

Proof of Concept (POC) Toolset User Guide for V2X Enabled Work Zone Data Collection Tool

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POC Toolset User Guide

1 Utilizing the POC TMC Website

1.1 Website Location

Navigate to the website (currently hosted in an unauthenticated POC website located at https://neaeraconsulting.com/V2x_Home)

1.2 Configuration Creator

Create, edit, and publish configuration files

Configuration files hold vital work zone information, used to generate the message after a work zone has been mapped.

All of the fields in the configuration creator are defined in Appendix A

1.2.1 Creating a new configuration file

To enter a new configuration file, open the Configuration Creator page and start entering information. The name of the configuration file will be automatically created using the WorkZone Description + RoadName + “.json”

All required data will not be required to save the configuration file, but in order to publish the data the required fields must be entered

Save config file

At any time, the information can be saved by selecting the save button

1.2.2 Updating a configuration file

Select config file by ID and import

1.2.2.1 *Edit file*

To edit a configuration file, select any file in the list, see Figure 1, and select Import

Figure 1 Edit configuration file

1.2.2.2 Save file

At any time the data can be saved by selecting the Save button option at the bottom of the configuration creator page

1.2.2.3 Configuration field descriptions

For a detailed description of each field and field types refer to Appendix A Configuration Field Definitions

1.2.3 Publishing a configuration file

1.2.3.1 Import config file

Importing a configuration file will download the configuration data and populate the configuration creator fields within the webpage by selecting an item in the published configuration list and clicking Import, see Figure 2

Figure 2 Import Published Configuration File

1.2.3.2 Publish config file

Publishing a configuration file will require all required fields to be populated and then move the configuration file from the in-progress to the published folders in the Cloud. By publishing the configuration file, it will allow the file to be used within the data collection tool

1.3 Upload Page

Upload work zone data ZIP archives

If the configuration files, csv and WZDx files were saved from another location (and saved as a zip file) you can select this option to upload the zip file to the published directory. Here, the files will be unzipped in the Cloud and made available in the published directory for the data collection tool to use

1.3.1 Upload work zone data

Select upload, select ZIP archive, and press upload

1.4 Verification and Visualization page

Verify and visualize mapped work zones for distribution

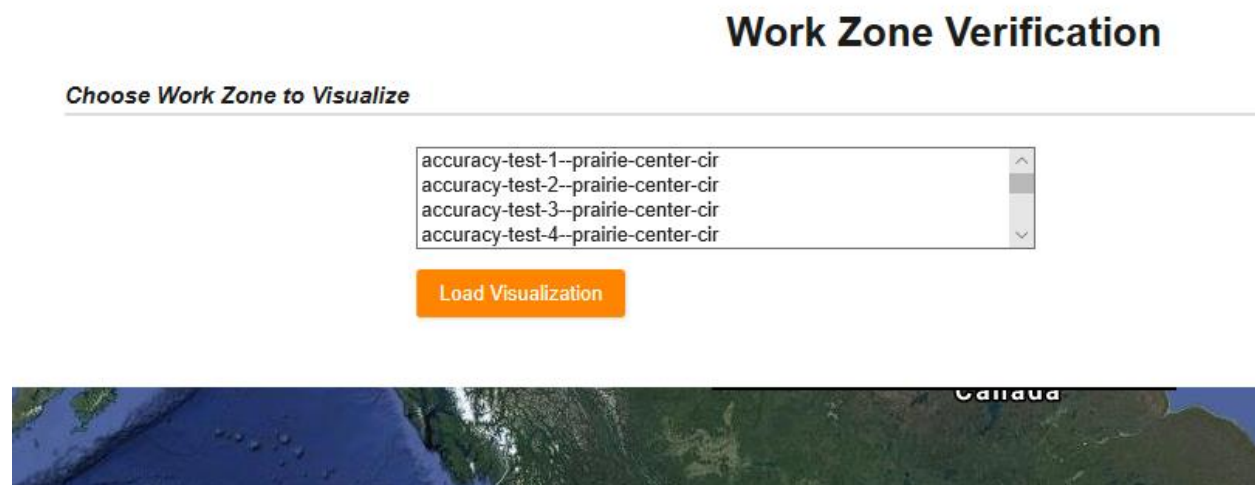


Figure 3 Work Zone Configuration

1.4.1 Load visualization of work zone

To view a visualization of the work zone, go to the Work Zone Verification page, select a workzone from the list and select load visualization. Here, 2 maps are displayed (the RSM as a pop-up) and WZDx

1.4.1.1 RSM visualization

The RSM map will display in a pop-up window (image shown below). The RSM visualization features an information window on the left side and a map overlay on the right side. The purple dots are vehicle path data points (recorded at 10Hz), and markers indicate features marked in the work zone (reference point, lane closures and the presence of workers)

White lines indicate lane lines, and small black lines perpendicular to lane lines indicate locations of the reduced vehicle path data. Red lines, red shading and traffic cones accompany lane closures and the tapering regions surrounding them. Speed limit signs are also shown on the map next to locations where the speed limit changes, as seen in Figure 4

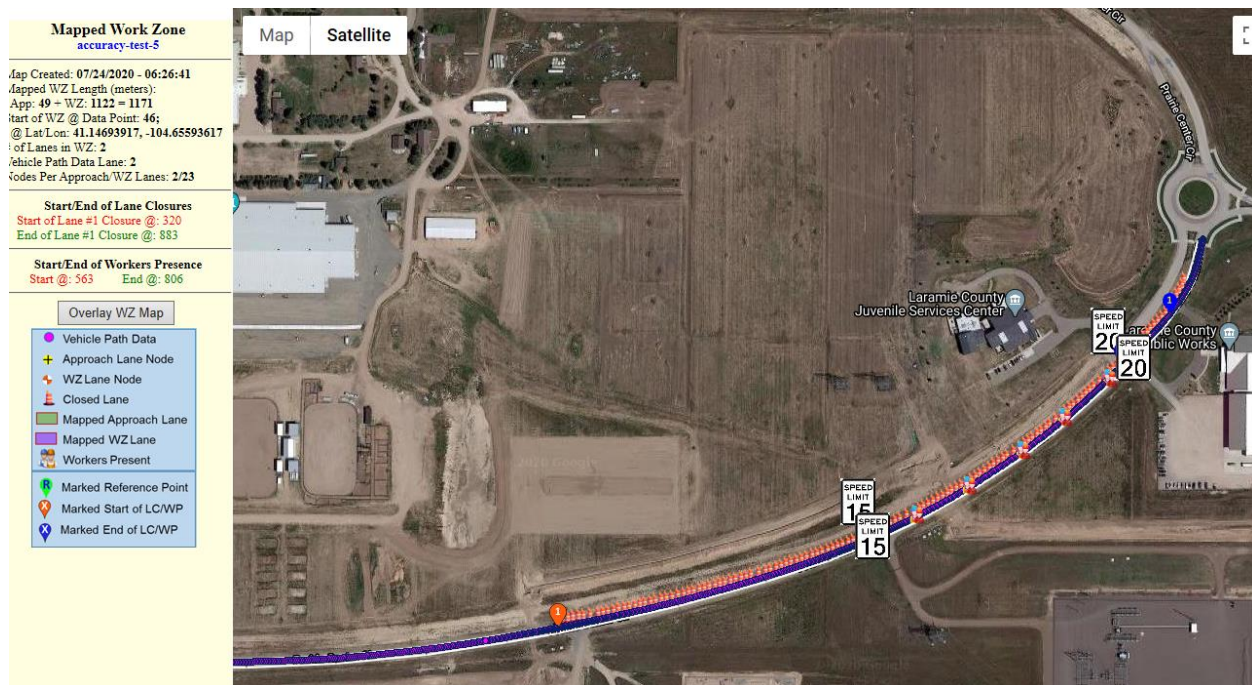


Figure 4 RSM Visualization

1.4.1.2 WZDx visualization

The WZDx visualization is overlaid on a satellite map, in the TMC website page (image below). Hover over the highlighted path to view detailed information associated with that path segment (displayed in the top center of the map) as seen on Figure 5



Figure 5 WZDx Visualization

1.4.2 Verify and publish work zone

After visualizing a work zone, verify for distribution. This will take the selected Work Zone and copy the file to a publish location within Azure and make it available

1.5 Published page

View and download published work zone data, go to the Published Work Zone Data page. Here you can select a published work zone and see the work zone in the map

Published Work Zone Data

Choose Work Zone to Download

Choose a work zone and specify messages to download

accuracy-test-1-prairie-center-cir
accuracy-test-2-prairie-center-cir
accuracy-test-3-prairie-center-cir
accuracy-test-4-prairie-center-cir

Description:
Road Name:
Start Date:
End Date:

☐ Work Zone Data Exchange message (WZDx), type = geojson
☐ XML Roadside Safety Message (RSM), type = xml
☐ Binary Roadside Safety Message (RSM), type = uper

Download Work Zone Data




Figure 6 Published Work Zone page

1.5.1 Download published work zone data

Select work zone and file types and download any of the file options for this specific published work zone

2 Utilizing the WZDC Tool

2.1 GitHub Location

Download and install the tool from <https://github.com/TonyEnglish/V2X-manual-data-collection>

2.2 Required hardware

The application required hardware:

- USB GPS (10Hz data rate)
- Laptop/tablet that can run Python

2.3 Required environment

- Internet access (not while driving/mapping)
- Python (explained below)
- Java (explained below)
- Environment variables (Email debbie@neaeraconsulting.com for instructions)

2.4 Setting up the tool

The Data collection tool is currently written in Python and some additional libraries are needed to run the application

2.4.1 Python

Install the latest version of python - <https://www.python.org/downloads/>

Ensure that python is added to your system path

Install the following python libraries:

- esptool
- azure-storage-blob
- image
- wheel
- serial
- pynmea2
- zipfile
- xmltodict
- tkinter

2.4.2 Java

Install java - <http://www.java.com/getjava/> (And add to your system path)

2.5 Initializing the tool

Load configuration file, establish GPS connection, begin data collection

- Open a command prompt and go to the location of the application
- Type in: 'python WZDC_tool.py' - you should see a window appear as in Figure 7

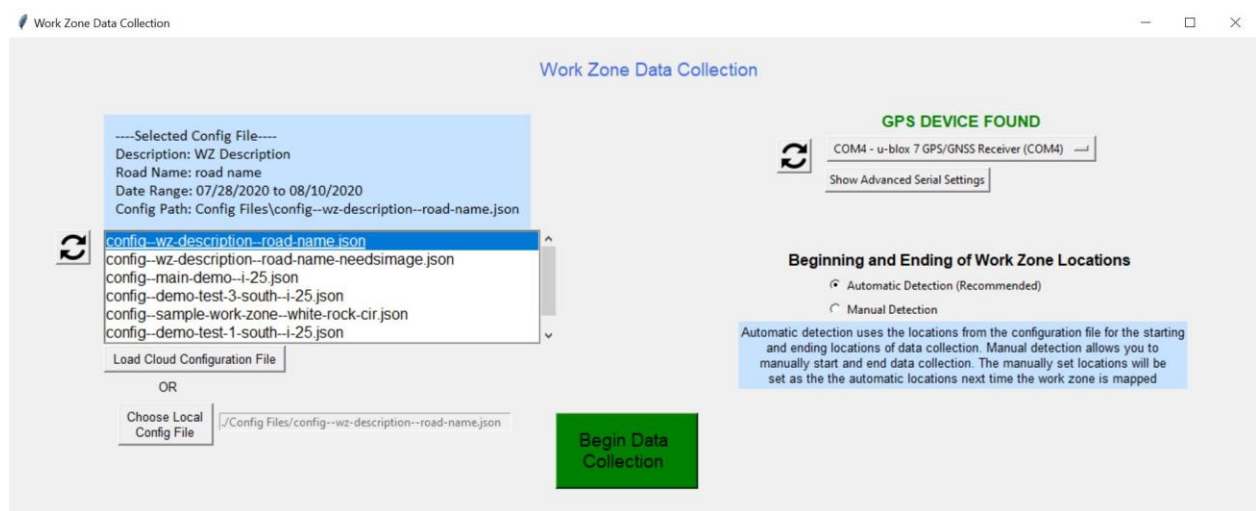


Figure 7 Initialize data collection tool

2.5.1 Loading a configuration file

You have a choice to load a configuration file from the cloud or local to your own device

2.5.1.1 Cloud

Select an item in the list and select Load Cloud Configuration File

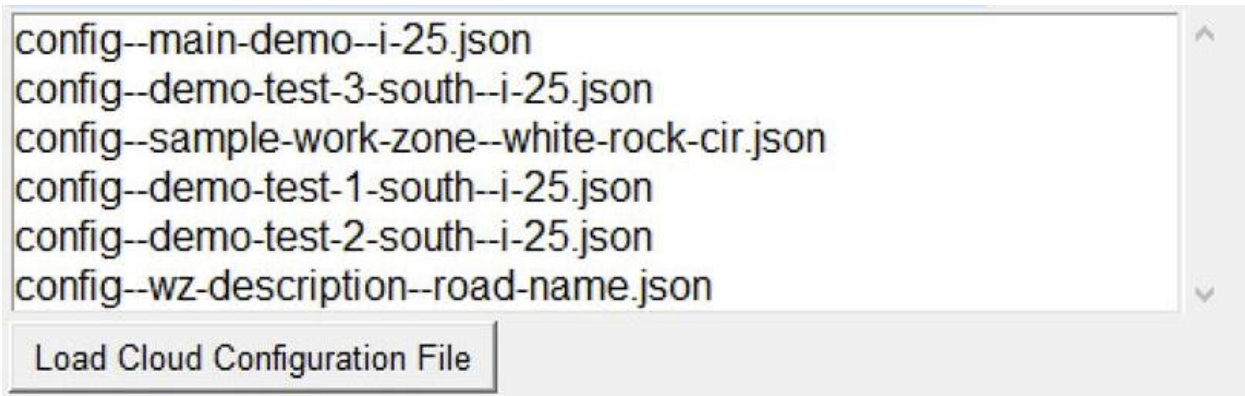


Figure 8 Import Configuration file from the Cloud(Azure)

2.5.1.2 Local File

Select the choose Local Config file button and browse to a local .json configuration file to import



Figure 9 Import Configuration File from local file storage

2.5.2 Detecting/connecting to GPS device

Plug in USB GPS device and refresh the GPS section (Refresh button next to GPS menu)

You can select advanced serial connection settings and edit the Baud rate and data rate for the GPS

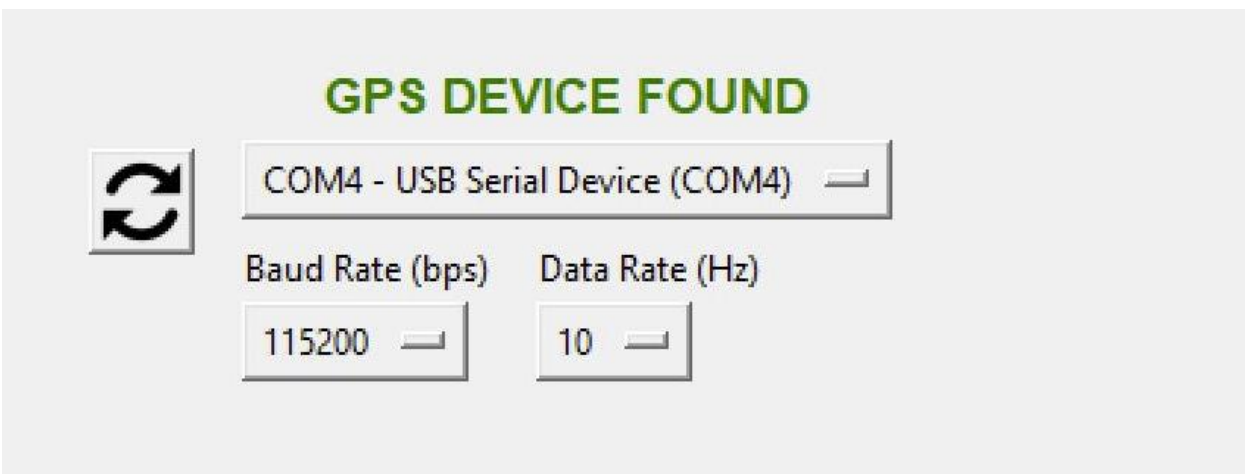


Figure 10 Connecting GPS

2.5.3 Beginning and Ending of WZ Detection Method

There are two modes of detecting the start/end points of the work zone and starting/ending data collection. The primary method is automatic detection; This method utilized the start/end locations saved in configuration file to begin/end data collection. The secondary method is manual detection, in which the user manually marks the start and end of the work zone/data collection. These manually

marked locations will be saved in the configuration file for use in automatic detection the next time that specific work zone is driven/mapped

2.6 Collecting vehicle path data

At the start of the data collection the application will show this screen (and show the correct number of lanes as defined in your configuration file) as in Figure 11

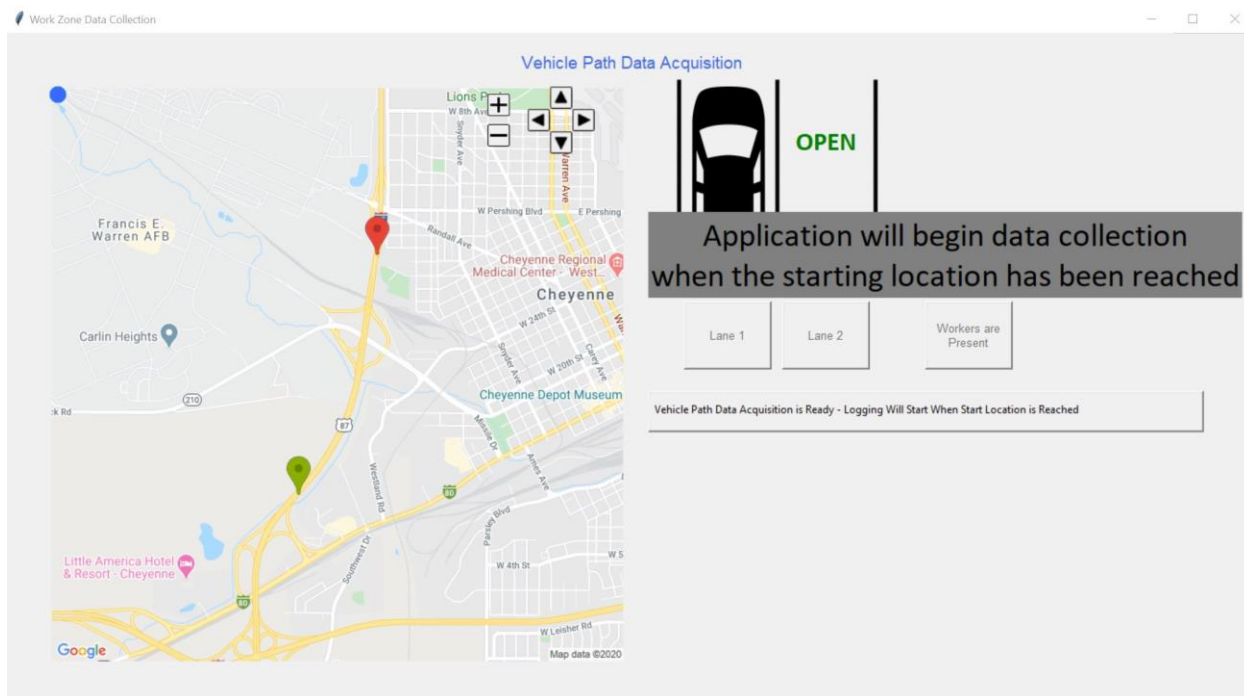


Figure 11 Collecting vehicle path data

The GPS will start collecting data once you have passed the starting point, and should show this notification as in Figure 12

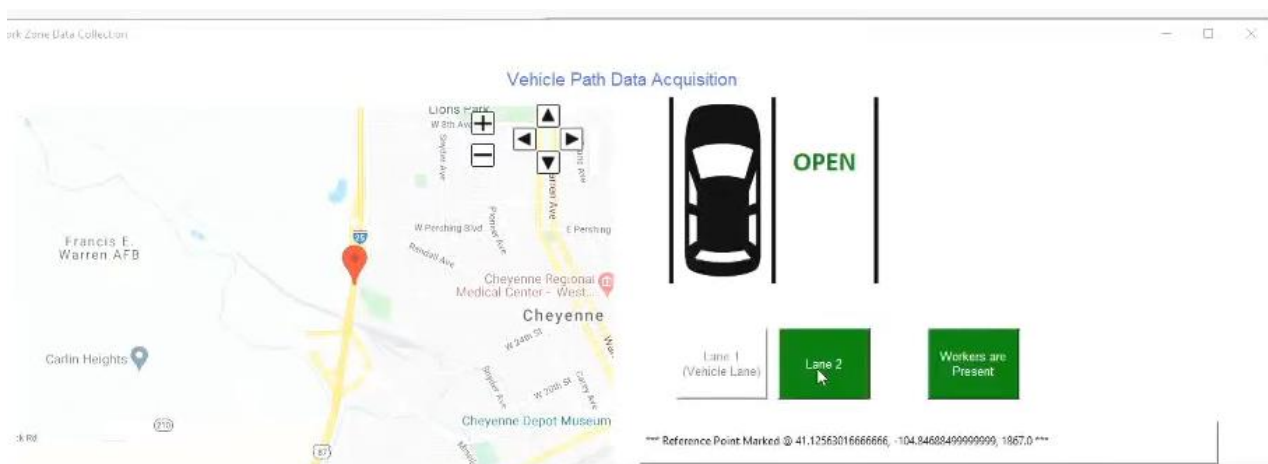


Figure 12 Data collection start configuration

2.6.1.1 Mark features

Features to mark:

- Lane Closures
- Workers Present
- Lane opening

Once you pass the starting location and data collection starts, you may start marking work zone features

To mark a lane closure/opening, simply click the button labeled 'Lane #'. Mark a lane as closed when the lane starts tapering to closed. Mark a lane as open when the lane starts tapering to open

To mark the presence/lack of workers, toggle the 'Workers are present'/'Workers no longer present' button

Once the GPS collection has started (passed the start reference point) you may select any of these features as you drive through the work zone

2.6.1.2 End of Work Zone

The End of the Work Zone will be defined as the end of the data collection. This will happen automatically (as defined in the configuration file) and will notify the user on the screen that the data collection has completed

2.7 Uploading mapped work zone data

After the data collection has been completed, the application will automatically process the data and try to upload the files to the Azure file storage location. The user will be notified by the Processing Data image on the screen as show in Figure 13

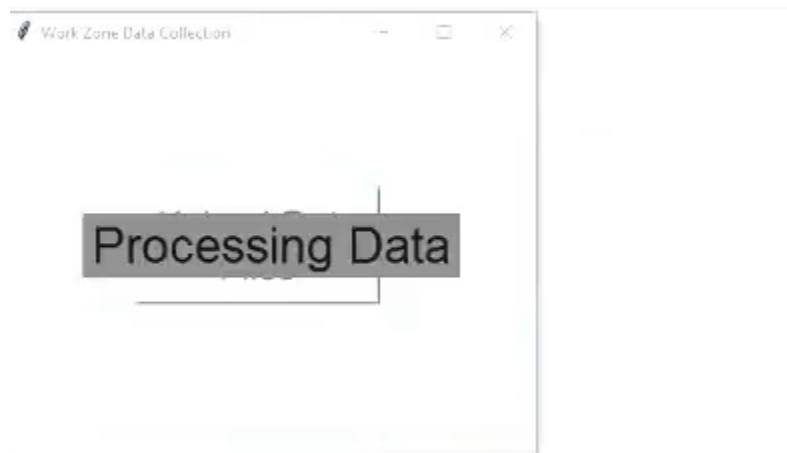


Figure 13 Processing Data Confirmation

If there is an internet connection is available, the application will automatically upload the data to the Azure file storage location. If no internet is available once an internet connection is established just select the upload button. If you wish to upload at a later time, close the application and manually upload the work zone (**Section 1.3.1**)



Figure 14 Upload Data file option

Appendix A Configuration Field Definitions

Table 1 Configuration Fields

Field Name	Description	Example	Optional/ Required	Notes
Configuration File				
Work Zone Description	Description of work zone (unique but brief)	Demo test 1 north	Required	Must be less than 20 characters
Road Name	The full name of the road which is being worked on	Highland Hills Cir	Required	Must be less than 20 characters
Road #	The name/number of the road	I-25	Optional	Must include identifier and number (I-80)
Configuration Data				
Number of Lanes	The number of unique lanes in the work zone (in 1 direction)	3	Required	Single direction of traffic, cannot be greater than 8
Vehicle Path Data Lane	The lane that the mapping vehicle will drive in for the entire	3	Required	Lanes are counted from the left
Avg Lane Width	The average lane width before the work zone (in meters)	3.6	Required	-
Approach Lane Padding	Difference in width of lanes just before start of work zone (in meters)	0	Required	This is commonly 0
WorkZone lane Padding	Difference in width of lanes within work zone (in meters)	0	Required	This is commonly 0
Normal Speed	Speed limit before work zone (in mph)	75	Required	-
At the Ref. Point(start of WZ)	Speed limit at start of work zone (in mph)	65	Required	-
When Workers are Present	Speed limit when workers are present (in mph)	55	Required	-
Cause Code	ITIS CauseCode, used for RSM message (3 for construction work)	3	Required	Recommended to leave as 3

SubCause Code	ITIS SubCauseCode, used for RSM message (leave as 0)	0	Optional	Recommended to leave as 0
Start Date	Date that the work will commence	7/6/2020	Required	The website will use the time zone from your browser
Start Time	Time of day that work will commence	7:00	Required	-
Days of week	Days of week that workers will be present	Mon, Tue, Wed, Thurs, Fri	Required	-
End Date	Date that the work will end	8/7/2020	Required	-
End Time	Time of day that work will end (24h hour time)	17:00	Required	The website will use the time zone from your browser
Additional Information				
Beginning Cross Street	Cross street at beginning of work zone	W 8 th Ave	Optional	-
Ending Cross Street	Cross street at ending of work zone	Missile Dr	Optional	-
Begin Mile Post	Mile post at beginning of work zone	18.3	Optional	Can have up to 2 decimal places
End Mile Post	Mile post at ending of work zone	10	Optional	Can have up to 2 decimal places
Event Status	Status of work zone	Planned	Required	-
Direction	Direction of roadway	Northbound	Required	-
Beginning Accuracy	Accuracy of beginning of work zone (location)	Estimated	Required	Verified means it was
Ending Accuracy	Accuracy of ending of work zone (location)	Estimated	Required	-
Start Date Accuracy	Accuracy of start date of road work	Estimated	Required	If Event Status is Pending, Active, or Completed, this should be Verified
End Date Accuracy	Accuracy of end date of road work	Estimated	Required	If Event Status is Completed, this should be Verified
Work Type	Type of work	Surface-work	Optional	-
Is architectural change	Is there an architectural change in the roadway		Optional	-
Lane Options				

Lane Number	Lane number (1 is far left)	2	Required	-
Restriction Type	Type of lane restriction	reduced-width	Optional	-
Restriction Units	Units of restriction value	ft	Optional	Some restriction types do not require units
Restriction Value	Value of lane restriction	12	Optional	Some restriction types do not require a value
Lane Number	Lane number (1 is far left)	1	Required	
Lane Type	Type of lane	left-lane	Required	Only use options referring to single lanes
Metadata				
Issuing Organization	Name of the organization issuing the work zone	Neaera Consulting	Required	-
WZ Location Method	The method used to verify the accuracy of the location information	Channel-device-method	Required	This value is fixed by the companion WZDC tool
Lrs Type	Linear referencing system used for milepost measurements	interpolative	Required	The values allowed here are not rigidly defined
Location Verify Method	The method used to verify the accuracy of the location (GPS device used)	GPS equipment accurate to 1 m	Required	-
Data Feed Frequency Update	Frequency that the data feed will be updated	24h	Optional	-
Contact Name	Name of the person managing the data feed	Debbie English	Required	-
Contact Email	Email of the person managing the data feed	debbie@neaeraconsulting.com	Required	-