



STATE OF THE TRAILS

FINAL REPORT



FEBRUARY 2017

Parks & Trails

COUNCIL OF MINNESOTA



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KEY FINDINGS

STATE TRAIL CONDITIONS:

- Minnesota State Trails are currently in good condition. Our inventory found 79% of state trail miles are in either excellent or good condition.
- Only 26 miles of Minnesota State Trails are currently in poor condition, and 90 miles are in fair condition.
- However, Minnesota State Trails are approaching a tipping point. Without adequate planning and funding, half the state trail system is at risk of being in poor or fair condition by 2023.

RECOMMENDATIONS:

- Lawmakers and the DNR should commit to rehabilitating an average of 20 state trail miles per year, which is the level needed to maintain Minnesota State Trails long term.
- Lawmakers should commit to funding state trail rehabilitation through consistent state bonding appropriations and the Parks and Trails Legacy Fund.
- The Minnesota Department of Natural Resources should create a state trail capital improvement plan that gives lawmakers and the public a clear understanding of priority projects and projected costs.



PROJECT OVERVIEW

Filling the information gap on Minnesota State Trails

Parks & Trails Council is proud to introduce the *State of the Trails Project*. The *State of the Trails Project* is a first-of-its-kind inventory of Minnesota State Trail conditions. We spent the summer and fall of 2016 riding the trails, making notes, taking photographs, and using iPhones to record the roughness of each trail.

Minnesota State Trails are among the best in the country. The state trail system was first envisioned in the 1960s, and today nearly 600 miles of state owned-and-operated paved trails exist across Minnesota. The state trail system is managed by the Department of Natural Resources (DNR). And as this report will show, the DNR does an overall excellent job of maintaining the trail system with the uncertain funding they receive. Still, the state trail system is aging; nearly one out of every six miles of trail are 20 years or older, and in some places trails have fallen into disrepair.

We initiated the *State of the Trails Project* as part of our ongoing effort to use data to better understand Minnesota State Trails. In 2015 we

completed Minnesota's first statewide state trail user count, from which we estimated the state trail system receives 1.8 million visits each year. Now, in addition to knowing how our trails are used, we also have a comprehensive dataset on their condition. This data is essential to effectively communicate the challenges and needs of the state trail system, track changes over time, and demonstrate how funding can improve the system.

Maintaining Minnesota State Trails requires both routine maintenance, which is needed annually, and capital improvements, which are needed periodically to either extend the life of a trail or replace a trail at the end of its useful life. Routine maintenance on state trails includes work such as mowing, sweeping, bridge inspection, garbage removal, and occasional crack sealing. Capital improvements include rehabilitation such as trail overlay and repaving, bridge and culvert replacement, and trailhead renewal. While all of these maintenance activities are vital to providing safe and quality state trail experiences, we have limited the scope of the *State of the Trails Project*

to state trail pavement conditions. Our ratings answer a simple question: How smooth are Minnesota State Trails to ride? We do not attempt to analyze the condition of state trail bridges and culverts, interpretive displays, or trailheads. Nor do we attempt to analyze the level of routine maintenance that state trails currently receive.

We collected and used three types of data to inventory state trail conditions. First, staff and volunteers rode (nearly) every mile of state trail and assigned it a rating based on their experience. Each trail segment was given one of four ratings:



Excellent: Trail is very smooth and provides ideal riding conditions.



Good: Trail is comfortable to ride, with few bumps or depressions.



Fair: Trail is tolerable to ride, with intermittent bumps or depressions.



Poor: Trail is uncomfortable to ride, with frequent bumps or depressions.

Second, we mounted iPhones to our bicycle handlebars and used the phone's accelerometer

to record data on the force of vibration caused by each bump and depression on the trail. We used the iPhone's accelerometer data to calculate a Trail Roughness Index (TRI), which is a statistic of how bumpy a trail is to ride. A high TRI is indicative of a rough trail in poor condition, whereas a low TRI is indicative of a smooth trail in excellent condition. A guide to interpreting TRI scores can be found on page 12.

Third, we took photographs of each trail segment. We did not use the photographs to rate any particular segment, but they help visualize on-the-ground conditions.

Our three data types, taken together, provide key insights into the current condition of Minnesota State Trails. Rather than combine our experiential ratings and TRI scores into a composite score, we report each individually. We trust the reader to weigh the pros and cons of each approach, and draw their own conclusions on the state of Minnesota State Trails. Our full methodology is available starting on page 59.





STATE OF THE TRAILS

Minnesota State Trails are in good condition

We collected vast amounts of data for the *State of the Trails Project*: 500 experiential ratings, nearly 412,000 accelerometer readings, and over 1,700 photographs. All our data pointed to the same conclusion: While numerous problem spots exist, Minnesota State Trails are in overall good condition. We collected data from 589 miles, and found nearly 80 percent of them are in either good or excellent condition.

Our conclusion that the state trail system is in good condition is surprising. The predominate narrative on Minnesota State Trails has focused on inadequate funding and trails in disrepair. Our analysis indicates that narrative overstates the problem and suggests the DNR has done an admirable job maintaining the state trail system. The needs of the state trail system should not be minimized, however; numerous trails certainly need repairs, and limited funding for routine maintenance remains a concern. But overall our data is clear: the majority of Minnesota State

Trails still offer comfortable conditions for trail users.

We've broken our findings into four sections. First, we provide an overview of our experiential ratings. Second, we give an overview of the results from the Trail Roughness Index. Third, we discuss how trail conditions compare across the investment groups used by the DNR. The fourth and final section provides a detailed segment-by-segment breakdown for each state trail.

EXPERIENTIAL RATINGS

Based on the experience of our trail evaluators, Minnesota State Trails are currently in good condition. Our trail evaluators rode every segment of the state trail system and reported 79% of the miles are in either good or excellent condition. Specifically, our evaluators rated 197 miles (33% of the system) as excellent, 267 miles (45%) as

good, and 111 miles (19%) as fair. Only 15 miles, or 3% of the state trail system, were classified as being in poor condition.

The trails in poorest condition, based on our trail evaluator's experience, include 6 miles of the Sakatah Singing Hills State Trail between Madison Lake and Waterville, 5 miles of the Willard Munger State Trail between Jay Cooke State Park and Duluth, and approximately 1-mile stretches of the Gateway State Trail, Paul Bunyan State Trail, Heartland State Trail, and Casey Jones State Trail.

TRAIL ROUGHNESS INDEX

Trail Roughness Index (TRI) scores also indicate the state trail system is in good condition. TRI scores, which are an objective measurement of trail conditions calculated from accelerometer data, had a strong but imperfect correlation with our experiential ratings. The two methods assigned the same rating to trail segments 65% of the time and, on a system-wide level, both methods found 79% of the system is in either good or excellent condition. On average, TRI ratings tended be

more conservative than the experiential ratings. The TRI classified 150 miles as excellent (25% of the system), 322 miles as good (54%), 90 miles as fair (15%), and 26 miles as poor (4%).

Based on TRI, the smoothest trail segments in the state trail system are on the Luce Line State Trail, sections of the Paul Bunyan State Trail north of Jenkins and near the Chippewa National Forest, and sections of the Sakatah Singing Hills State Trail west of Madison Lake. All of those trails have been repaved within the last few years. Conversely, the roughest trail sections are on the Currie Loop segment of the Casey Jones State Trail, the Sakatah Singing Hills State Trail between Madison Lake and Waterville, the Minnesota Valley State Trail between Chaska and Shakopee, and the Willard Munger State Trail between Thomson and Duluth.

The highest TRI we recorded, which was on the Willard Munger State Trail, presents a unique case. Sections of the Willard Munger Trail between Jay Cooke State Park and Duluth are currently being rehabilitated. The highest TRI was recorded on a trail segment that is currently all gravel, between Kangas Road and Stenman Road.

Experiential Rating Examples



On other segments between Jay Cooke State Park and Duluth, new pavement is interspersed with gravel sections. TRI indicated those sections are in fair condition, though in actuality they are partially excellent and partially poor.

Overall, the trails in best condition include the Luce Line State Trail, Brown’s Creek State Trail, and Mill Towns State Trail, all of which were paved within the last two years. Only two trails, the Gateway State Trail and Casey Jones State Trail, had a majority of their segments in either fair or poor condition.

DNR INVESTMENT GROUPS

The DNR manages and maintains state trails based on “investment groups.” The investment groups, which were created in 2015, are based on criteria developed by the DNR to assess the

“fit and function” of each state trail. Using those criteria, state trails are placed in one of three groupings that determine the level of investment they receive. “Destination Trails” are the highest ranked trails and receive the highest priority for funding, “Core-Division Led Trails” receive moderate priority for funding, and “Core-Partner Led Trails” have the lowest priority for funding. Maintenance to ensure safety remains a high priority for all investment groups. Tracking how trail conditions vary by investment group will be important, especially in future years, to ensure investments are successfully targeting the highest-use trails, and to ensure all trails are being maintained at an acceptable level, regardless of investment group.

Our analysis found current conditions are similar across the DNR’s investment groups. Based on TRI scores, 79% of Destination Trails are in either good or excellent condition, compared to 77%

State Trail Pavement Conditions, by Evaluation Method

		Experiential Ratings					
		Excellent	Good	Fair	Poor	Not Rated	Totals
Trail Roughness Index (TRI)	Excellent	130 (22%)	21 (3%)	---	---	---	150 (25%)
	Good	66 (11%)	201 (34%)	54 (9%)	2 (<1%)	---	322 (54%)
	Fair	---	40 (7%)	44 (7%)	6 (1%)	---	90 (15%)
	Poor	---	5 (1%)	14 (2%)	8 (1%)	---	26 (4%)
	Not Rated	2 (>1%)	---	---	---	4 (1%)	6 (1%)
	Totals	197 (33%)	267 (45%)	111 (19%)	15 (2%)	4 (1%)	593 miles

of Division-Led Trails and 85% of Partner-Led Trails.

Some small differences in condition did emerge between investment groups, however. Division-Led Trails are the most likely to be in poor condition (8%, compared to 4% of the system). Conversely, 43% of Partner-Led Trails are in excellent condition, compared to 24% of Destination Trails and 21% of Division-Led Trails. Partner-Led Trails are likely in the best condition because, on average, they are the newest trails in the state trail system. The average age of a Partner-Led Trail is approximately 9 years, versus 14 years for Division-Led Trails and 12 years for Destination Trails.






The difference in condition and age of each investment category is illustrative of one of the maintenance challenges facing the DNR: Many of the premier, most-visited state trails were among

the first developed 20 to 30 years ago, and thus are also the most likely to now be falling into disrepair. Consequently, some of the trail segments in the worst shape are also among the most frequently used. This may help explain why our analysis found Minnesota State Trails are in better condition than is often perceived.

SEGMENT-BY-SEGMENT RATINGS

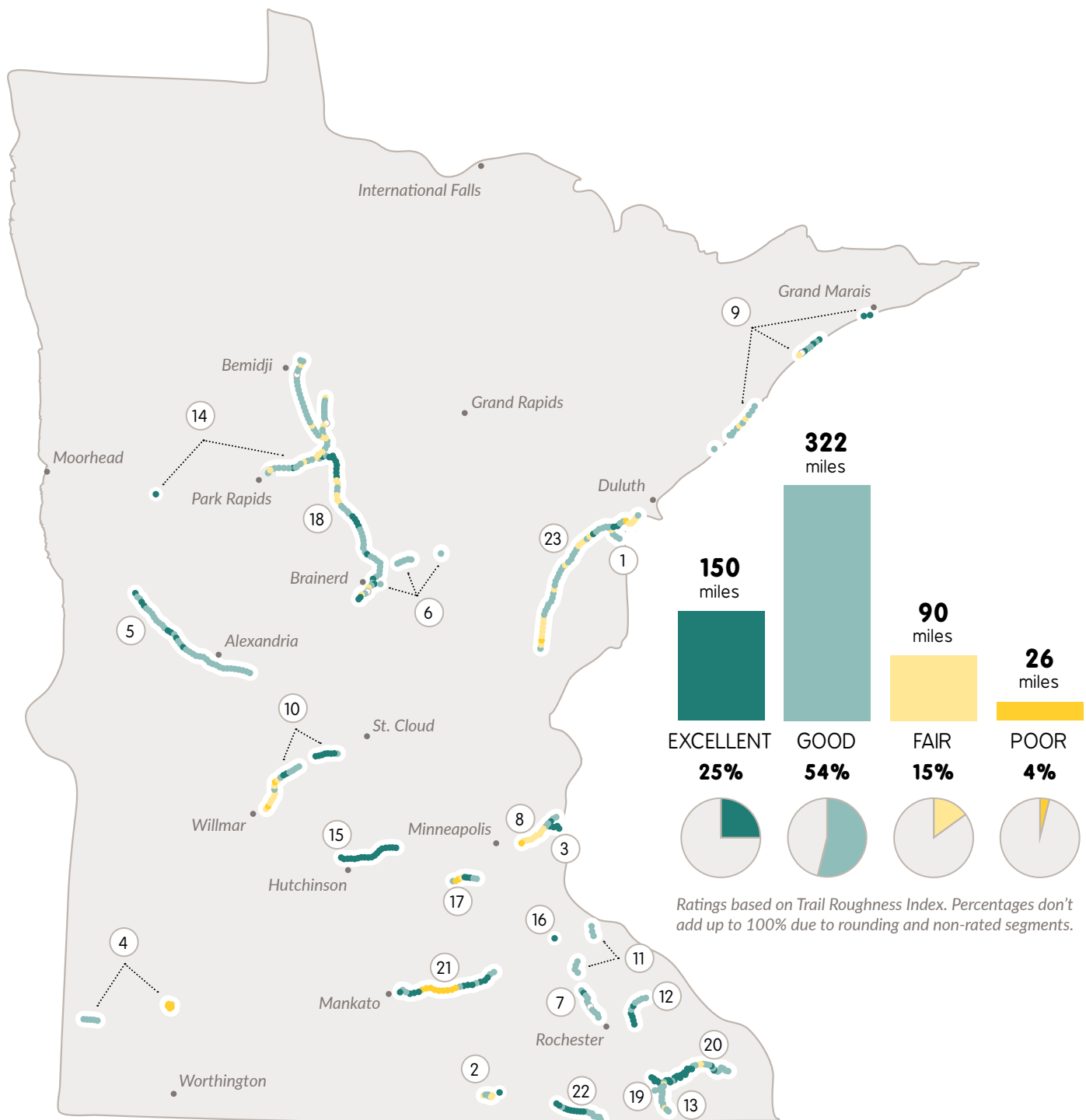
Ratings and selected photographs for every segment of the state trail system are provided starting on page 13. An interactive map of state trail conditions and all of our photographs are available online at www.parksandtrails.org.

State Trail Pavement Conditions by DNR Investment Groups

	Destination Trails		Division-Led Trails		Partner-Led Trails		Total System	
	Miles	%	Miles	%	Miles	%	Miles	%
 Excellent	70	24%	52	21%	29	43%	150	25%
 Good	158	55%	136	56%	28	42%	322	54%
 Fair	52	18%	29	12%	8	12%	90	15%
 Poor	4	1%	20	8%	2	3%	26	4%
 Not Rated	2	1%	4	2%	0	0%	6	1%
Totals:	285	---	241	---	68	---	593	---

Note: Ratings based on the Trail Roughness Index

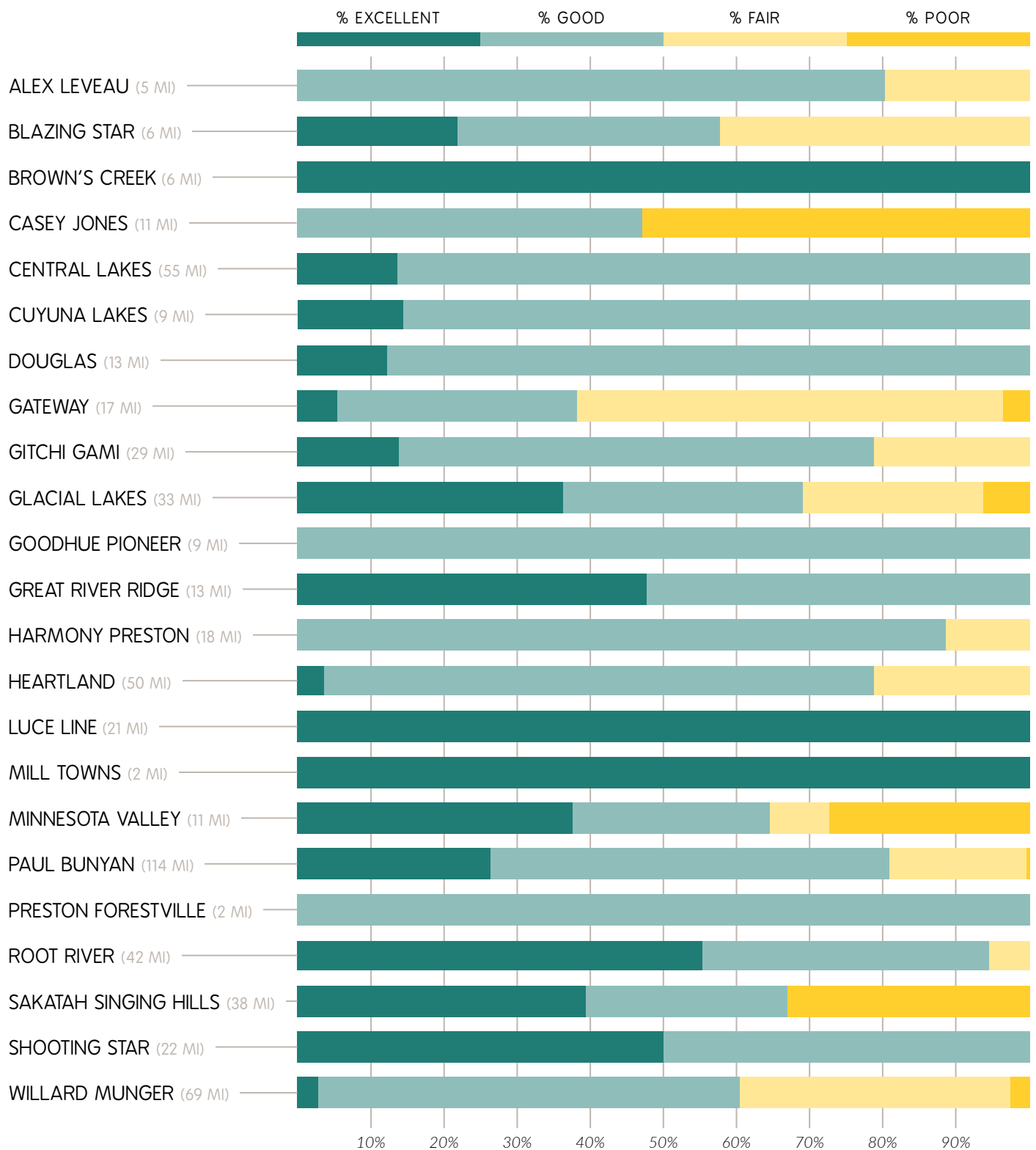
Overview of State Trail Pavement Conditions, Statewide



TRAIL IDENTIFICATION KEY:

- | | | | |
|--------------------------|-------------------------------|------------------------------|-----------------------------------|
| 1. Alex Leveau (p. 13) | 7. Douglas (p. 21) | 13. Harmony Preston (p. 29) | 19. Preston-Forestville (p. 36) |
| 2. Blazing Star (p. 14) | 8. Gateway (p. 22) | 14. Heartland (p. 31) | 20. Root River (p. 44) |
| 3. Brown's Creek (p. 15) | 9. Gitchi Gami (p. 23) | 15. Luce Line (p. 34) | 21. Sakatah Singing Hills (p. 47) |
| 4. Casey Jones (p. 16) | 10. Glacial Lakes (p. 24) | 16. Mill Towns (p. 36) | 22. Shooting Star (p. 49) |
| 5. Central Lakes (p. 17) | 11. Goodhue Pioneer (p. 27) | 17. Minnesota Valley (p. 37) | 23. Willard Munger (p. 51) |
| 6. Cuyuna Lakes (p. 20) | 12. Great River Ridge (p. 28) | 18. Paul Bunyan (p. 38) | |

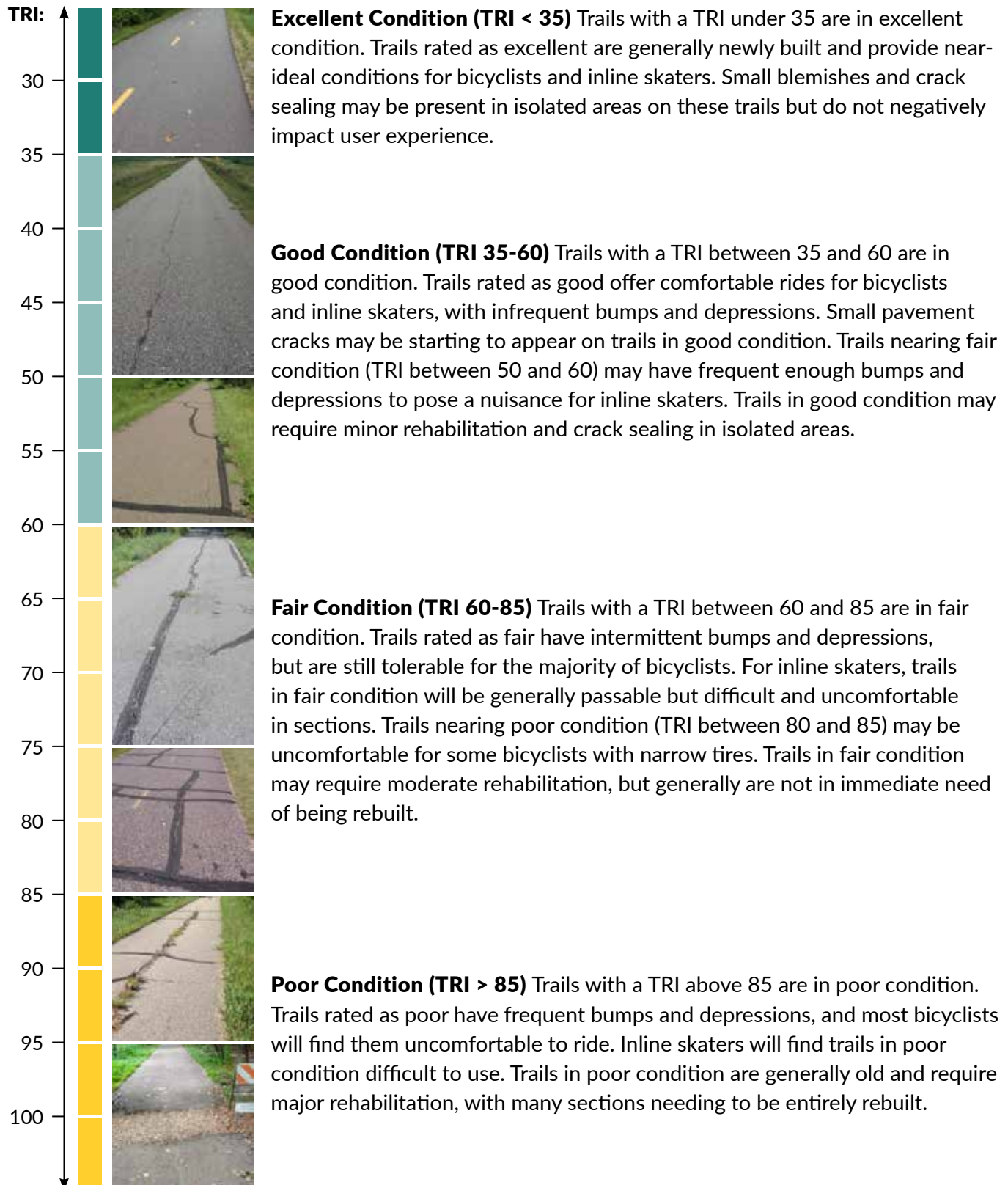
Overview of State Trail Pavement Conditions, by Trail



Note: Ratings based on the Trail Roughness Index

Understanding the Trail Roughness Index (TRI)

The Trail Roughness Index (TRI) is a statistic created by Parks & Trails Council to measure the roughness of paved trails. TRI is calculated from accelerometer data collected by bicycle-mounted iPhones. While TRI is subject to limitations, it is the best objective measurement of trail conditions we currently have. Use this chart to interpret the TRI scores found throughout this report.





ALEX LAVEAU STATE TRAIL (CARLTON TO HIGHWAY 23)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)






0% EXCELLENT

80% GOOD

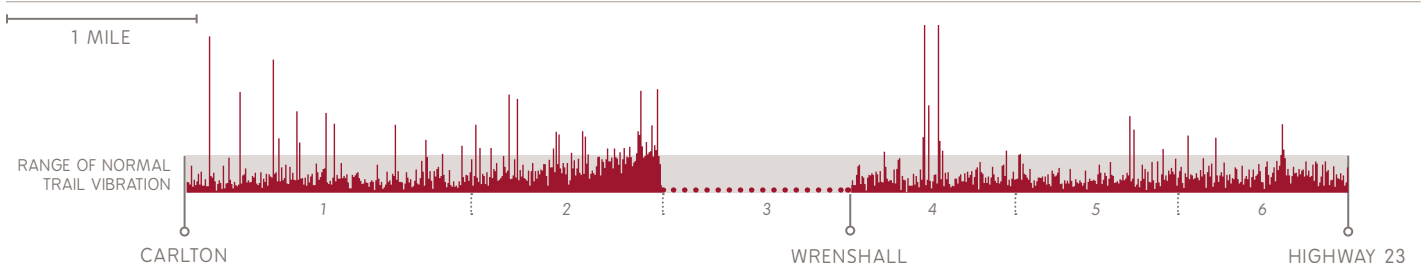
20% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
CARLTON, MN	1 GOOD	56.5	
LEIMER RD	2 GOOD	60.5	
CLARENCE RD	3 ROAD SHOULDER		
WRENSHALL, MN	4 GOOD	56.2	
COUNTY RD 18	5 GOOD	50.2	
CEMETERY RD	6 GOOD	55.7	
HIGHWAY 23			
			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





BLAZING STAR STATE TRAIL (ALBERT LEA TO HAYWARD)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)




22% EXCELLENT

36% GOOD

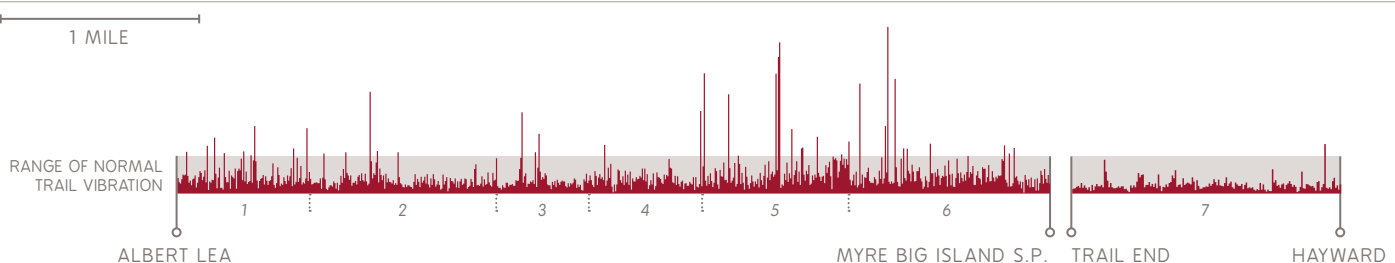
42% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT		EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
FRANK HALL PARK (ALBERT LEA)	1	GOOD	67.0	
FRONT ST TRAILHEAD	2	GOOD	50.1	
767TH ST	3	GOOD	46.8	
INTERSTATE 35	4	GOOD	46.8	
197TH ST	5	FAIR	71.4	
MYRE BIG ISLAND S.P.	6	FAIR	61.9	
END OF TRAIL	7	EXCELLENT	26.8	
HAYWARD, MN				

TRAIL PROFILE (FROM ACCELEROMETER DATA)





BROWN'S CREEK STATE TRAIL (DULUTH JCT TO STILLWATER)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)






100% EXCELLENT

0% GOOD

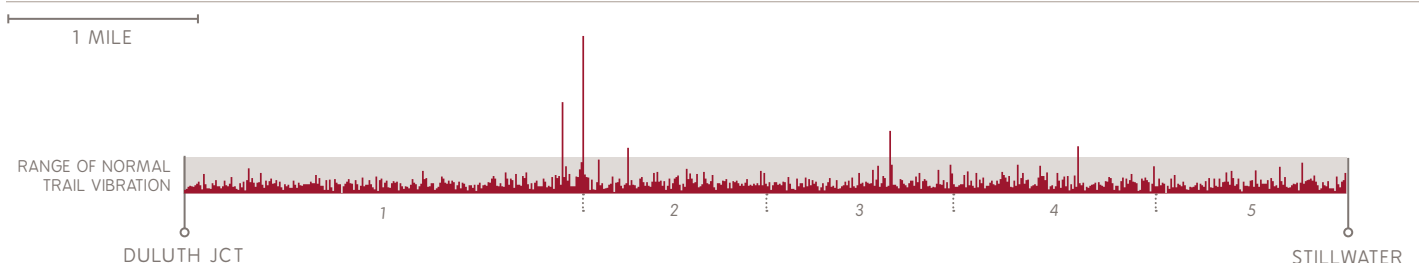
0% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
DULUTH JCT (GATEWAY TRAIL)	1 EXCELLENT	29.2	    
MANNING AVE	2 EXCELLENT	32.5	
COLDWATER TRAILHEAD	3 EXCELLENT	29.6	
STONEBRIDGE TRAIL	4 EXCELLENT	30.8	
ST. CROIX TRAIL	5 EXCELLENT	32.0	
STILLWATER, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





CASEY JONES STATE TRAIL (PIPESTONE & LAKE SHETEK S.P.)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

0% EXCELLENT

47% GOOD

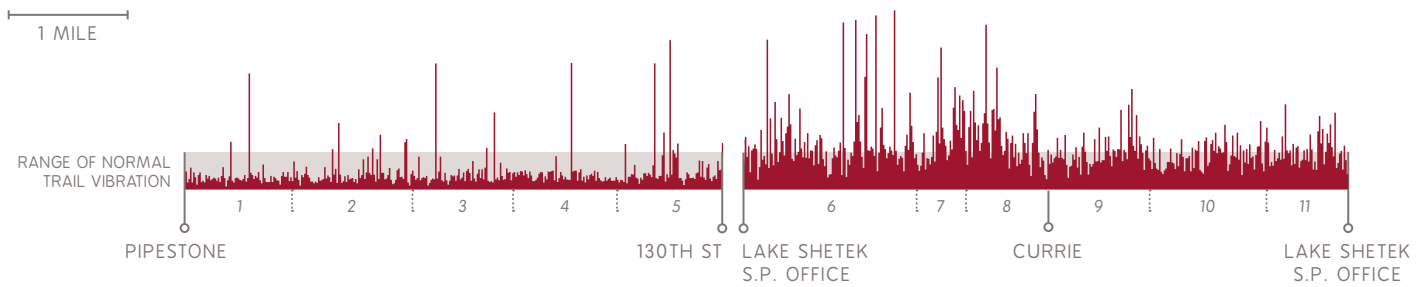
0% FAIR

53% POOR

TRAIL CONDITION

TRAIL SEGMENT	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
PIPESTONE, MN			
1	GOOD	38.1	1
90TH AVE	2	GOOD	2
100TH AVE	3	GOOD	3
110TH AVE	4	GOOD	4
120TH AVE	5	GOOD	5
130TH AVE			
LAKE SHETEK S.P. OFFICE	6	FAIR	6
TRAIL'S EDGE GENERAL STORE	7	POOR	7
166TH ST	8	FAIR	8
CURRIE, MN	9	GOOD	9
LAKE SHETEK DAM	10	GOOD	10
SMITH LAKE	11	GOOD	11
LAKE SHETEK S.P. OFFICE			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





CENTRAL LAKES STATE TRAIL (FERGUS FALLS TO MELBY)


OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

14% EXCELLENT

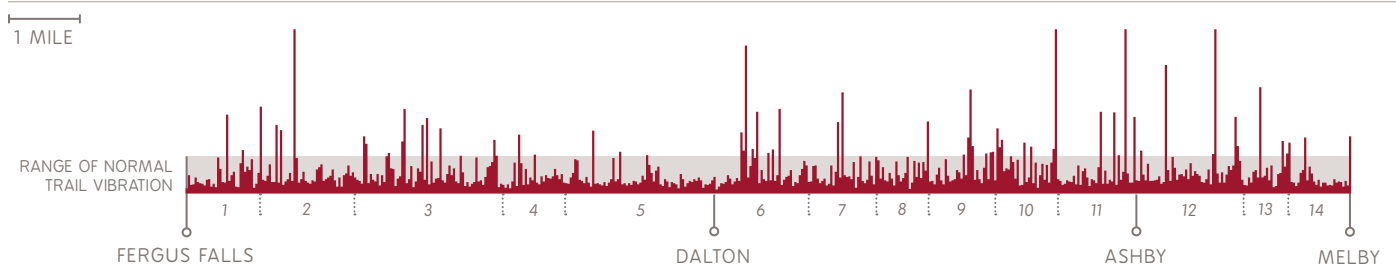
86% GOOD

0% FAIR













0% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
FERGUS FALLS, MN	1 GOOD	34.3	  
DELEGOON PARK	2 FAIR	43.3	
COUNTY RD 29	3 FAIR	40.5	
170TH ST	4 GOOD	32.8	  
POMME DE TERRE RIVER	5 GOOD	31.5	
DALTON, MN	6 FAIR	47.7	
130TH ST	7 GOOD	41.8	  
120TH ST	8 GOOD	39.4	
295TH AVE	9 FAIR	44.9	
305TH AVE	10 GOOD	41.6	  
PELICAN CREEK	11 GOOD	56.6	
ASHBY, MN	12 GOOD	51.6	
ASHBY RESORT & CAMPGROUND	13 GOOD	48.0	 
PALMQUIST LAKESHORE RD	14 GOOD	31.7	
MELBY, MN			

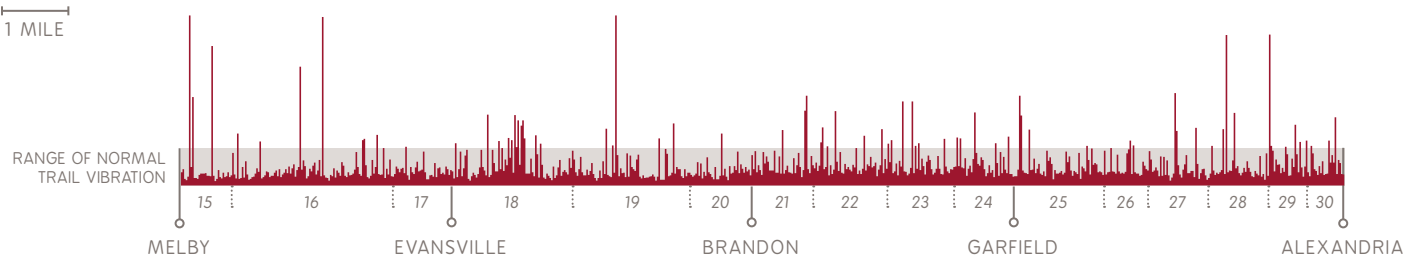
TRAIL PROFILE (FROM ACCELEROMETER DATA)



CENTRAL LAKES STATE TRAIL (MELBY TO ALEXANDRIA)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS		
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)			
MELBY, MN	15	GOOD	57.5		
OLD BRIDGE RD		GOOD	41.0		
COUNTY RD 1	17	GOOD	30.3		
EVANSVILLE, MN		GOOD	42.6		
STOWE LAKE RD	19	GOOD	44.6		
BURLINGTON RD		GOOD	30.9		
BRANDON, MN	21	GOOD	37.5		
HERMANSON RD		GOOD	44.9		
COUNTY RD 109	23	GOOD	49.3		
UTOPIA DR		GOOD	42.5		
GARFIELD, MN	25	GOOD	40.9		
CENTENNIAL DR		GOOD	36.7		
BROPHY LANE	27	GOOD	42.4		
NORTH UNION LAKE		GOOD	46.7		
RUBY ST	29	FAIR	55.2		
COUNTY RD 22		GOOD	44.9		
ALEXANDRIA, MN	30				

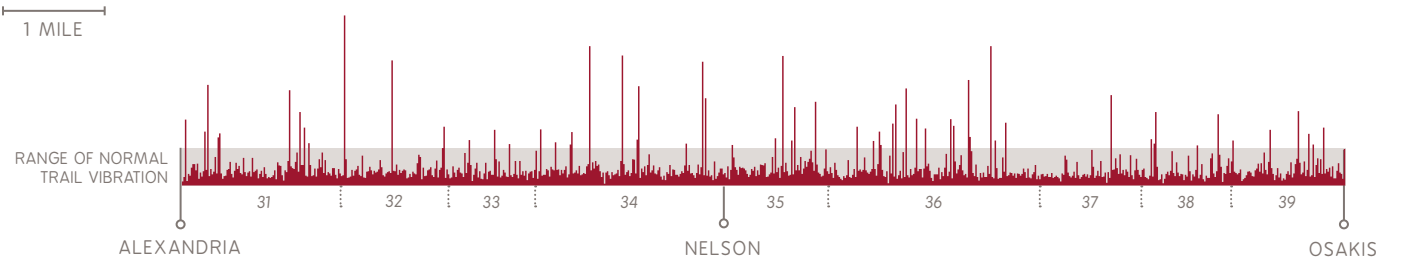
TRAIL PROFILE (FROM ACCELEROMETER DATA)



CENTRAL LAKES STATE TRAIL (ALEXANDRIA TO OSAKIS)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
ALEXANDRIA, MN	31 GOOD	50.7	<div><div>31</div><div>32</div><div>33</div><div>34</div></div>
BIRCH AVE	32 GOOD	44.5	
FREEDOM RD	33 GOOD	38.4	
LIBERTY RD	34 GOOD	48.4	
NELSON, MN	35 FAIR	51.7	<div><div>35</div><div>36</div><div>37</div><div>38</div></div>
WILDLIFE LANE	36 FAIR	50.0	
BIRD LAKE RD	37 GOOD	37.8	
CALVARY RD	38 GOOD	42.3	
COUNTY RD 3	39 GOOD	43.5	<div><div>39</div></div>
OSAKIS, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





CUYUNA LAKES STATE TRAIL (BRAINERD, CROSBY, AITKIN)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

15% EXCELLENT

85% GOOD

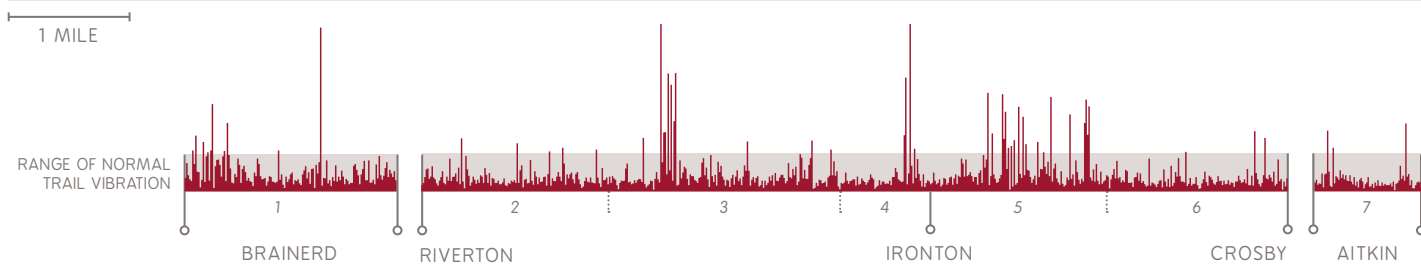
0% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT		EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
LAUREL ST (BRAINERD)	1	GOOD	58.2	
WASHINGTON ST (BRAINERD)				
RIVERTON, MN	2	GOOD	36.4	
LOON LANE				
CUYUNA TRAILHEAD	3	FAIR	57.7	
IRONTON, MN	4	GOOD	55.3	
HIGHWAY 6	5	FAIR	58.7	
CROSBY, MN	6	GOOD	30.7	
2ND ST (AITKIN, MN)	7	EXCELLENT	39.1	
RED OAK DR (AITKIN, MN)				

TRAIL PROFILE (FROM ACCELEROMETER DATA)





DOUGLAS STATE TRAIL (ROCHESTER TO PINE ISLAND)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

12% EXCELLENT

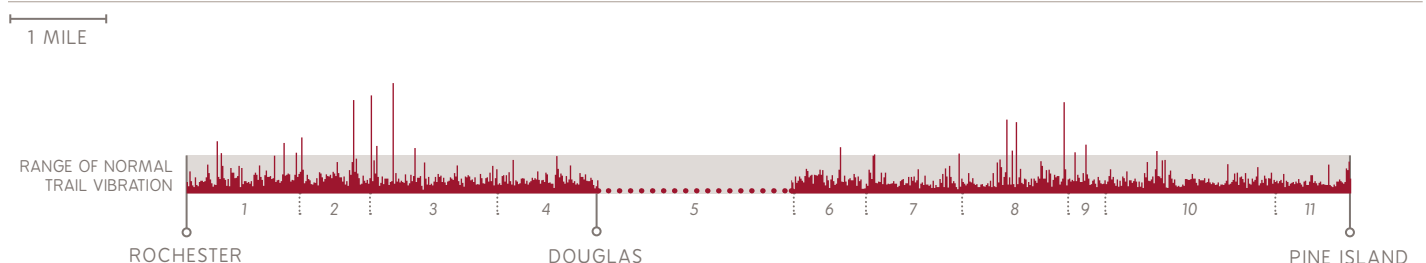
88% GOOD

0% FAIR

0% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
ROCHESTER, MN	1	GOOD 43.6	
WEST CIRCLE DR	2	GOOD 52.8	
50TH AVE	3	GOOD 43.2	
65TH ST	4	GOOD 37.9	
DOUGLAS, MN	5	CLOSED FOR RECONSTRUCTION	
90TH ST	6	GOOD 37.1	
PLUM CREEK	7	GOOD 36.5	
NEW HAVEN RD	8	GOOD 44.6	
117TH ST	9	GOOD 35.4	
85TH AVE	10	GOOD 34.8	
8TH ST	11	GOOD 35.3	
PINE ISLAND, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





GATEWAY STATE TRAIL (ST. PAUL TO PINE POINT PARK)















OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

5% EXCELLENT

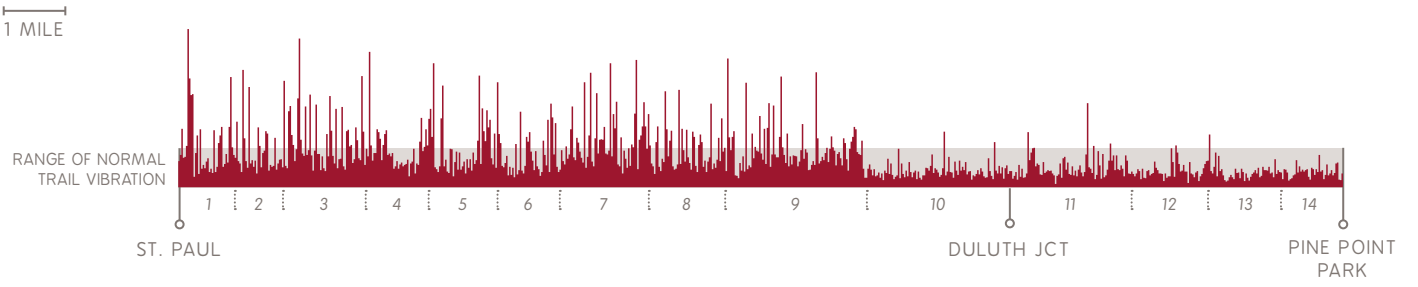
33% GOOD

58% FAIR

4% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
ARLINGTON AVE	1 POOR	96.4	  
LARPENDEUR AVE	2 FAIR	75.3	
HIGHWAY 61	3 FAIR	84.1	
BRUCE VENTO TRAIL	4 GOOD	77.3	 
WHITE BEAR AVE	5 GOOD	75.6	
MCKNIGHT RD	6 GOOD	61.0	
CENTURY AVE	7 FAIR	79.6	  
55TH STREET	8 GOOD	70.3	
HIGHWAY 36	9 GOOD	79.9	
COUNTY RD 12	10 EXCELLENT	37.9	  
DULUTH JCT	11 EXCELLENT	43.7	
LANSING AVE	12 EXCELLENT	34.6	
MANNING AVE	13 EXCELLENT	35.8	  
MYERON RD	14 EXCELLENT	36.6	
PINE POINT PARK			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





GITCHI GAMI STATE TRAIL (GOOSEBERRY TO SILVER BAY)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

14% EXCELLENT

65% GOOD

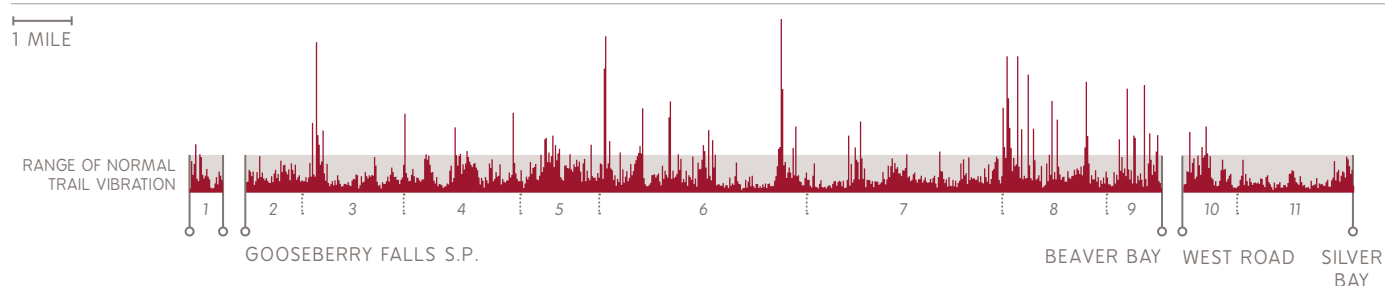
21% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
OLD HWY 61	1 EXCELLENT	42.9	1
SILVER CREEK WAYSIDE			2
GOOSEBERRY S.P. CAMPGROUND	2 EXCELLENT	36.2	3
GOOSEBERRY FALLS S.P. RD	3 EXCELLENT	52.4	4
J GREGRS INN	4 EXCELLENT	50.1	5
IONA'S BEACH WATER ACCESS	5 EXCELLENT	53.1	6
SPLIT ROCK RIVER TRAILHEAD	6 GOOD	64.5	7
SPLIT ROCK LIGHTHOUSE S.P.	7 GOOD	39.9	8
PINE BAY LOOP	8 GOOD	64.7	9
COVE POINT CROSSING	9 GOOD	57.9	10
BEAVER BAY, MN			11
WEST ROAD	10 EXCELLENT	54.3	
PIPE LINE RD	11 EXCELLENT	35.3	
SILVER BAY, MN			

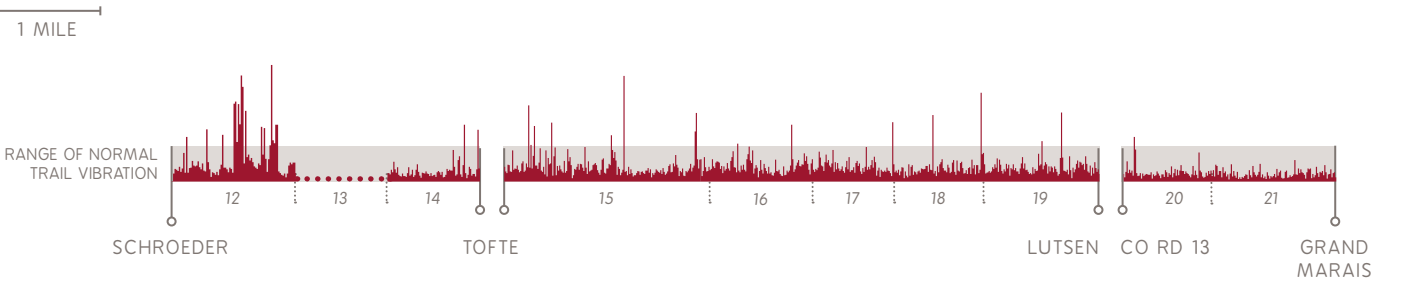
TRAIL PROFILE (FROM ACCELEROMETER DATA)



GITCHI GAMI STATE TRAIL (SCHROEDER TO GRAND MARAIS)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
SCHROEDER, MN	12 GOOD	70.1	12
TEMPERANCE RIVER S.P.			
COUNTY RD 1201	13 CLOSED FOR RECONSTRUCTION		13
TOFTE, MN	14 EXCELLENT	32.8	14
TOFTE, MN	15 GOOD	40.7	15
CHATEAU LEVEUAX			
RAY BERGLUND WAYSIDE	16 EXCELLENT	43.5	16
ROLLINS CREEK RD	17 EXCELLENT	32.2	
HWY 61 TUNNEL	18 EXCELLENT	36.1	18
SKI HILL RD (LUTSEN)	19 EXCELLENT	36.5	
COUNTY RD 13	20 EXCELLENT	27.0	20
HARBORVILLE TRAIL			
1ST AVE (GRAND MARAIS)	21 EXCELLENT	26.5	21

TRAIL PROFILE (FROM ACCELEROMETER DATA)





GLACIAL LAKES STATE TRAIL (WILLMAR TO HAWICK)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

36% EXCELLENT

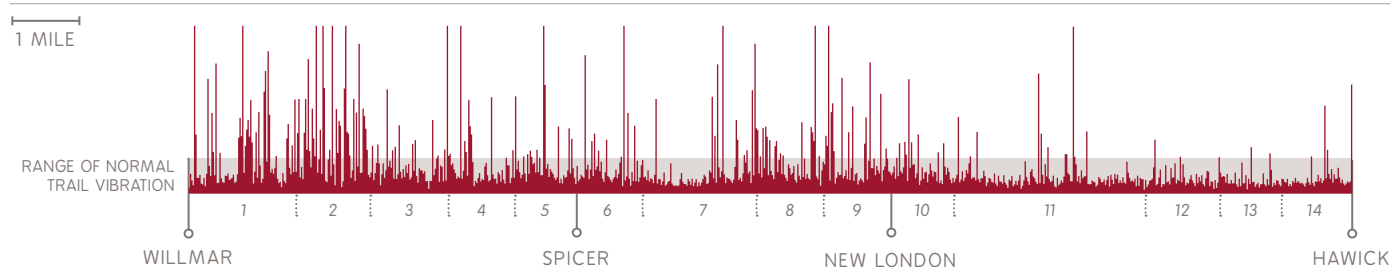
33% GOOD

25% FAIR

6% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
WILLMAR, MN	1 FAIR	79.6	1 No Photo Available
45TH AVE	2 FAIR	88.2	2
60TH AVE	3 FAIR	65.1	3
COUNTY RD 127	4 GOOD	62.6	4
HIGHWAY 23	5 GOOD	65.7	5
SPICER, MN	6 GOOD	60.2	6 No Photo Available
MEDAYTO ST	7 GOOD	57.6	7
NEST LAKE BRIDGE	8 GOOD	62.5	8 No Photo Available
LITTLE CROW C.C.	9 GOOD	91.5	9
NEW LONDON, MN	10 GOOD	72.3	10
187TH AVE	11 GOOD	44.3	11
115TH ST	12 GOOD	29.0	12
130TH ST	13 GOOD	31.1	13 No Photo Available
145TH ST	14 GOOD	43.2	14 No Photo Available
HAWICK, MN			

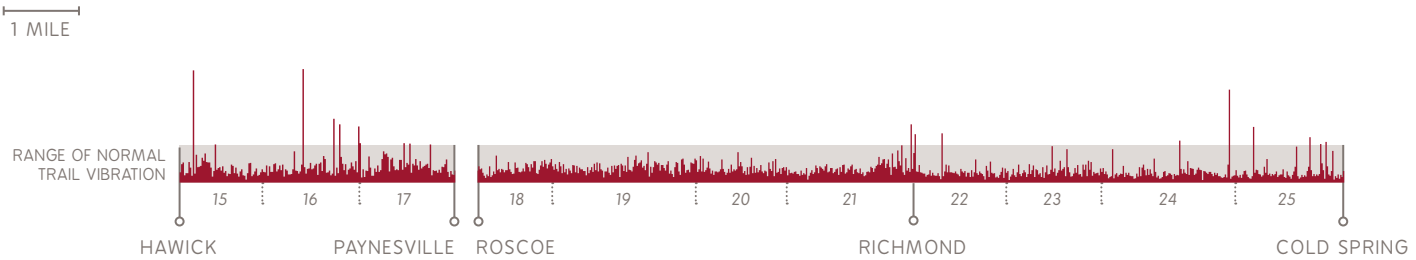
TRAIL PROFILE (FROM ACCELEROMETER DATA)



GLACIAL LAKES STATE TRAIL (PAYNESVILLE, ROSCOE & COLD SPRING)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
HAWICK, MN	15	GOOD	35.1
175TH ST			
255TH ST			
PAYNESVILLE, MN	17	GOOD	39.0
ROSCOE, MN	18	GOOD	32.3
246TH AVE			
ROSCHIE LAKE			
MAINE ST	19	EXCELLENT	30.4
GRANT AVE (RICHMOND, MN)			
191ST AVE			
178TH AVE	20	EXCELLENT	31.2
14TH AVE			
SAUK RIVER RD (COLD SPRING, MN)			
	21	EXCELLENT	31.6
	22	EXCELLENT	24.7
	23	EXCELLENT	26.2
	24	EXCELLENT	24.0
	25	EXCELLENT	37.1

TRAIL PROFILE (FROM ACCELEROMETER DATA)





GOODHUE PIONEER STATE TRAIL (ZUMBROTA & RED WING)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

0% EXCELLENT

100% GOOD

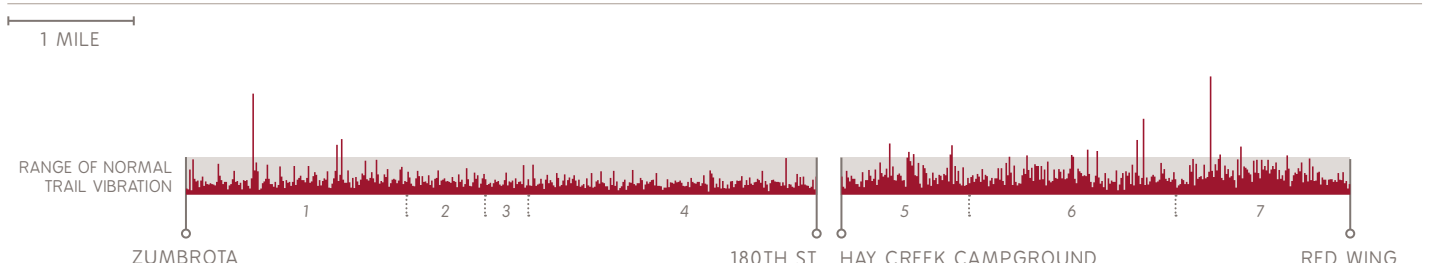
0% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT		EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS	
ZUMBROTA, MN	1	GOOD	43.0		
COVERED BRIDGE (MILE 2)	2	EXCELLENT	40.5		
GRAVEL DRIVEWAY (MILE 3)	3	EXCELLENT	38.7		
420TH ST	4	EXCELLENT	36.0		
180TH AVE					
HAY CREEK CAMPGROUND	5	EXCELLENT	48.4		
HAY CREEK RECREATION AREA	6	EXCELLENT	44.3		
HAY CREEK TRAIL	7	EXCELLENT	53.6		
PIONEER RD (RED WING, MN)					

TRAIL PROFILE (FROM ACCELEROMETER DATA)





GREAT RIVER STATE TRAIL (EYOTA TO PLAINVIEW)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

48% EXCELLENT

52% GOOD

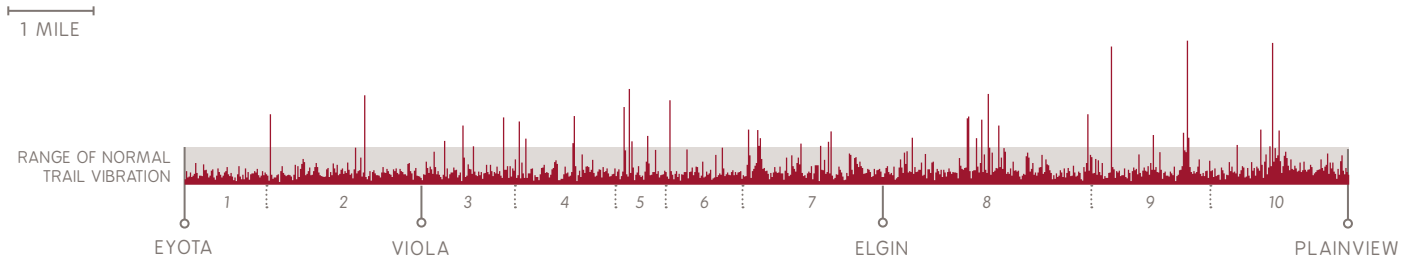
0% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT		EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS	
EYOTA	1	EXCELLENT	30.8	1	2
SILVER CREEK RD	2	EXCELLENT	34.8	3	
VIOLA	3	EXCELLENT	33.8		
55TH ST	4	EXCELLENT	31.9	4	5
65TH ST	5	EXCELLENT	42.2		
COUNTRY RD 24	6	GOOD	32.8	6	7
T-271	7	GOOD	40.3		
ELGIN	8	FAIR	46.3	8	9
T-229	9	FAIR	47.6		
265TH AVE	10	FAIR	43.6	10	
PLAINVIEW					

TRAIL PROFILE (FROM ACCELEROMETER DATA)





HARMONY-PRESTON STATE TRAIL (HARMONY TO PRESTON)












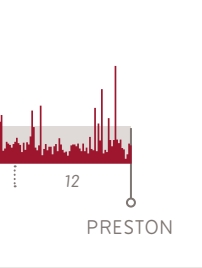
OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

0% EXCELLENT

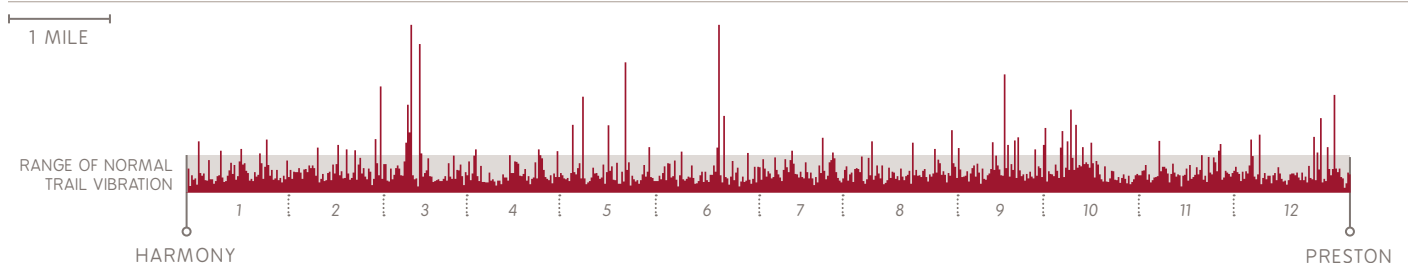
89% GOOD

11% FAIR






0% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
HARMONY, MN	1	FAIR 49.0	  
MILE 17	2	FAIR 44.2	
MILE 16	3	FAIR 64.1	
MILE 15	4	FAIR 40.4	 
MILE 14	5	FAIR 48.2	
MILE 13	6	FAIR 53.9	
MILE 12	7	GOOD 45.3	  
MILE 11	8	GOOD 44.9	
MILE 10	9	GOOD 52.9	
MILE 9	10	GOOD 53.1	  
MILE 8	11	GOOD 43.2	
MILE 7	12	GOOD 44.6	
PRESTON, MN			

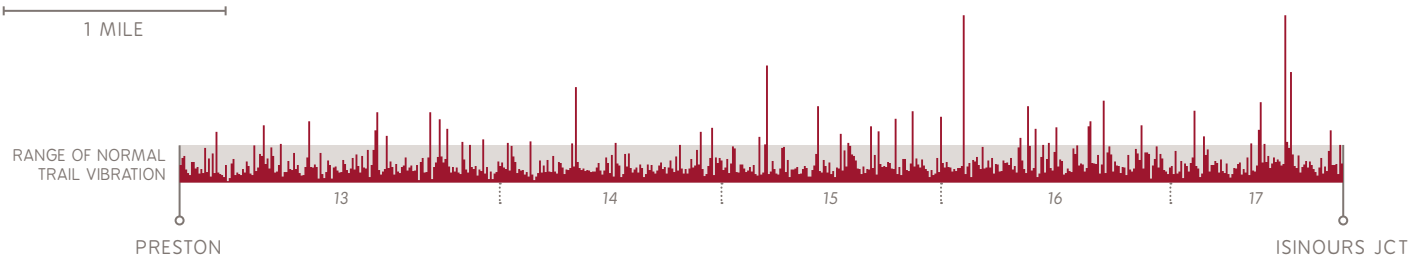
TRAIL PROFILE (FROM ACCELEROMETER DATA)



HARMONY-PRESTON STATE TRAIL (PRESTON TO ISINOORS JCT)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
PRESTON, MN	13	FAIR49.2	<div>13</div>  <div>14</div> 
MILE 4	14	GOOD52.7	
MILE 3	15	GOOD50.0	<div>15</div>  <div>16</div> 
MILE 2	16	GOOD56.7	
MILE 1	17	GOOD67.5	<div>17</div> 
ISINOORS JCT			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





HEARTLAND STATE TRAIL (DETROIT LAKES & GRAND RAPIDS)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

4% EXCELLENT

75% GOOD

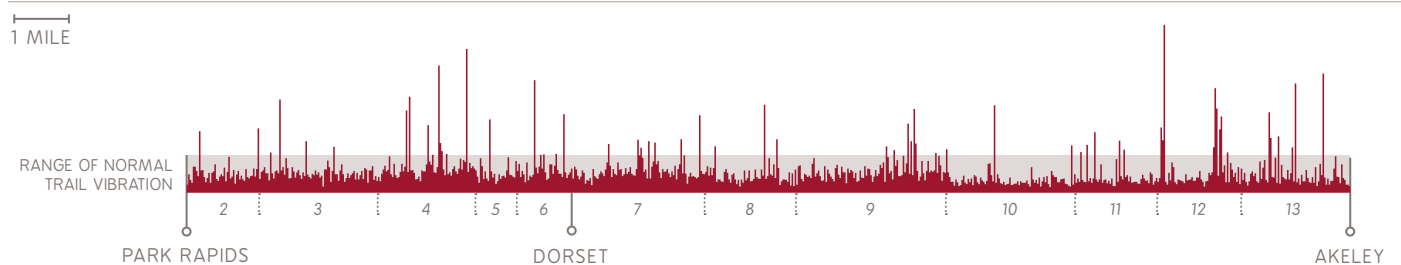
21% FAIR

0% POOR











TRAIL CONDITION

TRAIL SEGMENT	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
JACKSON AVE (DETROIT LAKES)	1 EXCELLENT	NO DATA	1 2 3
HIGHWAY 10 (DETROIT LAKES)			
PARK RAPIDS, MN	2 GOOD	44.2	4 5 6
COUNTY RD 1	3 GOOD	45.5	
COUNTY RD 4	4 GOOD	64.3	
185TH AVE	5 GOOD	49.0	7 8
189TH AVE	6 GOOD	51.3	
DORSET, MN	7 GOOD	51.4	
219TH AVE	8 EXCELLENT	41.6	9 10 11
COUNTY RD 18	9 GOOD	53.6	
NEVIS, MN	10 EXCELLENT	33.6	
269TH AVE	11 EXCELLENT	36.3	12 13
275TH AVE	12 GOOD	59.8	
285TH AVE	13 GOOD	47.9	
AKELEY, MN			

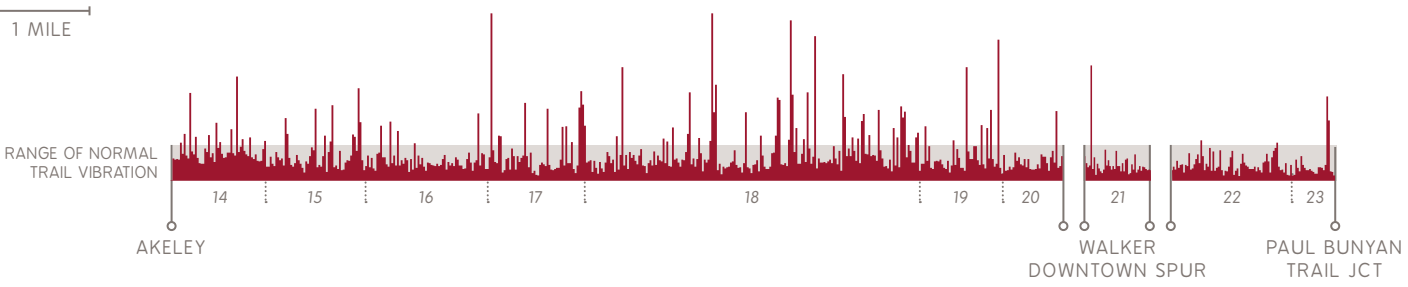
TRAIL PROFILE (FROM ACCELEROMETER DATA)


















HEARTLAND STATE TRAIL (AKELEY TO WALKER & PAUL BUNYAN JCT)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS		
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)			
AKELEY, MN	14	GOOD	59.8	  	
HORSESHOE RD (WEST JCT)		GOOD	54.4		
HORSESHOE RD (EAST JCT)		POOR	51.3		
PAUL BUNYAN JCT	17	GOOD	69.0	  	
LAKE ALICE RD		FAIR	68.9		
6TH LAKE RD		FAIR	70.4		
COUNTY RD 12	20	GOOD	51.6	  	
WALKER TRAIL JCT		21	EXCELLENT		49.5
WALKER TRAIL JCT			23		EXCELLENT
DOWNTOWN WALKER	EXCELLENT			47.9	
PAUL BUNYAN JCT					

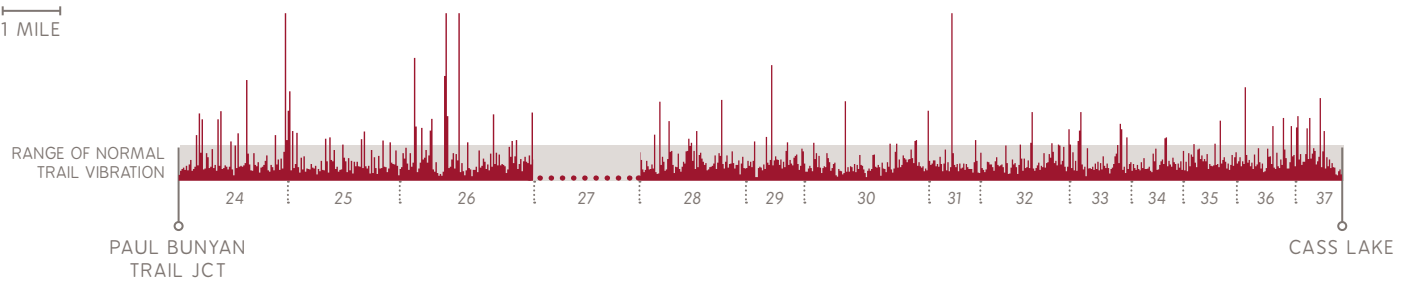
TRAIL PROFILE (FROM ACCELEROMETER DATA)



HEARTLAND STATE TRAIL (WALKER TO CASS LAKE)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
PAUL BUNYAN TRAIL JCT	24 GOOD	59.4	  
TRAILS RV PARK	25 GOOD	41.5	
100TH ST	26 GOOD	61.9	
STEAMBOAT LOOP	27 ROAD SHOULDER		  
COVE DR	28 GOOD	45.2	
HIGHWAY 371	29 EXCELLENT	51.8	
COUNTY RD 66	30 EXCELLENT	39.1	  
STEAMBOAT LAKE ACCESS	31 EXCELLENT	51.3	
134TH ST	32 GOOD	44.1	
140TH ST	33 EXCELLENT	43.3	  
144TH ST	34 EXCELLENT	38.2	
148TH ST	35 GOOD	45.7	
152ND ST	36 GOOD	49.2	  
NARY RD	37 GOOD	63.6	
CASS LAKE, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





LUCE LINE STATE TRAIL (HUTCHINSON TO SILVER LAKE)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

100% EXCELLENT

0% GOOD

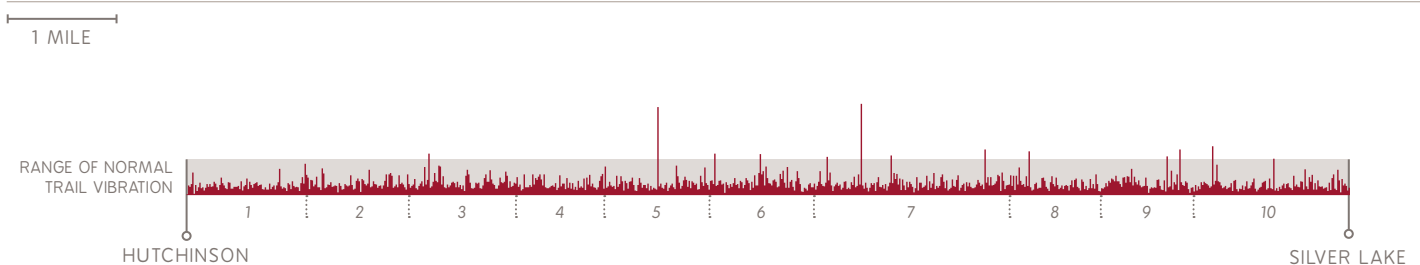
0% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
VALE AVE (HUTCHINSON, MN)	1 EXCELLENT	20.8	1
MNDNR OFFICE	2 EXCELLENT	26.8	2
LES KOUBA PKWY	3 EXCELLENT	32.2	3
HIGHWAY 15	4 EXCELLENT	28.9	4
MICHIGAN ST	5 EXCELLENT	30.8	5
HIGHWAY 22	6 EXCELLENT	31.1	6
HIGHWAY 7	7 EXCELLENT	27.5	7
MAJOR AVE	8 EXCELLENT	25.4	8
COUNTY RD 71	9 EXCELLENT	27.6	9
KALE AVE	10 EXCELLENT	24.9	10
SILVER LAKE, MN			

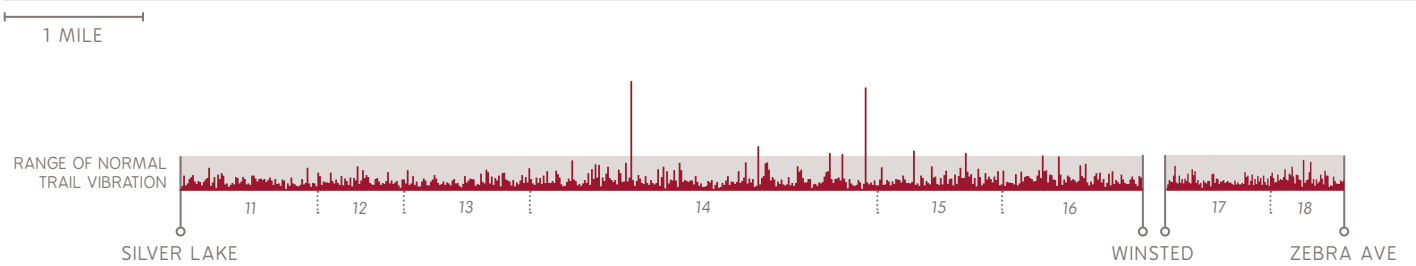
TRAIL PROFILE (FROM ACCELEROMETER DATA)



LUCE LINE STATE TRAIL (SILVER LAKE TO WINSTED)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
SILVER LAKE, MN	11 EXCELLENT	24.1	  
JADE RD	12 EXCELLENT	22.1	
HAMLET AVE	13 EXCELLENT	23.4	
COUNTY RD 86	14 EXCELLENT	31.0	 
EAGLE AVE	15 EXCELLENT	26.9	
DAIRY AVE	16 EXCELLENT	27.6	
WINSTED AIRPORT			
KINGSLEY ST (WINSTED, MN)	17 EXCELLENT	29.0	  
ZION AVE	18 EXCELLENT	33.7	
ZEBRA AVE (WINSTED, MN)			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





MILL TOWNS STATE TRAIL (LAKE BYLLESBY TO CANNON FALLS)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

100% EXCELLENT

0% GOOD

0% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT

EXPERIENTIAL
RATING

ROUGHNESS
INDEX (TRI)

TRAIL PHOTOS

LAKE BYLLESBY REGIONAL PARK

CANNON FALLS

1

EXCELLENT

23.6

1



TRAIL PROFILE (FROM ACCELEROMETER DATA)

1 MILE

RANGE OF NORMAL
TRAIL VIBRATION

LAKE BYLLESBY
REGIONAL PARK

CANNON
FALLS



PRESTON-FORESTVILLE STATE TRAIL (PRESTON TO FORESTVILLE)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

0% EXCELLENT

100% GOOD

0% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT

EXPERIENTIAL
RATING

ROUGHNESS
INDEX (TRI)

TRAIL PHOTOS

PRESTON, MN

TRAIL END

1

GOOD

43.1

1



TRAIL PROFILE (FROM ACCELEROMETER DATA)

1 MILE

RANGE OF NORMAL
TRAIL VIBRATION

PRESTON

TRAIL END



MINNESOTA VALLEY STATE TRAIL (CHASKA TO BLOOMINGTON)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

38% EXCELLENT

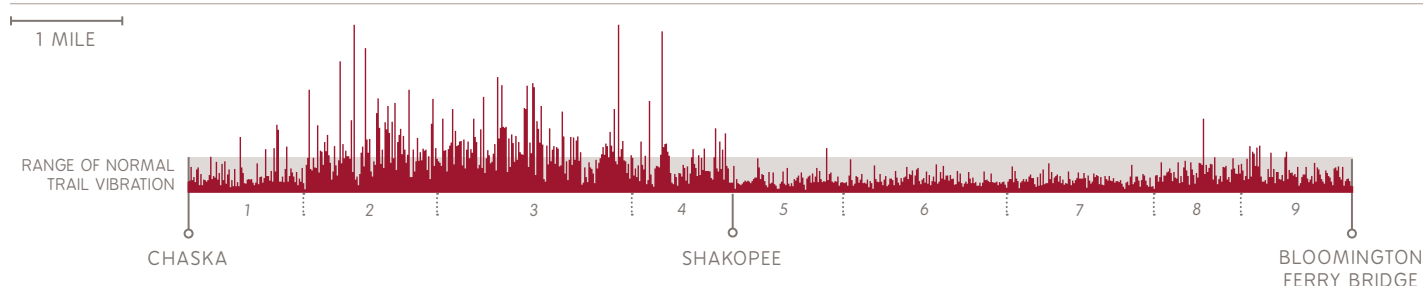
27% GOOD

8% FAIR

27% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
CHASKA	1 EXCELLENT	54.4	 
OLD TRAIL JCT	2 FAIR	122.1	
JORDAN BREWERY RUINS	3 FAIR	127.8	
HIGHWAY 101 UNDERPASS	4 GOOD	76.3	
MEMORIAL PARK (SHAKOPEE)	5 EXCELLENT	32.3	 
THE LANDING	6 EXCELLENT	31.3	
VALLEY FAIR PARK DRIVE	7 EXCELLENT	32.5	
MN VALLEY NWR TRAILHEAD	8 GOOD	54.5	
HIGHWAY 169 UNDERPASS	9 GOOD	51.3	 
BLOOMINGTON FERRY BRIDGE			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





PAUL BUNYAN STATE TRAIL (CROW WING S.P. TO MERRIFIELD)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)





26% EXCELLENT

55% GOOD

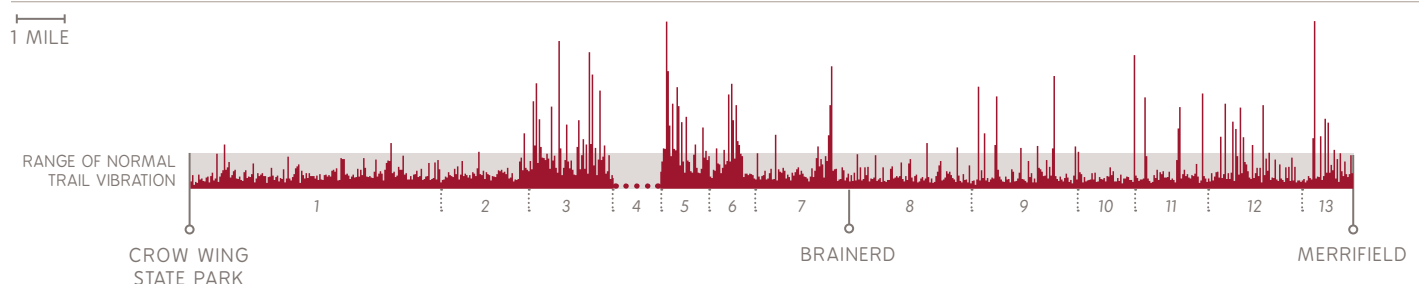
19% FAIR

0% POOR













TRAIL CONDITION

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
CROW WING STATE PARK	1 EXCELLENT	27.4	  
CROW WING HEIGHTS DR	2 EXCELLENT	28.1	
HIGHWAY 371	3 GOOD	70.9	
HIGHLAND SCENIC RD	4 NO DATA		 
ISLE DR	5 FAIR	73.6	
DOGWOOD DR	6 FAIR	67.3	 
INDUSTRIAL PARK RD	7 EXCELLENT	41.3	
NORTHLAND ARBORETUM (BRAINERD)	8 EXCELLENT	25.3	 
BEAVER DAM RD	9 GOOD	37.3	
WISE RD	10 EXCELLENT	35.0	 
CURELL RD	11 GOOD	39.5	
LEGIONVILLE RD	12 GOOD	39.8	 
NORTH LONG LAKE RD	13 GOOD	49.4	
MERRIFIELD			

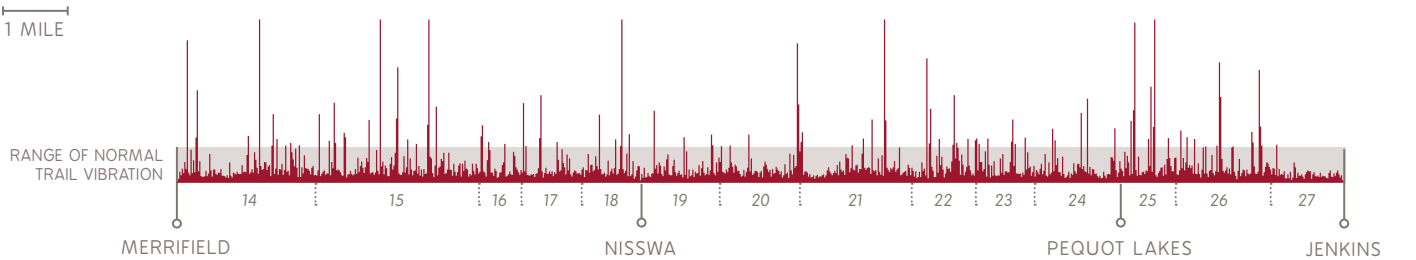
TRAIL PROFILE (FROM ACCELEROMETER DATA)



PAUL BUNYAN STATE TRAIL (MERRIFIELD TO JENKINS)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
MERRIFIELD, MN	14 GOOD	45.5	  
MOLLIE LAKE RD	15 FAIR	47.8	
COUNTY RD 137	16 EXCELLENT	36.8	
COUNTY RD 13	17 GOOD	37.5	  
SHADY ACRES LANE	18 GOOD	51.3	
NISSWA, MN	19 GOOD	35.0	
POPLAR AVE	20 EXCELLENT	47.9	  
WILDERNESS RD	21 GOOD	44.0	
OLSON RD	22 GOOD	59.1	
COUNTY RD 107	23 GOOD	40.5	  
DERKSEN RD	24 FAIR	39.0	
PEQUOT LAKES, MN	25 FAIR	59.3	
HIGHWAY 371	26 EXCELLENT	37.3	  
MYERS RD	27 EXCELLENT	31.5	
JENKINS, MN			

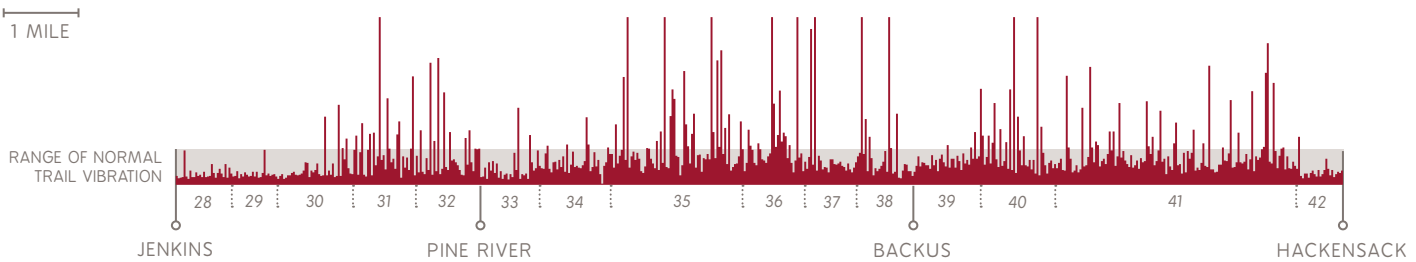
TRAIL PROFILE (FROM ACCELEROMETER DATA)



PAUL BUNYAN STATE TRAIL (JENKINS TO HACKENSACK)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
JENKINS, MN	28 EXCELLENT	19.0	
12TH AVE	29 EXCELLENT	20.5	
36TH AVE	30 EXCELLENT	23.5	
HASSMAN HILLS RD	31 FAIR	52.3	
NORWAY BROOK LN	32 FAIR	52.1	
PINE RIVER, MN	33 FAIR	36.3	
GOLFVIEW DR	34 FAIR	44.6	
16TH ST SW	35 FAIR	76.4	
8TH ST	36 POOR	68.5	
4TH ST	37 FAIR	78.5	
HIGHWAY 87	38 FAIR	59.5	
BACKUS, MN	39 FAIR	49.1	
PINE MT LAKE RD	40 FAIR	73.4	
16TH ST NW	41 FAIR	62.5	
COUNTY HWY 40	42 EXCELLENT	34.6	
HACKENSACK, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)



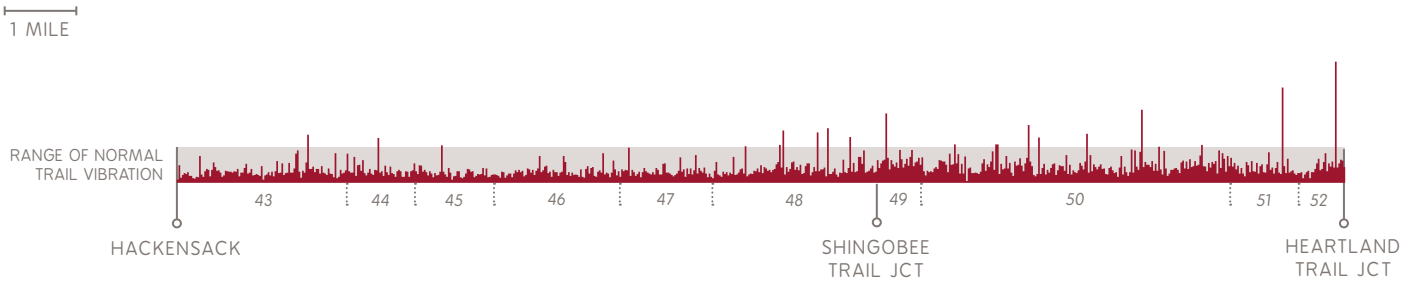
PAUL BUNYAN STATE TRAIL (HACKENSACK TO HEARTLAND TRAIL)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
HACKENSACK, MN	43 EXCELLENT	24.6	43
BIRCH LAKE LANE	44 EXCELLENT	30.1	
LOWER 10 MILE LAKE RD	45 EXCELLENT	27.0	45
LONG BAY RD	46 EXCELLENT	23.5	
COUNTY RD 50	47 EXCELLENT	23.2	47
PORTAGE LAKE	48 EXCELLENT	24.3	
SHINGOBEE TRAIL JCT	49 EXCELLENT	34.1	49
COUNTY RD 50 NW	50 EXCELLENT	39.5	
BACHELOR RD	51 EXCELLENT	33.8	51
CASS LINE RD	52 EXCELLENT	36.5	
HIGHWAY 34	53 GOOD	43.5	53
HEARTLAND TRAIL JCT			















FOR THE HEARTLAND-PAUL BUNYAN TRAIL CORRIDOR,
SEE PAGE 32



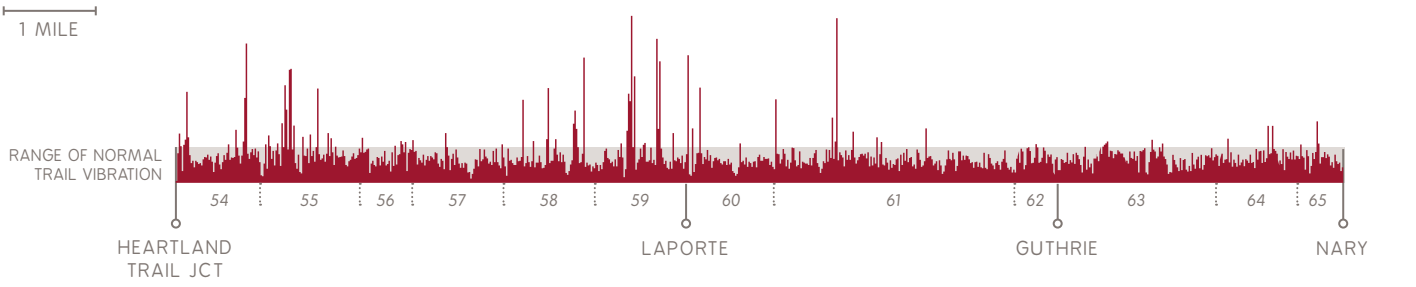
TRAIL PROFILE (FROM ACCELEROMETER DATA)










PAUL BUNYAN STATE TRAIL (HEARTLAND TRAIL TO NARY)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
HEARTLAND TRAIL JCT	54 GOOD	65.8	  
WOODLAND RESORT	55 FAIR	77.4	
COUNTY RD 38	56 EXCELLENT	53.9	
COUNTY RD 39	57 EXCELLENT	48.9	  
MERGANSER DR	58 FAIR	59.3	
NICKOLSON DR	59 FAIR	72.1	
LAPORTE, MN	60 GOOD	50.2	  
COUNTY RD 39	61 GOOD	50.4	
COUNTY RD 16	62 EXCELLENT	47.6	
GUTHRIE, MN	63 GOOD	45.6	  
470TH ST	64 GOOD	47.1	
482ND ST	65 GOOD	51.5	
NARY, MN			 

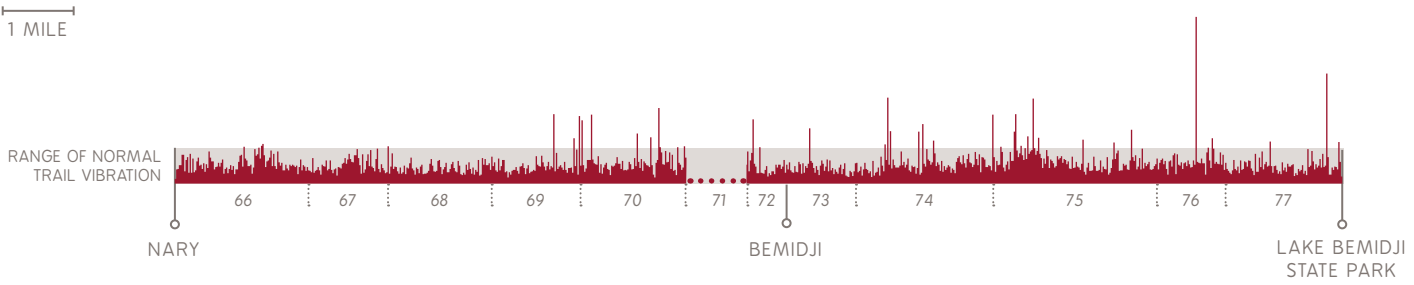
TRAIL PROFILE (FROM ACCELEROMETER DATA)



PAUL BUNYAN STATE TRAIL (NARY TO LAKE BEMIDJI STATE PARK)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
NARY, MN	66 GOOD	45.3	  
510TH ST	67 GOOD	44.4	
PLANTGENET RD	68 EXCELLENT	41.1	
HIGHWAY 2	69 EXCELLENT	49.8	 
CARR LAKE RD	70 GOOD	57.0	
CLAUSEN AVE (SOUTH JCT)	71 ROAD SHOULDER		  
CLAUSEN AVE (NORTH JCT)	72 EXCELLENT	51.1	
LAKE SHORE DR (BEMIDJI, MN)	73 EXCELLENT	40.2	
BLUE OX TRAIL JCT	74 GOOD	49.4	 
MISSISSIPPI RIVER	75 GOOD	60.8	
WHITETAIL RD	76 GOOD	59.8	 
NEW BASS RD	77 GOOD	54.6	
LAKE BEMIDJI STATE PARK			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





ROOT RIVER STATE TRAIL (FOUNTAIN TO LANESBORO)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

55% EXCELLENT

39% GOOD

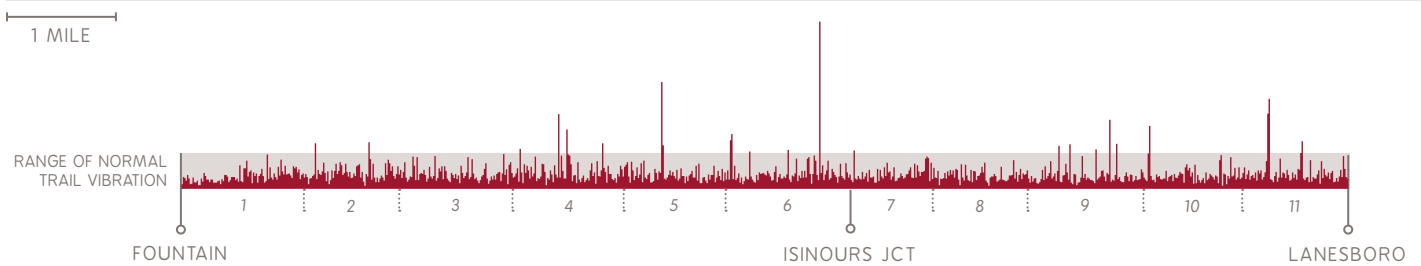
5% FAIR

0% POOR

TRAIL CONDITION

TRAIL SEGMENT		EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
FOUNTAIN, MN	1	EXCELLENT	33.7	
MILE 1	2	GOOD	33.6	
MILE 2	3	EXCELLENT	29.4	
MILE 3	4	EXCELLENT	36.4	
MILE 4	5	EXCELLENT	33.9	
MILE 5	6	EXCELLENT	44.2	
ISINOURS JCT	7	EXCELLENT	29.4	
MILE 7	8	EXCELLENT	23.9	
MILE 8	9	EXCELLENT	27.2	
MILE 9	10	EXCELLENT	27.0	
MILE 10	11	EXCELLENT	38.7	
LANESBORO, MN				

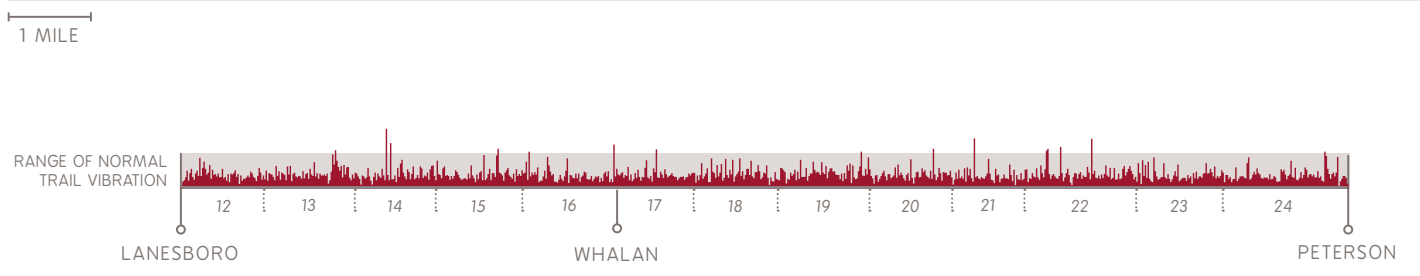
TRAIL PROFILE (FROM ACCELEROMETER DATA)



ROOT RIVER STATE TRAIL (LANESBORO TO PETERSON)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
LANESBORO, MN	12 EXCELLENT	27.4	12 13 14
MILE 12	13 EXCELLENT	30.1	
MILE 13	14 EXCELLENT	29.6	
MILE 14	15 EXCELLENT	29.2	15 16
MILE 15	16 EXCELLENT	25.4	
WHALAN, MN	17 EXCELLENT	28.8	
MILE 17	18 EXCELLENT	28.9	17 18 19
MILE 18	19 EXCELLENT	30.1	
MILE 19	20 EXCELLENT	30.0	
MILE 20	21 EXCELLENT	29.7	20 21 22
MILE 21	22 EXCELLENT	31.6	
MILE 22	23 EXCELLENT	27.5	
MILE 23	24 EXCELLENT	26.9	23 24
PETERSON, MN			

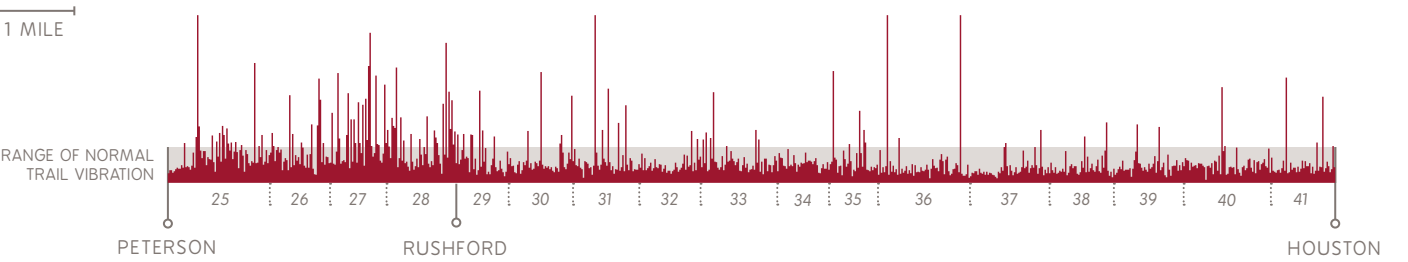
TRAIL PROFILE (FROM ACCELEROMETER DATA)



ROOT RIVER STATE TRAIL (PETERSON TO HOUSTON)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
PETERSON, MN	25	FAIR 51.4	25
MILE 26	26	FAIR 49.7	26
MILE 27	27	FAIR 67.5	27
MILE 28	28	FAIR 66.4	28
RUSHFORD, MN	29	FAIR 47.9	29
MILE 30	30	FAIR 40.4	30
MILE 31	31	FAIR 50.1	31
MILE 32	32	GOOD 29.5	32
MILE 33	33	GOOD 35.1	33
MILE 34	34	GOOD 29.1	34
MILE 35	35	GOOD 57.9	35
MILE 36	36	GOOD 54.2	36
MILE 37	37	GOOD 35.6	37
MILE 38	38	GOOD 37.0	38
MILE 39	39	GOOD 41.1	39
MILE 40	40	FAIR 36.5	40
MILE 41	41	GOOD 38.5	41
HOUSTON, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





SAKATAH SINGING HILLS STATE TRAIL (MANKATO TO WATERVILLE)
















OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

39% EXCELLENT

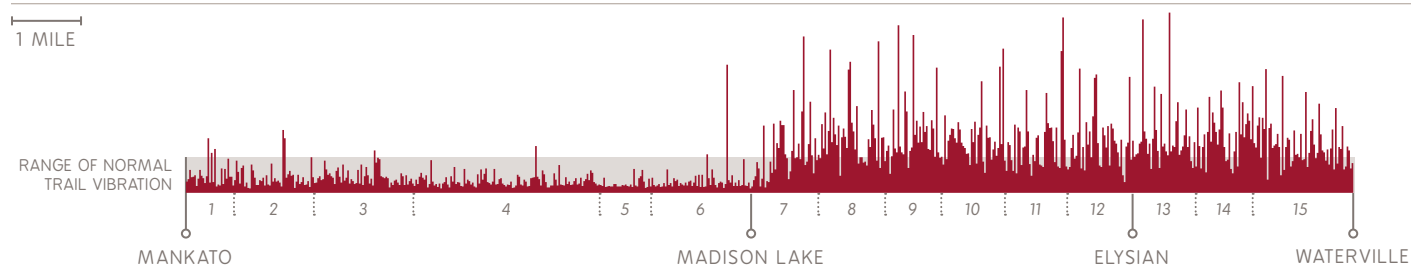
28% GOOD

0% FAIR

33% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
MANKATO, MN	1 EXCELLENT	32.5	  
LINE VALLEY DR	2 EXCELLENT	39.4	
HIGHWAY 22	3 GOOD	37.9	
589TH AVE	4 EXCELLENT	29.1	  
604TH AVE	5 EXCELLENT	20.4	
TWP RD 291	6 EXCELLENT	31.1	
MADISON LAKE, MN	7 POOR	96.9	  
T-310	8 POOR	107.8	
631 ST ST	9 POOR	110.5	
241 ST ST	10 POOR	105.1	  
231 ST ST	11 POOR	91.0	
221 ST ST	12 FAIR	94.4	
ELYSIAN, MN	13 FAIR	90.2	  
516TH ST	14 FAIR	86.3	
HIGHWAY 170	15 FAIR	100.2	
WATERVILLE, MN			

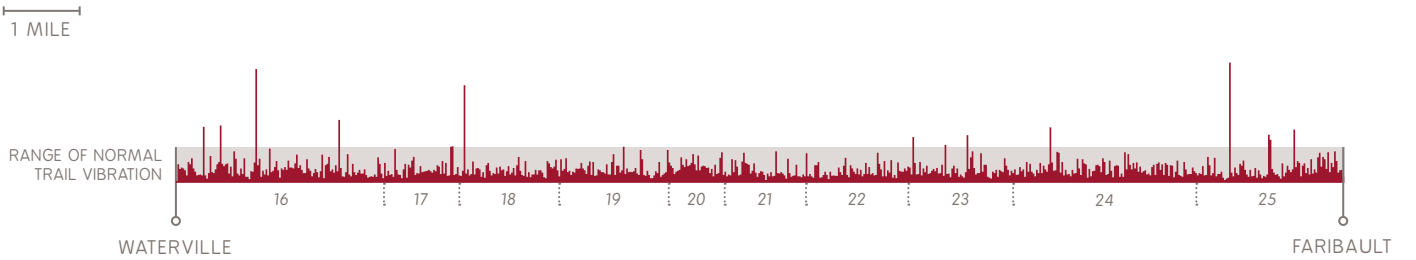
TRAIL PROFILE (FROM ACCELEROMETER DATA)



SAKATAH SINGING HILLS STATE TRAIL (WATERVILLE TO FARIBAULT)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
WATERVILLE, MN	16	EXCELLENT 42.4	16
LEROY AVE	17	EXCELLENT 33.9	17
KENT AVE	18	EXCELLENT 31.5	18
JACKSON AVE	19	EXCELLENT 31.9	19
HOLLAND AVE	20	EXCELLENT 37.3	20
HARRIS TRAIL	21	EXCELLENT 25.0	21
FOSSTON AVE	22	EXCELLENT 26.4	22
ELKTON TRAIL	23	EXCELLENT 31.7	23
SHAGER PARK	24	EXCELLENT 36.0	24
WELLS LAKE DR	25	GOOD 41.9	25
FARIBAULT, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





SHOOTING STAR STATE TRAIL (ROSE CREEK TO ADAMS)

OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

50% EXCELLENT

50% GOOD

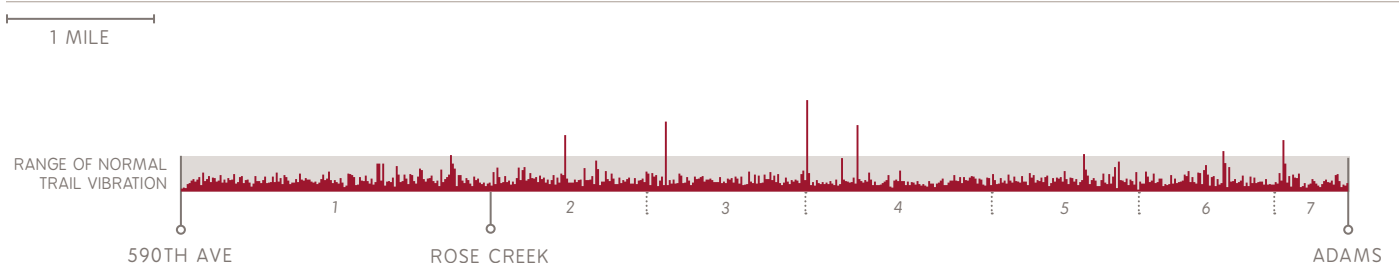
0% FAIR

0% POOR











TRAIL CONDITION

TRAIL SEGMENT		EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	TRAIL PHOTOS
590TH AVE	1	EXCELLENT	28.4	
ROSE CREEK, MN	2	GOOD	29.8	
620TH AVE	3	EXCELLENT	36.0	
630TH AVE	4	EXCELLENT	30.2	
640TH AVE	5	EXCELLENT	28.2	
650TH AVE	6	EXCELLENT	28.5	
660TH AVE	7	EXCELLENT	34.0	
ADAMS, MN				

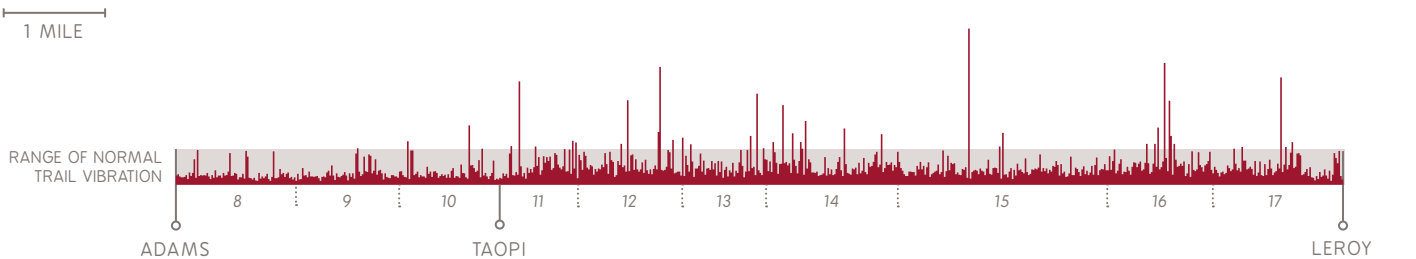
TRAIL PROFILE (FROM ACCELEROMETER DATA)



SHOOTING STAR STATE TRAIL (ADAMS TO LEROY)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
ADAMS, MN	8	GOOD23.6	 
680TH AVE	9	GOOD29.4	
690TH AVE	10	GOOD33.4	  
TAOPI, MN	11	GOOD47.4	
710TH AVE	12	GOOD49.4	
140TH ST	13	FAIR45.4	  
730TH AVE	14	GOOD47.4	
130TH ST	15	GOOD41.1	
755TH ST	16	GOOD51.7	 
LAKE LOUISE S.P.	17	GOOD41.9	
LEROY, MN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





WILLARD MUNGER STATE TRAIL (HINCKLEY TO WILLOW RIVER)
















OVERALL CONDITION (BASED ON TRAIL ROUGHNESS INDEX)

3% EXCELLENT

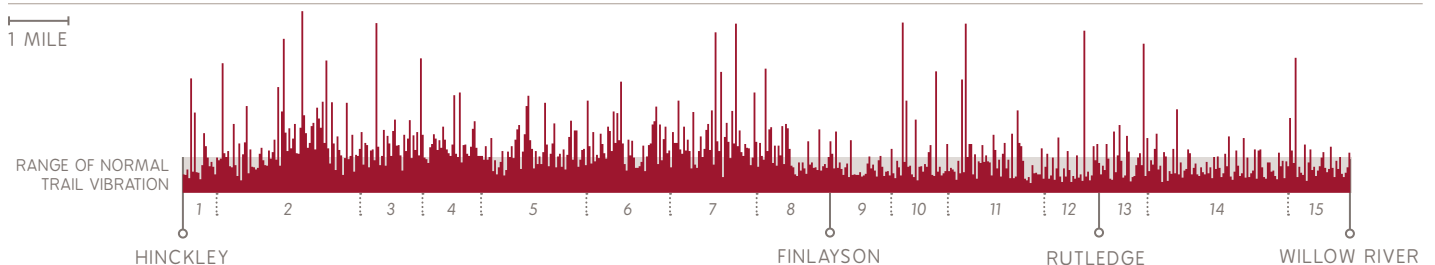
57% GOOD

37% FAIR

3% POOR

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
HINCKLEY, MN	1	GOOD 54.8	  
7TH ST	2	GOOD 80.5	
HAPPYS DR	3	GOOD 93.1	
FRIESLAND RD	4	GOOD 80.6	  
MILLER RD	5	GOOD 75.2	
SKUNK LAKE RD	6	FAIR 82.0	
GRONINGEN RD	7	FAIR 84.1	  
MARSHLAND DR	8	GOOD 65.8	
FINLAYSON, MN	9	EXCELLENT 41.6	
DIXON LINE RD	10	GOOD 58.7	  
LEWIS RD	11	GOOD 57.7	
PINE RIVER	12	EXCELLENT 53.1	
RUTLEDGE, MN	13	GOOD 54.3	  
KETTLE RIVER	14	GOOD 53.9	
LONG LAKE RD	15	GOOD 47.8	
WILLOW RIVER, MN			

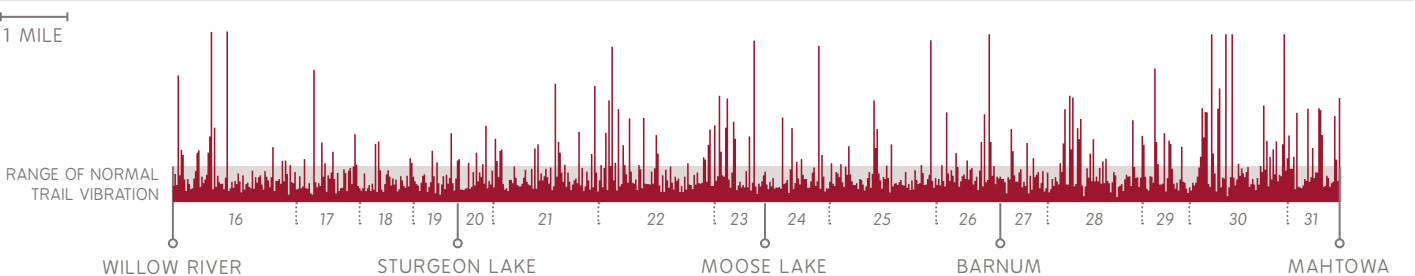
TRAIL PROFILE (FROM ACCELEROMETER DATA)
















WILLARD MUNGER STATE TRAIL (WILLOW RIVER TO MAHTOWA)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
WILLOW RIVER, MN	16 FAIR 60.9		16
DAGO LAKE RD	17 GOOD 49.9		17
DENHAM CROSSING RD	18 GOOD 44.5		18
NEW SAWMILL RD	19 GOOD 50.4		19
STURGEON LAKE	20 GOOD 46.3		20
GREEN LEAF RD	21 GOOD 47.4		21
MOOSE LAKE COUNTY AIRPORT	22 GOOD 53.3		22
MOOSE HORN RIVER	23 FAIR 72.1		23
MOOSE LAKE, MN	24 GOOD 57.8		24
ASPEN RD	25 GOOD 52.5		25
3911 COUNTY RD 61	26 GOOD 56.6		26
BARNUM, MN	27 GOOD 48.0		27
POINT RD	28 FAIR 59.7		28
GILBERT RD	29 FAIR 61.5		29
HIGHWAY 61	30 FAIR 71.2		30
TOWN RD 294	31 FAIR 62.6		31
MAHTOWA, MN			

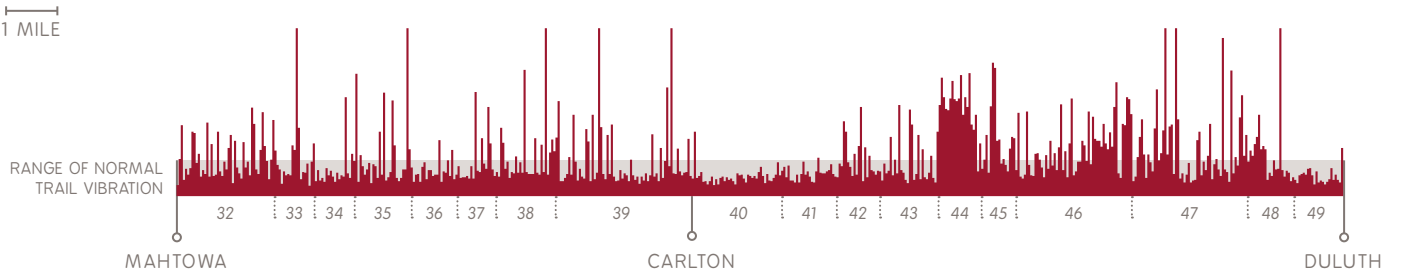
TRAIL PROFILE (FROM ACCELEROMETER DATA)



WILLARD MUNGER STATE TRAIL (MAHTOWA TO DULUTH)

TRAIL SEGMENT	TRAIL CONDITION		TRAIL PHOTOS
	EXPERIENTIAL RATING	ROUGHNESS INDEX (TRI)	
MAHTOWA, MN	32 GOOD 49.7		  
CARLSON RD	33 FAIR 65.4		
WALLER RD	34 GOOD 38.4		
BROMFIELD RD	35 GOOD 52.5		  
OLD ATKINSON RD	36 GOOD 47.3		
INTERSTATE 35	37 FAIR 48.9		
GILLOGLY RD	38 FAIR 54.0		  
DOUGLAS RD	39 GOOD 45.5		
CARLTON, MN	40 EXCELLENT 32.7		
THOMSON, MN	41 GOOD 32.3		  
DEERIDGE ST	42 GOOD 45.0		
JAY COOKE RD	43 GOOD 50.1		
KANGAS RD	44 POOR 163.4		  
STENMAN RD	45 POOR 75.3		
BUFFALO HOUSE	46 FAIR 61.2		
BECKS RD	47 POOR 77.7		  
95TH AVE	48 FAIR 66.1		
RIVERSIDE DR	49 GOOD 35.3		
WILLARD MUNGER INN			

TRAIL PROFILE (FROM ACCELEROMETER DATA)





RECOMMENDATIONS

Projecting and Protecting the Future State of Minnesota State Trails

Overall, Minnesota State Trails are in good condition. But the challenge of maintaining the state trail system is real, and our data provides a warning that the system is approaching a tipping point. Our assessment indicates that, without a continuing legislative commitment to maintaining Minnesota State Trails, the system is at risk of falling into disrepair within the next decade. We offer two recommendations to ensure a stable future for the state trail system.

RECOMMENDATION #1

Consistent State Trail Rehabilitation

Maintaining a state trail system requires consistent rehabilitation. In order to project the rate at which state trails need rehabilitation, we created a trail aging model. According to our model, which is based on TRI data and the approximate age of each trail, state trails have a 28-year life cycle: new

trails are in excellent condition for their first 8 years, good condition until age 20, fair condition until age 28, and poor condition thereafter. Importantly, our model estimates the life cycle of the average state trail; individual trails will age differently depending on quality of construction, topography, vegetation, and occurrences of major storm damage. The trail aging model also assumes the current level of routine trail maintenance. Our projected 28-year life cycle could potentially be extended if maintenance activities increased. For example, some studies have shown seal coating and trail overlaying - neither of which the DNR routinely does on state trails - can extend trail life by 4 to 12 years.¹

Based on our trail aging model, we estimate 20 miles of state trail need to be rehabilitated annually. Our recommendation to rehabilitate 20 miles annually matches the DNR's identified rehabilitation goals.² We recommend state

¹ LTAP, Indiana and Development Commission, Ohio River Greenway, "Best Practices in Trail Maintenance" (2014). *Indiana Local Technical Assistance Program (LTAP) Publications*. Paper 8.

² The Division of Parks and Trails 2012-2022 Strategic Plan sets a goal of rehabilitating 200 miles of state trail over the ten year period.

trail rehabilitation should be funded through a combination of two existing funding sources: the Parks and Trails Legacy Fund (Legacy Funds) and state bonding appropriations.

Legacy Funds have become a vital funding source for state trail rehabilitation. Legacy Funds were created when voters passed the Clean Water, Land and Legacy Amendment in 2008, and are guaranteed until the year 2034. As of 2017, the Legacy Fund generates approximately \$18 million annually for State Parks and Trails. Those funds are used for everything from acquiring and developing new parks and trails; renovating park visitor centers, roads, and campgrounds; creating new programs to connect people to the outdoors; and rehabilitating bridges and state trails.

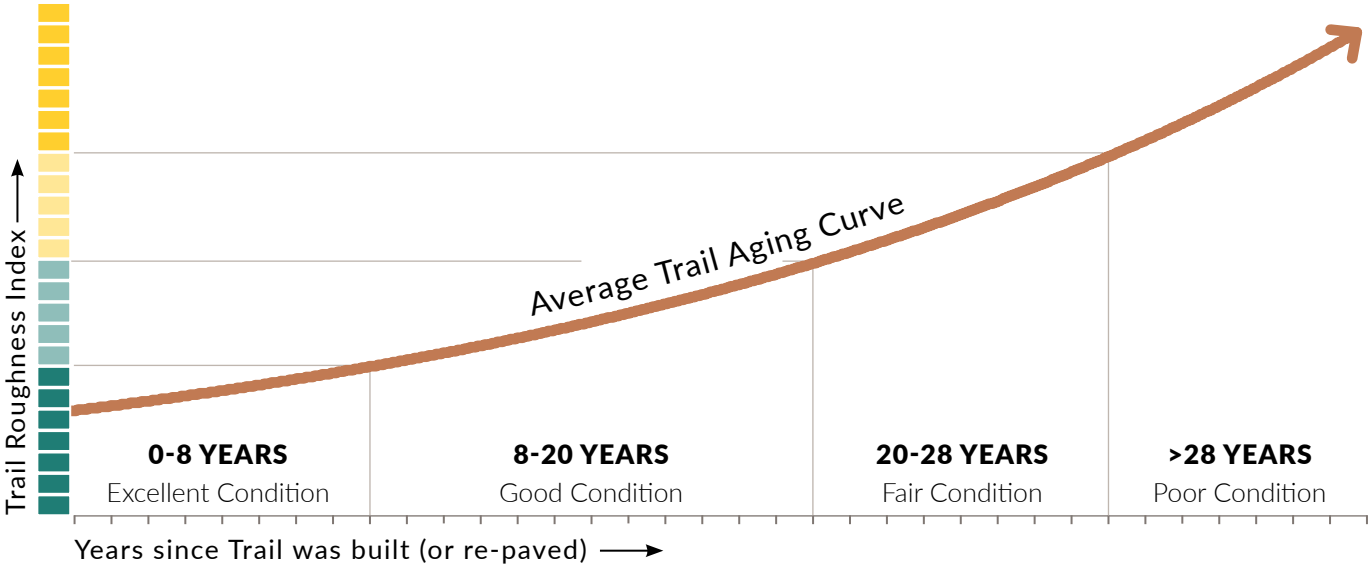
Legacy Funds were created to supplement traditional funding sources like bonding, and they are making a difference. Overall, between 2010 and 2017, Legacy Funds have been used to rehabilitate an average of nine state trail miles per year.³ For fiscal year 2017, the DNR is using Legacy Funds to rehabilitate portions of the Root River State Trail, Glacial Lakes State Trail,

and Douglas State Trail. Those projects, when completed, will have rehabilitated another 10 miles of trail we identified as either being in poor or fair condition.

In addition to Legacy Funds, the state of Minnesota pays for capital improvement projects by issuing bonds. Lawmakers typically pass a large bonding bill in even-numbered years. Historically, bonding bills were a critical source of funding for state trail rehabilitation: The 2008 bill included upwards of \$6 million for trail rehabilitation, the 2010 bill included \$4 million, and the 2012 bill included \$4 million split between trail rehabilitation and park rehabilitation. But recently bonding appropriations for state trail rehabilitation have been unreliable: the 2014 bill did not include funding specifically for trail rehabilitation, and no bonding bill was passed in 2016.

When bonding appropriations do not consistently fund state trail rehabilitation, state trail rehabilitation projects fall behind schedule. To illustrate this point, we used our trail aging model to project three potential futures for Minnesota

The Average Life Cycle of a Minnesota State Trail



Note: Model is based on TRI data collected by the Parks & Trails Council of Minnesota and the approximate age of each trail segment. Trail age data provided by the Minnesota DNR.

³ Figure is based on the DNRs FY 2016-17 Legacy Priorities and projects reported as completed on the State of Minnesota Legacy website. Additional Legacy Funds were used during that time to rehabilitate a number of state trail bridges. Theoretically, a greater share of Legacy Funds could be used to rehabilitate additional state trail miles, but this would lead to deficits in other key areas of the DNR budget.

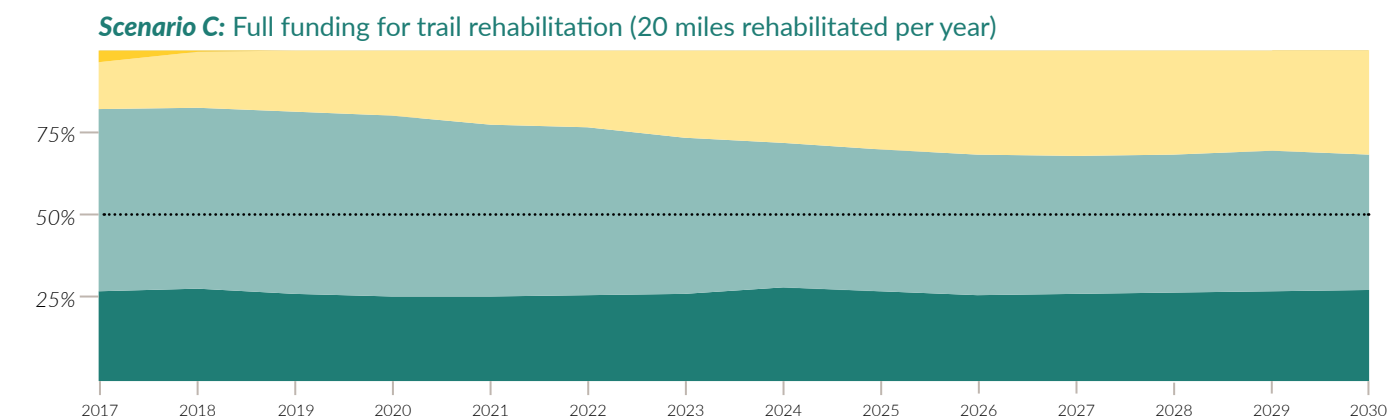
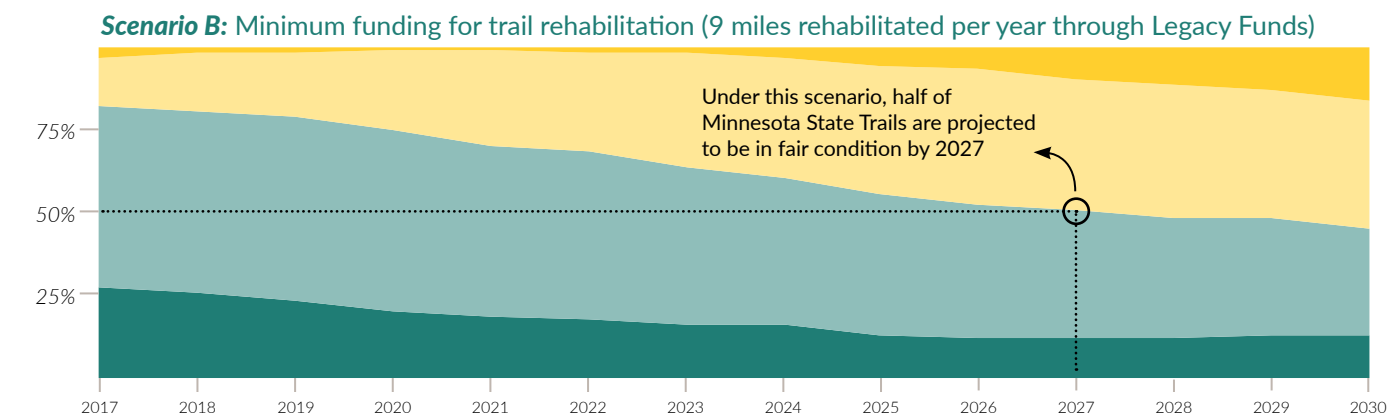
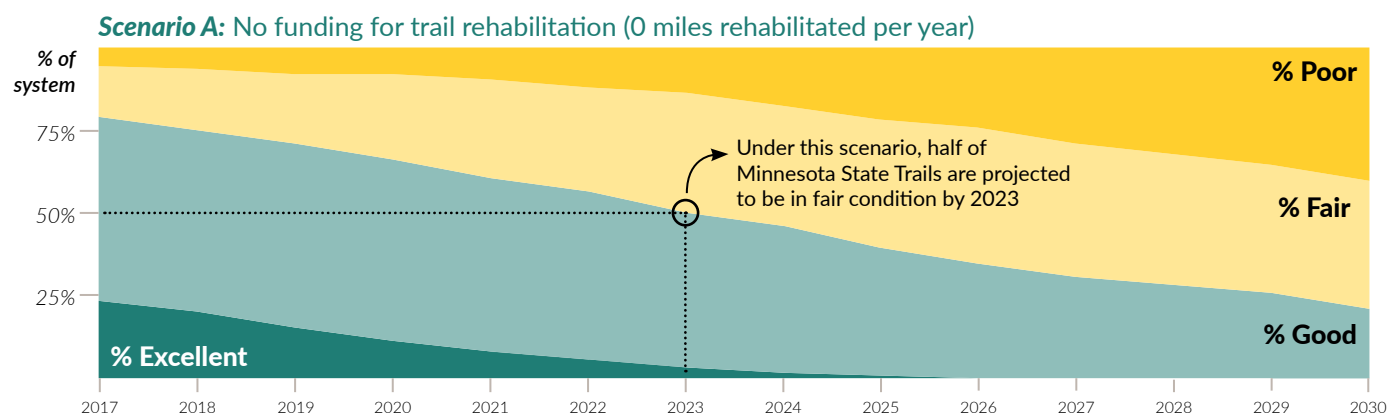
State Trails: a zero funding scenario, a minimum funding scenario, and a full funding scenario.

The zero funding scenario, Scenario A, represents a worst-case scenario in which neither Legacy Funds nor bonding appropriations are used for state trail rehabilitation. Under this scenario, we project the state trail system would fall into disrepair quickly: the number of trails in excellent

condition would decrease from 150 miles in 2016 to only 65 miles by 2020, half the state trail system would be in fair condition (or worse) by 2023, and 88% of the system would be in fair or poor condition by 2030.

The minimum funding scenario, Scenario B, assumes Legacy Funds - but not bonding appropriations - continue to be used at the current

Projecting Future Funding Scenarios for Minnesota State Trails



rate for state trail rehabilitation (i.e., nine miles per year). Under this scenario, we project the state trail system would remain in stable condition through 2020, but thereafter Legacy Funds would no longer be able to keep pace with the system's needs. A reliance solely on Legacy Funds would leave a legacy of trails in disrepair: half the system would be in fair or poor condition by 2027, and that number would rise to 55% by 2030. Relying solely on Legacy Funds for trail rehabilitation would also open the door to public and legal challenges that Legacy Funds are being used as a substitute, rather than a supplement, of traditional funding sources such as bonding.

The full funding scenario, Scenario C, assumes a mixture of Legacy Funds and state bonding appropriations are used to fund 20 miles of state trail rehabilitation annually. Under this scenario, we project the final mile in poor condition would be repaired in 2019, and two-thirds of the system would remain in good or excellent condition indefinitely. Making this scenario a reality will require Legacy Funds to truly be used as a supplement to state bonding appropriations, which is what Minnesota voters intended.

Our three scenarios only project the rehabilitation needs of the existing state trail system. If the state trail system expands in future years, as we expect it will, long-term rehabilitation needs will increase. While we do not attempt to quantify the effect of system expansion, the budgetary impact of each additional trail mile is likely marginal when amortized over the life of the trail. Future planning will be necessary to fully account for the costs of rehabilitating the existing, and potentially expanding, state trail system.

Finally, while it is beyond the scope of this project to put a price tag on rehabilitation costs, the three most recent rehabilitation projects bid by the DNR averaged \$165,000 per mile for 17 miles of work.⁴ While trail costs can vary widely, these recent projects indicate a bonding appropriation

of \$2 million could rehabilitate approximately 12 miles of trail, not including the costs of bridges and other trail amenities like signage and trailheads.

RECOMMENDATION #2

Create a State Trail Capital Improvement Plan

Funding sources for state trail rehabilitation already exist; but securing consistent funding from those sources, particularly bonding appropriations, is challenging. Part of that challenge is the perception among lawmakers that there is currently inadequate planning for trail maintenance and rehabilitation. In 2016, Representative Paul Torkelson, who then chaired the Minnesota House Capital Investment Committee, was quoted as saying, "People like trails and want more trails, but every time we add a trail, you're adding to the maintenance need. I'm not sure we've done an adequate job of planning for that."⁵

Creating a capital improvement plan for state trails would provide clarity and allow lawmakers to make informed decisions. While the *State of the Trails Project* is able to highlight the need to rehabilitate 20 miles of state trail per year, it does not account for the entirety of the state trail system's needs. We recommend the DNR create, and routinely update, a capital improvement plan that projects the trail system's needs over five-year periods. The plan should identify and prioritize specific needs of the state trail system, including costs related to trail repaving, bridge and culvert replacement, interpretive and way finding signs, and trailhead rehabilitation. Currently, a systematic account of these needs is not available for lawmakers or the public to review. Consequently, lawmakers do not have a clear sense of the system's needs, and the public cannot anticipate when or where their favorite trail will be repaired.

⁴ This figure is from rehabilitation projects on the Root River State Trail, Sakatah Singing Hills State Trail, and Glacial Lakes State Trail. Figure includes the cost of engineering and culvert replacement, but not bridges.

⁵ "DNR says it needs \$132M. So why is it only asking for \$33M?" *Twin Cities Pioneer Press*, March 31, 2016.

Providing specific funding targets for lawmakers via a capital improvement plan is at odds with how the DNR currently requests bonding appropriations. In recent years the DNR has generally requested an agency-wide bonding appropriation for “asset preservation” rather than making requests for its distinct divisions (e.g., Parks and Trails) or purposes (e.g., trail rehabilitation). Agency-wide requests give the DNR maximum flexibility, but make it difficult for lawmakers and the public to discern how much – or even if – the appropriation will be used towards state trail rehabilitation. By lumping a wide variety of capital improvement needs into a single request, identifying and evaluating specific funding needs is exceedingly difficult. Our sense is that a more transparent budget would encourage more robust funding for trail projects.

Our hope is that the *State of the Trails Project* is a first step towards the creation of a capital improvement plan for Minnesota State Trails,

but there is still work to be done. Creating and implementing a plan, securing funding, and maintaining the state trail system will require an ongoing commitment from managers, lawmakers, and advocates. We envision the *State of the Trails Project* as an integral component of that ongoing commitment, one that will need to be updated, improved, and expanded in future years.

Generations of Minnesotans have worked hard to create a system of trails that few states can match. Minnesota State Trails are community assets; they support local businesses, increase property values, improve public health, and enhance quality of life.⁶ But those benefits are only realized when trails are properly maintained. We initiated the *State of the Trails Project* because Minnesotans are banking on the future state of the trails. Good data leads to good planning, good planning leads to good trails, and good trails lead to healthy communities.



⁶ Headwaters Economics maintains a good online database of academic studies on trails: <https://headwaterseconomics.org/trail/>



METHODOLOGY

How to Understand Our Ratings

Our ratings are based on data collected during the summer and fall of 2016. Data was collected by staff and volunteers of the Parks & Trails Council, who rode, inspected, and recorded accelerometer data on nearly every mile of paved state trail in Minnesota. All of our volunteers had prior, if not extensive, experience riding bicycle trails.

We limited this project to trails that are (1) authorized under Minnesota Statute 85.015, (2) owned-and-operated by the state of Minnesota, and (3) paved. These criteria exclude a handful of existing trails that are considered a part of the state trail system but which are owned and operated by local units of government.⁷ In sum, our inventory included 593 miles. We collected usable data on 589 of those miles; the miles we missed were due to trails being closed for reconstruction (3 miles) or data collection errors (1 mile).

Ratings were conducted on a segment-by-segment basis. We demarcated segments using road intersections, keeping the length of each segment as close to one mile as possible. This method resulted in 452 segments with an average length of 1.3 miles. The median segment was 1.1 miles, with the longest being 4.9 miles and the shortest being 0.5 miles. For each trail segment, we assigned an experiential rating, a Trail Roughness Index score, and took photographs to visualize conditions.

EXPERIENTIAL RATINGS

Our experiential ratings are what might be called the “old fashioned” approach. We assigned staff and volunteers to ride each trail segment, observe its condition, take notes, and assign a rating based on their experience. All trail evaluators were given an instruction booklet that defined each rating category and provided example photographs. The strength of our experiential ratings is their

⁷ There are 20 miles of trail authorized under MS 85.015 that are not included in our inventory. Those miles include 6 miles of the Taconite Trail near Grand Rapids; 13 miles of the Minnesota River Trail near Ortonville, Milan, and Montevideo; 1 mile of the Mill Towns Trail between Northfield and Dundas; and a half-mile of the Wagon Wheel Trail in La Crescent

simplicity. When we say a trail segment has an experiential rating of “good,” it means a person rode that segment and determined it was comfortable to ride.

TRAIL ROUGHNESS INDEX

In addition to our experiential ratings, we also created an objective measurement of trail conditions called the Trail Roughness Index. The Trail Roughness Index, or TRI, is a measure of how bumpy a trail is to ride on a bicycle.

The TRI is calculated using data collected by bicycle-mounted iPhones. All iPhones come equipped with a sensor called an accelerometer, which is an instrument that measures the directional acceleration of an object. The iPhone uses this sensor primarily to measure the tilting and orientation of the phone; we instead used the accelerometer to measure how much jolting we experienced when riding a bike trail. The way it works is relatively straightforward. First, we mounted an iPhone to our bicycle’s handlebars and configured the phone to record the accelerometer data. Second, we went for a bike ride. Whenever we were on a smooth trail, the accelerometer recorded only weak vibrations. But whenever we hit a crack or rut, the accelerometer recorded a jolting force. We combined the accelerometer data with GPS location and speed (which iPhones can also record) and analyzed the data for each individual trail segment. During testing, we found the accelerometer on our iPhone produced good data on the “smoothness” or “roughness” of a trail.

We used an app called SensorLog (which retails for \$2.99 in the Apple App Store) to record and store our iPhone’s data. We configured the app to record GPS coordinates, travel speed, and accelerometer readings every half second. Using SensorLog, we collected 411,976 data points, each one indicating where the bicyclist was, how fast

they were traveling, and how much vibration they were experiencing from bumps and cracks in the pavement.

The accelerometer data is summarized as a TRI score. Statistically, the TRI is the standard deviation of the force felt along the vertical axis of the iPhone, adjusted for speed and bike effects, and multiplied by 100 for scale. The TRI measures how rough a trail is, so the higher the TRI score, the worse the trail. Trails in excellent condition have low TRIs, typically below 35, whereas trails in poor condition have high TRIs, typically above 85.

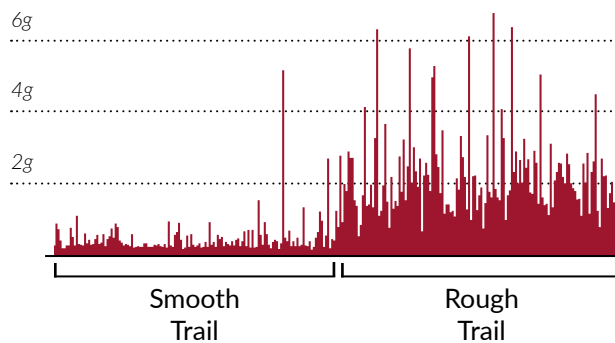
Applying adjustments for travel speed and bike were necessary to ensure all our data was comparable. The force felt by a bicyclist when hitting a bump is dependent upon both travel speed and absorption qualities of the bike.⁸ We adjusted all our data to estimate (1) the force a bike experiences at approximately 13 miles per hour, which was the average speed across all our samples, and (2) the force felt by an aluminum-frame road bike with approximately half-inch tires inflated to 80 psi.

PHOTOGRAPHIC EVIDENCE

In addition to our experiential ratings and TRI calculations, we took photographs to supplement and visualize our data. In total, we took 1,714 photos showing the good, the bad, and the ugly

Example Accelerometer Data

G-force (absolute value)



⁸ The greater the travel speed, the greater the force felt when hitting a bump or crack. During our testing we found an interaction between roughness and speed, whereas the rougher the trail, the greater effect speed had on TRI. On an average trail, increasing travel speed by 1 mph increased TRI by 3.25 points. We estimated adjustment factors for each bike used to collect data by comparing common segments; factors ranged from 0.38 to 3.62

of state trail conditions. Selected photographs of each segment are presented alongside the experiential ratings and TRI scores for each segment, starting on page 13. An interactive map of state trail conditions and all of our photographs are available on our website.

IMPORTANT CAVEATS

There are several important caveats to keep in mind when interpreting our trail condition ratings.

Our experiential ratings, in nearly every case, are based on only one person's judgment. Different people have different thresholds of how many bumps and cracks are acceptable, and thus reasonable people will often disagree with each other's assessment. We found that people generally agree on what constitutes a trail in excellent condition, but beyond that opinions sometimes diverged. In a small number of cases, we had two different volunteers ride a trail and report experiential ratings. In cases where those ratings differed, we report the lower of the two ratings.

The choice to use mile-long segments as our unit of analysis also has a bearing on our results. Over

the course of a mile, a trail may be in excellent condition for one stretch and in poor condition for another. By analyzing trails in one-mile segments, poor sections of trail that are isolated within longer stretches of good trail can be lost. Consequently, segments we have rated as good, or even excellent, may have stretches of poor pavement. The converse is also true, however; segments we have rated as fair, or even poor, may have stretches of good pavement.

The primary limitation of the TRI is that the accelerometer only measures what the bicyclist rides over, and thus TRI scores do not account for bumps or cracks that are easily avoidable. This limitation is particularly problematic for trails with longitudinal cracking and/or cracks forming along the pavement's edge. The TRI should be interpreted as a measure of how many bumps and cracks a bicyclist experiences when riding a trail, not the overall number of bumps and cracks present on a trail.

Similarly, our experiential rating categories are based on how smooth or rough a trail is to ride, not the visual appearance of the trail. In certain cases, a trail may have a poor visual experience (e.g., weeds growing through cracks) but still provide a smooth ride. Our ratings privilege the

Limitations of the Trail Roughness Index



The TRI likely overestimates the condition of trails with bumps that are easily avoidable, such as longitudinal cracking and cracks forming along pavement edges.

quality of the ride over the visual appearance of the trail.

The TRI should be interpreted as an estimate, with a margin of error of approximately 10%. The primary sources of error include random bicycle “noise” present in the accelerometer data (e.g., the vibrations from pedaling, swaying back and forth, debris on the trail, etc.), sampling error (e.g., bicyclists riding on the left vs. right side of the trail), and adjustment error (i.e., our adjustment factors only approximate the effect of speed and bike). As such, we cannot say with full confidence that a trail with a TRI of 50 is quantitatively better than a trail with a TRI of 55.

Our photographs are also subject to bias because they were not taken at regular, systematic intervals. Rather, trail evaluators were asked to take representative photographs and photographs of especially problematic areas. Thus, the photographs we have are dependent upon the judgment of the photographer.

Taken individually, the experiential ratings, Trail Roughness Index, and photographs all have limitations. But when taken together, we are confident they provide an accurate representation of conditions on Minnesota State Trails.



Maureen Noterman

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Year one of this project was something of an “exhaustive experiment”; exhaustive because of the vast amounts of data we collected, and experimental because we’re still just learning and testing how to best use smart phones to collect data on trail conditions. The project was and continues to be a learning experience.

We hope you find this project useful, and invite all of your feedback.

ABOUT THE PARKS & TRAILS COUNCIL OF MINNESOTA

Parks & Trails Council of Minnesota (P&TC) is an organization of more than 3,800 members dedicated to acquiring, protecting, and enhancing critical land for the public's use and benefit. Since 1954, P&TC has been working on behalf of Minnesotans who treasure these special places, protecting land and water to promote conservation, outdoor recreation, tourism, and healthy lifestyles. This work is accomplished by acquiring threatened and critical parcels of land, being an independent and forthright voice at the Minnesota Capitol, boosting the capacity of Friends Groups to help care for and promote parks and trails, and engaging in public policy research. For more than 60 years, P&TC has added nearly 11,000 acres, valued at more than \$33 million, to Minnesota's park and trail network.

For more information about how you can help acquire, protect, and enhance Minnesota's special places, please contact us.



www.parksandtrails.org

275 East 4th Street, Suite 250
Saint Paul, MN 55101



(651) 726-2457
(800) 944-0707