Management/Funding of Wyoming Transportation Infrastructures

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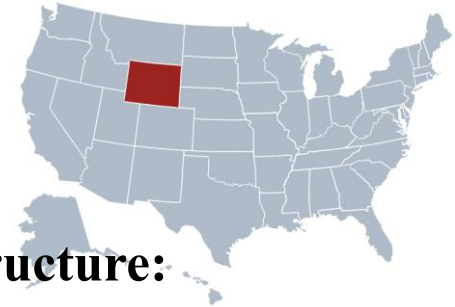
Wyoming Technology Transfer Center
WY T^2
LTAP
Local Technical Assistance Program

UNIVERSITY OF WYOMING

Introduction



- **Key Facts about Wyoming's Infrastructure:**

- 33 public-use airports in Wyoming
- Air travel accounts for 8% of all person miles of travel.

- 19% of major roads are in poor or mediocre condition.
- $354 per motorist per year in costs from driving on roads in need of repair.

- 344 bridges (11%) are structurally deficient.
- $13,197,824 on bridge capital projects in 2013

- Traffic congestion costs American motorists $170 billion a year in wasted time and fuel costs.

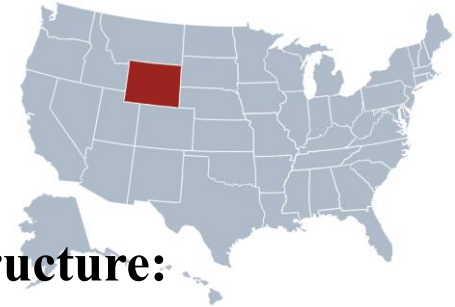
2017 INFRASTRUCTURE REPORT CARD

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

TRIP a national transportation research group

UNIVERSITY OF WYOMING

Introduction



❑ Key Facts about Wyoming's Infrastructure:

2016

- Vehicle travel on Wyoming's highways increased by 15%
- Wyoming's population grew by 17%

2000

- Roadway features contribute in 33% of traffic fatalities.
- Wyoming's traffic fatality rate: 1.20 fatalities per 100 million vehicle miles (national average is 1.18).
- 112 traffic fatalities in 2016 in Wyoming.
- A total of 617 people died on Wyoming's highways from 2012 through 2016

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TRIP a national transportation research group

Introduction

❑ Wyoming Transportation Assets:

Pavement

- All roadway surfacing

Bridge

- All bridges that are on or off of the state owned highway system

Safety

- Items affecting the safety of transportation systems
- Guardrail, fences, side slopes, signs, snow fences, etc.

Mobility

- Includes additional lanes, intersection improvement, turning lanes, etc.

Environmental Sustainability

- Air quality improvements, wet land banking, animal-vehicle crash mitigation, archeological and historical preservation, etc.

Source: Wyoming Department of Transportation

Introduction

❑ Wyoming Transportation Assets:

Community Development

- Items enhancing community livability
- Sidewalks, ADA upgrades, pathways, etc.

Urban

- Items within urban boundary

Maintenance

- Items for general maintenance of roadways
- Fencing, sign or guardrail replacement, crack sealing, snow removal, etc.

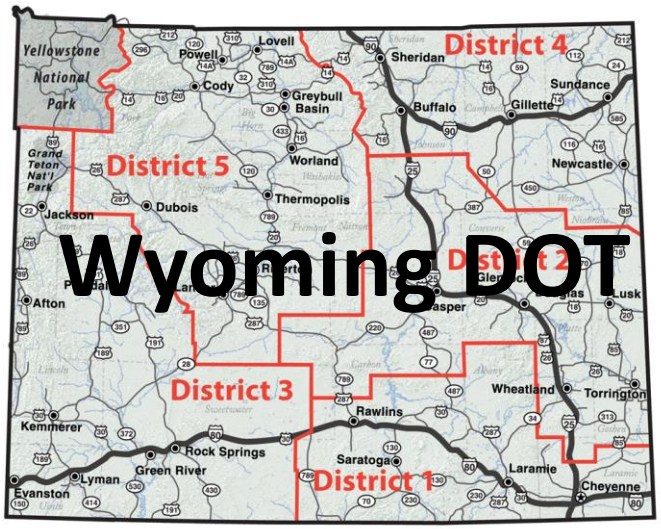
Other

- Other non-defined items

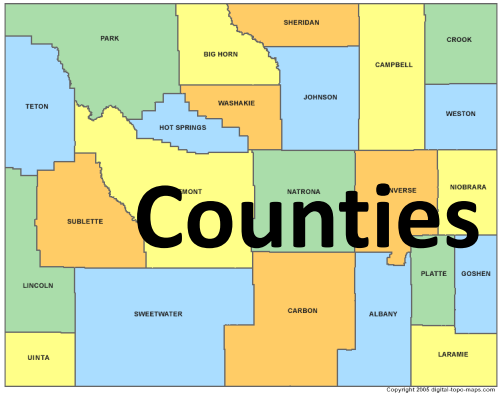
Source: Wyoming Department of Transportation

Introduction

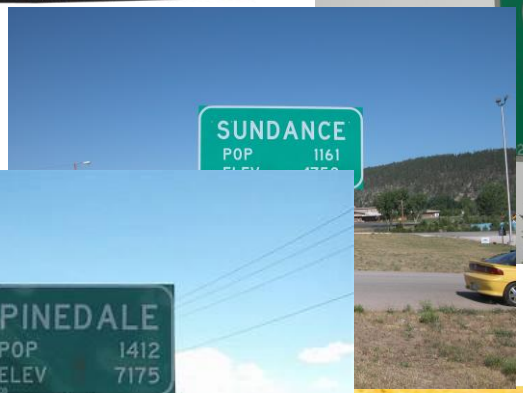
- Agencies managing Wyoming's Infrastructure:



Wyoming DOT



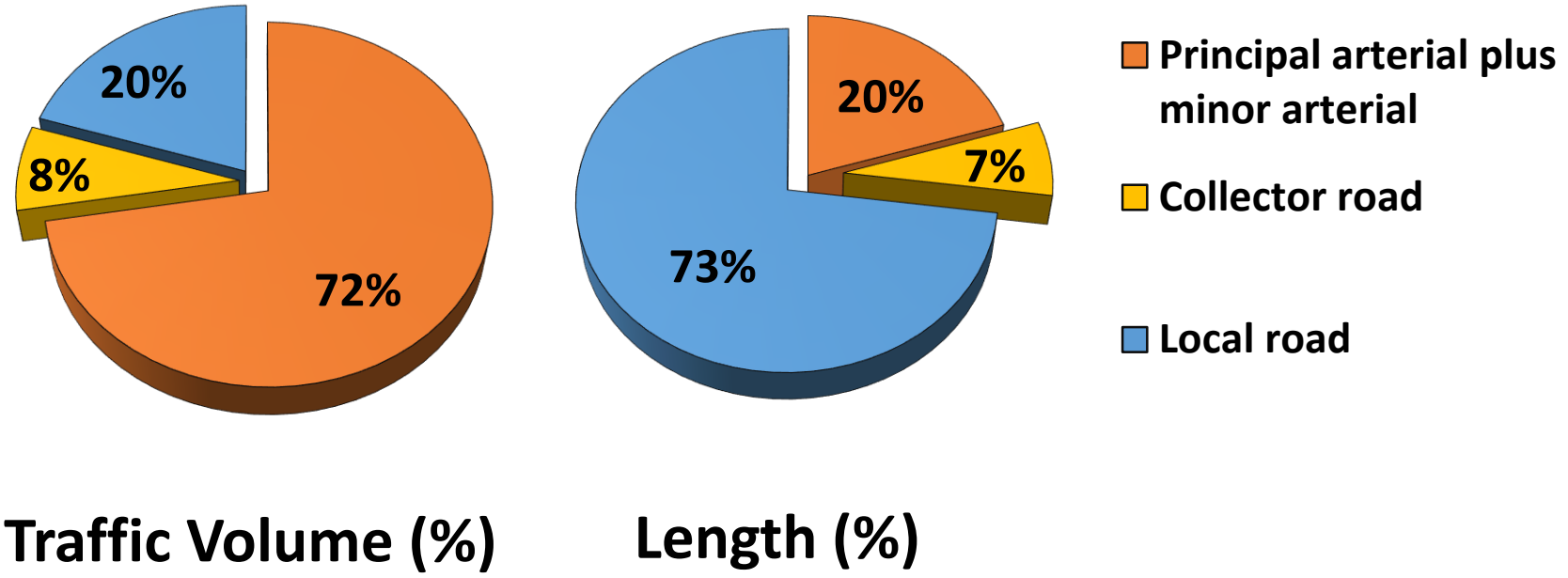
Counties



Cities and Municipalities

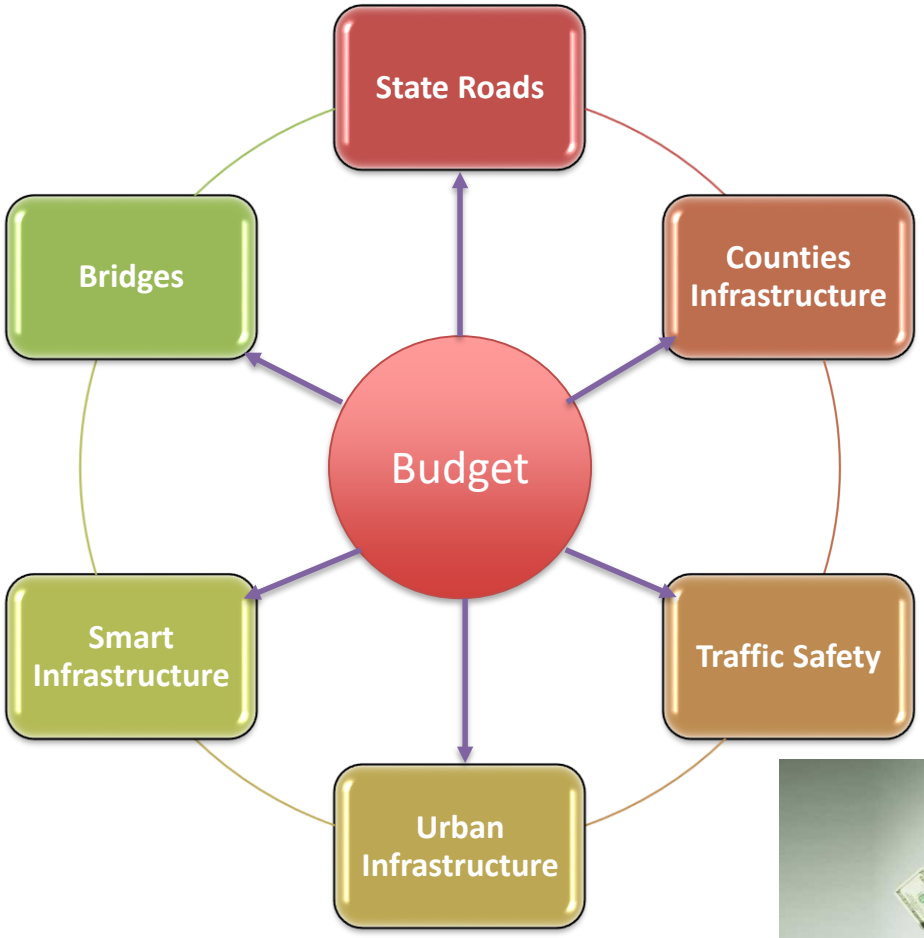
Background

❑ **Typical Distribution of Functional Systems**



Source: *A Policy on Geometric Design of Highways and Streets (AASHTO, 2011)*

Budget Allocation



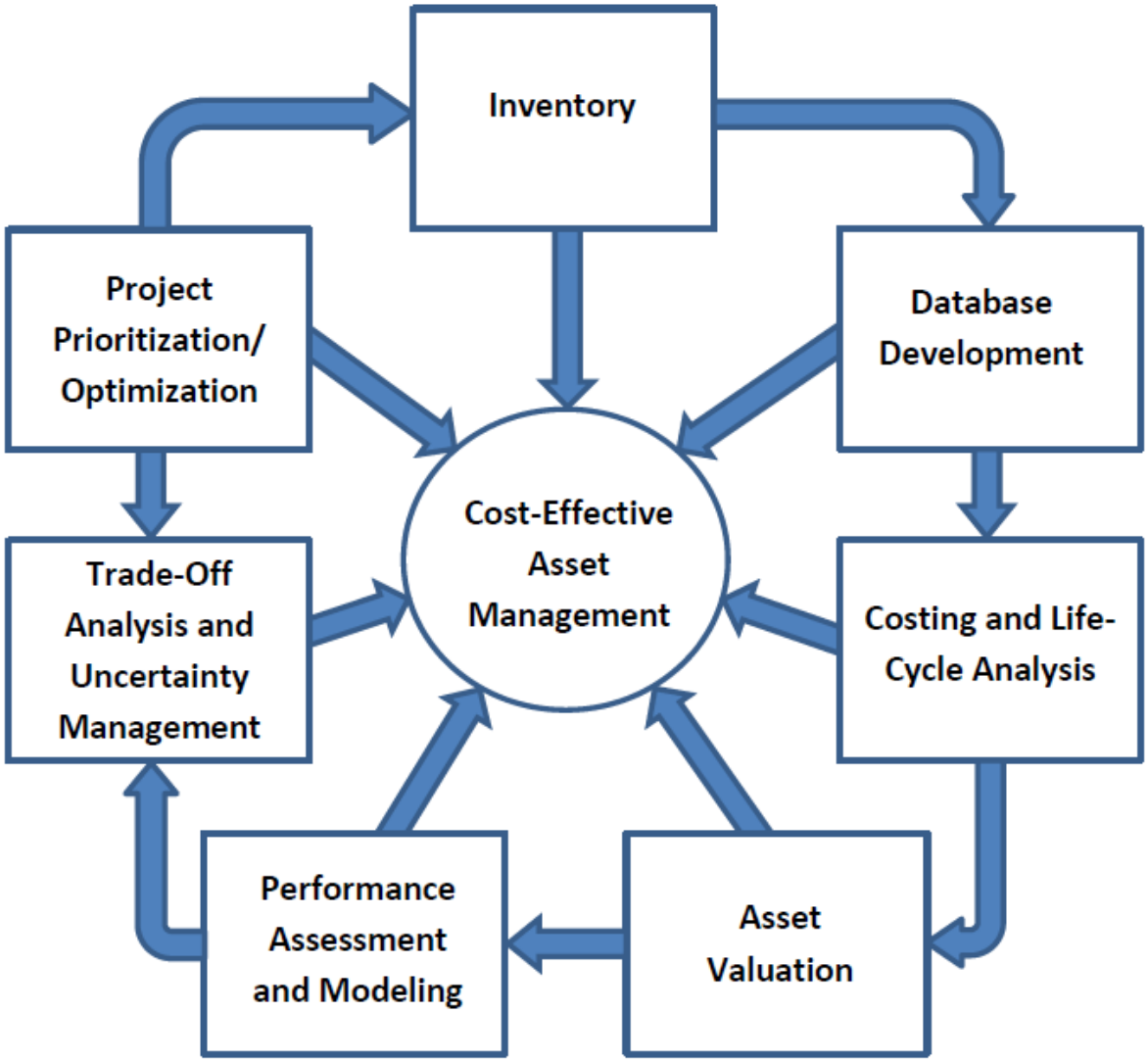
Infrastructure Asset Management

❑ Why is an asset management system needed?

- Funding provided by the FAST* Act falls short of the level needed to improve conditions and meet the nation's mobility needs.
- Deteriorating infrastructure impedes Wyoming's ability to provide an adequate, sustainable, and long-term revenue of infrastructure investments.
- President Trump's infrastructure plan, released in February 2018, would provide $200 billion in new federal grants over 10 years.
- State and local governments need knowledge-based management systems to face the escalating costs and risks of aging infrastructure system.

*Fixing America's Surface Transportation

Infrastructure Asset Management



Challenges

❑ Asset Management Challenges

- The desired goal is to maintain good conditions within all functional classification.
- Current funding levels are insufficient to accomplish this goal.
- With the nationally under-estimated infrastructure funding levels, **an optimal management system is required to minimize the lifecycle cost of infrastructure while maximizing its value with constrained fiscal funding.**

Optimization

- **Integrated-Optimization Management System**

Key factor of Asset Management

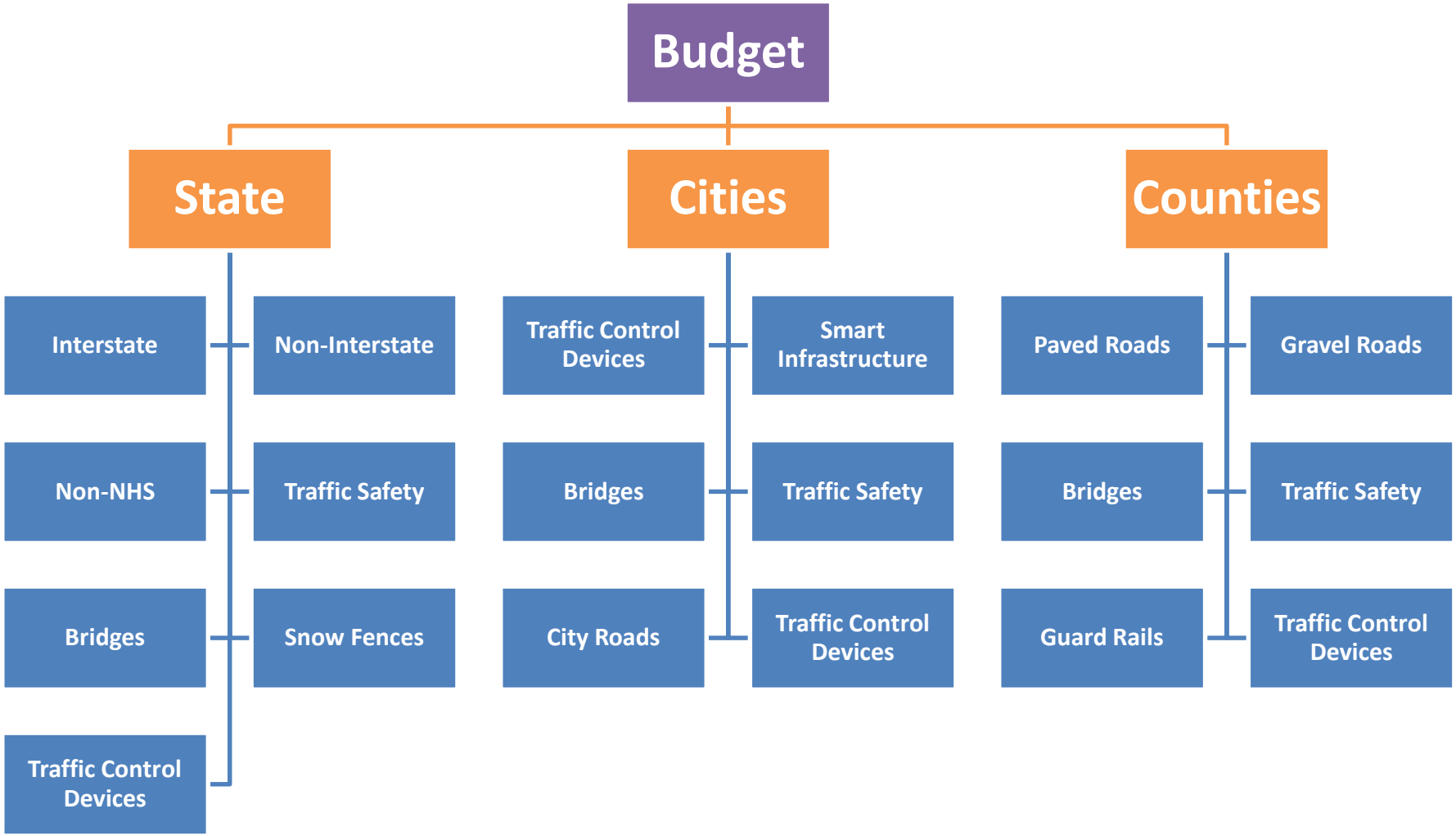
- **Inventory and Condition Assessment**







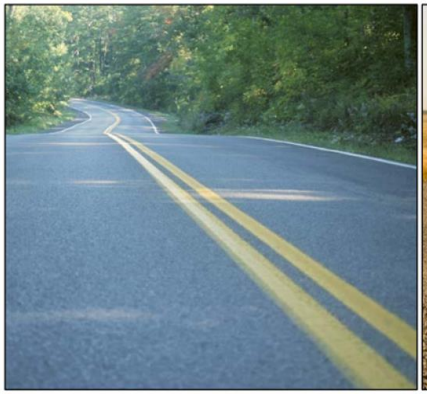

Transportation Infrastructure



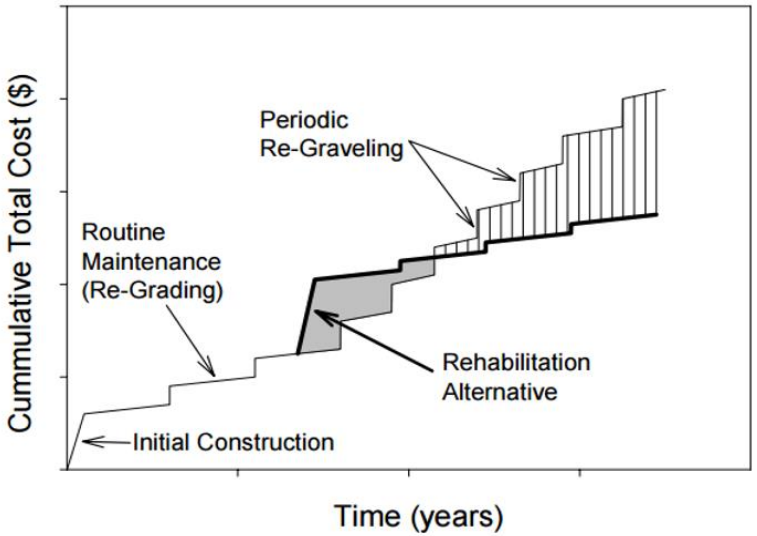
Management Efforts

- WYDOT has a good Asset Management program.
- Counties have an inventory system for their 2,400 miles of paved roads.
- Counties do not currently have any inventory system for their 12,000 miles of gravel roads or any of their other assets.
- Cities currently do not have any statewide management systems for any of their infrastructure.

County Roads



- **Types of Low-Volume Road Surfaces**
  - Paved roads using asphalt
  - Unpaved roads using gravel or stone surfaces
- **Framework for Selecting the Appropriate Surface**
  - Engineering Factors
  - Costs
  - Public Opinion



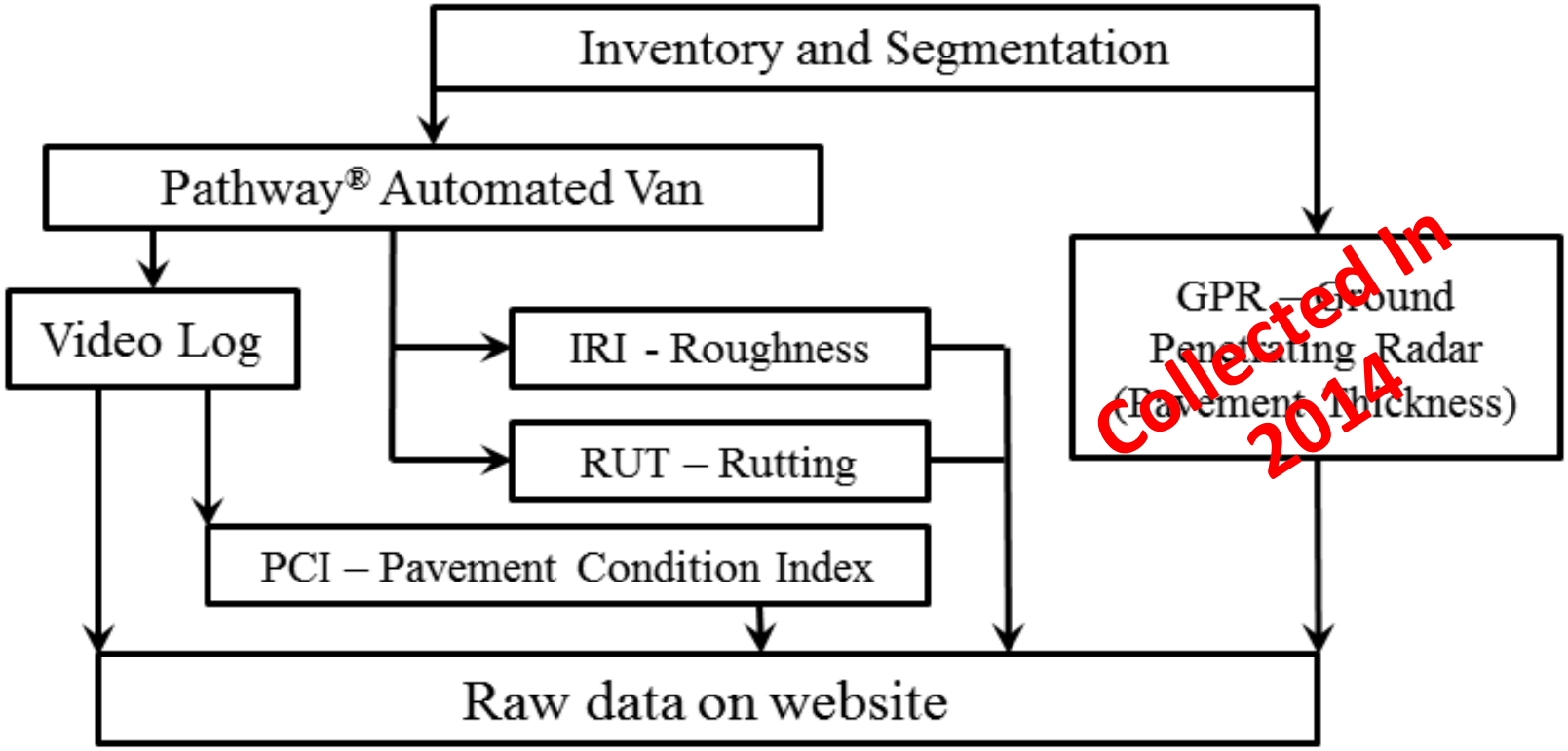
Road Cumulative Maintenance Costs of Different Surface Types

County Paved Roads

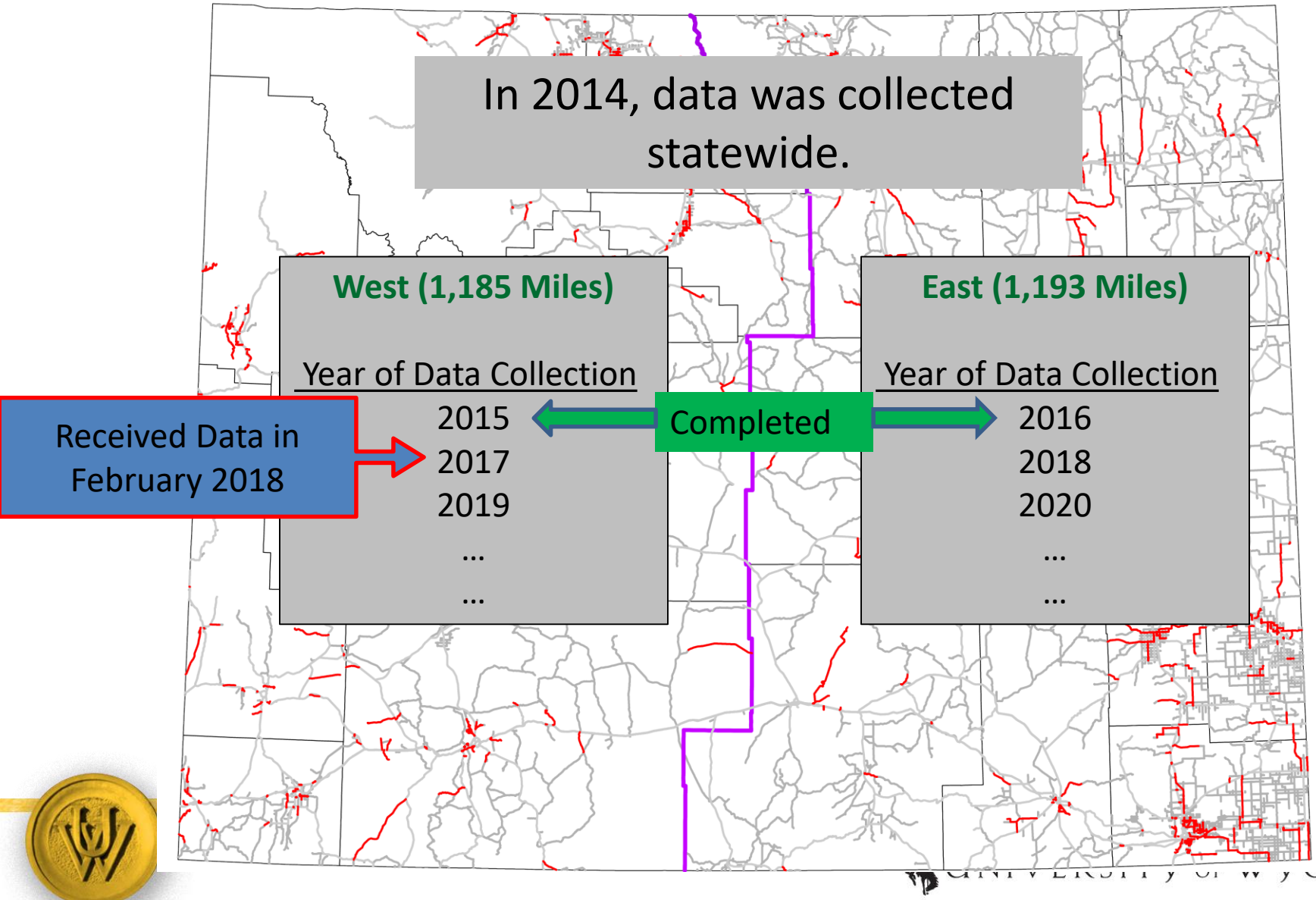
This program was initiated with cooperation among: Counties, WYDOT, and FHWA

- **Total Length:** 2,378 miles
- **Total Number of Segments:** 1,974
- **Minimum Length:** 52.8 ft.
- **Maximum Length:** 25.8 miles

County Paved Roads



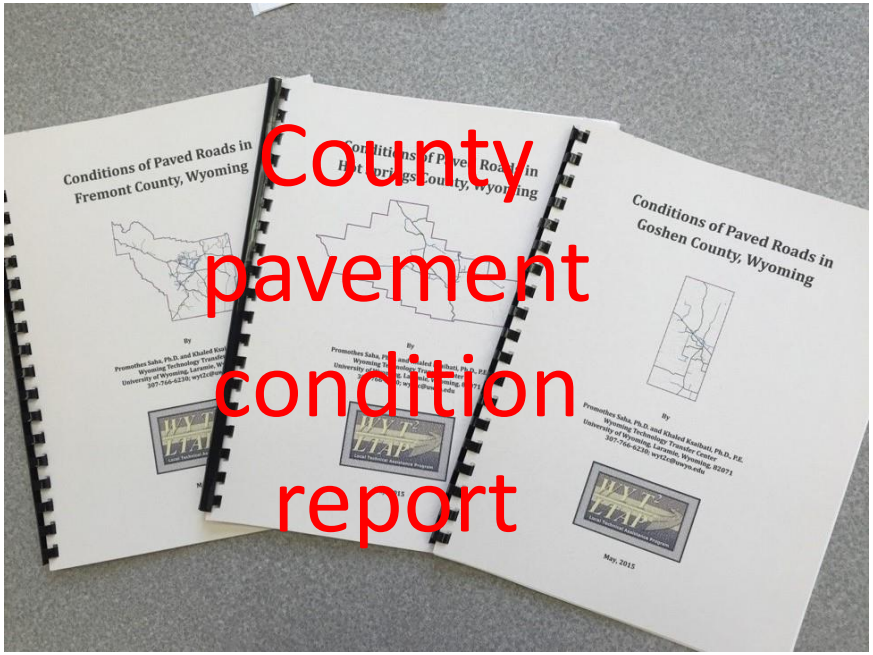
County Paved Roads



County Paved Roads

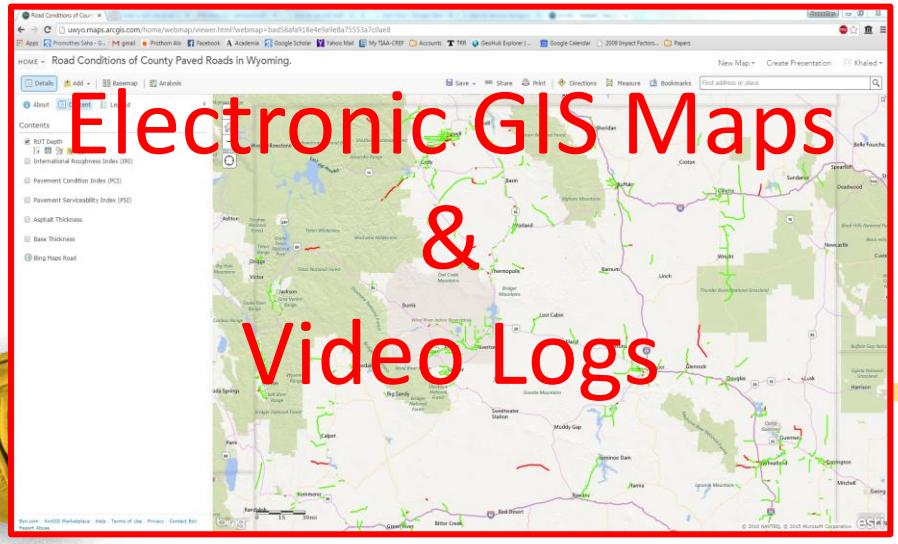
- International roughness index (IRI)
- Rutting
- Pavement condition index (PCI)
- Pavement serviceability index (PSI)

County Paved Roads

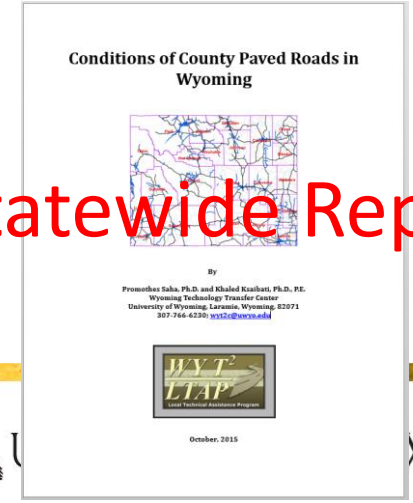


County pavement condition report

Electronic Data

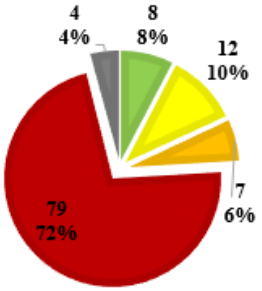


Electronic GIS Maps & Video Logs

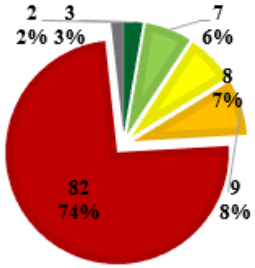


Statewide Report

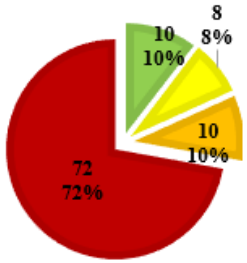
County Paved Roads



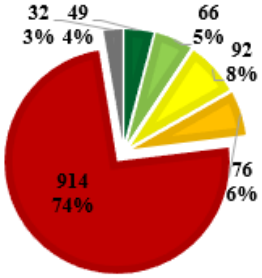
Big Horn County, 2014



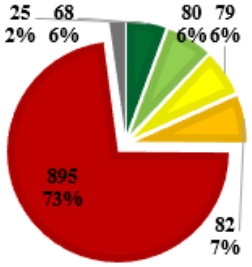
Big Horn County, 2015



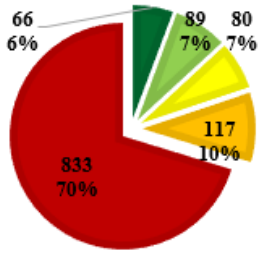
Big Horn County, 2017



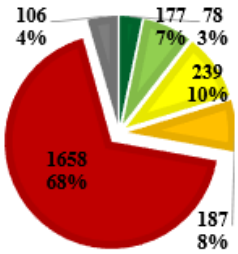
Western side of the State, 2014



Western side of the State, 2015



Western side of the State, 2017



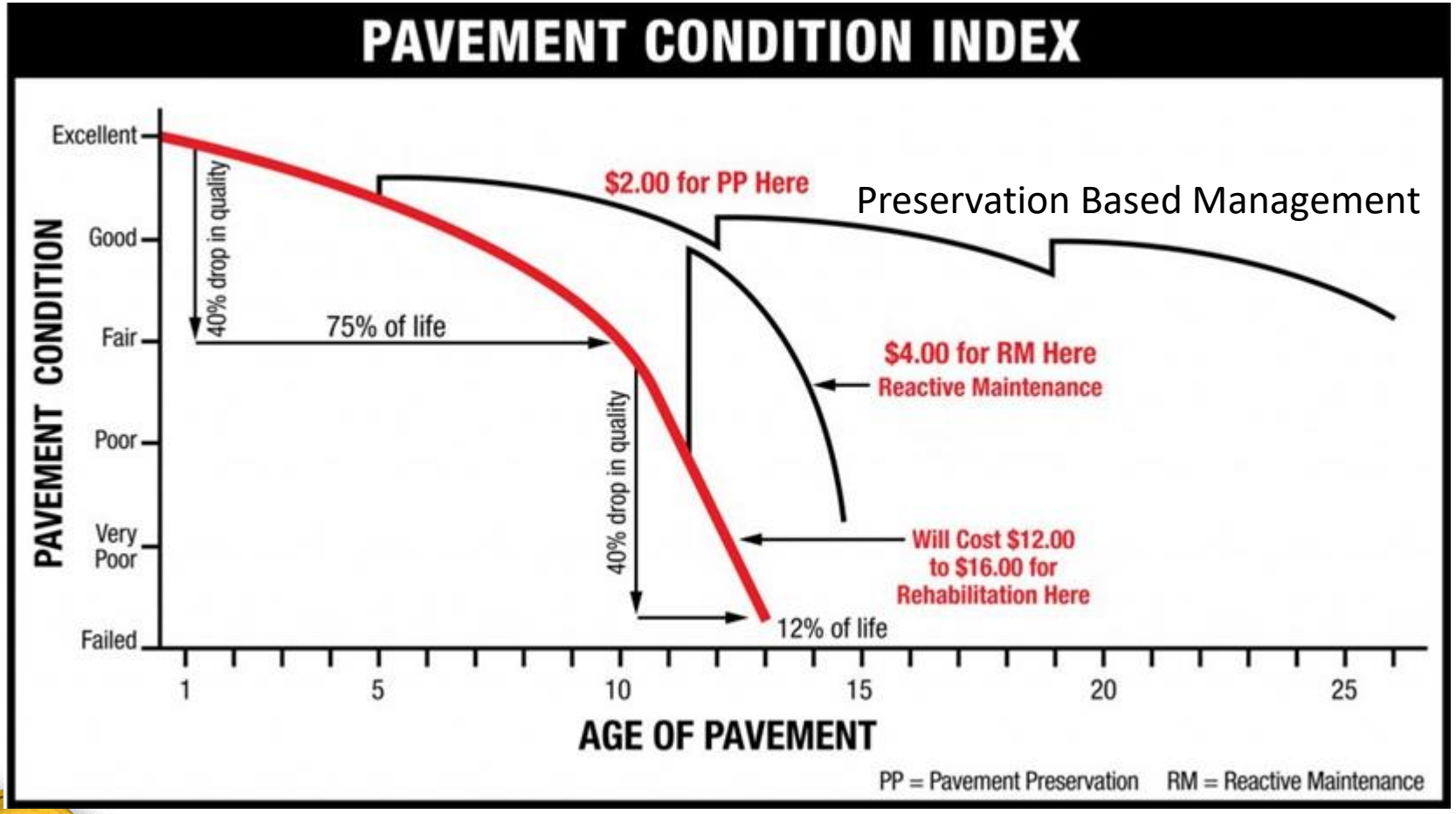
Statewide, 2014

Less than 2
2.00 - 2.50
2.51 - 3.00
3.01 – 3.50
Greater than 3.5
Not Available (N/A)

PSI

Rehabilitation cost

- **Pavement Performance and Maintenance:**



Challenges

- **Badly Deteriorated LVRs:**
  - Unserviceable roads
  - Local agencies are facing revenue shortfalls
  - Maintenance backlogs
  - With limited budgets: only few selected LVRs are rehabilitated
  - More deterioration to extreme level of distress

- **Maintenance Strategies**
  - Limited rehabilitation options
  - Alternative Solutions:
    - Holding Strategies
    - De-Paving

Source: *South Dakota LTAP*

Why this study is needed?

- Gravel roads are dynamic and their conditions change rapidly
- Local agencies have very limited resources
- Life-cycle cost analysis is not well implemented
- There is no long-term plan!!
- Decisions are made based on local considerations (i.e. the amount of complaints received)

Expected Benefits of GRMS

- Evaluating the current gravel road network condition
- Developing matrices for maintenance and rehabilitation identification
- Estimating future rehabilitation needs which can help in estimating the different funding needs
- Developing a general methodology that can be followed by all local agencies (consistency!)
- Providing legislatures with reliable data that can be used to justify or defense any funding needs for gravel roads

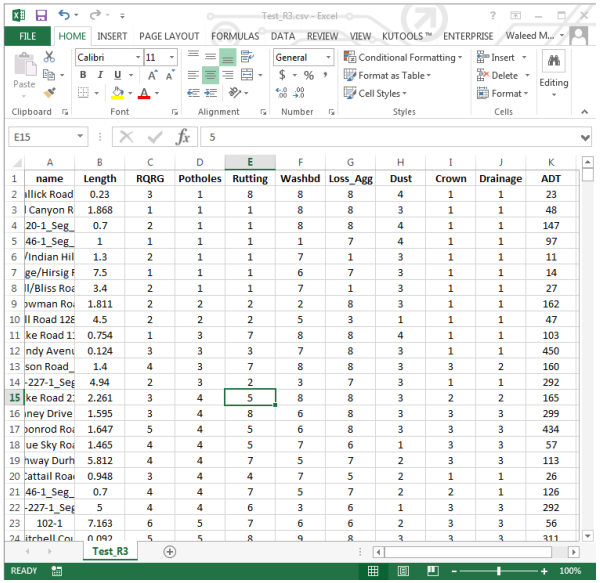
GRMS

Counties know the best maintenance practice for each road !

But they don't know →

Which roads should be maintained first?!

GRMS Program



	A	B	C	D	E	F	G	H	I	J	K
1	name	Length	RQRG	Potholes	Rutting	Washbd	Loss_Agg	Dust	Crown	Drainage	ADT
2	illick Road	0.23	3	1	8	8	8	4	1	1	23
3	l Canyon R	1.868	1	1	1	8	8	3	1	1	48
4	20-1_Seg_	0.7	2	1	1	8	8	4	1	1	147
5	46-1_Seg_	1	1	1	1	1	7	4	1	1	97
6	/Indian Hil	1.3	2	1	1	7	1	3	1	1	11
7	ge/Hirsig F	7.5	1	1	1	6	7	3	1	1	14
8	ll/Bliss Roa	3.4	2	1	1	7	1	3	1	1	27
9	owman Roa	1.811	2	2	2	2	8	3	1	1	162
10	ll Road 128	4.5	2	2	2	5	3	1	1	1	47
11	ke Road 1	0.754	1	3	7	8	8	4	1	1	103
12	ndy Avenu	0.124	3	3	3	7	8	3	1	1	450
13	son Road_	1.4	4	3	7	8	8	3	3	2	160
14	-227-1_Seg	4.94	2	3	2	3	7	3	1	1	292
15	ke Road 2	2.261	3	4	5	8	8	3	2	2	165
16	ney Drive	1.595	3	4	8	6	8	3	3	3	299
17	onrod Roa	1.647	5	4	5	6	8	3	3	3	434
18	ue Sky Roa	1.465	4	4	5	7	6	1	3	3	57
19	hway Durh	5.812	4	4	7	5	7	2	3	3	113
20	attail Roa	0.948	3	4	4	7	5	2	1	1	26
21	46-1_Seg_	0.7	4	4	7	5	7	2	2	1	126
22	-227-1_Seg	5	4	4	6	3	6	1	3	3	292
23	102-1	7.163	6	5	7	6	6	2	3	3	56
24	itchell Cou	0.092	5	5	8	9	8	3	3	3	311

Wyoming Technology Transfer Center (WYT2/LTAP)

Untreated Gravel Roads Optimization Tool

Genetic Algorithm Optimization Tool

Please input the different parameters related to the optimization problem:

Assigned Budget ($) 25000000

Light blading/routine maintenance (LB) ($/Mile) 250

Heavy blading/reshaping ditch/pulling shoulders (HB) ($/Mile) 1250

Treating gravel/dust control (TG)($/Mile) 5000

Major drainage repair (DR) ($/Mile) 15000

Regravel/building up road (RG) ($/Mile) 50000

Reconstruction/rehabilitation (RC) ($/Mile) 200000

Please input the diffferent parameters related to the genetic algorithm:

Mutation Rate 0.15

Initial Population Size 300

Maximum Time without Improvement (Minutes) 2

Choose File no file selected | Upload Variables | Setup GA | Run GA

Optimization results:

Iteration Number

Best Fitness Achieved

Estimated Required Budget ($)

Total Length of Treated Roads(Miles)

Time Elapsed (minutes)

Show Optimization Results | Save | Refresh

Click the save button to download the optimization results or click the refresh button to start over!

For more information about this tool:

Wyoming Technology Transfer Center

1000 E. University Avenue, Dept. 3295

Campus Location: EN 2094

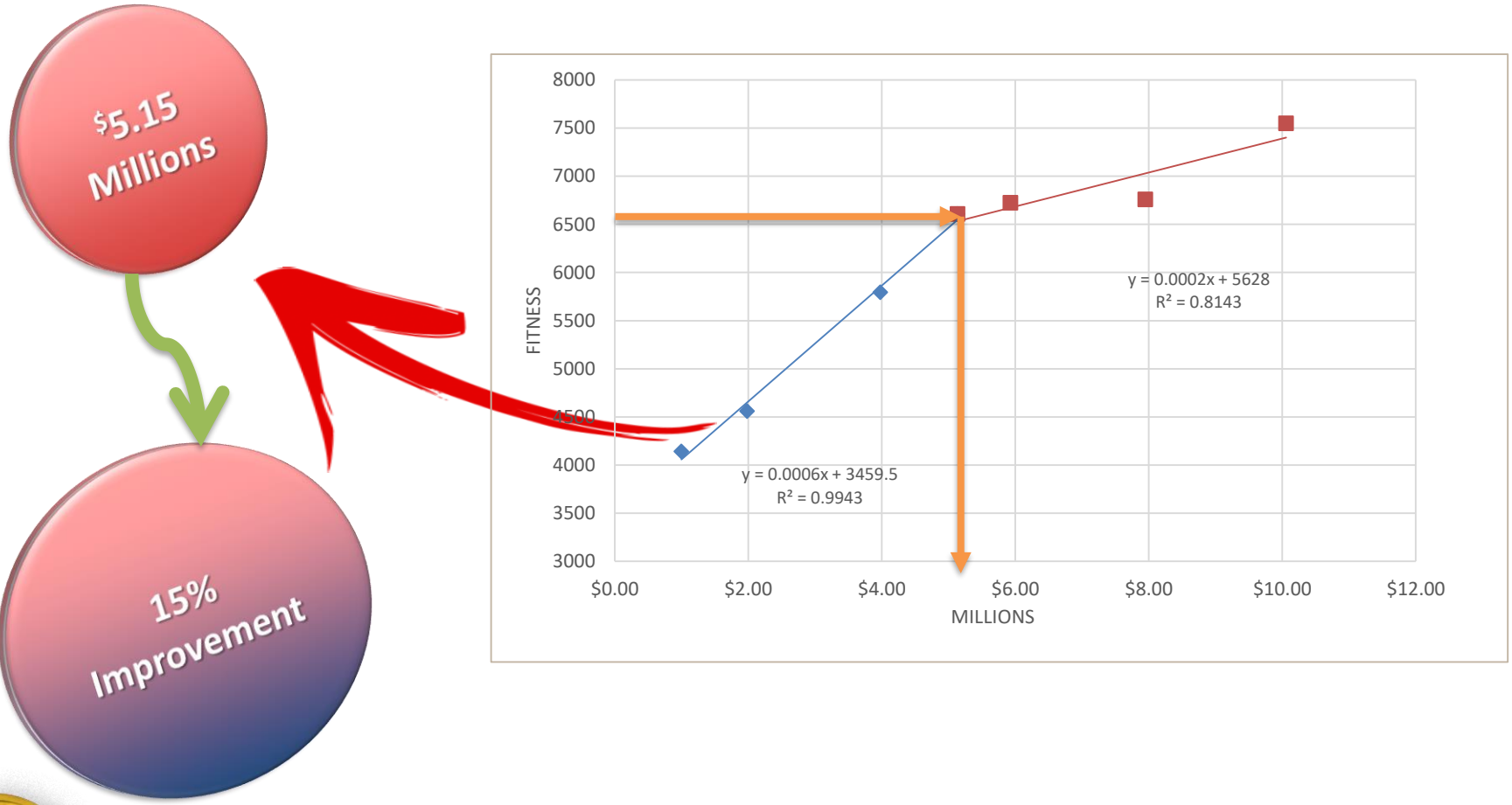
Laramie, WY 82071

Phone: 307-766-6743

Email: wyt2c@uwyo.edu

GRMS

- Critical Budget:



Problem Statement

Why this study is needed?

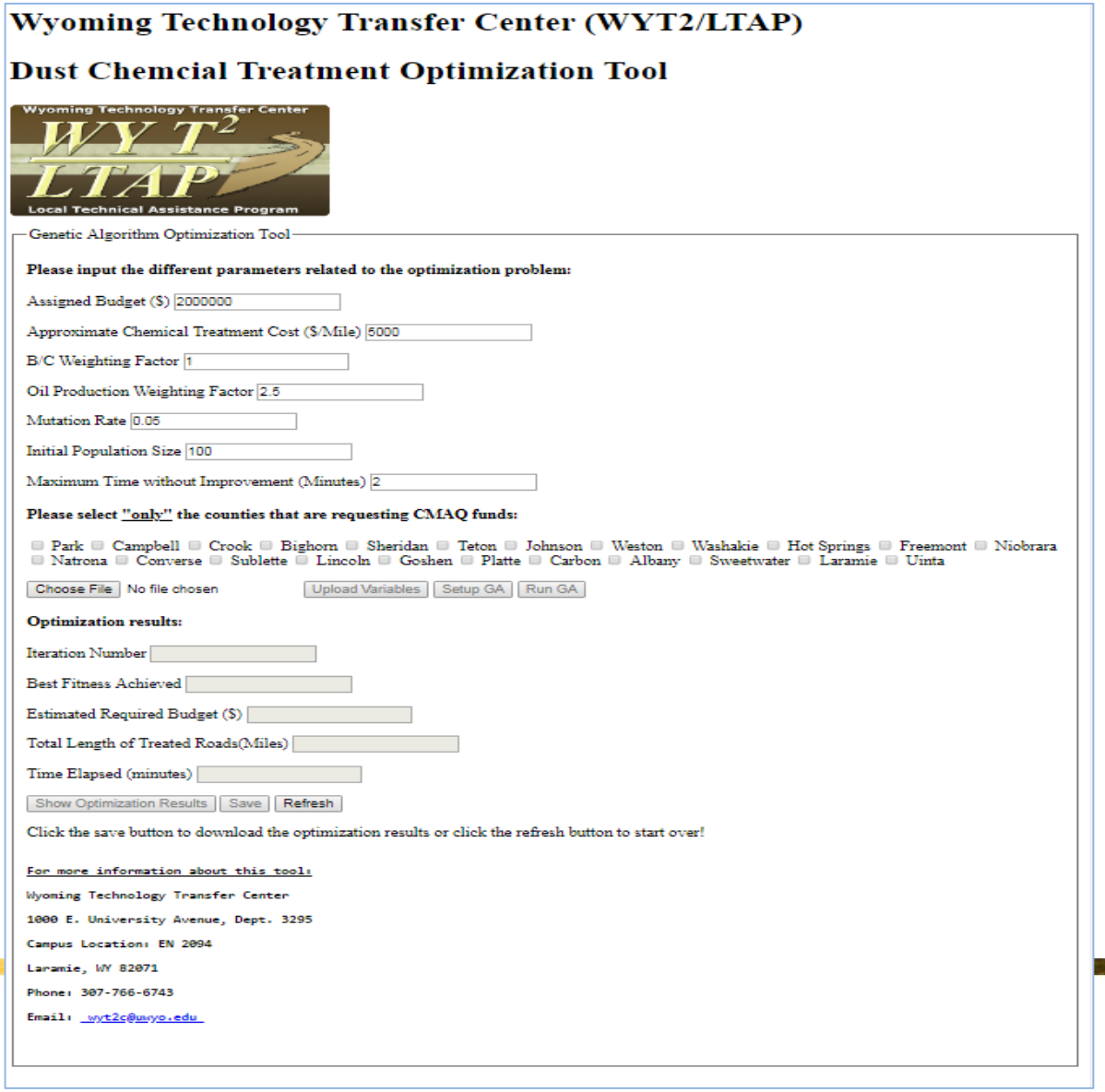
CMAQ

Which roads should be treated ?!

- Some of the important factors to be considered:
  - Environmental impacts
  - Road surface materials
  - Traffic characteristics
  - Mineral production
  - Weather conditions

Chemical Treatments of Gravel Roads

- **The developed Tool:**



Wyoming Technology Transfer Center (WYT2/LTAP)

Dust Chemcial Treatment Optimization Tool

Genetic Algorithm Optimization Tool

Please input the different parameters related to the optimization problem:

Assigned Budget ($) 2000000

Approximate Chemical Treatment Cost ($/Mile) 5000

B/C Weighting Factor 1

Oil Production Weighting Factor 2.5

Mutation Rate 0.05

Initial Population Size 100

Maximum Time without Improvement (Minutes) 2

Please select "only" the counties that are requesting CMAQ funds:

Park Campbell Crook Bighorn Sheridan Teton Johnson Weston Washakie Hot Springs Freemont Niobrara
Natrona Converse Sublette Lincoln Goshen Platte Carbon Albany Sweetwater Laramie Uinta

Choose File No file chosen Upload Variables Setup GA Run GA

Optimization results:

Iteration Number

Best Fitness Achieved

Estimated Required Budget ($)

Total Length of Treated Roads(Miles)

Time Elapsed (minutes)

Show Optimization Results Save Refresh

Click the save button to download the optimization results or click the refresh button to start over!

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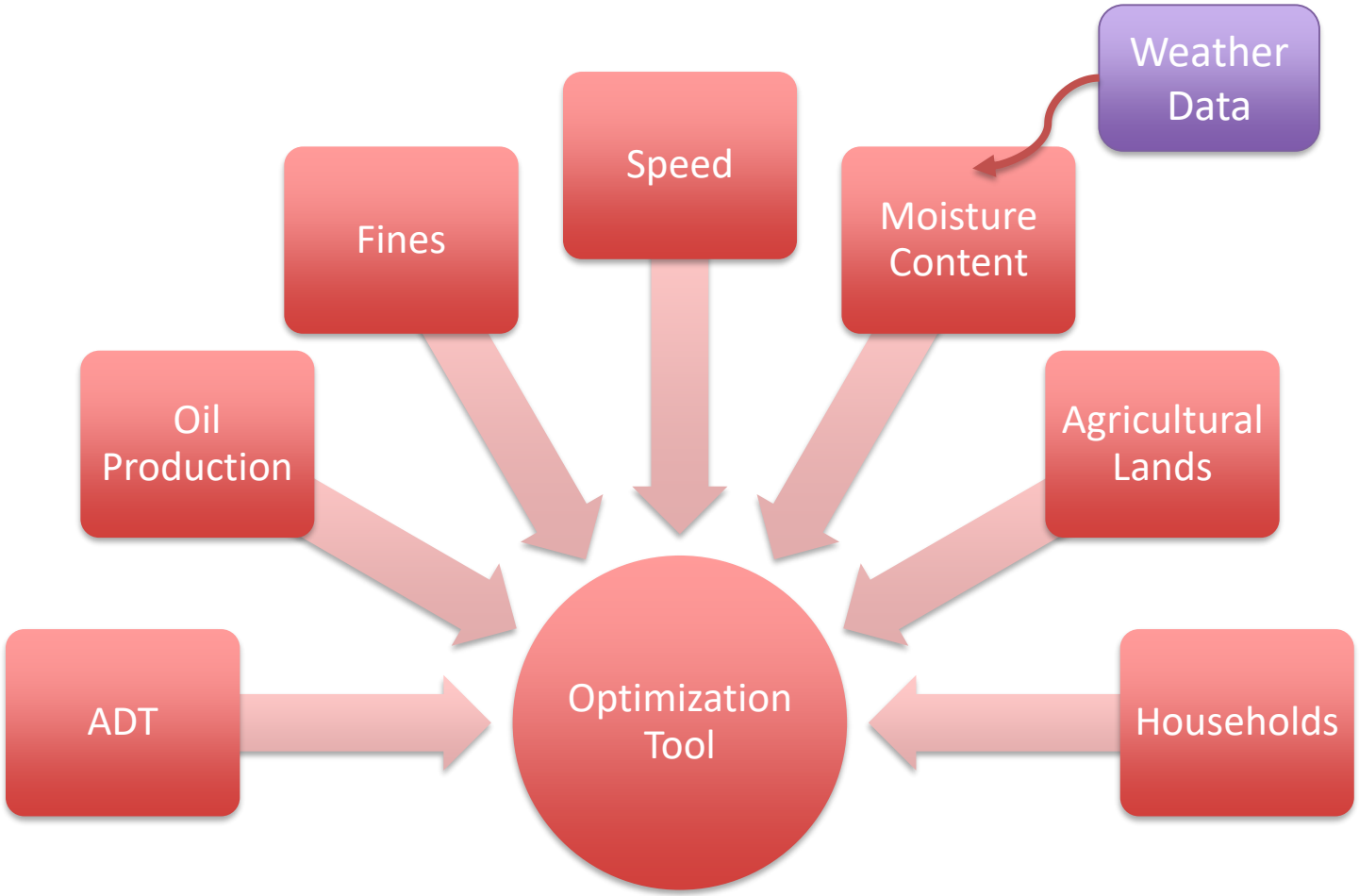


Survey objectives

1. Estimate the importance of AM on municipality's public infrastructure.
2. Estimate the infrastructure’s age, risk and annual budget for maintenance.
3. Identify which infrastructure needs additional support?

Cities and Municipalities


Transportation


Water


Buildings


Fleet


Wastewater


Drainage


Solid Waste and recycling

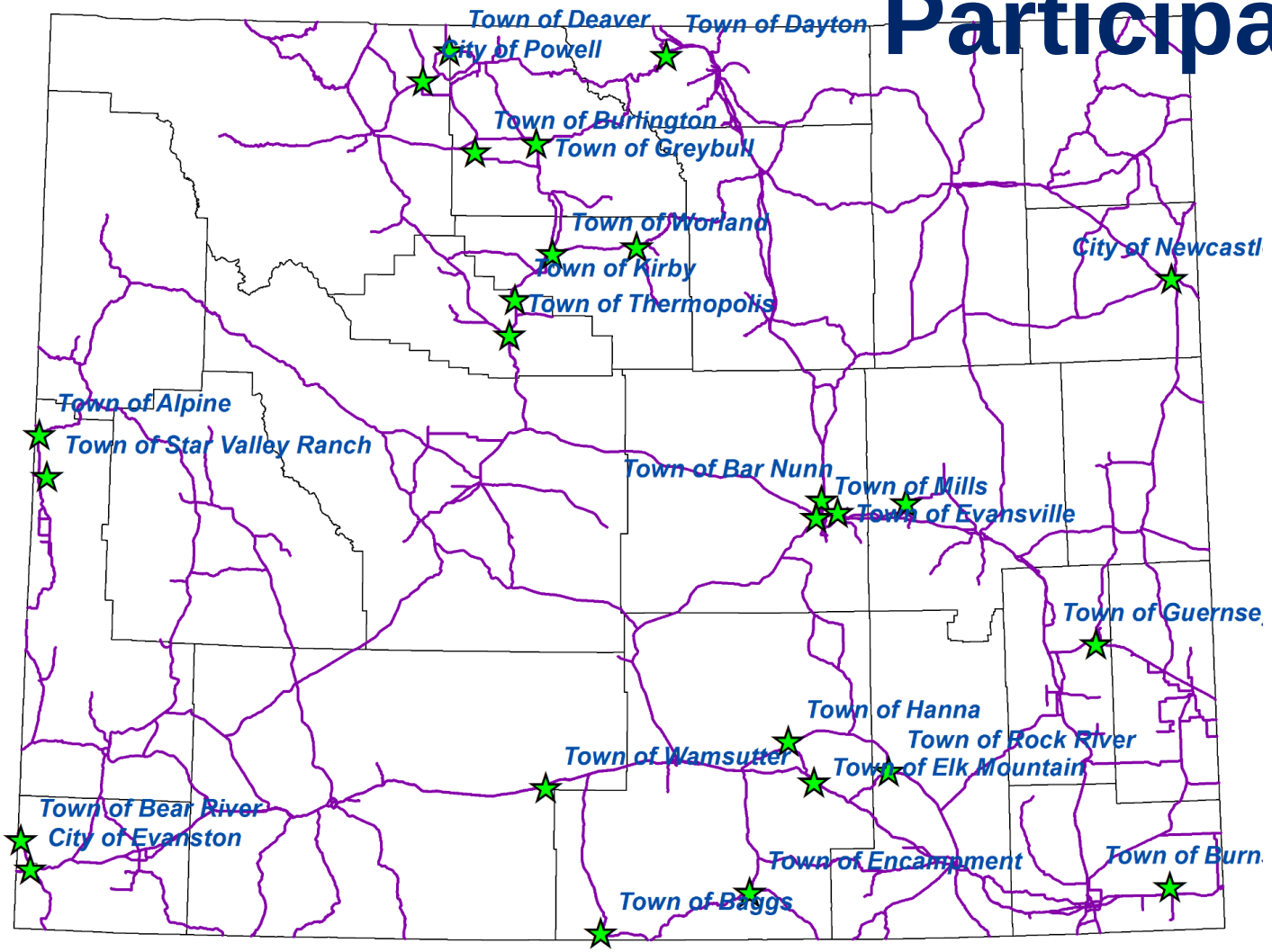

Parks and recreation

Cities and Municipalities

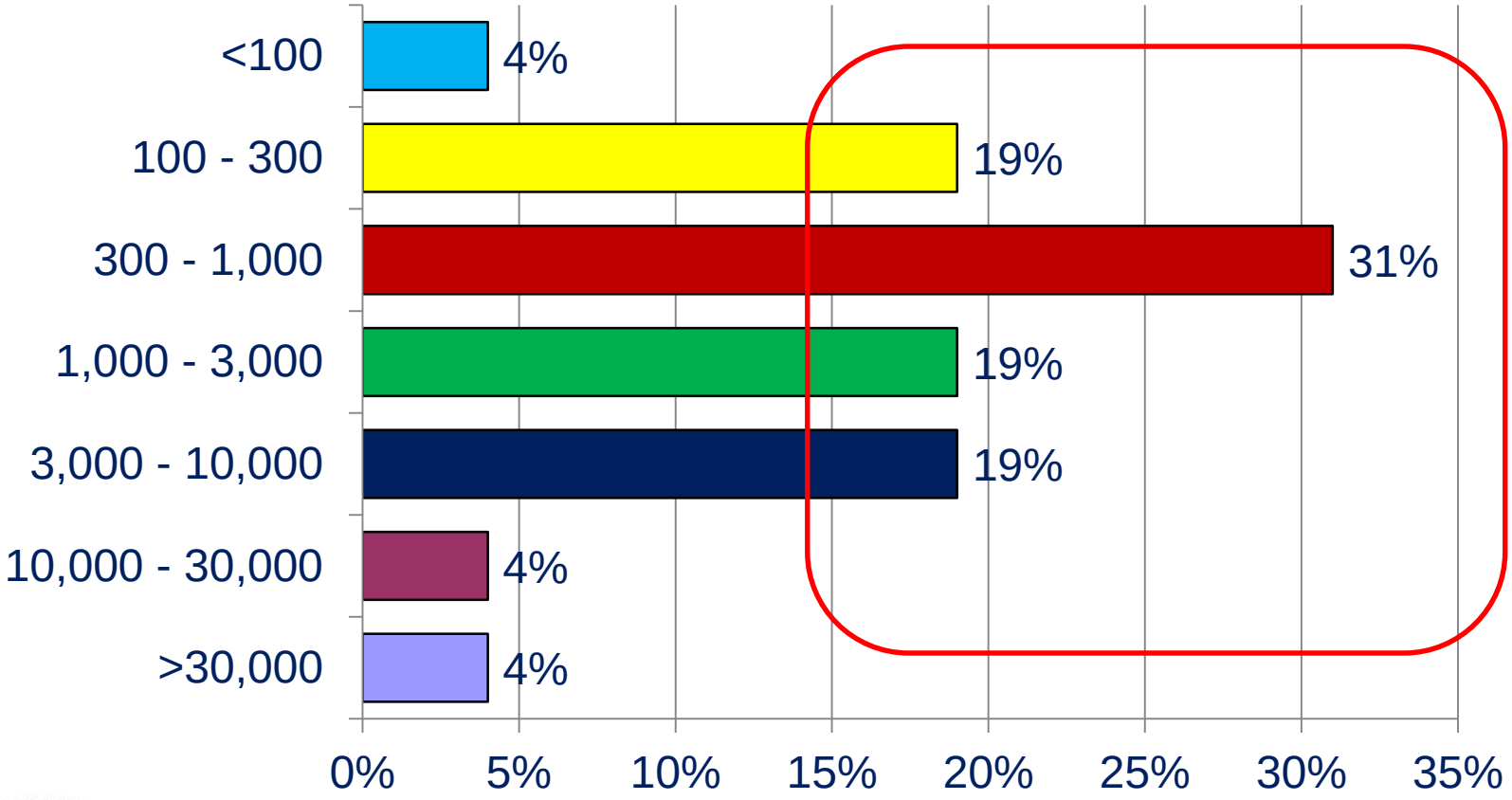
1. Responders: Municipalities of Wyoming
2. Number of Questions: 8
3. Surveys Delivered: 91
4. Total Responses: 29
5. Response rate: 32%

Cities and Municipalities

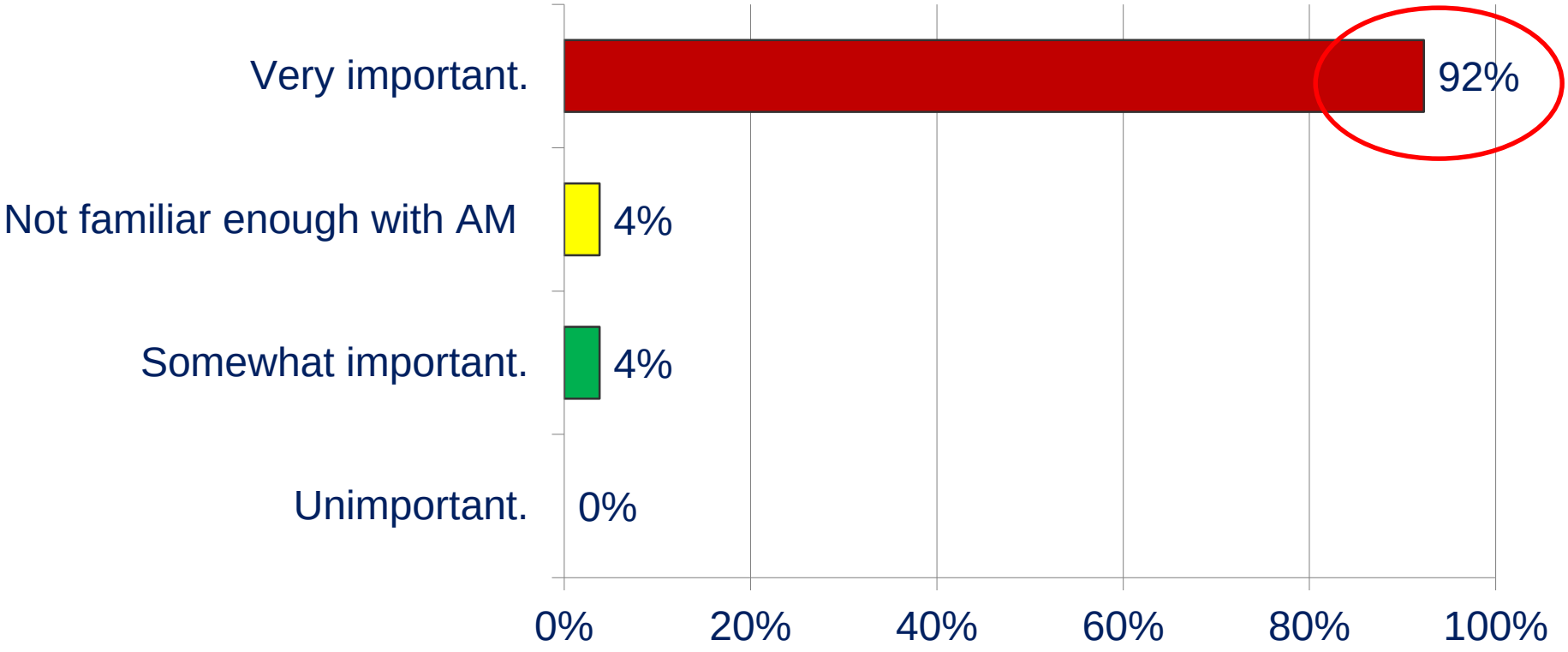
Survey Participation



Population of Municipality

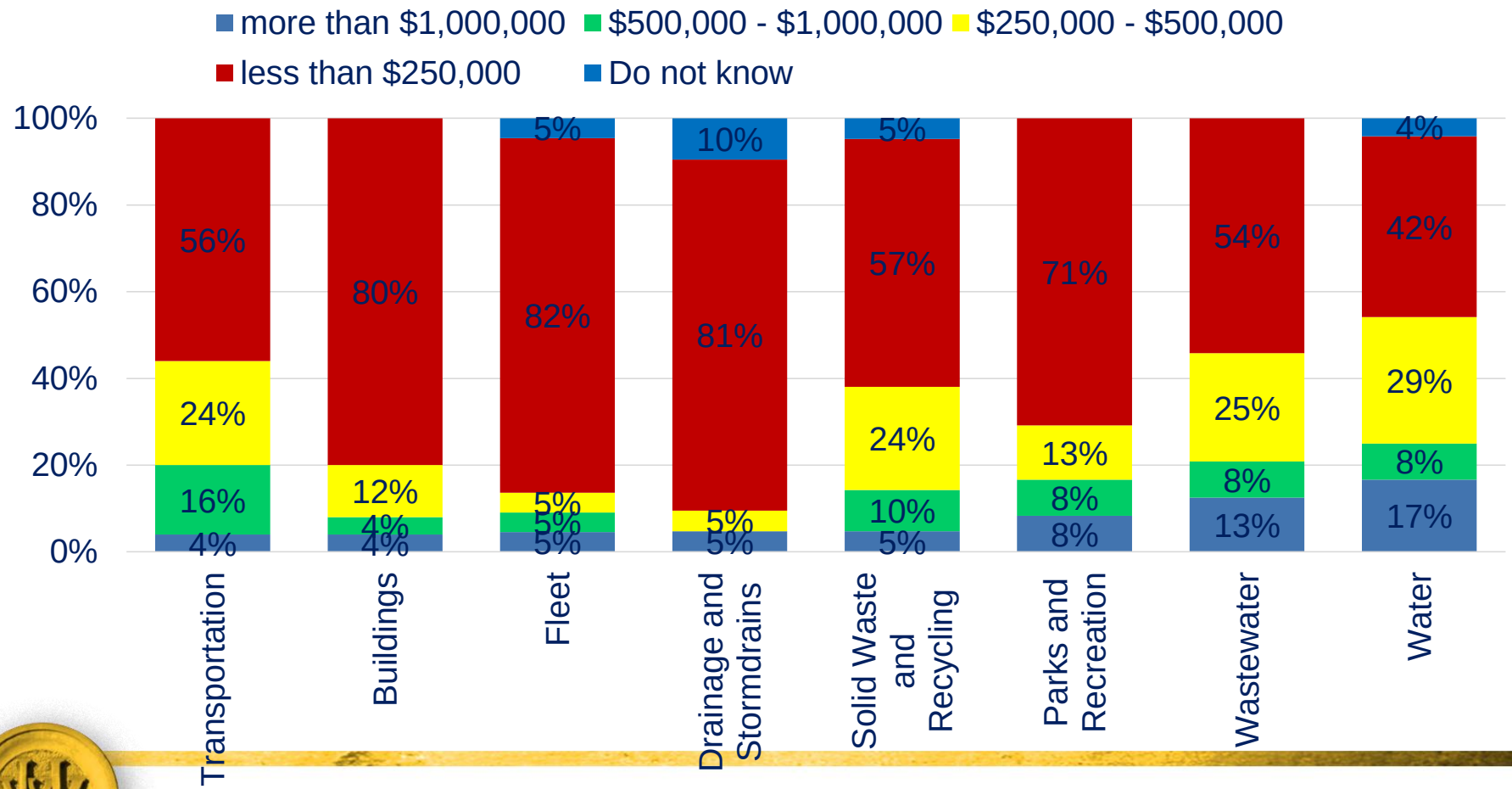


Importance of AM



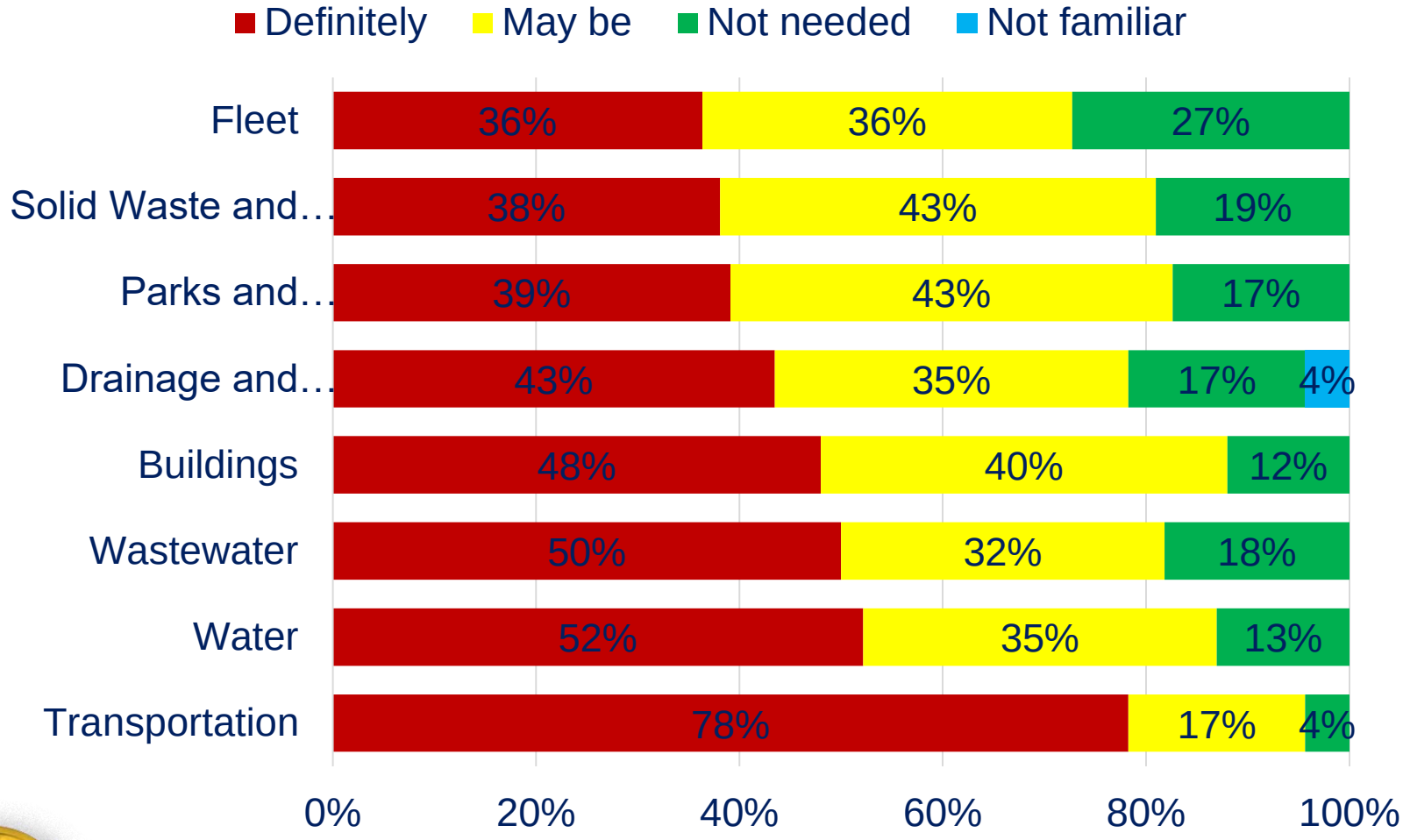
Cities and Municipalities

Annual Budget for Maintaining Infrastructures



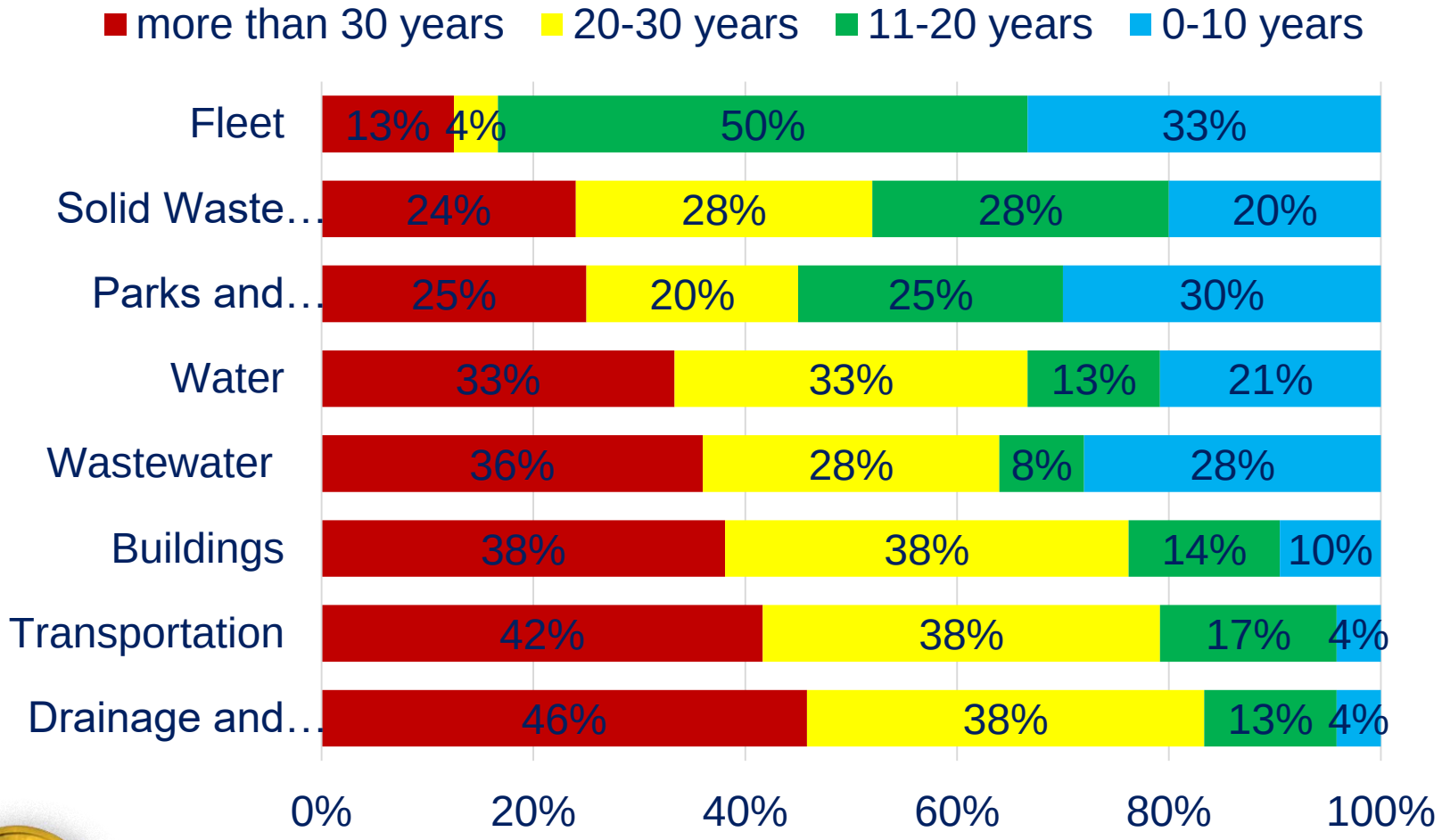
Cities and Municipalities

Which infrastructure needs additional support?



Cities and Municipalities

Average Age of Various Infrastructure Types



Responses to Open-Ended Question

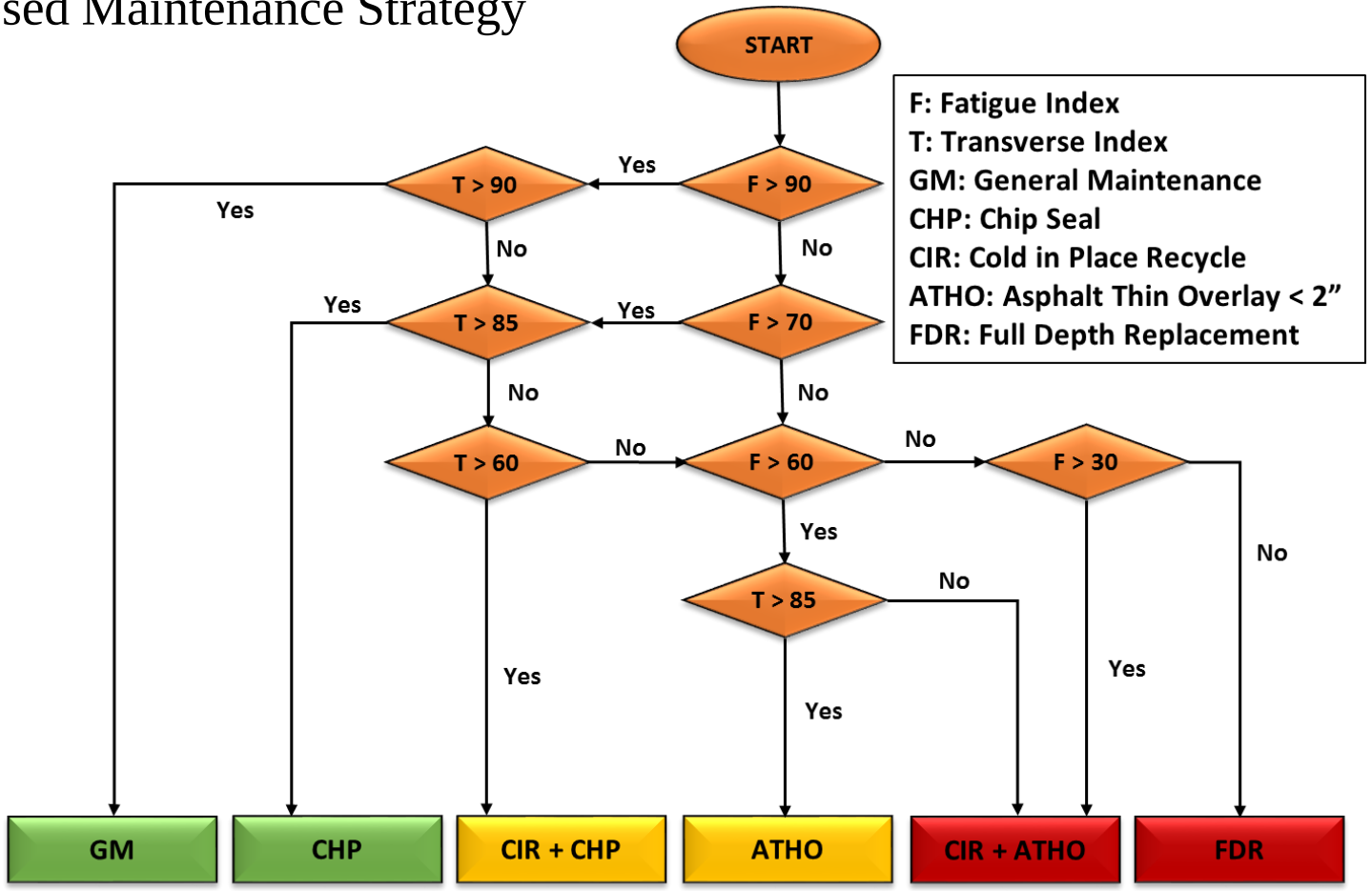
- Help needed with maintaining streets
- Water and sewer lines are very old
- More funding is needed
- SLIB funding is critical for municipalities
- General fund is the main source for maintaining infrastructures and it is volatile

Survey Findings

- Asset Management is very important.
- Additional support is needed.
- Annual budget is rated the highest in water and wastewater, and lowest in transportation.
- Transportation and drainage infrastructure types are the oldest.

Colorado Study

- Proposed Maintenance Strategy



*i: Initial Condition Index

CDOT Optimization for LVR

Optimization Strategies:

Performance Maximization

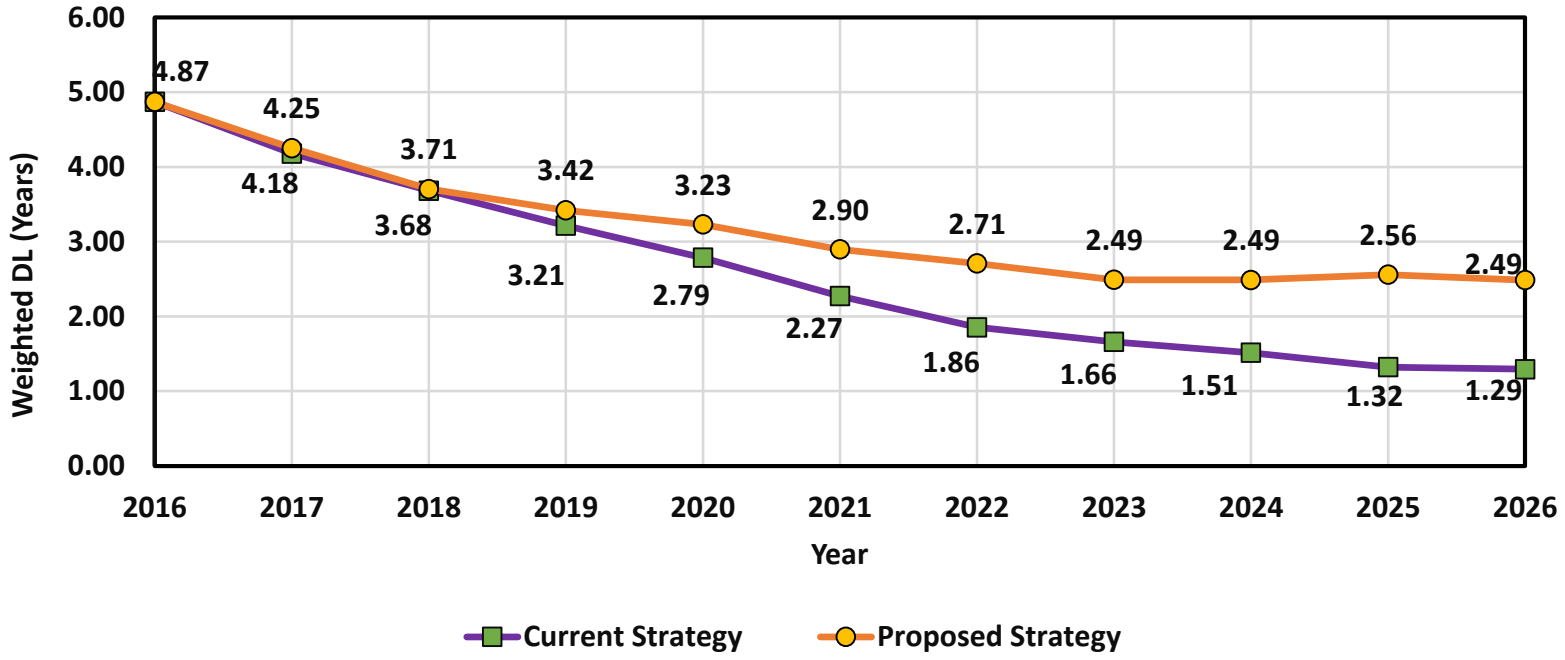
- Objective: Maximize the overall pavement drivability life
- Subject to: Annual budget constraints
- Maintenance strategies comparison

Costs Minimization

- Objective: Minimize the total annual maintenance costs
- Subject to: Performance targets
- Capital improvement plans

Performance Maximization Models

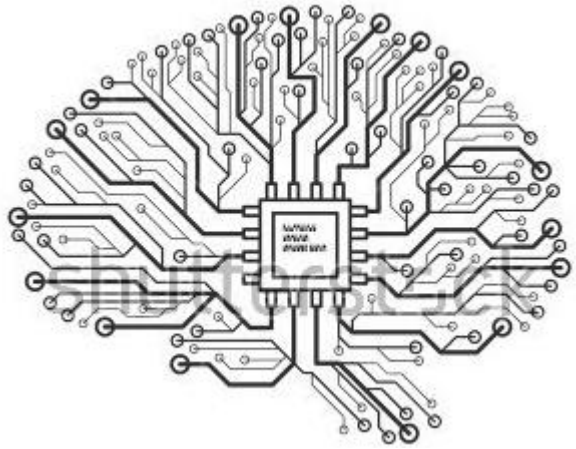
- Optimized Maintenance Program for Region 4



Expected Pavement Performance from Different Maintenance Strategies in Region 4

Ongoing CDOT Study

- **Statewide Implementation Plans:**
  - Large-scale optimization analysis
  - Defining budget requirements of Colorado LVRs maintenance
  - Enhancing treatment selection using artificial intelligence



Overall Summaries

- **Asset Management is very important for identifying needs and budget allocations.**
- **Optimization tools should be developed and implemented for all infrastructure in Wyoming.**
- **Help should be provided to agencies at all levels to enable them to manage their infrastructure and document their needs.**
- **This will make the job of allocating funds more systematic and based on actual needs and engineering principles.**

Questions?

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