

DISCUSSION DOCUMENT

Understanding the Total Cost of Ownership of Trails

Orlando, FL
May 6, 2004



Highlights of presentation

- ▶ The Trails TCO model is a concept being developed jointly by the NPS' Trails Working Group and Booz Allen. The model needs further refinement and development.
 - Contributors to the Trails TCO model include: Tobias Miller (Great Smoky National Park), Dave Larsen (Rocky Mountain National Park), David Reus (Appalachian Trail NT), Steve Griswold (Golden Gate NRA) and Michael Clayton (Booz Allen Hamilton)
- ▶ Currently, when applied to the New Storm Trail at Rocky Mountain National Park, the TCO model shows that:
 - the 50-year costs for maintaining the trail *decrease* if proper annual preventative maintenance is funded and executed
 - the 50-year costs for operating and maintaining the trail *exceed* the construction costs for that trail
 - the requirements and the condition of the trail can be projected into the future, enabling improved planning and budget formulation before trail conditions deteriorate
 - appropriate funding mechanisms (e.g., endowments) can be put into place during construction (or re-construction) of trails to ensure an appropriate condition over time



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Background for the Trails TCO Model



The Trails TCO model is one of several tools being developed by the NPS' Trails Working Group

- ▶ NPS' Trails Working Group established in June 2003 to assist in the development of trail assessment methodologies and tools
 - In the past year, the TWG has refined the Trails Current Replacement Value (CRV) Calculator and developed the Trails Inspection Guidance document

Current Replacement Value (CRV) Calculator: Trails

Total Length: 1.00 miles

CRV: \$38,291

Select Park ▶ Great Smoky Mountains NP - Tennessee

	Length ▼	Width ▼	Class ▼	Average Grade, Frequency of Drainage Structures ▼	Stone stairs per mile ▼	Number of trail bridges (equip) ▼	Tread ▼	Wall (% of segment) ▼
Segment 1 ▶	1.00 mi.	1.00 ft	Class V	11-20%, Med Frequency of Drainage Structures	0 stairs/mi	0	Puncheon	0%
Segment 2 ▶							Native	
Segment 3 ▶							Crushed aggregate (gravel)	
Segment 4 ▶							Chunk wood	
Segment 5 ▶							Paver Block	
Segment 6 ▶							Rip Rap	
Segment 7 ▶							Concrete	
Segment 8 ▶							Asphalt	
Segment 9 ▶							Puncheon	



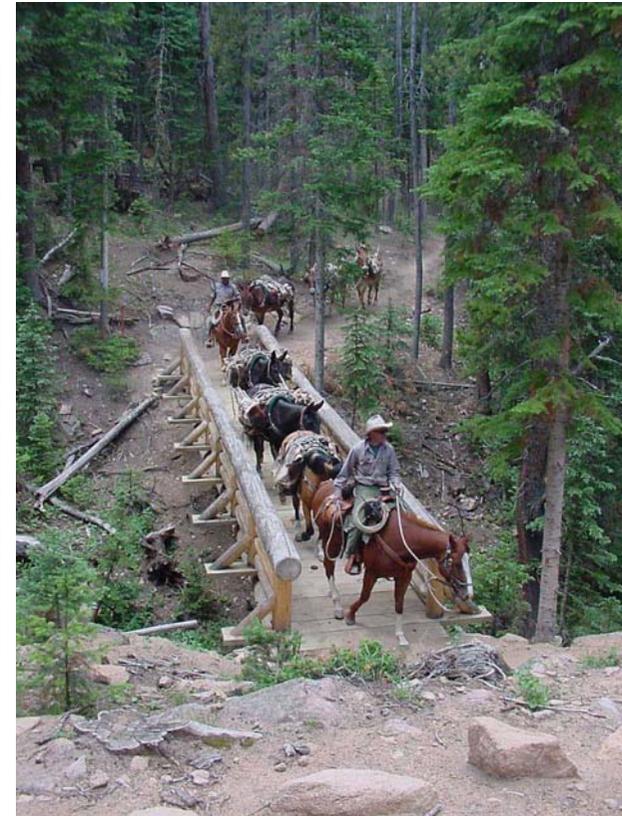
The Trails TCO model provides a defensible methodology for determining and communicating the real costs of maintaining trails over time

- The public increasingly demands transparent and defensible budgets that demonstrate the impact of investments
- “Crew week” budgets do not effectively articulate impact to a public interested in tracking how limited resources are spent
- As a result, all too often, **insufficient resources are dedicated to regular trail maintenance, resulting in a crisis-response, reactive approach to maintaining trails**
- This presentation aims to provide trail supervisors and facility managers **new tools and methodologies for thinking about how to plan, budget, track *and communicate* maintenance requirements over time**

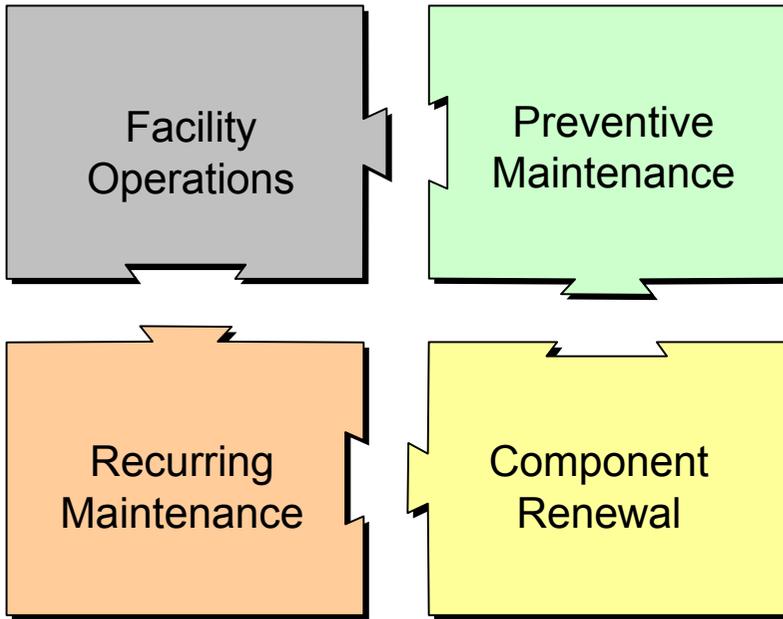


The TCO model allows users to incorporate stewardship and life-cycle mentalities into their management of trails

- ▶ Stewardship Mentality
 - What do we own?
 - What is its value?
 - What is its condition?
 - How will we sustain it over time?
- ▶ Life-Cycle Mentality
 - Plan/Design
 - Acquire/Construct
 - Maintain (operations + preventive)
 - Recapitalize (reinvestments)
 - Dispose (where appropriate)



The TCO is grounded in the understanding that a trail, like other assets, requires different types of maintenance across its life-cycle



By classifying and specifying trail maintenance requirements into these categories, trail managers can better articulate the need for annual base funding to maintain trails. At the same time, they can plan for recurring and recapitalization needs.

Facility Operations – Work activities performed on a recurring basis throughout year to meet routine, daily park operational needs. *Many trails do not have FO requirements. However, a highly developed trail may have trash receptacles that need to be emptied daily or certain areas where trash collection will need to be completed on a weekly basis.*

Preventive Maintenance – Regularly scheduled periodic maintenance activities (within a year) on selected equipment. *For trails, PM typically includes inspection, clearing and removal activities.*

Recurring Maintenance (Cyclic in nature) – Work activities that recur based on normal wear patterns on a periodic cycle of greater than 1 year and less than 10 years. *For trails, RM typically includes minor repair (rather than full replacement) of constructed structures. Specific examples of RM include: Renewing tread due to normal trail usage (not due to improper drainage); Resetting rocks on stairs, checks and waterbars (e.g., repairing a portion of a waterbar).*

Component Renewal (also known as Recapitalization) – The planned replacement of facility subsystems or components that have reached or will reach the end of its useful life based on condition and life-cycle analysis within the facility’s lifetime. *For trails, CR typically includes full replacement of constructed structures. Specific examples of CR include: Replacement of constructed structures (e.g., footlogs, waterbars, turnpikes); Replacement of entire deck of a bridge.*



Methodology and assumptions



The Trails TCO Model is based on a system-by-system analysis of frequency and unit costs of trail maintenance...

The TCO methodology utilizes NPS experience with specific trails to estimate the frequency and unit cost of Component Renewal, Recurring Maintenance and Preventative Maintenance requirements for each component type on a particular trail. Unit costs are developed for each required maintenance activity based on NPS estimates of material requirements and “crew hours” for specified tasks.

Equipment/ Feature	Required maintenance	Frequency (once every "x" years)	%	Cost / UM
Preventative Maintenance				
Drainage Structures	Clean water bars, swale drains, and drainage ditches	0.5 yr(s)	100%	\$361
Logging	Log out windfalls from trail corridor	0.5 yr(s)	100%	\$163
Recurring Maintenance				
Pruning	Prune trail side	5 yr(s)	100%	\$361
Waterbars	Repair rock waterbars (10%)	15 yr(s)	10%	\$150
Checks/steps	Repair rock checks (10%)	15 yr(s)	10%	\$125
Tread	Renew trail tread material (horse trail)	10 yr(s)	50%	\$5
Component Renewal				
Waterbars	Replace native pine waterbars	12 yr(s)	100%	\$100
Waterbars	Reset rock waterbars	40 yr(s)	100%	\$225
Checks/steps	Replace native pine checks	12 yr(s)	100%	\$104
Checks/steps	Reset rock checks	40 yr(s)	100%	\$200
Turnpike	Replace turnpike logs	20 yr(s)	100%	\$44
Handrails	Replace pine handrails	15 yr(s)	100%	\$867
Horse Bridge	Redeck treated plank bridge	25 yr(s)	100%	\$82
Signs/Posts	Replace wood sign/post	10 yr(s)	100%	\$118

NOTE: All cost estimates in 2004 dollars



...which, when multiplied by the number of systems on the trail, results in 50-year estimates of maintenance requirements for each type of system

The TCO methodology is based on the assumption that, although the actual period of repair or replacement of a specific trail system may differ from the projected “design life,” the maintenance requirements for each type of system will average out over time. Utilizing this methodology, the estimated cost for repairing 10% of the rock waterbars and checks every 15 years on the New Storm Trail is approximately \$6,000 over 50 years and pruning the side trail every 5 years is over \$8,500.

New Storm Pass Trail (ROMO): 50-year requirement (if maintained)								
Equipment/ Feature	Total Est. Quantity	Required maintenance	Frequency (once every "x" years)	%	Quantity Needing Maintenance	Cost / UM	Total Cost/Cycle	Total Cost /50 Years
Preventative Maintenance								
Drainage Structures	2.4 mi	Clean water bars, swale drains, and drainage ditches	0.5 yr(s)	100%	2.4 mi	\$361	\$867	\$86,700
Logging	2.4 mi	Log out windfalls from trail corridor	0.5 yr(s)	100%	2.4 mi	\$163	\$390	\$39,000
Recurring Maintenance								
Pruning	2.4 mi	Prune trail side	5 yr(s)	100%	2.4 mi	\$361	\$867	\$8,670
Waterbars	30 ea	Repair rock waterbars (10%)	15 yr(s)	10%	3 ea	\$150	\$450	\$1,350
Checks/steps	120 ea	Repair rock checks (10%)	15 yr(s)	10%	12 ea	\$125	\$1,500	\$4,500
Tread	14784 lf	Renew trail tread material (horse trail)	10 yr(s)	50%	7392 lf	\$5	\$36,960	\$184,800
Component Renewal								
Waterbars	25 ea	Replace native pine waterbars	12 yr(s)	100%	25 ea	\$100	\$2,500	\$10,000
Waterbars	30 ea	Reset rock waterbars	40 yr(s)	100%	30 ea	\$225	\$6,750	\$6,750
Checks/steps	80 ea	Replace native pine checks	12 yr(s)	100%	80 ea	\$104	\$8,320	\$33,280
Checks/steps	120 ea	Reset rock checks	40 yr(s)	100%	120 ea	\$200	\$24,000	\$24,000
Turnpike	150 lf	Replace turnpike logs	20 yr(s)	100%	150 lf	\$44	\$6,600	\$13,200
Handrails	6 ea	Replace pine handrails	15 yr(s)	100%	6 ea	\$867	\$5,202	\$15,606
Horse Bridge	450 sf	Redeck treated plank bridge	25 yr(s)	100%	450 sf	\$82	\$36,900	\$73,800
Signs/Posts	8 ea	Replace wood sign/post	10 yr(s)	100%	8 ea	\$118	\$944	\$4,720

NOTE: All cost estimates in 2004 dollars



The findings and recommendations are based on several key assumptions made during the development of the TCO model

- ▶ The TCO model focuses only on planned maintenance requirements
 - In the same way as a TCO study on a building does not incorporate the possibility of a tree falling through the roof, the Trail TCO does not capture the probability of damage caused to properly constructed and maintained trails by abnormal storms. The model could be adapted to incorporate the probability of storm damage and resulting cost over a 50-year period based on historical data.
 - The TCO study **does not consider the cost of safety hazards or resource damage caused by an improperly maintained trail**. The model could be adapted to incorporate such costs.



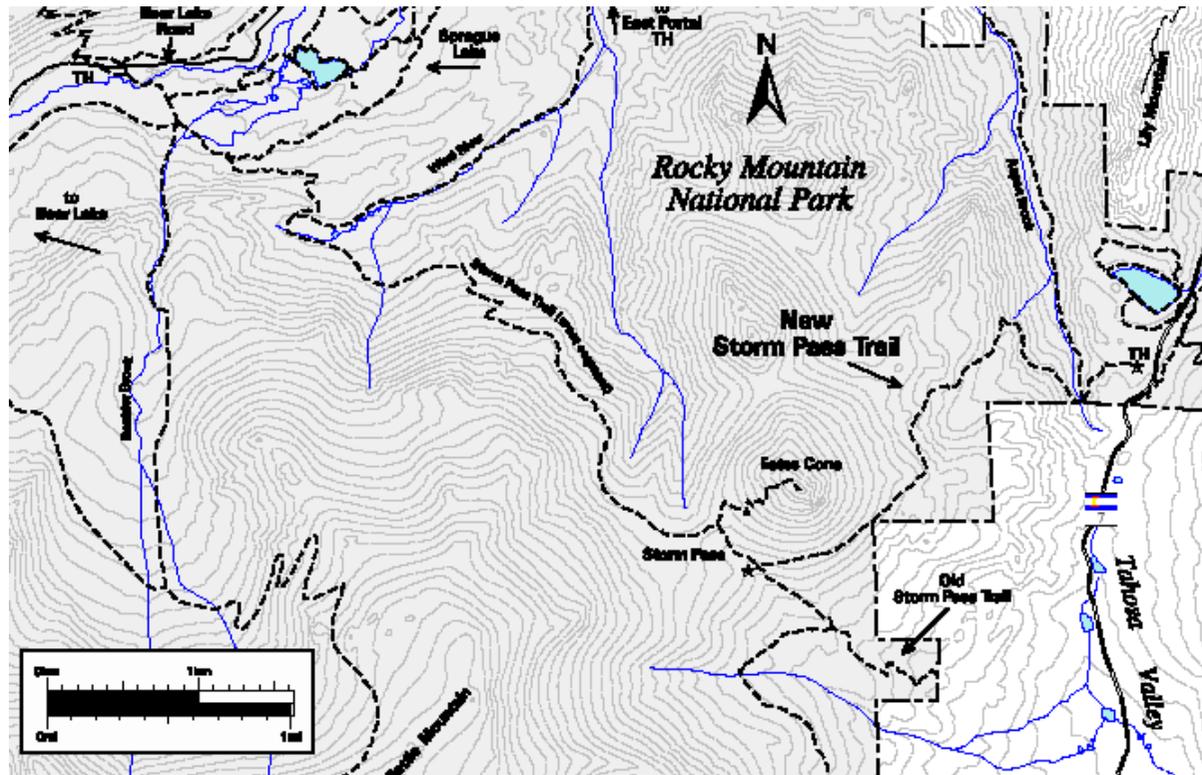
- ▶ The TCO model will **need to be adapted to reflect the conditions of specific trails and trail systems**. The assumptions on the frequency and unit costs of maintenance activities are based on general estimates specific to the New Storm Trail at Rocky Mountain National Park. These trail-specific estimates will be need to be refined and verified over time.



Findings



The New Storm Trail at Rocky Mountain National Park was completed in 2001 at a cost of under \$500,000 (in current year dollars)



The trail crew at Rocky Mountain National Park built the New Storm Trail from 1999-2001. The trail stretches 2.4 miles in length, with 70% of checks and waterbars constructed with rock. The trail has one 45-foot and two 15-foot horse bridges. Twenty percent of the trail has outside rock retaining wall (some multi-tier). Soil is mostly decomposed granite with very little binder; it is susceptible to erosion from both heavy rains and the impacts of horse use. The trail receives moderate horse use (300 trips/year).

The trail cost approximately \$490,000 in 2004 dollars to design, plan and construct.



The Total Cost of Trails Ownership of the New Storm Trail over the 50-year period is nearly \$1 million

ROMO New Storm Trail Total Costs of Ownership	
	Estimated 50-Year Costs (\$k)
Planning, Design and Construction	\$491k
Maintenance (Operations, PM, RM)	\$325k
Recapitalization	\$181k
Total	\$997k

NOTE: All cost estimates in 2004 dollars

This estimate assumes that ROMO has sufficient funding to complete annual requirements (e.g., clearing drainage structures and logging) for maintaining the trail



The Total Cost of Operations of ROMO's New Storm Trail for the 50-year period is over \$500,000

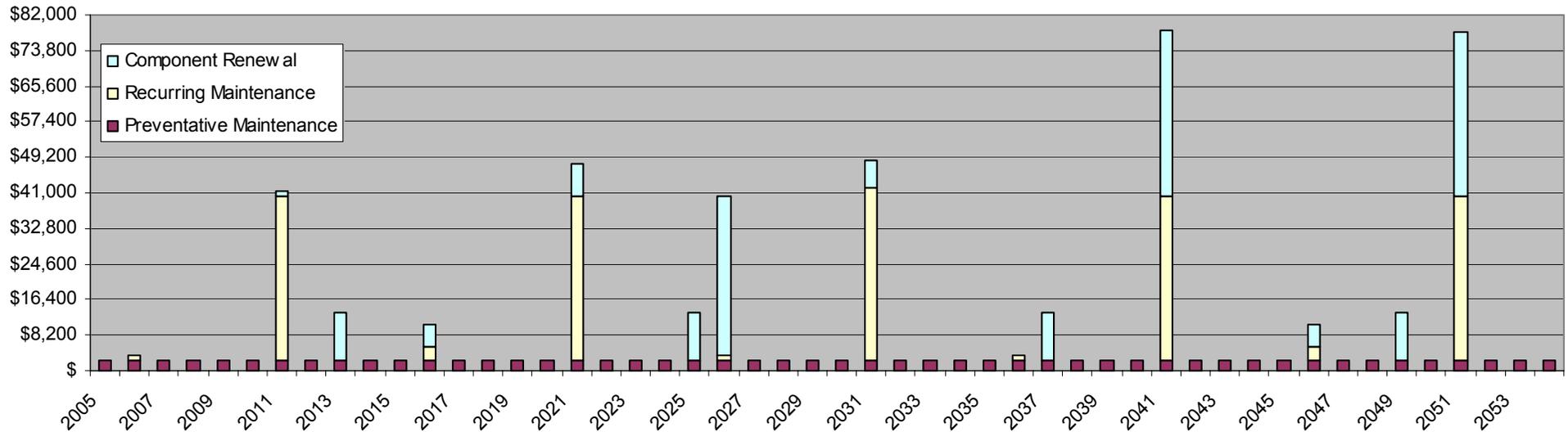
ROMO New Storm Trail Total Costs of Operations		
	Estimated Annualized Costs	Estimated 50-Year Costs
Preventative Maintenance	\$ 2,514	\$ 125,700
Recurring Maintenance	\$ 3,986	\$ 199,320
Component Renewal	\$ 3,627	\$ 181,356
Total	\$ 10,128	\$ 506,376

NOTE: All cost estimates in 2004 dollars

This estimate assumes that ROMO has sufficient funding to complete annual requirements (e.g., clearing drainage structures and logging) for maintaining the trail



These costs can be examined over time, facilitating better budgeting, planning and execution of maintenance requirements



Spikes in expected RM and CR costs can be used to schedule Repair Rehab requests before constructed trail components wear out and cause natural resource damage. For example, the TCO model identifies nearly \$38,000 of expected RM costs in 2021, primarily related to renewing tread worn away by horse use, as well as nearly \$8,000 for replacing turnpike logs.

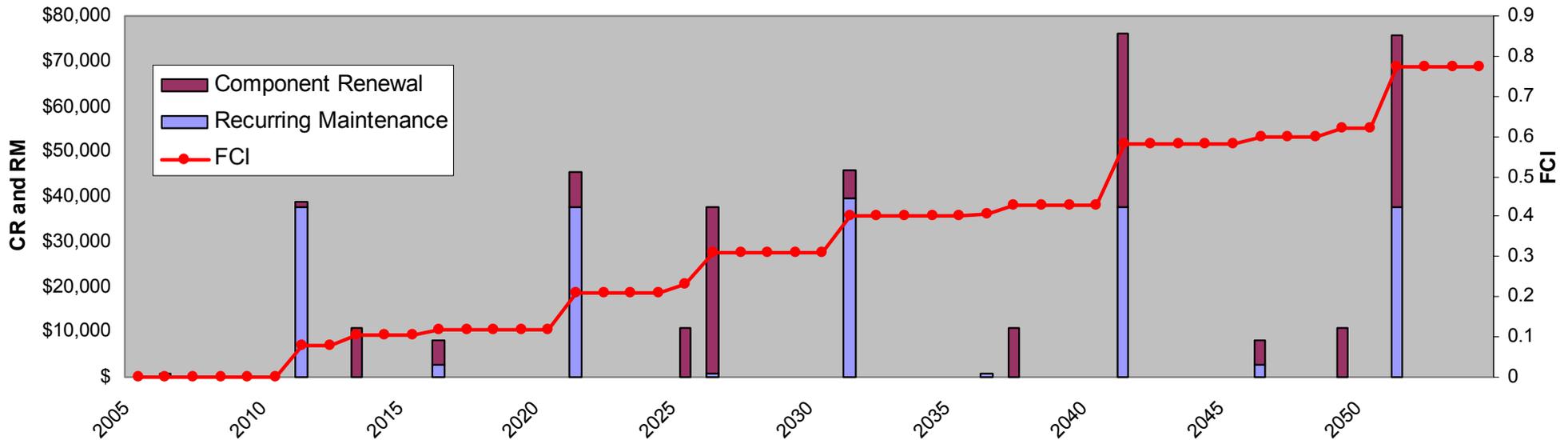
Estimated Costs for 2021	
Preventative Maintenance	\$ 2,514
Recurring Maintenance	\$ 37,827
Component Renewal	\$ 7,544
Total	\$ 47,885

NOTE: All cost estimates in 2004 dollars



Additionally, the TCO model can be used to show how unfunded future requirements will affect the condition of the trail over 50 years

The following analysis assumes that ROMO has funding for annual Preventative Maintenance requirements (clearing drainage structures and logging) but is not successful in securing funding for expected Recurring Maintenance and Component Renewal requirements over the next fifty years. **The red trend line highlights the increasing Facility Condition Index (FCI) – and the worsening condition of the trail.**



NOTE: NPS uses an industry metric called the Facility Condition Index (FCI) to measure the current condition of an asset relative to its as-new condition. The FCI calculation is the cost to repair the asset divided by the cost to replace the asset. For purposes of this initiative, the total construction cost (including design and planning) of \$491,000 was utilized as the cost to replace the trail.



Even more powerfully, the TCO can be used to show how unfunded annual requirements will affect the cost of the trail over 50 years...

The following analysis assumes that ROMO does not have funding for annual Preventative Maintenance requirements (clearing drainage structures and logging). By eliminating the annual maintenance work, ROMO would likely find itself needing to replace drainage structures and repair braid (social) trails more frequently.

ROMO New Storm Trail Total Costs of Operations (No PM)	
	Estimated 50-Year Costs (\$k)
Preventative Maintenance	\$0
Recurring Maintenance	\$337k
Component Renewal	\$192k
Total	\$529k

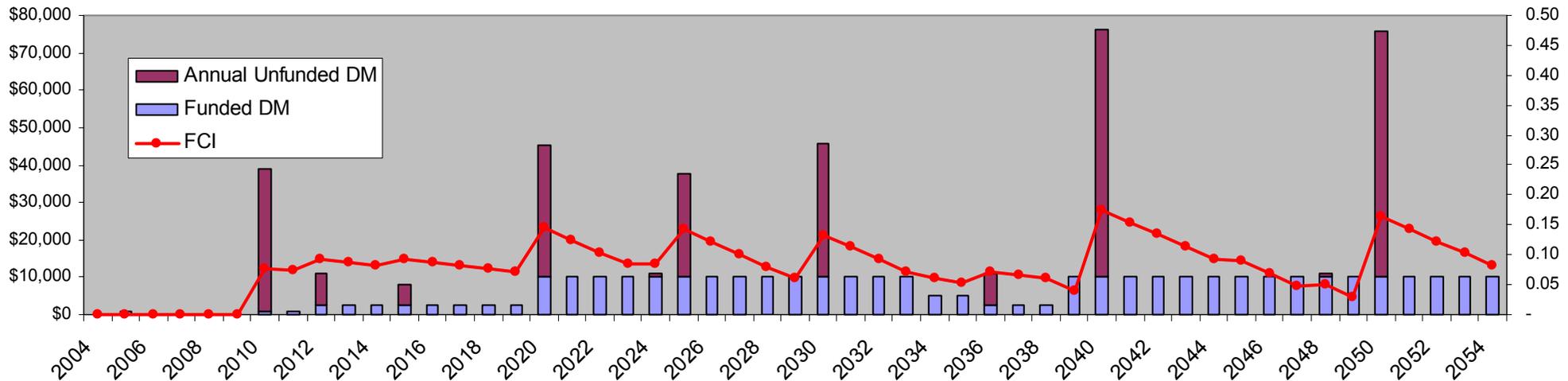
NOTE: All cost estimates in 2004 dollars

As mentioned before, the TCO model does not capture resource damage and health/safety costs related to improper trail maintenance.

Nevertheless, the cost of maintaining the trail over time increases when the park does not execute its annual PM requirements.



...or it can be used to explore how non-traditional funding scenarios might be utilized to maintain the trail's condition over time



The scenario above assumes that \$100,000 was raised and set aside specifically for funding Recurring Maintenance and Component Renewal requirements for the New Storm Trail. The scenario assumes, first and foremost, sufficient funding for annual trail requirements. It assumes a return of 5% above the inflation rate on the endowment and limits spending to the interest earned on the endowment (i.e., the endowment could not fall below \$100,000). Additionally, limits are placed on RM and CR spending in the earlier years – and the funding is utilized to manage the condition of the trail over time.



By using this tool, trail managers can begin to articulate the resources required to maintain trails to a given standard over time...

- ▶ The TCO model provides a defensible methodology both for estimating annual trail maintenance costs and for planning for future trail maintenance recapitalization requirements *for individual trails*. These estimates can be used for:
 - Better articulating budgetary requirements, including annual maintenance requirements, for existing trails
 - Planning for required recapitalization *before* improperly maintained trail structures cause damage to the trail or create safety hazards to the public
 - Securing dedicated funds (e.g., endowments) for future maintenance of newly constructed trails
- ▶ The TCO model can be easily adapted to estimate annual trail maintenance costs and plan for future trail maintenance recapitalization requirements *on multiple trails within one trail system*.
- ▶ With further research, the TCO model could be adapted to incorporate the probability of storm damage and resulting cost over a 50-year period based on historical data. It could also be adapted to consider the cost of safety hazards or resource damage caused by an improperly maintained trail. Such adaptations would further strengthen the power of the tool.



...in order to maintain their unique and aging trail systems at an appropriate standard into the future



Please contact the following members of the NPS Trails Working Group for more information on the Trails TCO initiative

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Questions and feedback

