26161	261610	4							
3											
4											
5											
6											
7											

Template has column headings and some information from the RunSpec

Edit sheet to include the appropriate information; save

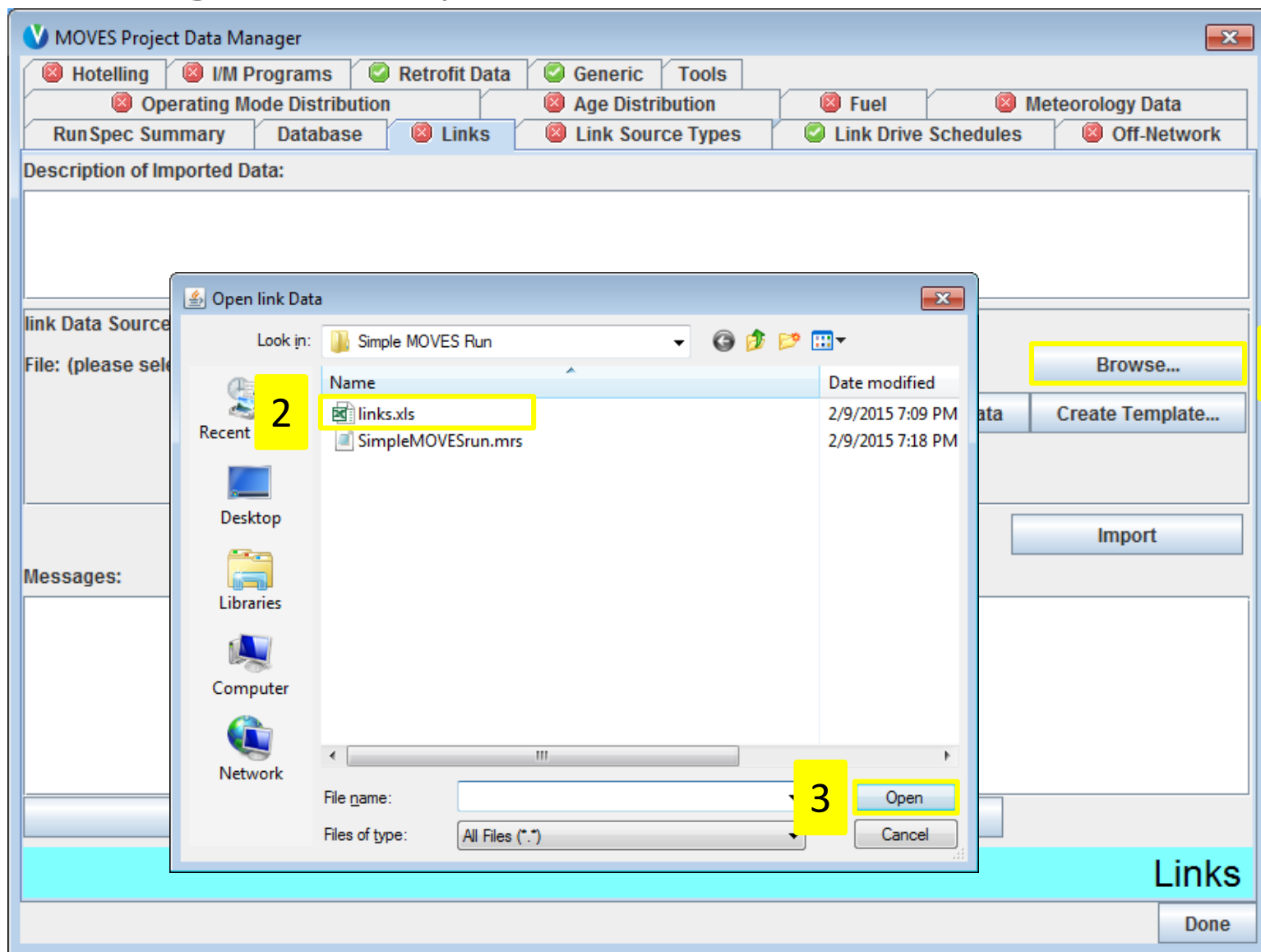


The screenshot shows the same Excel spreadsheet as above, but now it is filled with data. The first row (row 1) contains the same headers. The second row (row 2) contains: linkID is 1, countyID is 26161, zoneID is 261610, roadTypeID is 4, linkLength is 1.25, linkVolume is 765, linkAvgSpeed is 62.5, linkDescription is 'NB Highway', linkAvgGrade is 0. The third row (row 3) contains: linkID is 2, countyID is 26161, zoneID is 261610, roadTypeID is 4, linkLength is 1.25, linkVolume is 690, linkAvgSpeed is 61, linkDescription is 'SB Highway', linkAvgGrade is 0. The fourth row (row 4) is empty. The fifth row (row 5) is empty. The sixth row (row 6) is empty. The seventh row (row 7) is empty. The bottom of the spreadsheet shows a tab labeled 'link' and a status bar with 'READY'.

	A	B	C	D	E	F	G	H	I	J	K
1	linkID	countyID	zoneID	roadTypeID	linkLength	linkVolume	linkAvgSpeed	linkDescription	linkAvgGrade		
2	1	26161	261610	4	1.25	765	62.5	NB Highway	0		
3	2	26161	261610	4	1.25	690	61	SB Highway	0		
4											
5											
6											
7											



# Importing a Completed Table





# Importing a Completed Table

The screenshot displays the MOVES Project Data Manager application window. The 'Links' tab is selected in the top navigation bar. A 'Choose XLS Worksheet' dialog box is open, showing a list of worksheets: 'link', 'County', 'RoadType', and 'Zone'. The 'link' worksheet is highlighted. The 'Import' button in the main window is also highlighted. The 'Messages' section at the bottom is empty.

MOVES Project Data Manager

Hotelling I/M Programs Retrofit Data Generic Tools

Operating Mode Distribution Age Distribution Fuel Meteorology Data

RunSpec Summary Database Links Link Source Types Link Drive Schedules Off-Network

Description of Imported Data:

link Data Source:

File: (please select a file) Browse...

Clear Imported Data Create Template...

4

5

6

Import

Messages:

Export Most Recent Execution Data Export Imported Data

Links

Done



# Importing a Completed Table

The screenshot shows the MOVES Project Data Manager window with the 'Links' tab selected. The interface includes a toolbar with various data management options, a 'Description of Imported Data' section, a 'Link Data Source' section, a 'Messages' section, and a 'Links' table at the bottom.

**Annotations:**

- 1. filename:** Points to the 'File: links.xls' text in the 'Link Data Source' section.
- 2. worksheet:** Points to the 'XLS, link' text in the 'Link Data Source' section.
- 3. messages:** Points to the 'Link imported. Import complete.' text in the 'Messages' section.
- 4. green check:** Points to the green checkmark icon in the 'Links' tab.

**Check for correct filename, worksheet name, no error messages, green check mark**

**Buttons:** Browse..., Clear Imported Data, Create Template..., Import, Export Most Recent Execution Data, Export Imported Data, Done.

Links
-------



# Inputting data for the Mini-Run

We need only the 6 inputs in bold for the mini-run; we will also cover the other inputs (in gray)

- **Meteorology Data**
- **Age Distribution**
- **Fuel**
- I/M
- Hotelling
- Retrofit Data
- **Links**
- Off-Network
- **Link Source Types**
- Operating Mode Distribution
- **Link Drive Schedules (run 2)**



# Meteorology Input (ZoneMonthHour)

- Meteorology data should be entered with the specific month and hour selected in the RunSpec
- ZoneID is simply the countyID + zero
- Temperatures are in degrees Fahrenheit
- Relative humidity (% humidity) must be between 0 and 100

	A	B	C	D	E	F	G	H	I	J	K	L
1	monthID	zoneID	hourID	temperature	relHumidity							
2	7	180890	1	67.8	78.9							
3												
4												
5												
6												
7												



# Guidance on Meteorology

- Should enter data specific to the project's location and time period modeled
  - Default temperature and humidity values are available in MOVES, but are not recommended for use in a PM hot-spot analysis
- Use temperatures from the representative meteorological data selected for air quality modeling
  - Temperatures must be consistent with those used for the project's county in the regional emissions analysis (Section 93.123(c)(3))
- The temperature and humidity data should be the same for both the build and no-build scenarios
  - We will discuss more about obtaining representative met data in [Module 3](#)

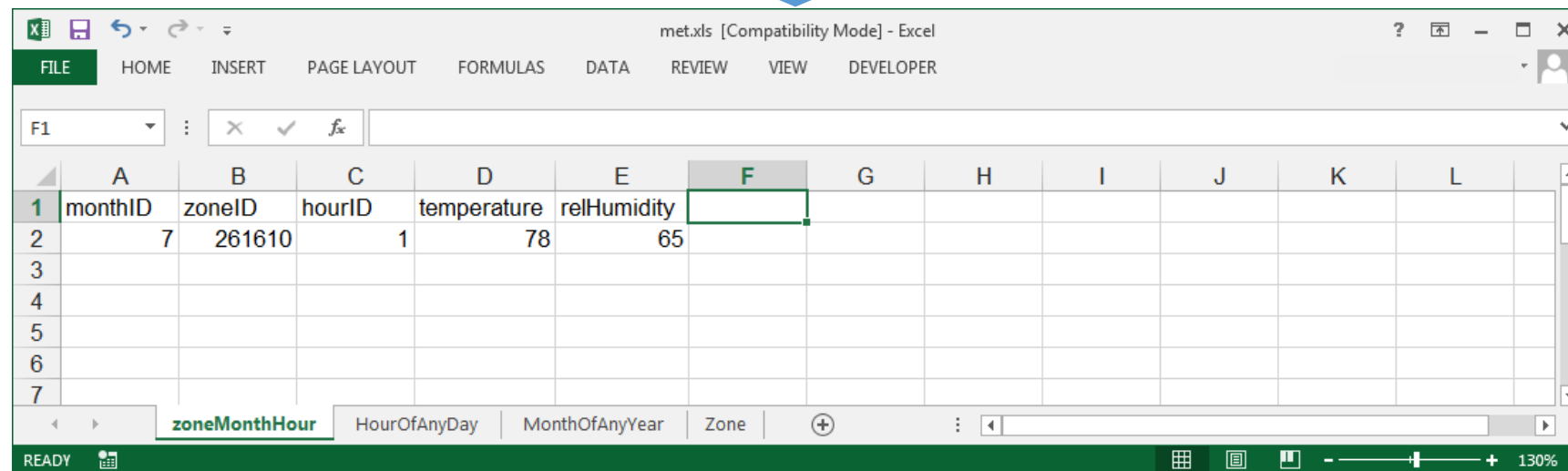
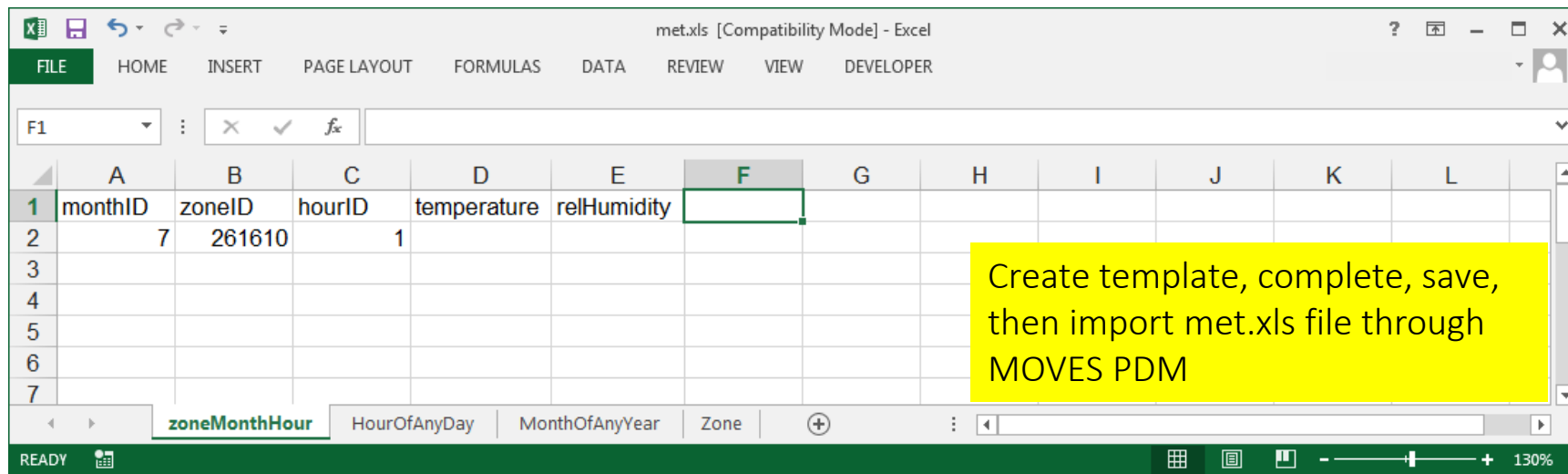


# Guidance on Meteorology

- Use a minimum of four hours per season (corresponding to AM peak traffic/PM peak traffic/MD traffic/ON traffic)...
  - For one day (weekday)
  - For January, April, July, and October.
- Within each period of day in each season, use average temperature within that time period
- For example, for January AM peak periods corresponding to 6 a.m. to 9 a.m., use average January temperature based on the meteorological record for those hours



# Completing the Meteorology Template





# Age Distribution Input (SourceTypeAgeDistribution)

- Age Distribution is entered according to MOVES source types (vehicle types) and calendar year
  - AgeFraction must sum to 1 within these fields
- Age Distribution covers new (0) to 30+ year old vehicles
- MOVES does not vary age distribution by month
- See decoder tab or handout for source type ID
  - 21 = passenger cars
  - 62 = combination long-haul truck

	A	B	C	D	E	F	G	H	I
1	sourceType	yearID	ageID	ageFraction					
2	21	2011	0						
3	21	2011	1						
4	21	2011	2						
5	21	2011	3						
6	21	2011	4						
7	21	2011	5						
8	21	2011	6						
9	21	2011	7						
10	21	2011	8						
11	21	2011	9						
12	21	2011	10						
13	21	2011	11						
14	21	2011	12						
15	21	2011	13						
16	21	2011	14						
17	21	2011	15						
18	21	2011	16						
19	21	2011	17						
20	21	2011	18						
21	21	2011	19						
22	21	2011	20						
23	21	2011	21						
24	21	2011	22						
25	21	2011	23						
26	21	2011	24						
27	21	2011	25						
28	21	2011	26						
29	21	2011	27						
30	21	2011	28						
31	21	2011	29						
32	21	2011	30						
33	62	2011	0						
34	62	2011	1						



# Guidance on Age Distribution

- There are 3 options for using age distribution data:
  - Latest from the SIP
  - Project-specific fleet age distribution
  - MOVES default age distribution
- **Option 1:** Use the latest state or local age distribution assumptions from the SIP or transportation conformity regional emissions analysis
  - Often available from local Metropolitan Planning Organization (MPO), state DOT, or state air agency
  - For cases where some but not all age distributions are available, we'll cover in Option 3



# Guidance on Age Distribution

- **Option 2:** If the project is designed to serve a fleet that operates only locally, the user should provide project-specific fleet age distribution data
  - Example: a drayage yard or bus terminal
  - For most captive fleets, an exact age distribution should be readily available or obtainable
- **Option 3:** If no state or local age distribution is available, the MOVES default age distribution should be used
  - Also relevant option where user has registration distributions only for one or more vehicle classes (e.g., LDVs) and has relied on MOBILE6.2 defaults in its SIP or regional conformity analysis for the remaining vehicle classes
  - MOVES default distributions available on the EPA's website:  
[www.epa.gov/otaq/models/moves/tools.htm](http://www.epa.gov/otaq/models/moves/tools.htm)



# Completing the Age Distribution Template

	A	B	C	D	E	F	G
1	sourceType	yearID	ageID	ageFraction			
2	21	2016	0				
3	21	2016	1				
4	21	2016	2				
5	21	2016	3				
6	21	2016	4				
7	21	2016	5				
8	21	2016	6				
9	21	2016	7				
10	21	2016	8				
11	21	2016	9				
12	21	2016	10				
13	21	2016	11				
14	21	2016	12				
15	21	2016	13				
16	21	2016	14				
17	21	2016	15				
18	21	2016	16				
19	21	2016	17				
20	21	2016	18				
21	21	2016	19				
22	21	2016	20				
23	21	2016	21				
24	21	2016	22				
25	21	2016	23				
26	21	2016	24				
27	21	2016	25				
28	21	2016	26				
29	21	2016	27				
30	21	2016	28				
31	21	2016	29				
32	21	2016	30				
33	62	2016	0				
34	62	2016	1				
35	62	2016	2				
36	62	2016	3				

sourceTypeAgeDistribution Age ...



	A	B	C	D	E	F	G
1	sourceType	yearID	ageID	ageFraction			
2	21	2016	0	0.5			
3	21	2016	1	0.5			
4	21	2016	2	0			
5	21	2016	3	0			
6	21	2016	4	0			
7	21	2016	5	0			
8	21	2016	6	0			
9	21	2016	7	0			
10	21	2016	8	0			
11	21	2016	9	0			
12	21	2016	10	0			
13	21	2016	11	0			
14	21	2016	12	0			
15	21	2016	13	0			
16	21	2016	14	0			
17	21	2016	15	0			
18	21	2016	16	0			
19	21	2016	17	0			
20	21	2016	18	0			
21	21	2016	19	0			
22	21	2016	20	0			
23	21	2016	21	0			
24	21	2016	22	0			
25	21	2016	23	0			
26	21	2016	24	0			
27	21	2016	25	0			
28	21	2016	26	0			
29	21	2016	27	0			
30	21	2016	28	0			
31	21	2016	29	0			
32	21	2016	30	0			
33	62	2016	0	0.5			
34	62	2016	1	0.5			
35	62	2016	2	0			
36	62	2016	3	0			

sourceTypeAgeDistribution Age ...

Create template, complete, save, then import agedist.xls file through MOVES PDM



# Fuel

- The Fuel tab contains four data tables
  - Fuel Supply
  - Fuel Formulation
  - Fuel Usage Fraction
  - AVFT
- Data must be selected/entered for each table
- It also includes the “Fuels Wizard,” which allows the user to modify fuel formulation parameters for gasoline and gasoline-ethanol blends

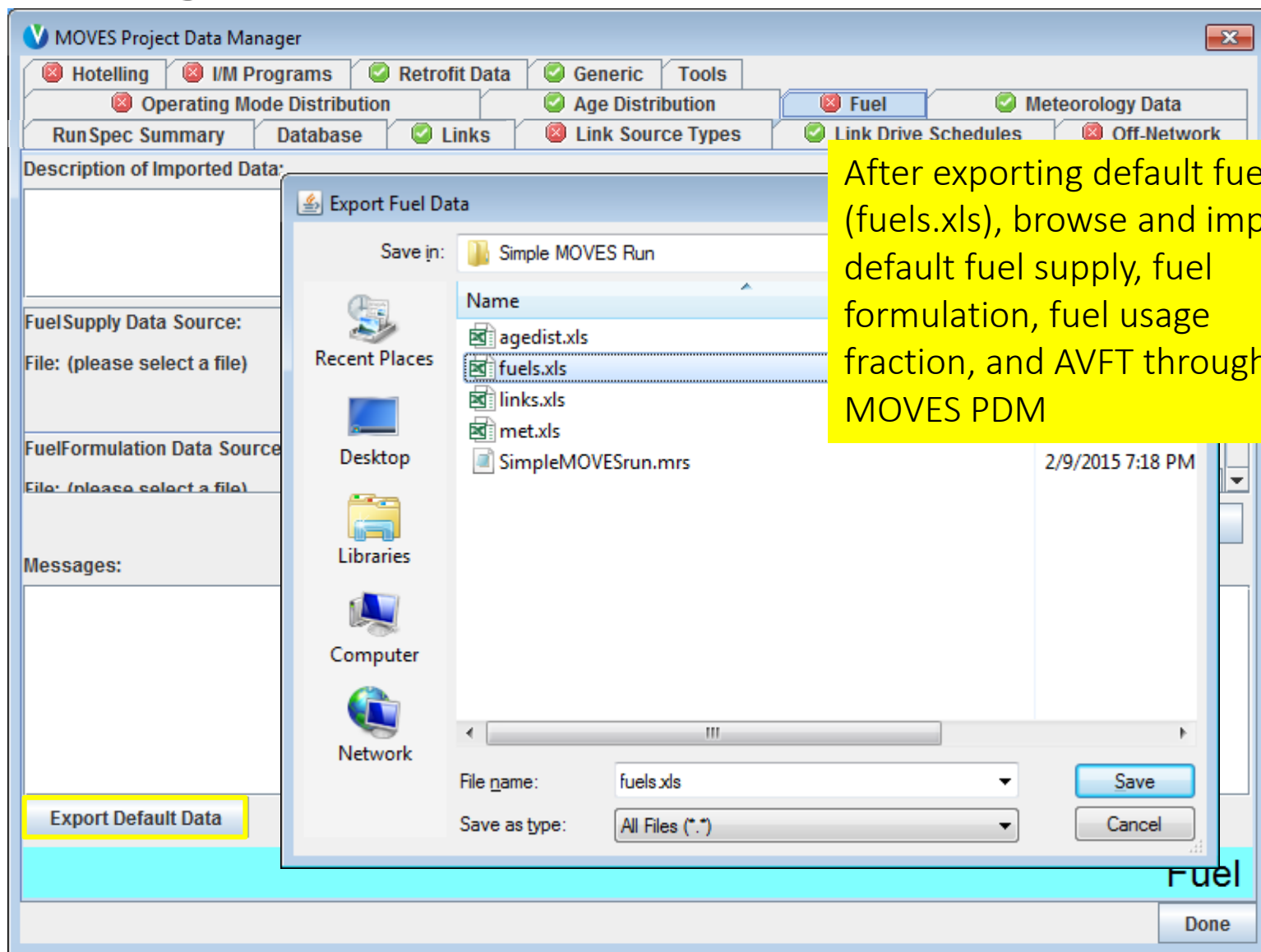


# Guidance on Fuels

- Users should review default fuels for the project area and make changes only when volumetric fuel data is available
  - Exception: Reid Vapor Pressure (RVP) should be changed in fuel formulation table to reflect ethanol blend requirements (e.g., Renewable Fuel Standards (RFS))
  - The Fuels Wizard should be used to make any adjustments needed
- Generally fuels should be the same for both build and no-build
  - Exception: if project will include addition of alternatively-fueled vehicles and infrastructure
- **Note:** fuels files should be consistent with those used in the latest SIP/regional conformity analysis



# Exporting Default Fuels





# Fuels Input: Fuel Supply

	A	B	C	D	E	F	G	H
1	fuelRegionID	fuelYearID	monthGroup	fuelFormulationID	marketShare	marketShareCV		
2	270000000	2016	7	3349	0.971682	0.5		
3	270000000	2016	7	3351	0.0283177	0.5		
4	270000000	2016	7	25005	1	0.5		
5	270000000	2016	7	27002	1	0.5		
6								
7								

FuelSupply | FuelFormulation | Fu ... (+) |

- Fuel Supply is entered according to county, year, month, fuel type
  - marketShare (column E) must sum to 1 within these fields
  - marketShare CV (column F) is inactive; ignore any values
- If defaults are exported, they will contain all fuel types selected in the MOVES RunSpec



# Fuels Input: Fuel Formulation

- Use only existing fuelFormulationID's with the appropriate fuelSubTypeID for the fuel properties being entered
- Properties can be changed for existing formulations using the Fuels Wizard
  - Gasoline fuelFormulationID's are 500-9419
  - Diesel: 20011-20491
  - CNG: 30

fuels.xls [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

A1 :

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	fuelFormul	fuelSubtyp	RVP	sulfurLevel	ETOHVolu	MTBEVolu	ETBEVolu	TAMEVolu	aromaticC	olefinConte	benzeneC	e200	e300	BioDieselE	CetaneInde	PAHConte	T50
2	10	10	6.9	30	0	0	0	0	26.1	5.6	1	41.09	83.09	0	0	0	
3	20	20	0	11	0	0	0	0	0	0	0	0	0	0	0	0	
4	50	51	7.7	11	85	0	0	0	0	0	0	49.9	89.5	0	0	0	
5	96	10	8.7	338	0	0	0	0	26.4	11.9	1.64	50	83	0	0	0	199
6	97	10	6.6	150	0	11.7581	0	0	24	11	0.8	52	84	0	0	0	195
7	98	10	6.9	30	0	0	0	0	26.1	5.6	1	41.09	83.09	0	0	0	
8	99	10	6.9	90	0	0	0	0	26.1	5.6	1	41.09	83.09	0	0	0	
9	2700	10	7	30	0	0	0	0	26.96	8.54	0.63	45.62	80.93	0	0	0	21

FuelSupply FuelFormulation FuelUsageFraction avft County Er ...

READY 100%



# Fuels Input: Fuel Usage Fraction

- Fuelusagefraction is a new required input that specifies the fraction of E-85 capable (flex-fuel) vehicles that use E-85 (sourceBinFuelTypeID 5) vs. conventional gasoline
- The table below shows that 97.4% of E-85 capable vehicles use conventional gasoline and 2.6% use E-85
- UsageFraction of 1 is required for sourceBinFuelTypeID 1, 2, and 3 (gas, diesel, and CNG fuel types)

	A	B	C	D	E	F	G
1	countyID	fuelYearID	modelYearGroupID	sourceBinFuelTypeID	fuelSupplyFuelTypeID	usageFraction	
2	26161	2016	0	1	1	1	
3	26161	2016	0	2	2	1	
4	26161	2016	0	5	1	0.973756	
5	26161	2016	0	5	5	0.026244	
6							
7							
8							
9							

FuelUsageFraction avft County ... (+)



# Fuels Input: AVFT

- The Alternate Vehicle and Fuel Technology (AVFT) input allows users to define the split between diesel, gasoline, CNG, and electricity, for each vehicle source type and model year.
- Combinations of sourceTypeID and modelyearID must sum to 1

	A	B	C	D	E	F
1	sourceTypeID	modelYearID	fuelTypeID	engTechID	fuelEngFraction	
2	21	1960	1	1	0.993123	
3	21	1960	2	1	0.006877	
4	21	1960	5	1	0	
5	21	1960	9	30	0	
6	21	1961	1	1	0.993123	
7	21	1961	2	1	0.006877	
8	21	1961	5	1	0	
9	21	1961	9	30	0	
10	21	1962	1	1	0.993123	
11	21	1962	2	1	0.006877	
12	21	1962	5	1	0	
13	21	1962	9	30	0	
14	21	1963	1	1	0.993123	
15	21	1963	2	1	0.006877	



# Fuels Wizard

- Once fuel formulation is imported, the Fuels Wizard can be used to adjust unknown fuel formulation properties based on known fuel properties, such as RVP
  - For gasoline and gasoline-ethanol blends
  - Not used for E-85, diesel, or CNG fuels
- Fuels Wizard calculates the appropriate values consistent with EPA's refinery modeling

Select	Region	Fuel ...	Mo...	Fu...	RVP	Sul...	Eth...	T50	T90	Aroma...	Olefi...	Benz...	E200	E300	Bio...	Cet...	PAH	MTBE	ETBE	TAME
<input type="checkbox"/>	1470011000	2015	7	1	17.1	30	10	193.20	326.70	17.13	7.85	0.77	50.98	85.24	0	0	0	0.00	0.00	0.00
<input type="checkbox"/>	1470011000	2015	7	1	17.1	30	15	180.77	324.33	15.79	6.67	0.77	57.11	85.76	0	0	0	0.00	0.00	0.00
<input type="checkbox"/>	1470011000	2015	7	2	0.0	15	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5	0	0	0.00	0.00	0.00
<input type="checkbox"/>	1470011000	2015	7	5	7.7	8	74	200.00	300.00	0.00	0.00	0.00	49.90	89.50	0	0	0	0.00	0.00	0.00
<input type="checkbox"/>	1470011000	2015	7	3	0.0	8	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00

Change  to



# Example: Change RVP of Gasoline to 7.5

(For example only; not part of our mini-run)

The 'Fuels Wizard' dialog box is titled 'Select fuels to modify'. It contains a table with columns: Select, Region, Fuel ..., Mo..., Fu..., RVP, Sul..., Eth..., T50, T90, Aroma..., Olefi..., Benz..., E200, E300, Bio..., Cet..., PAH, MTBE, ETBE, TAME. The first two rows are selected (checked in the 'Select' column). A yellow box labeled '1' highlights the first two rows. Below the table, there is a 'Change RVP' dropdown menu set to 'RVP', a 'to' field with '7.5', and a unit dropdown set to 'psi'. A yellow box labeled '2' highlights the 'Change RVP' dropdown, and a yellow box labeled '3' highlights the 'to' field. Below these are 'Done' and 'Calculate >' buttons. A yellow box labeled '4' highlights the 'Calculate >' button.

Select	Region	Fuel ...	Mo...	Fu...	RVP	Sul...	Eth...	T50	T90	Aroma...	Olefi...	Benz...	E200	E300	Bio...	Cet...	PAH	MTBE	ETBE	TAME
<input checked="" type="checkbox"/>	1000	2015	7	1	17.1	30	10	193.20	326.70	17.13	7.85	0.77	50.98	85.24	0	0	0	0.00	0.00	0.00
<input checked="" type="checkbox"/>	1000	2015	7	1	17.1	30	15	180.77	324.33	15.79	6.67	0.77	57.11	85.76	0	0	0	0.00	0.00	0.00
<input type="checkbox"/>	1000	2015	7	2	20.0	15	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5	0	0	0.00	0.00	0.00
<input type="checkbox"/>	1470011000	2015	7	5	7.7	8	74	200.00	300.00	0.00	0.00	0.00	49.90	89.50	0	0	0	0.00	0.00	0.00
<input type="checkbox"/>	1470011000	2015	7	3	0.0	8	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0.00	0.00	0.00

Change RVP to 7.5 psi

Done Calculate >

Both Gasoline fuels (Fuel type id 1) are selected

The 'Fuels Wizard' dialog box is titled 'Changes'. It contains a table with columns: Select, Region, Fuel ..., Mo..., Fu..., RVP, Sul..., Eth..., T50, T90, Aroma..., Olefi..., Benz..., E200, E300, Bio..., Cet..., PAH, MTBE, ETBE, TAME. The table shows 'Old' and 'New' values for the selected fuels. A yellow box highlights the 'New' row for the first two fuels. Below the table is a 'Messages' section with a text box containing 'Calculations complete.' and two buttons: '< Reject' and 'Accept >'.

Select	Region	Fuel ...	Mo...	Fu...	RVP	Sul...	Eth...	T50	T90	Aroma...	Olefi...	Benz...	E200	E300	Bio...	Cet...	PAH	MTBE	ETBE	TAME
Old	1470011000	2015	7	1	17.1	30	10	193.20	326.70	17.13	7.85	0.77	50.98	85.24	0	0	0	0.00	0.00	0.00
New	1470011000	2015	7	1	17.5	30	10	192.07	325.70	17.13	7.85	0.77	53.80	83.82	0	0	0	0.00	0.00	0.00
Old	1470011000	2015	7	1	17.1	30	15	180.77	324.33	15.79	6.67	0.77	57.11	85.76	0	0	0	0.00	0.00	0.00
New	1470011000	2015	7	1	17.5	30	15	179.64	323.33	15.79	6.67	0.77	59.89	84.34	0	0	0	0.00	0.00	0.00

Messages

Calculations complete.

< Reject Accept >



# I/M Program Input

## Guidance:

- MOVES does not provide a PM emission benefit from any I/M program
- If the user includes an I/M program in the run specification, the selection will have no impact on PM emissions



# Retrofit Data Input

- The Retrofit Data tab allows users to define emission reductions/increases that are provided by retrofit programs
  - In MOVES, retrofits are only applied to heavy-duty diesel vehicles (buses, trucks)
  - EPA's Retrofit and Replacement Guidance and PM Hot-Spot Guidance should be consulted to determine the appropriate inputs
- Retrofit programs should be defined only for the year being modeled
  - Modeling Year = Final Calendar Year
- Fraction/Year should be calculated in terms of the fraction of vehicles to which the retrofit was applied as of the year being modeled

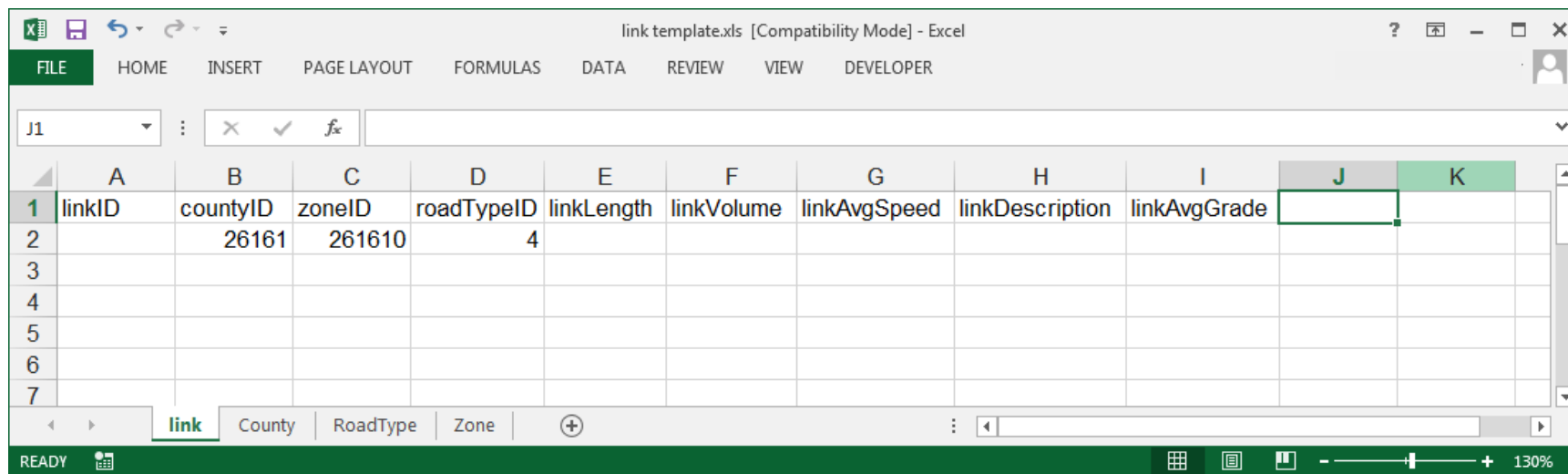


# Links Input

- Should reflect link information from traffic data
  - No defaults available; use template
- There are 9 data inputs for each link:
  - LinkID: Each link in Project must be entered
  - CountyID: Five digit code
  - ZoneID: county ID with zero at the end
  - RoadTypeID: each link is associated with a MOVES roadtype
  - Link Length: in miles
  - Link Volume: total traffic volume in one hour
  - Link Average Speed: in mph
  - Link Description: optional text field
  - Link Grade: in percent grade (100% = 45 degree slope)



# Completing the Links Input



link template.xls [Compatibility Mode] - Excel

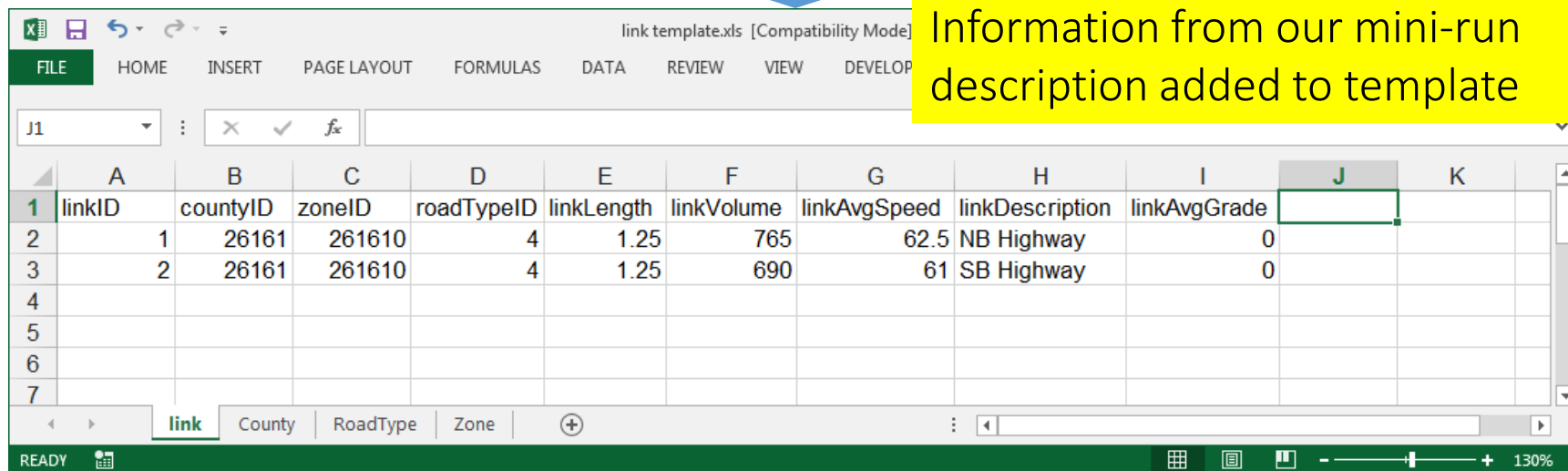
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

J1 : X ✓ fx

	A	B	C	D	E	F	G	H	I	J	K
1	linkID	countyID	zoneID	roadTypeID	linkLength	linkVolume	linkAvgSpeed	linkDescription	linkAvgGrade		
2		26161	261610	4							
3											
4											
5											
6											
7											

link County RoadType Zone +

READY 130%



link template.xls [Compatibility Mode]

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

J1 : X ✓ fx

	A	B	C	D	E	F	G	H	I	J	K
1	linkID	countyID	zoneID	roadTypeID	linkLength	linkVolume	linkAvgSpeed	linkDescription	linkAvgGrade		
2	1	26161	261610	4	1.25	765	62.5	NB Highway	0		
3	2	26161	261610	4	1.25	690	61	SB Highway	0		
4											
5											
6											
7											

link County RoadType Zone +

READY 130%

Information from our mini-run  
description added to template



# Link Source Type Input

Used to define the type of vehicles on each link. Table has 3 columns:

- LinkID
  - Must include all LinkIDs defined in Links Input
- SourceTypeID
  - Must include all source types selected in On Road Vehicle/Equipment panel
- SourceTypeHourFraction
  - Specify vehicle mix (fraction of Vehicle Hours Traveled (VHT)) on each link
  - Fractions should sum to “1” for each linkID

	A	B	C	D	E	F	G	H	I	J	K
1	linkID	sourceTypeID	sourceTypeHourFraction								
2		21									
3		62									
4											
5											
6											
7											



# Link Source Type Input

- Enter the fraction of the link traffic volume that is represented by each vehicle type (source type)
  - No defaults available
- This is not necessary for off-network links
- See the “For Reference” section at the end of this module for sources of information for the **Links** and **Link Source Type** inputs



# Guidance on Link Source Type Input

- **Option 1:** Collect project-specific data
  - Example: projects such as bus or freight terminals or maintenance facilities
  - This could be based on analysis of similar existing projects
- **Option 2:** Use regional fleet information
  - Use the same source type distribution used in the latest regional emissions analysis for each road type in the project
    - Data often available from state DOT, state air agency, or local MPO
  - May be adjusted if data are available for light-duty vs. heavy-duty mix



# Completing the Link Source Template

linksource.xls [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

D1

	A	B	C	D	E	F	G	H	I	J	K
1	linkID	sourceTypeID	sourceTypeHourFraction								
2		21									
3		62									
4											
5											
6											
7											

linkSourceHour SourceUseType

READY

Create template, complete, then import linksource.xls file through MOVES PDM

linksource.xls [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

D1

	A	B	C	D	E	F	G	H	I	J	K
1	linkID	sourceTypeID	sourceTypeHourFraction								
2	1	21	0.95								
3	1	62	0.05								
4	2	21	0.95								
5	2	62	0.05								
6											
7											

linkSourceHour SourceUseType

READY

Sums to one for each link



# Including Project Activity Data

- For this example, we will complete two simple MOVES runs using different options for activity:
  1. Using average speed in the links table
  2. Using a link-drive schedule (vehicle trajectory)
  3. Using an operating mode distribution is also an option, but will not be illustrated



# Defining Activity with Option 1: Average Speed



# Defining the Average Speed Function Through the Links Table

- If no Op-Mode distribution or Link Drive Schedule is defined, MOVES uses average speed combined with road type and road grade to calculate Op-Mode distribution
  - Based on default drive cycles
  - As defined in the Links Input
- Provides least resolution when analyzing project emissions
- ***Note:** We have already imported the Links table (with link average speeds) and no further action is needed*



# Allowable Average Speed Ranges

Allowable Average Speed Input Range for Project Scale Input by Source Type			
Sourcetypeid	Sourcetypepname	Min Speed (mph)	Max Speed (mph)
11	Motorcycle	2.5	76.0
21	Passenger Car	2.5	76.0
31	Passenger Truck	2.5	76.0
32	Light Commercial Truck	2.5	76.0
41	Intercity Bus	1.8	77.8
42	Transit Bus	1.8	77.8
43	School Bus	1.8	77.8
51	Refuse Truck	1.8	76.6
52	Single Unit Short-haul Truck	1.8	77.8
53	Single Unit Long-haul Truck	1.8	77.8
54	Motor Home	1.8	77.8
61	Combination Short-haul Truck	1.8	76.6
62	Combination Long-haul Truck	1.8	76.6

Note: Average speeds outside the allowable range will be assigned the closest available drive cycle. Also, speeds of "0" are allowed for all source types, indicating idle operation.



# Completed Input Database

The screenshot shows the MOVES Project Data Manager window. The title bar reads "MOVES Project Data Manager". The interface features a series of tabs at the top, each with a green checkmark except for "Operating Mode Distribution", which has a red 'X'. The tabs are: Hotelling, I/M Programs, Retrofit Data, Generic, Tools, Operating Mode Distribution, Age Distribution, Fuel, Meteorology Data, RunSpec Summary, Database, Links, Link Source Types (selected), Link Drive Schedules, and Off-Network. Below the tabs is a section labeled "Description of Imported Data:" followed by a large empty text area. Below that is a section labeled "linkSourceTypeHour Data Source:" with a "File: (please select a file)" label and another empty text area. At the bottom left is a "Messages:" label and a large empty text area. At the bottom right are two buttons: "Export Most Recent Execution Data" and "Export Imported Data". A green banner at the very bottom contains the text "Link Source Types" and a "Done" button.

MOVES Project Data Manager

Hotelling I/M Programs Retrofit Data Generic Tools  
Operating Mode Distribution Age Distribution Fuel Meteorology Data  
RunSpec Summary Database Links Link Source Types Link Drive Schedules Off-Network

Description of Imported Data:

linkSourceTypeHour Data Source:  
File: (please select a file)

Messages:

Export Most Recent Execution Data Export Imported Data

Link Source Types

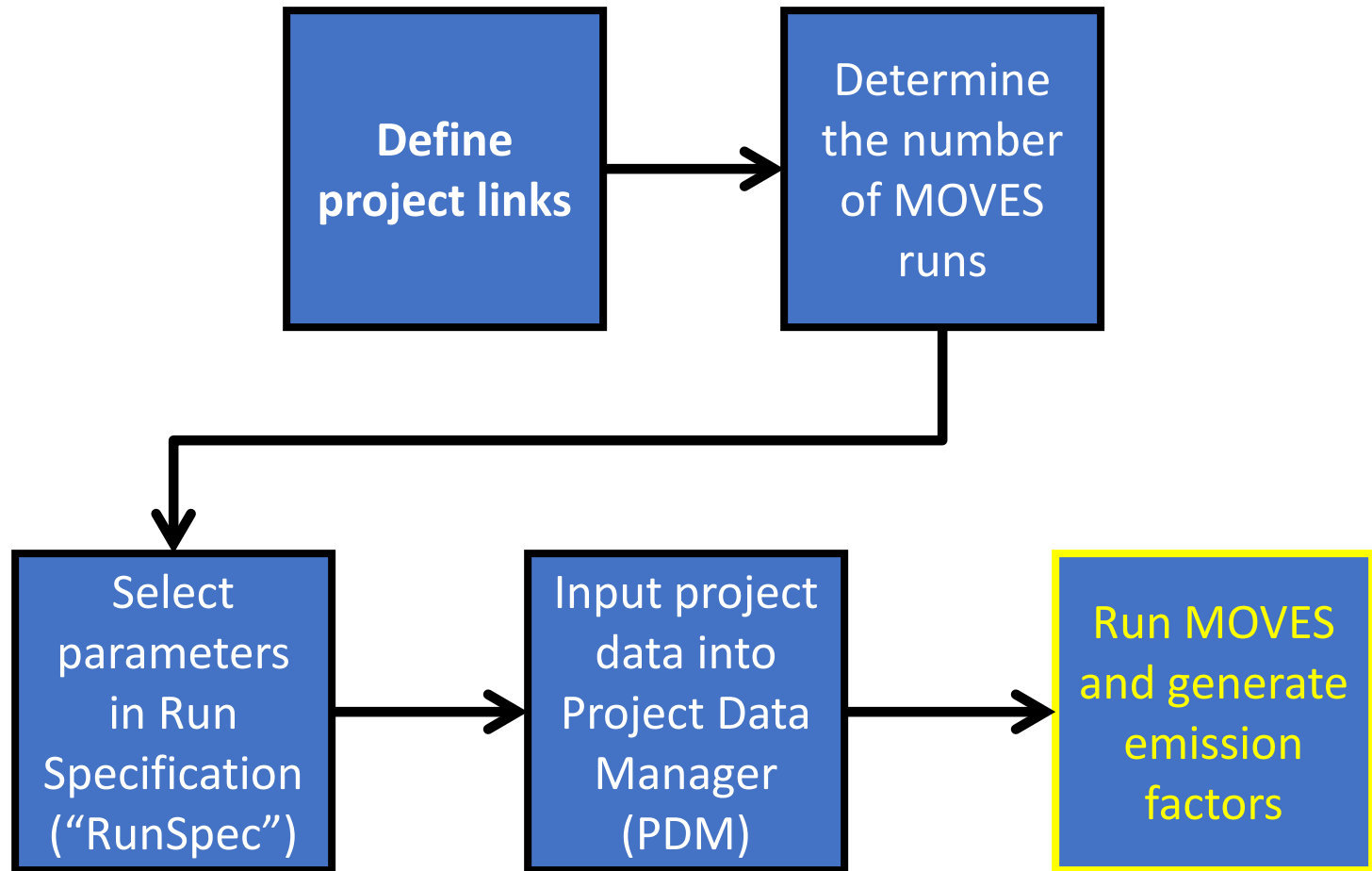
Done

Green checks for all tabs (except Operating Mode Distribution)

**Note:** This run will not use the Off-Network, Hotelling, Operating Mode Distribution, I/M Programs, Link Drive Schedule, or Generic database tables

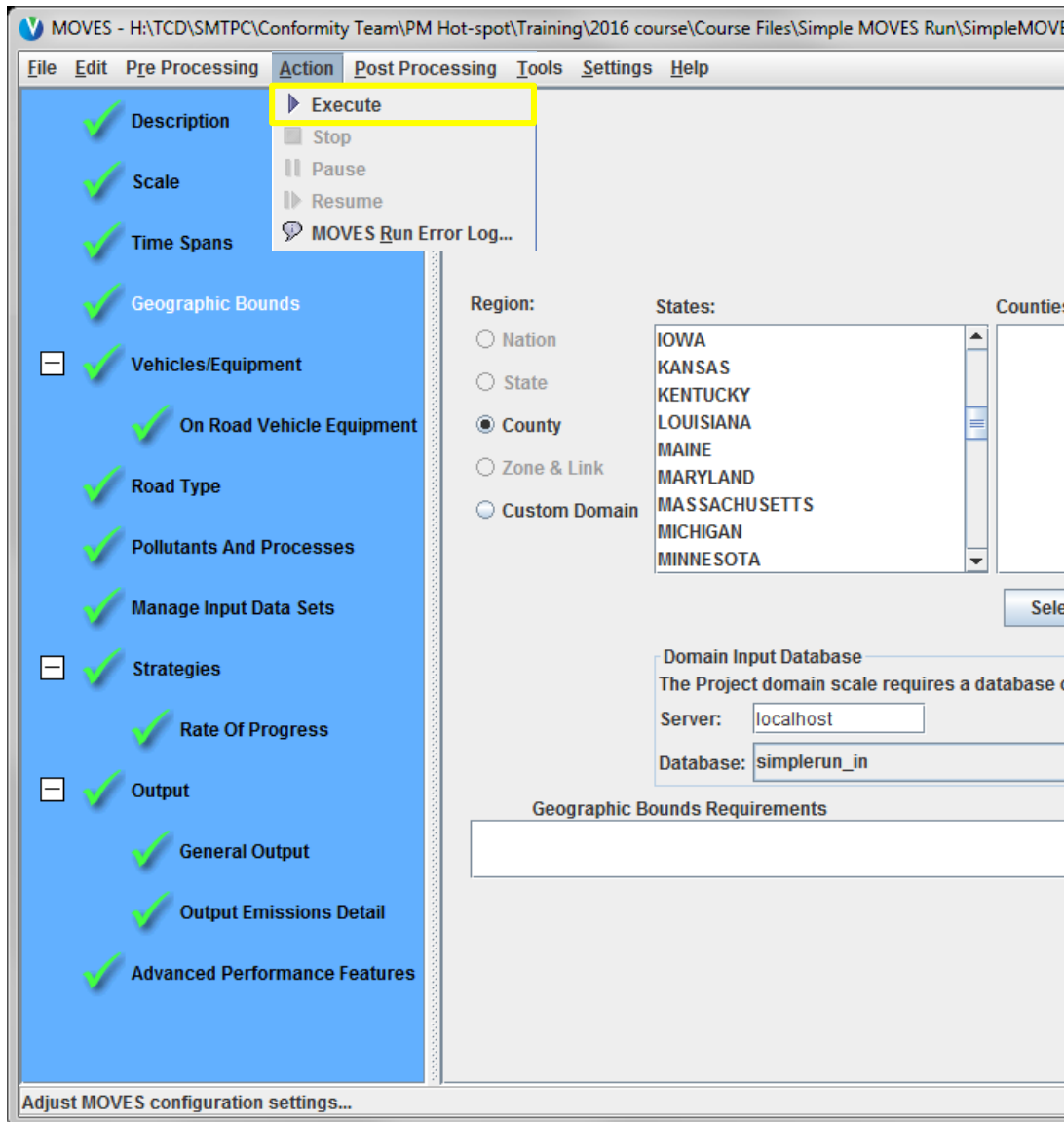


# Running MOVES at the Project Scale





# Save RunSpec and Execute the MOVES run



The screenshot shows the MOVES software interface. The 'Action' menu is open, and the 'Execute' option is highlighted. The left sidebar shows a list of configuration panels, all of which have a green checkmark next to them, indicating they are configured correctly. The 'Geographic Bounds' panel is currently selected. The main window displays the 'Region' settings, with 'County' selected. A list of states is shown, including IOWA, KANSAS, KENTUCKY, LOUISIANA, MAINE, MARYLAND, MASSACHUSETTS, MICHIGAN, and MINNESOTA. The 'Domain Input Database' section shows the server as 'localhost' and the database as 'simplerun\_in'. The 'Geographic Bounds Requirements' section is empty.

**Note:** It may be necessary to refresh the screen to get a green check for the Geographic Bounds Panel. To do this, simply click on another panel (e.g., Time Spans), and then click back to the Geographic Bounds Panel

To run MOVES, click “Execute”

Adjust MOVES configuration settings...



# Viewing MOVES Output in MySQL

The screenshot displays the MySQL Workbench interface. On the left, the Navigator pane shows the 'simplerun\_out' schema with a list of tables. The 'movesoutput' table is highlighted. The main window shows a query editor with the query: `SELECT * FROM simplerun_out.movesoutput;`. Below the query editor, the 'Result Grid' displays the output of the query. The table has 11 columns: linkID, pollutantID, processID, sourceTypeID, fuelSubTypeID, modelYearID, roadTypeID, engTechID, emissionQuant, and emissionQua. The data is organized into 16 rows, showing various vehicle types and their associated emission rates. The bottom pane shows the 'Output' tab with a message: '64 row(s) returned'.

linkID	pollutantID	processID	sourceTypeID	fuelSubTypeID	modelYearID	roadTypeID	engTechID	emissionQuant	emissionQua
1	118	15	62	NULL	NULL	NULL	NULL	0.259056	NULL
1	118	15	21	NULL	NULL	NULL	NULL	0.0112072	NULL
1	118	1	62	NULL	NULL	NULL	NULL	0.42267	NULL
1	118	1	21	NULL	NULL	NULL	NULL	1.40089	NULL
2	117	10	62	NULL	NULL	NULL	NULL	0.160549	NULL
2	117	10	21	NULL	NULL	NULL	NULL	0.837663	NULL
1	117	10	62	NULL	NULL	NULL	NULL	0.177999	NULL
1	117	10	21	NULL	NULL	NULL	NULL	0.928713	NULL
2	116	9	62	NULL	NULL	NULL	NULL	0.0753184	NULL
2	116	9	21	NULL	NULL	NULL	NULL	0.385012	NULL
1	116	9	62	NULL	NULL	NULL	NULL	0.0835052	NULL
1	116	9	21	NULL	NULL	NULL	NULL	0.426861	NULL



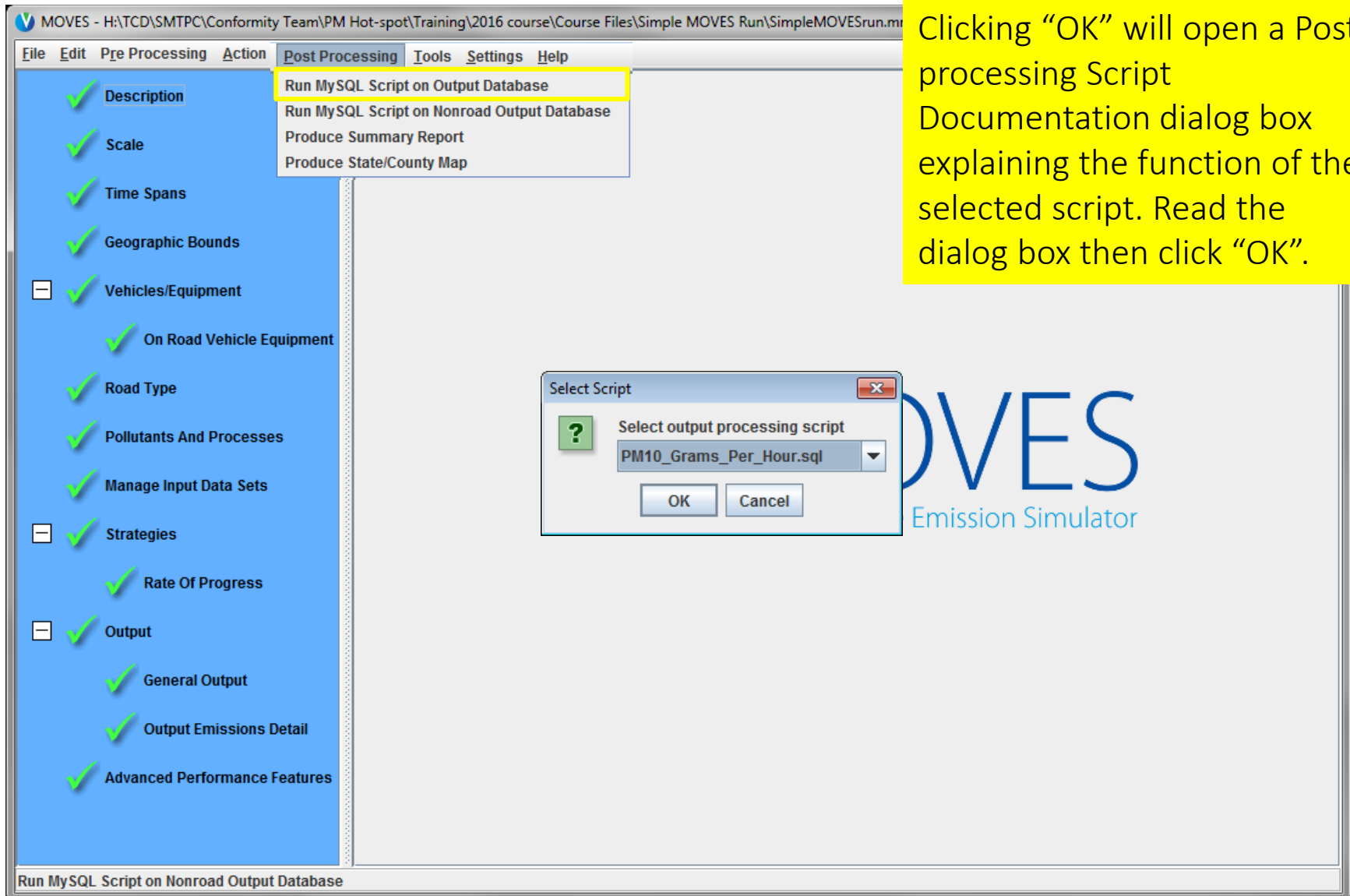
# Available Post-Processing Scripts for Calculating Emission Factors (EF)

Script Name:	Produces:
"PM10 Grams Per Hour"	An EF for each link as grams/hour (AERMOD)
"PM10 Grams Per Mile"	An EF for each link as grams/veh-mile (CAL3QHCR)
"PM2.5 Grams Per Hour"	An EF for each link as grams/hour (AERMOD)
"PM2.5 Grams Per Mile"	An EF for each link as grams/veh-mile (CAL3QHCR)

***Note:** MOVES scripts are also available for CO project-scale analyses.*



# Run Post-Processing Script on Output



The screenshot displays the MOVES software interface. The 'Post Processing' menu is open, showing options: 'Run MySQL Script on Output Database', 'Run MySQL Script on Nonroad Output Database', 'Produce Summary Report', and 'Produce State/County Map'. The 'Run MySQL Script on Nonroad Output Database' option is selected. A 'Select Script' dialog box is open, prompting the user to 'Select output processing script'. The dropdown menu shows 'PM10\_Grams\_Per\_Hour.sql'. The 'OK' button is highlighted. The background shows the MOVES Emission Simulator interface with a list of features on the left, including Description, Scale, Time Spans, Geographic Bounds, Vehicles/Equipment, On Road Vehicle Equipment, Road Type, Pollutants And Processes, Manage Input Data Sets, Strategies, Rate Of Progress, Output, General Output, Output Emissions Detail, and Advanced Performance Features. The status bar at the bottom indicates 'Run MySQL Script on Nonroad Output Database'.

Clicking "OK" will open a Post-processing Script Documentation dialog box explaining the function of the selected script. Read the dialog box then click "OK".



# New Summary Emission Factors Table

To view the output of the script, find and right click "Select Rows" on the table named "pm10\_grams\_per\_hour".

**Note:** You may need to refresh the Schemas to see the new table.

**Table: pm10\_grams\_per\_hour**

**Columns:**

movesRunId	smallint(5) UN
yearId	smallint(5) UN
monthId	smallint(5) UN
hourId	smallint(5) UN
linkId	int(10) UN
pollutant	varchar(10)
gramsPerHour	double

movesRunId	yearId	monthId	hourId	linkId	pollutant	gramsPerHour
1	2011	7	1	1	Total PM10	14.16172655554336
1	2011	7	1	2	Total PM10	13.41280195582658



# Defining Activity with Option 2: Link Drive Schedule



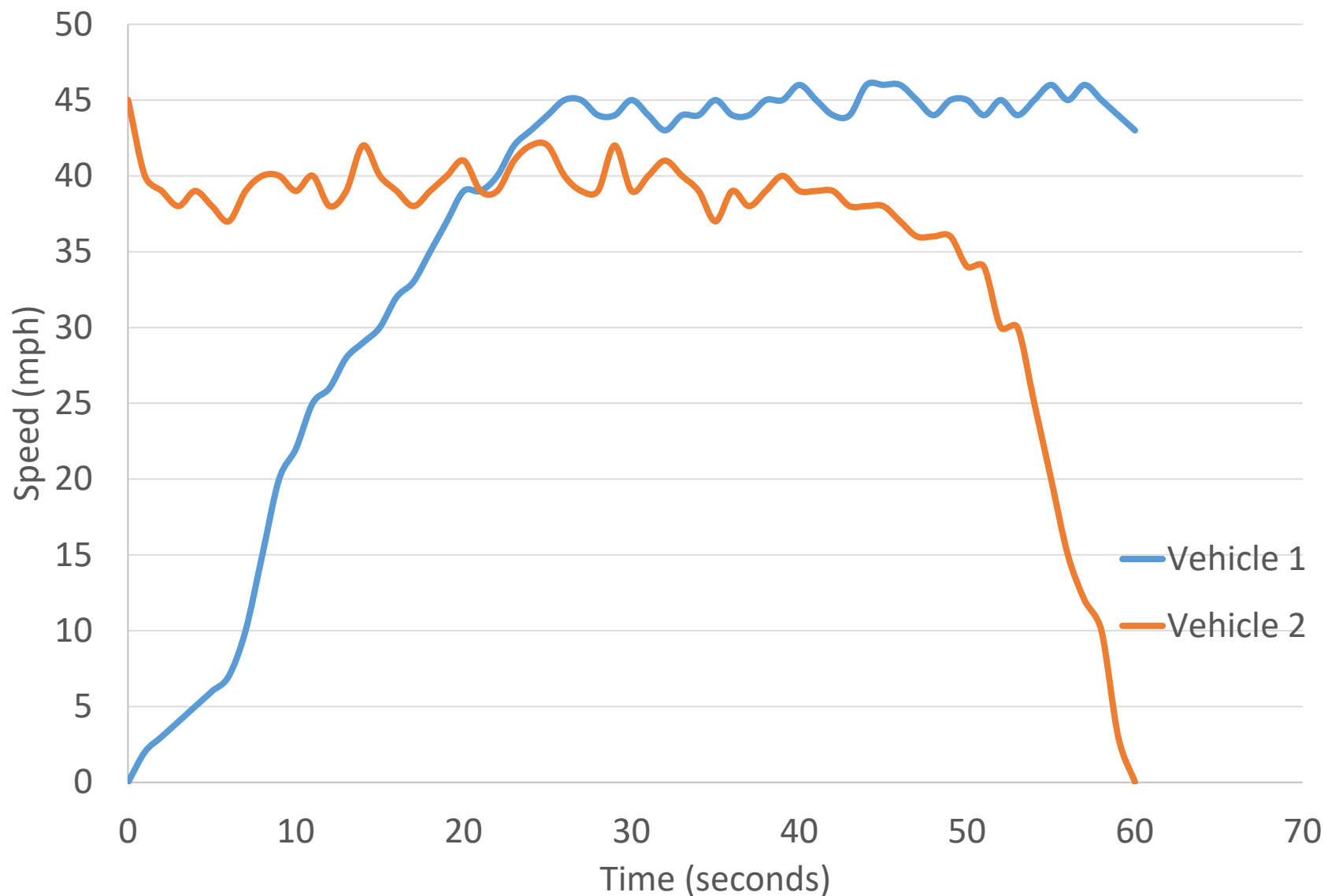
# Defining a Link Drive Schedule

- For any link, user can provide a “link drive schedule,” a second-by-second speed/grade profile (vehicle trajectory)
  - Not necessary to define all seconds for a link... emissions from defined link drive schedule will be applied to entire link (for specified distance in Links table)
- MOVES uses internal algorithm to calculate an Op-Mode distribution from Link Drive Schedule and the subsequent emissions
- The vehicle trajectory represents all vehicles driving an identical path on the links
  - “Overlapping links”: Individual links may be defined to represent single (or multiple) vehicle trajectories



# Example: Vehicle Trajectory Data

(For example only; not part of our mini-run)





# Second-by-Second Link Drive Schedule Table

- Possible sources of link drive schedule data:
  - Microsimulation model
  - Calculated from highway geometry
    - HCM
    - Other methods
  - Chase-Car Study

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D	E	F
	linkID	secondID	speed	grade		
1						
2	1	1	62.5	0		
3	1	2	62.5	0		
4	1	3	62.5	0		
5	1	4	62.5	0		
6	1	5	62.5	0		
7	1	6	62.5	0		
8	1	7	62.5	0		
9	1	8	62.5	0		
10	1	9	62.5	0		
11	1	10	62.5	0		
12	2	1	61	0		
13	2	2	61	0		
14	2	3	61	0		
15	2	4	61	0		
16	2	5	61	0		
17	2	6	61	0		
18	2	7	61	0		
19	2	8	61	0		
20	2	9	61	0		
21	2	10	61	0		
22						



# Using Output from Microsimulation Models

- Option 1: Model a representative vehicle trajectory, or;
- Option 2: Model multiple vehicle trajectories using multiple links:
  - Each vehicle would be assigned a unique LinkID with a volume of “1”
  - Emissions would then be aggregated in post-processing to calculate link total emission factors
  - **Note:** *Run times increase as more links are defined*
- Option 3: Model an op-mode distribution (developed outside of MOVES) based on vehicle trajectories (not covered in this course)



# Importing a Link Drive Schedule

MOVES - ID 5667576138333911954

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ Road Type
  - ✓ Pollutants And Processes
  - ✓ Manage Input Data Sets
- [-] ✓ Strategies
  - ✓ Rate Of Progress
- [-] ✓ Output
  - ✓ General Output
  - ✓ Output Emissions Detail
  - ✓ Advanced Performance Features

Region:

☐ Nation

☐ State

☒ County

☐ Zone & Link

☐ Custom Domain

States:

IOWA

KANSAS

KENTUCKY

LOUISIANA

MAINE

MARYLAND

MASSACHUSETTS

MICHIGAN

MINNESOTA

Counties:

Selections:

MICHIGAN - Washtenaw County

Select All Add Delete

Domain Input Database

The Project domain scale requires a database of detailed data.

Server:

Database:

Refresh

Enter/Edit Data

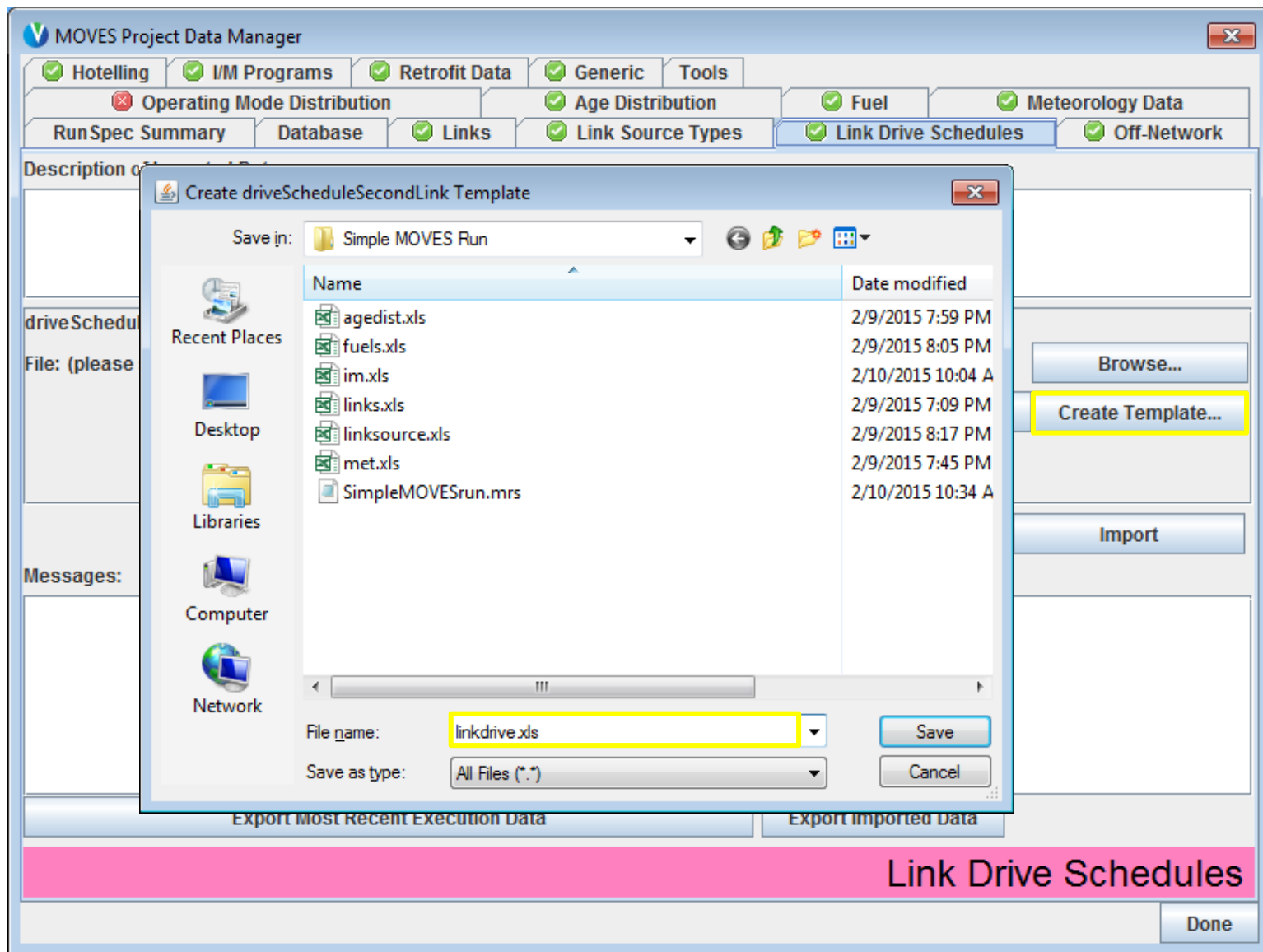
Geographic Bounds Requirements

Please select a domain database.

Ready...

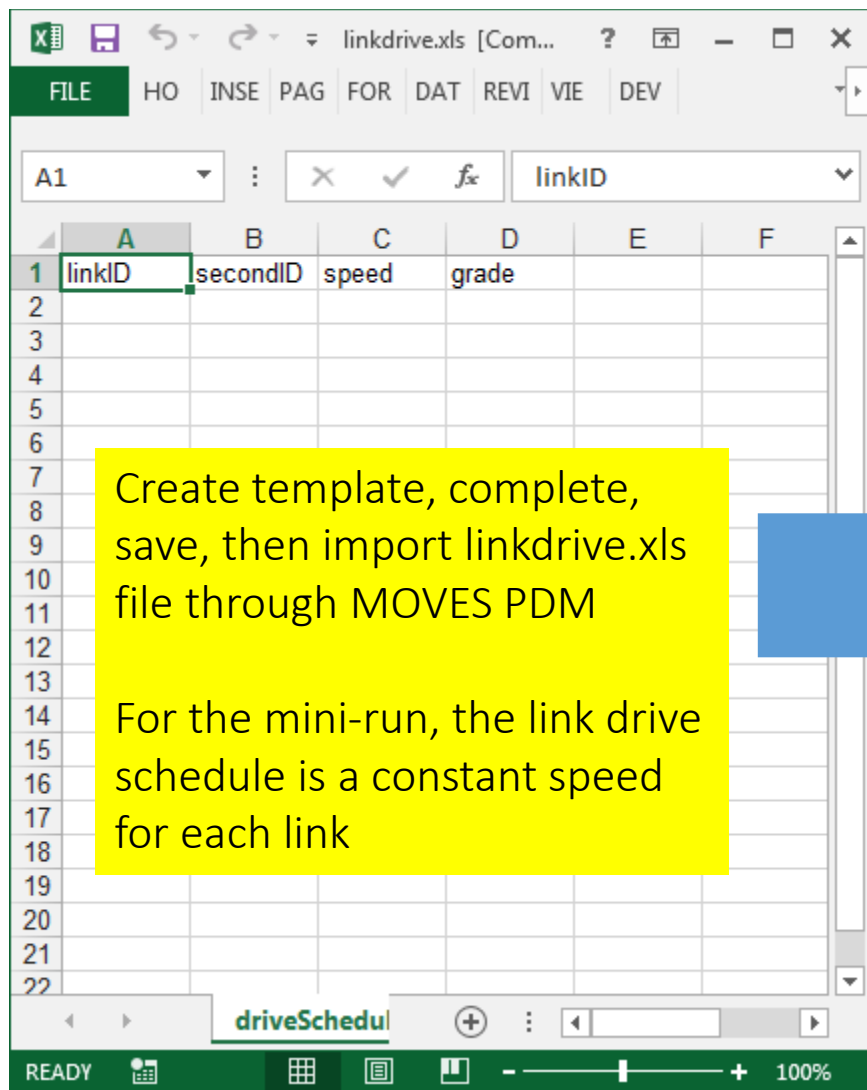


# Creating a Link Drive Schedule Template





# Completing the Link Drive Schedule Template



linkdrive.xls [Com...]

FILE HO INSE PAG FOR DAT REVI VIE DEV

A1 : X ✓ fx linkID

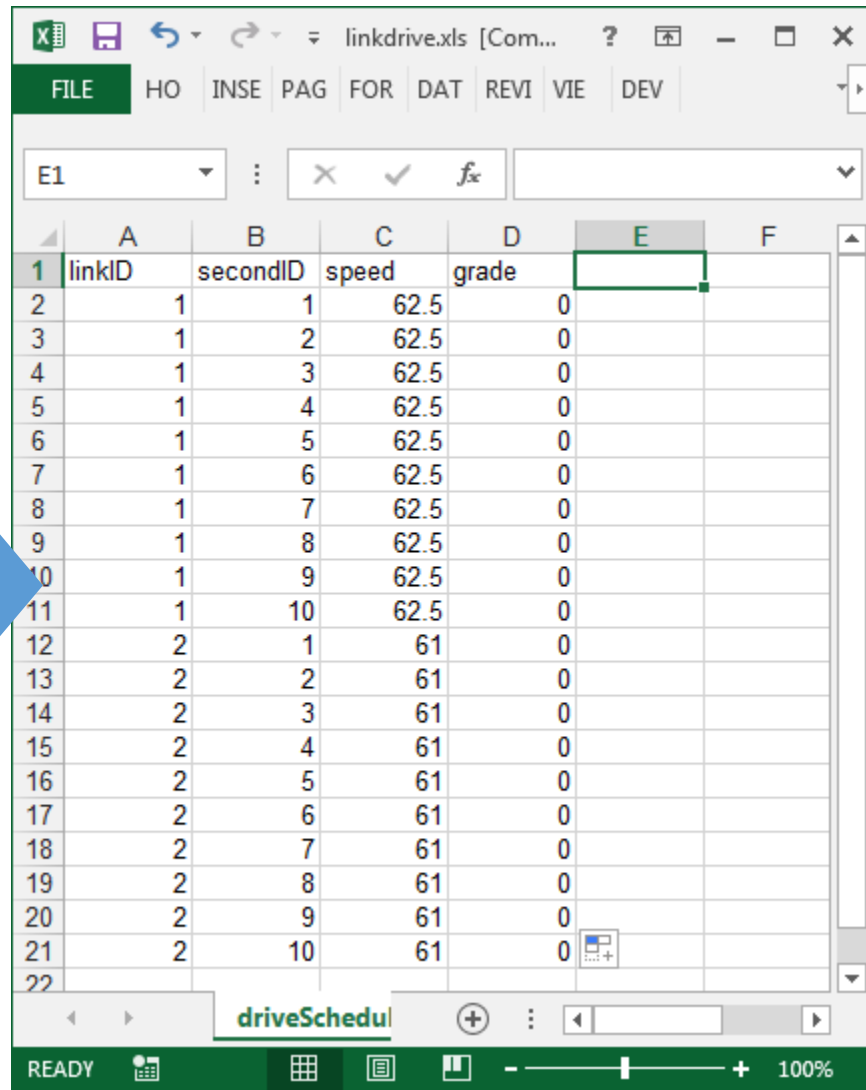
	A	B	C	D	E	F
1	linkID	secondID	speed	grade		
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

driveSchedul

READY 100%

Create template, complete, save, then import linkdrive.xls file through MOVES PDM

For the mini-run, the link drive schedule is a constant speed for each link



linkdrive.xls [Com...]

FILE HO INSE PAG FOR DAT REVI VIE DEV

E1 : X ✓ fx

	A	B	C	D	E	F
1	linkID	secondID	speed	grade		
2	1	1	62.5	0		
3	1	2	62.5	0		
4	1	3	62.5	0		
5	1	4	62.5	0		
6	1	5	62.5	0		
7	1	6	62.5	0		
8	1	7	62.5	0		
9	1	8	62.5	0		
10	1	9	62.5	0		
11	1	10	62.5	0		
12	2	1	61	0		
13	2	2	61	0		
14	2	3	61	0		
15	2	4	61	0		
16	2	5	61	0		
17	2	6	61	0		
18	2	7	61	0		
19	2	8	61	0		
20	2	9	61	0		
21	2	10	61	0		
22						

driveSchedul

READY 100%



# Executing the MOVES run

MOVES - H:\TCD\SMTPC\Conformity Team\PM Hot-spot\Training\2016 course\Course Files\Simple MOVES Run\SimpleMOVESrun.mrs - ID 5667576138333911954

File Edit Pre Processing **Action** Post Processing Tools Settings Help

**Execute**

- Stop
- Pause
- Resume
- MOVES Run Error Log...

**Description** ✓  
**Scale** ✓  
**Time Spans** ✓  
**Geographic Bounds** ✓  
☐ **Vehicles/Equipment** ✓  
    ✓ On Road Vehicle Equipment  
    ✓ Road Type  
    ✓ Pollutants And Processes  
    ✓ Manage Input Data Sets  
☐ **Strategies** ✓  
    ✓ Rate Of Progress  
☐ **Output** ✓  
    ✓ General Output  
    ✓ Output Emissions Detail  
    ✓ Advanced Performance Features

**Region:**

- ☐ Nation
- ☐ State
- ☒ **County**
- ☐ Zone & Link
- ☐ Custom Domain

**States:**

IOWA  
KANSAS  
KENTUCKY  
LOUISIANA  
MAINE  
MARYLAND  
MASSACHUSETTS  
MICHIGAN  
MINNESOTA

**Counties:**

**Selections:**

MICHIGAN - Washtenaw County

Select All Add Delete

**Domain Input Database**  
The Project domain scale requires a database of detailed data.

Server: localhost Refresh

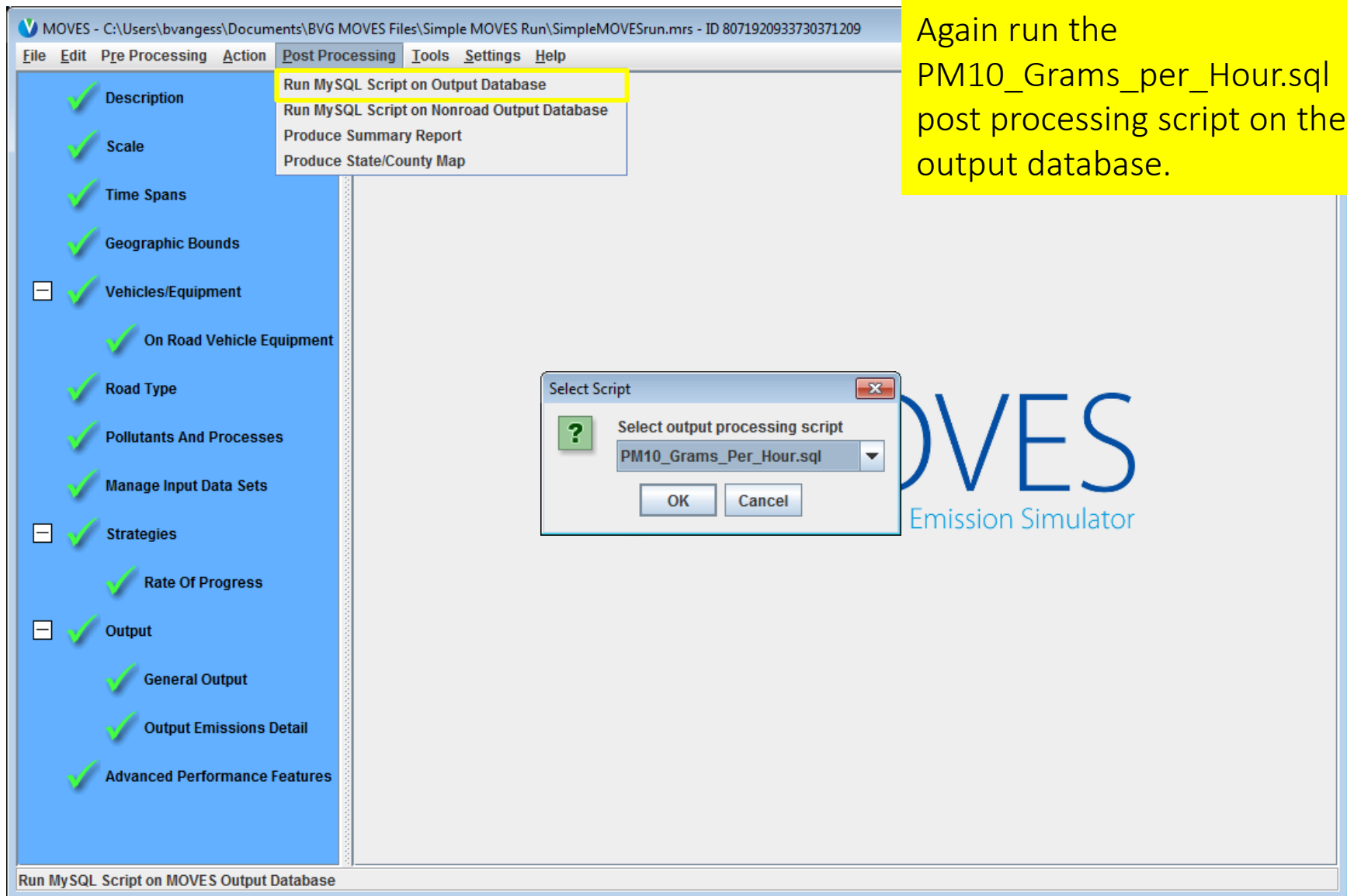
Database: simplerun\_in Enter/Edit Data

**Geographic Bounds Requirements**

Adjust MOVES configuration settings...



# Run Post-Processing Script on Output



The screenshot displays the MOVES software interface. The title bar reads "MOVES - C:\Users\lvangess\Documents\BVG MOVES Files\Simple MOVES Run\SimpleMOVESrun.mrs - ID 8071920933730371209". The menu bar includes File, Edit, Pre Processing, Action, Post Processing, Tools, Settings, and Help. The "Post Processing" menu is open, showing options: "Run MySQL Script on Output Database" (highlighted), "Run MySQL Script on Nonroad Output Database", "Produce Summary Report", and "Produce State/County Map".

On the left, a tree view shows various settings with green checkmarks indicating they are active: Description, Scale, Time Spans, Geographic Bounds, Vehicles/Equipment (expanded to show On Road Vehicle Equipment), Road Type, Pollutants And Processes, Manage Input Data Sets, Strategies (expanded to show Rate Of Progress), Output (expanded to show General Output, Output Emissions Detail, and Advanced Performance Features).

A "Select Script" dialog box is open in the center, titled "Select Script". It contains a green question mark icon, the text "Select output processing script", and a dropdown menu showing "PM10\_Grams\_Per\_Hour.sql". The dialog has "OK" and "Cancel" buttons.

In the background, the MOVES Emission Simulator logo is visible.

At the bottom of the MOVES window, a status bar reads "Run MySQL Script on MOVES Output Database".

Again run the PM10\_Grams\_per\_Hour.sql post processing script on the output database.



# New Summary Emission Factors Table

The screenshot shows the MySQL Workbench interface. The left sidebar displays the 'SCHEMAS' tree with the 'simplerun\_out' database selected. The main query editor contains the following SQL query:

```
SELECT * FROM simplerun_out.pm10_grams_per_hour;
```

The 'Result Grid' shows the following data:

movesRunId	yearId	monthId	hourId	linkId	pollutant	gramsPerHour
1	2016	7	1	1	Total PM10	14.143580242991447
1	2016	7	1	2	Total PM10	12.75695804785937
2	2016	7	1	1	Total PM10	9.876064969226718
2	2016	7	1	2	Total PM10	9.089002974331379

The 'Output' pane at the bottom shows the execution log:

#	Time	Action	Message	Duration / Fetch
1	17:52:31	SELECT * FROM simplerun_out.movesoutput	64 row(s) returned	0.000 sec / 0.000 sec
2	18:42:12	SELECT * FROM simplerun_out.pm10_grams_per_hour	2 row(s) returned	0.000 sec / 0.000 sec
3	18:45:11	SELECT * FROM simplerun_out.pm10_grams_per_hour	4 row(s) returned	0.000 sec / 0.000 sec

**Note:** You may need to hit "F5" to refresh the schema to see new table.

Run 2 emissions < Run 1 emissions  
Why?



# Defining Activity with Option 3: Operating Mode Distribution



# Defining Highway/Intersection Vehicle Activity in MOVES

- User has the option to directly enter a link-specific OpMode distribution
  - This would describe the distribution of activity on a link (fraction of time spent in each OpMode bin)
  - Not a typical output from current traffic models, but can be derived
- We will not cover this input for highway links in this course



# Importing Data for Off-Network Links in the Project Data Manager



# Defining Starts and Hotelling Activity

If the project includes an off-network link, off-network activity is entered in two import tabs:

1. The **Off-Network** Input defines:
  - What vehicles are present?
  - How many are starting?
  - How many are hotelling?
  
2. The **OpMode Distribution** Input defines:
  - The soak-time distribution: OpMode IDs 101 - 108
    - Soak time = How long since the last vehicle start
    - If there is start activity, for each pollutantprocess ID related to starts, soak-time op-mode fractions must sum to 1 for each vehicle type
  - Any hotelling activity: OpMode IDs 200-204
    - If there is any hotelling activity op-mode fractions across the 4 op-modes must sum to “1”



# Off-Network Input

- Source Type
- Vehicle Population: Total number of vehicles parked, starting, or idling on the off-network area over the hour covered by the MOVES run
- Start Fraction: Fraction of the total vehicle population that starts during the hour (may be greater than 1.0 if the average vehicle is started more than once per hour)
- Extended Idle Fraction
  - Used only for hoteling long-haul diesel trucks (0 – 1.0 range)
  - Fraction of time that vehicle population spends hotelling in the hour (e.g., if vehicle population is 20 and 10 vehicles are idling for entire hour, Idle Fraction would be 0.5)
- Parked Vehicle Fraction: Not required as an input – can be left blank



# Off-Network Input

- ***Note:** the Off-Network Input is only required if project includes off-network activity*
- No defaults available

	A	B	C	D	E	F	G	H	I
1	zoneID	sourceTypeID	vehiclePopulation	startFraction	extendedIdleFraction	parkedVehicleFraction			
2	261610	21							
3	261610	62							
4									
5									
6									
7									



# OpMode Distribution Input

- Used to define start and hotelling activity
- Table includes columns for sourceTypeID, hourDayID, linkID, polProcessID, opModelID, and opModeFraction
- OpModelID defines the “soak-time distribution” – how long vehicles have been parked
  - Soak times range in duration from < 6 minutes to >720 minutes
  - **OpModes 101-108** apply (see following slide)
- OpModelID also defines hotelling activity
  - Only long-haul heavy-duty trucks (source type 62); should not be used for any other source type (e.g., transit buses and cars do not “extended idle” in MOVES)
  - Hotelling Opmodes
    - 200 – Extended Idling**
    - 201 – Auxiliary Power Units (APUs)**
    - 203 – Battery Power**
    - 204 – Engine Off**



# OpModelIDs for Start and Extended Idle Activity

opmode\_template.xls [Compatibility Mode] - Excel

File Home Insert Page Layout Formulas Data Review View ACROBAT Tell me what's new

A21 35

Soak Time OpModes: 101-108  
Hotelling OpModes: 200-204

	A	B	C	D	E	F	G	H	I
21	35	Cruise/Acceleration; 6<=VSP<12; 50<=Speed	6	12	50	0	0	0	
22	36	Cruise/Acceleration; 12 <= VSP; 50<=Speed	12	0	50	0	0	0	
23	37	Cruise/Acceleration; 12<=VSP<18; 50<=Speed	12	18	50	0	0	0	
24	38	Cruise/Acceleration; 18<=VSP<24; 50<=Speed	18	24	50	0	0	0	
25	39	Cruise/Acceleration; 24<=VSP<30; 50<=Speed	24	30	50	0	0	0	
26	40	Cruise/Acceleration; 30<=VSP; 50<=Speed	30	0	50	0	0	0	
27	100	Starting (Used for all starts)	0	0	0	0	0	0	
28	101	Soak Time < 6 minutes	0	0	0	0	0	0	
29	102	6 minutes <= Soak Time < 30 minutes	0	0	0	0	0	0	
30	103	30 minutes <= Soak Time < 60 minutes	0	0	0	0	0	0	
31	104	60 minutes <= Soak Time < 90 minutes	0	0	0	0	0	0	
32	105	90 minutes <= Soak Time < 120 minutes	0	0	0	0	0	0	
33	106	120 minutes <= Soak Time < 360 minutes	0	0	0	0	0	0	1
34	107	360 minutes <= Soak Time < 720 minutes	0	0	0	0	0	0	3
35	108	720 minutes <= Soak Time	0	0	0	0	0	0	7
36	150	Hot Soaking	0	0	0	0	0	0	
37	151	Cold Soaking	0	0	0	0	0	0	
38	200	Extended Idling	0	0	0	0	0	0	
39	201	Hotelling Diesel Aux	0	0	0	0	0	0	
40	203	Hotelling Battery AC	0	0	0	0	0	0	
41	204	Hotelling APU Off	0	0	0	0	0	0	
42	300	All Running	0	0	0	0	0	0	
43	400	tirewear;idle	0	0	0	0	0	0	
44	401	tirewear;speed < 2.5mph	0	0	0	2.5	0	0	
45	402	tirewear;2.5mph <= speed < 7.5mph	0	0	2.5	7.5	0	0	

opModeDistribution HourDay **OperatingMode** PollutantProcessAssoc ...

Ready 130%



# Off-Network Activity Examples

- Let's look at how we might define off-network activity for three simple examples:
  - A transit bus facility (starts)
  - A park-and-ride lot (starts)
  - A truck rest area (hotelling)
- We will show the OpMode Distribution table (only) for each



# Start Activity Example: Transit Facility

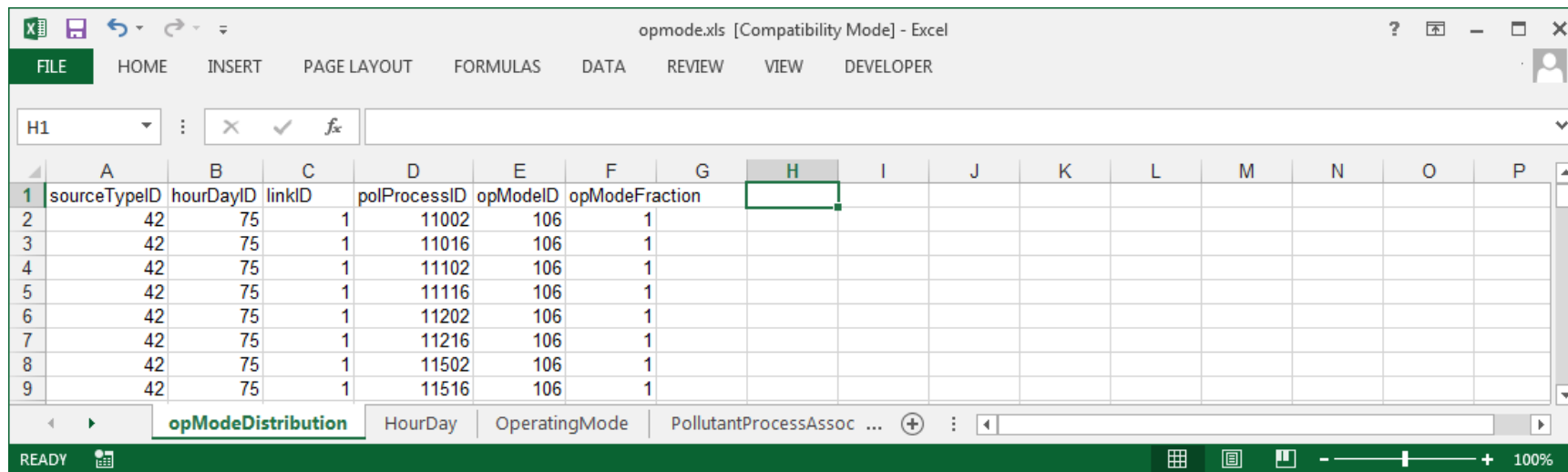
- 6 a.m. – 7 a.m. model run
- No hotelling (buses do not “extended idle”; only combination long-haul trucks can)
- Bus schedule indicates 100% of buses have been parked for 5 hours (300 minutes) prior to starting





# OpMode Distribution Input

## Defining Soak-Time Distribution for Starts



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	sourceTypeID	hourDayID	linkID	polProcessID	opModelID	opModeFraction										
2	42	75	1	11002	106	1										
3	42	75	1	11016	106	1										
4	42	75	1	11102	106	1										
5	42	75	1	11116	106	1										
6	42	75	1	11202	106	1										
7	42	75	1	11216	106	1										
8	42	75	1	11502	106	1										
9	42	75	1	11516	106	1										

- **Note:** All relevant sourceTypeID, hourDayID, and polProcessIDs must also be included
  - SourceTypeID 42: Transit Bus
  - HourDayID 75: Hour 7 = 6:00-6:59, Day 5= Weekday
  - OpMode 106: 300 minute soak



# Start Activity Example: Park-and-Ride Lot

- 5 p.m. – 6 p.m. model run
- No hotelling (cars do not “extended idle” – only long-haul combination trucks do)
- Survey data show most cars (95%) are parked for 9 hours prior to starting
- 5% are parked for less than 5 minutes





# OpMode Distribution Input Defining Soak-Time Distribution for Starts

- **Note:** All relevant *sourceTypeID*s, *hourDayID*s, and *polProcessID*s must also be included
  - OpModeID 101: < 5 minutes soak
  - OpModeID 108: > 9 hour soak

	A	B	C	D	E	F
	sourceTypeID	hourDayID	linkID	polProcessID	opModeID	opModeFraction
1						
2	21	175	1	11002	101	0.05
3	21	175	1	11002	108	0.95
4	21	175	1	11016	101	0.05
5	21	175	1	11116	108	0.95
6	21	175	1	11102	101	0.05
7	21	175	1	11102	108	0.95
8	21	175	1	11116	101	0.05
9	21	175	1	11116	108	0.95
10	21	175	1	11202	101	0.05
11	21	175	1	11202	108	0.95
12	21	175	1	11216	101	0.05
13	21	175	1	11216	108	0.95
14	21	175	1	11502	101	0.05
15	21	175	1	11502	108	0.95
16	21	175	1	11516	101	0.05
17	21	175	1	11516	108	0.95
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						



# Hotelling Activity Example: Truck Rest Area

- 12 a.m. – 1 a.m. model run
- All vehicles are combination long-haul trucks (SourceType 62)
- All trucks are in hotelling OpMode 200 (“extended idling”) for the entire hour
- Other hotelling OpModes are:
  - 201 Auxilliary Power Unit Use
  - 203 Battery Power
  - 204 Engine Off

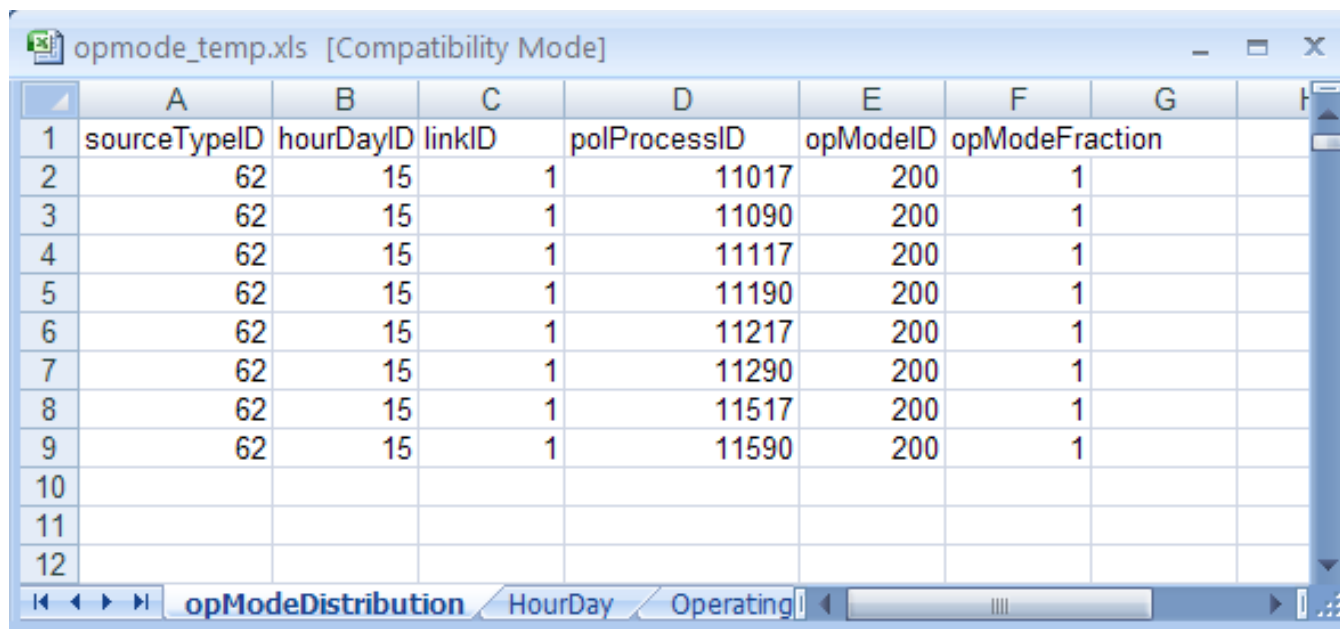




# OpMode Distribution Input

## Defining Extended Idle Activity

- Extended Idle = OpMode 200
- Note:** All relevant hourDayIDs, and polProcessIDs must also be included*



	A	B	C	D	E	F	G	H
1	sourceTypeID	hourDayID	linkID	polProcessID	opModeID	opModeFraction		
2	62	15	1	11017	200	1		
3	62	15	1	11090	200	1		
4	62	15	1	11117	200	1		
5	62	15	1	11190	200	1		
6	62	15	1	11217	200	1		
7	62	15	1	11290	200	1		
8	62	15	1	11517	200	1		
9	62	15	1	11590	200	1		
10								
11								
12								



# Considering Bus and Truck Idle Emissions

- Some terminals may have significant bus or truck idling emissions that is not “hotelling”
  - This type of idling is defined in the [Links](#) input, as a link with an average speed of “0” and a length of “0”
  - Not in the Off-network input
- MOVES assumes the vehicles on such a link idle for the entire hour
  - The output for this link must be adjusted for “dwell time” – percentage of the hour spent idling
    - Example: at a bus terminal, once an hour buses arrive and idle for 10 minutes  
$$\text{Adjusted Link Emissions} = \text{MOVES output for link} \times (10/60)$$
  - Will be demonstrated in example analysis, Module 4



# From Example Analysis





# Considering Running Emissions in Parking Lots

- Some parking lots may have significant running emissions from vehicles entering and exiting the lot or garage
- The decision to include these emissions should be based on:
  - Average distance from parking spot to lot exit
  - Fleet composition (e.g., passenger cars or diesel trucks)
  - Parking lot volume
- Running links may be defined in Links Importer to account for this activity





# Summary: Which activity importers (inputs) are necessary for MOVES to run?

	Links	Link Drive Schedule	OpMode Distribution	Off-Network	Hotelling
Running Links (highways, intersections, etc.)	Yes	When data available*	When data available*	No	No
Off-Network Links (parking lots, transit facilities, etc.)	Yes	No	Yes	Yes	Yes

**Note:** Although not needed by MOVES to run, users are encouraged to use Link Drive Schedules and/or Op-Mode Distributions for defining activity on running links



# PM Hot-Spot Training: Example Analysis



# Project Details

- The project is a lane expansion of the existing highway and the addition of an interchange (on/off ramps) to access two park-and-ride lots and bus terminals
- Modeling choices for example analysis:
  - MOVES2014a to generate emission rates
  - AERMOD to generate air quality concentrations











# Project Details

- Location: Washtenaw County, MI
- Area is in nonattainment for the annual  $PM_{2.5}$  and 2006 24-hour  $PM_{2.5}$  NAAQS
- The project is expected to be completed in 2019
  - Year of expected peak emissions (analysis year): 2020
  - Four-hour AM/PM peak periods
- Determined through interagency consultation to be a project of local air quality concern
- The area surrounding the project is primarily residential and commercial, with no nearby sources that need to be included in modeling



# Available Traffic Data

- Traffic estimates for all links
  - Peak hour volume and average speed
  - Off-peak hour volume and average speed
  - \*Average speed approach will be used to define activity**
- Expected bus volumes for peak and off-peak periods
  - Also average dwell time in bus bays (3 minutes)
- Expected start activity on parking lots for peak and off-peak periods
  - Also soak time distribution

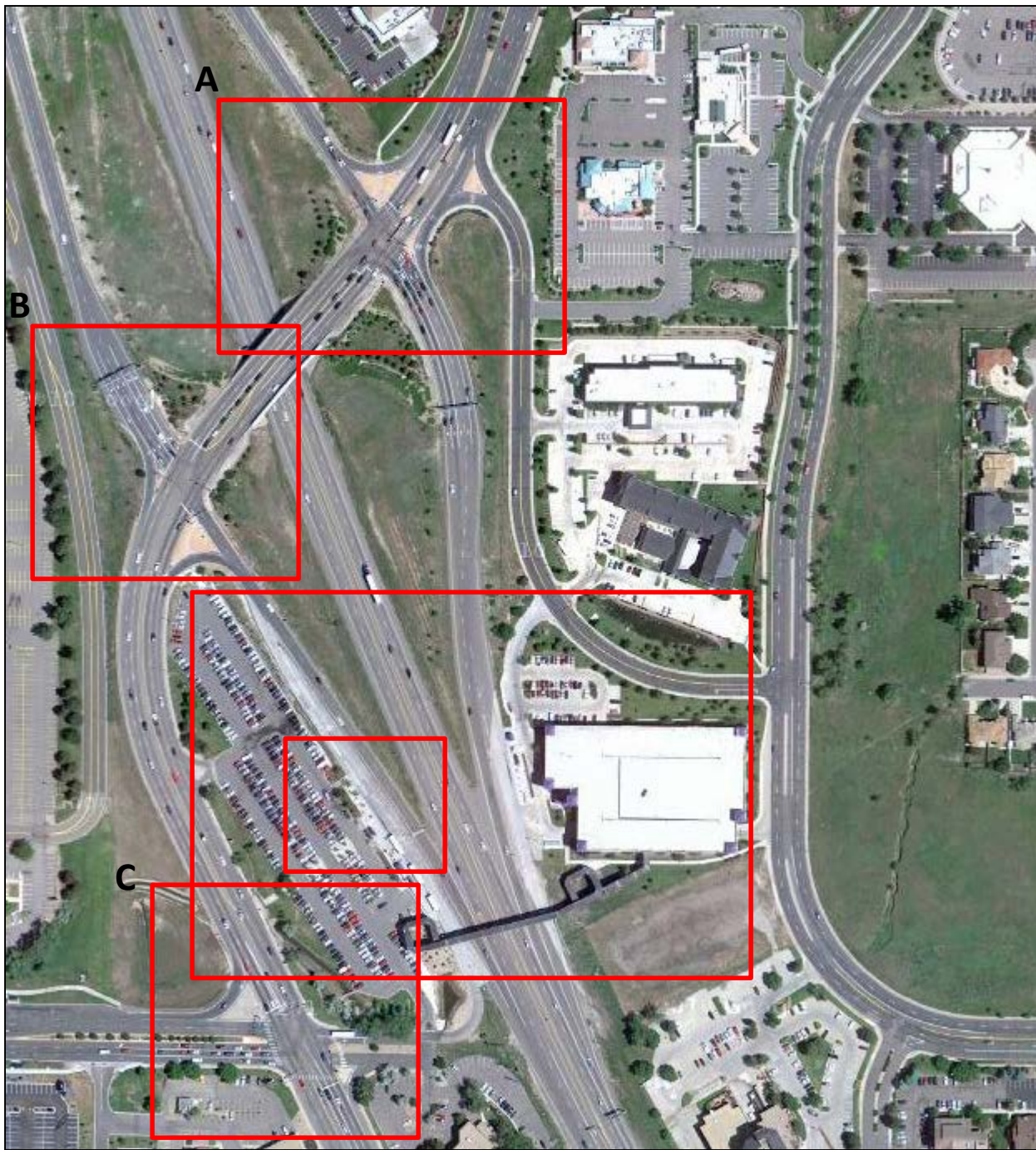
\* This is one of several options that could be used to define links and characterize activity



# Available Fleet Data

- Age distribution provided by MPO
  - Light-duty (LD) from state data
  - Heavy-duty (HD - long-haul trucks) from MOVES national defaults
- Fleet mix provided by MPO
  - Arterial mix, Highway mix
- Detailed bus roster (bus type and age distribution) provided by transit agency
  - All diesel buses
- Truck hoteling activity is 100% APU use for all model years







# Steps before running MOVES

## 1. Divide project into links

- Based on geometry and volumes
- Activity information (average speed) based on V/C, signal timing, and free-flow speeds

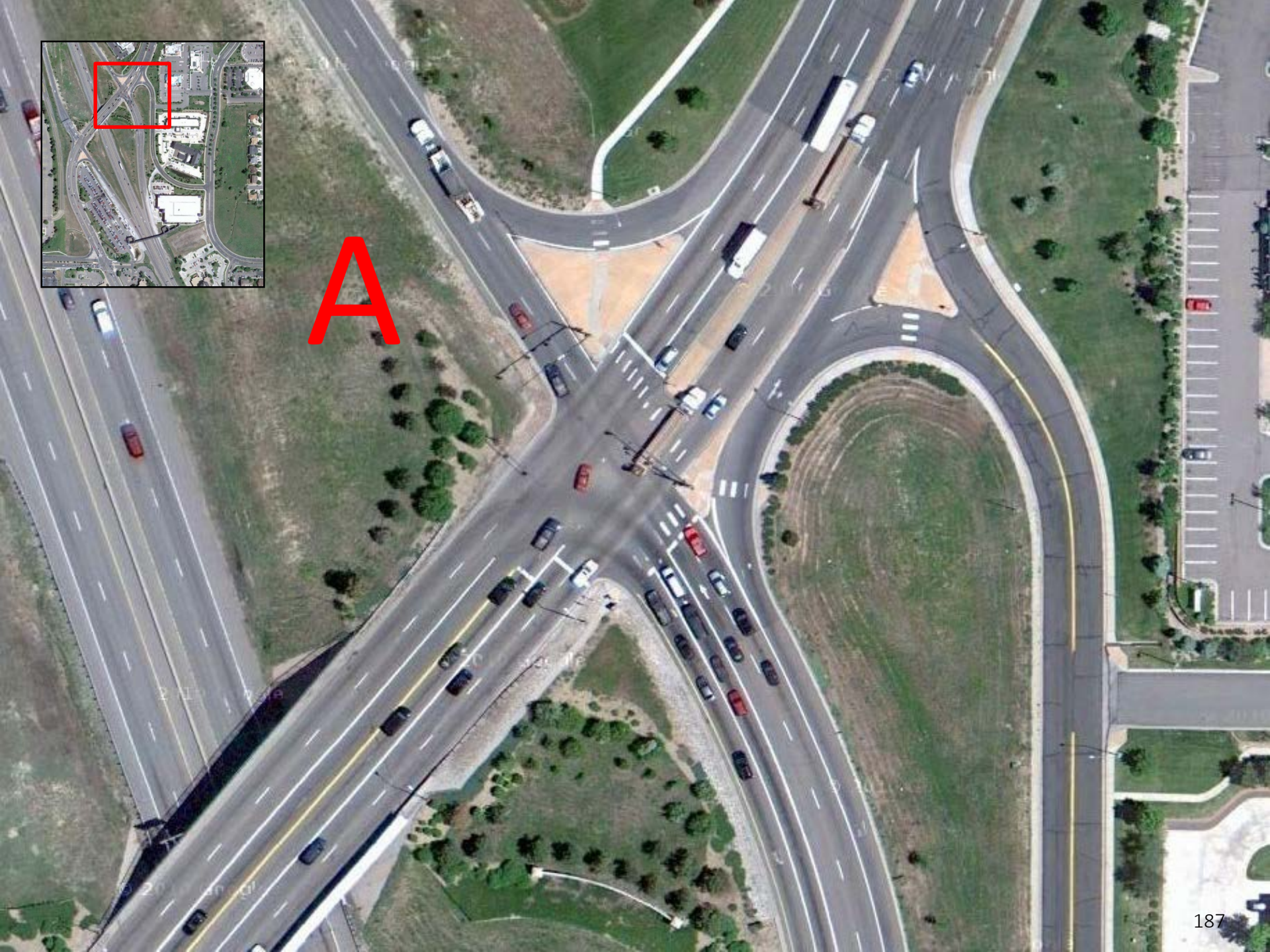
## 2. Determine number of MOVES runs

- Based on available data (peak/off peak): 16 for build analysis
  - For the example analysis, we will only be setting up one MOVES run
  - Results will be provided for all 16 runs

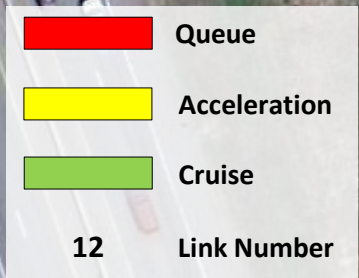




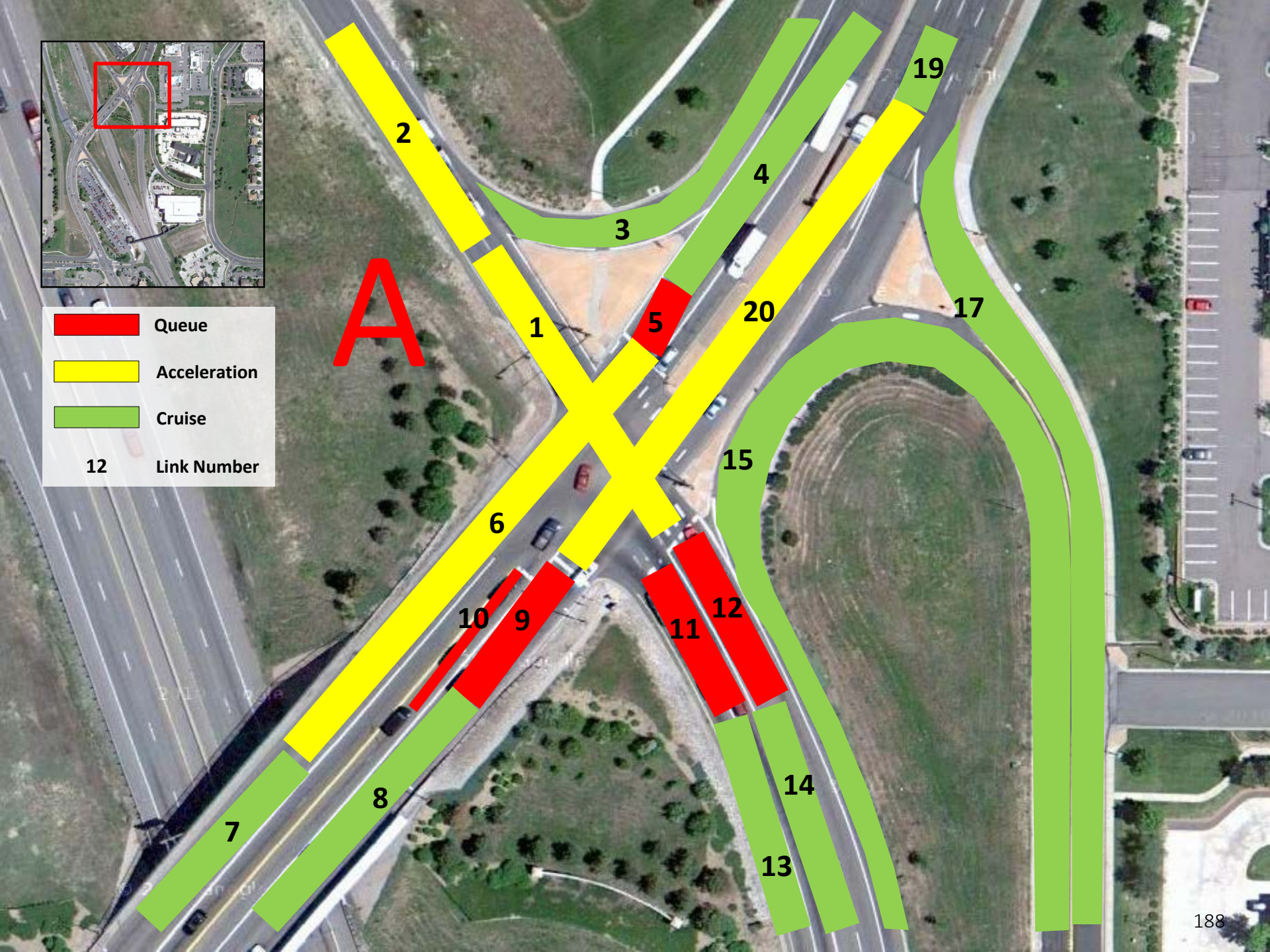
A



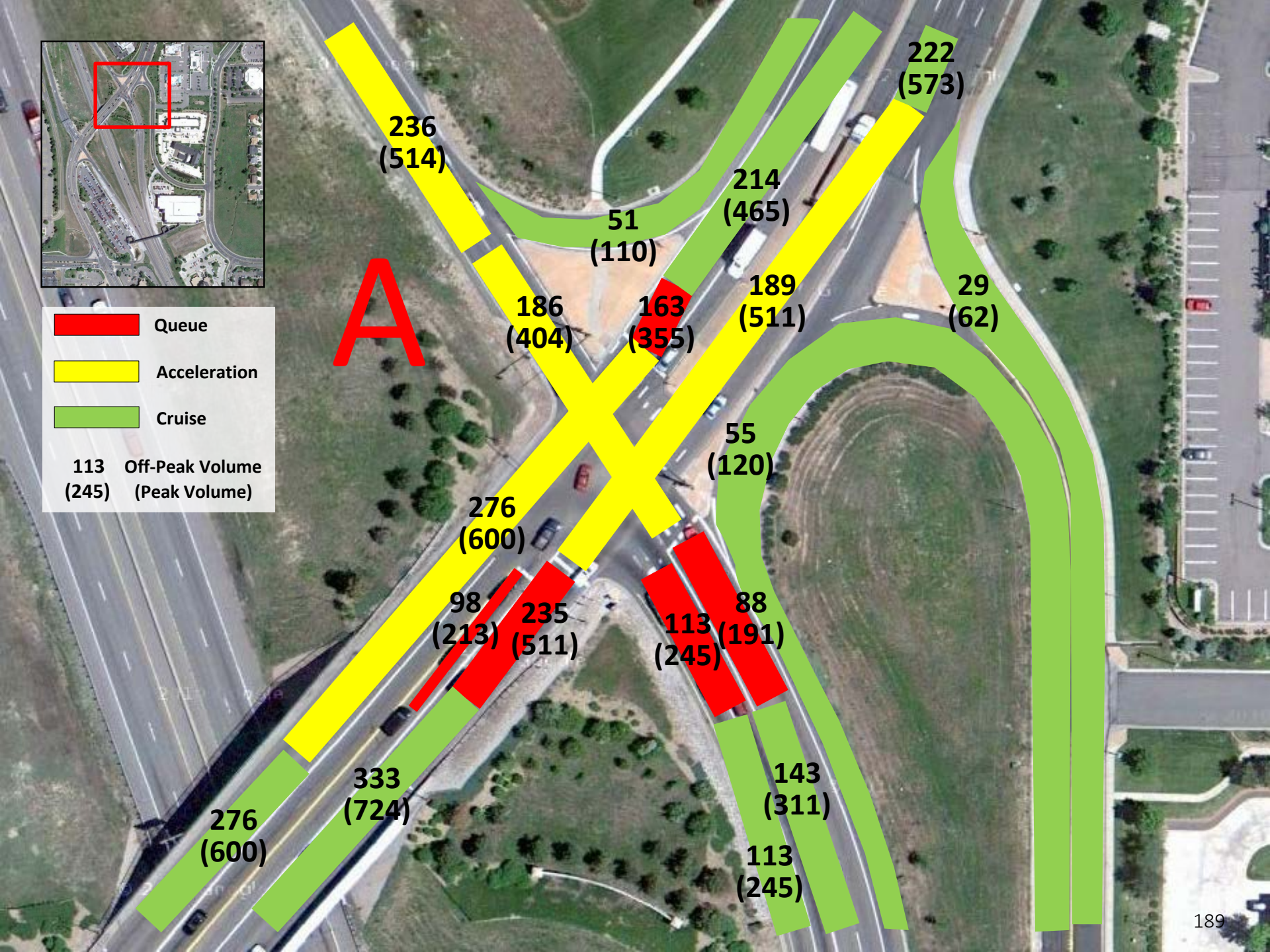
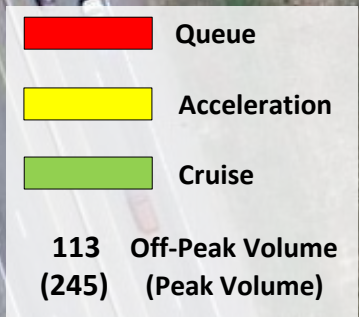




A









B





24

25

26

23

31

28

36

27

21

22

32

30

29

7/

8

38

40

191





**B**

69  
(150)  
69  
(150)

277  
(602)  
302  
(656)

149  
(324)  
148  
(322)

112  
(243)

165  
(359)

184  
(400)

118  
(256)

165  
(359)

259  
(563)

333  
(724)

111  
(241)

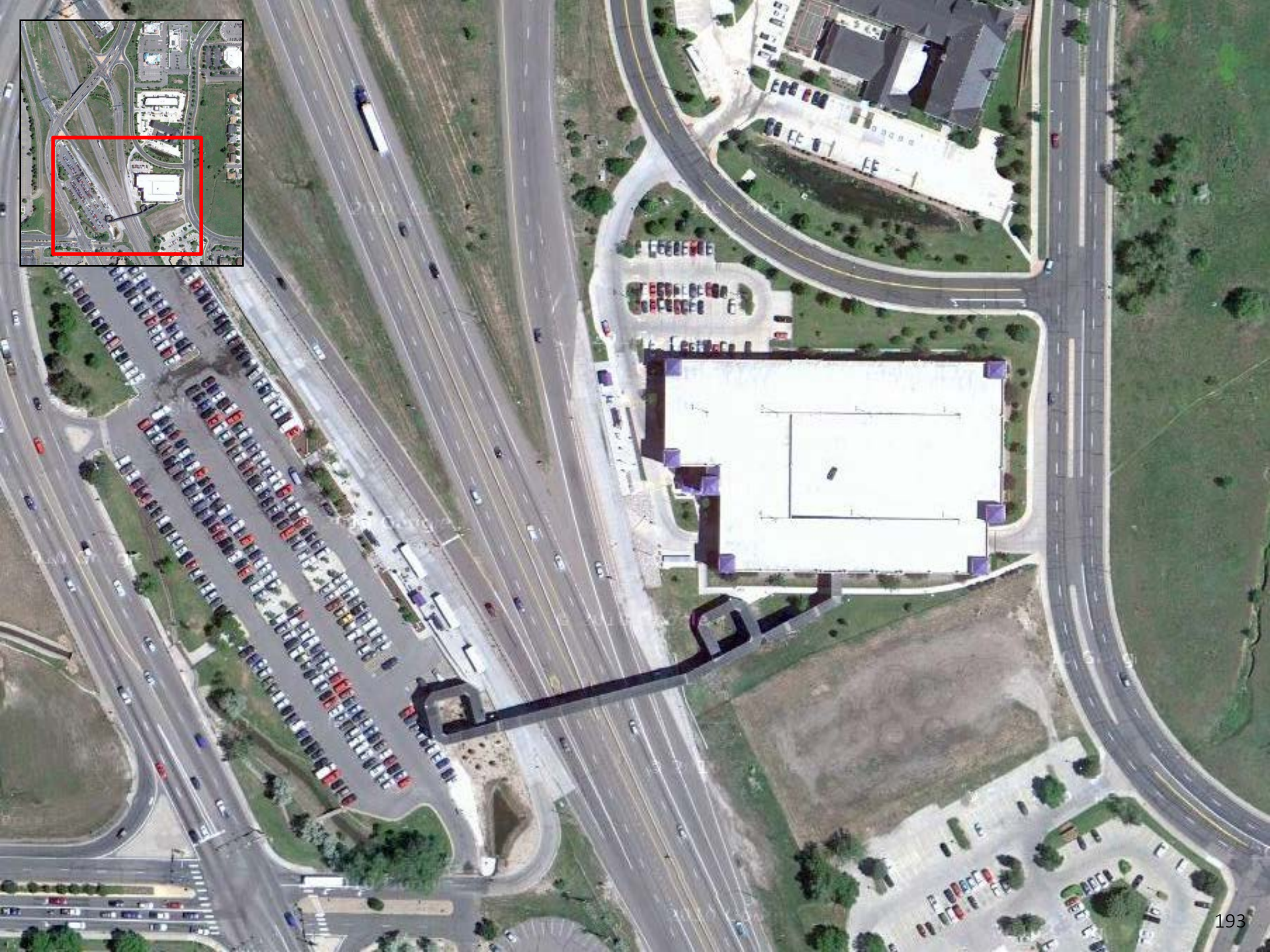
276  
(600)

333  
(724)

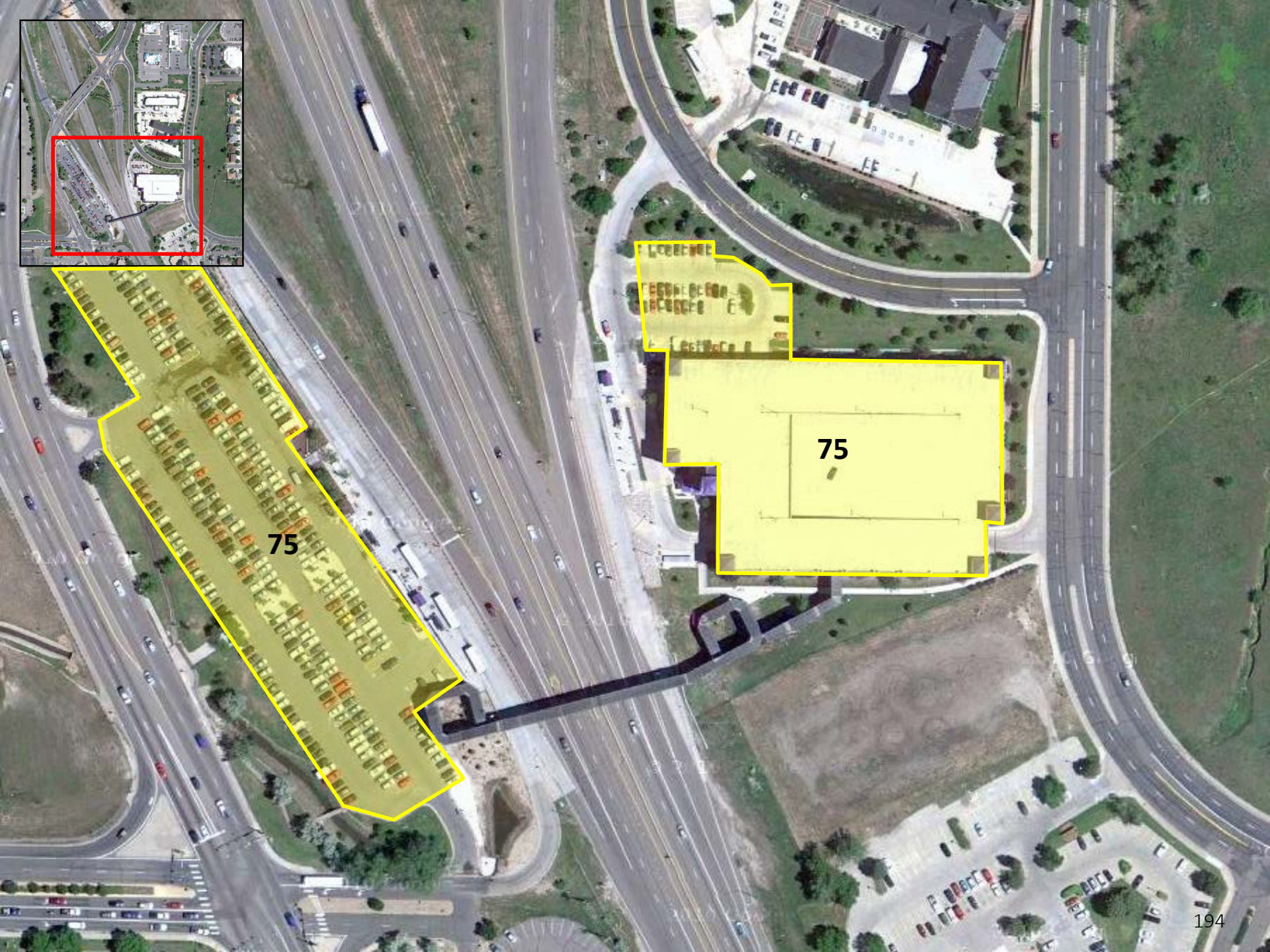
3456  
(5786)  
3780  
(5890)

377  
(819)









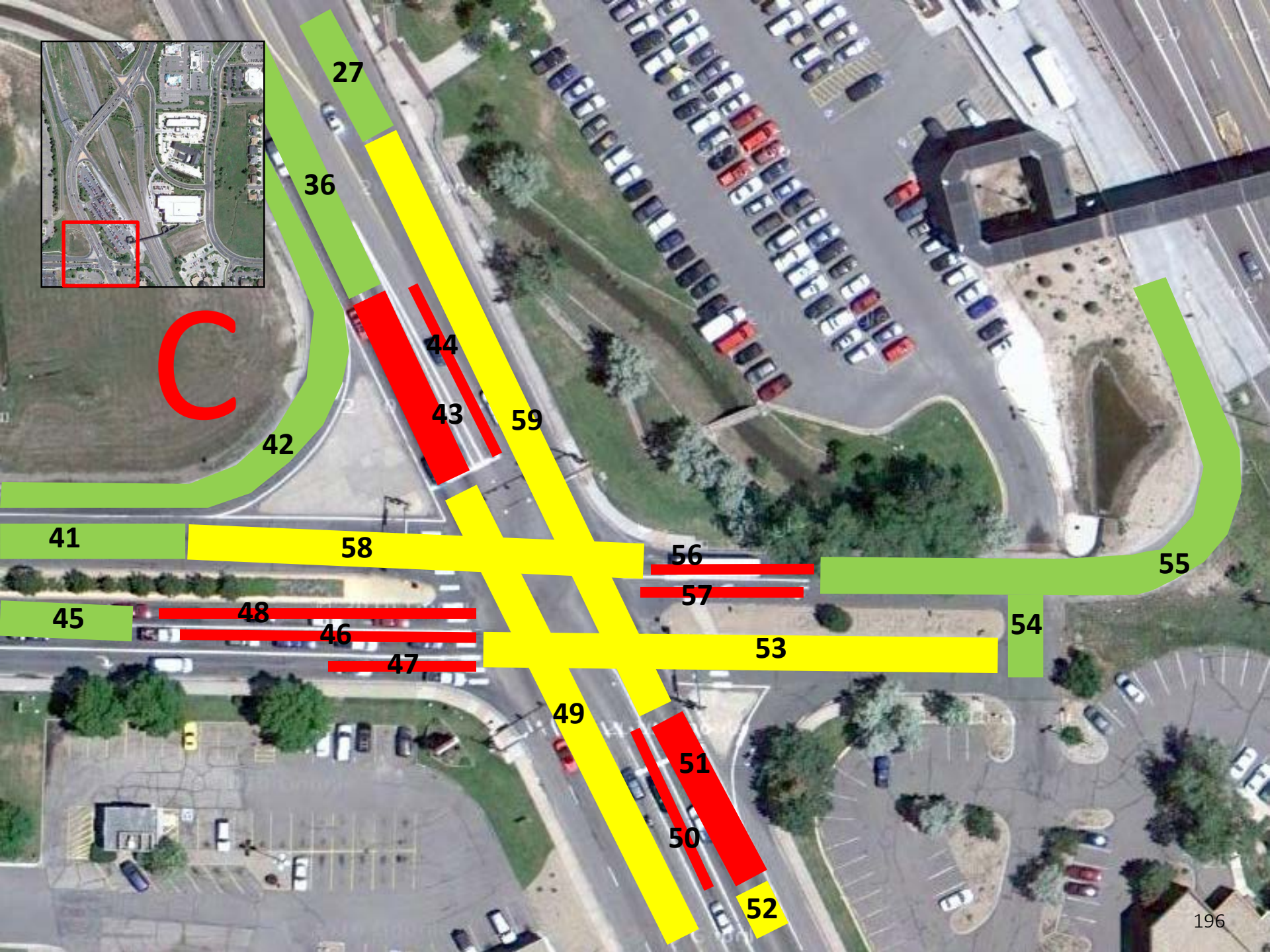




C











C

302  
(656)

277  
(602)

302  
(656)

22  
(48)

157  
(341)

98  
(213)

297  
(644)

253  
(549)

141  
(307)

29

(62)

83

(180)

279  
(606)

166  
(360)

129  
(280)

166  
(360)

83

39  
(180)

(85)

69

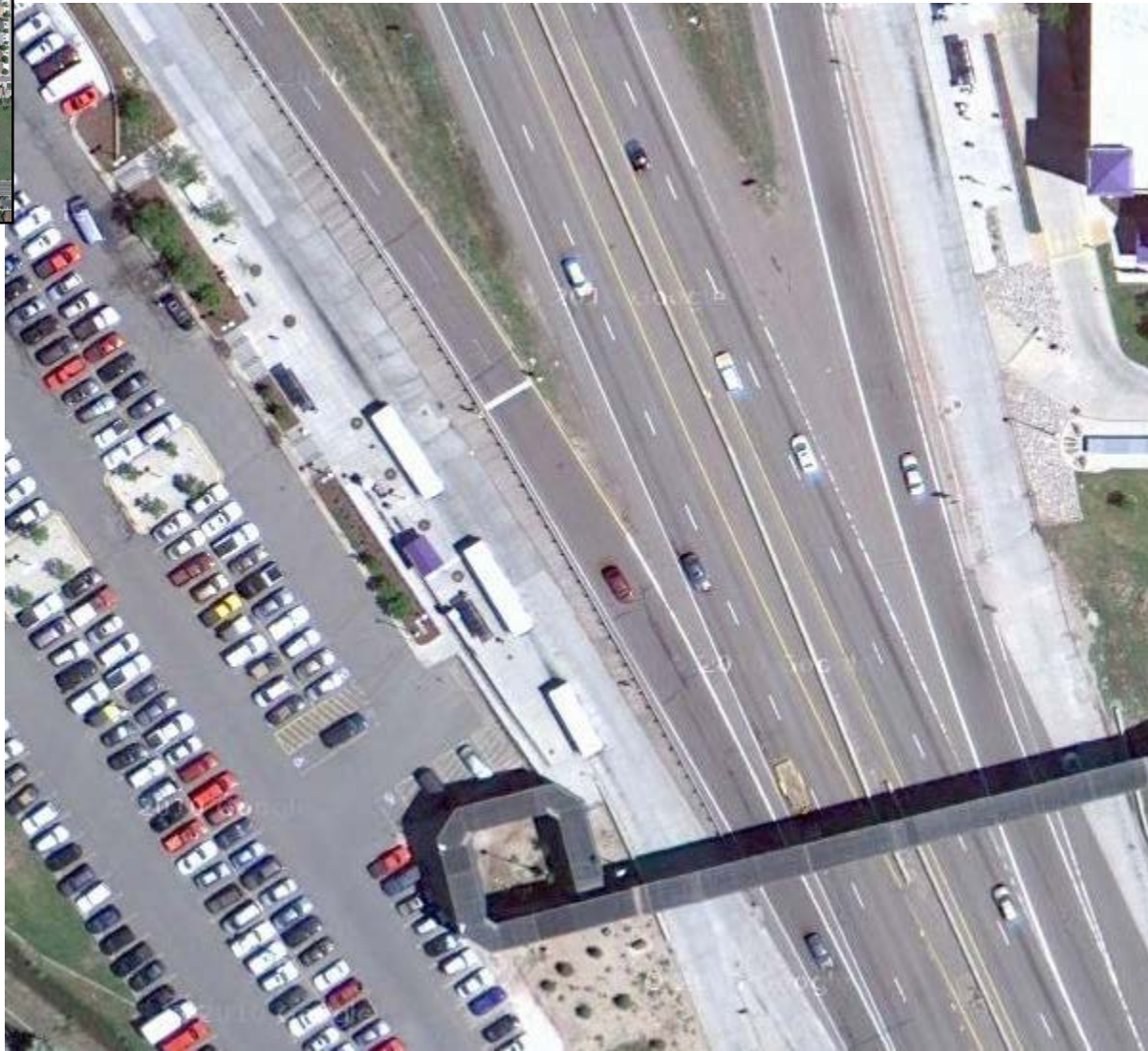
(150)

69

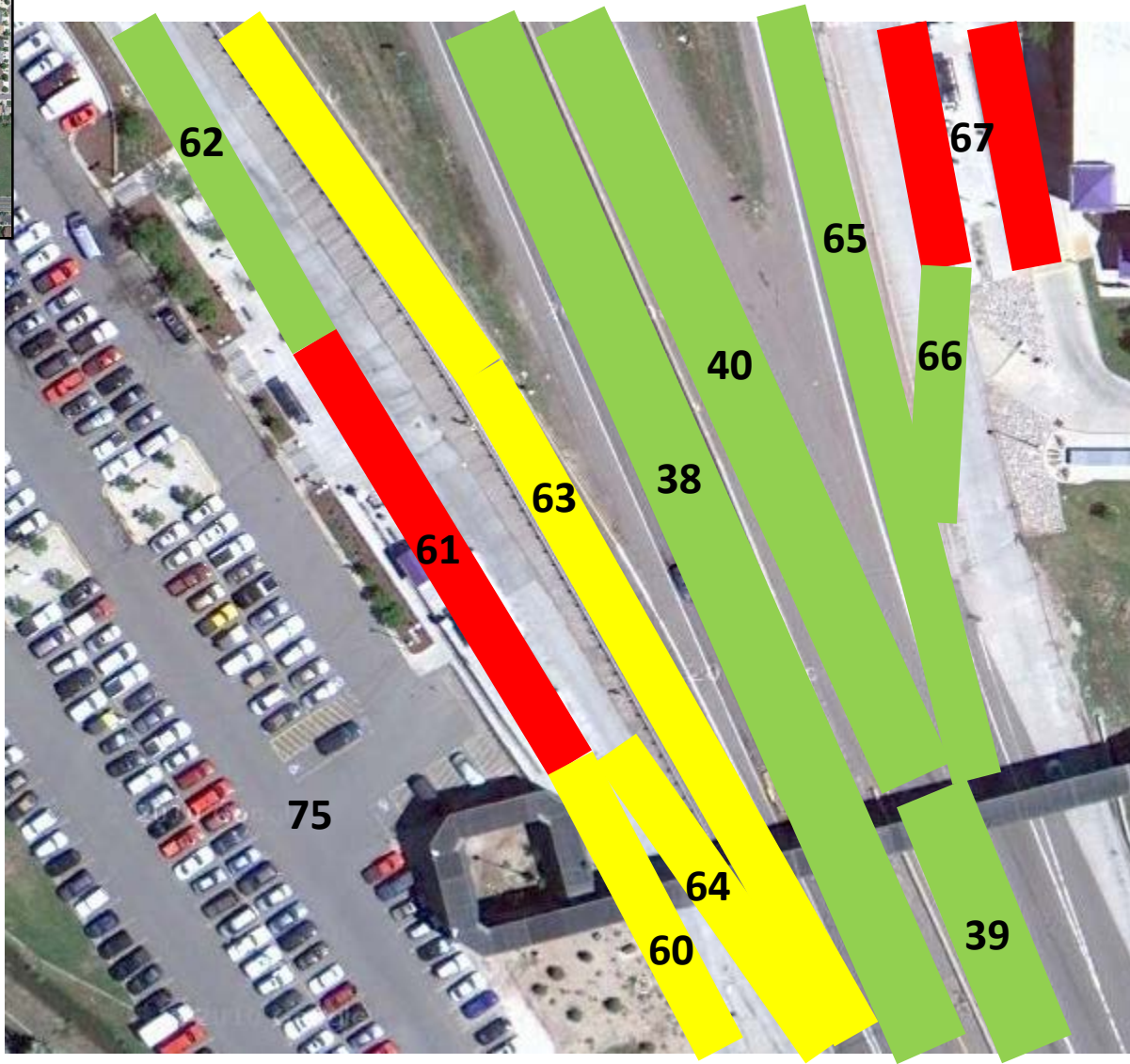
(150)

122  
(265)

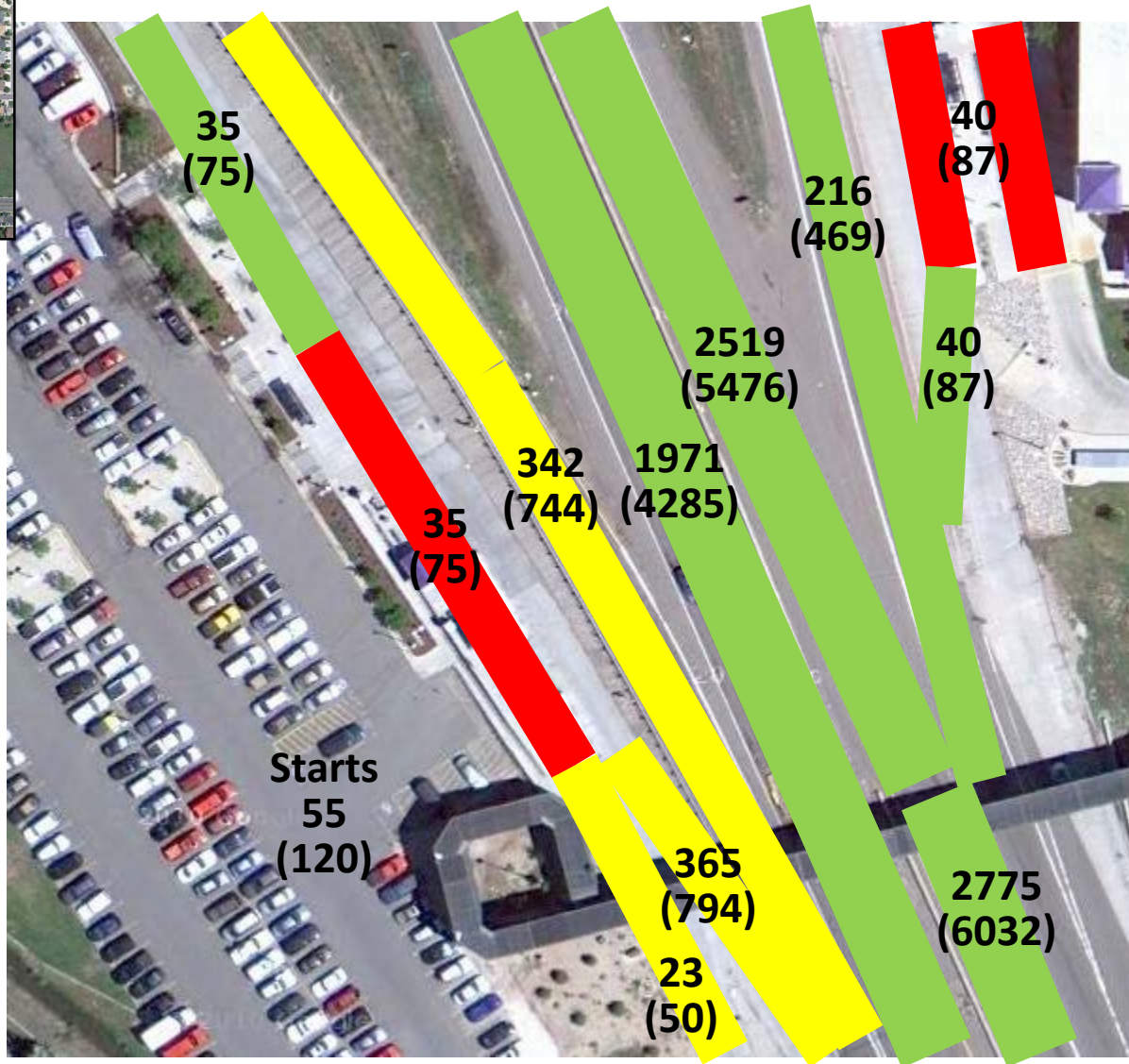




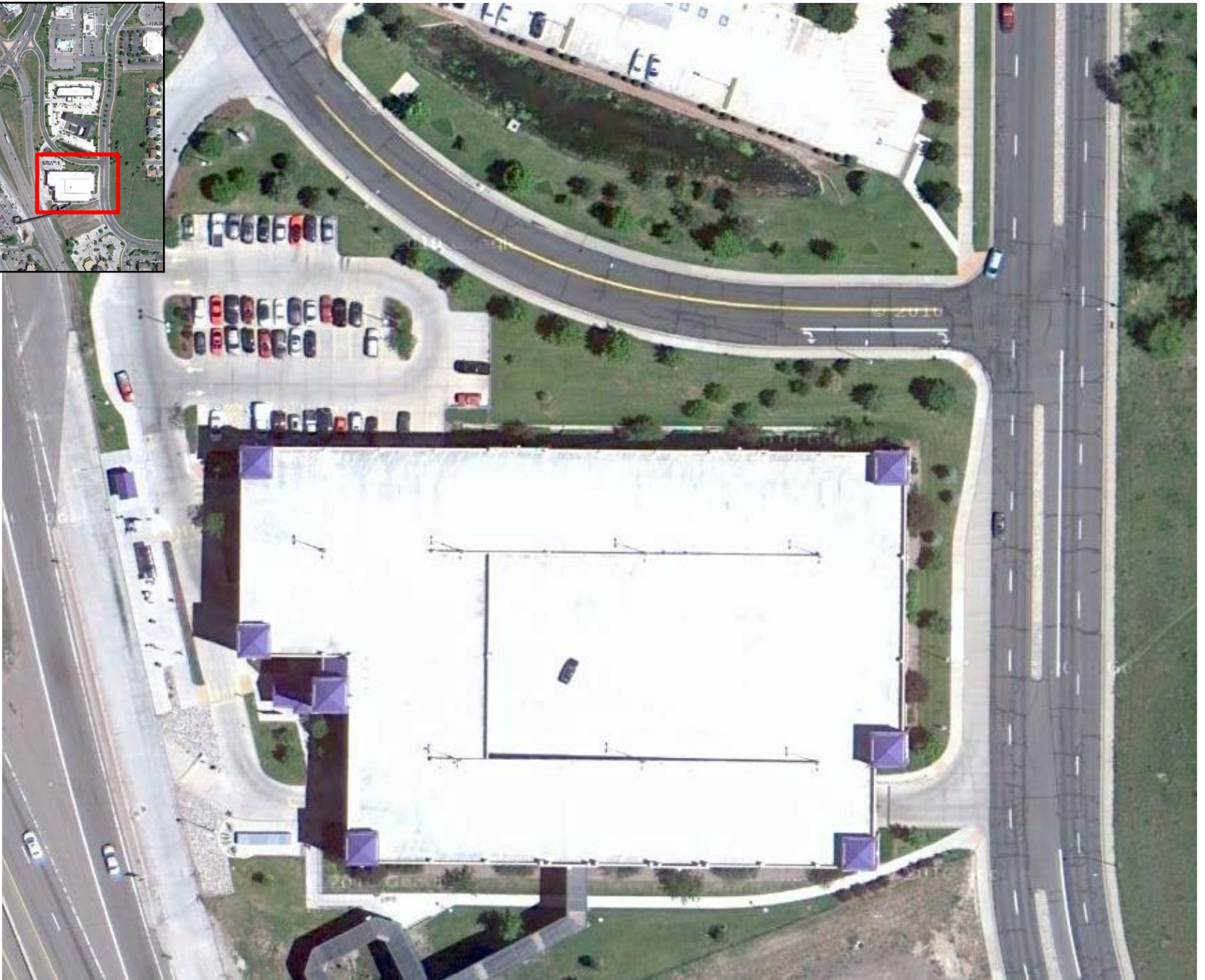




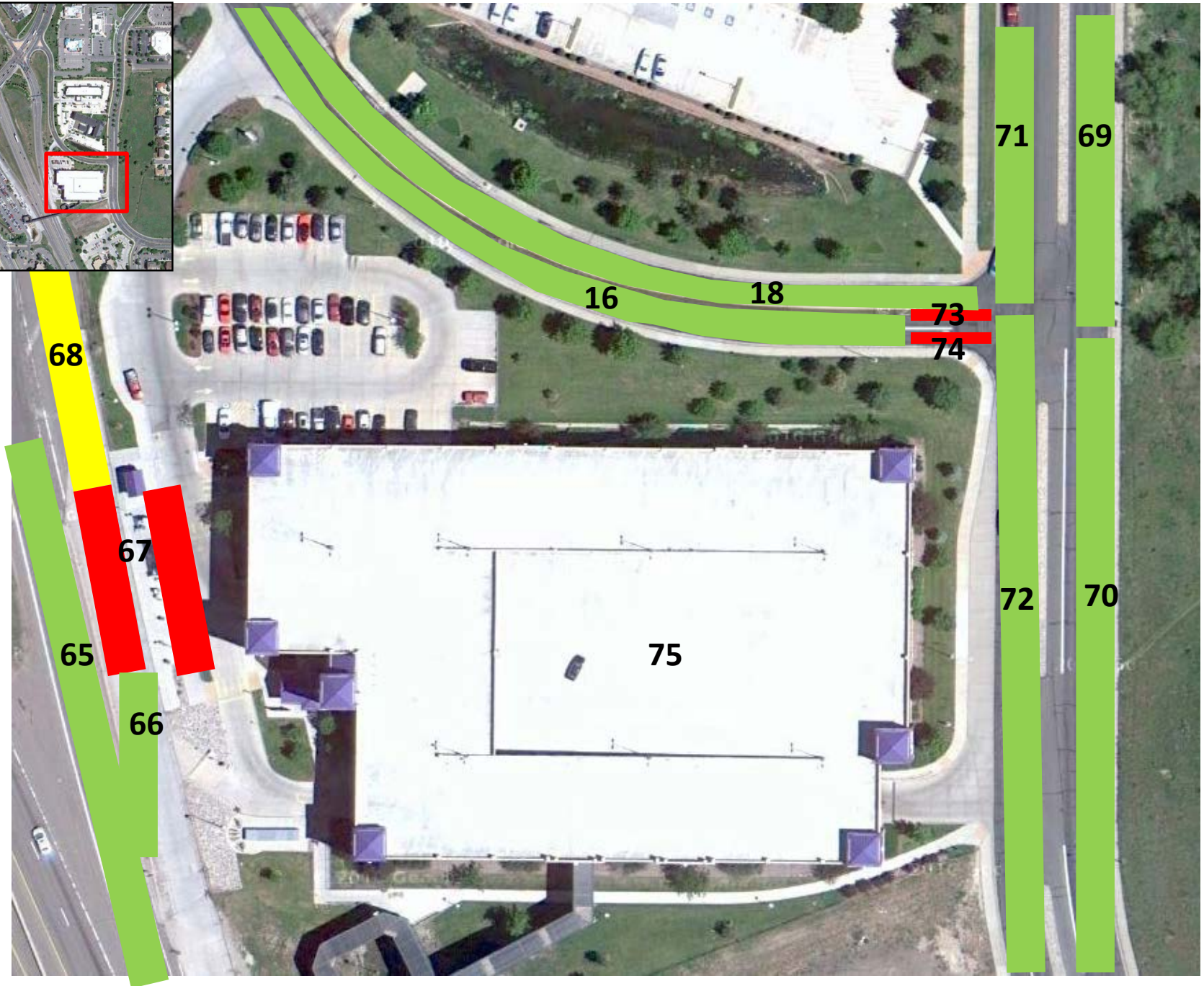




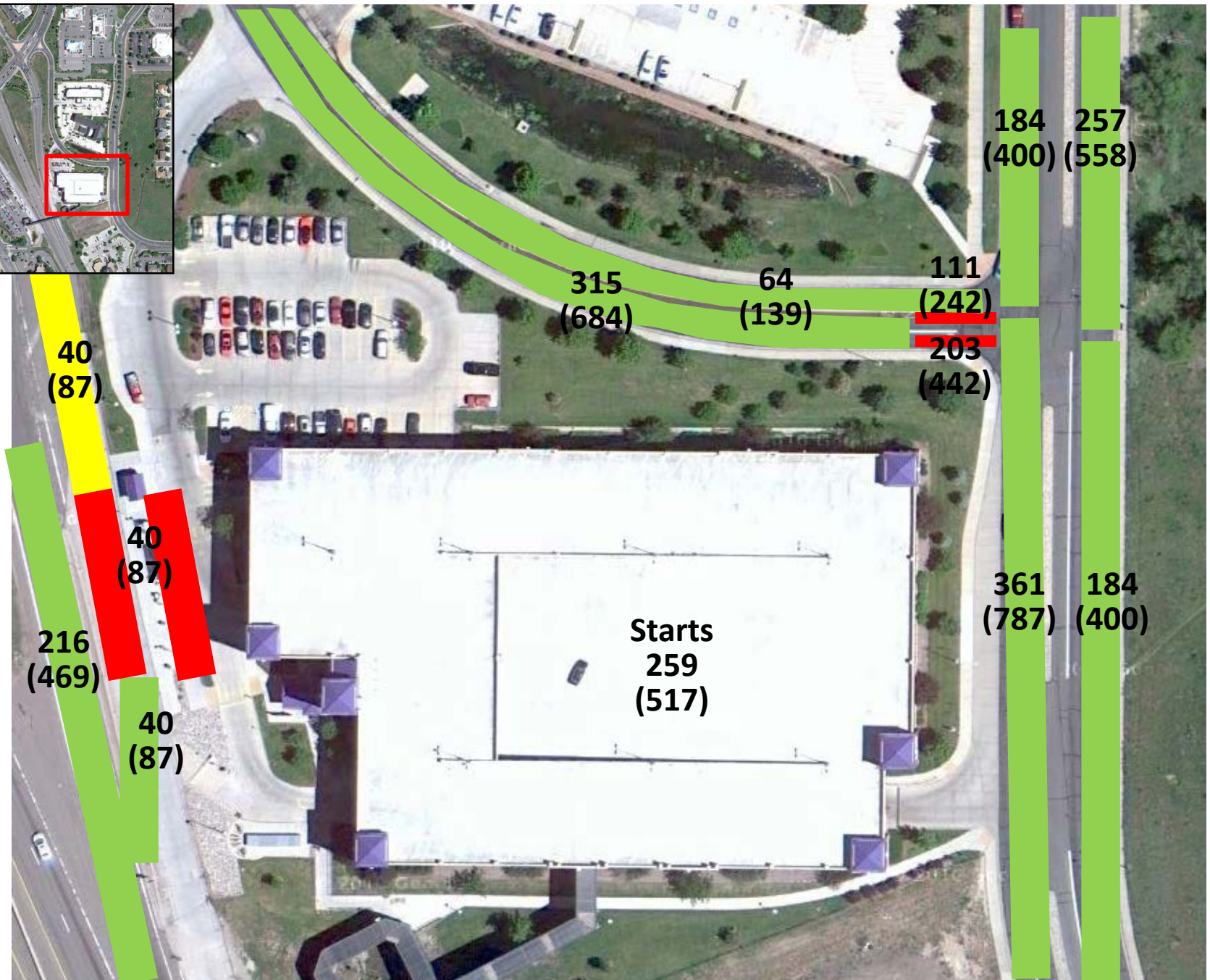




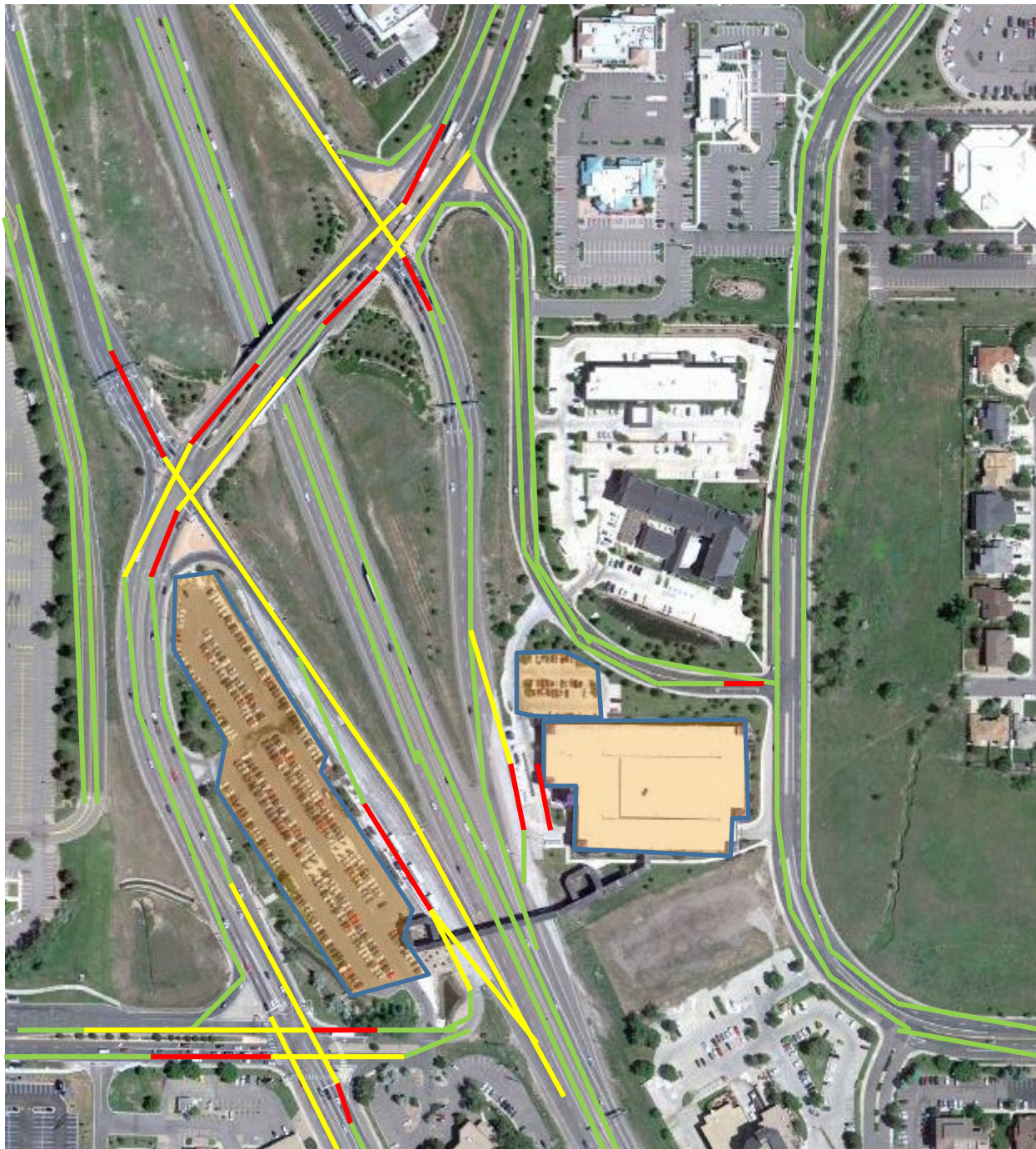














# Traffic Data: Link Volumes/Speeds/Lengths

traffic\_data.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View ACROBAT Tell me what you want to do Share

K67  $\times$   $\checkmark$   $f_x$   $=J67*3$

	A	B	C	D	E	F	G	H	I	J	K
				Link Volume (off-peak hour)	Link Volume (peak hour)	average speed - off-peak hour(mp h)	average speed - peak hour(mph)	link length (meters)	link length (miles)	number of lanes	link wid (meter
1	linkid	Link Description	Link Type								
2	1	intersection (A) NW bound entrance ramp	accel	186	404	20.0	20.0	258.5	0.160658794	2	
3	2	intersection (A) NW bound entrance ramp	cruise	236	514	40.0	40.0	64.0	0.039776259	2	
4	3	intersection (A) WB RT lane	cruise	51	110	40.0	40.0	49.0	0.030453698	1	
5	4	intersection (A) SW bound approach	cruise	214	465	40.0	40.0	233.1	0.144872592	3	
6	5	intersection (A) SW bound queue	queue	163	355	5.9	5.9	22.1	0.013735239	3	
7	6	intersection (A) SW bound departure	accel	276	600	25.8	25.8	90.5	0.056246116	3	
8	7	intersection (A) SW bound connect	cruise	276	600	40.0	40.0	68.9	0.042821628	3	
9	8	intersection (A) NE bound approach	cruise	333	724	40.0	40.0	68.6	0.042635177	3	
10	9	intersection (A) NE bound queue	queue	235	511	12.7	6.2	27.4	0.017029211	2	
11	10	intersection (A) NB LT queue	queue	98	213	5.9	5.9	39.6	0.02461156	1	
12	11	intersection (A) WB LT queue	queue	113	245	5.9	5.9	21.3	0.013238036	2	
13	12	intersection (A) NB queue	queue	88	191	5.9	5.9	17.5	0.010876321	2	
14	13	intersection (A) WB LT approach	cruise	113	245	40.0	40.0	127.9	0.079490367	2	
15	14	intersection (A) NB approach	cruise	143	311	40.0	40.0	142.7	0.088688626	2	
16	15	intersection (A) SB to E Transit Center	cruise	55	120	30.0	30.0	294.1	0.182784338	2	
17	16	intersection (A) SB to E Transit Center	cruise	315	684	30.0	30.0	86.5	0.053760099	2	
18	17	intersection (A) NB from E Transit Center	cruise	29	62	30.0	30.0	257.6	0.160099441	1	
19	18	intersection (A) NB from E Transit Center	cruise	64	139	15.0	15.0	116.4	0.07234307	2	
20	19	intersection (A) NE bound	cruise	264	573	40.0	40.0	215.4	0.13387197	2	
21	20	intersection (A) NE bound departure	accel	235	511	20.0	20.0	85.1	0.052889994	2	
22	21	intersection (B) SW bound queue	queue	165	359	5.9	5.9	17.5	0.010876321	2	
23	22	intersection (B) SE LT queue	queue	111	241	5.9	5.9	48	0.029832194	1	

Traffic Data Fleet Mix Bus Roster Bus Age Distribution Soak Distr ...

Ready Average: 4 Count: 6 Sum: 24 100%



# Traffic Data: Fleet Mix

traffic\_data.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View ACROBAT Tell me what you want to do Share

E36

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	All Bus														
2	11 Motorcycle		0												
3	21 Passenger Car		0												
4	31 Passenger Truck		0												
5	32 Light Commercial Tr		0												
6	41 Intercity Bus		0												
7	42 Transit Bus		1												
8	43 School Bus		0												
9	51 Refuse Truck		0												
10	52 Single Unit Short-ha		0												
11	53 Single Unit Long-ha		0												
12	54 Motor Home		0												
13	61 Combination Short-		0												
14	62 Combination Long-l		0												
15	Highway														
16	11 Motorcycle		0.0058												
17	21 Passenger Car		0.5170												
18	31 Passenger Truck		0.3350												
19	32 Light Commercial Tr		0.0204												
20	41 Intercity Bus		0.0030												
21	42 Transit Bus		0.0002												
22	43 School Bus		0.0020												
23	51 Refuse Truck		0.0002												
24	52 Single Unit Short-ha		0.0115												
25	53 Single Unit Long-ha		0.0100												
26	54 Motor Home		0.0028												
27	61 Combination Short-		0.0100												
28	62 Combination Long-l		0.0002												

Traffic Data **Fleet Mix** Bus Roster Bus Age Distribution Soak Distr ...

Ready



# Age Distribution Based on Bus Roster

traffic\_data.xlsx - Excel

File Home Insert Page Layout Formulas Data Review View ACROBAT Tell me what you want to do Share

M21

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Bus ID	Type	Age	Fuel			age	count	fraction of total								
2	11	BUS	2	Diesel			2	6	0.061224								
3	12	BUS	2	Diesel			3	22	0.22449								
4	13	BUS	2	Diesel			4	3	0.030612								
5	14	BUS	2	Diesel			5	1	0.010204								
6	86	BUS	2	Diesel			6	2	0.020408								
7	87	BUS	2	Diesel			7	25	0.255102								
8	48	BUS	3	Diesel			8	11	0.112245								
9	88	BUS	3	Diesel			9	9	0.091837								
10	89	BUS	3	Diesel			10	4	0.040816								
11	90	BUS	3	Diesel			12	12	0.122449								
12	91	BUS	3	Diesel			13	1	0.010204								
13	92	BUS	3	Diesel			14	1	0.010204								
14	93	BUS	3	Diesel			15	1	0.010204								
15	94	BUS	3	Diesel													
16	95	BUS	3	Diesel													
17	96	BUS	3	Diesel													
18	97	BUS	3	Diesel													
19	98	BUS	3	Diesel													
20	99	BUS	3	Diesel													
21	100	BUS	3	Diesel													
22	101	BUS	3	Diesel													
23	102	BUS	3	Diesel													
24	103	BUS	3	Diesel													
25	104	BUS	3	Diesel													
26	105	BUS	3	Diesel													
27	106	BUS	3	Diesel													

Traffic Data Fleet Mix **Bus Roster** Bus Age Distribution Soak Distr ...

Ready



# Running MOVES



# Run Description

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

✓ Description

≈ Scale

! Time Spans

! Geographic Bounds

+ ! Vehicles/Equipment

! Road Type

! Pollutants And Processes

≈ Manage Input Data Sets

+ ✓ Strategies

+ ! Output

✓ Advanced Performance Features

Create new Run Spec

Description:

January 12am off-peak run



# Scale and Calculation Type

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

☒ Description

☒ Scale

☐ Time Spans

☐ Geographic Bounds

☐ Vehicles/Equipment

☐ Road Type

☐ Pollutants And Processes

☐ Manage Input Data Sets

☐ Strategies

☐ Output

☒ Advanced Performance Features

Create new RunSpec


**Model**

☒ Onroad

☐ Nonroad

**Domain/Scale**

☐ National Use the default national database with default state and local allocation factors.

 Caution: Do not use this scale setting for SIP or conformity analyses. The allocation factors and other defaults applied at the state or county level have not been verified against specific state or county data and do not meet regulatory requirements for SIPs and conformity determinations.

☐ County Select or define a single county that is the entire domain.

Note: Use this scale setting for SIP and regional conformity analysis. Use of this scale setting requires user-supplied local data for most activity and fleet inputs.

☒ Project Use project domain inputs.


Note: Use this scale setting for project-level analysis for conformity, NEPA, or any other regulatory purpose. Use of this scale setting requires user-supplied data at the link level for activity and fleet inputs that describe a particular transportation project.

**Calculation Type**

☒ Inventory Mass and/or Energy within a region and time span.

☐ Emission Rates Mass and/or Energy per unit of activity.

MOVESScenarioID:

 Caution: Changing these selections changes the contents of other input panels. These changes may include losing previous data contents.



# Time Spans

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- + ! Vehicles/Equipment
- ! Road Type
- ! Pollutants And Processes
- Manage Input Data Sets
- + ✓ Strategies
- + ! Output
- ✓ Advanced Performance Features

Time Aggregation Level

☐ Year ☐ Month ☐ Day ☒ Hour

Years

Select Year: 2020 Add

Years:

2020

Remove

Months

☒ January ☐ July

☐ February ☐ August

☐ March ☐ September

☐ April ☐ October

☐ May ☐ November

☐ June ☐ December

Select All Clear All

Days

☐ Weekend

☒ Weekdays

Select All Clear All

Hours

Start Hour: 00:00 - 00:59

End Hour: 00:00 - 00:59

Select All Clear All

Create new Run Spec



# Geographic Bounds

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

☒ Description

☒ Scale

☒ Time Spans

☒ **Geographic Bounds**

☒ Vehicles/Equipment

☒ Road Type

☒ Pollutants And Processes

☒ Manage Input Data Sets

☒ Strategies

☒ Output

☒ Advanced Performance Features

Region:

☐ Nation

☐ State

☒ County

☐ Zone & Link

☐ Custom Domain

States:

MAINE

MARYLAND

MASSACHUSETTS

MICHIGAN

MINNESOTA

MISSISSIPPI

MISSOURI

MONTANA

NEBRASKA

Counties:

MICHIGAN - Shiawassee County

MICHIGAN - St. Clair County

MICHIGAN - St. Joseph County

MICHIGAN - Tuscola County

MICHIGAN - Van Buren County

MICHIGAN - Washtenaw County

MICHIGAN - Wayne County

MICHIGAN - Wexford County

Selections:

MICHIGAN - Washtenaw County

Select All Add Delete

Domain Input Database

The Project domain scale requires a database of detailed data.

Server:

Database:

Refresh

Enter/Edit Data

Geographic Bounds Requirements

Please select a domain database.

Create new Run Spec



# Fuel/Source Use Types

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

✓ Description

✓ Scale

✓ Time Spans

! Geographic Bounds

[-] ✓ Vehicles/Equipment

✓ On Road Vehicle Equipment

! Road Type

! Pollutants And Processes

≈ Manage Input Data Sets

[+] ✓ Strategies

[+] ! Output

✓ Advanced Performance Features

**Fuels:**

Compressed Natural Gas (CNG)

Diesel Fuel

Electricity

Ethanol (E-85)

Gasoline

**Source Use Types:**

Combination Long-haul Truck

Combination Short-haul Truck

Intercity Bus

Light Commercial Truck

Motor Home

Motorcycle

Passenger Car

Passenger Truck

Refuse Truck

School Bus

Single Unit Long-haul Truck

Single Unit Short-haul Truck

Transit Bus

**Selections:**

Diesel Fuel - Combination Long-haul Truck

Diesel Fuel - Combination Short-haul Truck

Diesel Fuel - Intercity Bus

Diesel Fuel - Light Commercial Truck

Diesel Fuel - Motor Home

Diesel Fuel - Passenger Car

Diesel Fuel - Passenger Truck

Diesel Fuel - Refuse Truck

Diesel Fuel - School Bus

Diesel Fuel - Single Unit Long-haul Truck

Diesel Fuel - Single Unit Short-haul Truck

Diesel Fuel - Transit Bus

Ethanol (E-85) - Light Commercial Truck

Ethanol (E-85) - Passenger Car

Ethanol (E-85) - Passenger Truck

Gasoline - Combination Short-haul Truck

Gasoline - Light Commercial Truck

Gasoline - Motor Home

Gasoline - Motorcycle

Gasoline - Passenger Car

Gasoline - Passenger Truck

Gasoline - Refuse Truck

Gasoline - School Bus

Gasoline - Single Unit Long-haul Truck

Gasoline - Single Unit Short-haul Truck

Gasoline - Transit Bus

Select All Select All Delete

Add Fuel/Type Combinations

Create new Run Spec



# Road Type

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ **Road Type**
- ! Pollutants And Processes
- ≈ Manage Input Data Sets
- [+] ✓ Strategies
- [+] ! Output
- ✓ Advanced Performance Features

Available Road Types:

Off-Network
Rural Restricted Access
Rural Unrestricted Access
Urban Restricted Access
Urban Unrestricted Access

Select All Add

Selected Road Types:

Off-Network
Urban Restricted Access
Urban Unrestricted Access

Delete

☐ Provide separate ramp output

Create new Run Spec



# Pollutants and Processes

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

✓ Description

✓ Scale

✓ Time Spans

! Geographic Bounds

[-] ✓ Vehicles/Equipment
 

✓ On Road Vehicle Equipment

✓ Road Type

✓ Pollutants And Processes

≈ Manage Input Data Sets

[+] ✓ Strategies

[+] ! Output

✓ Advanced Performance Features

	Running Exhaust	Start Exhaust	Brakewear	Tirewear	Evap Permeation	Evap Fuel Vapor
<input checked="" type="checkbox"/> Total Gaseous Hydrocarbons	<input checked="" type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Non-Methane Hydrocarbons	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Non-Methane Organic Gases	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Total Organic Gases	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Volatile Organic Compounds	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Methane (CH4)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Carbon Monoxide (CO)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Oxides of Nitrogen (NOx)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrogen Oxide (NO)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrogen Dioxide (NO2)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrous Acid (HONO)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Ammonia (NH3)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Nitrous Oxide (N2O)	<input type="checkbox"/>	<input type="checkbox"/>				
<input checked="" type="checkbox"/> Primary Exhaust PM2.5 - Total	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
<input checked="" type="checkbox"/> [+] Primary Exhaust PM2.5 - Species	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>				
<input checked="" type="checkbox"/> Primary PM2.5 - Brakewear Particulate			<input checked="" type="checkbox"/>			
<input checked="" type="checkbox"/> Primary PM2.5 - Tirewear Particulate				<input checked="" type="checkbox"/>		
<input type="checkbox"/> Primary Exhaust PM10 - Total	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Primary PM10 - Brakewear Particulate			<input type="checkbox"/>			
<input type="checkbox"/> Primary PM10 - Tirewear Particulate				<input type="checkbox"/>		
<input type="checkbox"/> Sulfur Dioxide (SO2)	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Total Energy Consumption	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Petroleum Energy Consumption	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Fossil Fuel Energy Consumption	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Atmospheric CO2	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> CO2 Equivalent	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/> Benzene	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Ethanol	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> MTBE	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>

Select Prerequisites

Clear All

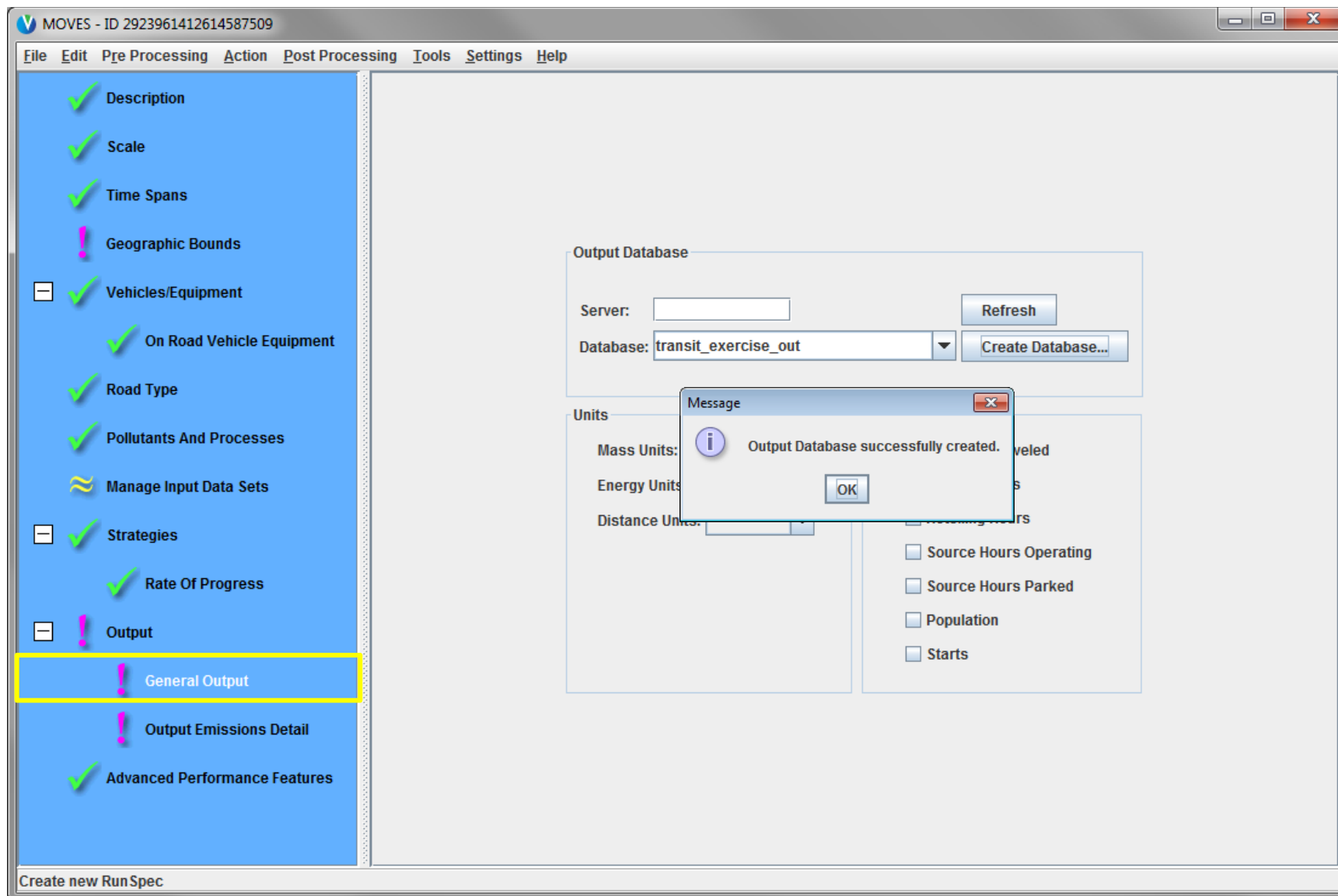
Create new RunSpec

EPA

215



# Creating Output Database





# Selecting Output Activity

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ Road Type
  - ✓ Pollutants And Processes
- Manage Input Data Sets
- [-] ✓ Strategies
  - ✓ Rate Of Progress
- [-] ! Output
  - ✓ General Output**
  - ! Output Emissions Detail
  - ✓ Advanced Performance Features

Output Database

Server:  Refresh

Database: transit\_exercise\_out Create Database...

Units

Mass Units: Grams

Energy Units: Joules

Distance Units: Miles

Activity

- ☒ Distance Traveled
- ☐ Source Hours
- ☐ Hotelling Hours
- ☐ Source Hours Operating
- ☐ Source Hours Parked
- ☒ Population
- ☒ Starts

Create new Run Spec



# Output Emissions Detail

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ Road Type
  - ✓ Pollutants And Processes
  - Manage Input Data Sets
- [-] ✓ Strategies
  - ✓ Rate Of Progress
- [-] ✓ Output
  - ✓ General Output
  - ✓ Output Emissions Detail**
  - ✓ Advanced Performance Features

**Always**

- ☒ Time
- ☒ Location
- ☒ Pollutant

**for All Vehicle/Equipment Categories**

- ☐ Model Year
- ☐ Fuel Type ☐ Fuel Subtype
- ☒ Emission Process

☐ Estimate Uncertainty

**On Road/Off Road**

- ☒ On Road/Off Road

**On and Off Road**

- ☐ Road Type
- ☒ Source Use Type
- ☐ SCC
- ☐ Regulatory Class

**Off Road**

- ☐ Sector
- ☐ Engine Tech.
- ☐ HP Class

Number of iterations:

- ☐ Keep pseudo-randomly sampled input
- ☐ Keep output from each iteration

Create new Run Spec



# Importing Project Data: PDM

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

- ✓ Description
- ✓ Scale
- ✓ Time Spans
- ! Geographic Bounds
- [-] ✓ Vehicles/Equipment
  - ✓ On Road Vehicle Equipment
  - ✓ Road Type
  - ✓ Pollutants And Processes
  - Manage Input Data Sets
- [-] ✓ Strategies
  - ✓ Rate Of Progress
- [-] ✓ Output
  - ✓ General Output
  - ✓ Output Emissions Detail
  - ✓ Advanced Performance Features

Region:

☐ Nation

☐ State

☒ County

☐ Zone & Link

☐ Custom Domain

States:

MAINE

MARYLAND

MASSACHUSETTS

MICHIGAN

MINNESOTA

MISSISSIPPI

MISSOURI

MONTANA

NEBRASKA

Counties:

Selections:

MICHIGAN - Washtenaw County

Select All Add Delete

Domain Input Database

The Project domain scale requires a database of detailed data.

Server:

Database:

Refresh

Enter/Edit Data

Geographic Bounds Requirements

Please select a domain database.

Create new RunSpec



# Creating Input Database

The screenshot shows the MOVES Project Data Manager application window. The 'Database' tab is selected, and the 'Create Database' button is highlighted with a yellow border. A message dialog box is displayed in the center, indicating that the database was successfully created.

MOVES Project Data Manager

Hotelling I/M Programs Retrofit Data Generic Tools

Operating Mode Distribution Age Distribution Fuel Meteorology Data

RunSpec Summary Database Links Link Source Types Link Drive Schedules Off-Network

Select or create a database to hold the imported data.

Server: localhost Refresh

Database: training\_jan12am\_in Create Database

Log: Clear All Imported Data

Message

Database successfully created.

OK

Database

Done



# Importing Data

- Follow the regular process of browsing and importing data into the tabs. Use the list below to supply data to the Project Data Manager for this exercise.
  - Links: Links\_offpeak.xls
  - Link Source Types: linksource.xls
  - Link Drive Schedule: not used
  - Fuel: fuels\_jan.xls
  - Age Distribution: agedist.xls
  - Operating Mode Distribution: opmode.xls
  - Off-Network: offnetwork.xls
  - Meteorology Data: met\_jan12am.xls
  - Hotelling: hoteling.xls
  - I/M Programs: not used
  - Generic: not used



# Deriving Links Table from Traffic Data

traffic\_data.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

A1 : X ✓ fx linkid

	A	B	C	D	E	F	G	H	I	J	K
						average speed - off-peak hour(mp h)	average speed - peak hour(mph)				
1	linkid	Link Description	Link Type	Link Volume (off-peak hour)	Link Volume (peak hour)			link length (meters)	link length (miles)	number of lanes	link wid (meter
2	1	intersection (A) NW bound entrance ramp	accel	186	404	20.0	20.0	258.5	0.160658794	2	
3	2	intersection (A) NW bound entrance ramp	cruise	236	514	40.0	40.0	64.0	0.039776259	2	
4	3	intersection (A) WB RT lane	cruise	51	110	40.0	40.0	49.0	0.030453698	1	
5	4	intersection (A) SW bound approach	cruise	214	465	40.0	40.0	233.1	0.144872592	3	
6	5	intersection (A) SW bound queue	queue	163	355	5.9	5.9	22.1	0.013735239	3	
7	6	intersection (A) SW bound departure	accel	276	600	25.8	25.8	90.5	0.056246116	3	
8	7	intersection (A) SW bound connect	cruise	276	600	40.0	40.0	68.9	0.042821628	3	
9	8	intersection (A) NE bound approach	cruise	333	724	40.0	40.0	68.6	0.042635177	3	
10	9	intersection (A) NE bound queue	queue	235	511	12.7	6.2	27.4	0.017029211	2	
11	10	intersection (A) NB LT queue	queue	98	213	5.9	5.9	39.6	0.02461156	1	
12	11	intersection (A) WB LT queue	queue	113	245	5.9	5.9	21.3	0.013238036	2	
13	12	intersection (A) NB queue	queue	88	191	5.9	5.9	17.5	0.010876321	2	
14	13	intersection (A) WB LT approach	cruise	113	245	40.0	40.0	127.9	0.079490367	2	
15	14	intersection (A) NB approach	cruise	143	311	40.0	40.0	142.7	0.088688626	2	
16	15	intersection (A) SB to E Transit Center	cruise	55	120	30.0	30.0	294.1	0.182784338	2	
17	16	intersection (A) SB to E Transit Center	cruise	315	684	30.0	30.0	86.5	0.053760099	2	
18	17	intersection (A) NB from E Transit Center	cruise	29	62	30.0	30.0	257.6	0.160099441	1	
19	18	intersection (A) NB from E Transit Center	cruise	64	139	15.0	15.0	116.4	0.07234307	2	
20	19	intersection (A) NE bound	cruise	264	573	40.0	40.0	215.4	0.13387197	2	
21	20	intersection (A) NE bound departure	accel	235	511	20.0	20.0	85.1	0.052889994	2	
22	21	intersection (B) SW bound queue	queue	165	359	5.9	5.9	17.5	0.010876321	2	
23	22	intersection (B) SE LT queue	queue	111	241	5.9	5.9	48	0.029832194	1	
24	23	intersection (B) SW bound departure	accel	165	359	20.0	20.0	73.1	0.045431945	2	

Traffic Data Fleet Mix Bus Roster Bus Age Distribution Soak Distr ...

READY 100%



# Links Input (links\_offpeak.xls)

links\_offpeak.xls [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

H68 : X ✓ fx East Bus terminal passenger pick up

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	linkID	countyID	zoneID	roadTypeID	linkLength	linkVolume	linkAvgSpeed	linkDescription	linkAvgGrade				
2	1	26161	261610	5	0.160659	186	20.00	intersection (A) NW bound entrance ramp	0				
3	2	26161	261610	5	0.039776	236	40.00	intersection (A) NW bound entrance ramp	0				
4	3	26161	261610	5	0.030454	51	40.00	intersection (A) WB RT lane	0				
5	4	26161	261610	5	0.144873	214	40.00	intersection (A) SW bound approach	0				
6	5	26161	261610	5	0.013735	163	5.90	intersection (A) SW bound queue	0				
7	6	26161	261610	5	0.056246	276	25.76	intersection (A) SW bound departure	0				
8	7	26161	261610	5	0.042822	276	40.00	intersection (A) SW bound connect	0				
9	8	26161	261610	5	0.042635	333	40.00	intersection (A) NE bound approach	0				
10	9	26161	261610	5	0.017029	235	12.69	intersection (A) NE bound queue	0				
11	10	26161	261610	5	0.024612	98	5.90	intersection (A) NB LT queue	0				
12	11	26161	261610	5	0.013238	113	5.90	intersection (A) WB LT queue	0				
13	12	26161	261610	5	0.010876	88	5.90	intersection (A) NB queue	0				
14	13	26161	261610	5	0.07949	113	40.00	intersection (A) WB LT approach	0				
15	14	26161	261610	5	0.088689	143	40.00	intersection (A) NB approach	0				
16	15	26161	261610	5	0.182784	55	30.00	intersection (A) SB to E Transit Center	0				
17	16	26161	261610	5	0.05376	315	30.00	intersection (A) SB to E Transit Center	0				
18	17	26161	261610	5	0.160099	29	30.00	intersection (A) NB from E Transit Center	0				
19	18	26161	261610	5	0.072343	64	15.00	intersection (A) NB from E Transit Center	0				
20	19	26161	261610	5	0.133872	264	40.00	intersection (A) NE bound	0				
21	20	26161	261610	5	0.05289	235	20.00	intersection (A) NE bound departure	0				
22	21	26161	261610	5	0.010876	165	5.90	intersection (B) SW bound queue	0				
23	22	26161	261610	5	0.029832	111	5.90	intersection (B) SE LT queue	0				
24	23	26161	261610	5	0.045432	165	20.00	intersection (B) SW bound departure	0				
25	24	26161	261610	5	0.018956	149	5.90	intersection (B) NE bound LT queue	0				
26	25	26161	261610	5	0.018956	148	5.90	intersection (B) SE bound queue	0				
27	26	26161	261610	5	0.056619	112	30.00	intersection (B) SB entrance	0				
28	27	26161	261610	5	0.115227	302	40.00	intersection (B) NE bound approach	0				
29	28	26161	261610	5	0.036793	118	30.00	intersection (B) SE bound connect	0				
30	29	26161	261610	5	0.075886	377	40.00	intersection (B) bus lane approach	0				
31	30	26161	261610	5	0.063456	259	20.00	intersection (B) SE bound departure	0				
32	31	26161	261610	5	0.018956	184	5.90	intersection (B) NE bound queue	0				
33	32	26161	261610	5	0.046799	333	20.00	intersection (B) NE bound departure	0				

link County RoadType Zone (+)

READY 100%



# Link Source Type Input (linksource.xls)

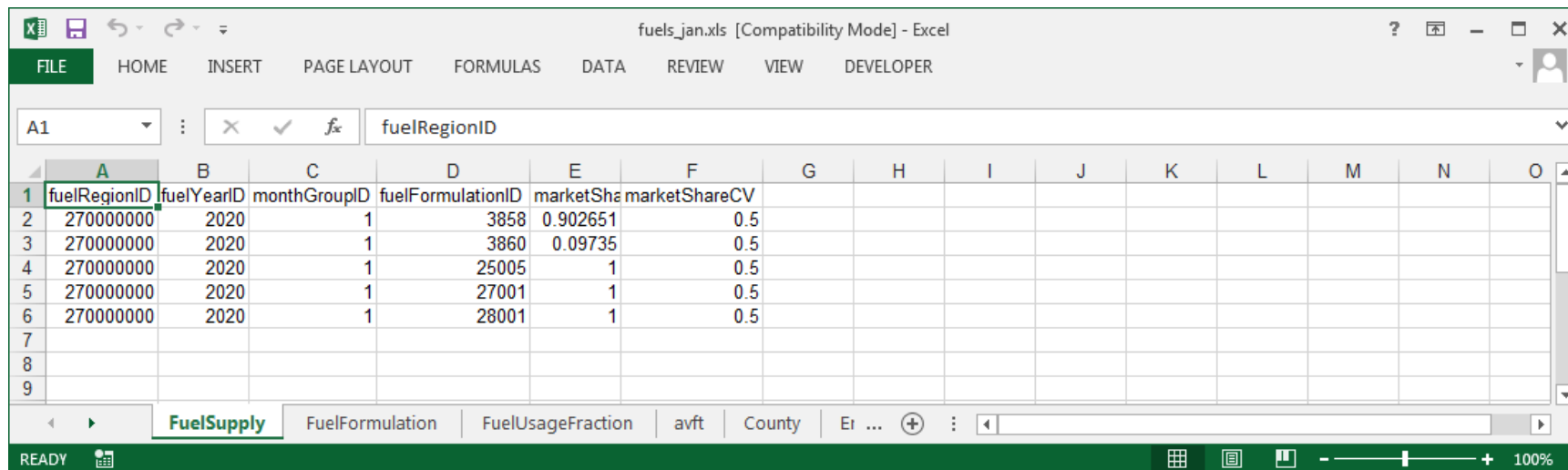
- Arterial and Highway Fleet Mix from MPO county-scale analysis
- Bus-only links are entirely sourcetype 42

	A	B	C	D	E	F
1	linkID	sourceTypeID	sourceTypeHourFraction			
2	1	11	0.0082			
3	1	21	0.5919			
4	1	31	0.3336			
5	1	32	0.0290			
6	1	41	0.0004			
7	1	42	0.0002			
8	1	43	0.0028			
9	1	51	0.0003			
10	1	52	0.0178			
11	1	53	0.0020			
12	1	54	0.0040			
13	1	61	0.0046			
14	1	62	0.0052			
15	2	11	0.0082			
16	2	21	0.5919			
17	2	31	0.3336			
18	2	32	0.0290			
19	2	41	0.0004			
20	2	42	0.0002			
21	2	43	0.0028			
22	2	51	0.0003			
23	2	52	0.0178			
24	2	53	0.0020			
25	2	54	0.0040			
26	2	61	0.0046			
27	2	62	0.0052			
28	3	11	0.0082			
29	3	21	0.5919			
30	3	31	0.3336			
31	3	32	0.0290			
32	3	41	0.0004			
33	3	42	0.0002			



# Fuels Input (fuel\_jan.xls)

- MOVES Default Fuel Supply and Fuel Formulation Used



fuels\_jan.xls [Compatibility Mode] - Excel

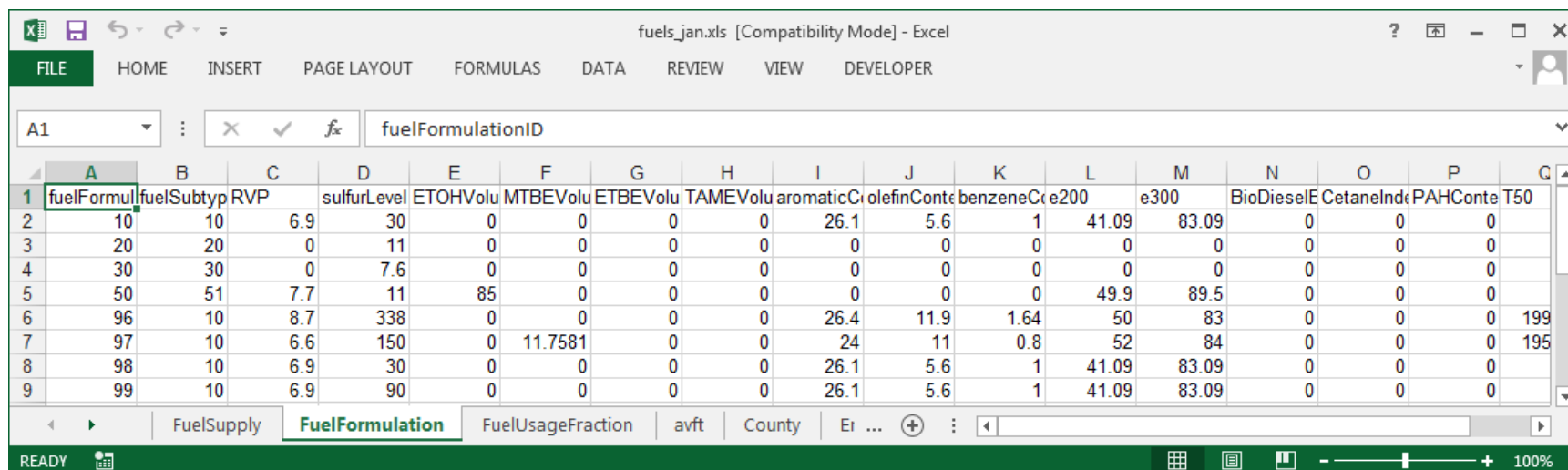
FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

A1 : X ✓ fx fuelRegionID

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	fuelRegionID	fuelYearID	monthGroupID	fuelFormulationID	marketShare	marketShareCV									
2	270000000	2020	1	3858	0.902651	0.5									
3	270000000	2020	1	3860	0.09735	0.5									
4	270000000	2020	1	25005	1	0.5									
5	270000000	2020	1	27001	1	0.5									
6	270000000	2020	1	28001	1	0.5									
7															
8															
9															

FuelSupply FuelFormulation FuelUsageFraction avft County Er ...

READY 100%



fuels\_jan.xls [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DEVELOPER

A1 : X ✓ fx fuelFormulationID

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	fuelFormul	fuelSubtyp	RVP	sulfurLevel	ETOHVolu	MTBEVolu	ETBEVolu	TAMEVolu	aromaticC	olefinConte	benzeneC	e200	e300	BioDieselE	CetaneIndx	PAHConte	T50
2	10	10	6.9	30	0	0	0	0	26.1	5.6	1	41.09	83.09	0	0	0	
3	20	20	0	11	0	0	0	0	0	0	0	0	0	0	0	0	
4	30	30	0	7.6	0	0	0	0	0	0	0	0	0	0	0	0	
5	50	51	7.7	11	85	0	0	0	0	0	0	49.9	89.5	0	0	0	
6	96	10	8.7	338	0	0	0	0	26.4	11.9	1.64	50	83	0	0	0	199
7	97	10	6.6	150	0	11.7581	0	0	24	11	0.8	52	84	0	0	0	195
8	98	10	6.9	30	0	0	0	0	26.1	5.6	1	41.09	83.09	0	0	0	
9	99	10	6.9	90	0	0	0	0	26.1	5.6	1	41.09	83.09	0	0	0	

FuelSupply FuelFormulation FuelUsageFraction avft County Er ...

READY 100%



# Fuels Input (fuel\_jan.xls) AVFT Tab

- For all model years transit buses (sourcetype 42)– a fraction of 1 is entered for diesel fuel (fuel type 2 in column C) and all other fuel types are assigned a fraction of 0.

AVFT.xls [Compatibility Mode]

	A	B	C	D	E	F	G
741	42	1986	2	1	1		
742	42	1987	2	1	1		
743	42	1988	2	1	1		
744	42	1989	2	1	1		
745	42	1990	2	1	0.993		
746	42	1990	3	1	0.007		
747	42	1991	2	1	0.982		
748	42	1991	3	1	0.018		
749	42	1992	1	1	0.01		
750	42	1992	2	1	0.944		
751	42	1992	3	1	0.046		
752	42	1993	1	1	0.01		
753	42	1993	2	1	0.914		
754	42	1993	3	1	0.076		
755	42	1994	1	1	0.01		
756	42	1994	2	1	0.905		
757	42	1994	3	1	0.085		
758	42	1995	1	1	0.01		
759	42	1995	2	1	0.837		
760	42	1995	3	1	0.153		
761	42	1996	1	1	0.01		
762	42	1996	2	1	0.892		
763	42	1996	3	1	0.098		
764	42	1997	1	1	0.01		
765	42	1997	2	1	0.816		
766	42	1997	3	1	0.174		
767	42	1998	1	1	0.01		
768	42	1998	2	1	0.841		
769	42	1998	3	1	0.149		



fuels\_jan.xls...

File Home Insert Page L Formu Data Review View ACROf Tell me Share

D1343

	A	B	C	D	E	F	G	H
1	sourceTyp	modelYear	fuelTypeID	engTechID	fuelEngFraction			
1326	42	1976	3	1	0			
1327	42	1977	1	1	0			
1328	42	1977	2	1	1			
1329	42	1977	3	1	0			
1330	42	1978	1	1	0			
1331	42	1978	2	1	1			
1332	42	1978	3	1	0			
1333	42	1979	1	1	0			
1334	42	1979	2	1	1			
1335	42	1979	3	1	0			
1336	42	1980	1	1	0			
1337	42	1980	2	1	1			
1338	42	1980	3	1	0			
1339	42	1981	1	1	0			
1340	42	1981	2	1	1			
1341	42	1981	3	1	0			
1342	42	1982	1	1	0			
1343	42	1982	2	1	1			
1344	42	1982	3	1	0			
1345	42	1983	1	1	0			
1346	42	1983	2	1	1			
1347	42	1983	3	1	0			
1348	42	1984	1	1	0			
1349	42	1984	2	1	1			
1350	42	1984	3	1	0			
1351	42	1985	1	1	0			
1352	42	1985	2	1	1			
1353	42	1985	3	1	0			
1354	42	1986	1	1	0			
1355	42	1986	2	1	1			
1356	42	1986	3	1	0			
1357	42	1987	1	1	0			

FuelSupply FuelForm ...

Ready 100%



# Age Distribution Input (agedist.xls)

- Provided by MPO
- Local Data for Transit Buses (sourcetype 42) Obtained from Bus Roster

	A	B	C	D	E	F	G	H
1	sourceType	yearID	ageID	ageFraction				
2	11	2020	0	0.071362				
3	11	2020	1	0.071075				
4	11	2020	2	0.071147				
5	11	2020	3	0.070357				
6	11	2020	4	0.068521				
7	11	2020	5	0.065452				
8	11	2020	6	0.064117				
9	11	2020	7	0.061838				
10	11	2020	8	0.058894				
11	11	2020	9	0.054936				
12	11	2020	10	0.047725				
13	11	2020	11	0.042259				
14	11	2020	12	0.037962				
15	11	2020	13	0.033661				
16	11	2020	14	0.030885				
17	11	2020	15	0.028874				
18	11	2020	16	0.024984				
19	11	2020	17	0.021669				
20	11	2020	18	0.015195				
21	11	2020	19	0.011895				
22	11	2020	20	0.009375				
23	11	2020	21	0.00763				
24	11	2020	22	0.006016				
25	11	2020	23	0.004323				
26	11	2020	24	0.003227				
27	11	2020	25	0.002695				
28	11	2020	26	0.002217				
29	11	2020	27	0.002197				
30	11	2020	28	0.002242				
31	11	2020	29	0.001777				
32	11	2020	30	0.005492				
33	21	2020	0	0.060182				



# Modeling Off-Network Activity

- MOVES can only model one off-network link per run
  - Our project has two distinct parking areas with an identical fleet, but varying number of starts
- A work-around option is to input a place-holder number of starts
  - Ensure that fleet mix (i.e., ratio of source types) and soak-time distribution is identical for all parking areas
- Results will be used to derive a grams/start value
  - Can be applied to any number of starts
  - Discussed following tomorrow's AERMOD module



## Off-network Input (offnetwork.xls)

- Expected use of park-and-ride facility (ratio of source types 21 vs. 31 correct, but numbers are only a placeholder... actual grams/start emission rates will be calculated in a post-processing step)

The screenshot shows an Excel spreadsheet with the following data:

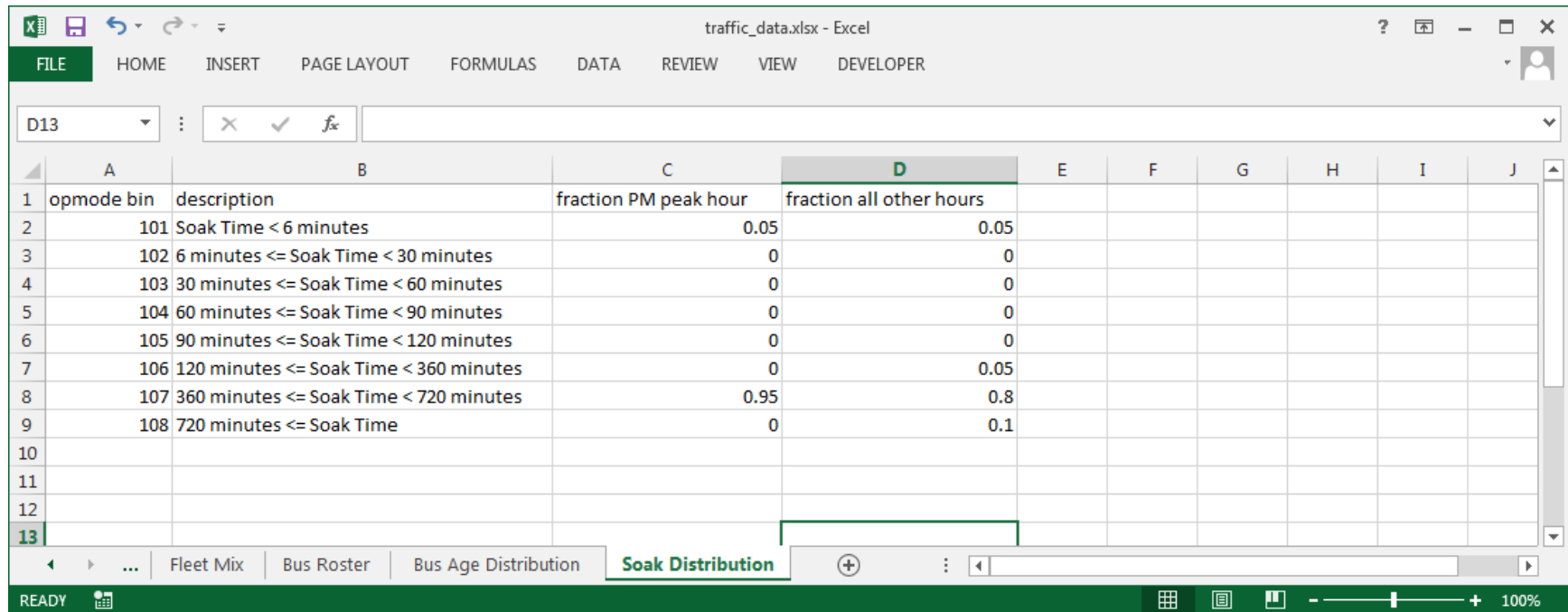
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	zoneID	sourceTypeID	vehiclePopulation	startFraction	extendedIdleFraction	parkedVehicleFraction								
2	261610	11	0	0	0									
3	261610	21	421	1	0									
4	261610	31	216	1	0									
5	261610	32	0	0	0									
6	261610	41	0	0	0									
7	261610	42	0	0	0									
8	261610	43	0	0	0									
9	261610	51	0	0	0									
10	261610	52	0	0	0									
11	261610	53	0	0	0									
12	261610	54	0	0	0									
13	261610	61	0	0	0									
14	261610	62	0	0	0									
15														

The 'offNetworkLink' tab is selected at the bottom. The status bar shows 'READY' and '100%' zoom.



# Deriving OpMode Distribution from Traffic Data

- Expected use of park-and-ride facility



The screenshot shows an Excel spreadsheet titled "traffic\_data.xlsx" with the following data:

opmode bin	description	fraction PM peak hour	fraction all other hours
101	Soak Time < 6 minutes	0.05	0.05
102	6 minutes <= Soak Time < 30 minutes	0	0
103	30 minutes <= Soak Time < 60 minutes	0	0
104	60 minutes <= Soak Time < 90 minutes	0	0
105	90 minutes <= Soak Time < 120 minutes	0	0
106	120 minutes <= Soak Time < 360 minutes	0	0.05
107	360 minutes <= Soak Time < 720 minutes	0.95	0.8
108	720 minutes <= Soak Time	0	0.1



# OpMode Distribution Input (opmode.xls)

- Single file contains all four hourly scenarios (12 a.m., 6 a.m., 12 p.m., 6 p.m.)

	A	B	C	D	E	F	G	H
1	sourceType	hourDayID	linkID	polProcess	opModelID	opModeFraction		
2	11	15	75	11002	101	0.05		
3	11	15	75	11002	106	0.05		
4	11	15	75	11002	107	0.8		
5	11	15	75	11002	108	0.1		
6	21	15	75	11002	101	0.05		
7	21	15	75	11002	106	0.05		
8	21	15	75	11002	107	0.8		
9	21	15	75	11002	108	0.1		
10	31	15	75	11002	101	0.05		
11	31	15	75	11002	106	0.05		
12	31	15	75	11002	107	0.8		
13	31	15	75	11002	108	0.1		
14	32	15	75	11002	101	0.05		
15	32	15	75	11002	106	0.05		
16	32	15	75	11002	107	0.8		
17	32	15	75	11002	108	0.1		
18	41	15	75	11002	101	0.05		
19	41	15	75	11002	106	0.05		
20	41	15	75	11002	107	0.8		
21	41	15	75	11002	108	0.1		
22	42	15	75	11002	101	0.05		
23	42	15	75	11002	106	0.05		
24	42	15	75	11002	107	0.8		
25	42	15	75	11002	108	0.1		
26	43	15	75	11002	101	0.05		
27	43	15	75	11002	106	0.05		
28	43	15	75	11002	107	0.8		
29	43	15	75	11002	108	0.1		
30	51	15	75	11002	101	0.05		
31	51	15	75	11002	106	0.05		
32	51	15	75	11002	107	0.8		
33	51	15	75	11002	108	0.1		



# Meteorology Input (met\_jan12am.xls)

- Temperature and humidity data taken from nearby met station (same dataset used for air quality analysis)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	monthID	zoneID	hourID	temperature	relHumidity											
2	1	261610	1	20	78.1											
3																
4																
5																
6																
7																
8																
9																



# All Files Imported

The screenshot shows the MOVES Project Data Manager application window. The title bar reads "MOVES Project Data Manager". The interface includes a top menu bar with options: Hotelling, I/M Programs, Retrofit Data, Generic, and Tools. Below this is a sub-menu bar with: Operating Mode Distribution, Age Distribution, Fuel, and Meteorology Data. A second row of sub-menus includes: RunSpec Summary, Database (which is selected), Links, Link Source Types, Link Drive Schedules, and Off-Network. The main area contains a section titled "Select or create a database to hold the imported data." with input fields for "Server:" (localhost) and "Database:" (training\_jan12am\_in), and buttons for "Refresh", "Create Database", and "Clear All Imported Data". Below this is a "Log:" section displaying a list of import events with timestamps and descriptions. At the bottom right, there is a green bar labeled "Database" and a "Done" button.

MOVES Project Data Manager

Hotelling I/M Programs Retrofit Data Generic Tools

Operating Mode Distribution Age Distribution Fuel Meteorology Data

RunSpec Summary Database Links Link Source Types Link Drive Schedules Off-Network

Select or create a database to hold the imported data.

Server: localhost Refresh

Database: training\_jan12am\_in Create Database

Log: Clear All Imported Data

2015-02-11 15:50:28.0 Meteorology Data Filled ZoneMonthHour table  
2015-02-11 15:40:03.0 Fuel Filled avft table  
2015-02-11 15:40:02.0 Fuel Filled FuelSupply table  
2015-02-11 15:40:02.0 Fuel Filled FuelFormulation table  
2015-02-11 15:40:02.0 Fuel Filled FuelUsageFraction table  
2015-02-11 15:18:30.0 Operating Mode Distribution Filled OpModeDistribution table  
2015-02-11 15:04:49.0 I/M Programs Flag No data needed  
2015-02-11 15:04:39.0 Age Distribution Filled SourceTypeAgeDistribution table  
2015-02-11 15:02:27.0 Link Source Types Filled LinkSourceTypeHour table  
2015-02-11 15:00:38.0 Off-Network Filled OffNetworkLink table  
2015-02-11 14:35:09.0 Links Filled Link table

Database

Done



# Execute Jan 12 a.m. RunSpec

The screenshot shows the MOVES software interface with the title bar 'MOVES - ID 2923961412614587509'. The menu bar includes File, Edit, Pre Processing, Action, Post Processing, Tools, Settings, and Help. The 'Action' menu is open, highlighting the 'Execute' option. The left sidebar contains a list of features with green checkmarks: Description, Scale, Time Spans, Geographic Bounds, Vehicles/Equipment, Road Type, Pollutants And Processes, Manage Input Data Sets, Strategies, Rate Of Progress, Output, General Output, Output Emissions Detail, and Advanced Performance Features. The main panel displays configuration options for Region (Nation, State, County, Zone & Link, Custom Domain), States (MAINE, MARYLAND, MASSACHUSETTS, MICHIGAN, MINNESOTA, MISSISSIPPI, MISSOURI, MONTANA, NEBRASKA), Counties, and Selections (MICHIGAN - Washtenaw County). Below these are buttons for Select All, Add, and Delete. A section for Domain Input Database includes fields for Server (localhost) and Database (training\_jan12am\_in), with Refresh and Enter/Edit Data buttons. A Geographic Bounds Requirements section is at the bottom.

MOVES - ID 2923961412614587509

File Edit Pre Processing Action Post Processing Tools Settings Help

Execute

Stop

Pause

Resume

MOVES Run Error Log...

Region:

☐ Nation

☐ State

☒ County

☐ Zone & Link

☐ Custom Domain

States:

MAINE

MARYLAND

MASSACHUSETTS

MICHIGAN

MINNESOTA

MISSISSIPPI

MISSOURI

MONTANA

NEBRASKA

Counties:

Selections:

MICHIGAN - Washtenaw County

Select All Add Delete

Domain Input Database

The Project domain scale requires a database of detailed data.

Server: localhost

Database: training\_jan12am\_in

Refresh

Enter/Edit Data

Geographic Bounds Requirements

Execute active RunSpec



# Completing the MOVES Analysis

- All 16 runs are created through the same steps:
  1. RunSpec created (use same RunSpec saved under new name)
    - Only month and hour will vary
    - Should have same output database (Transit\_Exercise\_Out)
  2. Input files imported
    - Meteorology and Link (off-peak vs. peak) will vary by hour
    - Fuels will vary by season
  3. MOVES executed

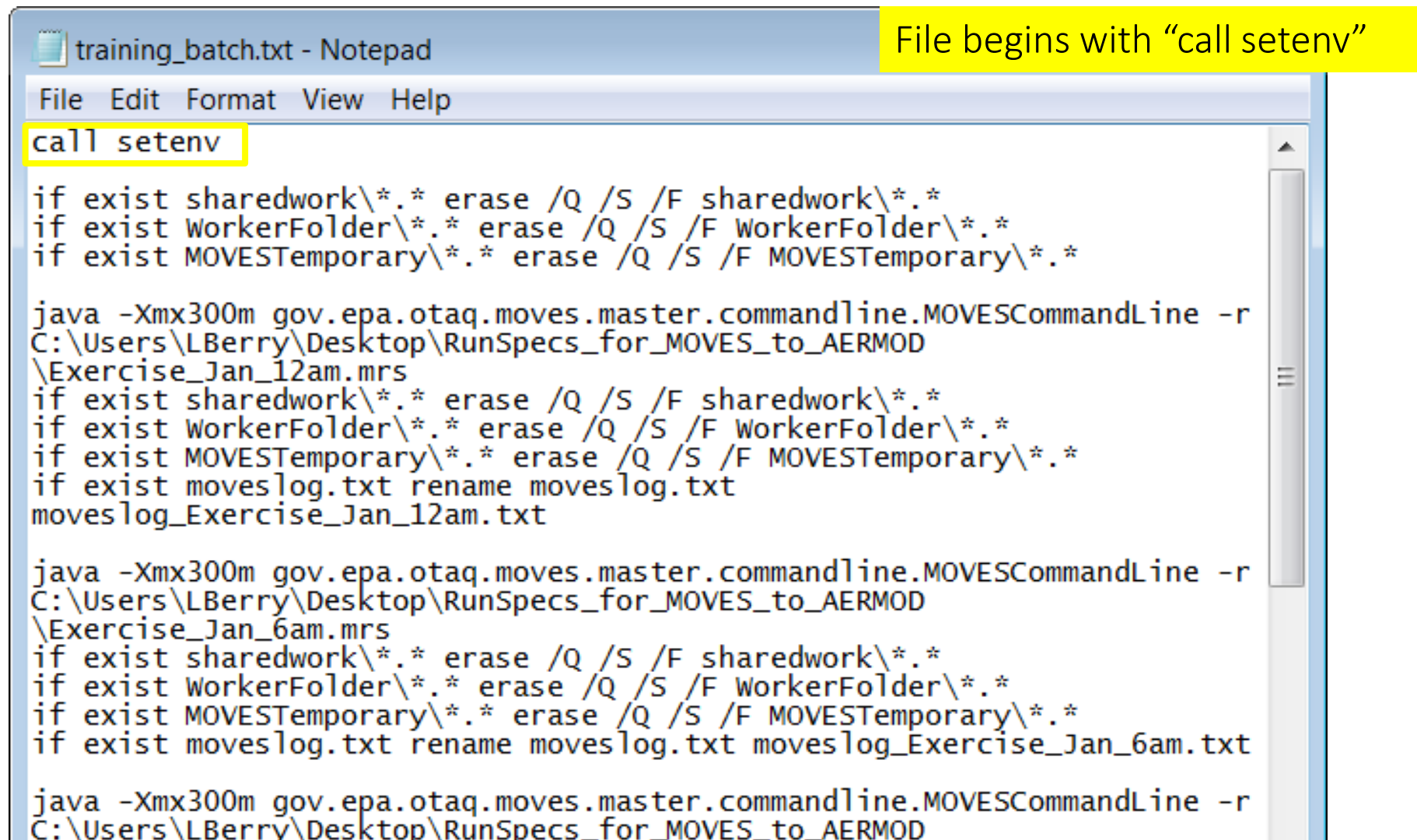


# Optional: Use a Batch File to Automate Runs

- Once all RunSpecs are created and input databases populated, a user can create batch text file listing location of each RunSpec
- Example batch file, “training\_batch.txt” provided in Course Files, Example Analysis folder
- See notes next slides



# Optional: Use a Batch File to Automate Runs



```
training_batch.txt - Notepad
File Edit Format View Help
call setenv

if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *

java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
\Exercise_Jan_12am.mrs
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
if exist moveslog.txt rename moveslog.txt
moveslog_Exercise_Jan_12am.txt

java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
\Exercise_Jan_6am.mrs
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
if exist moveslog.txt rename moveslog.txt moveslog_Exercise_Jan_6am.txt

java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
```



# Optional: Use a Batch File to Automate Runs

training\_batch.txt - Notepad

File Edit Format View Help

```
call setenv
```

```
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *  
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *  
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
```

```
java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r  
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD  
\Exercise_Jan_12am.mrs
```

```
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *  
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *  
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
```

```
if exist moveslog.txt rename moveslog.txt  
moveslog_Exercise_Jan_12am.txt
```

```
java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r  
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD  
\Exercise_Jan_6am.mrs
```

```
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *  
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *  
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
```

```
if exist moveslog.txt rename moveslog.txt moveslog_Exercise_Jan_6am.txt
```

```
java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r  
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
```

Next three lines instruct MOVES to clear previous work; repeated between each run



# Optional: Use a Batch File to Automate Runs

training\_batch.txt - Notepad

File Edit Format View Help

```
call setenv
```

```
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *  
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *  
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
```

```
java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r  
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD  
\Exercise_Jan_12am.mrs
```

```
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *  
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *  
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *  
if exist moveslog.txt rename moveslog.txt  
moveslog_Exercise_Jan_12am.txt
```

```
java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r  
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD  
\Exercise_Jan_6am.mrs
```

```
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *  
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *  
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *  
if exist moveslog.txt rename moveslog.txt moveslog_Exercise_Jan_6am.txt
```

```
java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r  
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
```

Lines beginning with “java” instruct MOVES to run a specific RunSpec



# Optional: Use a Batch File to Automate Runs

A line to preserve the “moveslog” for each RunSpec is included

```
training_batch.txt - Notepad
File Edit Format View Help
call setenv

if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *

java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
\Exercise_Jan_12am.mrs
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
if exist moveslog.txt rename moveslog.txt
moveslog_Exercise_Jan_12am.txt

java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
\Exercise_Jan_6am.mrs
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
if exist moveslog.txt rename moveslog.txt moveslog_Exercise_Jan_6am.txt

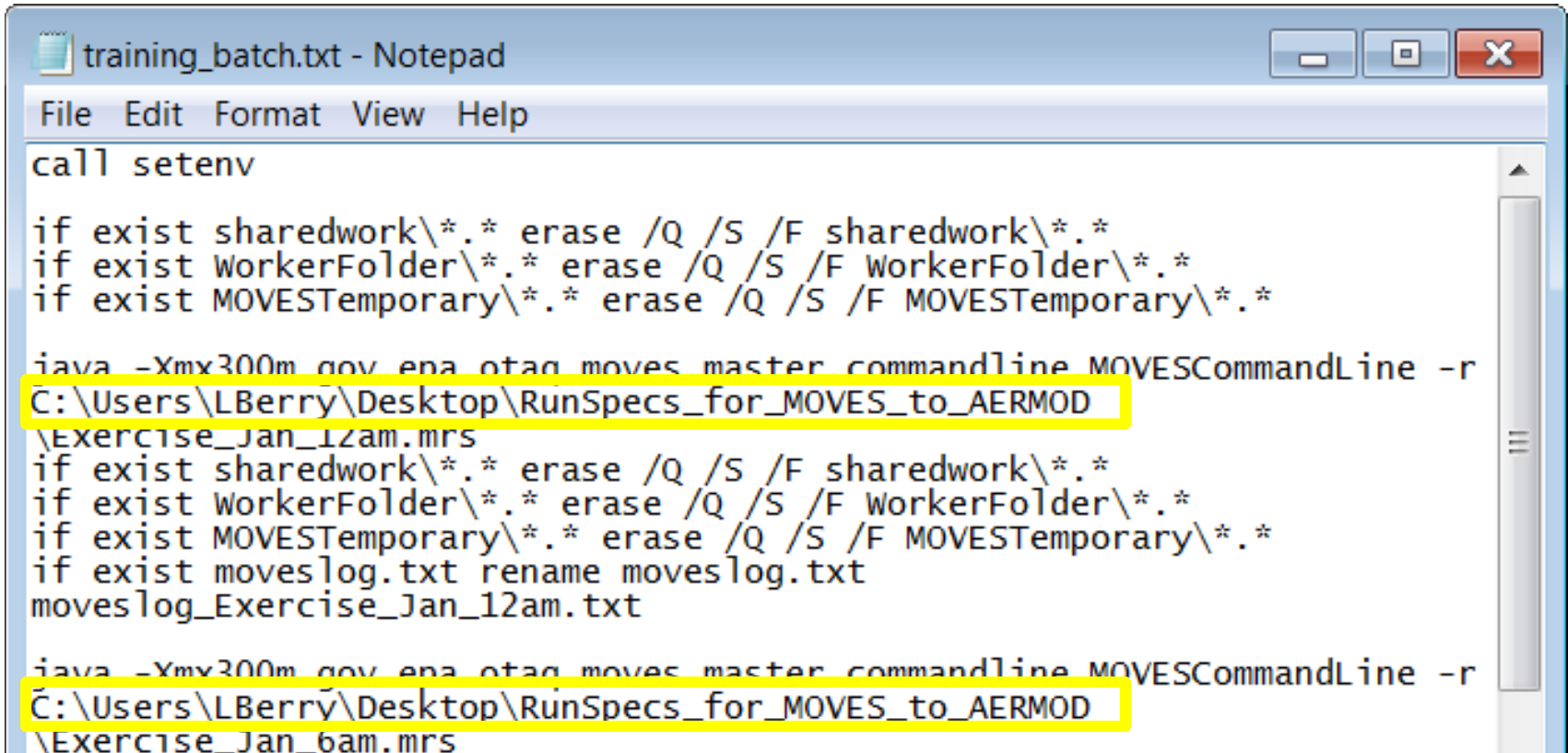
java -Xmx300m gov.epa.otaq.moves.master.commandline.MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
```



# Optional: Use a Batch File to Automate Runs

Directions:

- Within the text file, replace file path  
`C:\Users\Lberry\Desktop\RunSpecs_for_MOVES_to_AERMOD\` with the correct folder where you saved your RunSpecs, for all 16 RunSpecs in the text file



```
training_batch.txt - Notepad
File Edit Format View Help

call setenv

if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *

java -Xmx300m gov.epa.otag.moves.master.commandline MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
\Exercise_Jan_12am.mrs
if exist sharedwork\*. * erase /Q /S /F sharedwork\*. *
if exist WorkerFolder\*. * erase /Q /S /F WorkerFolder\*. *
if exist MOVESTemporary\*. * erase /Q /S /F MOVESTemporary\*. *
if exist moveslog.txt rename moveslog.txt
moveslog_Exercise_Jan_12am.txt

java -Xmx300m gov.epa.otag.moves.master.commandline MOVESCommandLine -r
C:\Users\LBerry\Desktop\RunSpecs_for_MOVES_to_AERMOD
\Exercise_Jan_6am.mrs
```



# Optional: Use a Batch File to Automate Runs

Directions, continued:

- Save “training\_batch.txt” to your MOVES folder, e.g.:  
C:\Users\Public\EPA\MOVES\MOVES2014a
- **Change computer settings as necessary so that the computer does not switch off during the batch run (~13 hours on our computers)**
- Rename “training\_batch.txt” to “training\_batch.bat”
- Double click on “training\_batch.bat” to run it

MOVES will execute all 16 RunSpecs and place the results in the output database “Transit\_Exercise\_Out”



Reference:  
How Do I Develop Traffic Data for  
MOVES?



# General Tips for Developing Traffic Data

- Develop traffic data by using appropriate methods based on best practices
  - Some resources are available through FHWA's Travel Model Improvement Program (TMIP)
  - Methodologies for computing intersection control delay provided in the Highway Capacity Manual (HCM) 6<sup>th</sup> Edition.
  - Coordinate early with traffic analysts to use and/or adjust existing data for PM hot-spot analyses
- Project sponsor should document traffic data sets, their sources, key assumptions, and methods used to develop build/no-build scenario inputs

***Note:** The following slides include approaches for dividing up links based on best practices, but there may be other best practice approaches*



# Tips for Highway Links

## 1. Use Network Schematic

- Shows volumes and number of lanes
  - May be consolidated with arterial network
- Volumes at each interchange should be balanced
  - Consider other changes, such as vehicle mix (e.g., major freight terminal at interchange)



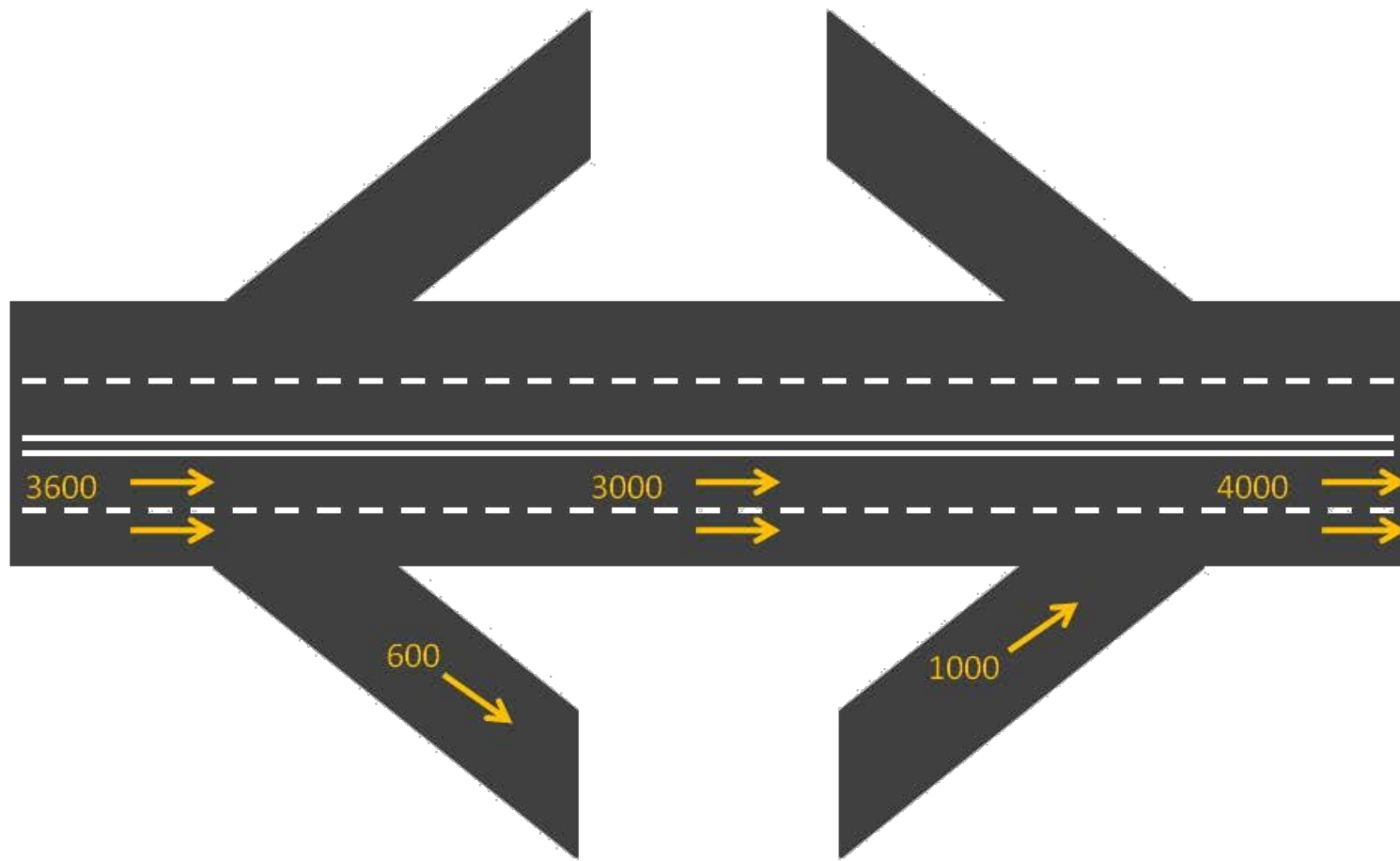
# Tips for Highway Links

## 2. Define Distinct Links

- Use points with changes in volume
  - For example, at ramps, have three (or more) links
    - Freeway before
    - Freeway after
    - Ramp
- Segments with different characteristics
  - E.g., high occupancy vehicle (HOV) or bus lane
  - Changes in road grade
- Segments with different operations
  - Ramp may have portion with speed changes and portion with steady speed, or lane additions, or drops, or curvature



# Example: Highway Links





# Tips for Highway Links

## 3. Define Cruise Links

- Such links would occur on the freeway
- Speeds will vary with changes in volumes
- When average speed option is used:
  - Average speed equal to cruise speed
  - Simplifying assumptions in this approach:
    - No restrictions on cruise (e.g., capacity)
    - Limited vehicle interference by vehicle type



# Tips for Highway Links

## 4. Define Ramp Links

- Use vehicle activity options discussed later for acceleration and deceleration links
  - Estimate distance and average speed
    - Distance of link will typically be based on geometry of ramp (Might not begin or end at stopped condition)
    - Operations might vary along length of ramp (e.g. deceleration, then cruise, then acceleration)
- Might use link drive schedule for typical ramp operations

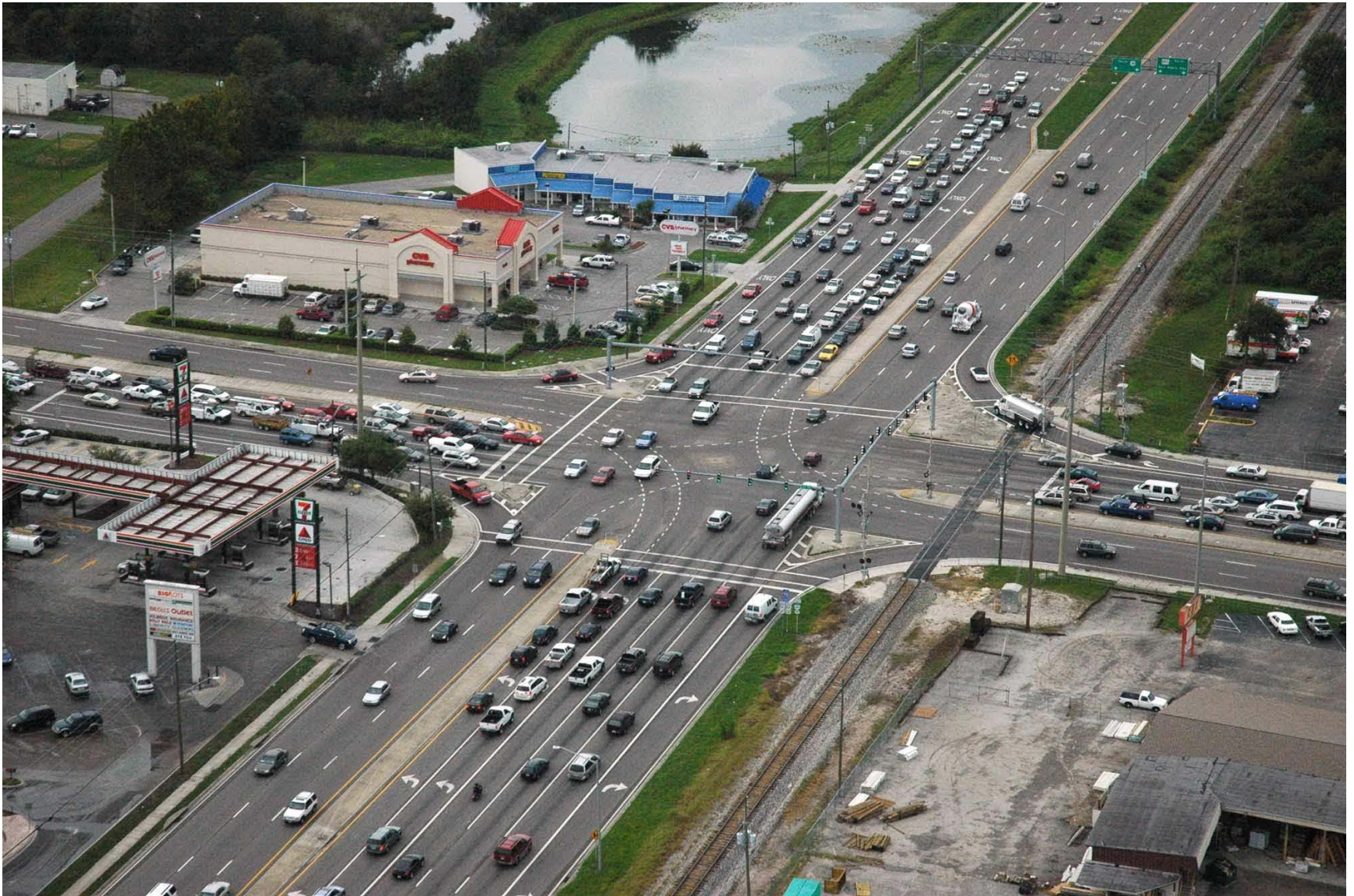


# Highway Links from Example Analysis





# Developing Traffic Data for MOVES Intersection Links





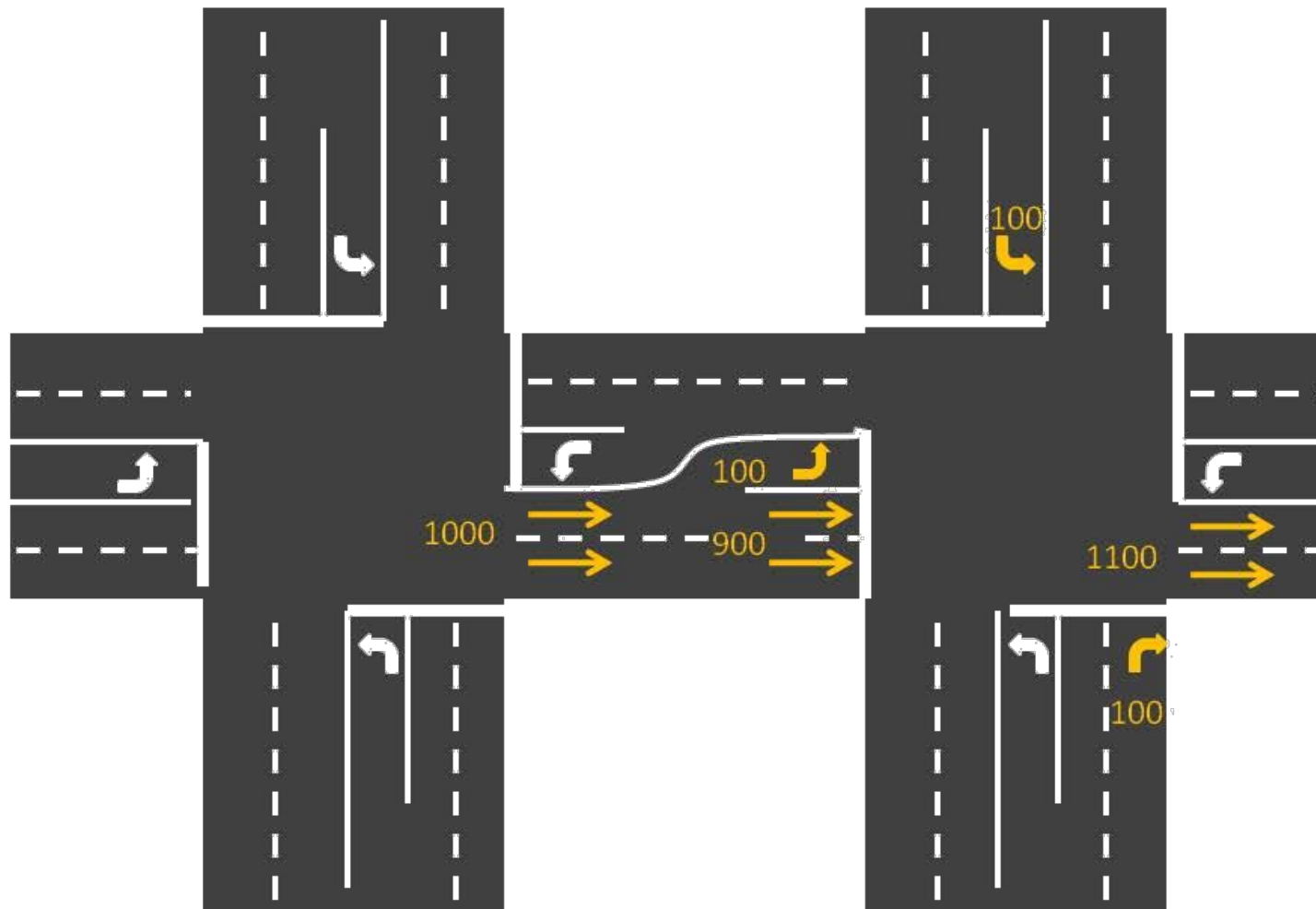
# Tips for Intersection Links

## 1. Turn Movement Schematic

- Intersection approach volumes
  - How many vehicles for each movement?
- Intersection departure volumes
  - How many vehicles from each approach?
- Need for all intersections, all time periods analyzed



# Example: Intersection Links





# Tips for Intersection Links

## 2. Traffic Analysis (Operational Details)

- Define the network in segments for:
  - Queue (includes deceleration, cruise, and idle)
  - Cruise
  - Acceleration
- For each link, determine:
  - Link Length
  - Average Speed
  - Road Grade

***Note:** This approach for dividing up links is only one possible option when using the average speed activity option in MOVES. Using other approaches with the average speed option, or using other activity options (such as link drive schedule) may require a different definition of links.*



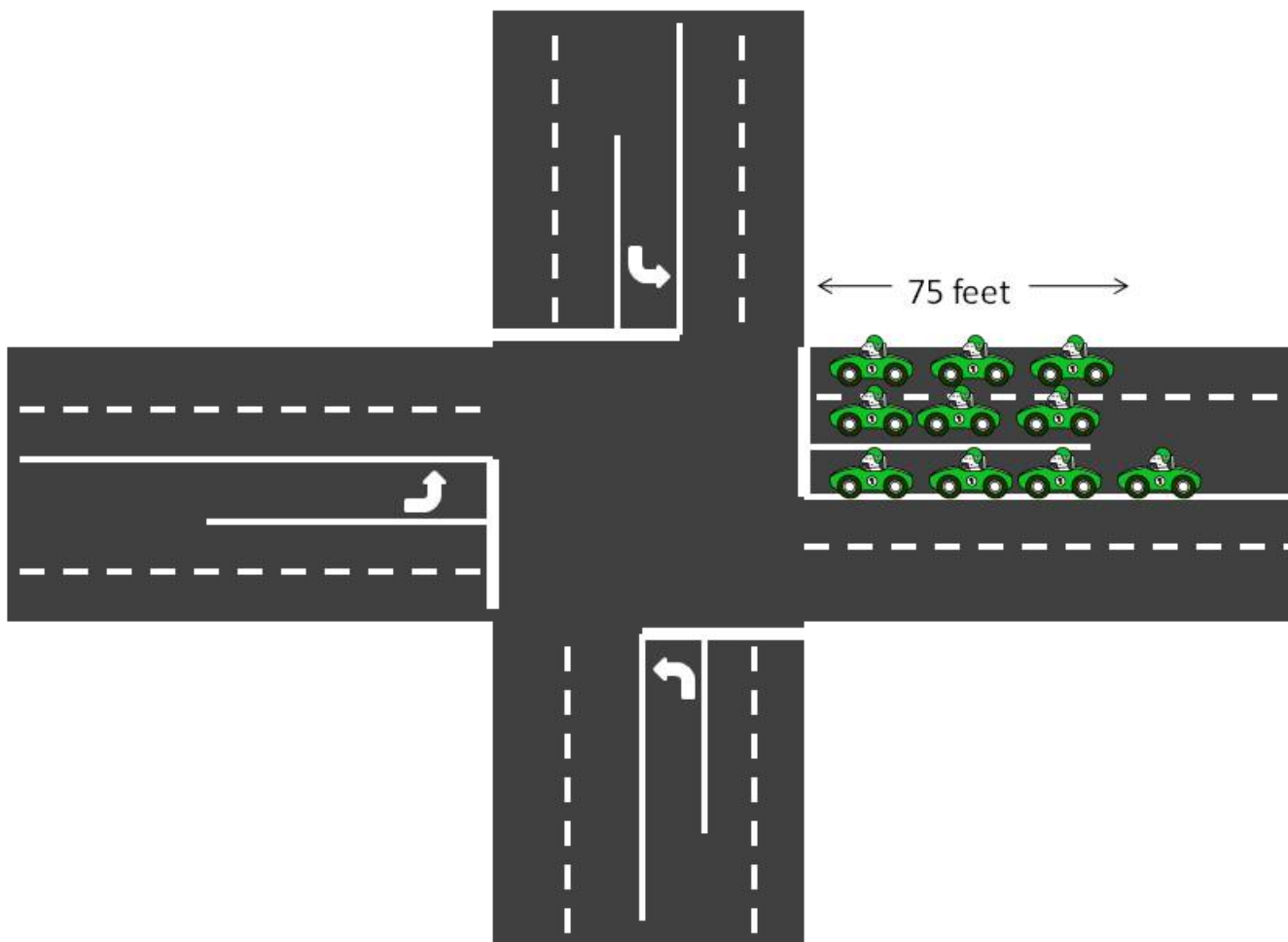
# Tips for Intersection Links

## 3. Define Queue Links

- Assume the queue begins at stop bar
  - Builds backward from there
- Average speed = distance / total time;
  - Speed should account for both red light (idle, acceleration, and deceleration) and green light (cruise).
- For side-by-side queues:
  - If similar length, create one approach
  - If different, create two approaches



# Example: Intersection Links





# Tips for Intersection Links

## 4. Define Acceleration Links

- Assume the acceleration begins at stop bar
  - Builds forward from there

- Calculate the length of the link from:

$$d = v_o * t + 0.5 * a * t^2$$

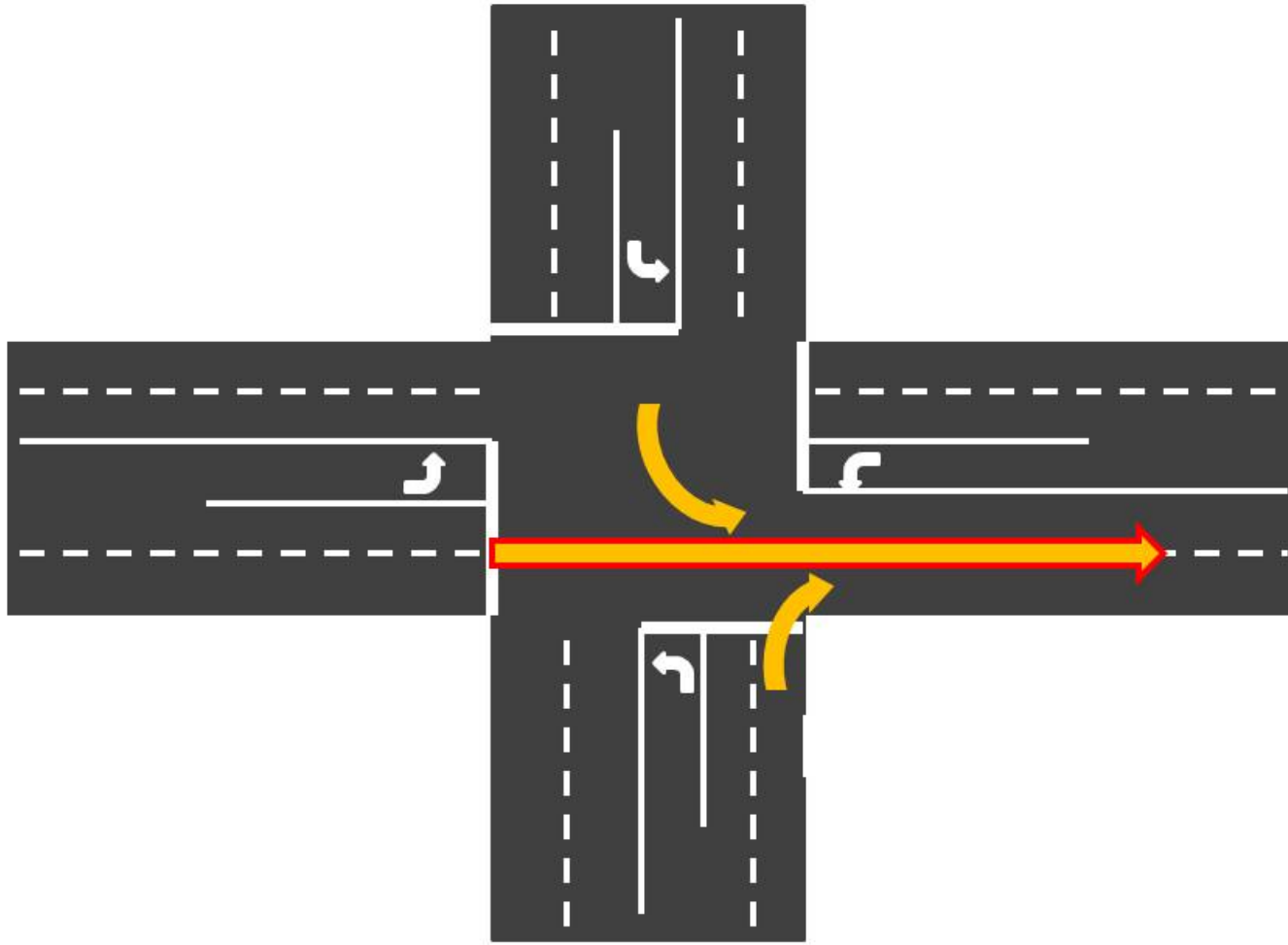
$$t = (v_i - v_o) / a$$

Where:             $d$  = distance             $v_o$  = initial speed             $v_1$  = final speed  
                      $t$  = time                         $a$  = acceleration

- Average speed = distance / total time;
  - Speed should account for cruise (green-light) and acceleration from a stop (red-light)



# Example: Intersection Links



*Note: Add related turning movement volumes to through movement for departure volume*



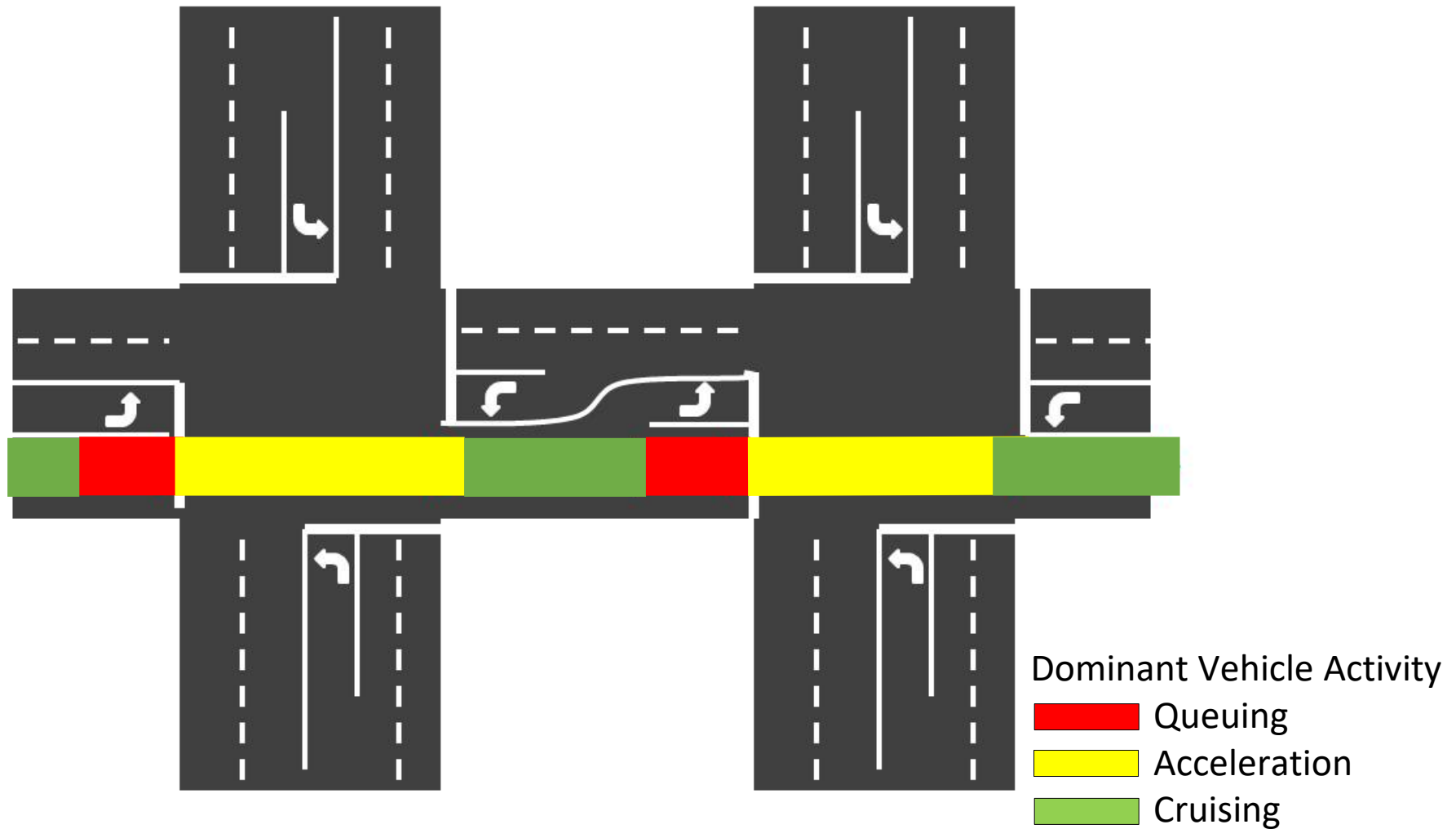
# Tips for Intersection Links

## 5. Define Cruise Links

- Length from end of acceleration link to the back end of the next queue link
- Average speed is equal to cruise speed
- Simplifying assumptions in this approach:
  - No restrictions on cruise (e.g., capacity)
  - Uniform acceleration
  - Limited vehicle interference by vehicle type



# Example: Intersection Links





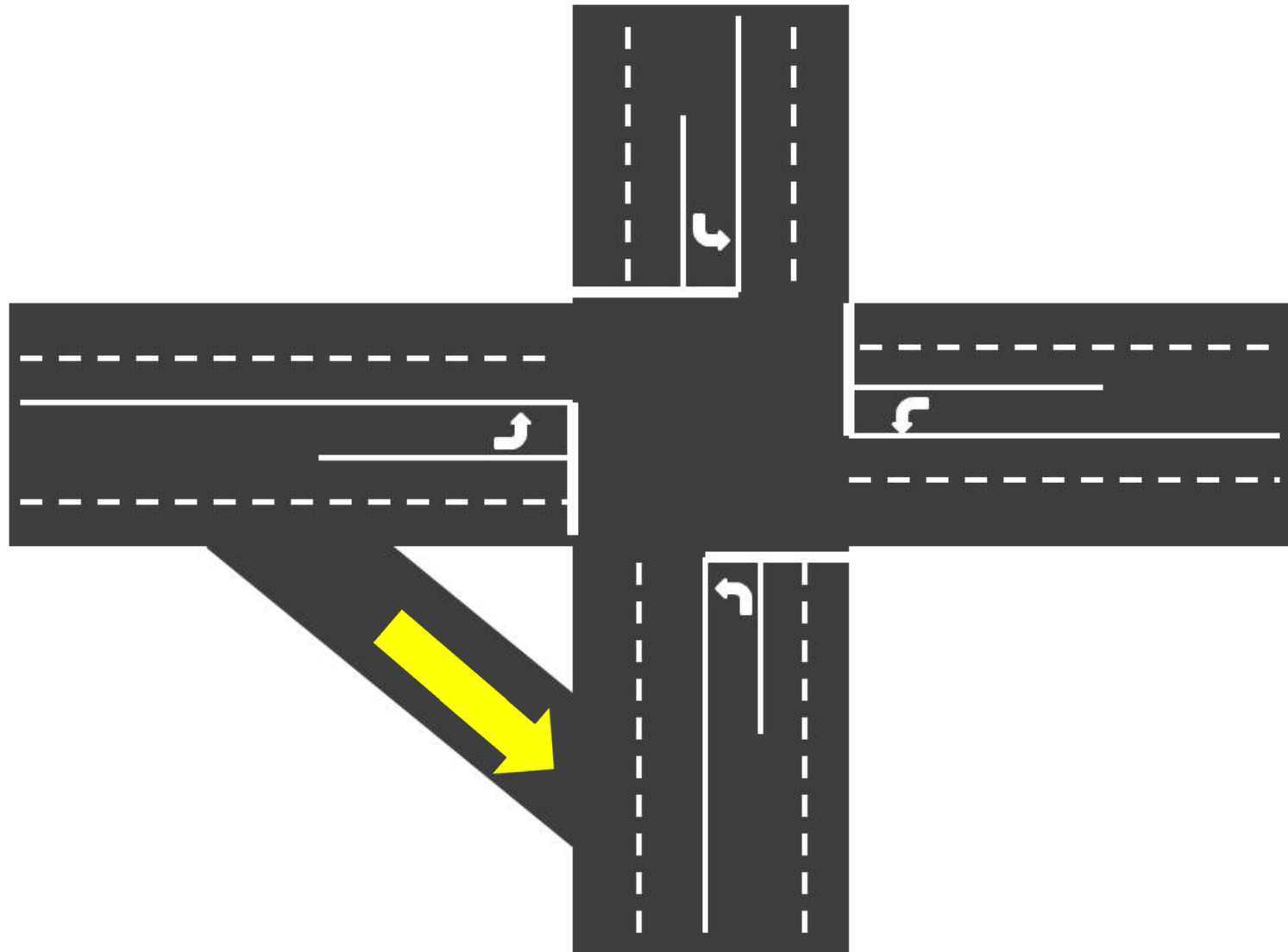
# Tips for Intersection Links

## 6. Define Special Links

- Some roadway segments may differ from these generalized link categories
- For example, channelized right turn may have deceleration into turn, and acceleration out of it
  - Simplifying assumption: treat as cruise link but use a lower speed
- Need to evaluate what is reasonable approach



# Example: Intersection Links





Questions?