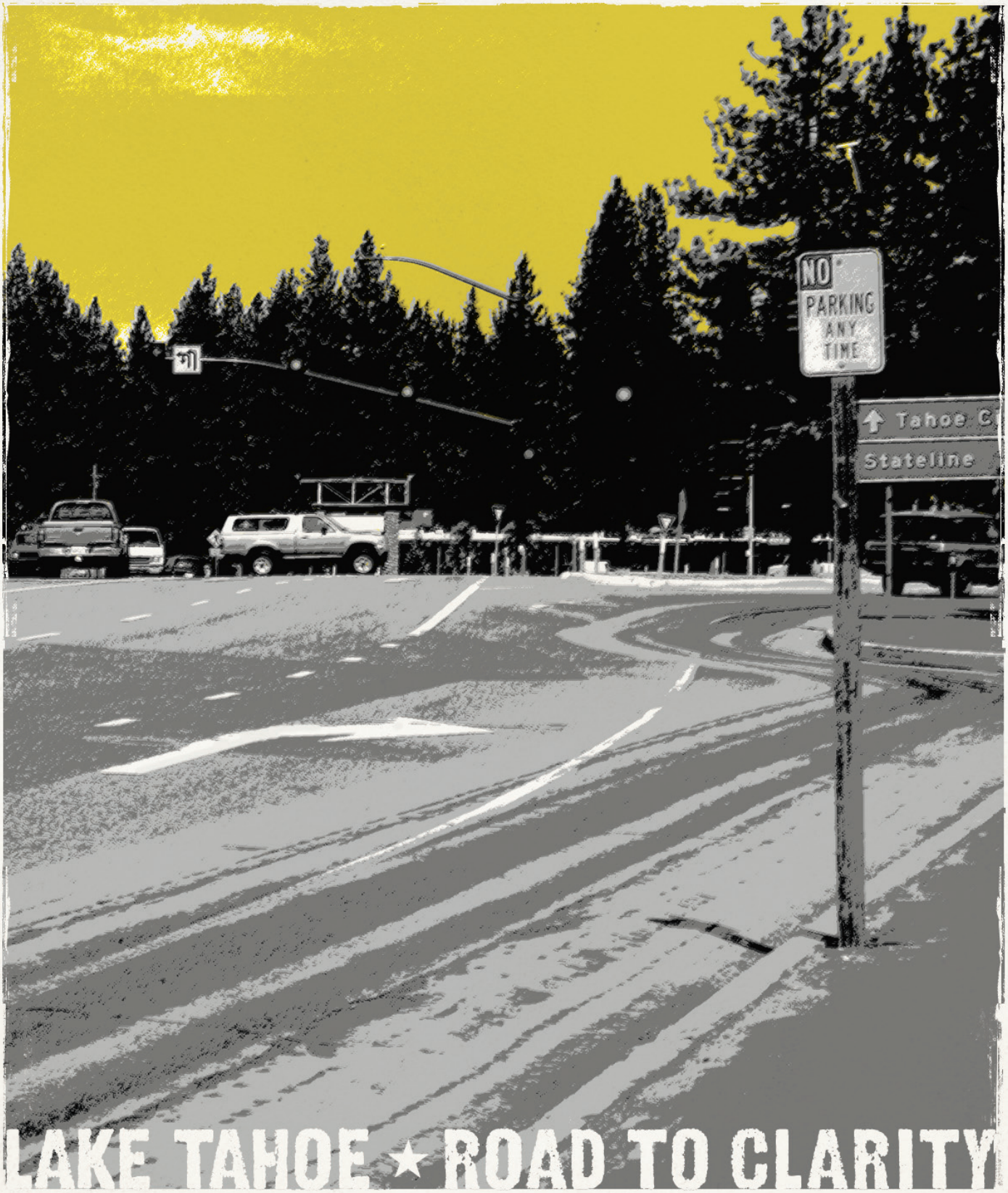
ROAD RAM USER MANUAL V2 | FINAL MAY 2015



LAKE TAHOE ★ ROAD TO CLARITY

ROAD RAPID ASSESSMENT METHODOLOGY (ROAD RAM)

Environmental Incentives

2NDNATURE
ecosystem science + design

nhc

Road Rapid Assessment Methodology (Road RAM)

Road RAM User Manual v2
Final May 2015

The Road RAM development is part of a multi-stakeholder collaborative effort to minimize the deleterious effects of urban stormwater on the ecosystem and economy of the Lake Tahoe Basin. This product would not be possible without the generous participation of several Basin regulatory and project implementing entities.

Prepared for:

Prepared by:

Recommended citation:
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Any questions regarding the Road RAM tool or associated protocols should be directed to the Database Administrator. Contact information is available on the website (www.tahoeroadram.com).

With great appreciation to our Project Advisory Committee

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Cara Moore	Tahoe Resource Conservation District
Eric Friedlander	City of South Lake Tahoe
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FOREWARD

This Tahoe Road RAM User Guidance provides Tahoe Basin natural resource managers with a method to assess the concentration of fine sediment particles on Tahoe Basin roads and to assist in meeting regulatory requirements. Since the first release of the Road RAM Technical Document and User Guidance in 2010, revisions have been made with respect to the Road RAM's relationship with the Lake Clarity Crediting Program and annual reporting requirements. These revisions specifically include the recommended minimum number of road segments by road class for the spatial extrapolation of road segments scores (Technical Document, Tables 8.3 and 8.4) and the recommended minimum number of observation periods by season for the temporal integration to water year scores (Technical Document, Table 8.6). For information on the revised recommendations, please refer to the updated Crediting Program Handbook available online (www.tahoeroadram.com/cap). All aspects related to the technical algorithms and scoring methods remain relevant and an interested user is directed to view the Road RAM Technical Document available online.

WELCOME

The *Road Rapid Assessment Methodology (Road RAM)* is a set of quick and simple field observations that, when coupled with its complimentary web-based data management tool, assists Tahoe Basin natural resource managers in determining *road condition* with respect to the downslope water quality risk. RAM field observations are based on scientific and engineering analysis, informed by rigorous visual monitoring and runoff sampling across Tahoe Basin roads. The RAM Score is directly correlated to the concentration of fine sediment particles (*FSP*, particles <16µm in diameter) generated from a 10,000 ft^2 road segment. The road segment is defined by the width of the impervious road surface and includes bike lanes, sidewalks, or asphalt ditches, if present and contiguous with the road surface. Results of the Road RAM help inform maintenance needs, track condition over time and convey progress towards meeting stormwater program goals.

The Tahoe Road RAM User Manual is broken into 8 chapters. Chapters 1-7 detail sections of the Tahoe Road RAM website, including setting up an account, delineating an area, classifying roads, selecting road segments, entering field observations, and generating results. These chapters include (1) a brief description of the purpose of the step, (2) the detailed how-to steps for completing the necessary tasks, and (3) troubleshooting tips for common issues. Chapter 8 includes additional resources, such as the Tahoe Road RAM Glossary and Field Datasheets.

Throughout this tool, a number of formatting tips have been used to more easily communicate tool functionality and best practices:

Italicized words are defined in the Tahoe Road RAM Glossary.

Bolded red text indicates important reminders for required actions to ensure proper tool function.

"Quoted text" indicates specific terms used in ArcGIS or Tahoe Road RAM**.**

Helpful Hints

General helpful hints in brown boxes provide quick tips to perform steps more efficiently.

Tahoe Tools

Tahoe Tool tips in blue boxes provide best practices for using Tahoe Road RAM in conjunction with the Lake Tahoe Crediting Program and the suite of associated stormwater tools (PLRM, CAP, Tahoe BMP RAM). These tips are not intended to be exhaustive. For a complete guide, consult the Crediting Program Handbook available online at www.tahoeroadram.com/cap.

Important Safety Tips

Important tips in red boxes provide suggestions to maintain field personnel safety while conducting Road RAM observations.

1 SET UP USER ACCOUNT

There is one user account per organization (e.g., jurisdiction, agency, etc.) and only the data associated with that account can be viewed by that account. Multiple personnel can use the account, but all will have to access using the same user name and password.

> **Tahoe Tools**
>
> Tahoe Road RAM is not the appropriate tool to create a new user for your Tahoe Tools account. Please go to the Credit Accounting Platform (CAP) (www.tahoeroadram.com/cap) or Tahoe BMP RAM (www.tahoebmpram.com) to create a new user account.

1.1 HOW-TO STEPS

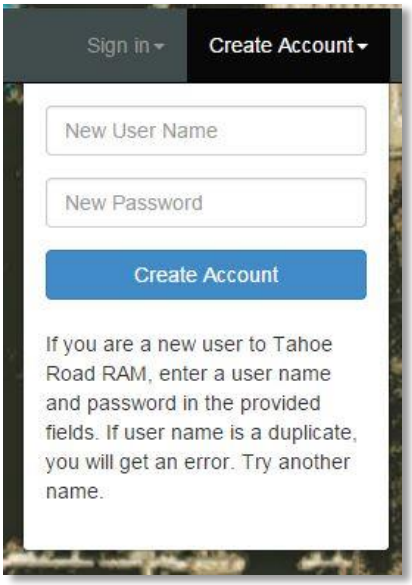
Step 1: Open website.

- Using Google Chrome, navigate to www.tahoeroadram.com.

> **Helpful Hints**
>
> Road RAM is only optimized for GOOGLE CHROME.

Step 2: Create account

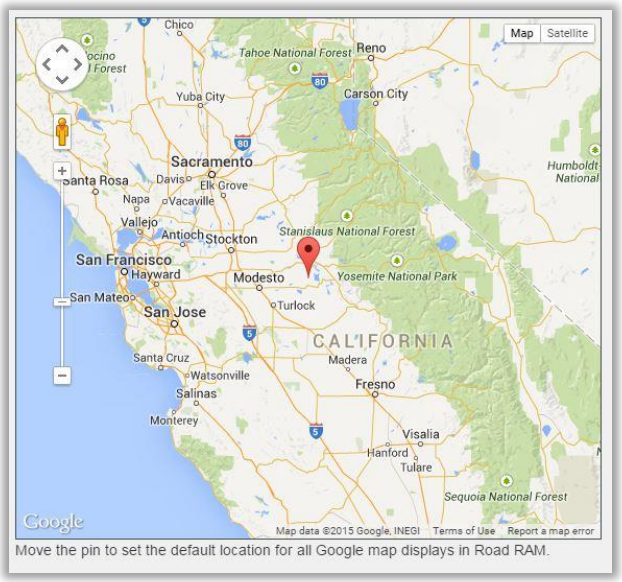
- On the welcome screen banner, click "Create Account".
- Enter a user name and password.
- Click the "Create Account" button.
- Your account has been created and you can now log on to the website.



Enter new user name & password and click Create Account to set up a new user account for Tahoe Road RAM.

Step 3: Adjust account settings.

- Set the default map center point by dropping the pin to the desired location. Once you set this location, you cannot modify it. Each time you log on, this will be the map display.
- At this time, the website will also create a default road segment for your user account with the ID: "Test". Use 'Test' to enter Road RAM observations and generate a score, without having to inventory a segment.



Map Settings window

1.2 TROUBLESHOOTING & FAQS

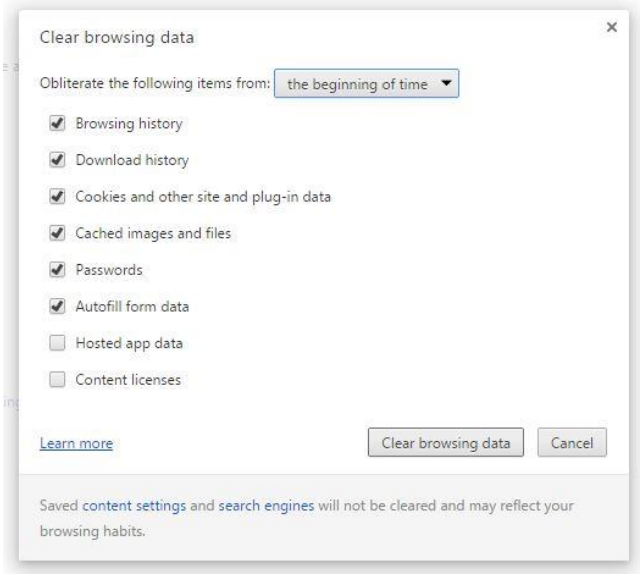
If you have forgotten your password or want to change it, please contact 2NDNATURE at 831-426-9119 or maggie@2ndnaturellc.com.

HOW DO I ADJUST THE MAP SETTINGS FROM MY DEFAULT?

The only opportunity to define your map settings is upon logging on to the website for the first time.

Helpful Hints

Regularly clear the browsing history in Google Chrome (More Tools -> Clear Browsing Data) to optimize website functionality. Check boxes to obliterate cookies & other site and plug-in data and cached images and files).



Regularly clear Google Chrome browsing history to optimize website functionality.

2 DELINEATE AREA

An area of interest can be used to group user inputs or view Road RAM results. Typical types of areas relevant to Tahoe Road RAM are: urban catchments, jurisdictional boundaries, or specific road networks. In order to spatially extrapolate road segment observations to determine road class condition for specific observation periods, an area of interest must be defined. Grouping jurisdictional areas or neighborhoods that better delineate how road crews conduct maintenance may also be useful for field maps or summarizing results.

Helpful Hints

An *area of interest* does not need to be defined in order to use Tahoe Road RAM. The user can inventory discrete *road segments* and track *road condition* at those specific locations over time without delineating an area of interest. However, without an area of interest, the tool will not spatially integrate *road segment scores* to generate *Road RAM scores* for defined road networks.

2.1 HOW-TO STEPS

The user creates a polygon shapefile in ArcGIS, exports the shapefile as a KMZ, and uploads this file into Tahoe Road RAM. The user can also modify an existing area of interest using similar steps.

Step 1: In ArcGIS 9.3 or higher, create a polygon shapefile that defines your area of interest.

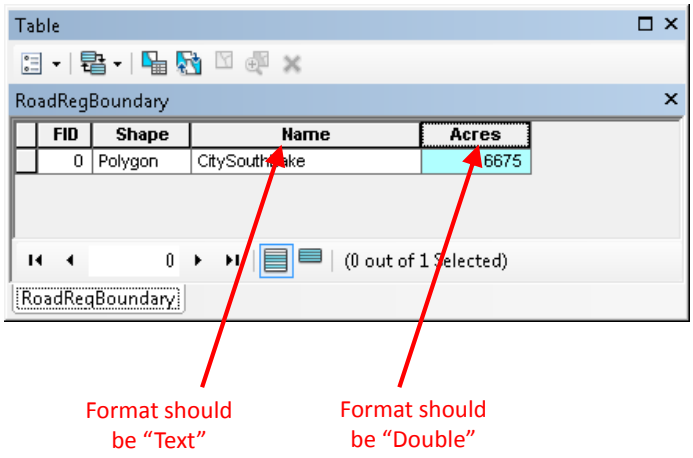
- Make sure your polygon has a projected coordinate system. NAD 1983 UTM Zone 10 is recommended.

Tahoe Tools

Clip your jurisdictional boundary by the Tahoe Basin boundary to create a jurisdictional area of interest. By using the largest extent possible, you will only need to do this step one time.

Step 2: Add two fields to the attribute table: "Name" and "Acres".

- The formatting for the added fields should match the table shown below.
- Populate "Name" with the name of your area.
- Use "Calculate Geometry" to calculate the area of the polygon in acres.



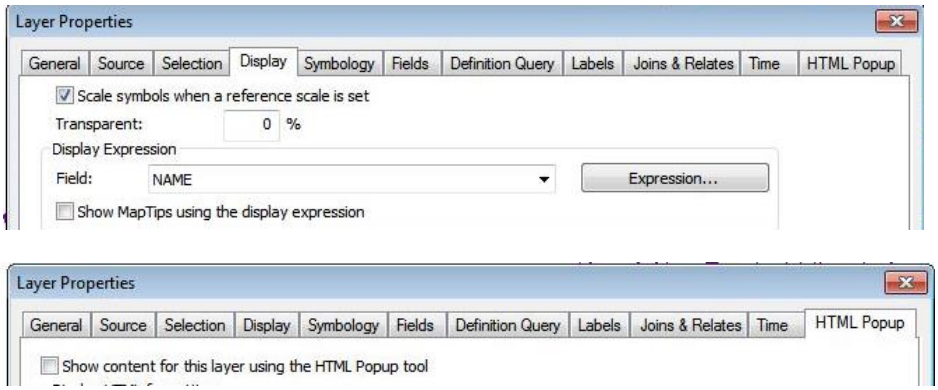
Attribute table for area of interest polygon

Step 3: Convert GIS layer to KMZ.

- Turn on the layer in the table of contents so the polygon is displayed.
- Set map scale to layer extent. Right-click the layer in the table of contents and choose "Zoom to Layer".
- Verify shapefile properties are compatible with Tahoe Road RAM. Right-click the layer in the table of contents and choose "Properties". **In the "Display" tab, ensure the "Display Expression" field = "Name". In the "HTML Popup" tab, ensure the "Show content for this layer using the HTML Popup tool" is unchecked.**

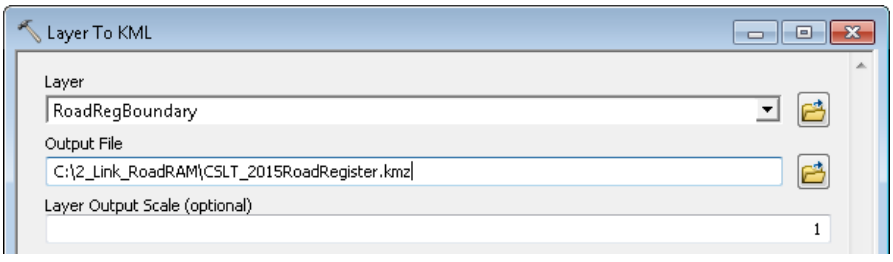
Helpful Hints

The area of interest polygon will appear exactly how it appears in ArcGIS. We recommend a 2pt border in any color (avoiding shades of blue) and either no fill or the display transparency set to at least 50%.



Display and HTML Popup Properties

- Open the "Layer to KML (Conversion)" tool and enter the following parameters:
  - "Layer" is the polygon of the area of interest.
  - "Output File" is the location and file name for the KML file to be created. Be sure to place in a location that makes sense with your data management system.
  - "Layer Output Scale" is the current map scale. When entering the map scale, leave out preceding "1:". **This step is not optional. This field cannot be the default zero value.**
  - Click OK.
- You can check to see if the KMZ file was created correctly by opening the file in Google Earth.

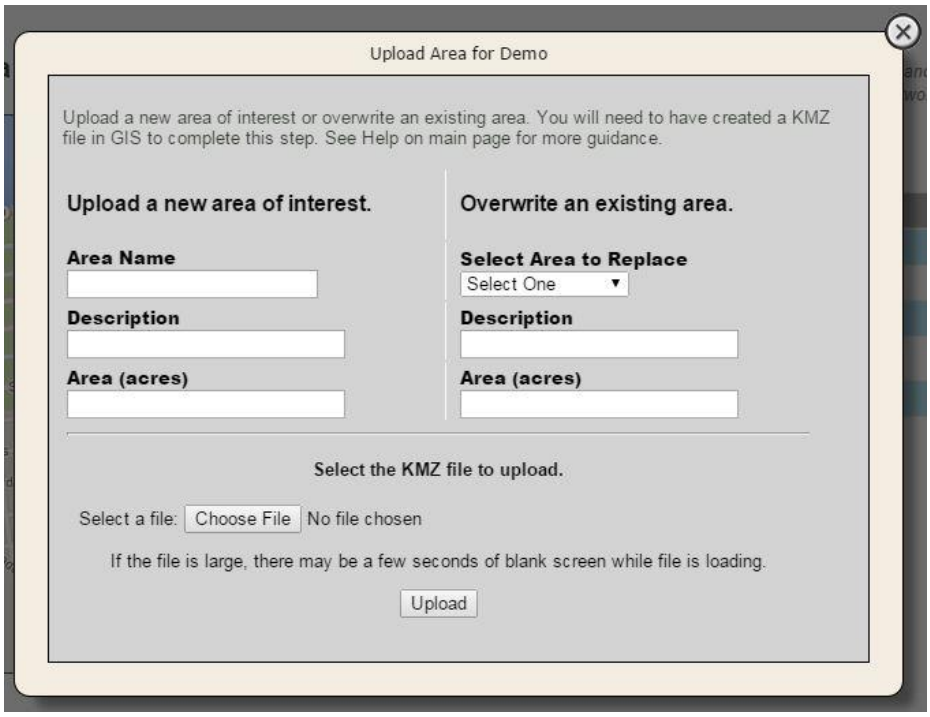


Layer to KML Conversion tool in ArcGIS

Step 4**:** Upload KMZ to Tahoe Road RAM.

> **Tahoe Tools**
>
> To simplify data management, we recommend you name the Tahoe Road RAM area of interest the same as the Road Operations Catchment in CAP.

- Navigate to "Delineate".
- Click "Upload Area" and complete the necessary fields in the form.
- To upload a new area of interest, complete the information on the left side of the window.
    - "Area Name" is a unique name.
    - "Description" can be any text to easily communicate more information about the area and how or when it was defined.
    - "Area" is the acreage calculated in GIS for the polygon.



Using the same window, the user can upload a new area (left side) or replace an existing area (right side).

- To overwrite or modify an existing area of interest, complete the information on the right side of the window.
    - Select the existing area to replace from dropdown.
    - "Description" and "Area" are the same as above.
- Click "Choose File" and locate the KMZ file you created.
- Click "Upload" to begin the transfer process.
- Close the window. The area polygon will appear on the map and in the table.

2.2 TROUBLESHOOTING & FAQS

HOW DO I DELETE AN AREA OF INTEREST?

Locate the area of interest in the table on the right. Click "Delete Area" in the table. If "Has Roads" is noted in the table, the area cannot be deleted until the roads associated with the area have been deleted. Refer to Chapter 3: Classify Roads for details on how to delete roads.

HOW DO I EDIT AN AREA OF INTEREST?

The desire to change an area boundary is likely for one of 3 reasons:

A. there is a correction to the initial delineation;

B. the boundaries of the area have changed over time; or

C. the roads within the area have changed significantly.

- For reason A, overwrite the existing area. Click "Upload Area" and in the popup window, use the right-hand side to "Overwrite an existing area". Complete the steps as described above in Chapter 2: Step 4.
- For reasons B or C, leave the existing area and create a new area with a new name. This allows the area and information to be managed without compromising the data and area summaries that have been conducted in the past. Click "Upload Area" and in the popup window, use the right-hand side to "Upload a new area of interest". Complete the steps as described above in Chapter 2: Step 4.

Helpful Hints

Make sure you are uploading a KMZ file. A KMZ is a compressed Keyhole Markup Language (KML) file. Tahoe Road RAM only accepts properly formatted KMZ files as defined by Chapter 2: Step 3.

Common issues are:

- Uncheck the "Show content for this layer using the HTML Popup tool" box under Layer Properties;
- Ensure the layer is visible when the export to KMZ is completed; and
- Define the "Layer Output Scale" as a value greater than 0.

3 CLASSIFY ROADS

A user can define up to 9 unique road classes to define road maintenance practices across maintained road networks. *Road class* is defined as the combination of pollutant control practices employed on a particular road throughout the year, including the relative planned *abrasive application priority* during winter road conditions and relative planned *sweeping priority* when the weather is favorable for pollutant recovery. Road class is used to spatially extrapolate road segment scores observed on roads maintained using the same practices to determine Road RAM scores for complete road networks.

Helpful Hints

(1) We recommend creating the minimum number of road classes. Define enough to capture the relative differences across road maintenance practices without creating a data management burden.

(2) *Road class* does not need to be defined in order to use Tahoe Road RAM. The user can inventory discrete *road segments* and track *road condition* at those specific locations over time without classifying roads. In this case, *road segment scores* will be generated but *Road RAM scores* will not.

3.1 HOW-TO STEPS

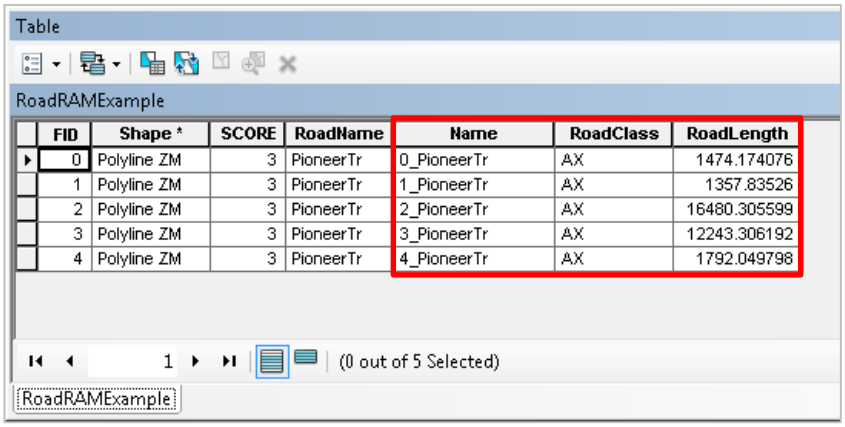
The user creates a polyline shapefile of the roads in ArcGIS, exports the attribute table as a CSV, exports the shapefile as a KMZ, and uploads these files into Tahoe Road RAM. The user can also modify an existing road class using similar steps.

Tahoe Tools

Use the Road Condition shapefiles provided with PLRM v2. Clip to the jurisdiction boundary in the preceding step.

Step 1: Define road class for all roads in your area of interest.

- In ArcGIS 9.3 or higher, create a polyline shapefile of the roads within your area of interest. Make sure your shapefile has a projected coordinate system. NAD 1983 UTM Zone 10 is recommended.
- Add three fields to the attribute table: "Name", "RoadClass" and "RoadLength".



FID	Shape *	SCORE	RoadName	Name	RoadClass	RoadLength
0	Polyline ZM	3	PioneerTr	0_PioneerTr	AX	1474.174076
1	Polyline ZM	3	PioneerTr	1_PioneerTr	AX	1357.83526
2	Polyline ZM	3	PioneerTr	2_PioneerTr	AX	16480.305599
3	Polyline ZM	3	PioneerTr	3_PioneerTr	AX	12243.306192
4	Polyline ZM	3	PioneerTr	4_PioneerTr	AX	1792.049798

Attribute table for roads.
The attributes highlighted in the red box are required.

- "Name" is a text field. **It must be formatted as "#_letters". The numbering must be unique, sequential, and start at 0. There can be no extra spaces between the # and the "_".**
- "Road Class" is a text field. **Values must be one of nine designations: AX, AY, AZ, BX, BY, BZ, CX, CY, CZ.** See Troubleshooting & FAQs for considerations when defining road class.
- "Road Length" is a numbered field. Use "Calculate Geometry" to calculate the length in feet.

Helpful Hints

Use the "Field Calculator" in ArcGIS to ensure fields are properly formatted.

Step 2: Export the GIS attribute table to CSV.

- Ensure "Name", "RoadClass", and "RoadLength" fields conform to the format shown above.
- Export the attribute table. Navigate to the appropriate folder and save as a text file (*.txt).
- Open the text file in Microsoft Excel and "Save As" a CSV.
- Ensure the CSV is formatted exactly as shown below.
  - A CSV template named "RRAM_template_classify.csv" is provided under "Downloads" section of Tahoe Road RAM.
  - Extra data columns not shown below must be deleted.
  - Values in the first 5 columns can be blank.

	A	B	C	D	E	F	G	H
1	FID_	RoadAA	RoadSE	RoadRSI	RoadRisk	RoadClass	Name	RoadLength
2						AX	0_PioneerTr	1474
3						AX	1_PioneerTr	1357
4						AX	2_PioneerTr	16480
5						AX	3_PioneerTr	12243
6						AX	4_PioneerTr	1792

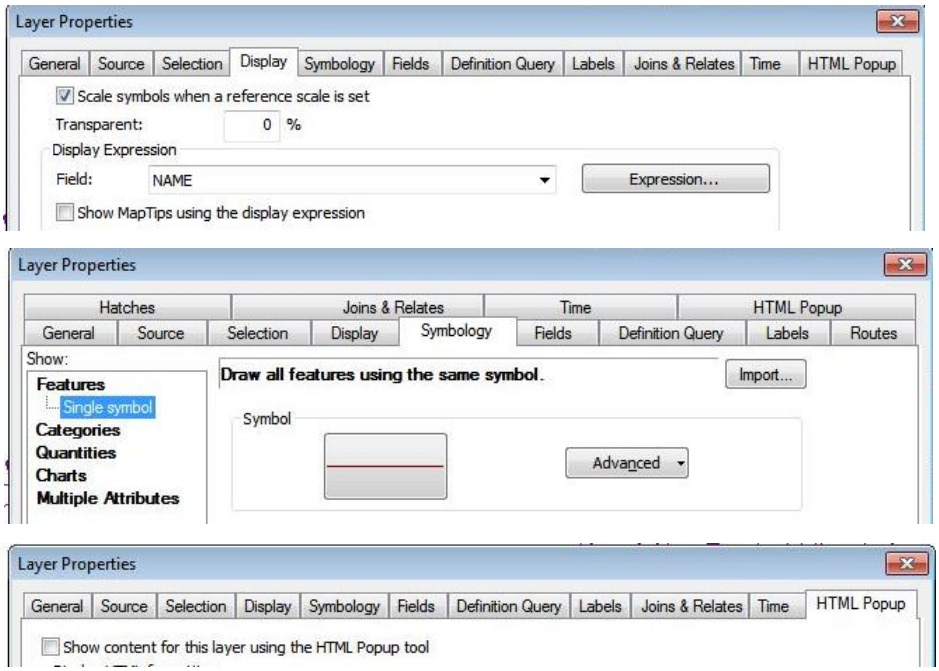
Properly formatted road class CSV

Step 3: Convert GIS layer to KMZ.

- Turn on the layer in the table of contents so the roads are displayed.
- Set map scale to layer extent. Right-click the layer in the table of contents and choose "Zoom to Layer".
- Verify shapefile properties are compatible with Tahoe Road RAM. Right-click the layer in the table of contents and choose "Properties". **In the "Display" tab, ensure the "Display Expression" field = "Name". In the "HTML Popup" tab, ensure the "Show content for this layer using the HTML Popup tool" is unchecked. In the "Symbology" tab, ensure features are displayed as a "Single Symbol".**
- Open the "Layer to KML (Conversion)" tool and enter the following parameters:
  - "Layer" is the roads shapefile.
  - "Output File" is the location and file name for the KML file to be created. Be sure to place in a location that makes sense with your data management system.
  - "Layer Output Scale" is the current map scale. When entering the map scale, leave out preceding "1:". **This step is not optional. This field cannot be the default zero value.**

- Click OK.

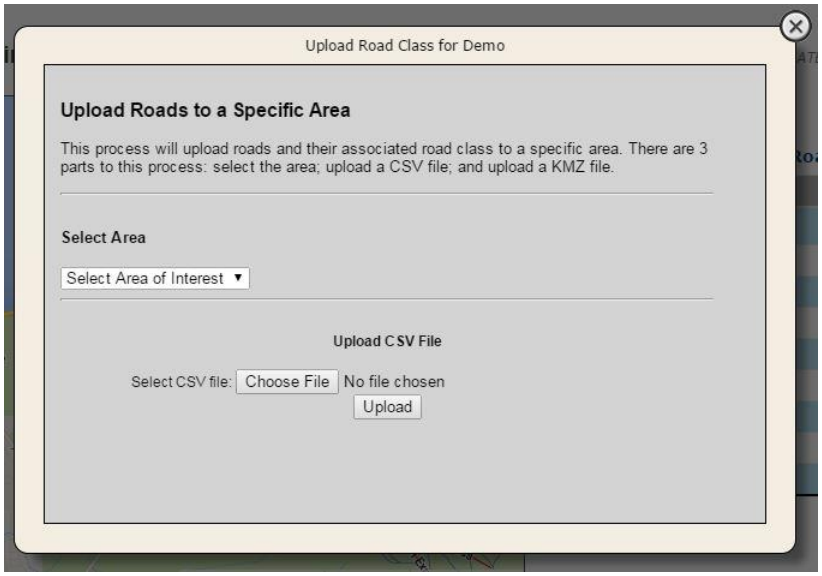
- You can check to see if the KMZ file was created correctly by opening the file in Google Earth.



Display, Symbology and HTML Popup Properties

Step 4: Upload CSV and KMZ to Tahoe Road RAM.

- Navigate to "Classify Roads".
- Click "Upload" and complete the information requested.
    - For the "Select Area" dropdown, select the area of interest used to create the road layer.
    - Click "Choose File" and located the CSV file designating road class.
    - Click "Upload" to begin the transfer process.
    - When the CSV upload is complete, click "Choose File" and locate the KMZ file of the roads.
    - Click "Upload" to begin the transfer process.



Upload Roads window in Tahoe Road RAM

- Close the window. The roads will appear on the map and in the table.

3.2 TROUBLESHOOTING & FAQS

WHAT IS ROAD CLASS?

Road class is defined in Tahoe Road RAM as a network of roads that are maintained using similar road maintenance practices, such that there is reasonable confidence that Road RAM observations conducted at specific segments are representative of all road lengths of the same class. This confidence confirms that spatial extrapolation of Road RAM observations can be reasonably used (+/- 0.5 RAM score) across the entire network of the subject class. There are a series of factors to consider when assigning road class:

Abrasive applications**:** The timing of abrasives applied to a road network is dictated primarily by the weather, with protecting driver safety a priority during freezing and storm conditions. The relative frequency and amount applied varies across jurisdictions based on traffic density, locations of schools, intersections, shading, etc. Road class designations should consider these relative jurisdictional priorities of the frequency and amount of abrasives applied. Roads of the same class are generally subjected to the same amount and frequency of abrasive applications during winter road maintenance.

Other sources of sediment: Similar to abrasives, other source of sediment to the road can be also be pulverized and contribute to the FSP mass on the roadway. These sources may include tracking from cars via other adjacent erodible surfaces, construction, or potentially road surface degradation and tire wear. Additional sources of sediment may also include sidewalks that are adjacent to the roads as well as asphalt or concrete ditches. The seasonal contributions of these sources to the overall road FSP load will likely vary, with perhaps the greatest sources coming from car transport and tracking via roads with relative high FSP concentrations.

Sweeping practices: Each jurisdiction has different equipment and available resources that drive their feasible sweeping program. In general, high traffic roadways, locations of relatively higher abrasive applications and the potential contributions of other sediment sources onto the roadways dictate the relative frequency at which specific roads are swept and perhaps the equipment used. Practices that minimize the amount of time abrasives and other sediment remain in the road (i.e., residence time) will generally lead to the relatively lower mass of FSP generation and accumulation on the road surface. In order to implement the desired sweeper program effectively and ensure the best possible performance per unit effort, the sweepers must be maintained at an acceptable level and operated properly, pavement condition must be good and the road surface must be accessible to the sweeper. Road class designations must consider the relative jurisdictional frequency the roadway is swept and group road networks where similar sweeping equipment, timing and frequency is implemented.

Pavement condition index (PCI): The pavement condition, or surface integrity, is a critical factor that directly influences road condition. There is little question that high PCI scores can greatly improve the effectiveness of sweeping efforts. Roads with moderate to high degree of cracking limit the ability of sweepers to recover material from the road surface. However, subsequent rain events will mine these cracks of available FSP, transporting the material downslope, and Road RAM will identify these as poor condition roads. Roads with poor PCI will consistently have lower RAM scores than a road maintained using the same practices with a high PCI. Road class mapping should consider consistent pavement conditions, as variability within the class will lead to reduced confidence and ability to extrapolate road segment observations to the complete road class network.

Sweeper accessibility: Parked cars, speed bumps, snow berms, and other barriers can prevent the sweeper from accessing the entire impervious road surface, thereby reducing sweeper performance per level of effort. Opportunities exist to modify the sweeping program to improve access, but relative accessibility should be considered when defining roads that belong to similar road class.

HOW DO I APPLY ROAD CLASS CONCEPTS TO MY ROAD NETWORKS?

The goal is to categorically define both the sources and the sinks of FSP the roads within your area of interest. Road class may change over time as jurisdictions institute new practices, buy new equipment, construct new roads, etc. The tool allows users to redefine road class without losing previously entered data by associating the road class definition with the specific date the file was uploaded (see discussion below on editing an existing road class layer).

Below we consider the sources and the sinks of FSP to the roads separately. On a practical layer, the process of creating the road class layer can be done one of two ways: (1) creating 2 separate layers (sources and sinks) and then intersect them to create the road class layer or (2) create one class layer and assign abrasive application priority and sweeping effectiveness within that layer. Either approach is acceptable and will generate a valid road class layer. Creating two separately layers allows you to be more detailed in the spatial distribution of sources vs sinks, while creating one layer is easier from a data management standpoint.

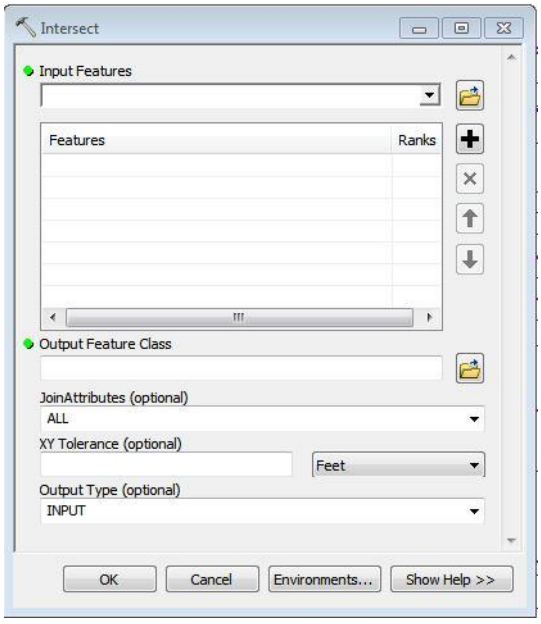
Sources include abrasive applications plus other sources, and are designated as intensive, moderate, or rarely to never as a relative scale as treated by the respective jurisdiction.

- Define up to 3 categories for the roads in your area: High (A); Moderate (B); and Low (C). Considerations when defining the categories include, but are not limited to: type of abrasives applied; ratio of abrasives to salt applied; equipment used to apply abrasives; frequency of application (every storm, most storms, never); likelihood of abrasives being tracked to location from nearby roads; likelihood of tracking to sidewalks adjacent to roads, where recovery is more challenging; likelihood of tracking from unpaved private driveways; other adjacent erodible sources and/or construction; and potential road surface degradation and tire wear.
- Assign each road length a relative source value. Using the definitions above, create a "RoadAA" field in the attribute table and assign each road length a value of "A", "B" or "C". You may need to split and merge features as necessary to ensure the shapefile matches the spatial distribution of the abrasive application practices or other sources.

Sinks include sweeping practices, pavement condition index, and sweeper accessibility, and are designated as intensive, moderate, or rarely to never as a relative scale as practiced by the respective jurisdiction.

- Define up to 3 categories of sinks for the roads: High (X); Moderate (Y); and Low (Z). Considerations when defining the categories include, but are not limited to: type of equipment (sweeper, blower, plow) used; speed at which equipment is operated; frequency at which equipment is used; number of passes equipment makes along road; road surface integrity; and existence of parked cars, snow berms, speedbumps, etc. that will inhibit sweepers access to the full width of the impervious road surface.
- Assign each road length a sink value. Using the definitions above, create a "RoadSE" field in the attribute table and assign each road length a value of "X", "Y" or "Z". You may need to split and merge features as necessary to ensure the shapefile matches the spatial distribution of the sweeping practices, pavement index, and/or barrier presence.

If you have created two separate layers to define the sources and sinks, use the ArcGIS "Intersect" tool to create a new road layer for road class. The "Input Features" are the 2 layers to be intersected. The "Output Feature Class" is the name and location of the new road class layer. All other fields should be completed as shown.



Intersect the source and sink layers to create one road class layer

HOW DO I DELETE A ROAD CLASS?

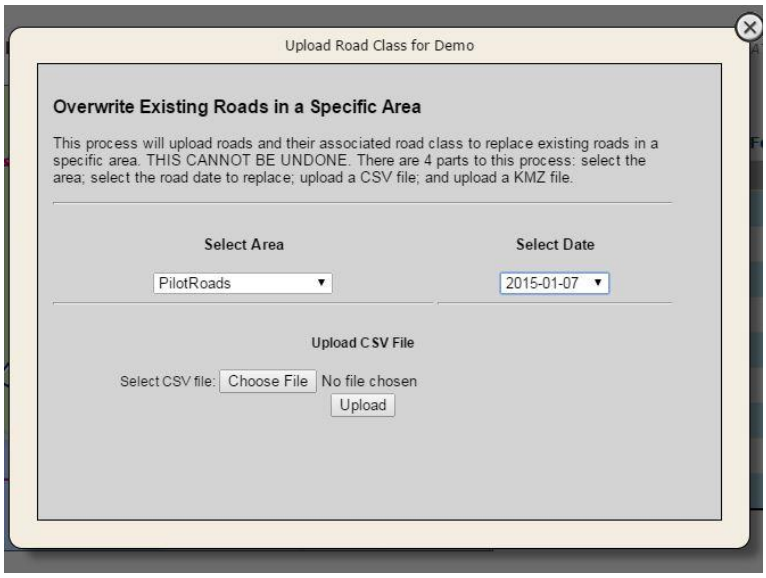
Identify the desired road class in the table to the right. Click "Delete Roads" in the table. If "Has Segments" is noted, the roads cannot be deleted. See the Chapter 3: Classify Roads for details on how to delete roads. Instead you can edit an existing road class layer using "Overwrite". See below for more information.

HOW DO I EDIT AN EXISTING ROAD CLASS?

The desire to change the road class file is likely for one of 3 reasons:

A. there was a mistake in the initial categorization of road class;
B. road maintenance practices in the area have changed significantly and the definitions need to change; or
C. the roads within the area have changed significantly due to construction projects.

- If for reason A, then you should "Overwrite" the existing roads in an area to edit any mistakes or changes.
    - Click "Overwrite" and follow the 4-step directions.
    - Select the appropriate area of interest from the dropdown list.
    - Select the date associated with the file you want to replace from the dropdown list.
    - Follow the remaining steps described in Chapter 3: Step 4.



Upload Roads window in Tahoe Road RAM

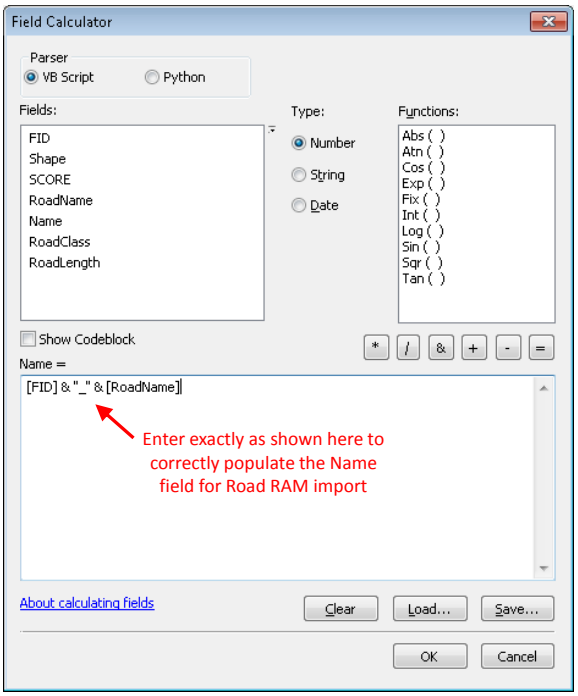
- If for reasons B or C, you should upload new roads to the same area. That way you can add new data to the updated roads without compromising the data you've already collected.
    - Click "Upload" and follow the steps described in Chapter 3: Step 4.

HOW CAN I USE THE ARCGIS FIELD CALCULATOR TO STANDARDIZE THE ATTRIBUTE FIELDS?

- Right-click the field name in the attribute table and select "Field Calculator..." from the drop down list.
- For "Name", type the following equation in the lower frame: [FID]&"_"&[RoadName]. Click OK. The resulting calculation should create unique, sequential field names starting at 0.

> **Helpful Hints**
>
> If "RoadAA" and "RoadSE" fields were created when defining road class, type [RoadAA] + [RoadSE] in the lower frame to quickly calculate "RoadCass" for all records.

- For "RoadClass", type "AX", "AY", "AZ", "BX", "BY", "BZ", "CX", "CY", or "CZ" in the lower frame. **The " " are required**. For faster calculation, select all roads of the same road class prior to performing this step.



Use ArcGIS Field Calculator to standardize Name field

> **Helpful Hints**
>
> (1) Make sure you are uploading a CSV and a KMZ file. A CSV is a Comma Separated Values file, which stores tabular data in a plain text file by separating data fields using a comma. A KMZ is a compressed Keyhole Markup Language (KML) file. Tahoe Road RAM only accepts properly formatted CSV and KMZ files.
>
> (2) The CSV file must be formatted just like the template provided under Downloads. This includes the column header names, the format of the data fields (letters vs. numbers, length of data), and the format of the road names (#_letters).
>
> (3) Follow the KMZ conversion directions explicitly (Step 3). Common issues are:
>
> - Uncheck the "Show content for this layer using the HTML Popup tool" box under Layer Properties;
> - Ensure the "Name" field is selected as the "Display Expression Field" under Layer Properties;
> - Ensure the features are displayed as a "Single Symbol";
> - Ensure the layer is visible when the export to KMZ is completed; and
> - Define the "Layer Output Scale" as a value greater than 0.

HOW DO I CHANGE THE ROAD CLASS DISPLAY IN TAHOE ROAD RAM?

The roads are displayed based on the road class symbology defined in Road RAM v1 to provide a standardized presentation of road class. The colors by class cannot be changed.

WHAT IS THE AX, AY,.....CY, CZ NOMENCLATURE?

These are the simple road class category names. The A, B, C refer to the sources and X, Y, Z refer to the sinks. Each road class is the defined as the respective combination these 2 practices.

Sinks	**Sources**		
	High (A)	**Moderate (B)**	**Low (C)**
High (X)	AX	BX	CX
Moderate (Y)	AY	BY	CY
Low (Z)	AZ	BZ	CZ

WHY IS THERE A DATE WITH MY ROAD CLASS?

Road class definitions may change over time as jurisdictions institute new practices, buy new equipment, construct new roads, etc. The tool allows users to redefine road class without losing previously entered data by associating the road class definition with the specific date the file was uploaded. All field observations are associated with the road class file most recently uploaded (without being uploaded later than the field observation), and the spatial extrapolation is performed with that road class file.

DOES ROAD RAM STORE OTHER ROAD ATTRIBUTES?

Road RAM can store abrasive application priority, sweeping effectiveness, road surface integrity and PLRM road risk data if values are uploaded in the CSV file. However, these attributes cannot be displayed within Road RAM. Because only road class is used in the spatial extrapolation process, these other road attributes are not used or displayed in Road RAM. If you wish to explore and quantify these other road attributes further you can do so in GIS, summarizing the total miles and percent distribution by attribute category. You can also export Road RAM results to a CSV file and join this data to GIS attributes to analyze the data further.

4 SELECT SEGMENTS

A *road segment* is a 10,000 ft^2 road unit, the standardized road area selected and evaluated by the Road RAM user. This size is assumed to be large enough to be representative of a road, while small enough that the road condition can be assessed rapidly in less than 10 minutes per site. Road segment field observations are constrained to the impervious extent of the road surface and the adjacent bike lanes, sidewalks, or asphalt/concrete ditches. The user can inventory discrete road segments and track *road condition* at those specific locations over time without assigning a road class to the segment. In this case, *road segment scores* will be generated but *Road RAM scores* will not.

Helpful Hints

Users must create road segments in order to use Tahoe Road RAM. Field observations must be tied to a specific location to calculate scores. Upon creating an account, a default "Test" road segment is automatically created for the user to allow testing of field observation data entry and score generation.

4.1 HOW-TO STEPS

The user creates a point shapefile in ArcGIS, exports the attribute table as a CSV, exports the shapefile as a KMZ, and uploads the files into Tahoe Road RAM.

Step 1: Select road segment locations.

- In ArcGIS 9.3 or higher, create a point shapefile. Make sure your shapefile has a projected coordinate system. NAD 1983 UTM Zone 10 is recommended.
- Add two fields to the attribute table: "ID" and "Name".
    - "ID" is a text field.
    - "Name" is a text field. **It cannot start with a number and must be unique. Creating a segment with the same name as an existing segment will replace the all data associated with the original segment. See more information in Troubleshooting & FAQs about overwriting segments versus creating new segments.**

Tahoe Tools

Specific numbers of road segments per road class are required for the Crediting Program. See the Handbook Guidance for more information.

Helpful Hints

Road segment selection should consider field personnel safety as well as monitoring purpose & objectives. More information available in Troubleshooting & FAQs.

Important Safety Tips

First and foremost, select sites where field personnel safety is not an issue. Locate sites where crosswalks are available and lines of sight provide at least 300ft of visibility for oncoming traffic in both directions.

Step 2: Export the GIS attribute table to CSV.

- Ensure "ID" and "Name" conform to the format shown above.
- Export the attribute table. Navigate to the appropriate folder and save as a text file (*.txt).
- Open the text file in Microsoft Excel and "Save As" a CSV.
- Ensure the CSV is formatted exactly as shown below.
    - A CSV template named "RRAM_template_segment.csv" is provided under "Downloads" section of Tahoe Road RAM.
    - Extra data columns not shown below must be deleted.
    - Values in the "RSRisk", "RSAA", "RSSE" and "RSI" can be blank.

CAP_RO1segmentsJ

FID	Shape *	ID	Name	RoadAA	RoadSE	RoadClass
0	Point	0	RS_0	A	X	AX
1	Point	1	RS_1	A	X	AX
2	Point	2	RS_2	A	X	AX
3	Point	3	RS_3	A	X	AX
4	Point	4	RS_4	B	Y	BY
5	Point	5	RS_5	B	Y	BY
6	Point	6	RS_6	B	Y	BY

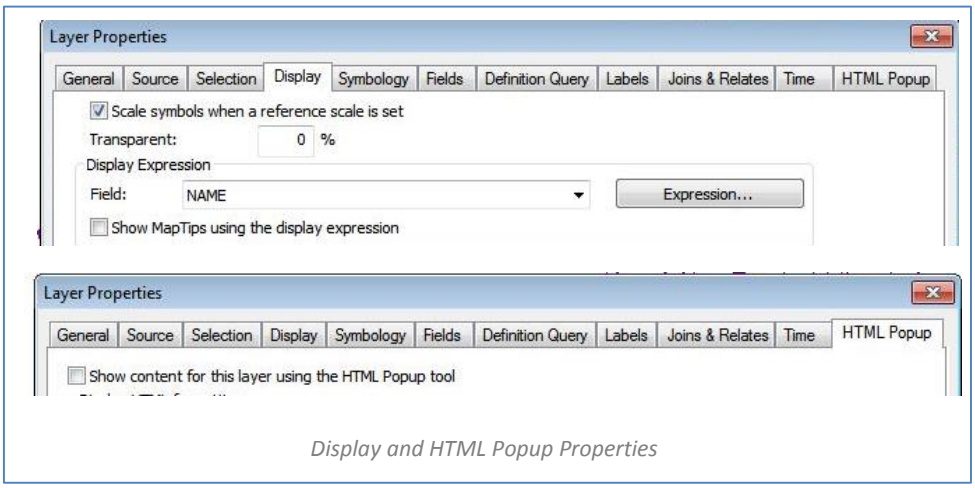
Attribute table for road segments. The attributes highlighted in the red box are required.

	A	B	C	D	E	F	G	H
1	FID_	ID	Name	RSRisk	RSAA	RSSE	RSClass	RSI
2		0	Caltrans_0	PLR	A	X	AX	3
3		1	Caltrans_1	PLR	A	X	AX	3
4		2	Caltrans_2	PMR	A	X	AX	3
5		3	Caltrans_3	PMR	A	X	AX	3
6		4	Caltrans_4	PMR	A	X	AX	3

Properly formatted road segment CSV

Step 3: Convert GIS layer to KMZ.

- Turn on the layer in the table of contents so the segments are displayed.
- Set map scale to layer extent. Right-click the layer in the table of contents and choose "Zoom to Layer".
- Verify shapefile properties are compatible with Tahoe Road RAM. Right-click the layer in the table of contents and choose "Properties". **In the "Display" tab, ensure the "Display Expression" field = "Name". In the "HTML Popup" tab, ensure the "Show content for this layer using the HTML Popup tool" is unchecked.**
- Open the "Layer to KML (Conversion)" tool and enter the following parameters:
    - "Layer" is the segments shapefile.
    - "Output File" is the location and file name for the KML file to be created. Be sure to place in a location that makes sense with your data management system.
    - "Layer Output Scale" is the current map scale. When entering the map scale, leave out preceding "1:". **This step is not optional. This field cannot be the default zero value.**
    - Click OK.
- You can check to see if the KMZ file was created correctly by opening the file in Google Earth.



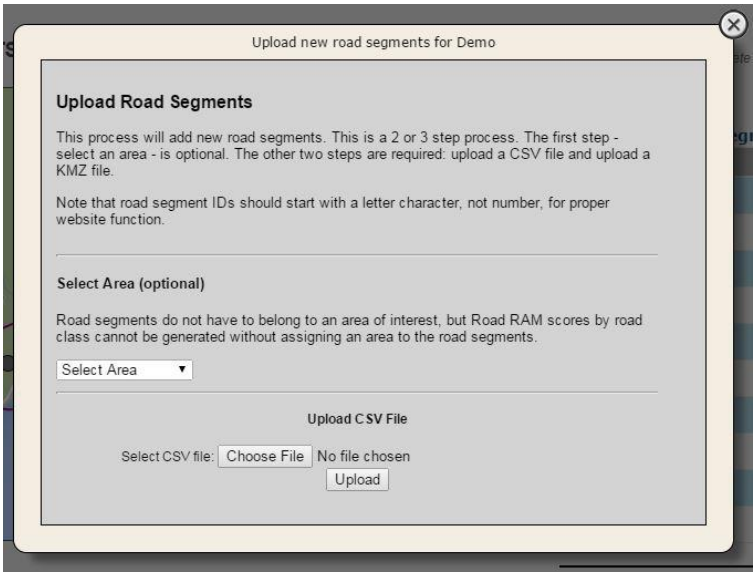
Display and HTML Popup Properties

Step 4: Upload CSV and KMZ to Tahoe Road RAM.

- Navigate to "Select Segments".
- Click "Upload" and complete the information requested.
  - The "Select Area" step is optional. To an area, select the area of interest from the dropdown.
  - Click "Choose File" and located the CSV file designating road class.
  - Click "Upload" to begin the transfer process.
  - When the CSV upload is complete, click "Choose File" and locate the KMZ file of the roads.
  - Click "Upload" to begin the transfer process.
- Close the window. The roads will appear on the map and in the table.

Tahoe Tools

To spatially extrapolate scores to your registered road operations, you must select an area from the dropdown list.



Upload Segments window in Tahoe Road RAM

4.2 TROUBLESHOOTING & FAQS

HOW DO I SELECT A ROAD SEGMENT?

The two most important considerations when selecting road segments are:

- Field personnel safety: Select sites where field personnel safety is not an issue. Tahoe Road RAM observations require personnel to be outside the car, taking measurements across the 10,000 ft^2 segment. Road segments should be located near crosswalks, and never located where visibility in either direction is limited to less than 300ft (hills, curves, etc.).
- Purpose for conducting Road RAM: Align the segment locations and number to support your data objectives and purpose of the analysis. Road segments can be selected based on a range of criteria: road class, other road attributes such as road surface integrity, road shoulder condition, etc. To appropriately test the relationship between these criteria and observed road condition, road segments must be selected that will allow analyses to isolate the influence of other factors.

The road segment screening process can be initiated in the office using Google Maps, Google Street View and GIS, and then confirmed in the field. We recommend the following process:

- Define the purpose of using Road RAM to inform your strategy for the types of road segments desired.
- Use GIS to screen sites for specific road attributes based on purpose/strategy for using Road RAM: road class, road surface integrity, road shoulder condition, etc. Locate general areas where segments should be located.
- Use Google Street View to perform secondary screening of each site. Field personnel safety is critical and all sites should be evaluated for:
    - Access to crosswalks or stop signs whenever possible to allow safe location for field personnel to cross road.
    - Distance from curves to ensure visibility of personnel to drivers. Never select a site on a curve. At least 300ft of visibility from oncoming traffic should be available from both directions.
- Visit location in the field to confirm its appropriateness for RAM observations. Consider safe vehicle parking access for field personnel completely off of the road right of way.
- Once site location is confirmed in the field; assign each road segment a unique ID.

HOW MANY ROAD SEGMENTS SHOULD I CREATE?

That depends on why you are using Road RAM. The Crediting Program defines a minimum number of road segments required per road area, which can be found at www.tahoeroadram.com/cap. Otherwise, we recommend that you consider the purpose of the data collection and align your road segment number and distribution with the data you need for your analysis.

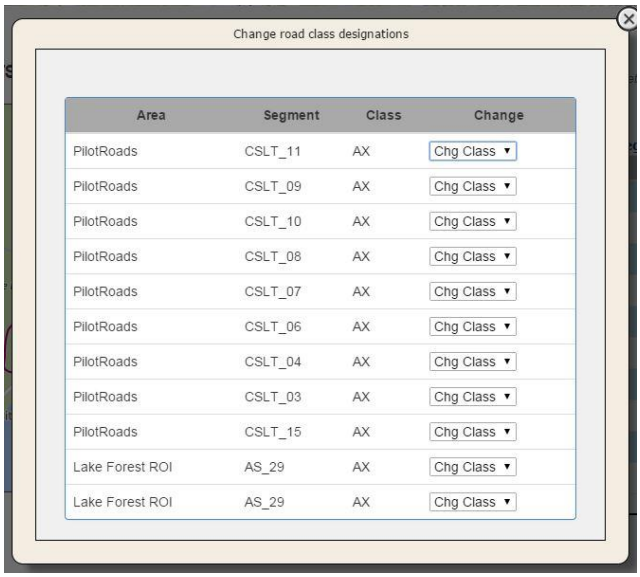
HOW DO I SEE THE ROAD SEGMENT IDS ON THE MAP?

For clarity, the labels are only displayed when the map is zoomed in to a certain extent. Click "Enlarge Map" below the Google map to open an enlarged map in a new window where labels are visible.

HOW DO I EDIT MY ROAD SEGMENTS?

In general, unlike "Delineate Area" and "Classify Roads", you cannot overwrite existing road segments and you cannot change the name of your road segment.

- If you want to change the location (x, y coordinate) of a road segment, you will need to upload a new road segment with a new name. Follow the instructions above to upload new road segments.
- If you need to change the road class associated with a road segment, go to its current road class in the table and select "Edit". Locate the segment in the table and select the new road class from the dropdown list. **NOTE: If you are updating the road class due to an updated road class layer, DO NOT CHANGE THE CLASS HERE. Instead you will need to upload a new road segment with the new class. Changing the class here will recalculate and update all Road RAM scores previously entered based on the new class designation.**
- If you have updated the road class layer and need to update the road class for an existing segment, you will need to assign a new **Name** to the road segment and update the road class in the GIS attribute table. This will maintain the integrity of the Road RAM database and prevent recalculations of previous road class and area scores. Follow the instructions above to upload new road segments.



Use the dropdown menu to change the road class assigned to a segment.

Helpful Hints

(1) Make sure you are uploading a CSV and a KMZ file. A CSV is a Comma Separated Values file, which stores tabular data in a plain text file by separating data fields using a comma. A KMZ is a compressed Keyhole Markup Language (KML) file. Tahoe Road RAM only accepts properly formatted CSV and KMZ files.

(2) The CSV file must be formatted just like the template provided under Downloads. This includes the column header names, the format of the data fields (letters vs. numbers, length of data), and the format of the names (cannot start with #).

(3) Follow the KMZ conversion directions explicitly (Step 3). Common issues are:

- Uncheck the "Show content for this layer using the HTML Popup tool" box under Layer Properties;
- Ensure the "Name" field is selected as the "Display Expression Field" under Layer Properties;
- Ensure the layer is visible when the export to KMZ is completed; and
- Define the "Layer Output Scale" as a value greater than 0.

DOES TAHOE ROAD RAM STORE OTHER ROAD SEGMENT ATTRIBUTES?

Tahoe Road RAM can store abrasive application priority, sweeping effectiveness, road surface integrity and PLRM road risk data if values are uploaded in the CSV file. However, these attributes cannot be displayed within Road RAM. Because only road class is used in the spatial extrapolation process, these other road segment attributes are not used or displayed in Road RAM. If you wish to explore and quantify these other road segment attributes further you can do so in GIS. You can also export Road RAM results to a CSV file and join this data to GIS attributes to analyze the data further.

5 ENTER FIELD OBSERVATIONS

Implement Road RAM field observations to determine road condition. Tahoe Road RAM field observations are a compilation of distinct rapid observations and/or measurements made at road segments over time to evaluate and track condition using Road RAM.

5.1 HOW-TO STEPS

The user has 2 options to record field observation data:

A. Print a hard copy of the field and complete it in the field. Return to your office and enter the data into www.tahoeroadram.com. Field datasheets are provided in 2 forms: single site and multi-site, both are available in downloads in the tool.
B. Enter the field observation data directly into www.tahoeroadram.com using a smartphone or tablet where cell service is available. There is a QR code available on the website under the left hand menu that will access the field observation form on your mobile devise. See Troubleshooting & FAQs for more information.

Tahoe Road RAM QR code

Step 1**:** Preparation

- If using hardcopy datasheet, populate field datasheet with each road segment ID and length/width pacing (if known) prior to going into the field.

- Field Checklist
  - Field datasheet/field map or smartphone/table with cell service
  - Safety vest
  - Clipboard
  - Pencil
  - Handbroom
  - Baby wipes
  - Dust pan (optional)
  - Graduated cylinder (optional)

Helpful Hints
Field observations should not be made when pavement is wet or in windy conditions. Critical field observations, like the height and time of the dust cloud, are highly sensitive to wind and scores can be skewed in highly windy conditions. We recommend that you reschedule your data collection for calmer conditions.

Important Safety Tips

- Never make observations in conditions that are unsafe, such as foggy conditions, during poor lighting (dusk or dawn), slippery road conditions, high traffic times, etc.
- Always work in pairs and wear brightly colored safety vests at all times.
- Have one person always face traffic when the other is conducting measurements and looking at road surface.
- Use crosswalks and stop signs when available to cross the road.
- Never turn your back to oncoming traffic.
- Use proper roadway signage based on the requirements of the jurisdiction in which you are working. This may include: flashing lights, traffic cones, 'Workers Ahead' signage, etc.

Ultimately your safety is the most important thing. If you do not feel safe, do not conduct the observation.

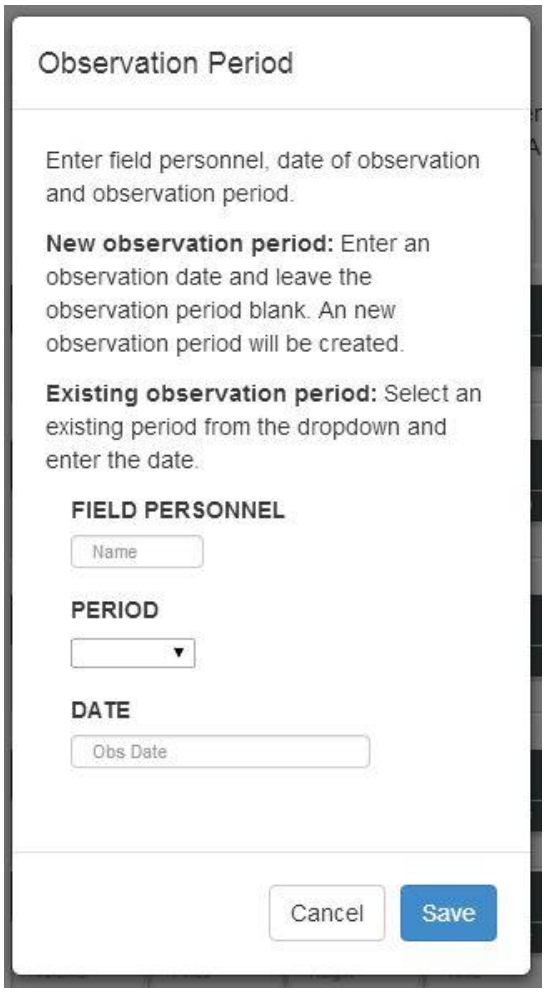
Step 2: Field Observation Datasheet

- Arrive at site.
- Locate segment using field map (hard copy) or website.
- Click "RAM" button to enter Tahoe Road RAM field observations. Sequentially click on the table blue tabs to complete RAM field observations.
    - Step 2a: OBSERVATION PERIOD
    - Step 2b: SEGMENT DIMENSIONS
    - Step 2c: MATERIAL DISTRIBUTION
    - Step 2d: VOLUME & FINES OBSERVATIONS BY ACCUMULATION ZONE

Data entry for Tahoe Road RAM field observations.

5.1.1 STEP 2A: OBSERVATION PERIOD

- For the first segment being recorded for the observation period, leave the "Period" field blank and enter a date in "Date". A new observation period is created with that date.
- For all subsequent segments, select the appropriate date from the "Period" dropdown. Enter a date in "Date".
- Click "Save".



Observation Period data entry

5.1.2 STEP 2B: SEGMENT DIMENSIONS

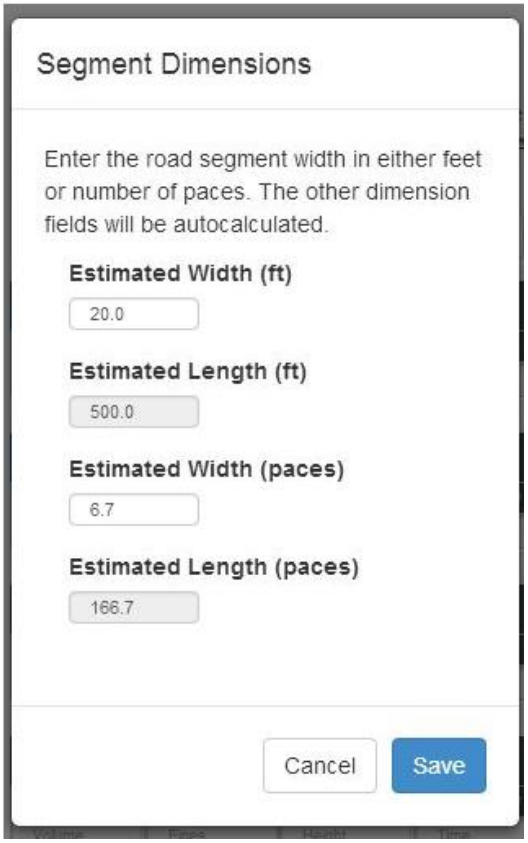
- Complete only during the first visit to the road segment. During subsequent visits, data is auto-populated in the website.

Helpful Hints
To speed up observations, use pacing instead of a measuring tape in the field. Optimize your personal pace that equals 3ft per step. Practice your pacing using a measuring tape.

- Measure and document the average width of the road segment. The width is defined as the continuous impervious surface including sidewalks, up to a maximum width of 65 ft. Find a safe place to cross the street and measure width in feet or paces (1 pace = 3 ft).

Helpful Hints
The low accumulation zone is typically the drive lane, so rather than pacing, calculate length of low as:

Light = Width – Heavy – Moderate.

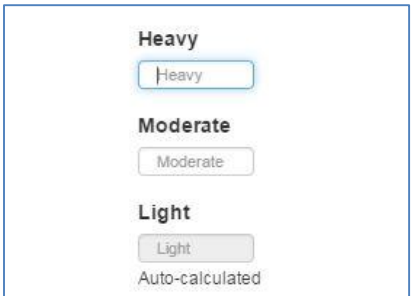


Segment Dimensions data entry

- Open "Segment Dimensions" and enter "Estimated Width" as feet or paces. Click "Save".
- Road RAM will automatically calculate the "Estimated Width" in the other units and "Estimated Length" in both units (feet and paces), based on the road width input.

5.1.3 STEP 2C. MATERIAL DISTRIBUTION

- Walk the perimeter, visually assessing material accumulation patterns and distribution throughout segment. Depending on time of year and road condition, there can be 1-3 material accumulation areas. The delineation of heavy, moderate and light zones is relative to that segment at that time of observation.
- Find a representative cross section (not the dirtiest or cleanest section) of the accumulation pattern. Starting on road shoulder, count paces for heavy and moderate accumulation areas across width of road. Only cross road where it can be done safely. Calculate light zone. Resolution is 0.5 paces.



Percent Accumulation data entry

- Calculate % distribution for each accumulation zone based on incremental pacing results. Round answers to nearest 5%. Visually confirm that distribution percentages make sense.
- Open "Material Distribution" and enter "Heavy" and "Moderate" values. Click "Save".

Helpful Hints

- Identify the cleanest (light, usually the drive lane) and dirtiest (heavy, usually the road shoulder) first. Then decide if there is a moderate zone.
- If areas are not obvious, use a hand broom to generate a dust cloud at different spots on the road. Different dust cloud heights can distinguish areas of accumulation.
- If you identify only 1 area of accumulation, double check dust cloud height and fines (finger test) at several spots to verify homogeneity.

5.1.4 STEP 2D. VOLUME & FINES OBSERVATIONS BY ACCUMULATION ZONE

For each accumulation area where the percent of segment is greater than 0%:

- Estimate Volume of Material
- Measure Dust Cloud
- Conduct Fingerprint Test

Estimate Volume of Material

- For each accumulation zone, select a representative and safe 1x1 square.
- Visually estimate the volume of material within the square based on the 7 categories on field datasheet. Observation includes both fine and coarse material, and any material within cracked pavement. Do not include organic material (e.g., pine needles, leaves, etc.) in estimate.
- Select appropriate "Volume of material" category.

Helpful Hints

Practice visually estimating volume of material in 1 x 1 area based on 7 categories. Know the categories and gain the estimating skill to avoid sweeping and measuring material. Practice in a safe environment (e.g., parking lot).

Volume of Material data entry

Measure Dust Cloud

- Select a representative and safe 1x1 square for each area of accumulation.
- Position backside upwind so dust will blow the direction you are facing.
- Place heels together.
- Sweep the 1 x 1 area in front of you. The intention is to create a dust cloud with 3 to 4 vigorous sweeps. The user must make firm and consistent contact with the ground to ensure a dust cloud is generated if fines are present on the road surface.
- Record maximum height that cloud reaches.
- Determine the duration the dust cloud remains visible as < 2 seconds or > 2 seconds.
- For each accumulation area where the percent of segment is greater than 0%, select appropriate "Height of cloud" and "Time cloud hangs in air" category.

Helpful Hints

Road RAM scoring is highly sensitive to the degree of fines as measured by the dust cloud & fingerprint tests. See Troubleshooting & FAQs for a suggested approach to determine the level of fines within a 1x1 square.

Dust Cloud data entry

Helpful Hints

- The dust cloud is best observed by the non-sweeping partner.
- Err towards the lower height. If you are unsure of the height following a number of measurements, select the lower height.

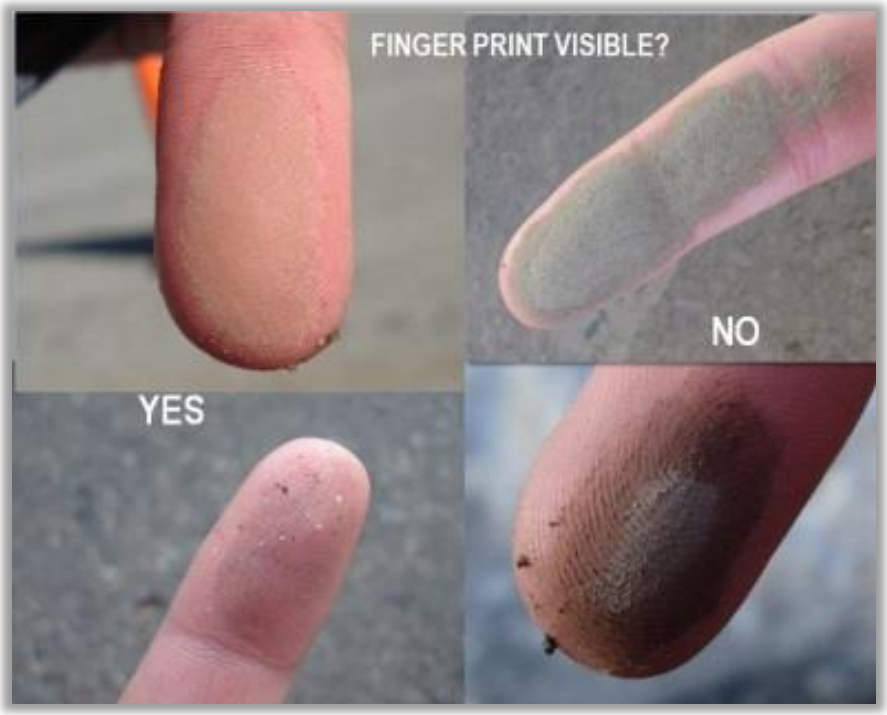
Conduct Fingerprint Test

- Adjacent to the dust test, in a visually similar area, perform the fingerprint test.
- Wipe hands with baby wipe or a wet towel to make sure they are clean and moist.
- With moderate pressure rub 2-3 fingers into road surface, going side to side 2 times.
- Examine fingerprints. Are your fingerprints visible through the layer of material?
- Wet your thumb with the baby wipe, and then rub middle finger. Does your finger feel gritty, slimy or both? When wet, clay particles will feel slimy.
- For each accumulation area where the percent of segment is greater than 0%, select appropriate "Visible" and "Feel" category.

Fingerprint data entry

Helpful Hints

- If any amount of material is present on your finger, do not answer None.
- If any part of your fingerprint is visible, answer No.
- If you are unsure, answer Yes.
- Slimy indicates 100% clay-size material. If you are unsure, answer Yes.
- Err towards the lower height. If you are unsure of the height following a number of measurements, select the lower height.

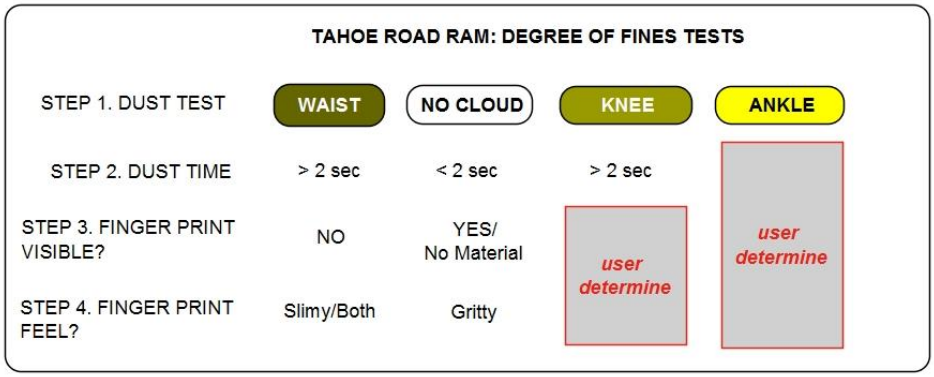


Fingerprint result examples

5.2 TROUBLESHOOTING & FAQS

FIELD OBSERVATION TIPS FOR DEGREE FINES TEST

Road segment scores are highly sensitive to the degree of fines. The schematic below details the sequence and priority of observations, with the dust test height being the priority. The end member dust test results - waist and no cloud - allow the user to assume the answers to other tests. When intermediate dust heights are observed (knee or ankle), additional user measurements are required. The red 'user determine' boxes indicate when these observations are critical for determining the level of fines within the 1x1 square.



Sequence to perform degree of fines tests

CAN I ENTER RAM OBSERVATION DATA DIRECTLY INTO THE DATABASE IN THE FIELD?

YES. You can scan the black and white square (QR code) under the left hand menu and bring up the digital field datasheet. Download a QR reader such as QR Reader or Quick Scan, and scan the code with your phone to open the mobile Road RAM field observation form. Data entered into this form is automatically uploaded to Road RAM. You will need cellular service and an iOS tablet or phone in the field to access this feature.

HOW DO I DELETE AN OBSERVATION?

Click "Road Segment Scores". Click "View Obs Per" and select the observation period of interest. In the table, locate the road segment of interest and click "Delete" in the corresponding row. You will be asked to confirm the deletion.

HOW OFTEN SHOULD I RAM A ROAD SEGMENT?

It depends on the reason you are performing the observations. The Crediting Program defines a minimum number of observations required per season, which can be found at www.tahoeroadram.com/cap. Otherwise, we recommend that you consider the purpose of the data collection and align your data collection plan with the data you need for your analysis.

Tahoe Tools

A specific number of observation periods per season are required for the Crediting Program. See the Handbook Guidance for more information.

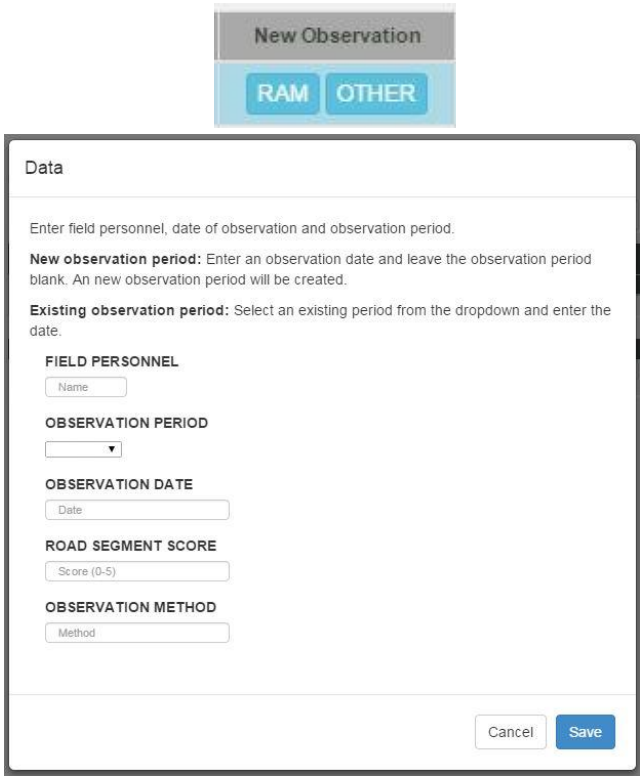
WHAT IS AN OBSERVATION PERIOD?

An observation period is the discrete period of time when Road RAM field observations are conducted to determine road condition and calculate Road RAM scores. If the area of interest is relatively large and requires a number of consecutive days to obtain results, all observations are lumped into one observation period and documented as the date the Road RAM observations were initiated. Ideally neither road maintenance practices (e.g., sweeping or abrasive application) nor a stormwater runoff event occur during an observation period.

Depending on the number of segments being evaluated, field personnel may require more than 1 day to make all the observations. To ensure all observations are related, the first day of the observation defines the observation period. The observation date is the specific date of the observation.

HOW DO I ENTER A ROAD SEGMENT SCORE DIRECTLY?

If using non-RAM field observation protocols, click "Other" button and enter field personnel, observation period (see next bullet), date, road segment score, and method. Click "Save".



Data entry for non-RAM field observations.

6 VIEW SEGMENT SCORES

A *road segment score* is a value between 0 and 5 obtained from Road RAM field observations at one point in time for a 10,000 sq ft road area.

The colors and associated scores represent very specific definitions of relative road condition. The table describes the score ranges and associated colors and FSP concentrations.

RAM Score	Condition	FSP concentration (mg/L) range	Description
0 - 1.0	Poor	1,592-680	Significant potential risk to downslope water quality should runoff event occur. Road maintenance practices require immediate improvements. Capital improvement projects downslope may need to be considered to capture road-generated pollutants.
>1.0 - ≤ 2.0	Degraded	679-291	Likely potential risks to downslope water quality. Road maintenance practices require immediate improvements. Capital improvement projects downslope may need to be considered to capture road-generated pollutants.
> 2.0 - ≤ 3.0	Fair	290-124	Road condition is closer to degraded than desired, may pose downslope water quality risk. Road maintenance should be prioritized as needed if time and resources permit.
> 3.0 - ≤ 4.0	Acceptable	123-53	No immediate risk to downslope water quality should runoff event occur. Minimal need to improve road maintenance practices.
> 4.0 – 5.0	Desired	52-23	Maximum achievable road condition. No need to improve road maintenance practices.

6.1 HOW-TO STEPS

Step 1**:** View scores by observation period.

- Click "View Obs Per" and select the observation period of interest from the dropdown list.
- The most recent data shows the most recent road segment score, regardless of observation period.
- Click "Enlarge Map" below the Google map to open a large map in a new window. Print using the web browser print functionality, or take a screenshot of the map and copy the image to a word document.

Step 2**:** View scores for a specific segment over time.

- In the table, locate the road segment of interest and click "Graph".
- A time series graphic will open showing all scores for that road segment over time.

Step 3: Download data

- Click "Download" to generate a CSV file that can be saved to your computer.
- The downloaded file includes the area of interest (Area), road segment ID (RSID), observation date (ObsDate), observation period (ObsPeriod), road segment score (Score), road segment road class (Road Class), and observation method (Method). If the Method field is blank, the Tahoe Road RAM field observations and scoring algorithms were use.

6.2 TROUBLESHOOTING & FAQS

HOW DO I DELETE AN OBSERVATION?

Click "Road Segment Scores". Click "View Obs Per" and select the observation period of interest. In the table, locate the road segment of interest and click "Delete" in the corresponding row. You will be asked to confirm the deletion.

HOW DO THESE FIELD OBSERVATIONS TURN INTO A 0-5 ROAD CONDITION SCORE?

2NDNATURE collected hundreds of FSP samples from road surfaces using a customized rain simulator while simultaneously testing and array of field observation proxies to predict the FSP concentrations measured in a 1' x 1' square. The most powerful proxies are conducted by the Road RAM user in the field. Each series of Road RAM observations conducted within the road segments 3 zones of the material accumulation are used to predict the FSP concentration that the portable simulator would measure. These 3 concentrations are spatially weighted based on the distribution as documented by the Road RAM user in the field. The weighted road segment FSP concentration is then converted to a 0-5 score using a standard equation. All of these scoring details are provided in the Road RAM Technical Document that can be downloaded from the website.

HOW CAN I USE THE ROAD SEGMENT SCORE RESULTS?

There are a number of uses. Road segments scores can be used to prioritize maintenance actions, by highlighting on a map where the locations in poor condition (red) are. Condition at a specific location can be viewed over time in a graph, to show changes over time. This data can be analyzed outside the tool with respect to meteorological, road attribute, or road maintenance data to evaluate causal relationships. It is really up to you how you want to apply the data.

7 VIEW ROAD RAM SCORES

A *Road RAM score* is a value between 0 and 5 that represents the temporally-discrete, spatially-extrapolated road condition for all roads belonging to a single road class. The Road RAM score is the average of road segment scores for roads of the same road class for the respective observation period.

The colors and associated scores represent very specific definitions of relative road condition. The table describes the score ranges and associated colors and FSP concentrations.

RAM score	Condition	FSP concentration (mg/L) range	Description
0 - 1.0	Poor	1,592-680	Significant potential risk to downslope water quality should runoff event occur. Road maintenance practices require immediate improvements. Capital improvement projects downslope may need to be considered to capture road-generated pollutants.
>1.0 - ≤ 2.0	Degraded	679-291	Likely potential risks to downslope water quality. Road maintenance practices require immediate improvements. Capital improvement projects downslope may need to be considered to capture road-generated pollutants.
> 2.0 - ≤ 3.0	Fair	290-124	Road condition is closer to degraded than desired, may pose downslope water quality risk. Road maintenance should be prioritized as needed if time and resources permit.
> 3.0 - ≤ 4.0	Acceptable	123-53	No immediate risk to downslope water quality should runoff event occur. Minimal need to improve road maintenance practices.
> 4.0 – 5.0	Desired	52-23	Maximum achievable road condition. No need to improve road maintenance practices.

7.1 HOW-TO STEPS

The user can view Road RAM results by (1) area and road class for an observation period, (2) area and road class for a water year, and (3) data download of all road class results.

Step 1**:** View scores by observation period.

- Click "View Obs Per" and select the area, water year and observation period of interest.
- Click "View Graph" to view a time series graphic of all scores for that road class over time.

Tahoe Tools

See the Handbook Guidance for information on how Road RAM scores are used as annual inspection results to verify credit awards.

- Click "Enlarge Map" below the Google map to open a large map in a new window. Print using the web browser print functionality, or take a screenshot of the map and copy the image to a word document.

Step 2: View scores by water year.

- Click "View WY" and select the area and water year of interest.
- Click "View Graph" to view a time series graphic of all water year scores for that road class over time.
- Click "Enlarge Map" below the Google map to open a large map in a new window. Print using the web browser print functionality, or take a screenshot of the map and copy the image to a word document.

Helpful Hints
The water year is from October 1 to September 30.

Step 3: Download data

- Click "Download" to generate a CSV file that can be saved to your computer.
- The downloaded file includes the area of interest (Area), road class (RSClass), number of road segment observations contributing to road class score calculation (# Obs), road class score – average score for all road segments of that class (Score), standard deviation of all scores measured (StdDev), and observation period (ObsPeriod).

7.2 TROUBLESHOOTING & FAQS

WHAT IS THE AREA SCORE AT THE BOTTOM OF EACH TABLE?

The area score is a spatial integration of the road lengths and associated scores for each road class in the area of interest. The "Classify Roads" page displays the percent of miles in the area designated as each road class. This weighting is applied to the road class average scores to calculate a single average Area Score. This calculation is done for both a specific observation period and by water year. See the Road RAM Technical Document that can be downloaded from the website for more details.

HOW IS THE WATER YEAR AVERAGE ROAD RAM SCORE CALCULATED?

The water year average is based on a standardized seasonal weighting developed specifically to calculate annual Road RAM scores for each road class using a series of Road RAM results observed throughout the year. See the Handbook Guidance for more details.

HOW CAN I USE THE ROAD RAM RESULTS?

Road RAM scores can be used to prioritize maintenance actions where roads in poor condition are located. Road RAM results can be used to evaluate the effectiveness of road maintenance practices to protect water quality. The time series graph can provide valuable data for comparisons with actual road maintenance practices implemented by the respective jurisdiction to inform optimal road management practices to protect water quality. If Road RAM is being used to verify compliance and achieve annual credits under the Crediting Program, refer to Crediting Program Handbook. Additional options as to how Road RAM results can be used to inform road management in the Tahoe Basin are discussed in the Road RAM Technical Document that can be downloaded from the website for more details.

8 GLOSSARY & FIELD DATA SHEETS

Abrasive Applications	The timing of abrasives applied to a road network is dictated primarily by the weather, with protecting driver safety a priority during freezing and storm conditions. The relative frequency and amount applied varies across jurisdictions based on traffic density, locations of schools, intersections, shading, etc. Road class designations should consider these relative jurisdictional priorities of the frequency and amount of abrasives applied.
Area of Interest	An area of interest can be used to group user inputs or view Road RAM results. Typical types of areas relevant to Tahoe Road RAM are: urban catchments, jurisdictional boundaries, or specific road networks.
Field Observations	A compilation of distinct rapid observations and/or measurements made at road segments over time to evaluate and track condition using Road RAM.
Fine Sediment Particles (FSP)	FSP refers to the mass fraction of the TSS (total suspended sediment) concentration that consists of particles 16µm or smaller, expressed as a % TSS by mass and allowing a concentration of FSP to be simply calculated.
Material Accumulation Category	Roads have a typical pattern of heavy, moderate and light material accumulation as a result of transport and sorting by vehicle traffic and wind. The distribution of material accumulation is unique to each distinct road segment and the categories are relative to one another for the specific day of observation. Material accumulation distribution is a key field observation in Road RAM.
Observation Period	The discrete period of time when Road RAM field observations are conducted to determine road condition and calculate Road RAM scores. If the area of interest is relatively large and requires a number of consecutive days to obtain results, all observations are lumped into one observation period and documented as the date the Road RAM observations were initiated. Ideally neither road maintenance practices (e.g., sweeping or abrasive application) nor a stormwater runoff event occur during an observation period.
Other Sediment Sources	Similar to abrasives, other source of sediment to the road can be also be pulverized and contribute to the FSP mass on the roadway. These sources may include tracking from other roadways via cars, tracking from unpaved private driveways, other adjacent erodible surfaces, construction, or potentially road surface degradation and tire wear. The seasonal contributions of these sources to the overall road FSP load will likely vary, with perhaps the greatest sources coming from discrete locations such as driveway, localized erosion or construction activities.
Pavement Condition Index	The pavement condition, or surface integrity, is a critical factor that directly influences road condition. There is little question that high PCI scores can greatly improve the effectiveness of sweeping efforts. Roads with moderate to high degree of cracking limit the ability of sweepers to recover material from the road surface. However, subsequent rain events will mine these cracks of available FSP, transporting the material downslope, and Road RAM will identify these as poor condition roads. Road class mapping should consider consistent pavement conditions, as variability within the class will lead to noise in the Road RAM signal.

Pollutants of Concern	The pollutants identified to have the greatest impact on the receiving waters' beneficial uses. In the case of Lake Tahoe, the continued decline in lake clarity is attributed to both the increased loading in fine sediment particles (FSP; <16µm in diameter) and algae production. Therefore the identified pollutants of concern are FSP and biologically available nutrient species: nitrate-nitrite (NO_x) and soluble reactive phosphorous (SRP).
Road Class	A jurisdiction can define up to 9 unique road classes to define their road maintenance practices across the road networks they maintain. Road class is defined as the combination of pollutant control practices employed on a particular road throughout the year, including the relative planned abrasive application priority during winter road conditions and relative planned sweeping priority when the weather is favorable for pollutant recovery. Road class is used to spatially extrapolate road segment scores to determine Road RAM scores for complete road networks. The jurisdictions classify the roads in their jurisdiction in GIS based on actual maintenance practices. Road class is defined as the relative practices implemented by the respective jurisdiction. Road class is not intended to be comparable across two jurisdictions.
Road Condition	The relative risk to downslope water quality from a road at the time of observations, quantitatively expressed as a Road RAM score. The primary pollutant of concern is fine sediment particles (FSP < 16µm), but total suspended sediment and nutrient species are also assumed to vary in relative magnitude with road condition. The condition of a road fluctuates over time due to the continual balance of pollutant sources and sinks based on a variety of factors, primarily physiographic characteristics, associated road maintenance practices and stormwater runoff. The Road RAM tool provides a quantitative measure of road condition on a 0-5 scale, with 5 being the best possible condition and corresponding to the best achievable condition with minimal threat to downslope water quality.
Road RAM	Road RAM is a simple and repeatable field observation and data management tool to assist Lake Tahoe natural resource managers in determining the relative condition of paved roads to protect downslope water quality. The tool includes GIS tasks and a custom online data management system (www.tahoeroadram.com). The tool outputs the relative condition of paved road networks at the time of observation on a 0-5 scale. The tool automates result summaries using Google® Maps, tables and time series graphics. Road RAM is an approved road maintenance effectiveness verification tool that a jurisdiction can use to meet annual regulatory reporting requirements, including NPDES monitoring permits.
Road RAM Database (database)	The customized online database (www.tahoeroadram.com) stores and manages all information necessary to implement, track and maintain Road RAM data and results over time. The users enter GIS and RAM field observation results directly into the database via the website or iOS tablet/phone application in the field. The Road RAM database translates the user inputs into 0-5 scores and summarizes the results using Google® Maps, tabular summaries and graphical time series.
Road RAM Score	A value between 0 and 5 that represents the temporally-discrete, spatially-extrapolated road condition as a result of Road RAM field observations conducted at one or more road segments. The Road RAM score is an average of road segment scores for roads of the same road class. A Road RAM score of 5 is the achievable score that equates to minimal downslope water quality threat during a subsequent runoff event. The Road RAM score declines as the relative amount of available fine sediment particles present on the road segment increases, thus increasing the risk to downslope water quality should a runoff event occur.

Road Segment	A 10,000 ft^2 road unit is the standardized road area selected and evaluated by the Road RAM user. This size is assumed to be large enough to be representative of a road, while small enough that the road condition can be assessed rapidly in less than 10 minutes per site.
Road Segment Score	A value between 0 and 5 obtained from Road RAM field observations at one point in time for a 10,000 sq ft road unit. Road segment scores are obtained from a number of road segments belonging to the same road class. They are averaged to determine a Road RAM score for that road class.
Sources	Sources of FSP on an impervious road surface include abrasive applications plus other sources, and are designated as intensive, moderate, or rarely to never as a relative scale as treated by the respective jurisdiction.
Sinks	Sinks of FSP on an impervious road surface include sweeping practices, pavement condition index, and sweeper accessibility, and are designated as intensive, moderate, or rarely to never as a relative scale as practiced by the respective jurisdiction.
Sweeper Accessibility	Parked cars, speed bumps, snow berms, and other barriers can prevent the sweeper from accessing the entire impervious road surface, thereby reducing sweeper performance per level of effort. Opportunities exist to modify the sweeping program to improve access, but relative accessibility should be considered when defining roads that belong to similar road class.
Sweeping Practices	Each jurisdiction has different equipment and available resources that drive their feasible sweeping program. In general, high traffic roadways, locations of relatively higher abrasive applications and the potential contributions of other sediment sources dictate the relative frequency at which specific roads are swept and perhaps the equipment used. Road class designations should consider the relative jurisdictional frequency the roadway is swept. Practices that minimize the amount of time abrasives and other sediment remain in the road (i.e., residence time) will generally lead to the relatively lower mass of FSP generation and accumulation on the road surface. In order to implement the desired sweeper program effectively and ensure the best possible performance per unit effort, the sweepers must be maintained at an acceptable level and operated properly, pavement condition must be good and the road surface must be accessible to the sweeper.
Threshold Value	A Road RAM score of 2 is identified as the threshold value, below which there is high confidence that the road is an immediate threat to downslope water quality should a runoff event occur. A Road RAM score of 2 equates to a predicted FSP concentration of 291 mg/L generated from the road segment based on existing data (Technical Document; Focused Stormwater Quality Monitoring Research).

Tahoe Road RAM Field Datasheet – SINGLE SITE

Log on to www.tahoeroadram.com to enter observations and obtain road condition score.

Row #	ROAD RAM STEP 4 Field Observation Datasheet			
1	RS ID	Field Personnel	Observation Date	
Road Segment (RS)				
2	Width	Length	RS Start	RS End
	pace	pace		
	ft	ft		
Percent Distribution Material Accumulation Area				
3		Heavy	Moderate	Light
	% of Road Segment			
Dry Material Collection				
HEAVY MATERIAL ACCUMULATION AREA				
4	**Volume (ml)**	**Fines Test**	**Dust Test**	
	0 0 - 1 1 - 5 5 - 10 10 - 30 30 - 100 > 100	Finger print visible? No Material Yes No	Height	No Cloud Ankle Knee Waist
		Gritty / Both / Slimy	Seconds	< 2 seconds >2 seconds
MODERATE MATERIAL ACCUMULATION AREA				
5	**Volume (ml)**	**Fines Test**	**Dust Test**	
	0 0 - 1 1 - 5 5 - 10 10 - 30 30 - 100 > 100	Finger print visible? No Material Yes No	Height	No Cloud Ankle Knee Waist
		Gritty / Both / Slimy	Seconds	< 2 seconds >2 seconds
LIGHT MATERIAL ACCUMULATION AREA				
6	**Volume (ml)**	**Fines Test**	**Dust Test**	
	0 0 - 1 1 - 5 5 - 10 10 - 30 30 - 100 > 100	Finger print visible? No Material Yes No	Height	No Cloud Ankle Knee Waist
		Gritty / Both / Slimy	Seconds	< 2 seconds >2 seconds

DATE ______________________

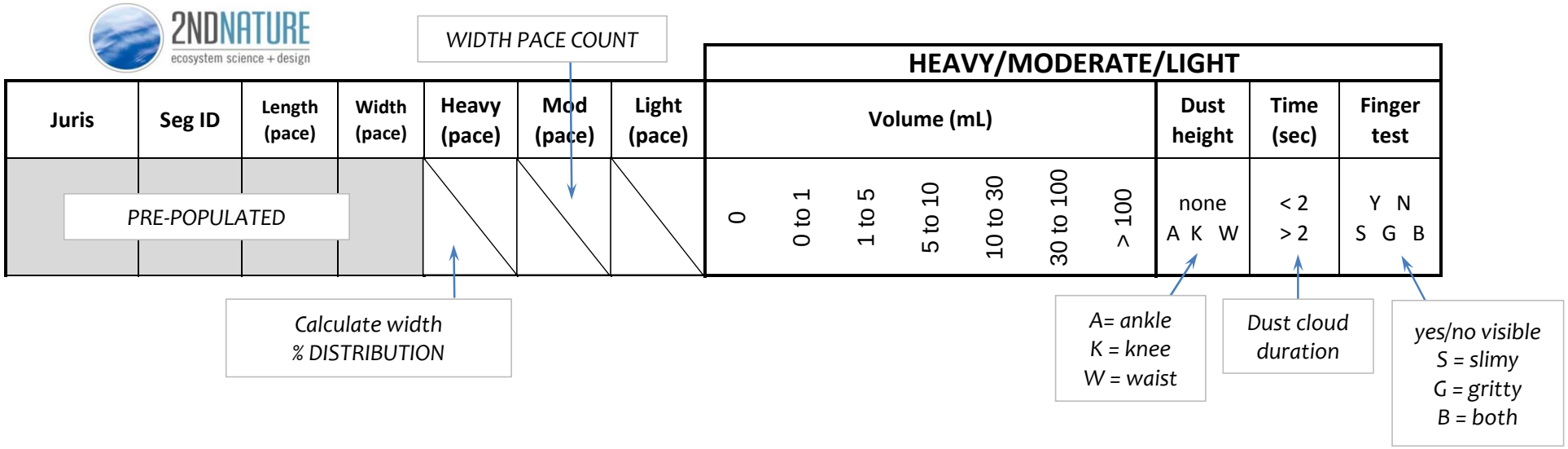
Personnel ______________________

TAHOE ROAD RAM

FIELD DATA SHEET

2NDNATURE ecosystem science + design

Juris	Seg ID	Length (pace)	Width (pace)	Heavy (pace)	Mod (pace)	Light (pace)	HEAVY Volume (mL)	HEAVY Dust Height	HEAVY Time (sec)	HEAVY Finger test	MODERATE Volume (mL)	MODERATE Dust Height	MODERATE Time (sec)	MODERATE Finger test	LIGHT Volume (mL)	LIGHT Dust Height	LIGHT Time (sec)	LIGHT Finger test
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B
							0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B	0 / 0 to 1 / 1 to 5 / 5 to 10 / 10 to 30 / 30 to 100 / > 100	none A K W	< 2 > 2	Y N S G B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ecosystem science + design
WIDTH PACE COUNT
HEAVY/MODERATE/LIGHT
Juris
Seg ID
Length (pace)
Width (pace)
Heavy (pace)
Mod (pace)
Light (pace)
Volume (mL)
Dust height
Time (sec)
Finger test
PRE-POPULATED
0
0 to 1
1 to 5
5 to 10
10 to 30
30 to 100
> 100
none
A K W
< 2
> 2
Y N
S G B
Calculate width
% DISTRIBUTION
A= ankle
K = knee
W = waist
Dust cloud duration
yes/no visible
S = slimy
G = gritty
B = both