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# Using Traffic Analysis Tools for Work Zone Projects

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# Outline

- Role and importance of traffic analysis tools
- Scoping the problem and analysis
- Selecting an appropriate analysis tool
- Applying a traffic analysis tool
- Resources

# Why Should We Use Traffic Analysis Tools?

Why waste time on analysis when the answer is obvious... close lanes during the night/weekends!

Analysis tools won't tell us anything we don't already know through experience!

This work zone is only temporary. Besides, people expect delays in work zones!



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# Why Use Traffic Analysis Tools?

- WZ impacts can be regional and system-wide
- WZ impacts are costly to the public
- WZ strategies can be complex
- WZ Final Rule recommends that States develop and implement systematic procedures to assess work zone impacts

# Work Zone Impacts



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# Categories of Traffic Analysis Tools

1. Sketch Planning
2. Travel Demand Models
3. Analytical/Deterministic (HCM)
4. Traffic Signal Optimization
5. Macroscopic Simulation
6. Mesoscopic Simulation
7. Microscopic Simulation

Increasing Level of:

- Detail
- Complexity
- Effort

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# Sketch Planning Tools

- Order of magnitude estimates
- Alternative evaluations without in-depth engineering analysis
- Preparing preliminary budgets and proposals
- Least costly traffic analysis technique
- Limited in scope, robustness and presentation capabilities

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# Analytical/Deterministic Tools

- Quickly predict capacity, density, speed, delay and queuing
- Analyze the performance of isolated and small scale facilities
- Limited in analyzing network or system effects

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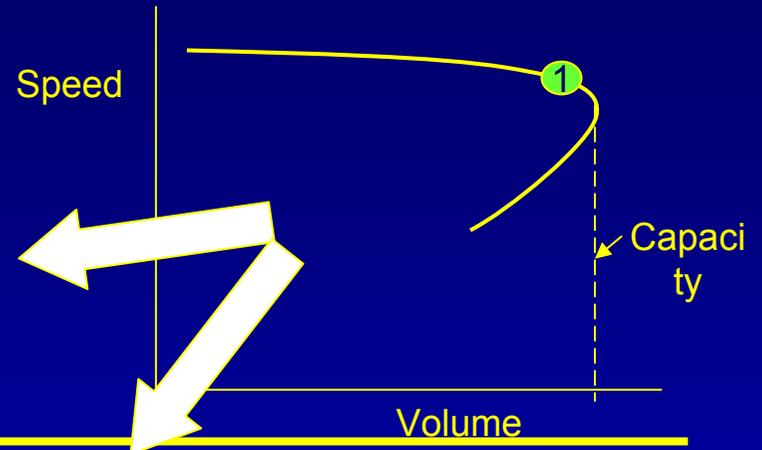
# Microscopic Simulation Models

- Simulate movement of individual vehicles
- Uses statistical distribution of arrivals
- Tracked through network
- Computer/storage requirements are large
- Usually more data intensive
- Limits network size and number of runs
- May have built-in en-route diversion capability

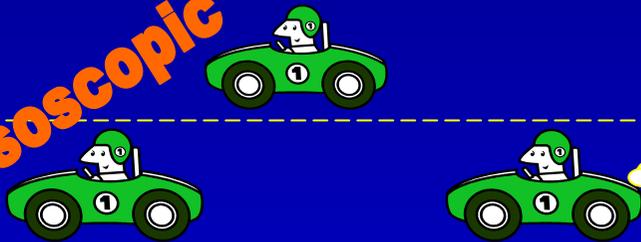
# Simulation Models

**Macroscopic**

The average speed for this link is based on macro theory.

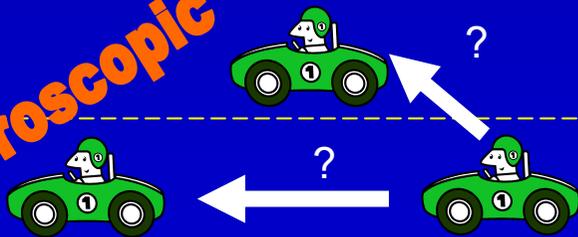


**Mesososcopic**



I will travel at the average speed for this link based on macro theory.

**Microscopic**



Do I want to change lanes, accelerate or decelerate?

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# How Do We Define the Problem?

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# Defining the Problem/Analysis Scope

- First step in a traffic analysis
- Problem by whose standard?
- Defining goals and objectives (i.e., success)
- What performance measures should be chosen?
- What WZ scenarios and strategies will be considered?
- Determine study area and analysis period

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# Defining Project Success

It is a goal and objective of this study to identify an alternative which:

1. Provides for minimum average freeway speeds of 47 mph throughout the peak period between Points A and Point B.
2. Supports a freeway flow rate of 2150 pcphpl throughout the peak period.
3. Provides for ramp operations which do not generate queues or spillback which impact operations on the freeway or major crossroad.
4. All parcels are within 2.5 miles of a major arterial which has the following operational characteristics:
  - a) arterial operations do not result in phase failure or spillback along the approach defined as the major roadway.
  - b) operations favor traffic flowing along the major roadway at an average speed of 35 mph.
  - c) supports continuous arterial flow along the major roadway for a minimum of 5 signals before a vehicle is required to stop.
  - d) minimizes delay at all signalized approaches.

# Selecting Performance Measures

- Accessibility of community resources such as hospitals or special generators
- Travel Time to Interstate (minutes)
- Schedule Adherence of Transit
- Number of Phase Failures on Major Arterial
- % of demand served
- % of demand served in peak hour
- % of capacity used on signalized ramp terminals
- Maximum Queue Length
- Average Queue Length
- Travel Time On Network (vehicle-hours)
- Persons/vehicles served (vehicle-miles)
- Average speed and density
- Average trip length (vehicle/hours per trip)
- Duration of Congestion (hours at a defined density, speed or flow rate)
- Extent (segment miles congested)
- Reliability (buffer index)
- Variability in Travel Time
- LOS as defined by HCM
- And Many More...

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# Work Zone Scenarios

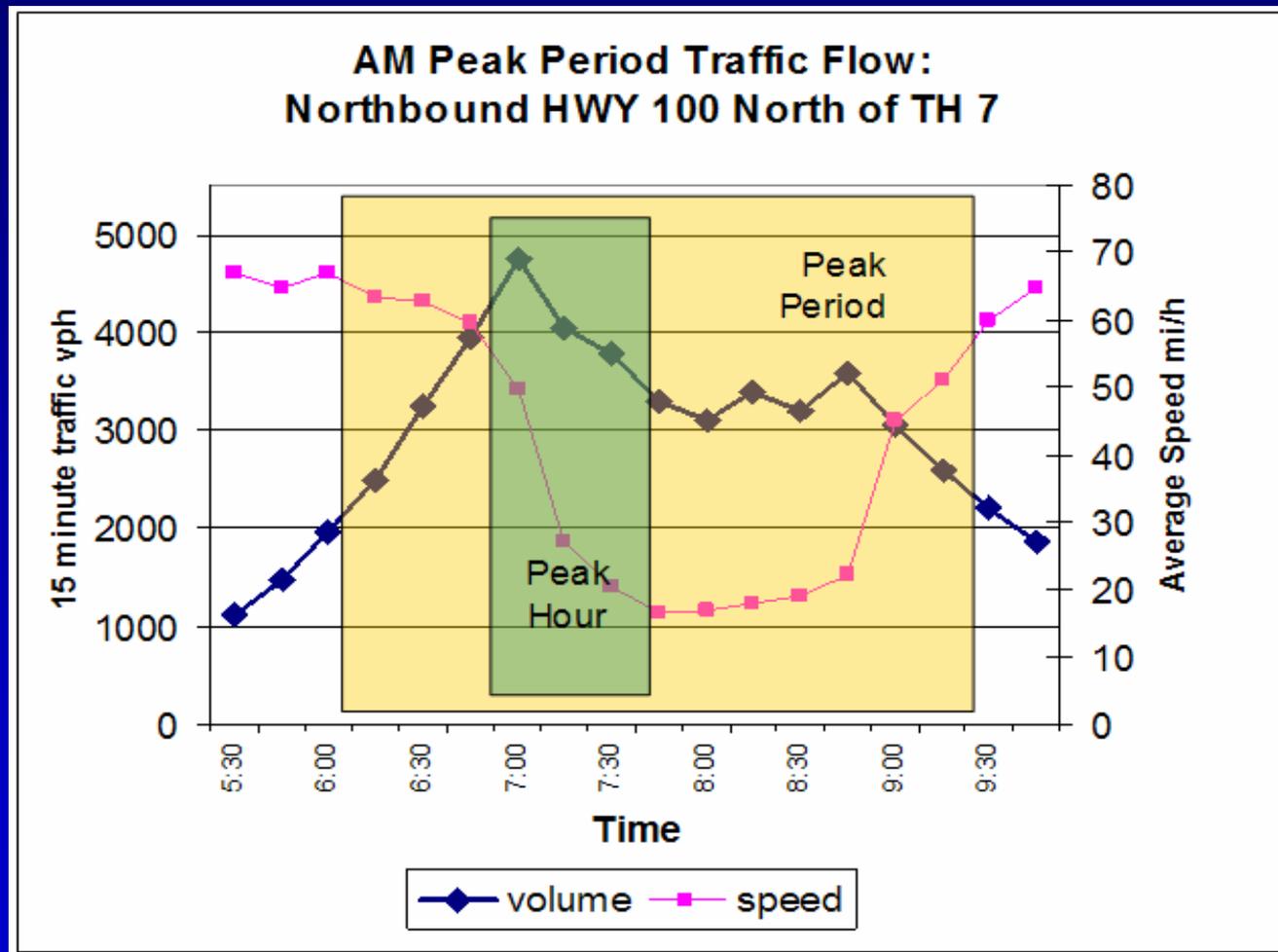
- Gain consensus early on scenarios and strategies to consider at high-level
- Scenarios: what the WZ will look like
  - Phases
  - Duration
  - Times of day/Days of week
  - Lane/Shoulder closures

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# Work Zone Strategies

- Strategies: what can we do to mitigate WZ impacts
  - Traveler information
    - Pre-trip, En-route
    - Alternate route guidance
  - Traffic management & control
    - Ramp metering/signal timing adjustments
    - HOV/HOT lanes
    - Congestion pricing
    - Dynamic speed control

# Selecting an Analysis Period



# How Do I Select a Traffic Analysis Tool?

There are too many different tools to select from!

When do I need a microscopic simulation model for my project?

I don't need a tool that can do everything, just one that is right for my project!



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# Tool Selection Principles

- No single tool can do everything
- Multiple tools may be necessary at different levels of project development
- FHWA does not require a specific tool be used
- Select the simplest tool that best matches the needs of your project (i.e., can analyze the full impacts and strategies)

# Tool Selection Methodology\*

## 1. Select the analysis context

- Planning, Design, or Operations/Construction

## 2. Select the appropriate tool category

- 7 categories (Sketch Planning, Deterministic/Analytical, Microscopic Simulation, etc.)
- Excel-based spreadsheet tool available

## 3. Select the most appropriate tool within the category

- Example: If Sketch Planning category is selected, now select which specific Sketch Planning tool to use.

\* - From "Traffic Analysis Toolbox Volume II: Decision Support Methodology for Selecting Traffic Analysis Tools," FHWA, 2004.

# Tool Selection Criteria

1	2	3	4	5	6	7
Geographic Scope	Facility Type	Travel Mode	Management Strategy	Traveler Response	Performance Measures	Tool/Cost-Effectiveness
<p><b>What is your study area?</b></p> <ul style="list-style-type: none"> <li>Isolated Location</li> <li>Segment</li> <li>Corridor/ Small Network</li> <li>Region</li> </ul>	<p><b>Which facility types do you want to include?</b></p> <ul style="list-style-type: none"> <li>Isolated Intersection</li> <li>Roundabout</li> <li>Arterial</li> <li>Highway</li> <li>Freeway</li> <li>HOV Lane</li> <li>HOV Bypass Lane</li> <li>Ramp</li> <li>Auxiliary Lane</li> <li>Reversible Lane</li> <li>Truck Lane</li> <li>Bus Lane</li> <li>Toll Plaza</li> <li>Light Rail Line</li> </ul>	<p><b>Which travel modes do you want to include?</b></p> <ul style="list-style-type: none"> <li>SOV</li> <li>HOV (2, 3, 3+)</li> <li>Bus</li> <li>Rail</li> <li>Truck</li> <li>Motorcycle</li> <li>Bicycle</li> <li>Pedestrian</li> </ul>	<p><b>Which management strategies should be analyzed?</b></p> <ul style="list-style-type: none"> <li>Freeway Mgmt</li> <li>Arterial Intersections</li> <li>Arterial Mgmt</li> <li>Incident Mgmt</li> <li>Emergency Mgmt</li> <li>Work Zone</li> <li>Spec Event</li> <li>APTS</li> <li>ATIS</li> <li>Electronic Payment</li> <li>RRX</li> <li>CVO</li> <li>AVCSS</li> <li>Weather Mgmt</li> <li>TDM</li> </ul>	<p><b>Which traveler responses should be analyzed?</b></p> <ul style="list-style-type: none"> <li>Route Diversion <ul style="list-style-type: none"> <li>- Pre-Trip</li> <li>- En-Route</li> </ul> </li> <li>Mode Shift</li> <li>Departure Time Choice</li> <li>Destination Change</li> <li>Induced/ Foregone Demand</li> </ul>	<p><b>What performance measures are needed?</b></p> <ul style="list-style-type: none"> <li>LOS</li> <li>Speed</li> <li>Travel Time</li> <li>Volume</li> <li>Travel Distance</li> <li>Ridership</li> <li>AVO</li> <li>v/c Ratio</li> <li>Density</li> <li>VMT/PMT</li> <li>VHT/PHT</li> <li>Delay</li> <li>Queue Length</li> <li># Stops</li> <li>Crashes/ Duration</li> <li>TT Reliability</li> <li>Emissions/ Fuel Consump</li> <li>Noise</li> <li>Mode Split</li> <li>Benefit/Cost</li> </ul>	<p><b>What operational characteristics are necessary?</b></p> <ul style="list-style-type: none"> <li>Tool Capital Cost</li> <li>Effort (Cost/ Training)</li> <li>Ease of Use</li> <li>Popular/Well-Trusted</li> <li>Hardware Requirements</li> <li>Data Requirements</li> <li>Computer Run Time</li> <li>Post-Processing</li> <li>Documentation</li> <li>User Support</li> <li>Key Parameters User Definable</li> <li>Default Values</li> <li>Integration</li> <li>Animation/ Presentation</li> </ul>

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# When To Select Simulation (generally speaking...)

- When the project impacts or strategies are beyond the limitations of simpler tool categories
- When the project will result in one or more of the following:
  - System-wide congestion that changes dynamically over multiple hours of the day
  - Queues and congestion that impact adjacent facilities (e.g., freeway queues spillback onto arterials)
  - Route, mode, and/or departure time shifts occurring
  - Need to evaluate ITS, advanced traffic operations, and/or major public information strategies

# How Do I Apply a Traffic Analysis Tool?

It's easy, you just enter some data and it gives you the answers!

I don't need to waste time on calibration – it already comes calibrated!

I don't need to look at the model output – I just look at the animation!



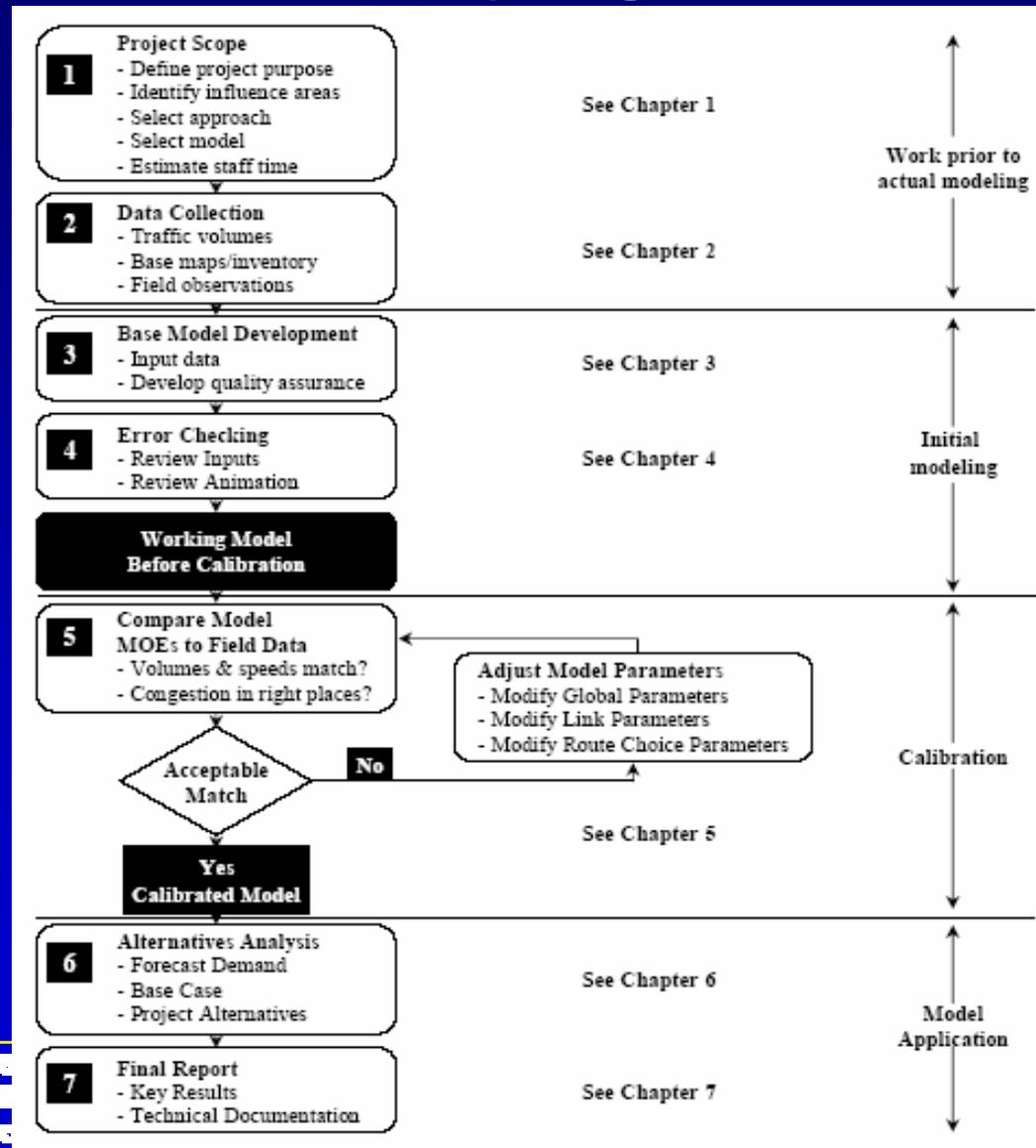
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# Importance of Proper Application of Tool

- “There was no indication that any one model was notably better or worse than the others. This suggests that model selection is less important than the ability to effectively code, test, calibrate, and apply these models.”  
- TRB 2002 Case Study Conclusions

**Selection of Proper Tool + Proper Application of Tool  
= Valid Analysis Results**

# Process for Applying Traffic Analysis Tools\*



\* - From "Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Software," FHWA, 2004.

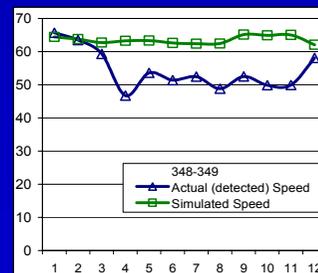
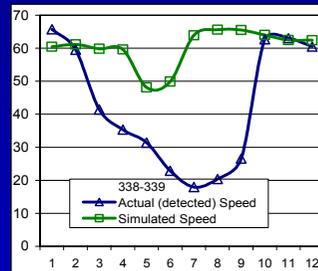
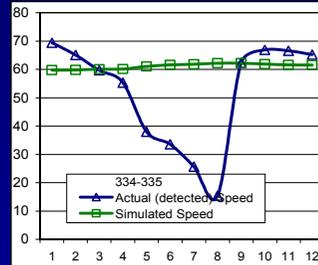
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# Model Calibration

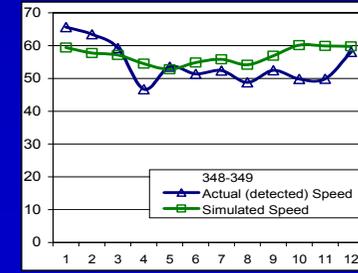
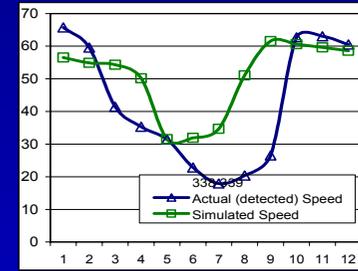
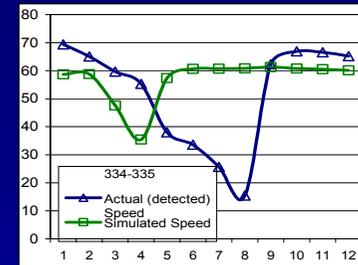
- Calibration = Adjusting model parameters so the model results match field conditions
- No model will match your field conditions exactly
- Budget adequately for calibration  
(e.g., 25% for microsimulation projects)

# Model Calibration Example

## SB I-494 TRY 1: Default Parameters



## SB I-494 TRY 12: Car Following Factors and Free Flow Speeds Modified



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# Resources

- FHWA Traffic Analysis Toolbox

1. Traffic Analysis Primer

2. Decision Support Methodology

3. Simulation Guidelines

4. CORSIM Guidelines

5. Case Studies

<http://www.ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm>

- *“Work Zone Impact Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects,”* FHWA, 2006

[http://www.ops.fhwa.dot.gov/wz/resources/final\\_rule/wzi\\_guide/index.htm](http://www.ops.fhwa.dot.gov/wz/resources/final_rule/wzi_guide/index.htm)

- *“Developing and Implementing Transportation Management Plans for Work Zones,”* FHWA, 2005

[http://www.ops.fhwa.dot.gov/wz/resources/publications/trans\\_mgmt\\_plans/index.htm](http://www.ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/index.htm)

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# FHWA Market-Ready Technologies

- QuickZone
  - Sketch planning tool for work zones
- IDAS
  - Sketch planning/travel demand model for analyzing ITS strategies
  - Can be used for work zone analysis
- Dynasmart-P
  - Mesoscopic simulation model with dynamic traffic assignment
  - Has been used for analyzing regional work zone impacts

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# Thank you!