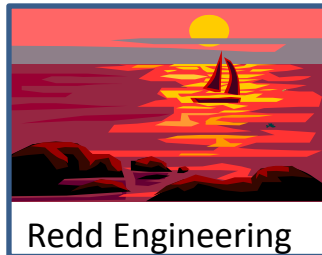


Beyond The Risk Register –

Incorporating Risk into Asset Management Decisions

Larry Redd, P.E. – Redd Engineering

JoAnn Mattson and Gary Aucott – Colorado DOT

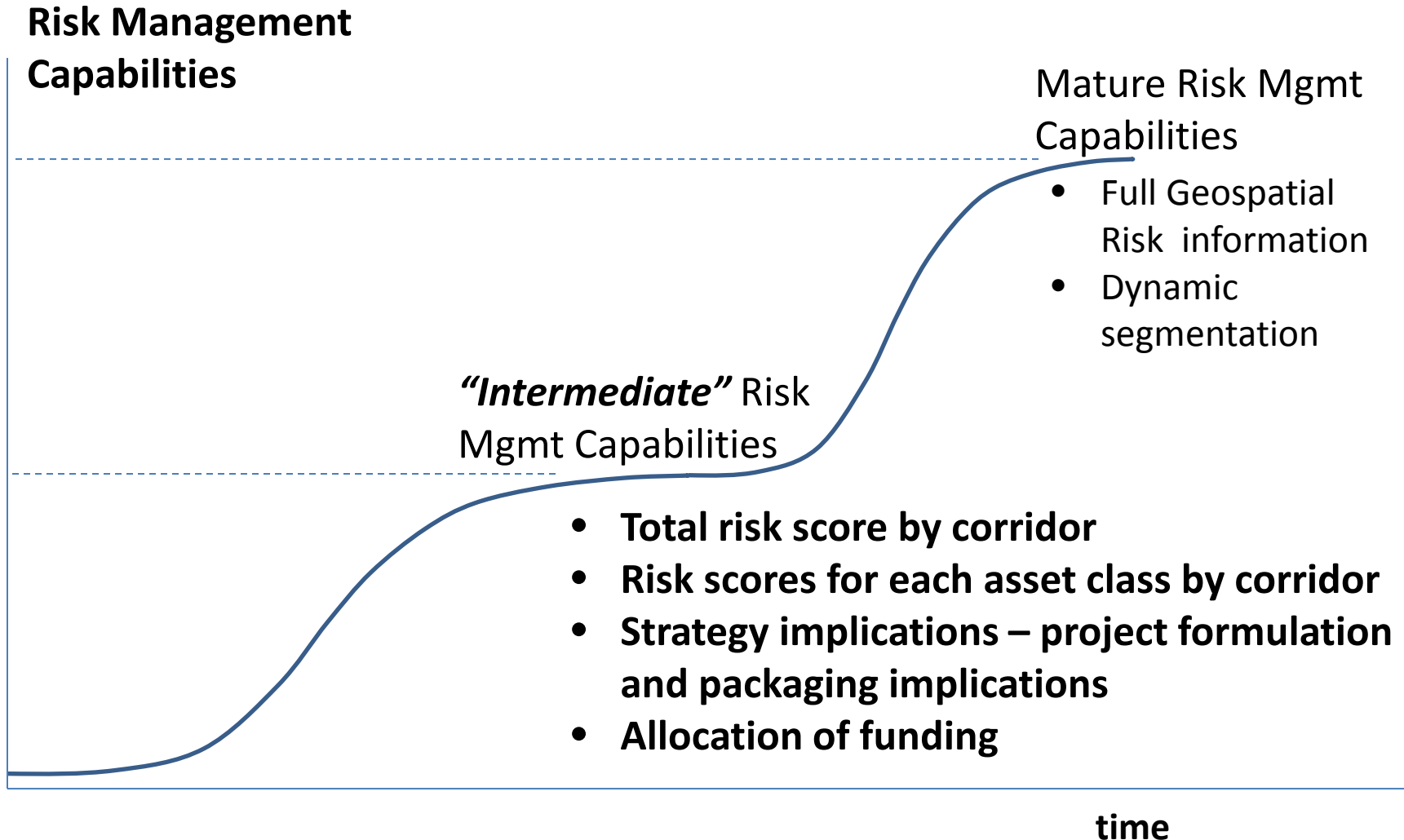


COLORADO
Department of
Transportation

What, Why, How

- What did we develop?
 - Method for portraying and understanding risk across the highway network
- Why was this important?
 - Include risk in asset management decision making
 - No current way to identify and prioritize a range of risk opportunities across the highway network
 - Needed the ability to allocate funding to both performance AND risk-based opportunities across regions, corridors, and asset classes

Levels of Capability – Risk Mgmt



What, Why, How (cont)

- How – the steps we followed
 - Started with the statewide Risk Register – Top 50 risk event types
 - Spread risk scores across corridor types, and then corridors, for all affected asset classes
 - 17 Corridors – combinations of: Terrain type, Rural/Urban, Traffic Level, Interstate/Not
 - RESULT – visual information, supporting strategy development and project formulation



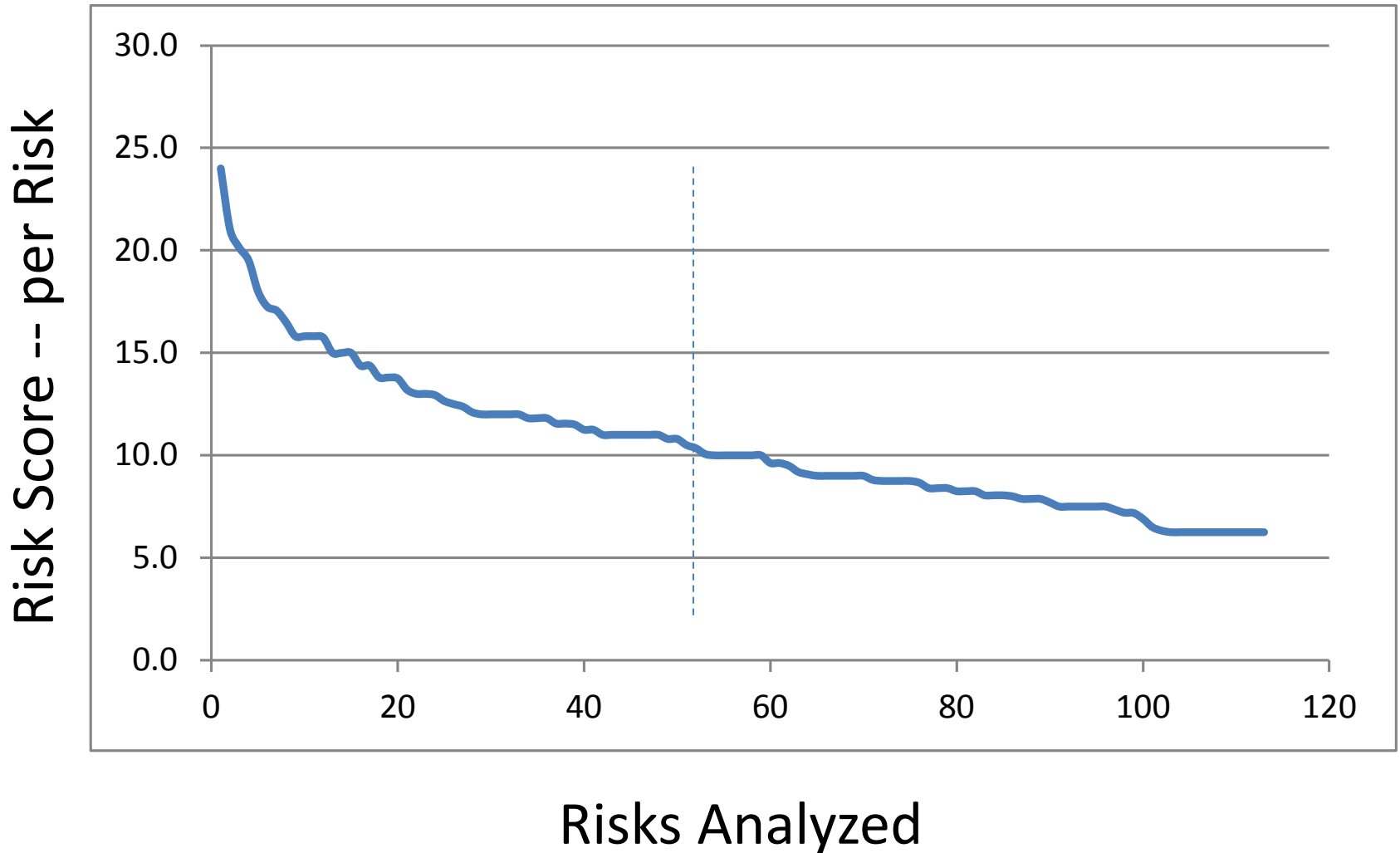
Risk Register -- Excerpt

Page 2 of 3

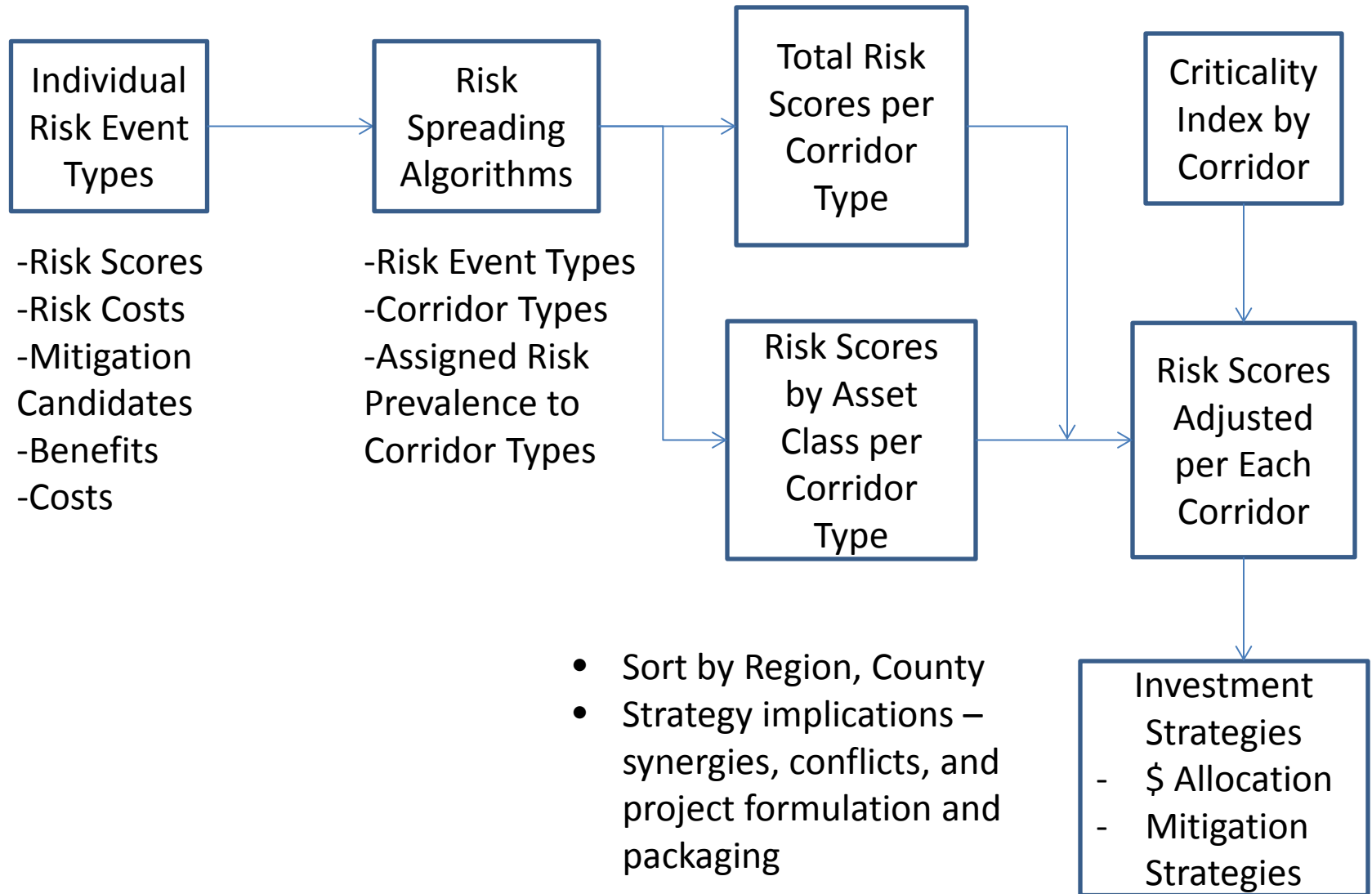
Risk Level	Asset Class	Event/Occurrence	Consequence Score					Other Considerations					Risk Score	Risk Management Strategy (Treat, Tolerate, Transfer, Terminate)	Benefit in % Risk Score Reduction	Annual Cost of Strategy - \$mm	Owner
			Likelihood	Safety	Mobility	Asset Damage	Other Financial Impact	Funding	Insurance	Regulatory	Political	Reputation					
Project	All	Flooding (or any inclement weather event) (resulting in long term impacts -- damage to assets, requiring replacement)	4	5	5	5	5	x	x		x	x	24.0	Treat - determine risk and resilience strategy and organizational structure and communication plans to support future events	5.0%	0.50	Dir of Office of Emerg Mgmt for response; multiple cdot roles working on strategy
Agency	All	With limited and variable funding CDOT may not be able to meet CDOT established targets in the desired timeframe	5	3	4	4	2	x		x	x	x	19.5	Tolerate - if we don't have funding to meet targets, we can only tolerate	0.0%	0.0	TC decision if CDOT does this
Agency	All	Are the targets the right targets, and are the targets set by FHWA	5	3	4	4	2	x		x	x	x	19.5	Treat - move funding from capacity projects or other assets or programs to meet these targets	50.0%	400.0	TC decision if CDOT does this
Agency	All	Reprioritization among programs	3	3	3	3	3	x			x	x	10.4	Tolerate	0.0%	0.0	Exec Dir or Gov or TC
Agency	All	Investment does not result in anticipated performance over time	2	2	2	2	2	x			x	x	4.6	Treat - actively evaluate investment and results over time and identify early warning signs that performance is appearing to be less than expected	50.0%	0.2	Asset Managers
Agency	All	Local control of off system NHS segments (10% of the system), however CDOT is responsible for the meeting the overall statewide performance target for the system	1	3	2	3	2	x		x	x	x	3.0	Treat by putting more of our money into our pavement and bridges to get the overall condition higher	40.0%	24.0	TC decision
Agency	All	MPO selects a lower target (worse condition) than CDOT for on system roads in their boundary	1	1	2	2	3	x				x	2.2	Tolerate	0.0%	0.0	DTD Director
Project	All	Subsurface utilities impacts CDOT ROW and infrastructure Ex. Water main disrupted I-25 (58th) Interstates cause the most grief.	4	3	3	4	2	x	x		x	x	14.4	Tolerate - use TC contingency, or may get funds from local agency (partially) - fix it when it happens	0.0%	0.0	Region Director
Program	All	I-70 viaduct will pull funding from other projects so now uncertainty is impact to other programs	5	2	3	3	2	x	x		x	x	15.0	Tolerate	0.0%	0.0	TC, Bridge Enterprise
Program	All	Data management (lack of data or ability to understand data, that impacts ability of CDOT to document accomplishments) --	5	1	2	2	2			x		x	9.6	Treat - senior management directs and supports effort to manage data by asset managers	70.0%	3.0	DTD Director supporting asset managers
Agency	All	Revenue variations/uncertainties	5	1	1	2	3	x	x		x	x	10.5	Treat to the extent possible, by strategizing about possible alternatives	20.0%	0.0	CFO
Agency	All	Commodity price volatility	4	1	1	2	3	x			x	x	8.1	Tolerate	0.0%	0.0	CFO



Overall Risk Analysis Pareto

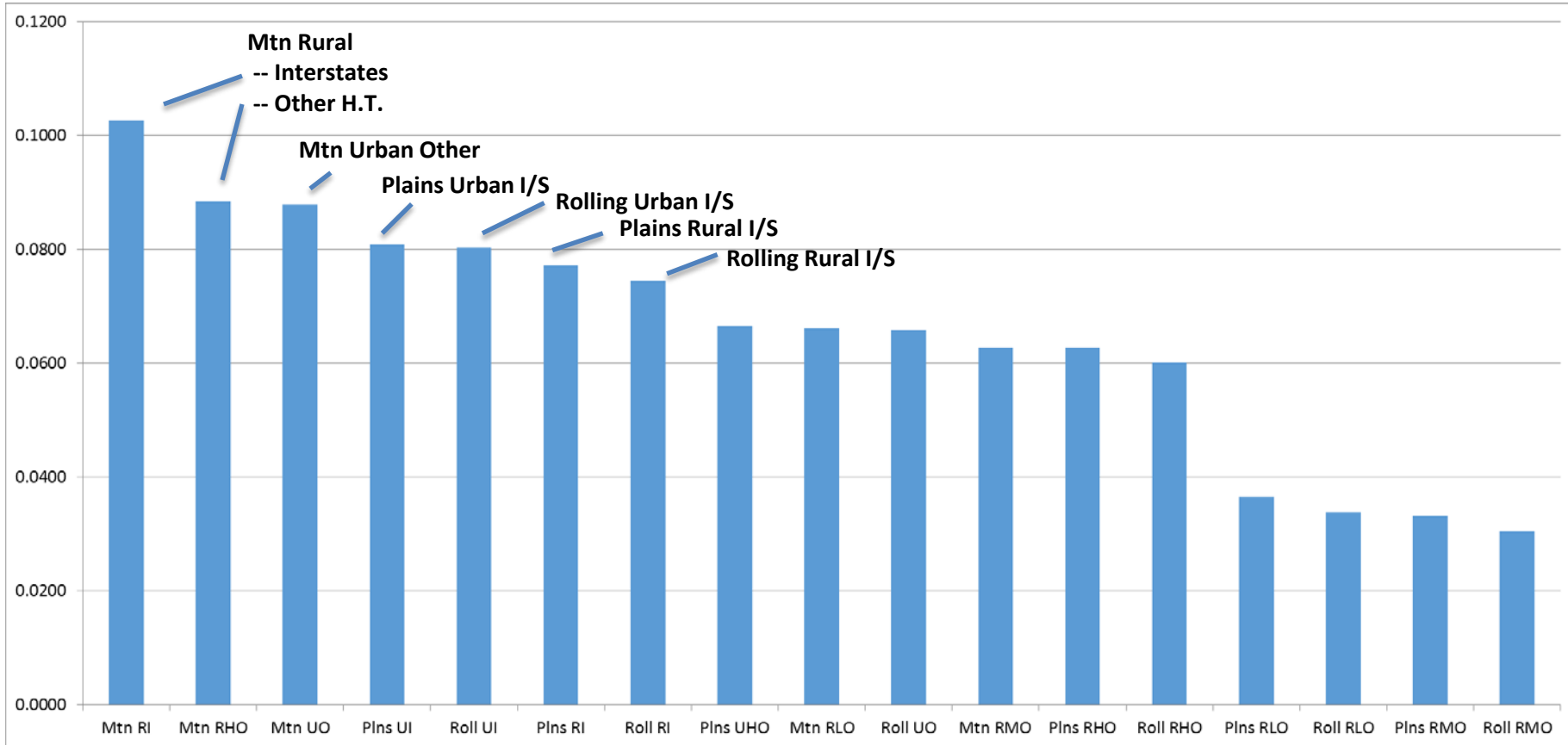


From Risk Register to Strategy





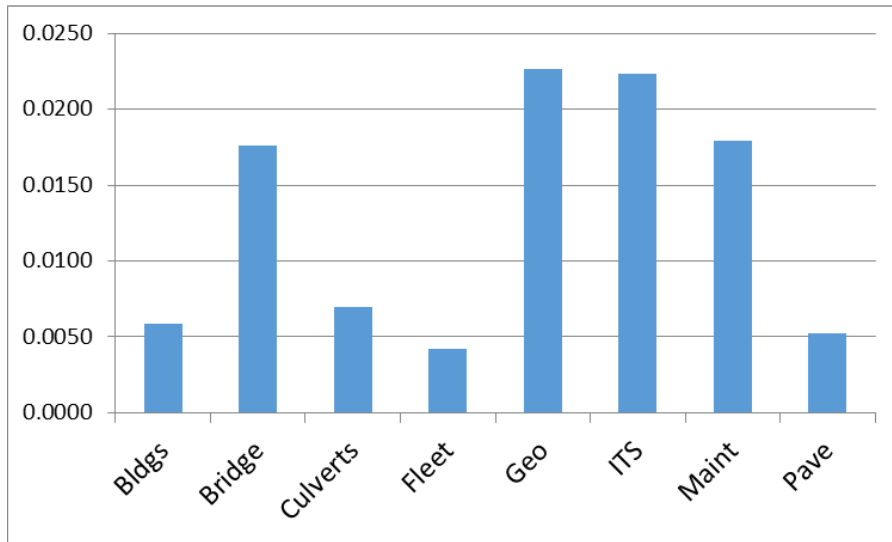
Total Risk Score per Mile for Each Corridor Type



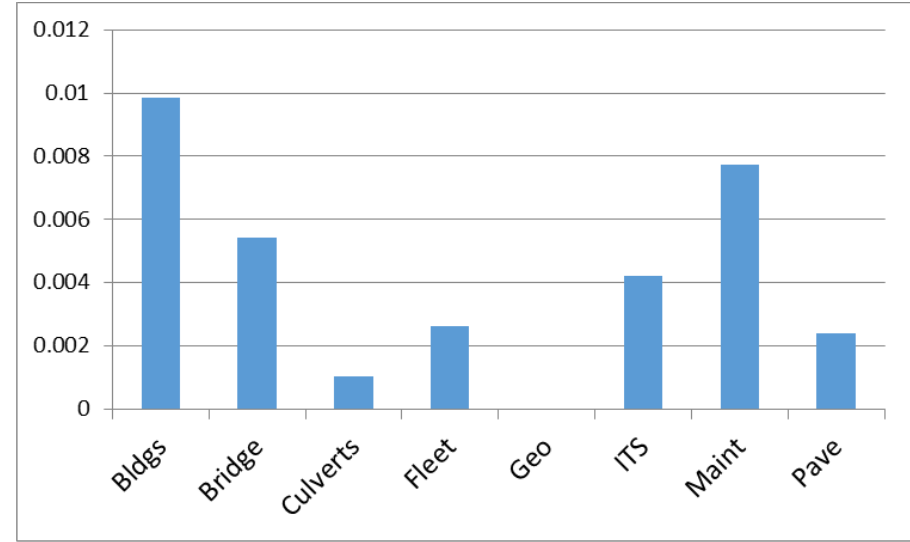


Risk per Mile for Each Asset Class (two corridor types shown here)

Risk score per mile
Mountain Rural Interstates

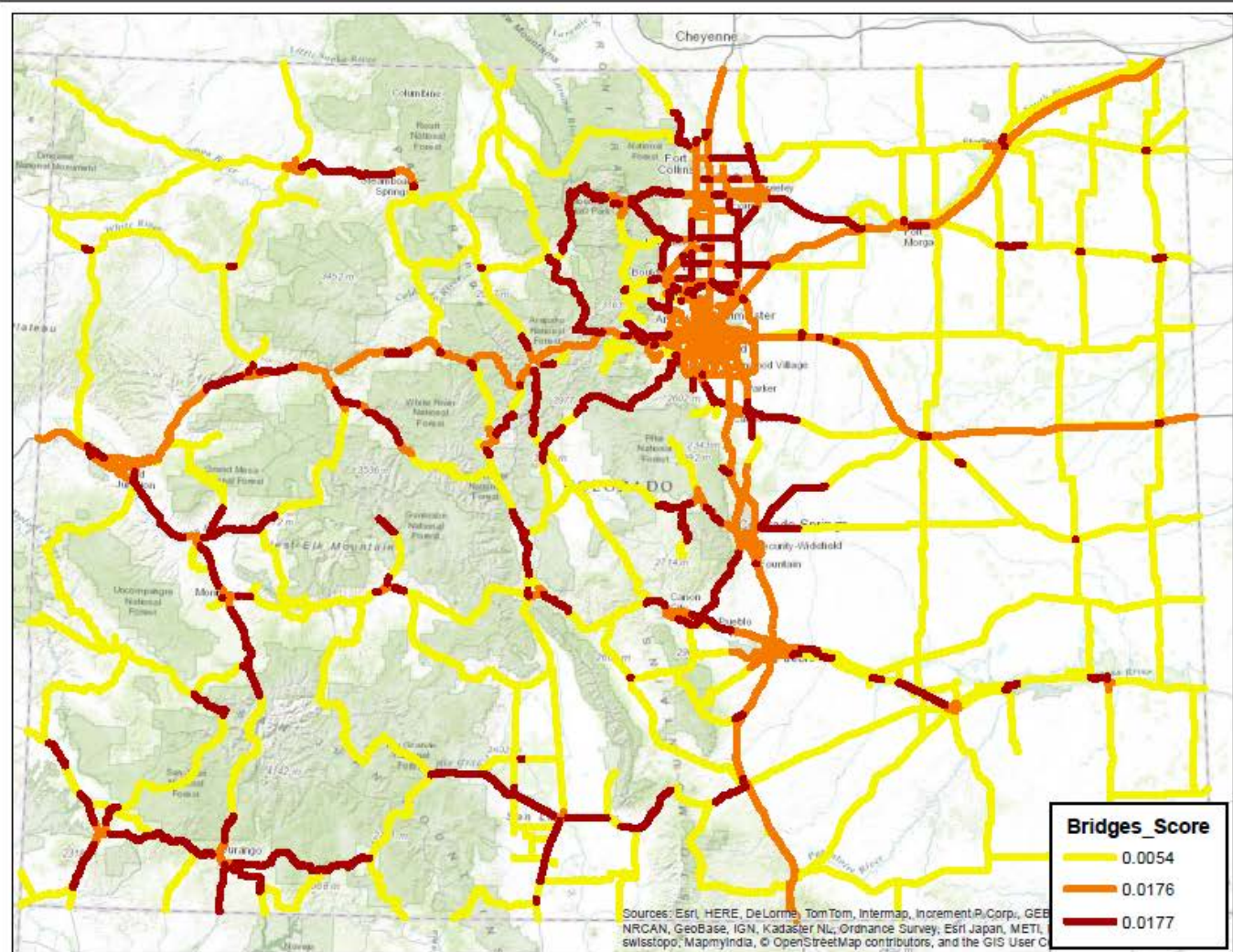


Risk score per mile
Plains Rural Medium Traffic, Non I/S



Bridge Risk Scores by Corridor

Adobe Reader
Window Help
1 / 1 68.4%
Tools Sign



Taskbar icons: Start button, Chrome, File Explorer, Edge, Skype, Adobe Reader, Excel, System tray (clock, volume, network, power).

Contact Info

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Extra Slides

GIS-Supported Decision Making

The screenshot displays a web browser window with the URL <http://cdot.maps.arcgis.com/home/webmap/viewer.html?webmap=1f164f9a5a494e408f24b5d1b6f8fddd>. The browser tabs include "Track Economic Index Trends...", "Sandwich Shop - Google Maps", and "Corridor Types for Risk". The application interface features a "HOME" dropdown, the title "Corridor Types for Risk", and a "MODIFY MAP" button. A "Sign In" link is also present. The main map area shows a topographic map of Colorado with various risk corridors highlighted in different colors: pink, orange, green, blue, and purple. The legend on the left side of the map is titled "Contents" and lists the following items:

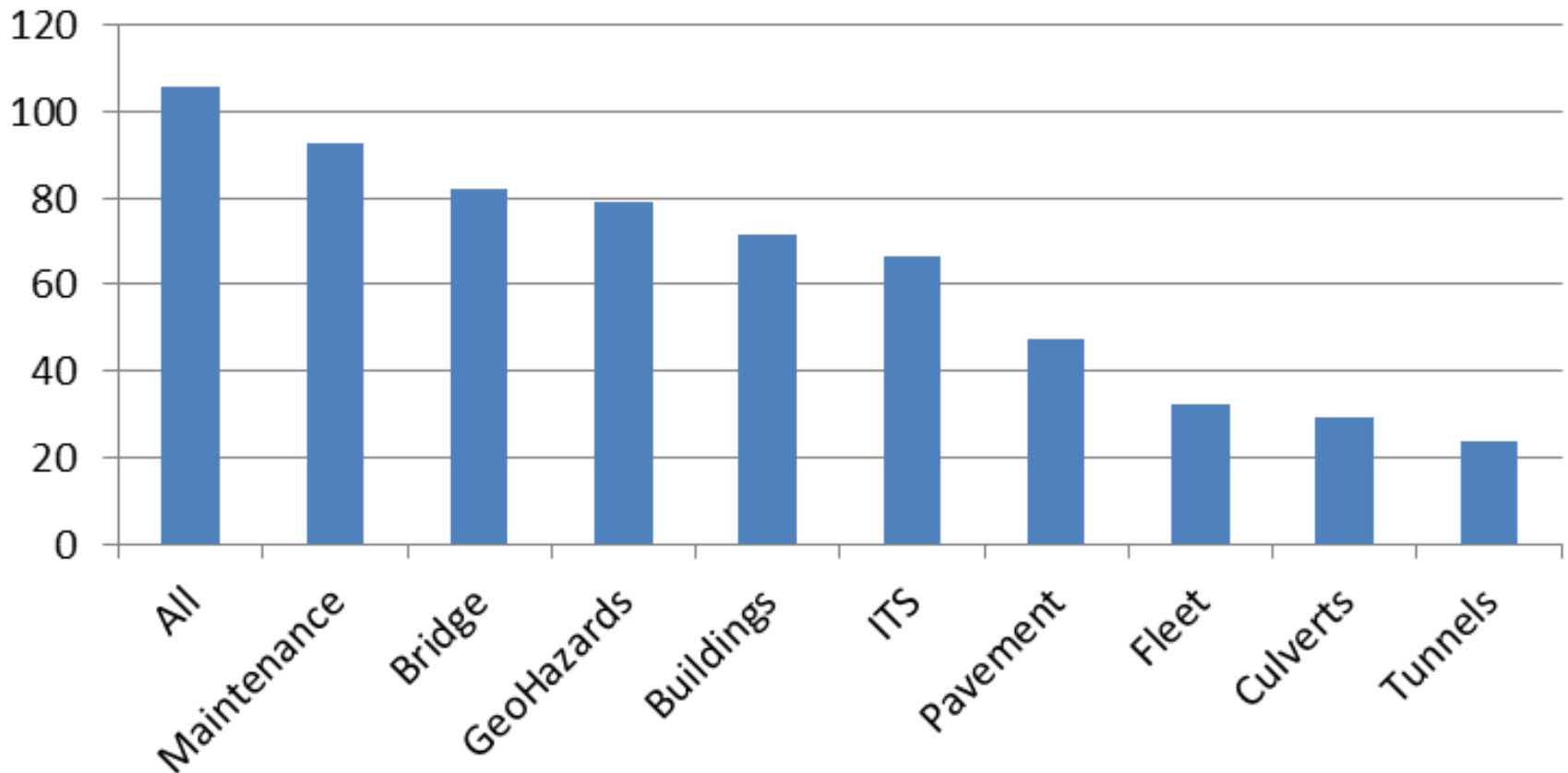
- CorridorTypesForRisk
 - Interstates Mountain Rural
 - Interstates Plains Rural
 - Interstates Rolling Rural
 - Interstates Mountain Urban
 - Interstates Plains Urban
 - Interstates Rolling Urban
 - Other Mountain Rural High
 - Other Mountain Rural Medium
 - Other Mountain Rural Low
 - Other Plains Rural High
 - Other Plains Rural Medium
 - Other Plains Rural Low
 - Other Rolling Rural High
 - Other Rolling Rural Medium

The map includes a scale bar (0, 30, 60mi) and a search bar with the text "Find address or place". The taskbar at the bottom shows various application icons, including Internet Explorer, Google Chrome, and Microsoft Office applications. The system tray in the bottom right corner displays the time as 1:24 PM and the date as 4/27/2015.



Overall Risk Scores by Asset Class – From the Risk Register

Sum of Risk Scores >10.0





Representative Corridors



CDOT Risk Discussion: Representative Corridors								
Count	Representative Corridors	Region	Beginning MP	End MP	Volume > 4,000 High 1,000 to 4,000 Med < 1,000 Low	AADT range	Terrain Source: statewide db	Urban/Rural
1	I-70 from Vail to C-470	3 and 1	176	259	High	19,000-74,000	Mtn	Rural
2	US 36 (36B) Lyons to Estes	4 and 1	0	57.418	High	5,500-141,000	Rolling	Rural
3	US 40 over Berthoud Pass	3 and 1	229.621	258.258	High	4,700-9,700	Mtn	Rural
4	US 160 (160A) Cortez to near Durango	5	40	83	High	5,500-18,000	Mtn/Rolling Mix	Rural
5	SH 2 from 270 to Hampden	1	0	9.842	High	26,000-62,000	Rolling/Plains Mix	Urban
6	SH 6 (6G) Golden to Denver	1	272	284	High	28,000-142,000	Rolling	Urban
7	I-70 from Limon to Kansas state line	1	361	449.589	High	7,500-11,000	Plains	Rural
8	96 from Westcliffe to Jct with 67	2	0	26.273	Med	1,300-3,600	Rolling	Rural
9	SH 14 (14C) east of Ault to west of Sterling	4	157	229	Med	1,100 to 2,400	Plains	Rural
10	SH 78 (78B) west of Pueblo	2	12	28	Med	1,100-1,400	Rolling	Rural
11	285 (285B) Saguache to Villa Grove	5	86	105	Med	1,300-2,200	Mtn	Urban/Rural
12	SH 96 (96D) Near Eads to Kansas State Line	2	168.992	207.454	Low	430-1,000	Plains	Rural
13	SH 90 (90A) Utah state line to near Naturita	5	0	33.874	Low	230-440	Mtn	Rural
14	368 (368A) from Hwy 370 to Estrella	5	0	12.328	Low	290-760	Rolling	Rural
15	SH 10 (10A) Walsenburg to Jct with SH 71 (near La Junta)	2	0	62	Low	410-700	Plains	Rural



"Risk Spreading Tool"

Terrain	Interstates					Other Highways								
	Mtn Rural	Plains Rural	Rolling Rural	Plains Urban	Rolling Urban (incl I-25 thru Denver and Col. Spgs)	Mountain Rural			Plains Rural			Rollinr		
Traffic	High					High	Medium	Low	High	Medium	Low	High	M	
Centerline Miles	187.3	158.8	338.3	5.9	229.7	521.9	1231.0	793.8	76.3	589.8	1207.5	721.3		
% of Overall Network (centerline miles)	2.1	1.8	3.7	0.1	2.5	5.8	13.6	8.8	0.8	6.5	13.3			
Flooding (or any inclement weather event) (resulting in long term impacts -- damage to assets, requiring replacement)														

Risk Level	Asset Class	Description	Terrain	Interstates					Other Highways									TOTALs	Risk Score	Owner (the person who will deal with it; who's in charge of that event)			
				Mtn Rural	Plains Rural	Rolling Rural	Plains Urban	Rolling Urban (incl I-25 thru Denver and Col. Spgs)	Mountain Rural			Plains Rural			Rolling Rural						Mountain Urban	Plains Urban	Rolling Urban
			Traffic	High					High	Medium	Low	High	Medium	Low	High	Medium	Low	High/Med/Low	High	High/Med/Low			
			Centerline Miles	187.3	158.8	338.3	5.9	229.7	521.9	1231.0	793.8	76.3	589.8	1207.5	721.3	1076.1	815.8	147.1	94.3	871.1	9,065.99		
			% of Overall Network (centerline miles)	2.1	1.8	3.7	0.1	2.5	5.8	13.6	8.8	0.8	6.5	13.3	8.0	11.9	9.0	1.6	1.0	9.6	100.0		
Project	All	Flooding (or any inclement weather event) (resulting in long term impacts -- damage to assets, requiring replacement)																			0.0	24.0	
Agency	All	Not having enough funds to meet targets																			0.0	19.5	
Agency	All	Local control of off system NHS segments (10% of the system), however CDOT is responsible for the meeting the overall statewide performance target for the system																			0.0	15.0	
Agency	All	Programs are reprioritized by senior management or above																			0.0		
Agency	All	Investment does not result in anticipated performance over time																			0.0		
Agency	All	MPOs select a lower target than CDOT for on system roads within their boundaries																			0.0		
Project	All	Subsurface utilities impacts by others in ROW (and below roadways)																			0.0	13.8	

Risk Spreading – Core Archetypes

Simplifying Patterns...

- Mountains
- Mountains, Rolling
- Interstates
- High Traffic
- Mountains, High Traffic
- Plains, Rural
- Urban