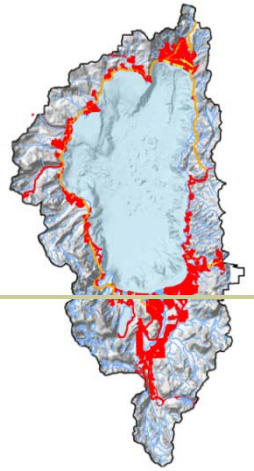
Road RAM
overview and issue discussion

SWQIC MEETING



April 20, 2011

Road RAM Technical Goals & Objectives

Goal

- Repeatable rapid assessment
- Track relative condition
- Large areas of roads
- Proxy for water quality risk

Objectives

- Consistent with BMP RAM
- Simple field observations
- Standardized data management structure, extrapolation, reporting
- Simple yet accurate communication

Road RAM Products

TECHNICAL DOCUMENT

Provides background and foundation for stormwater managers

- Goals and objectives
- Documents rationale and justification
- RAM process overview

USERS MANUAL

Detailed protocols of RAM STEPs for operations personnel

- Data collection
- Database inputs
- Database outputs (RAM results)

RAM DATABASE

Automates important steps and simplifies RAM use

- RAM score calculations
- Data management

Available: http://ndep.nv.gov/bwqp/tahoe8.htm

Tahoe ROAD RAM STEPs

	Timeframes
STEP 1: Define area of interest **STEP 2**: Create Inventory (GIS) **STEP 3**: CLASSIFY Roads	Years
STEP 4: Field Observations **STEP 5**: Obtain RAM Scores **STEP 6**: Analyze Results **MAKE DECISIONS**	Months or seasons

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ROAD RAM Scores

Road RAM Score	Condition	FSP Concentration (mg/L) range
0-1.0	Poor	1,592-680
>1.0- ≤ 2.0	Degraded	679-291
> 2.0- ≤ 3.0	Fair	290-124
> 3.0- ≤ 4.0	Acceptable	123-53
> 4.0 - 5.0	Desired	52-23

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Pressing Questions Raised

Technical Questions

- Do Road RAM scores correlate to relative downslope WQ risk?
- Is Road RAM score sensitive to road maintenance practices?
- Are Road RAM techniques repeatable across users?
- Can Road RAM validate PLRM Road Methodology?

Policy Questions

- How will Road RAM results be applied ?
- Is the level of effort reasonable?

Other Pressing Questions?

Answers to Questions

TECHNICAL ASPECTS

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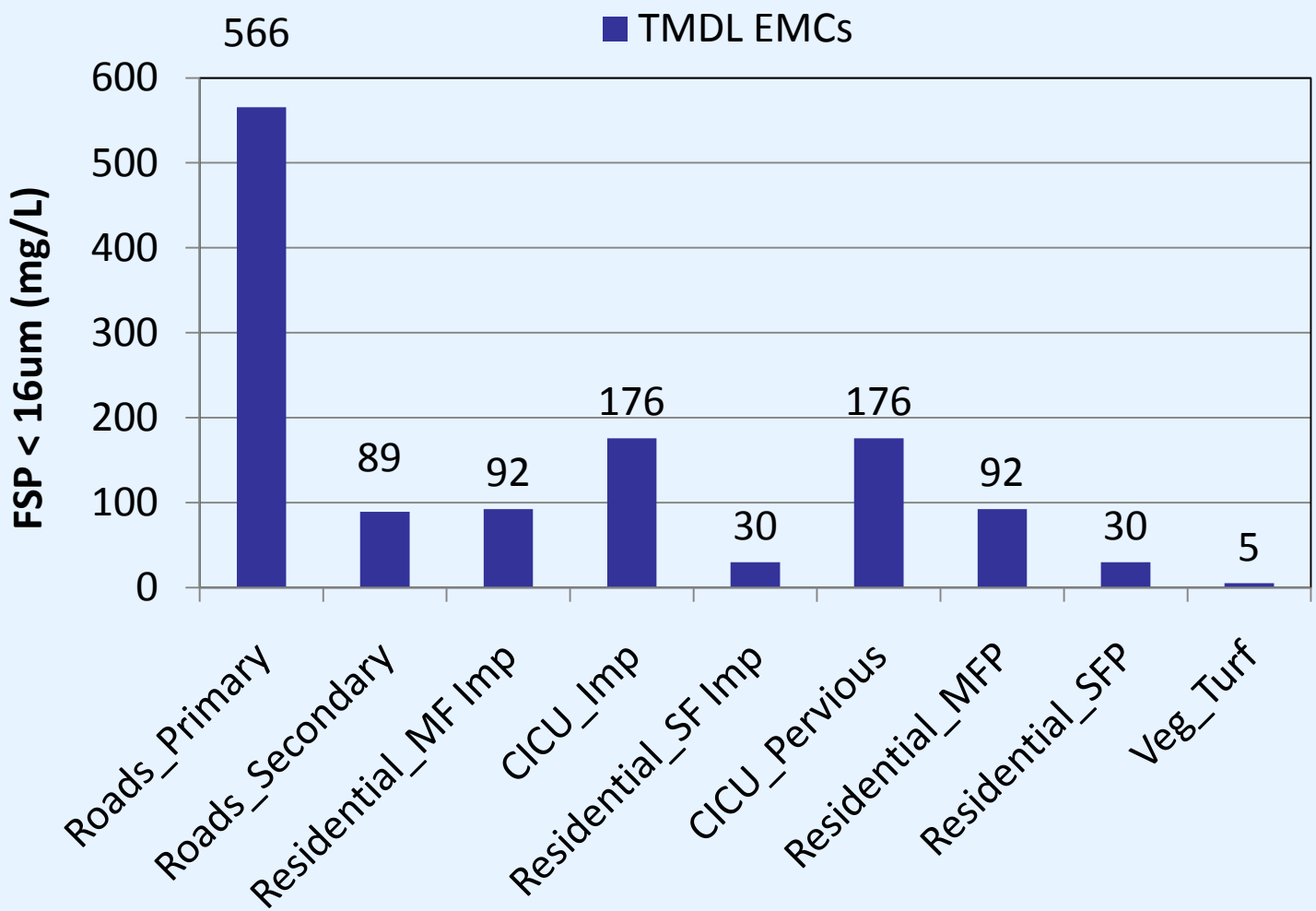
Do Road RAM scores correlate to relative downslope water quality risk?



Watershed Model EMCs

LRWQCB and NDEP (2010)

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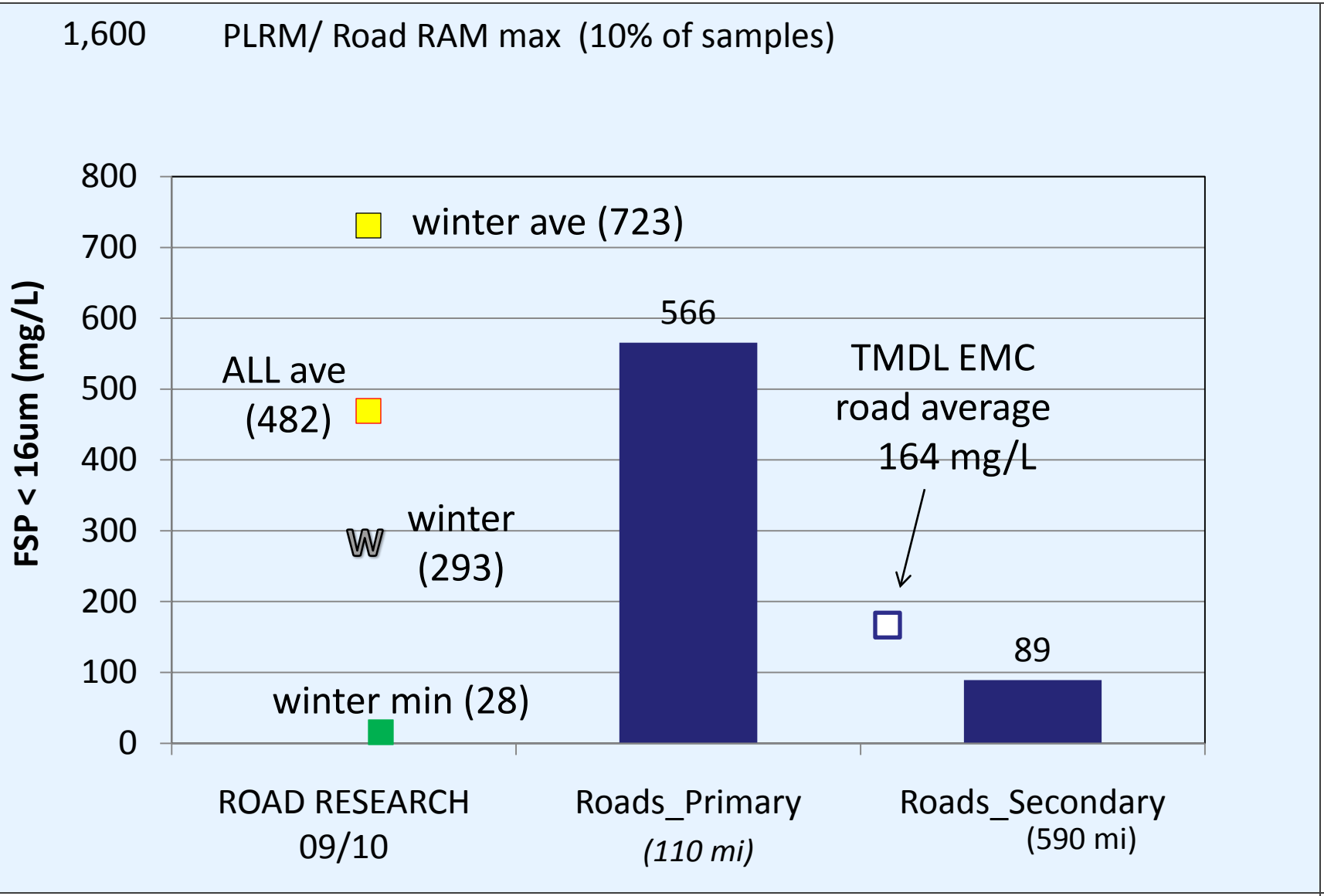
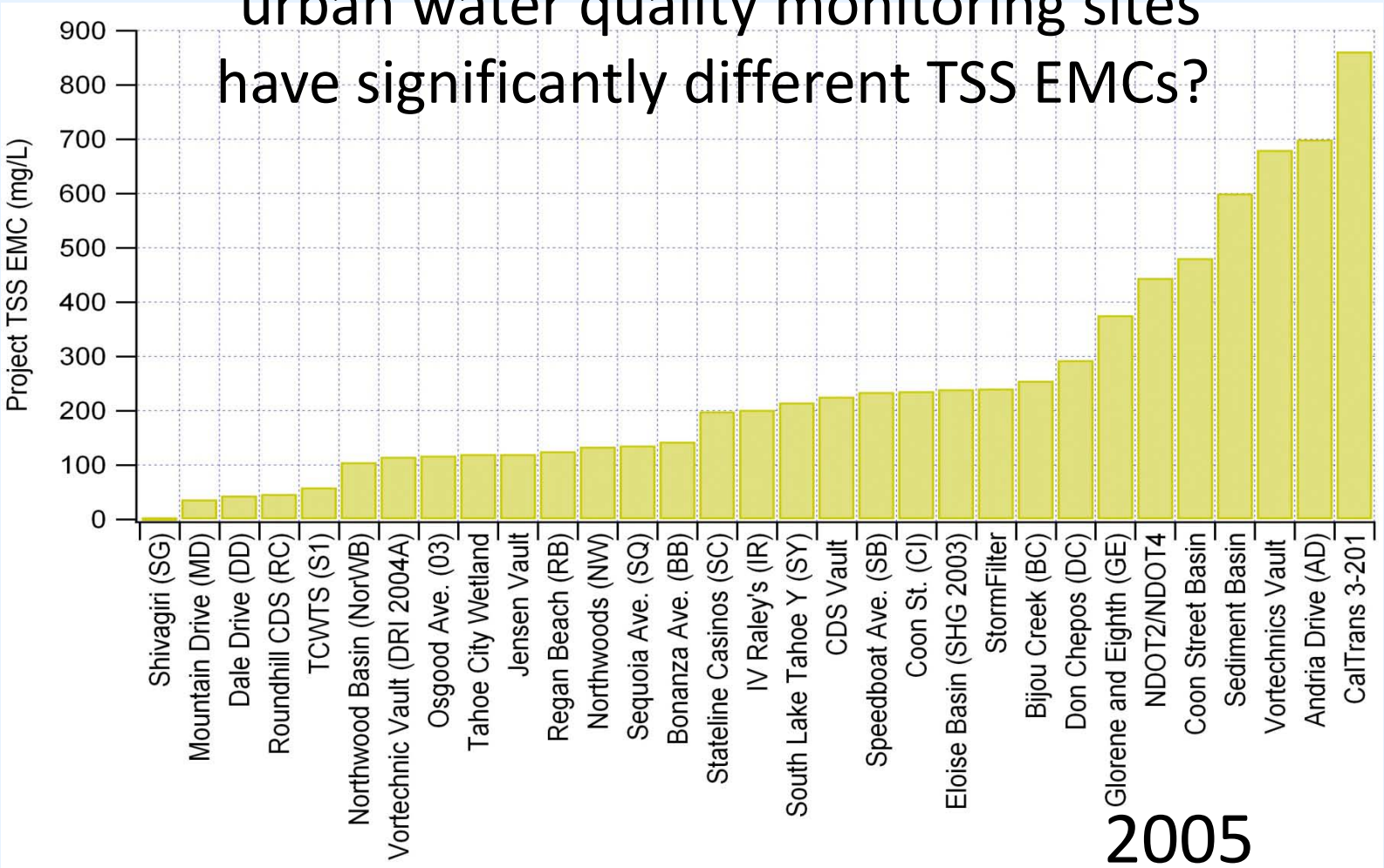
2N Data v TMDL EMCs



LRWQCB and NDEP (2010)

Why do seemingly similar urban water quality monitoring sites have significantly different TSS EMCs?



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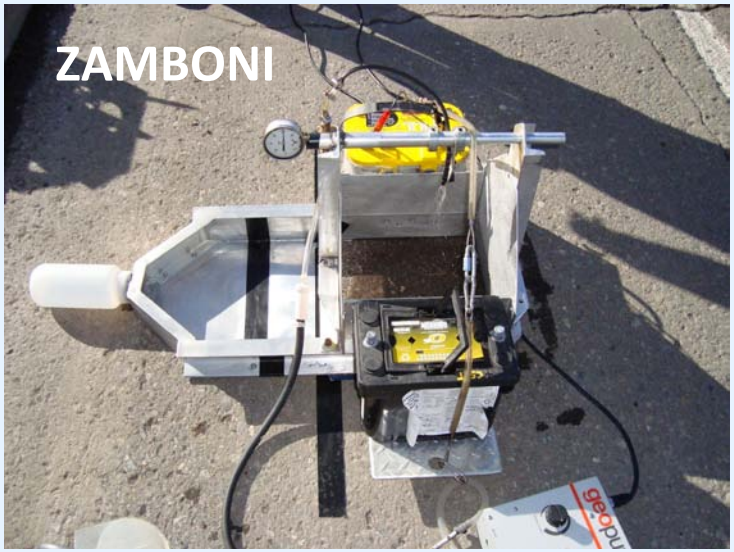
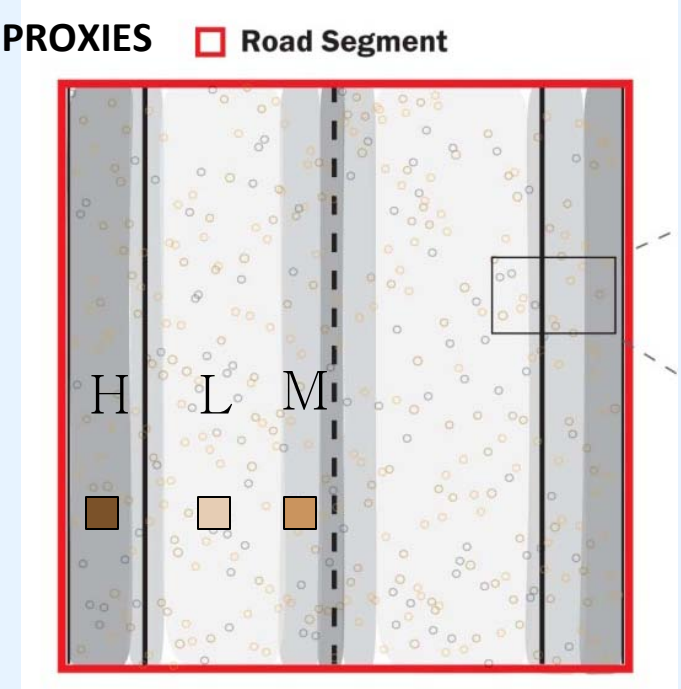
Do Road RAM scores correlate to relative downslope water quality risk?



RAPID PROXIES



TEST HYPOTHESES

Repeatable consistent water sample

RAM STATISTICAL MODEL

Simultaneous visual proxies to predict [FSP]

Road RAM proxies explain 75% [FSP] variance (*n*= 238)

Spatial weighting of H, M, L = road segment condition

Condition expressed as [FSP] or RAM score

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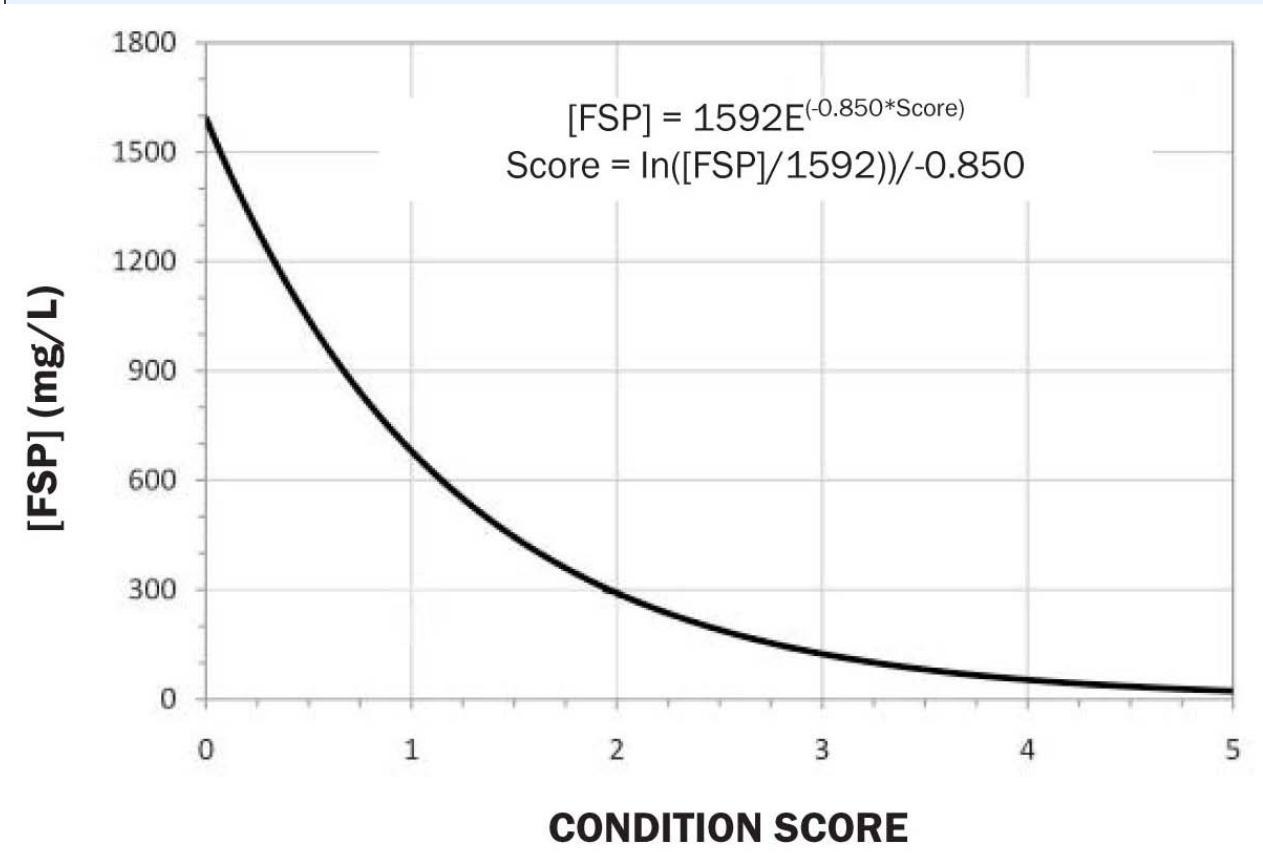
PLRM and Road RAM FSP to Score EQ



Research confirmed
Max exceeded
Min achievable
Shape representative

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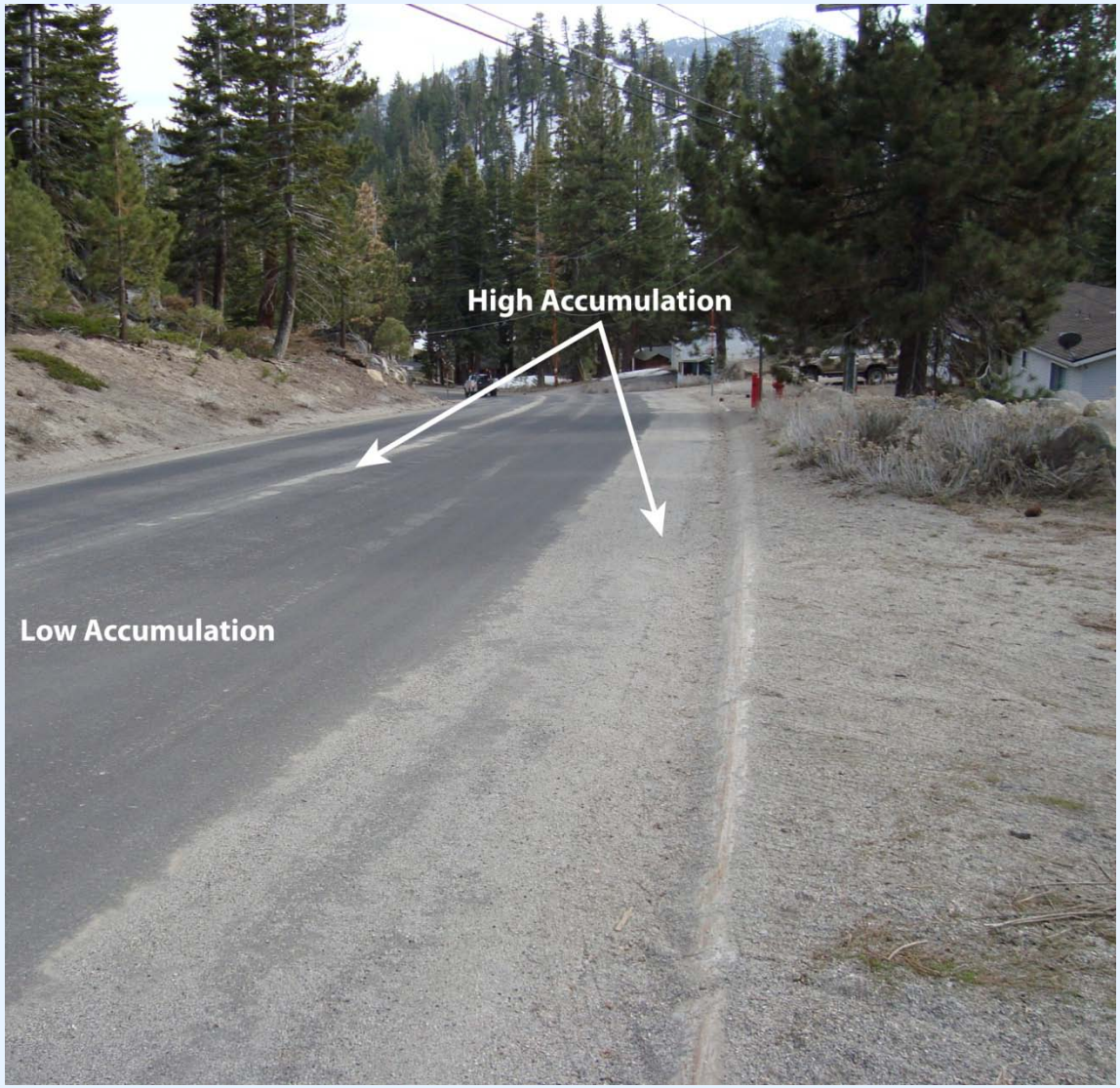
Road Examples

Douglas Co



1/10/07

[FSP]

1,425 mg/L

RAM = 0.2

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Wildwood

3/17/09

[FSP]
610 mg/L

RAM = 1.2

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South Y

3/17/09

[FSP]

28 mg/L;

RAM = 5.0

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South Y

2/18/10

[FSP]
725 mg/L

RAM = 1.9

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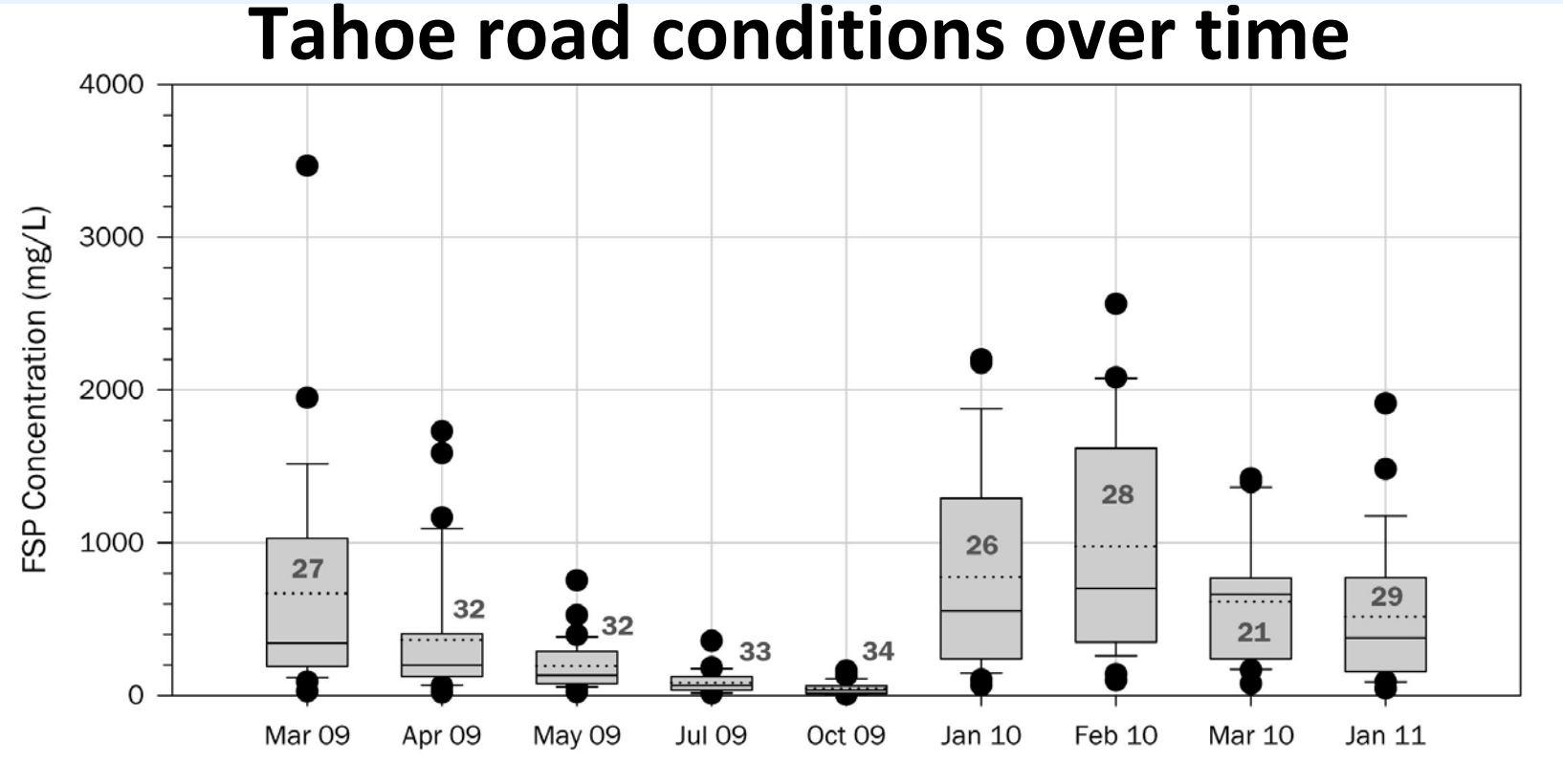

WY09-WY11 all road samples
34 sites across jurisdictions and road types

n = 267

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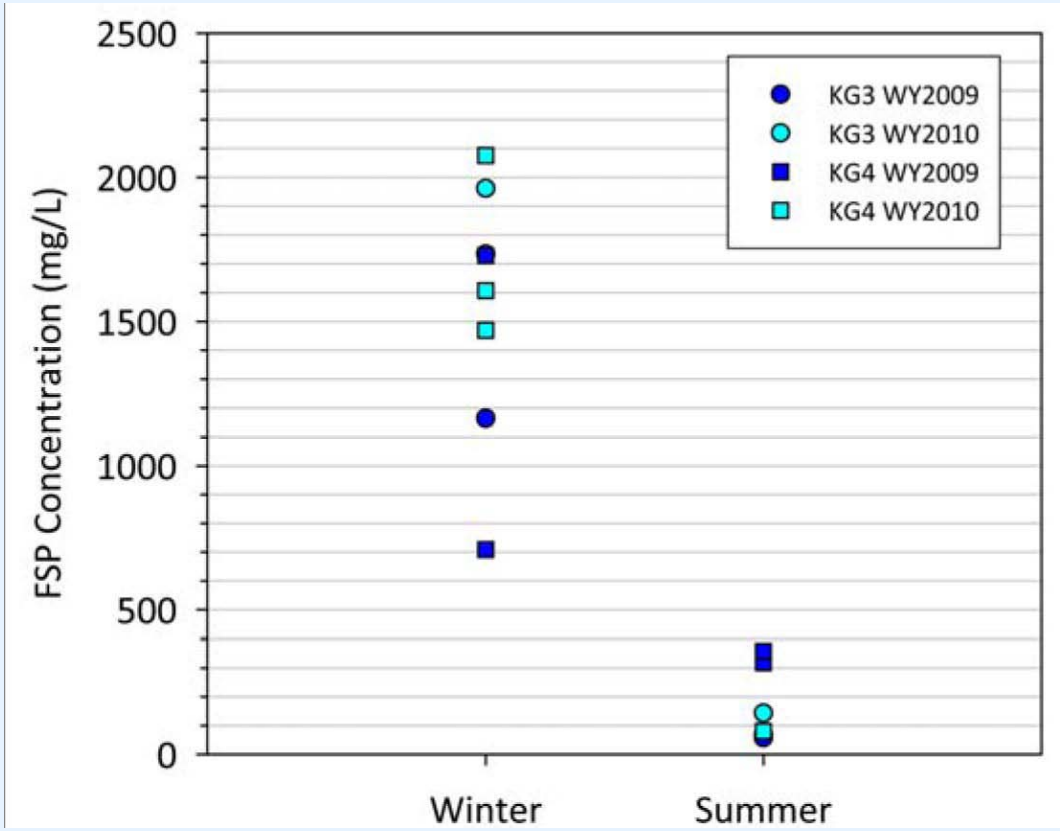
2 sites where abrasive applied, no recovery; road conditions still better in summer



n = 8 *n* = 8

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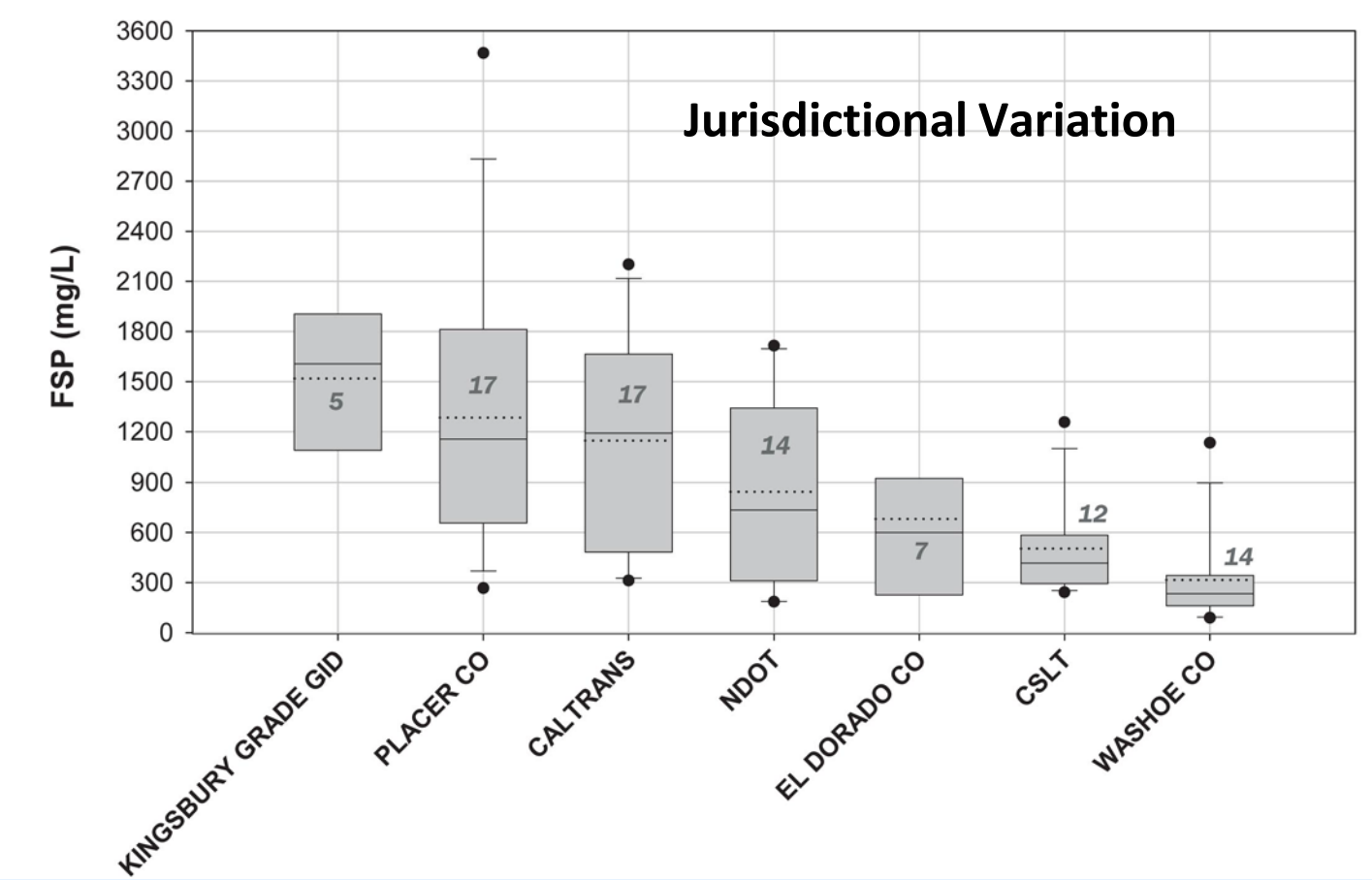
Is Road RAM score sensitive to road maintenance practices?



Winter samples only (Dec-March)
No roads where abrasives are not applied

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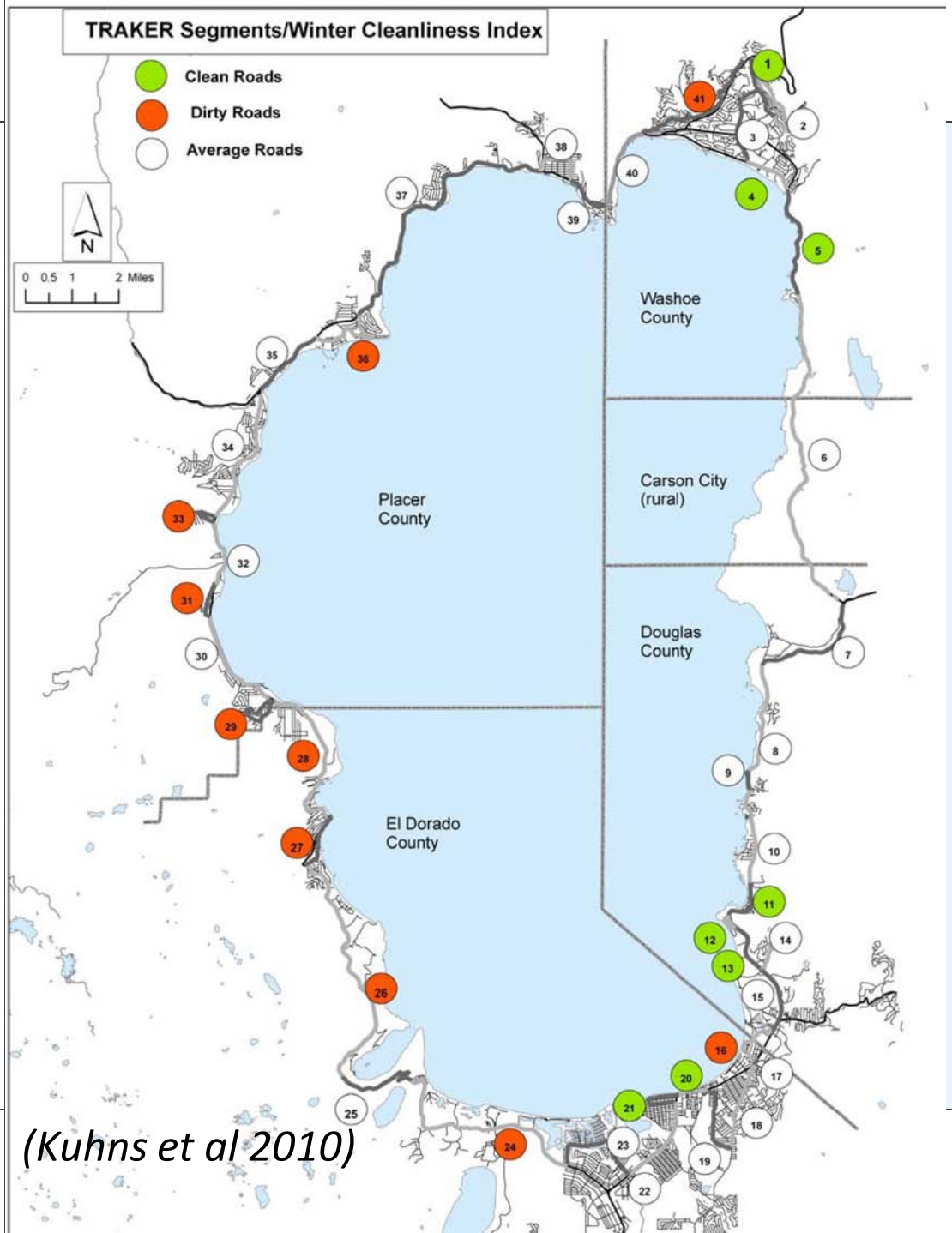

(Kuhns et al 2010)

Is Road RAM score sensitive to road maintenance practices?

Jurisdictional Variation winter

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2N validation Jan 26-27 2011

Two trained personnel
31 sites

METRIC	MM	TM	DIFFERENCE
	RAM SCORES	RAM SCORES	
AVERAGE	1.7	1.7	**0.2**
MAX	3.3	3.3	**0.5**
MIN	0.7	0.9	0.0

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Can Road RAM validate PLRM Road Methodology?

YES
but PLRM improvements and tool integration will improve alignment.

PLRM

- Predicts average annual road condition
  - expressed as a FSP CRC by RISK
  - simple conversion to score.

- Sensitive to actions that reduce sources, increase sinks

Road RAM

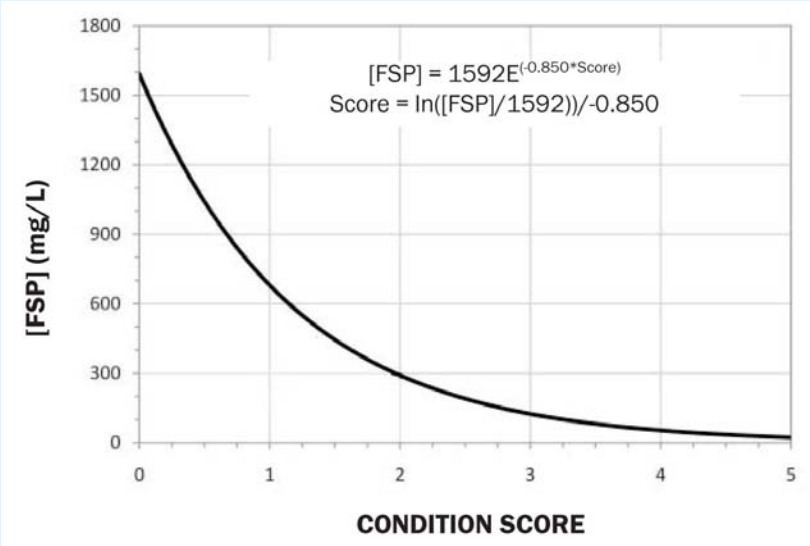
- Measures instantaneous road condition
  - expressed as score by CLASS
  - simple conversion to FSP CRC.

- Sensitive to actions that reduce sources, increase sinks

PRLM Road Methodology

Input series of actions by RISK to reduce CRC/improve condition

Road Risk	FSP CRC (mg/L)	Score
SHR	574	1.2
SMR	291	2.0
SLR	53	4.0



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Mapping different road attributes that can be compared.

PRLM Road Methodology (2005-06)

RISK: objective approach to categorize relative sources.

Road RAM (2010)

CLASS: research road conditions most sensitive to practices
revised approach to categorize relative sources from research
RAM uses CLASS to spatially extrapolate RAM observations
Can easily be incorporated into PLRMv2

CLASS will assist jurisdictions with road maintenance strategy development

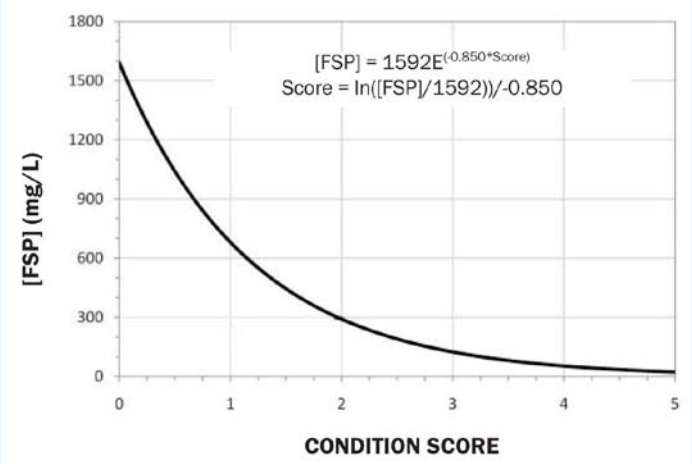
PRLM improvements

•CLASS replaces RISK
•User sets future expected RAM score by CLASS
•PLRM translates to FSP CRC and completes catchment loading calculations

Priority Research

• Improve correlation between road maintenance practices to Road RAM scores

• Catchment validation clean roads equate to lower FSP loads



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Program Applications

1) Basin-wide Restoration Progress Report
2) Jurisdiction Stormwater Programs
3) Lake Clarity Crediting Program

POLICY ASPECTS

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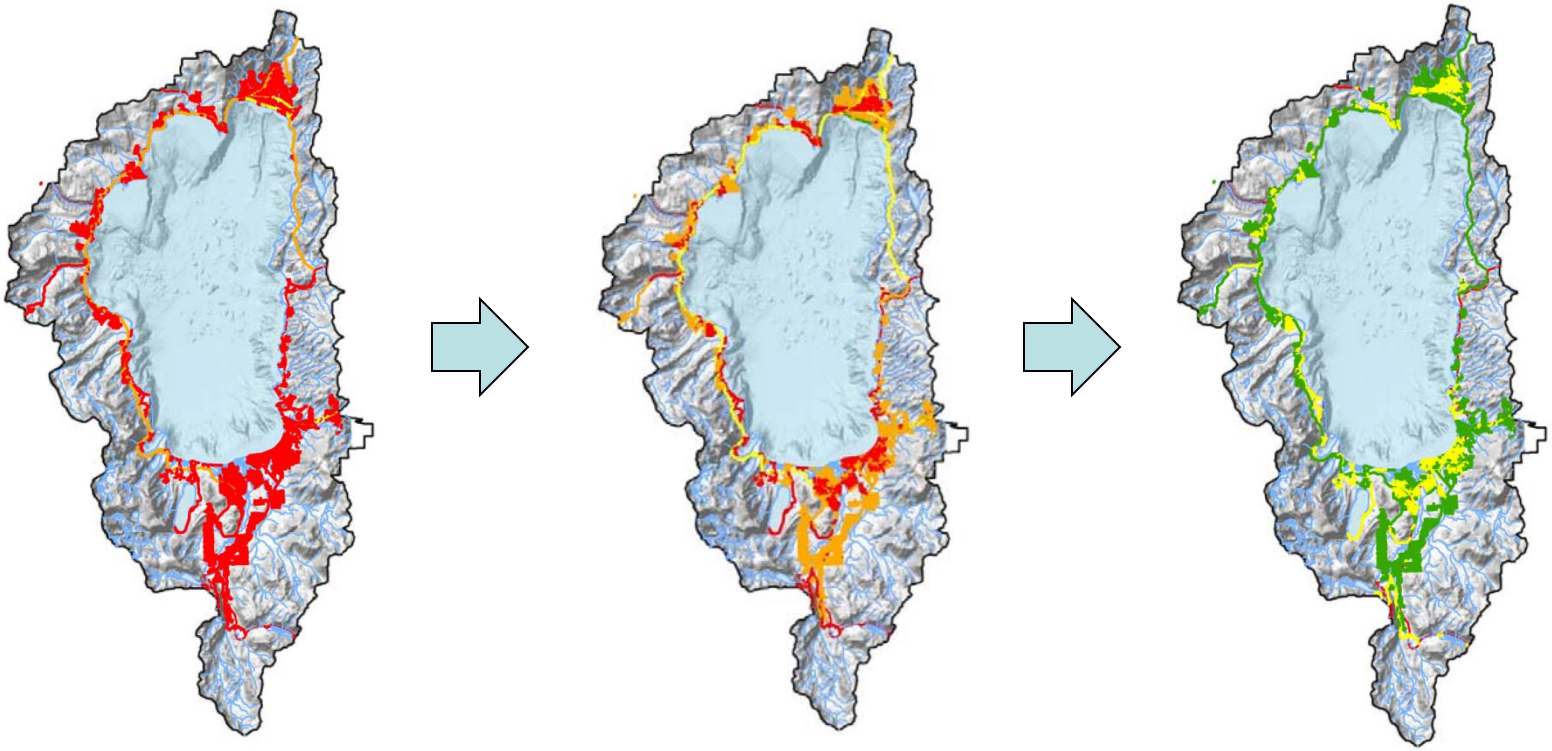
Basin-wide Progress Reporting



2004 2012 2020

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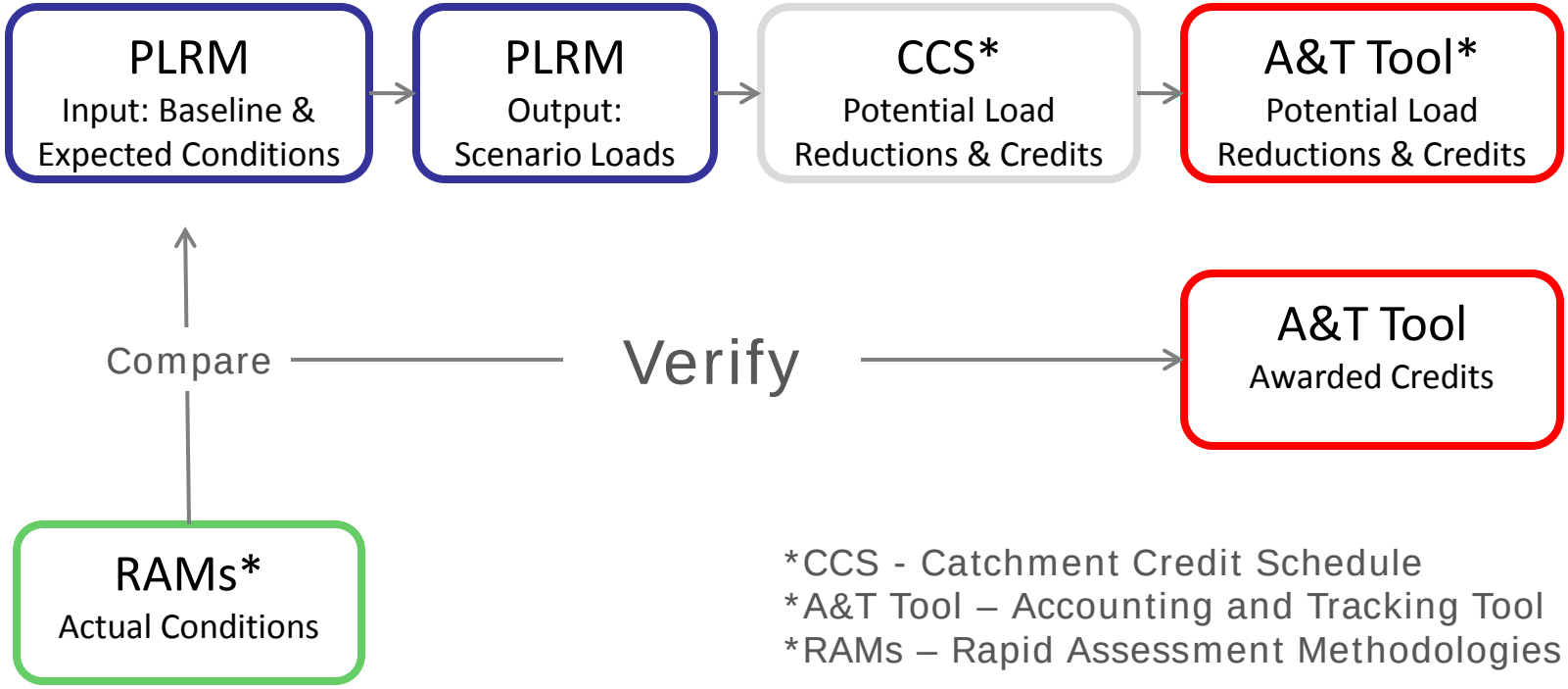
Jurisdiction Stormwater Programs

- Primary uses -
  - Targeting action
  - Operations feedback
  - Cost effectiveness information
  - Quick and consistent communication
    - Internal with crews
    - External

Lake Clarity Crediting Program

- Primary use: assess conditions
  - Provide back up for credit awards



*CCS - Catchment Credit Schedule
*A&T Tool – Accounting and Tracking Tool
*RAMs – Rapid Assessment Methodologies

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Level of Effort

- Balancing needs for
  - Operations feedback
  - Diversion from necessary operations work
- Two-tiered approach
  - Calibration Years: Every 5th year
  - Check-up Years: 4 out of 5 years
- Optimizing
  - Number of Segments Assessed and score variability
  - Number Observation Periods

Estimated Effort

- Effort estimate includes Road RAM
  - Field time
  - Data entry
  - Annual reporting
- Conservative assumptions
  - 15 minutes/segment
  - 6 hr days
  - Admin/overhead time removed
  - Extra time for data entry & annual reporting
- Results
  - 23% FTE for Calibration; 8% FTE for Check-up

WRAP UP

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Pressing Questions Answered

- Technical
  1. WQ representativeness -> best science avail, 75% of variance
  2. O&M sensitivity-> jurisdictional differences
  3. Repeatability -> low deviations for trained observers
  4. PLRM comparability -> yes, but not yet aligned; will be soon
- Policy
  1. Programmatic uses-> Basin-wide, jurisdiction, TMDL crediting
  2. Level of effort ->
     - Scientific minimum of observation times & points
     - 4 of 5 years low effort, about 8% FTE

- Other pressing questions?

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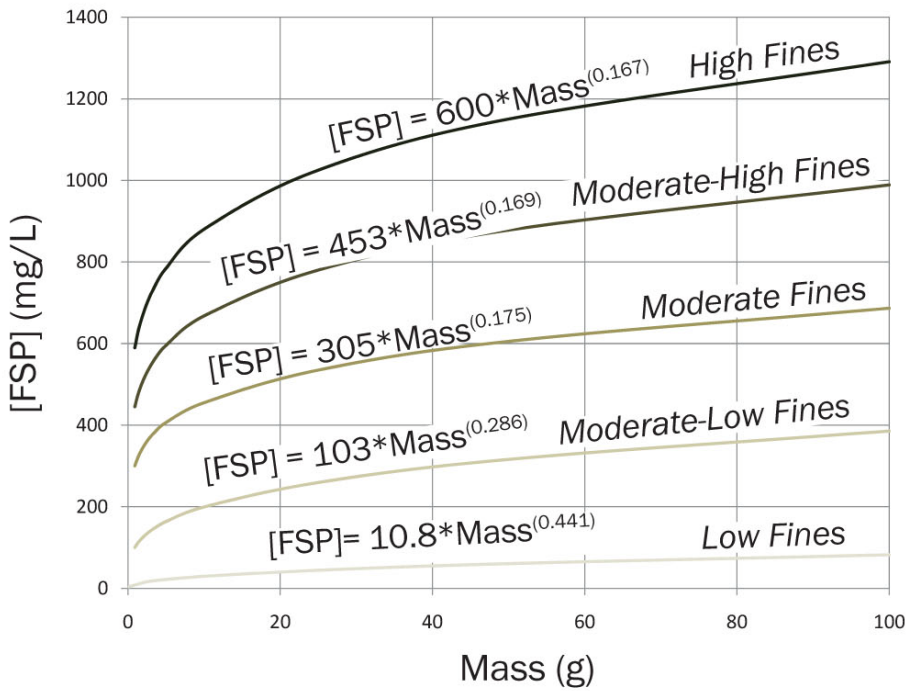
GROUP DISCUSSION

ADDITIONAL SLIDES

RAM Statistical Model

Visual proxy correlated to measured [FSP]



$[FSP]_{HEAVY}$

$[FSP]_{MODERATE}$

$[FSP]_{LIGHT}$

*Mass + Degree of Fines = FSP Concentration [**FSP**] (mg/L)*

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Road Class flexibility

Sweeping effectiveness (*sinks*)	**Abrasive application priority (*sources*)**		
	Intensive (A) *high sources*	Moderate (B)	Rarely to Never (C) *low sources*
Intensive (X) *high sinks*	AX	BX	CX
Moderate (Y)	AY	BY	CY
Rarely to Never (Z) *low sinks*	AZ	BZ	CZ

A: intensive abrasives volcanic

B: intensive abrasives high hardness

C: rarely abrasives

X: Best Sweeper: high intensity

Y: MB moderate + Sed Traps

Z: Rarely swept

Number of Segments Assessed

TABLE 9.3. Calibration year number of road segments and target standard deviation for each road class.

Sweeping Effectiveness	Abrasive Application Priority		
	Priority (A)	Moderate (B)	Rarely to Never (C)
Priority (X)	15 /±0.5	12 /±0.75	8 /±1.0
Moderate (Y)	15 /±0.5	12 /±0.75	8 /±1.0
Rarely to Never (Z)	15 /±0.5	15 /±0.5	12 /±0.75

TABLE 9.4. Check-up year number of road segments and target standard deviation for each road class.

Sweeping Effectiveness	Abrasive Application Priority		
	Priority (A)	Moderate (B)	Rarely to Never (C)
Priority (X)	8 /±0.6	5 /±0.9	3 /±1.3
Moderate (Y)	8 /±0.6	5 /±0.9	3 /±1.3
Rarely to Never (Z)	8 /±0.6	8 /±0.6	5 /±0.9

Reference: Road RAM Tech Document, p. 8.4

Number of Observation Periods

Season (months)	CALIBRATION YEAR Minimum # of Observation Periods (% weighting)	CHECK UP YEAR Minimum # of Observation Periods (% weighting)	Specific Timing and Rationale
Fall (Oct-Dec)	1 (20%)	0 (0%)	Observations should occur prior to first winter rain event. Stormwater runoff event probability of occurrence is high.
Winter (Jan-Feb)	1 (20%)	1 (33%)	Road condition expected to be at annual low when abrasive application occurs frequently. Larger stormwater runoff event probability of occurrence is low, typical runoff is gradual localized snowmelt.
Late Winter/ Early Spring (March-April)	2 (40%)	2 (66%)	Air temperature increases and snow fall frequency decreases, providing opportunity for aggressive sweeping. Stormwater runoff event probability of occurrence increases to moderate/high. All observations must be conducted prior to first significant (1 in/12hr) rainstorm event washing roads clean.
Spring (May-June)	1 (20%)	0 (0%)	Snowmelt and spring snow and rain events with frequent runoff. Temperatures provide opportunity for sweeping. Probability of roads being washed by a spring rain event is high.
Summer (July-Sept)	0 (0%)	0 (0%)	Road conditions expected to be at annual high due to extended duration since last abrasive applications and road cleaning by spring/summer rains.

Reference: Road RAM Tech Document, p. 8.6

Jurisdiction Choices

- Entire jurisdiction as “area of interest”
  - Minimize level of effort
  - Practical for field crews: catchment differentiation
  - Road Class consistent across all catchments
    - Easier annual SW report – Road Class Table
- Selecting Field Personnel
  - Develop an “eye” for conditions
  - Best practice to occasionally use SW mgrs.

Development Process

• Review literature & Tahoe practices	• 2008
• Defined conceptual approach	• 2008
• Created road risk & GIS	• 2008
• Intensive road measurements	• 2008-10
• Developed protocols	• 2009
• Check field protocols	• April
• Test extrapolation concepts	• May
• Develop draft products	• August
• Review products with PAC	• Aug/Sept.
• Incorporate comments, finalize	• October

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Road RAM Level of Effort Estimate

	Callibration Year	Checkup Year
Field Observation Time		
# Segments	112	53
Minutes/Segment	15	15
Observation Periods/year	5	3
Minutes/Hour	60	60
Hours/Day	6	6
Days/Year/Person	23.3	6.6
# People	2	2
Subtotal # Person-Days	46.7	13.3
Data Entry & Analysis Time		
# Person-Days/Observation Period	1	1
Subtotal # Person-Days	5	3
Annual Reporting Time(1)		
Subtotal # Person-Days/Year	2	2
Total Time (Person-Days)	53.7	18.3
Work Days/Year(2)	235	235
% Full Time Equivlent Position	**23%**	**8%**

Notes:

(1) Annual reporting time is included, but may be over-estimated because other reporting needs are already in place and this reporting will not increase time proportionately

(2) 260 work days is a typical estimate for work days in a year, this estimate uses 235 days to account for holidays, vactions and sick days

(3) this time estimate assumes that the user has some experience with the Road RAM. The first attempts to do any of the tasks will take extra time to learn the process

(4) List of concervative assumptions:
* 15 min/ segment (probably 10 min)
* 6 hour days (other work)
* 235 days/year (accounts for PTO and sick)
* 1 day/period for data entry (could be none)
* 2 day/year for reporting (could be 1)

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Road RAM Future Development

1. Integration with other tools
   - PLRM
   - Accounting & Tracking Tool
2. Database features – internalize mapping
3. Catchment-scale validation testing
   - Confirm loads vary with road conditions
4. O&M practices effectiveness study
5. Create Road Class Maps
6. Reevaluation of observation period numbers
   - How many periods annually?
   - What are acceptable standard deviations?

Credit Award Example

(Hypothetical for one road class)

	Estimated Condition (PLRM)	Estimated Load Reduction (PLRM)	Actual Condition (Road RAM)	Estimated Credits (A&T Tool)	Awarded Credits (A&T Tool)
Year 1	2.3	4000 lb. FSP	1.0	20	0/partial
Year 2	2.3	4000 lb. FSP	1.9	20	20
Year 3	2.3	4000 lb. FSP	2.5	20	20
Year 4	4.1	8000 lb. FSP	4.0	40	40

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