Baxter State Park
Trail Maintenance Inventory & Planning

BSP Advisory Meeting
April 10, 2012
Rick Morrill BSP Resource Manager
Paul Sannicandro Trail Crew Supervisor

Trail Maintenance Inventory

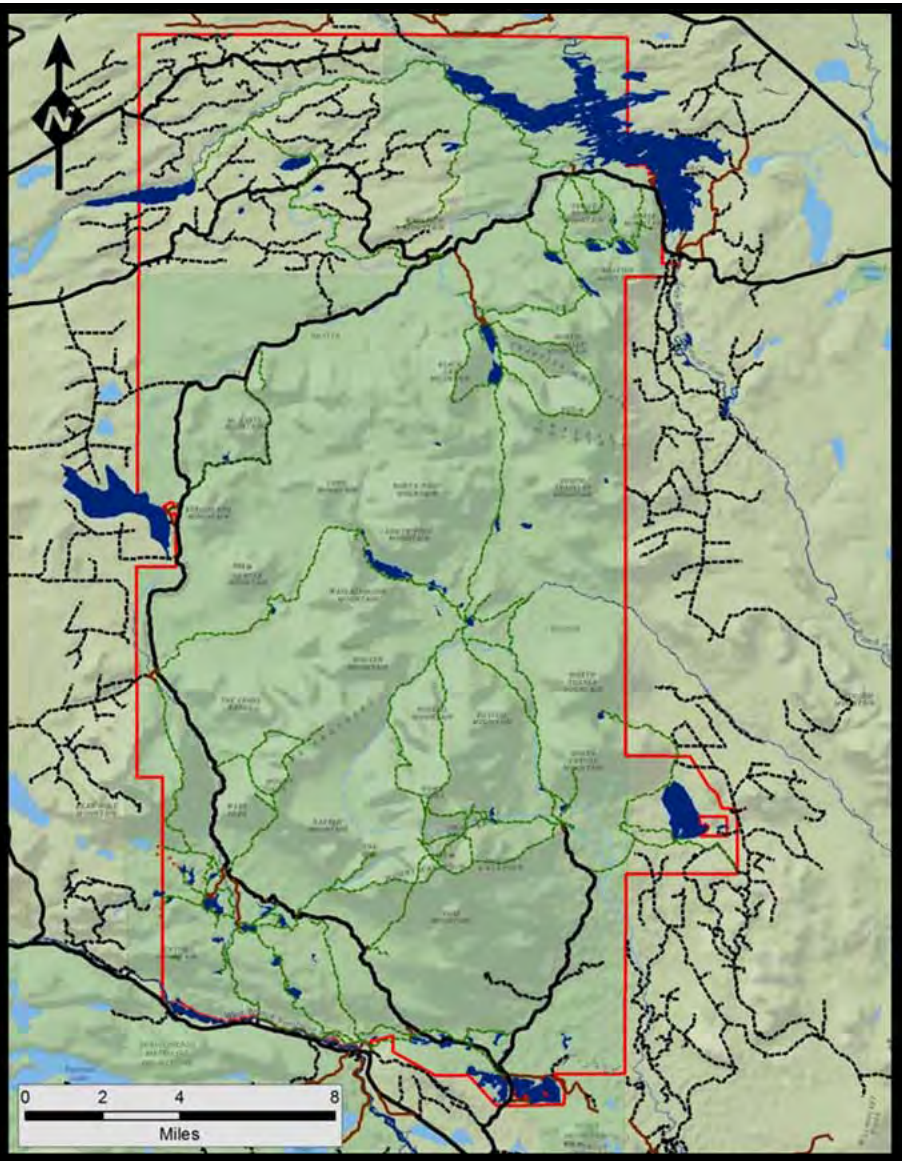
1. Why?

2. How?

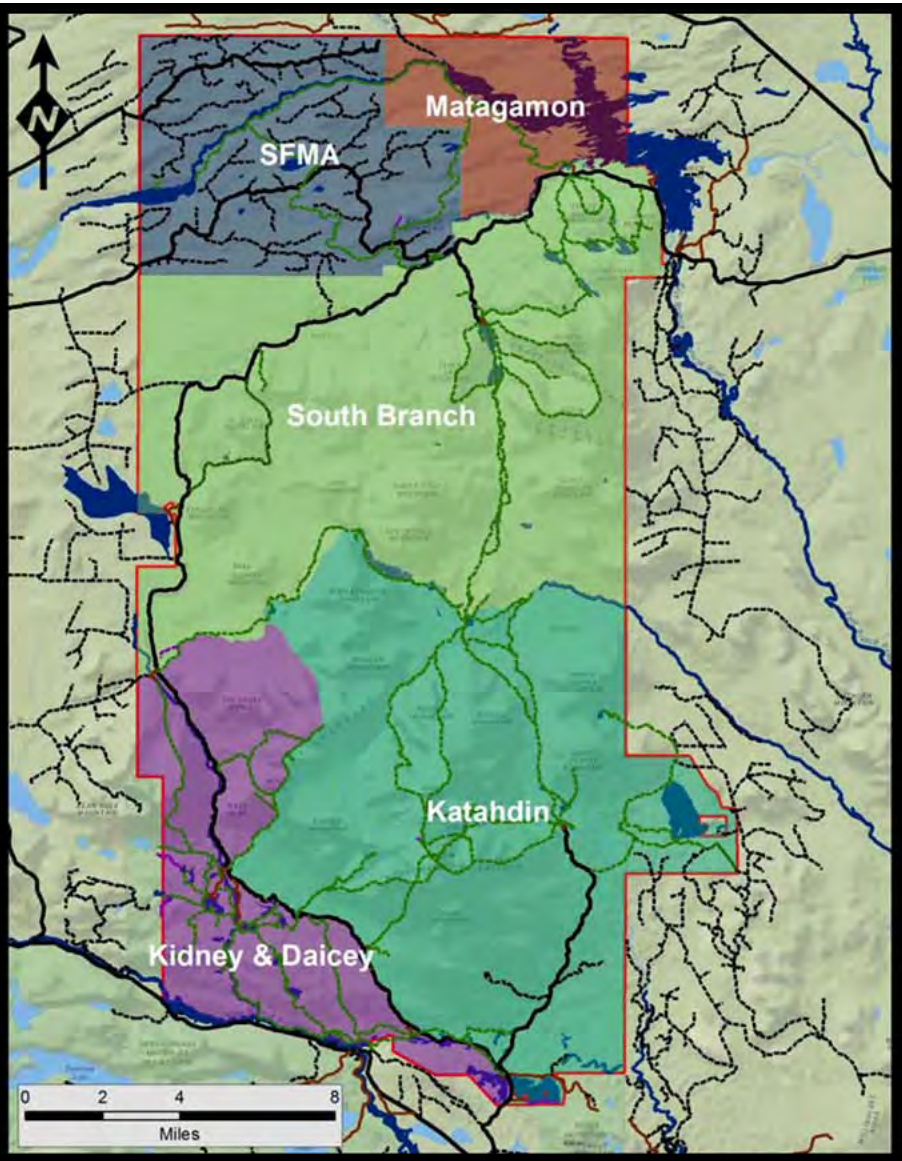
3. Now What???

This presentation attempts to answer these 3 basic questions regarding the Baxter State Park trail maintenance inventory project.

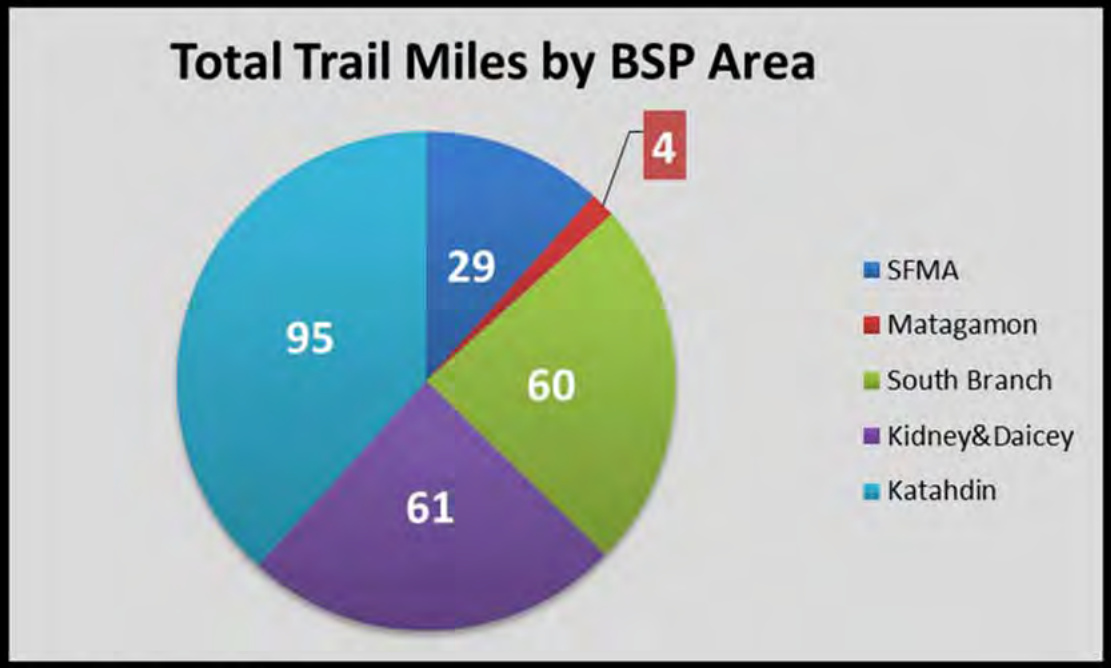
1. Why do we need to inventory our trail maintenance features.
2. How do we structure this type of project to ensure successful data collection and analysis.
3. Once the data has been collected how to we use it to make management decisions.



I think we would all acknowledge that trails are the principle recreation feature we have in the Park. Lets spend a minute looking at the trails in more detail.

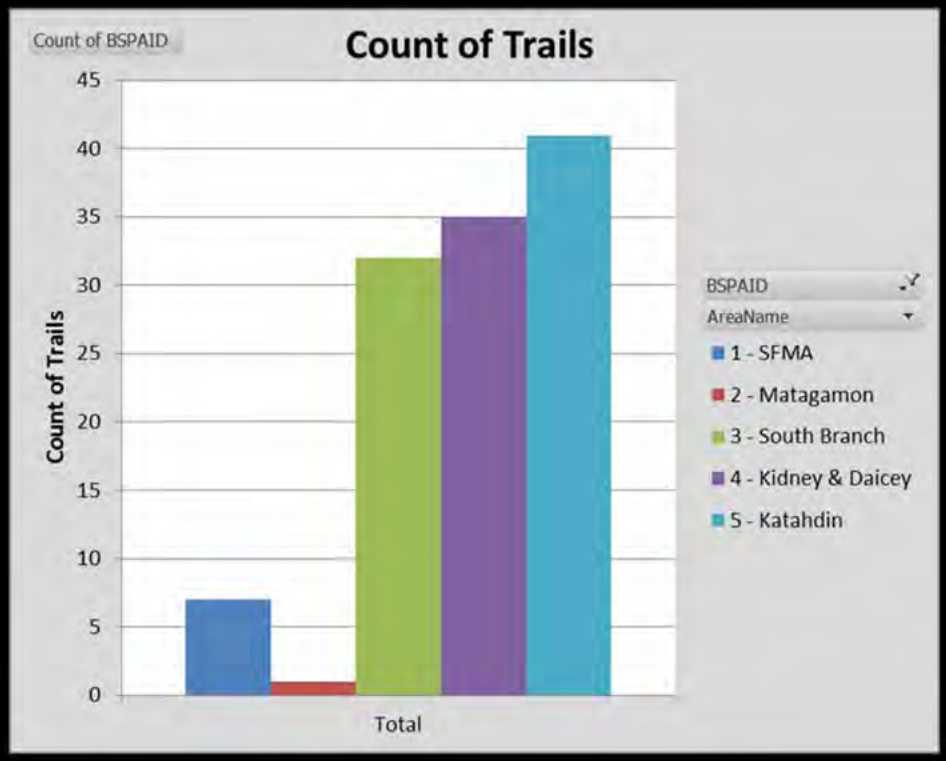


If we divide the park into regions we can examine specific trail attributes based on these general areas designations.



BSP Area	SlopeTrail Length (mi)
SFMA	28
Matagamon	4
South Branch	52
Kidney&Daicey	54
Katahdin	83
Total	221

First how many miles of trail do we have in each region and in total? You can see in the chart that 95 miles of trail are in the Katahdin region with South Branch and Kidney & Daicey each having 60 miles and half that amount in the SFMA. The table shows the same values plus the total trail miles of 221 across all regions.



BSP Area	Count of Trails
SFMA	7
Matagamon	1
South Branch	32
Kidney&Daicey	35
Katahdin	41
Total	116

Second how many named trails are there? The chart shows the count of the number of named trails by region. Again Katahdin has the most but the number of individual trails is more even across the three principle regions. The table shows a total of 116 named trails in the park.

Rum Pond Trail

So these trails require maintenance. Because they may look like this….

Rum Pond Trail

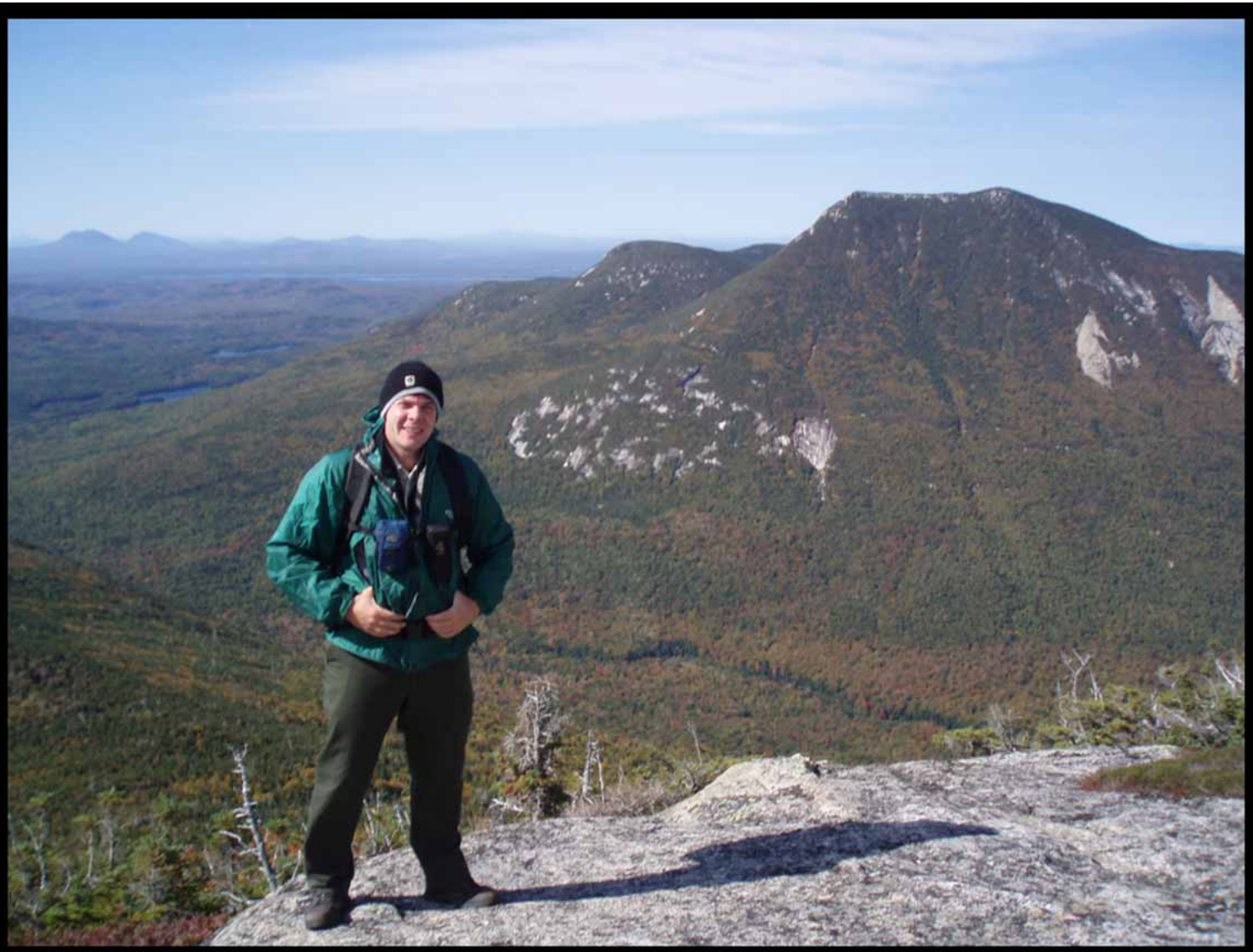
…And we may want them to look like this.

To make this happen we need lots of young backs to move rocks, logs, and water!

But these crews cost money, and…

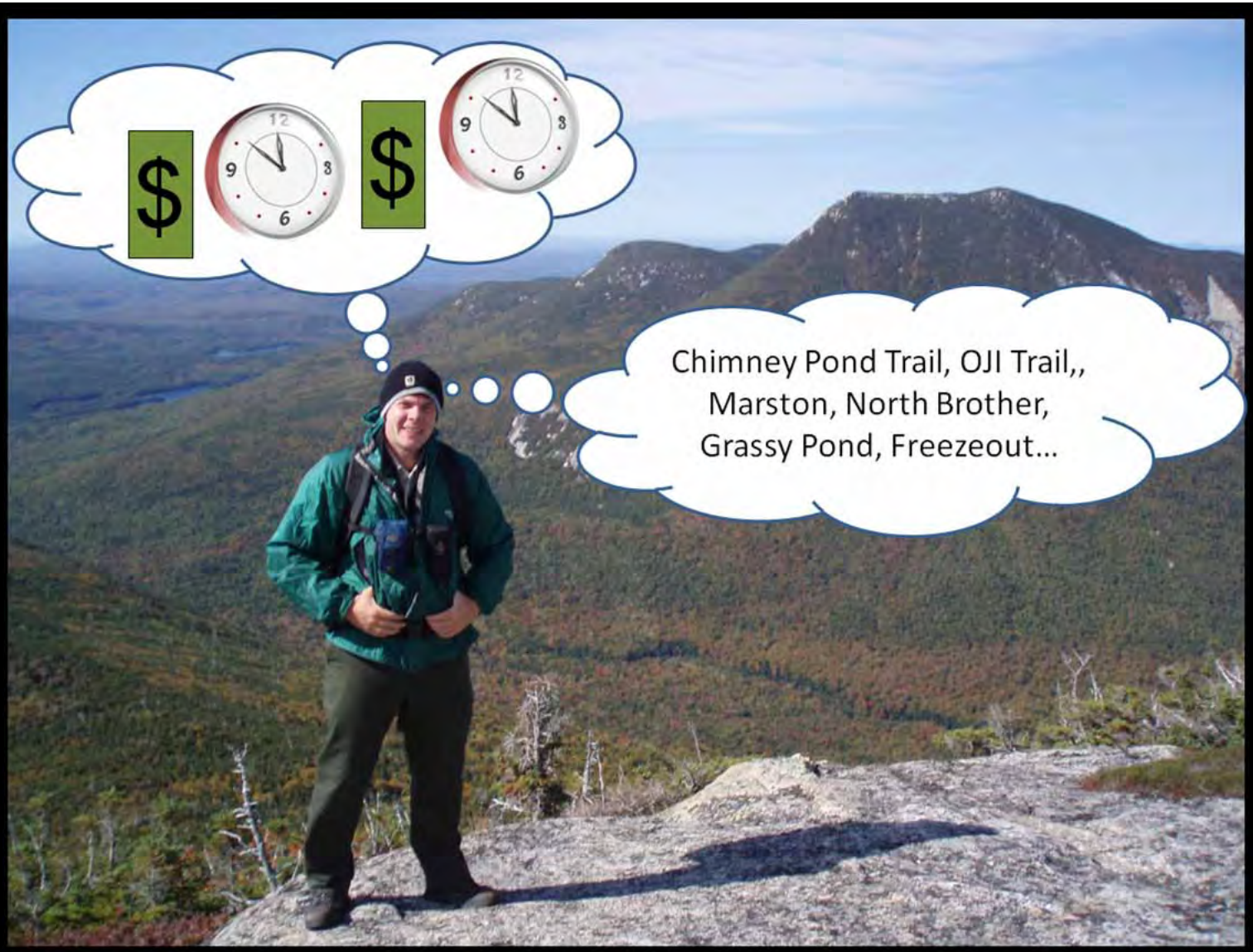
…the materials they use cost money, and…

…we only have a few months out of the year when we can really hammer out this work.



Enter Paul Sannicandro the trail crew supervisor. Now we only have one Paul, and he is responsible for planning the work that trail crew will tackle each season.

So on one hand Paul has to determine how he wants to allocate his limited amount of money and limited time, but…



He also has a long list of trails that need maintenance, so he has to prioritize his to do list based on the information available to him.

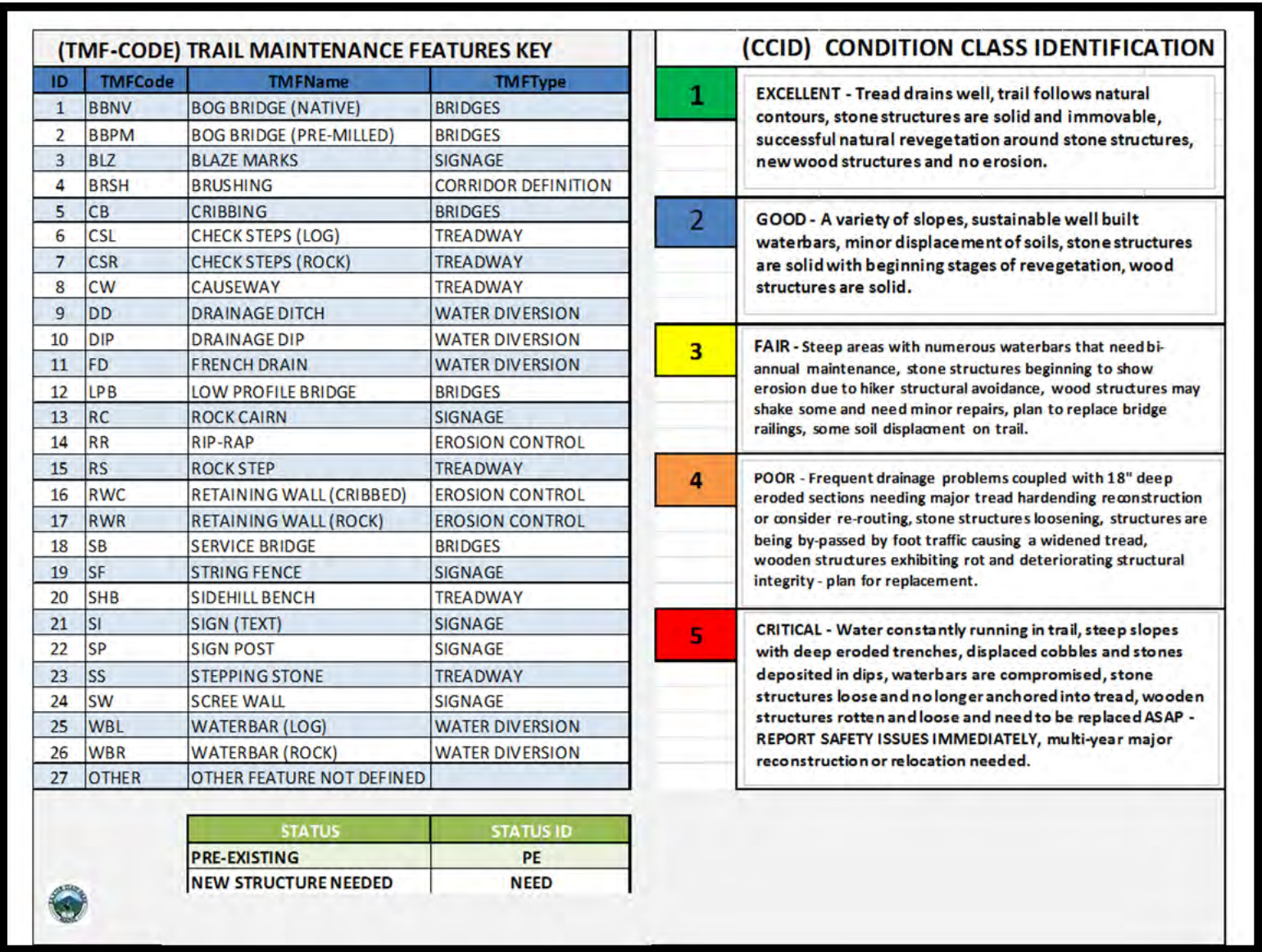
Trail Maintenance Inventory

1. Why?

2. How?

3. Now What???

So we know that why we want to collect information about the maintenance needs along Park trails, but how do we design and conduct this type of inventory?



(TMF-CODE) TRAIL MAINTENANCE FEATURES KEY

ID	TMFCode	TMFName	TMFType
1	BBNV	BOG BRIDGE (NATIVE)	BRIDGES
2	BBPM	BOG BRIDGE (PRE-MILLED)	BRIDGES
3	BLZ	BLAZE MARKS	SIGNAGE
4	BRSH	BRUSHING	CORRIDOR DEFINITION
5	CB	CRIBBING	BRIDGES
6	CSL	CHECK STEPS (LOG)	TREADWAY
7	CSR	CHECK STEPS (ROCK)	TREADWAY
8	CW	CAUSEWAY	TREADWAY
9	DD	DRAINAGE DITCH	WATER DIVERSION
10	DIP	DRAINAGE DIP	WATER DIVERSION
11	FD	FRENCH DRAIN	WATER DIVERSION
12	LPB	LOW PROFILE BRIDGE	BRIDGES
13	RC	ROCK CAIRN	SIGNAGE
14	RR	RIP-RAP	EROSION CONTROL
15	RS	ROCK STEP	TREADWAY
16	RWC	RETAINING WALL (CRIBBED)	EROSION CONTROL
17	RWR	RETAINING WALL (ROCK)	EROSION CONTROL
18	SB	SERVICE BRIDGE	BRIDGES
19	SF	STRING FENCE	SIGNAGE
20	SHB	SIDEHILL BENCH	TREADWAY
21	SI	SIGN (TEXT)	SIGNAGE
22	SP	SIGN POST	SIGNAGE
23	SS	STEPPING STONE	TREADWAY
24	SW	SCREE WALL	SIGNAGE
25	WBL	WATERBAR (LOG)	WATER DIVERSION
26	WBR	WATERBAR (ROCK)	WATER DIVERSION
27	OTHER	OTHER FEATURE NOT DEFINED	

STATUS	STATUS ID
PRE-EXISTING	PE
NEW STRUCTURE NEEDED	NEED

(CCID) CONDITION CLASS IDENTIFICATION

1	EXCELLENT - Tread drains well, trail follows natural contours, stone structures are solid and immovable, successful natural revegetation around stone structures, new wood structures and no erosion.
2	GOOD - A variety of slopes, sustainable well built waterbars, minor displacement of soils, stone structures are solid with beginning stages of revegetation, wood structures are solid.
3	FAIR - Steep areas with numerous waterbars that need bi-annual maintenance, stone structures beginning to show erosion due to hiker structural avoidance, wood structures may shake some and need minor repairs, plan to replace bridge railings, some soil displacment on trail.
4	POOR - Frequent drainage problems coupled with 18" deep eroded sections needing major tread hardending reconstruction or consider re-routing, stone structures loosening, structures are being by-passed by foot traffic causing a widened tread, wooden structures exhibiting rot and deteriorating structural integrity - plan for replacement.
5	CRITICAL - Water constantly running in trail, steep slopes with deep eroded trenches, displaced cobbles and stones deposited in dips, waterbars are compromised, stone structures loose and no longer anchored into tread, wooden structures rotten and loose and need to be replaced ASAP - REPORT SAFETY ISSUES IMMEDIATELY, multi-year major reconstruction or relocation needed.

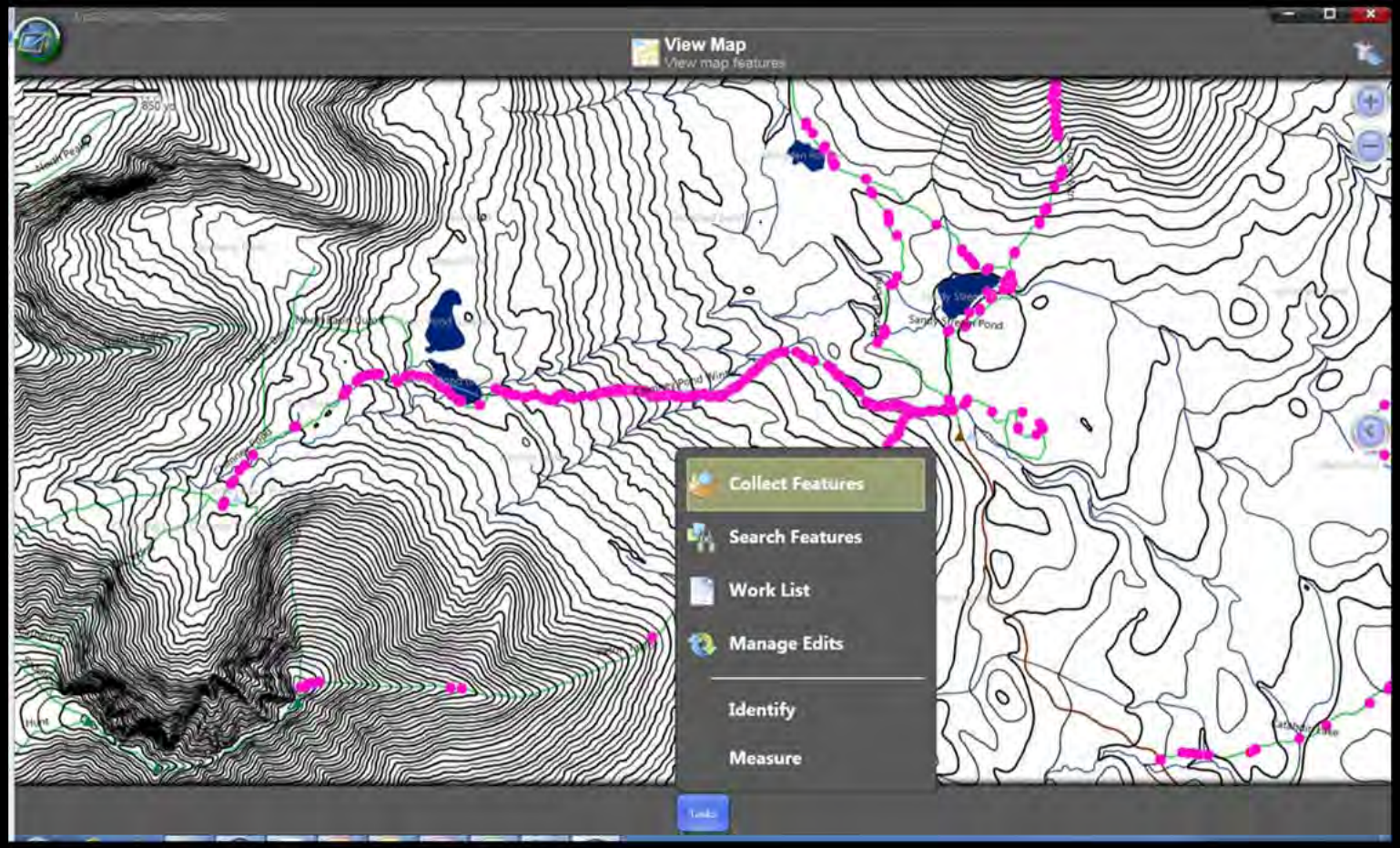
This work started with Paul creating a classification system covering each of the different types of trail maintenance features such as water bars or sign posts. (Blue table)
Then he created a system to rate the condition or integrity of the feature, with a 1 being in excellent condition and a 5 being in critical condition requiring immediate attention.
Lastly, he established that features could be either pre-existing or if a feature was absent the need for a feature could be noted.

Trail Inventory Interns
Patrick Aldrich & Andrew Pelletier

Next, 2 summer interns were hired, who would hike on Park trails and evaluate the maintenance features they encountered. These interns were outfitted with hand held computers with mapping software and GPS capabilities to enable them to record this data. Funding from the Friends of Baxter State Park helped cover the costs of equipment and staff time.

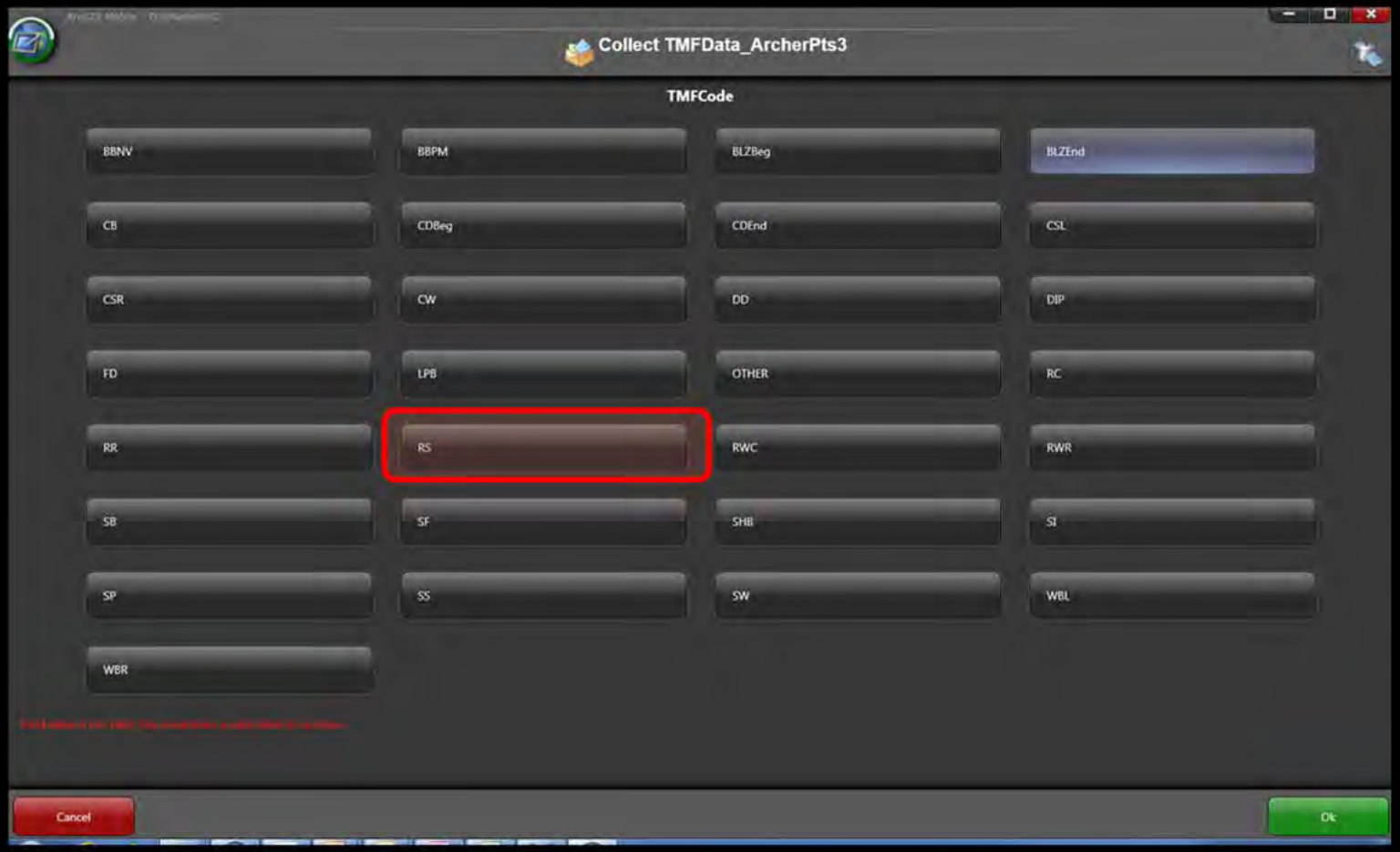
The data collection process works like this. The field technician locates a feature like these rock steps on the Chimney Pond Trail…

When they open up the software on these field computers it looks like this, showing topography, trails, and the pink dots are features that have already been collected.



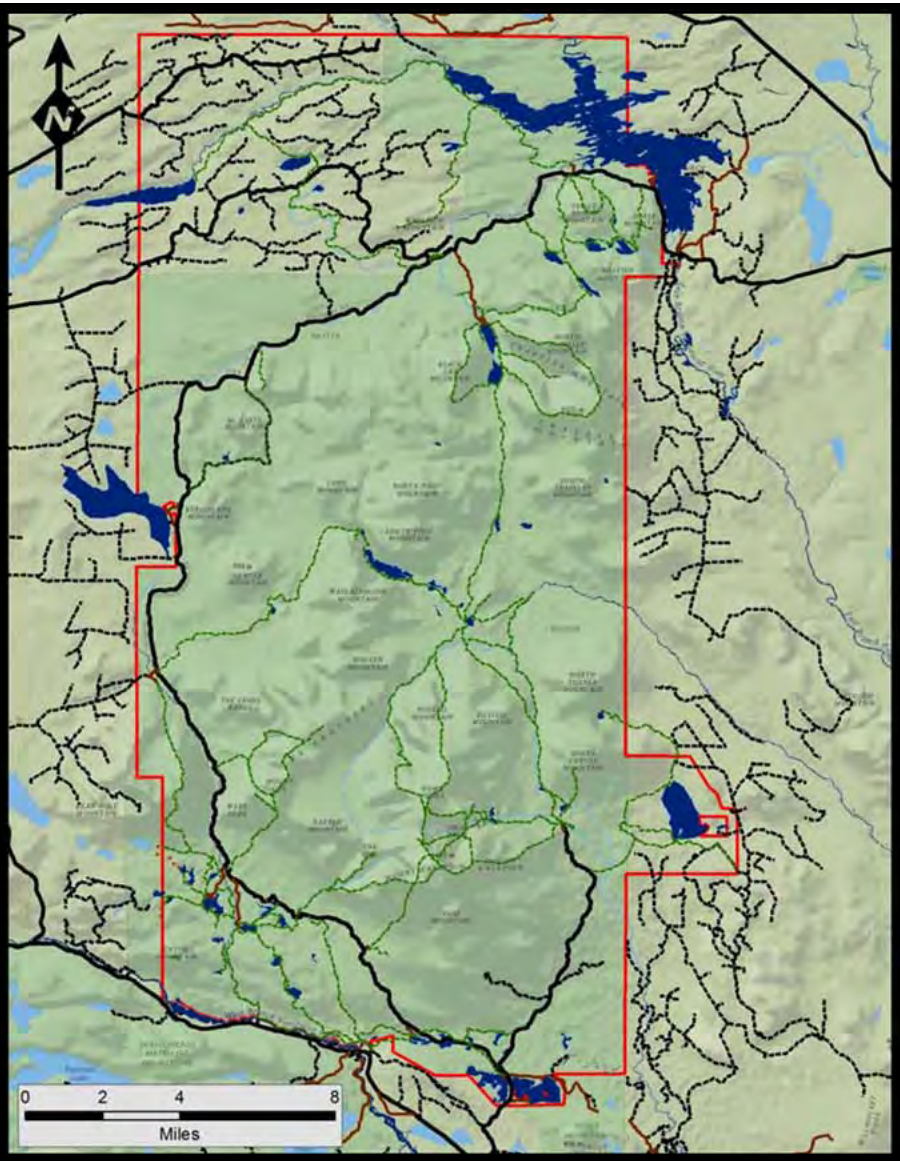
They collect the location of the new feature and then…

Begin to record attributes about that feature like the feature type.

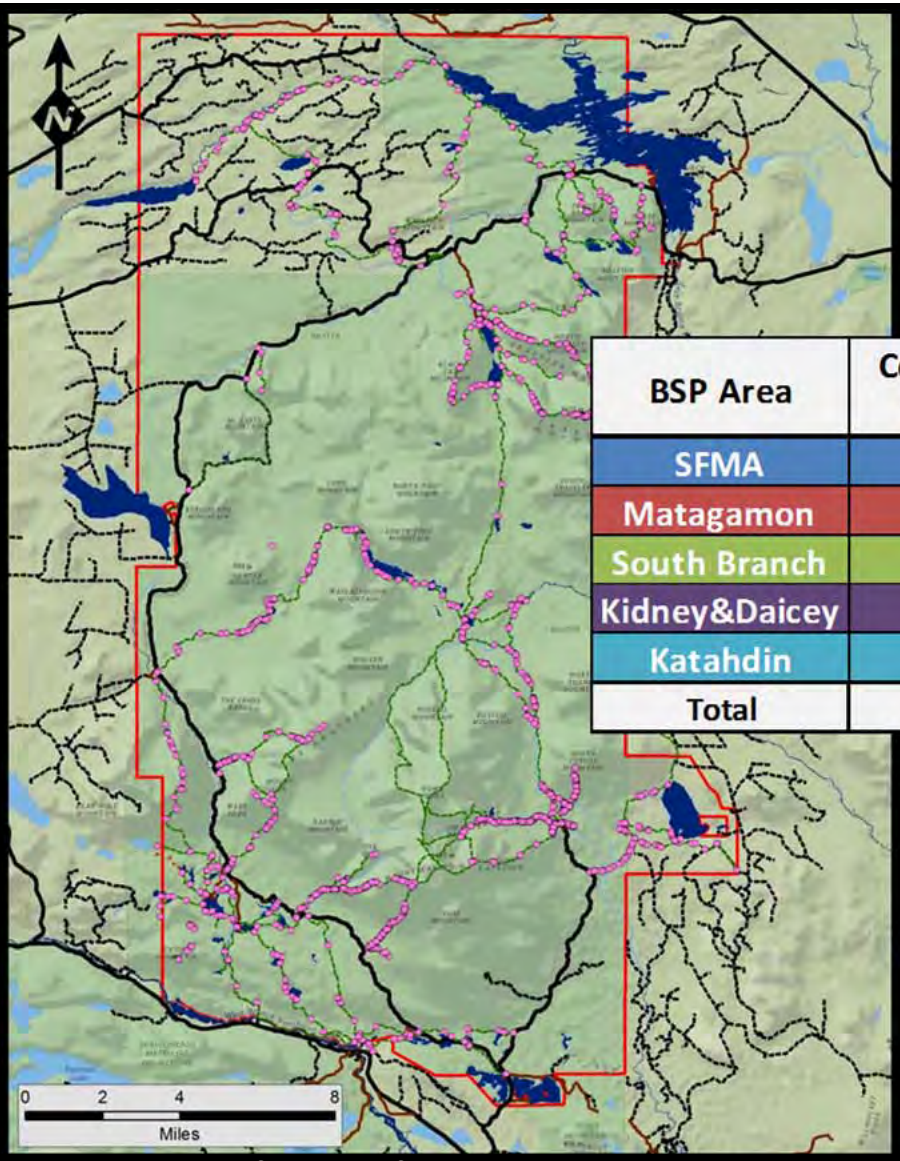


In this case it is a Rock Step so they select the code for that feature ,“RS” from the menu on above.

After that they work through a list of other attributes including the 1-5 condition class rating, whether the feature is pre-existing or needed, what the percent slope is at the location, the length of the feature if applicable, how many features are present (in this case 2 steps), the installation year if known, whether materials to repair or replace are on site, and then they took photos of the features like this image.



When we began this project we really didn't know how long it would take to inventory all the trails in the Park. A conservative estimate was we might get through 25% to 50% of the total trail miles.



BSP Area	Count of Trails	Count of Trails
SFMA	4	57%
Matagamon	1	100%
South Branch	25	78%
Kidney&Daicey	28	80%
Katahdin	29	71%
Total	87	75%

This map shows all the locations of all the features collected by Pat and Andy over the course of 10 weeks in June-August. In total they inventoried over 2000 features. The pink dots on the map indicate the locations of these features. Conservatively we estimate that they inventoried at least 75% of all the trails in the Park. With the largest area remaining in the Katahdin region. (The low percentage in the SFMA is an artifact of the analysis, the actual number if closer to 100%.)

The amount of miles and the number of features inventoried in this effort is impressive.

We might wonder just what motivated these guys to cover so much ground so quickly….
Perhaps close encounters with a few of these guys….

Trail Maintenance Inventory

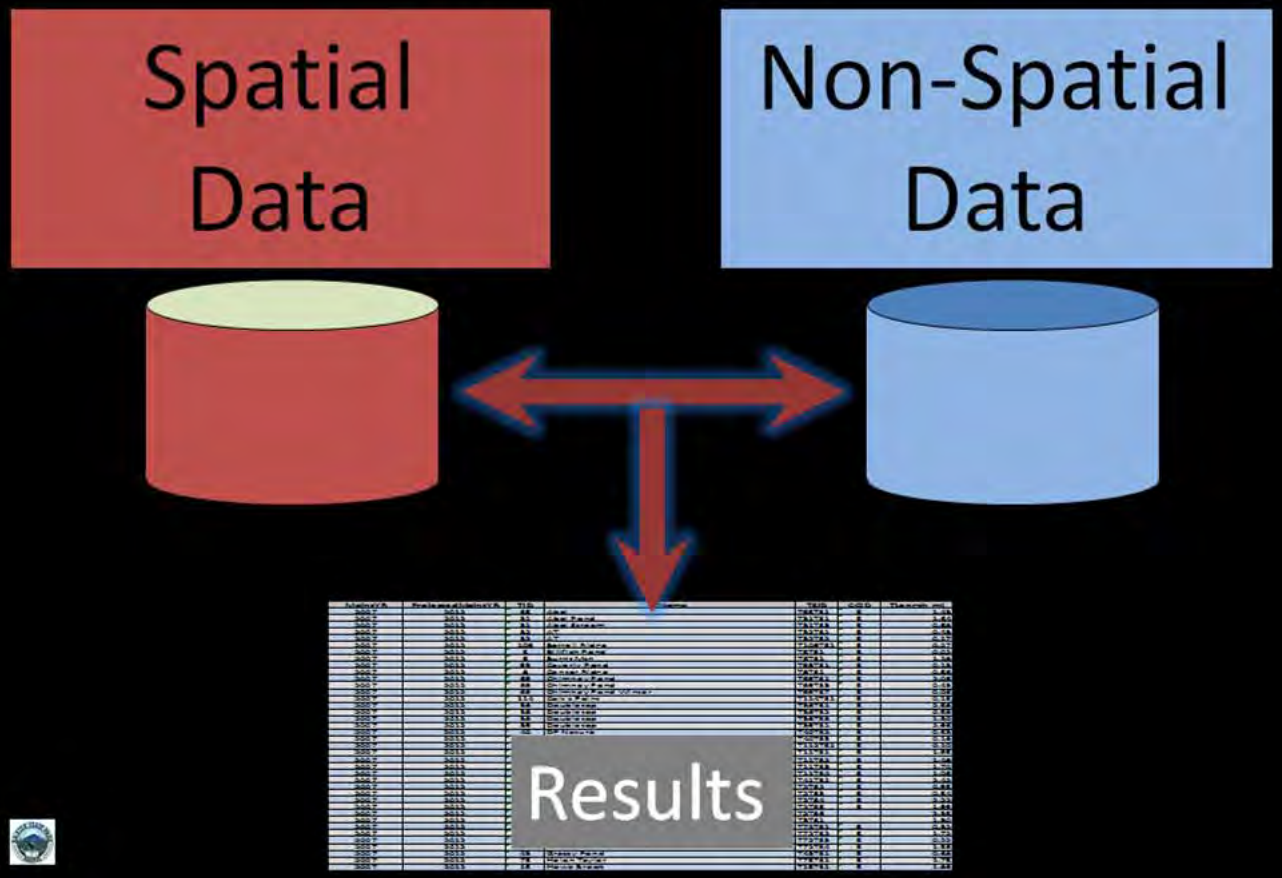
1. Why?

2. How?

3. Now What???

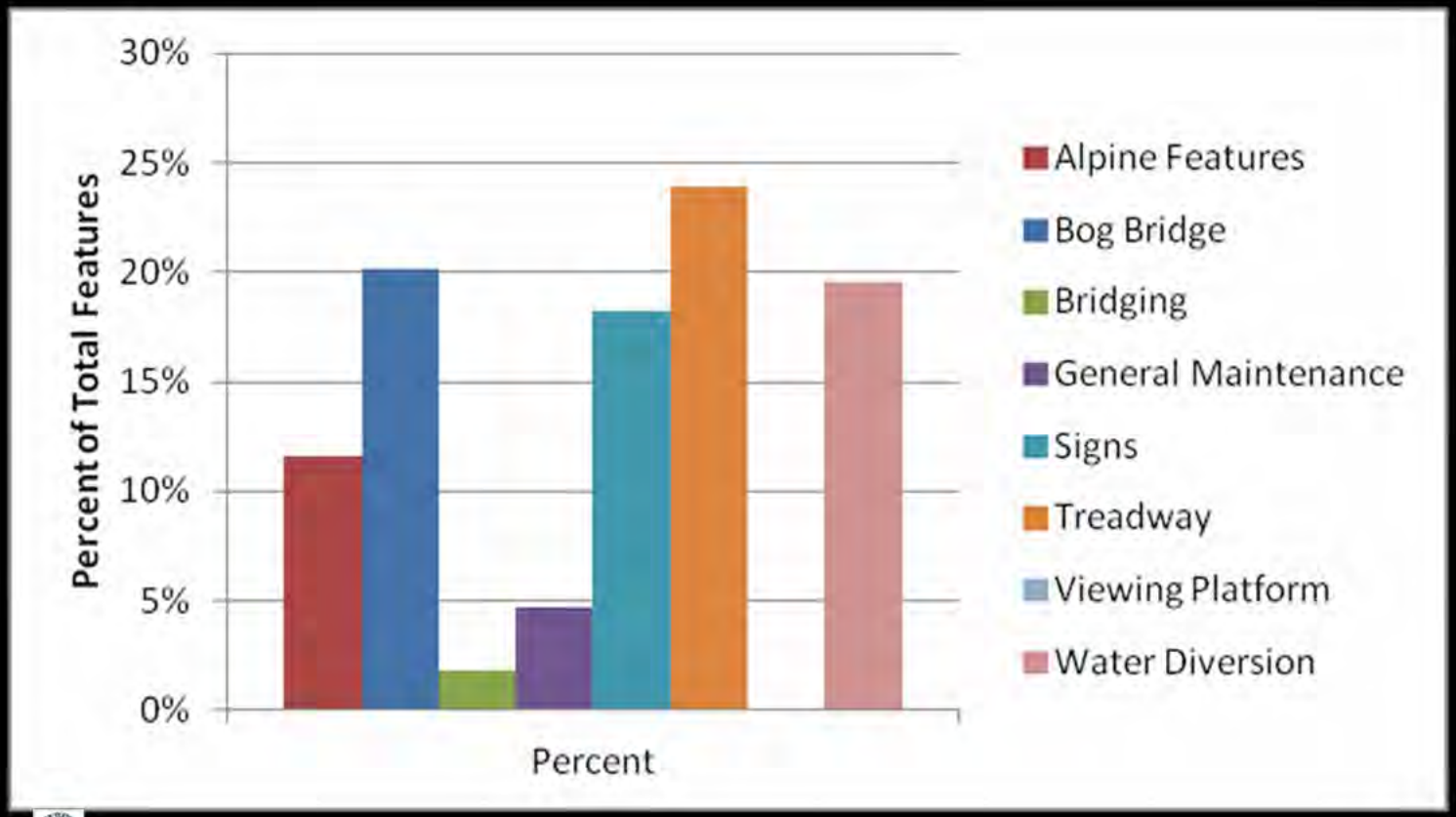
So now that we have collected all this data what do we do with it and how does it help us plan our maintenance activities?

Data Analysis



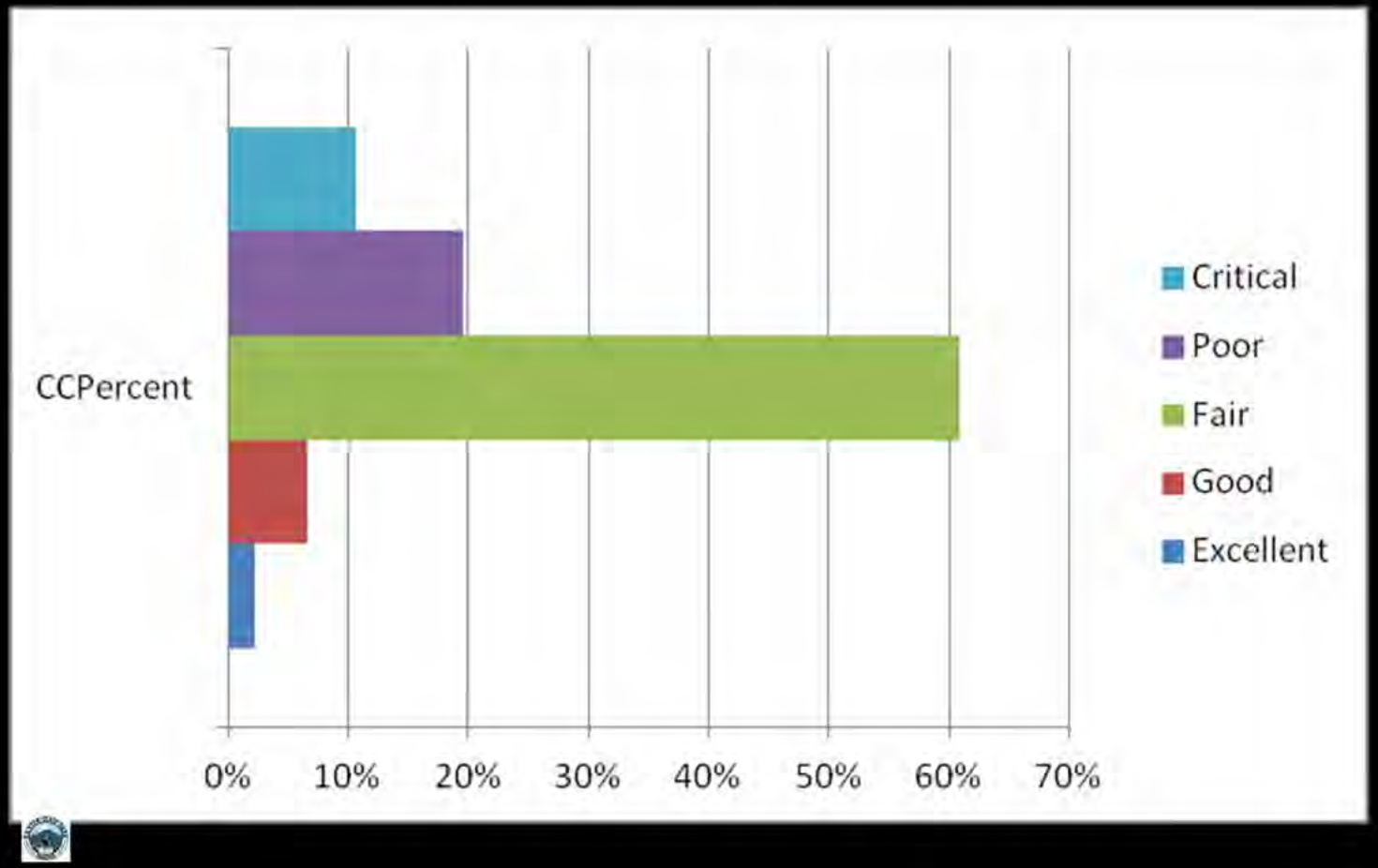
We are able to link the spatial data related to this work, like the location of each feature, with all the attribute data associated with the features and other elements like the trails and landscape.

Percent of Features by Type



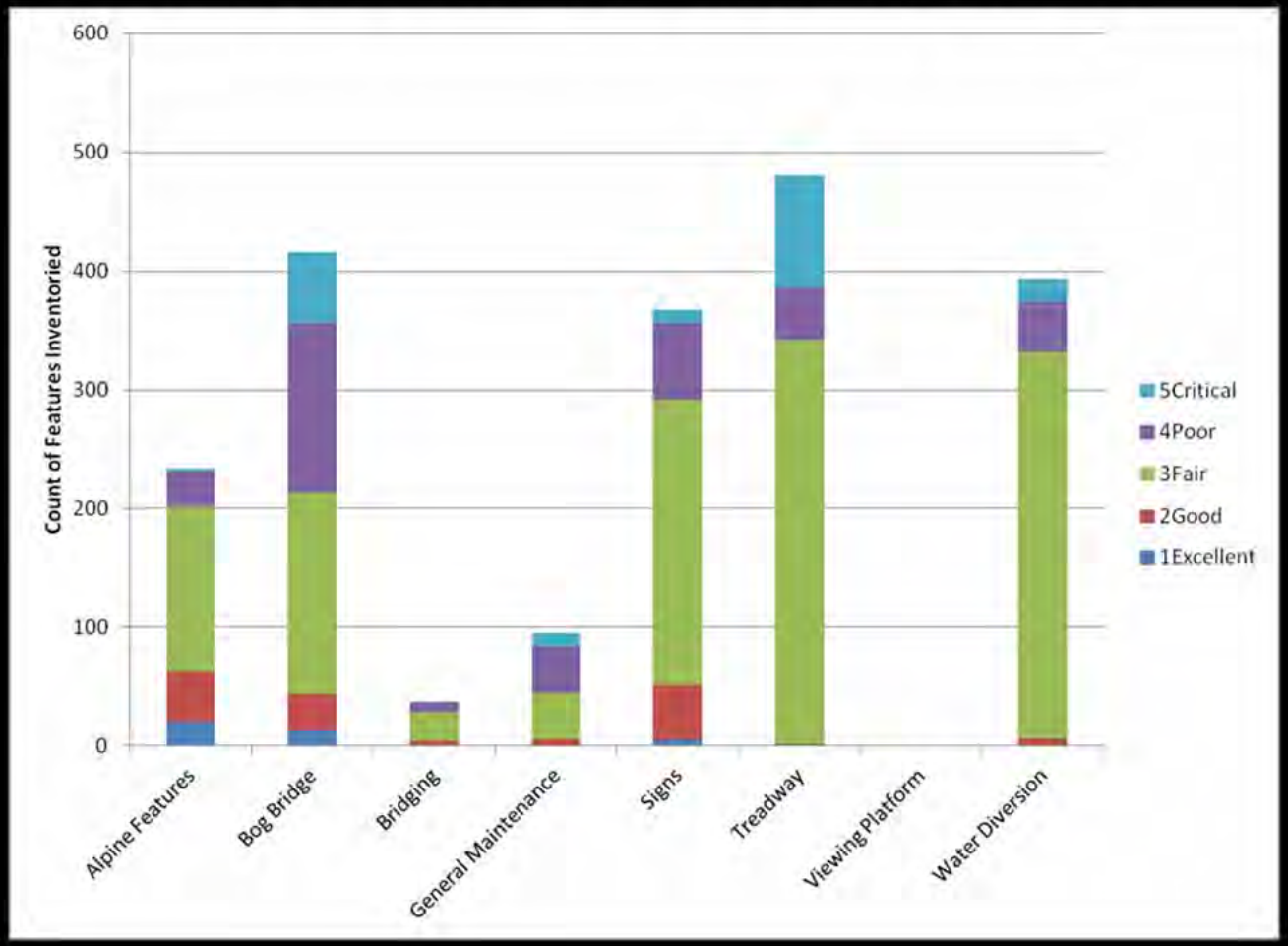
Lets begin with some basic summary statistic about the inventory data. This graph shows the percent of features broken down into some general categories like water diversion and treadway. You can see that the features are pretty well distributed between the major categories.

Percent of Features by Condition



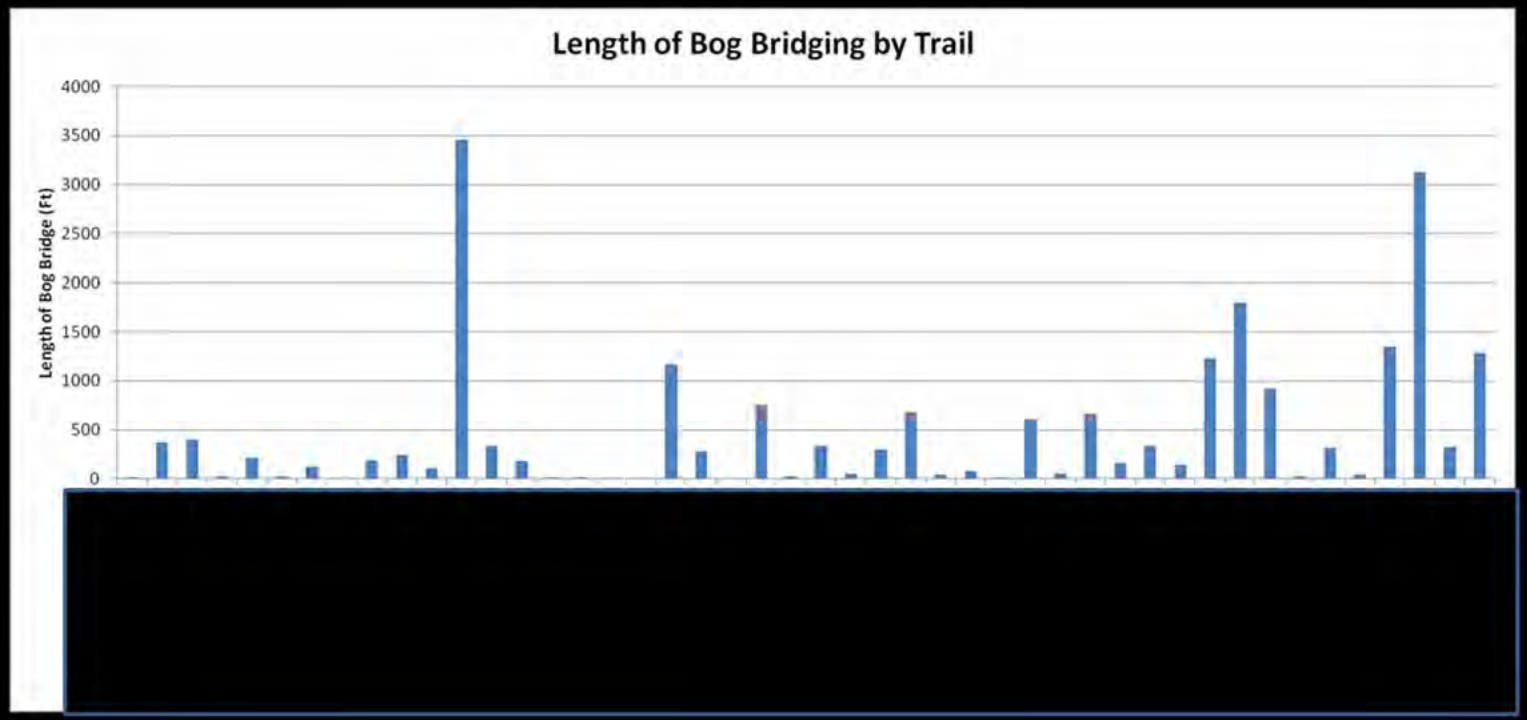
This chart shows the percent of features in the different condition classes. The majority are in the "fair" category and more are in the poor and critical class than are in the good and excellent.

Count of Maintenance Features by Condition



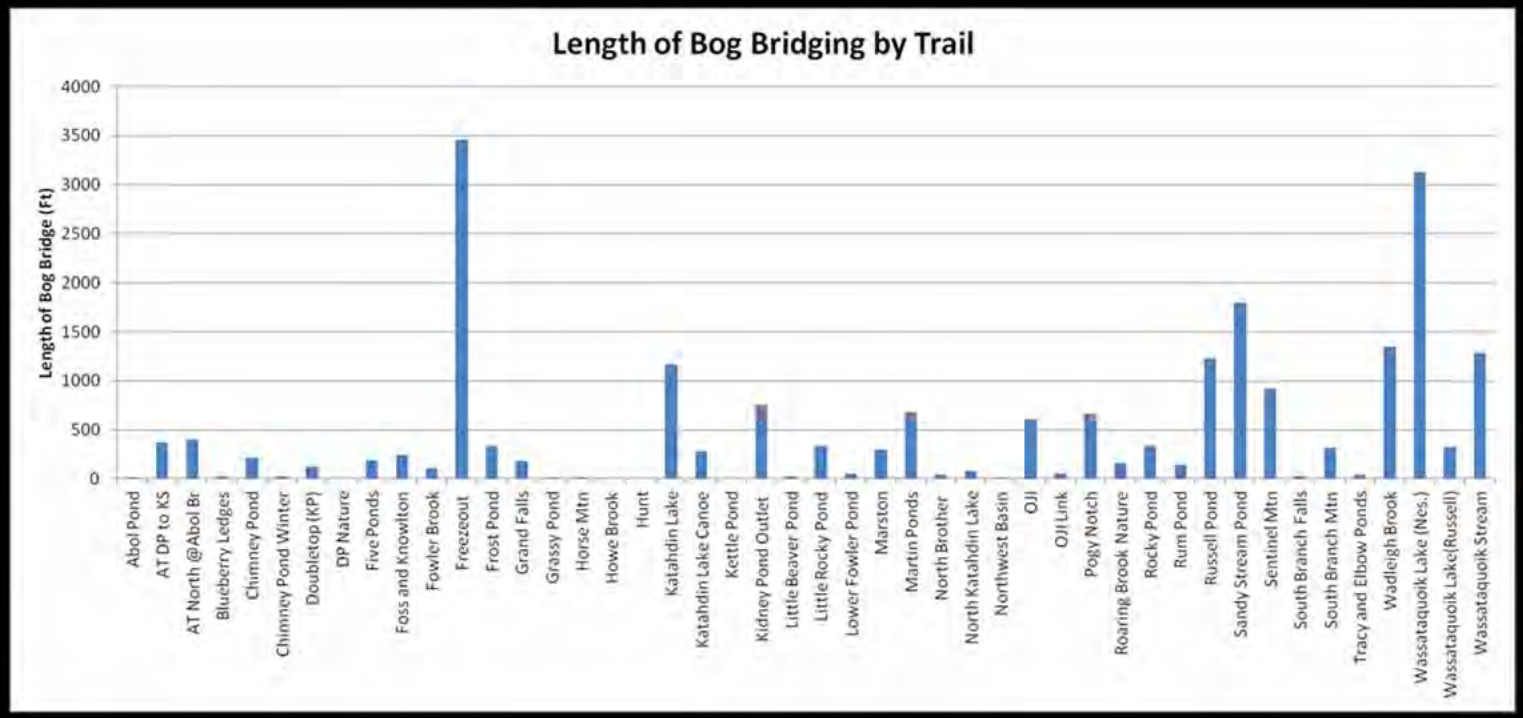
The stacked bar graph shows the combination of the feature type, and the condition class. The stacking shows the percent of the feature type in each of the 5 conditions.

Guess Which Trail has the Most Bog Bridging?



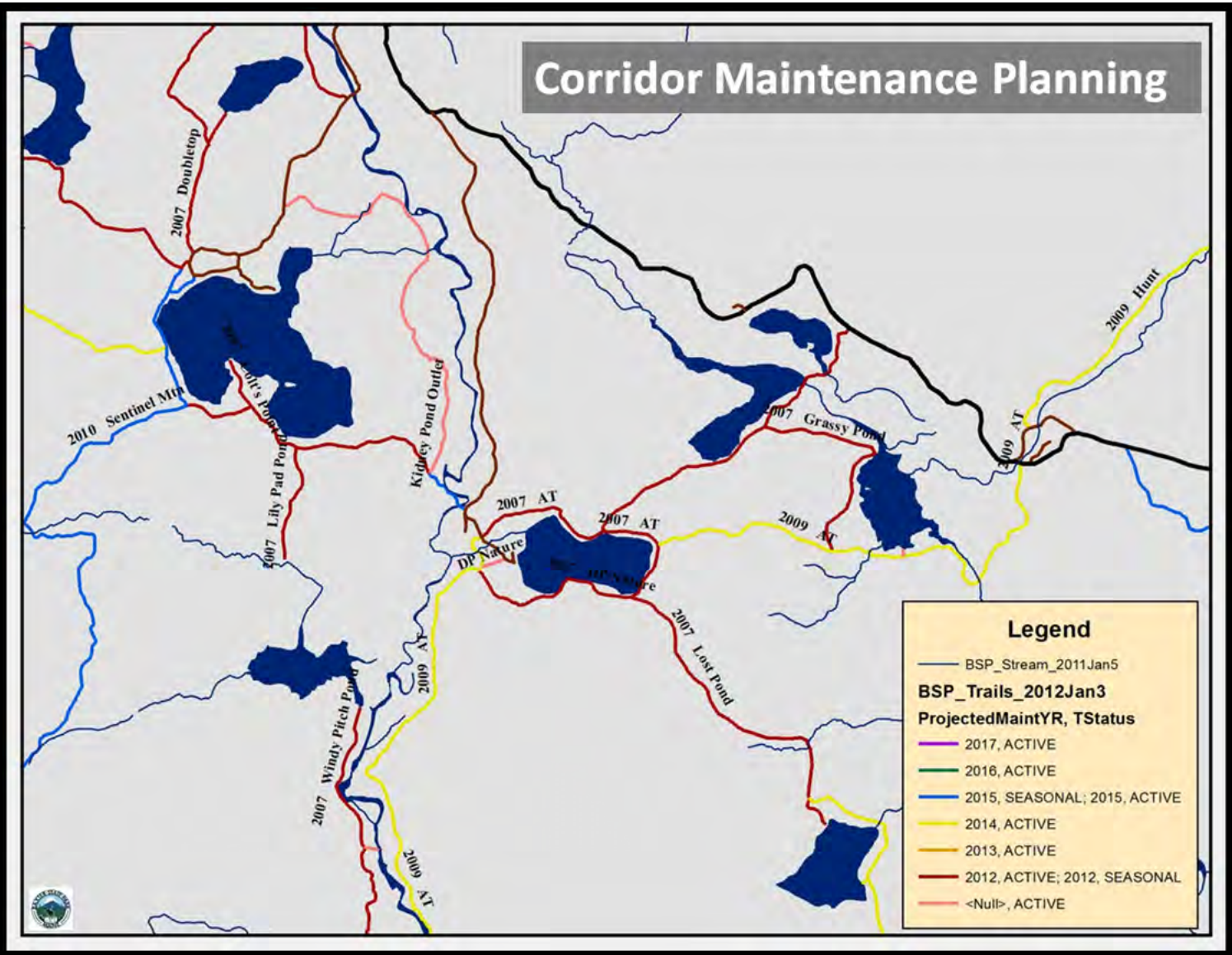
Now can you guess which Park trail has the most bog bridging.

Guess Which Trail has the Most Bog Bridging?



The freeze out trail and the Wassataquoik Lake Trail are about tied for first place with almost 3500 feet of bog bridging.

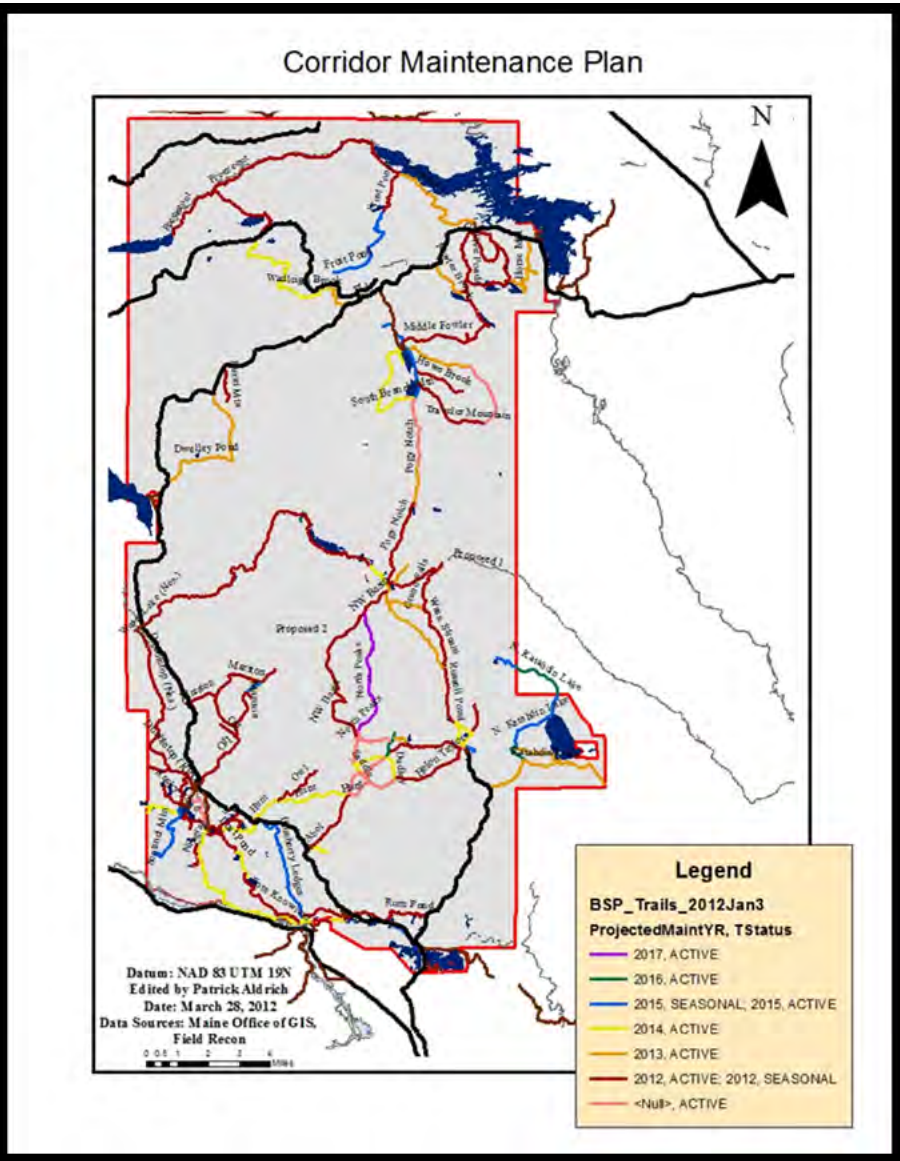
One planning tool that Paul was interested in getting out of this work was a schedule of when trails needed corridor maintenance (brushing the edges of the trail back).



This map shows the schedule of this work in the Daicey Pond area. The date labeled on each trail is the date of the most recent corridor work, and the color coding (see the map legend) indicates when that trail is scheduled for the next maintenance visit. This work is on a 5 year rotating schedule.

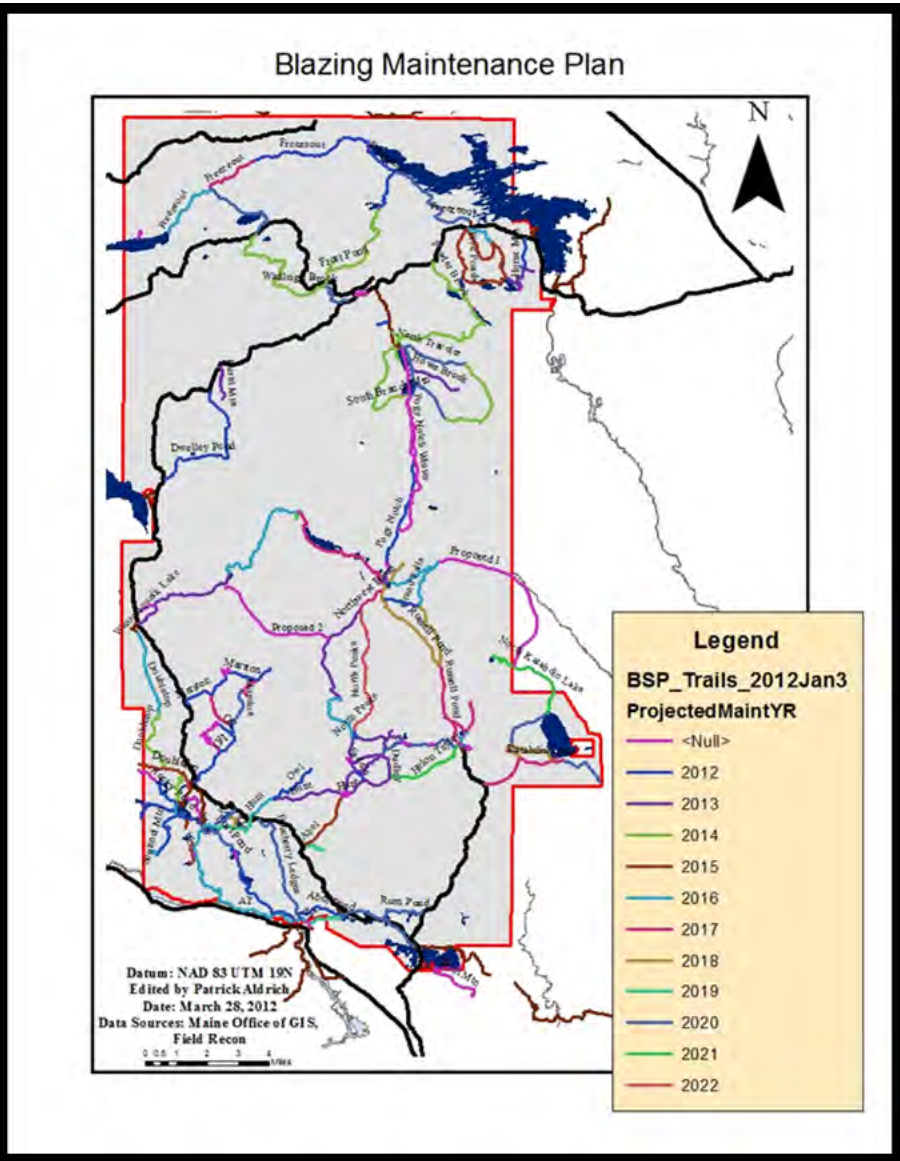
MaintYR	ProjectedMaintYR	TID	TName	TSID	CCID	TLength_mi
2007	2012	65	Abol	T65TS1	5	1.43
2007	2012	31	Abol Pond	T31TS1	5	1.64
2007	2012	31	Abol Stream	T31TS3	5	0.68
2007	2012	32	AT	T32TS1	5	0.43
2007	2012	32	AT	T32TS2	5	0.17
2007	2012	109	Barrell Ridge	T109TS1	5	0.27
2007	2012	5	Billfish Pond	T5TS1	5	0.02
2007	2012	6	Burnt Mtn	T6TS1	5	1.28
2007	2012	93	Caverly Pond	T93TS1	5	0.13
2007	2012	8	Center Ridge	T8TS1	5	0.56
2007	2012	69	Chimney Pond	T69TS1	5	2.06
2007	2012	69	Chimney Pond	T69TS3	5	0.43
2007	2012	69	Chimney Pond Winter	T69TS7	5	0.06
2007	2012	114	Colt's Point	T114TS1	5	0.15
2007	2012	38	Doubletop	T38TS1	5	2.58
2007	2012	38	Doubletop	T38TS2	5	0.58
2007	2012	38	Doubletop	T38TS3	5	1.30
2007	2012	39	Doubletop	T39TS1	5	2.96
2007	2012	40	DP Nature	T40TS2	5	0.53
2007	2012	40	DP Nature	T40TS3	5	0.18
2007	2012	112	Draper Pond	T112TS1	5	0.10
2007	2012	11	Five Ponds	T11TS1	5	1.95
2007	2012	11	Five Ponds	T11TS2	5	1.48
2007	2012	11	Five Ponds	T11TS3	5	1.70
2007	2012	11	Five Ponds	T11TS4	5	1.06
2007	2012	41	Foss and Knowlton	T41TS1	5	2.42
2007	2012	2	Freezeout	T2TS2	5	0.95
2007	2012	2	Freezeout	T2TS3	5	0.54
2007	2012	2	Freezeout	T2TS4	5	2.22
2007	2012	2	Freezeout	T2TS5	5	1.99
2007	2012	2	Freezeout	T2TS6		2.35
2007	2012	3	Frost Pond	T3TS1		1.30
2007	2012	72	Grand Falls	T72TS1	5	0.32
2007	2012	72	Grand Falls	T72TS2	5	1.72
2007	2012	72	Grand Falls	T72TS3	5	0.22
2007	2012	72	Grand Falls	T72TS4	5	1.56
2007	2012	43	Grassy Pond	T43TS1	5	0.68
2007	2012	75	Helon Taylor	T75TS1	5	2.75
2007	2012	15	Howe Brook	T15TS1	5	1.88

Paul also has this schedule in tabular format so he can easily assign this type of work to the volunteer trail stewards who volunteer their time to the Park work on Park trails over the course of the year.



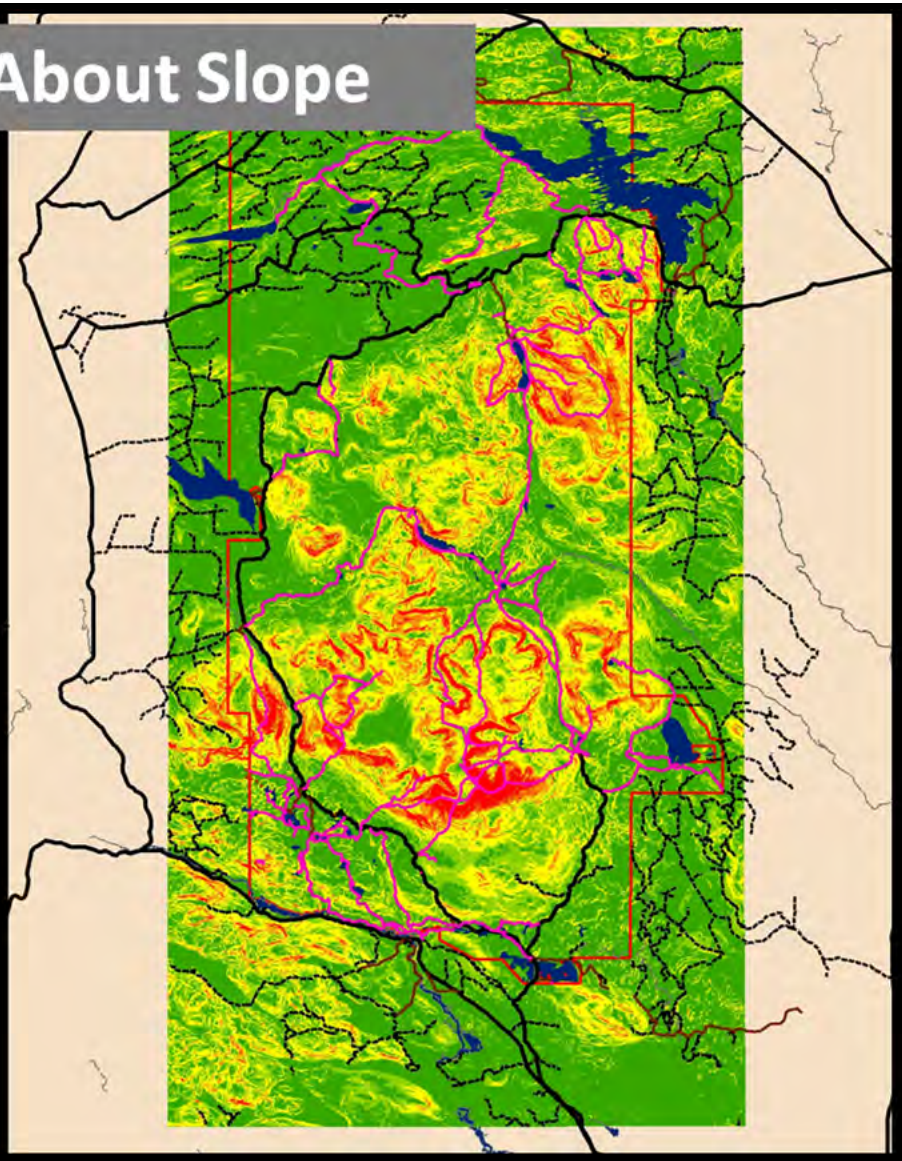
This schedule of work is comprehensive across the Park trail system. All trails are accounted for on this schedule.

A similar planning exercise for blazing work was completed for Park trails.



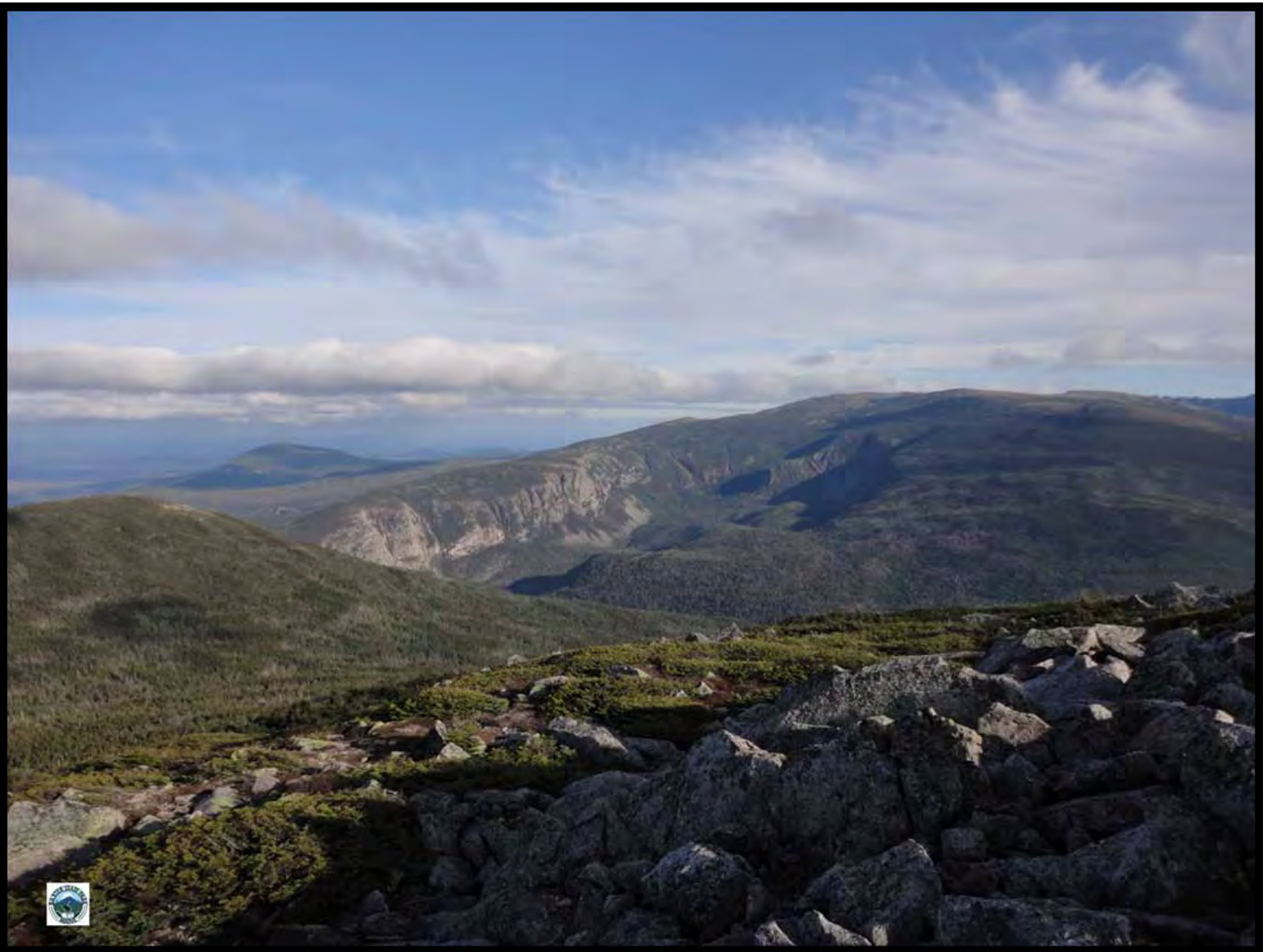
All Park trails are represented in this schedule for the renewal of trail blazes.

A Word About Slope



As we begin to examine some more complicated analysis of this dataset we need to consider the role of slope in planning trail maintenance efforts.

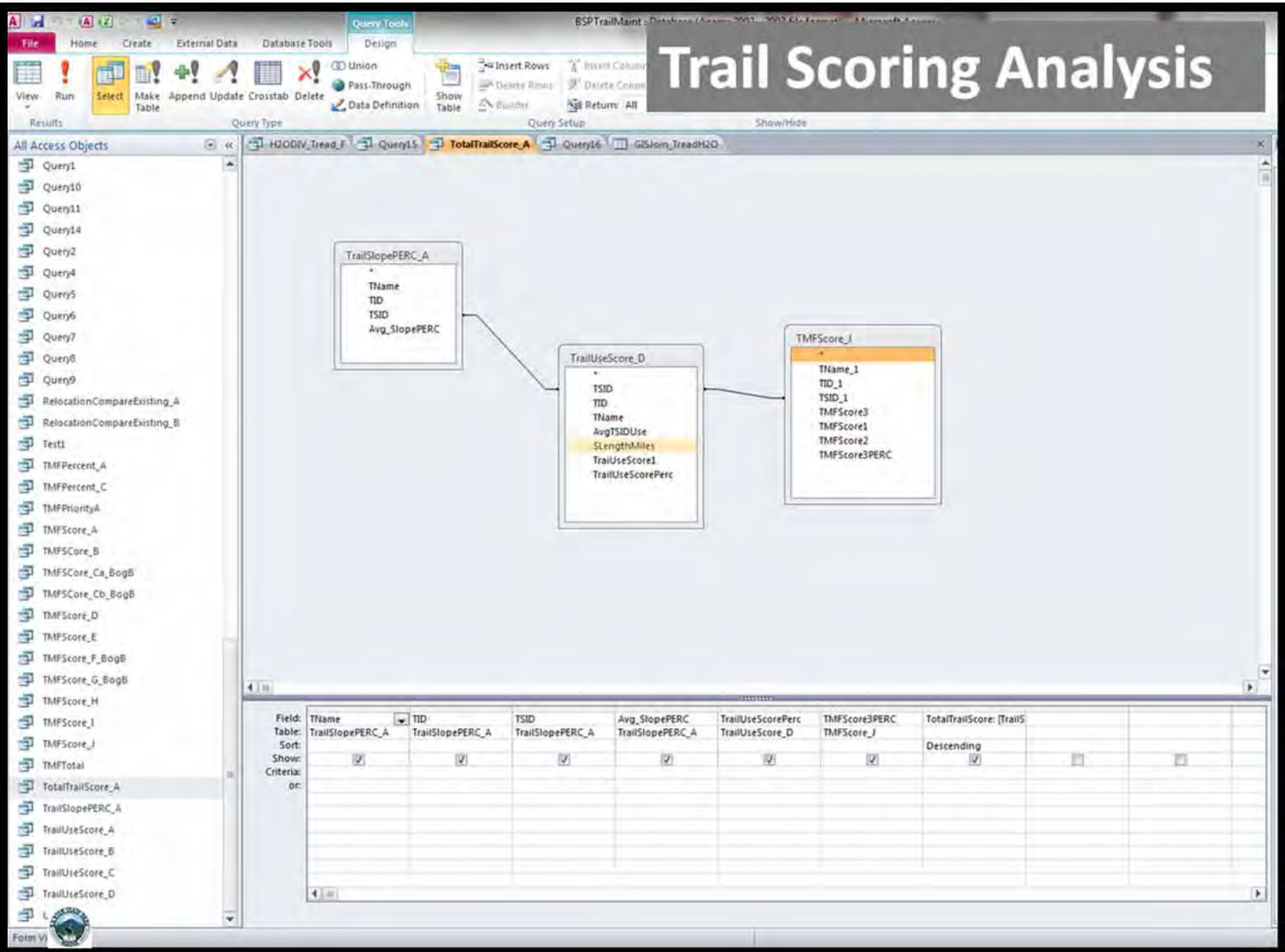
As well all know water runs down hill and is probably the most important force acting on the condition of Park trails.



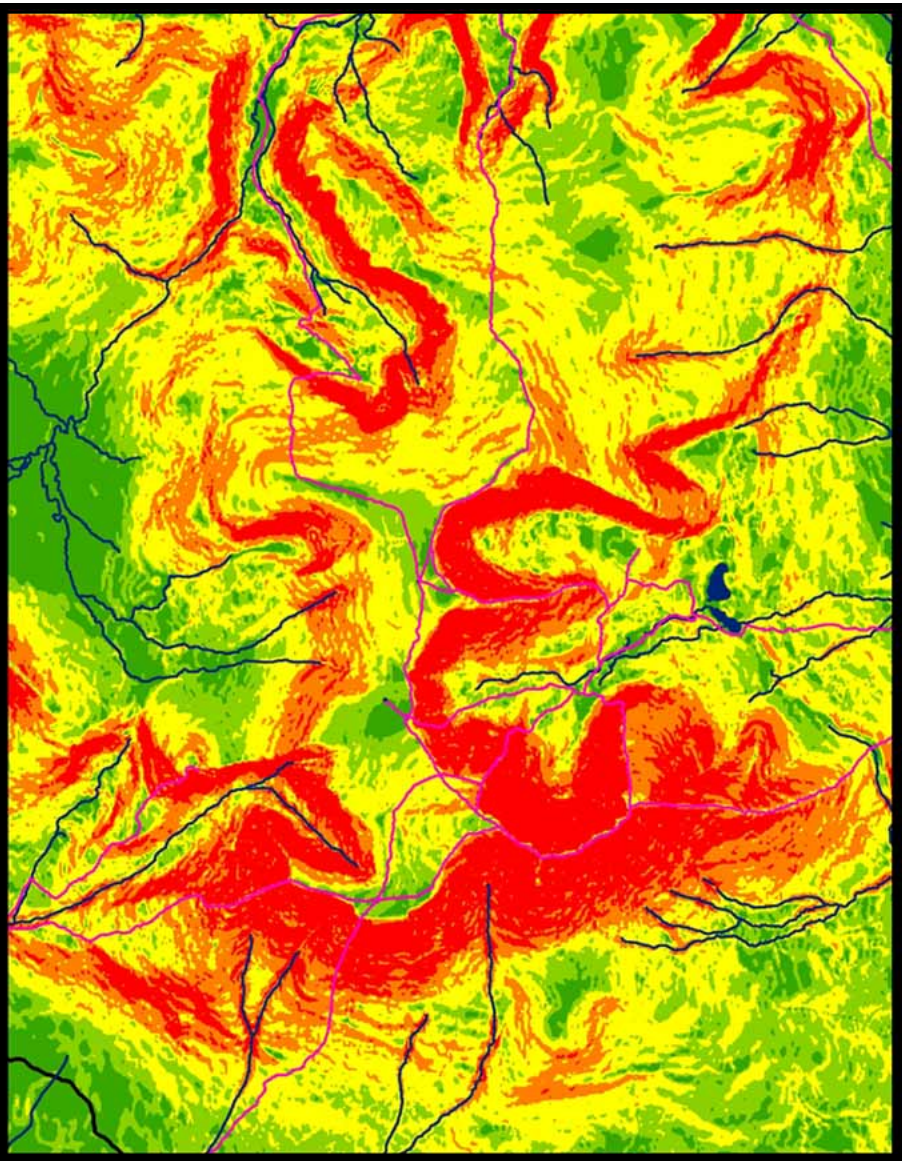
There are a lot of impressive slopes in the Park.

And there are many trails that cross these slopes.

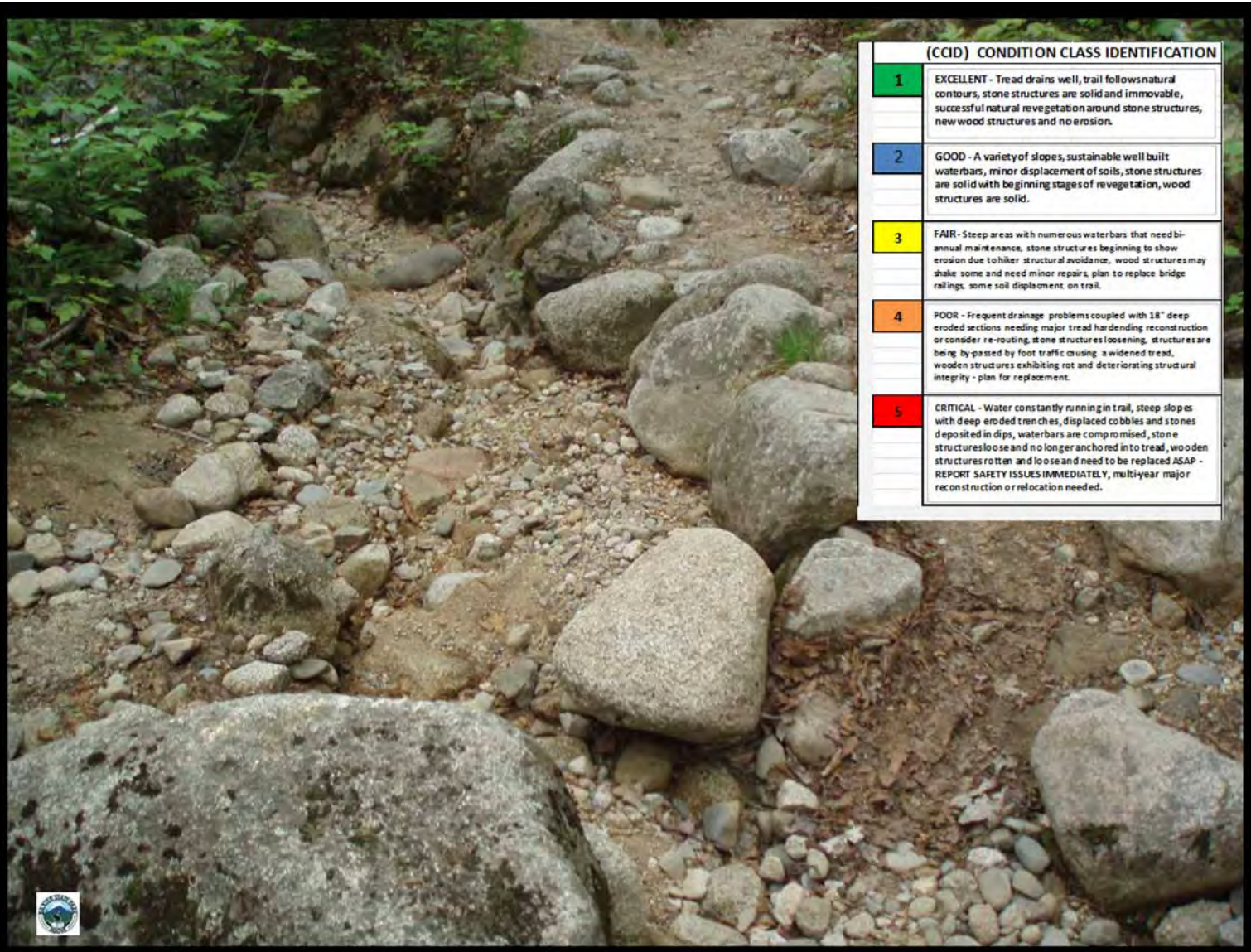
Trail Scoring Analysis



We wanted to develop a way to score all the Park trails relative to one another in order to objectively evaluate which trails require the most immediate maintenance attention. Databases enable us to integrate a variety of datasets to develop this type of scoring system.

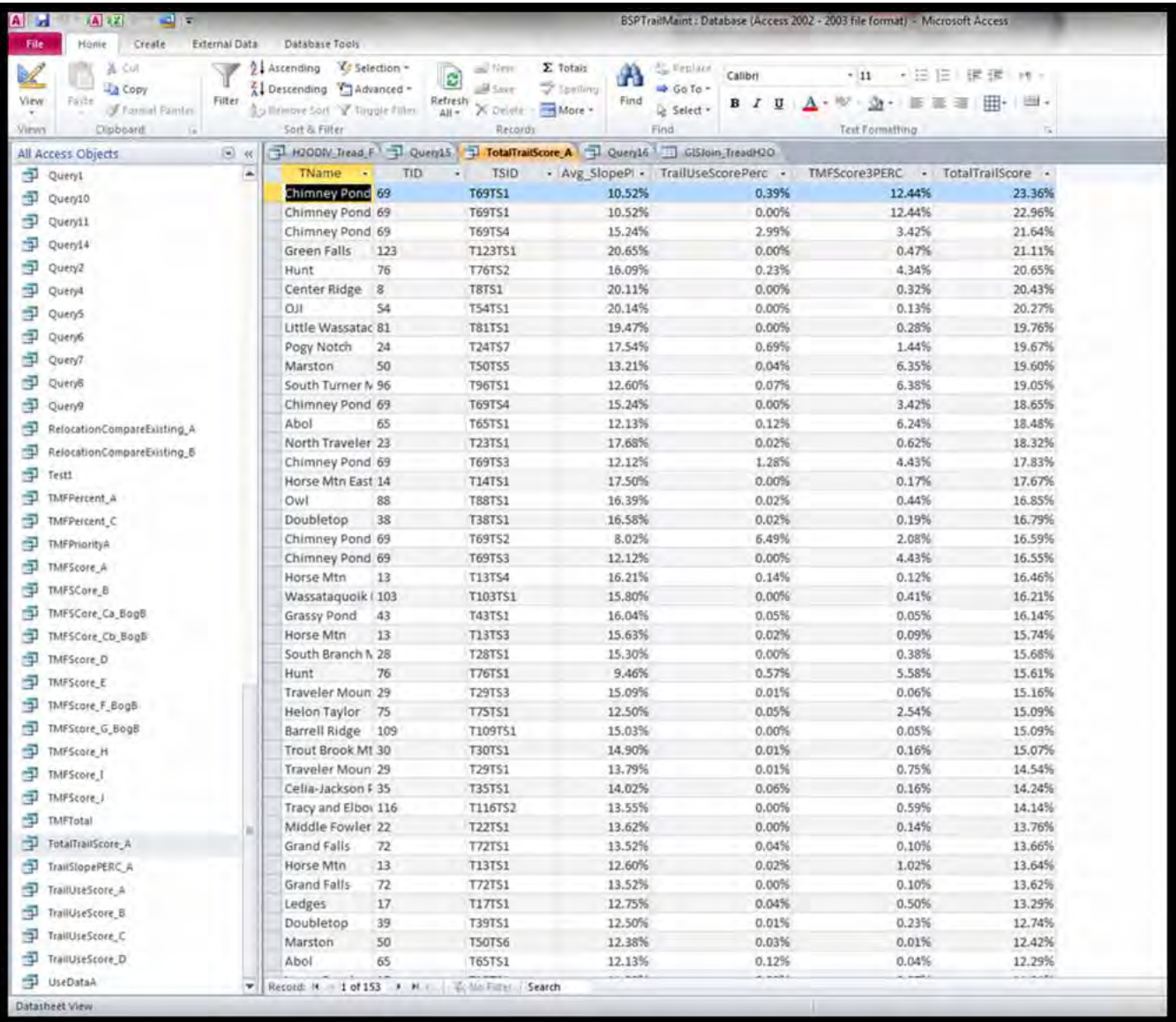


So for this analysis we used a average percent slope for each trail segment…



…The condition class for each feature, tied to a specific trail segment…

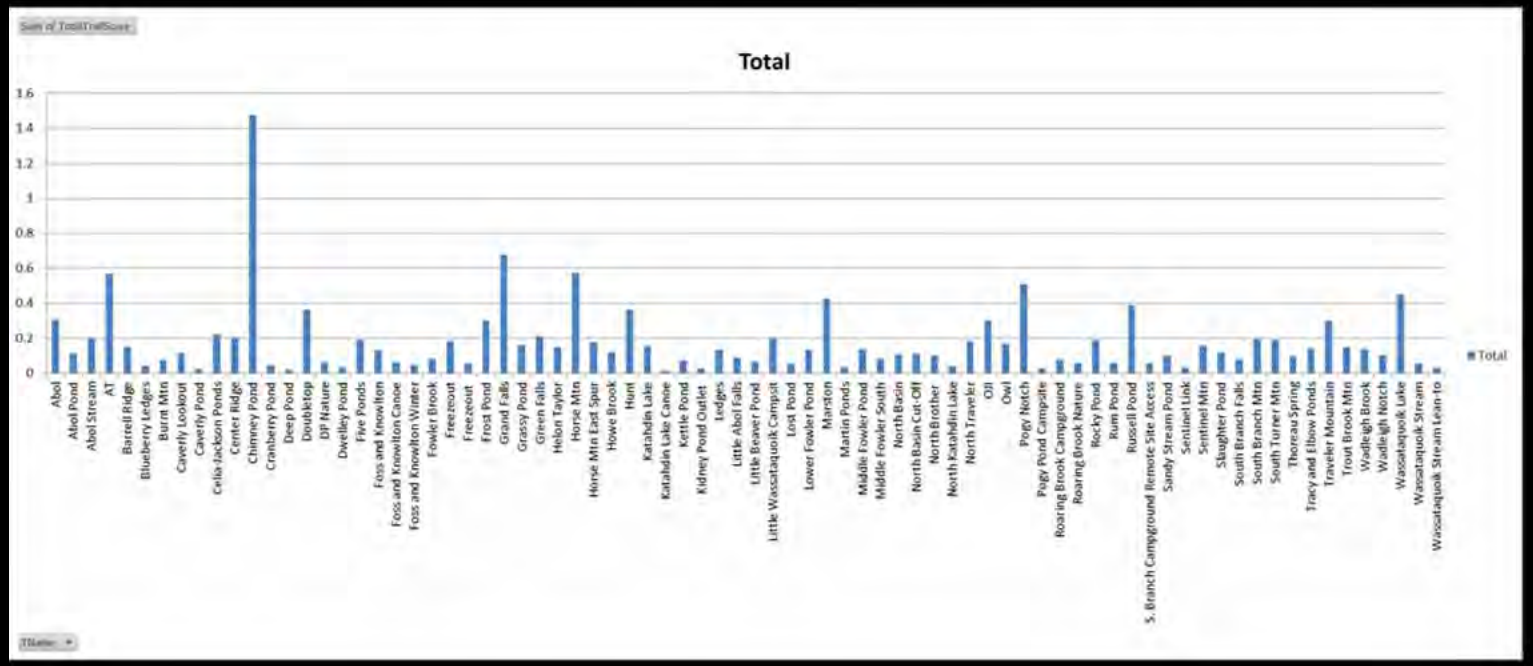
And the a measure of the specific trail use by park visitors, derived from the trailhead registries.



We combine all this factors together in the analysis and produce a big report like this one where each trail receives a score as show in the far right hand column.

Total Trail Score

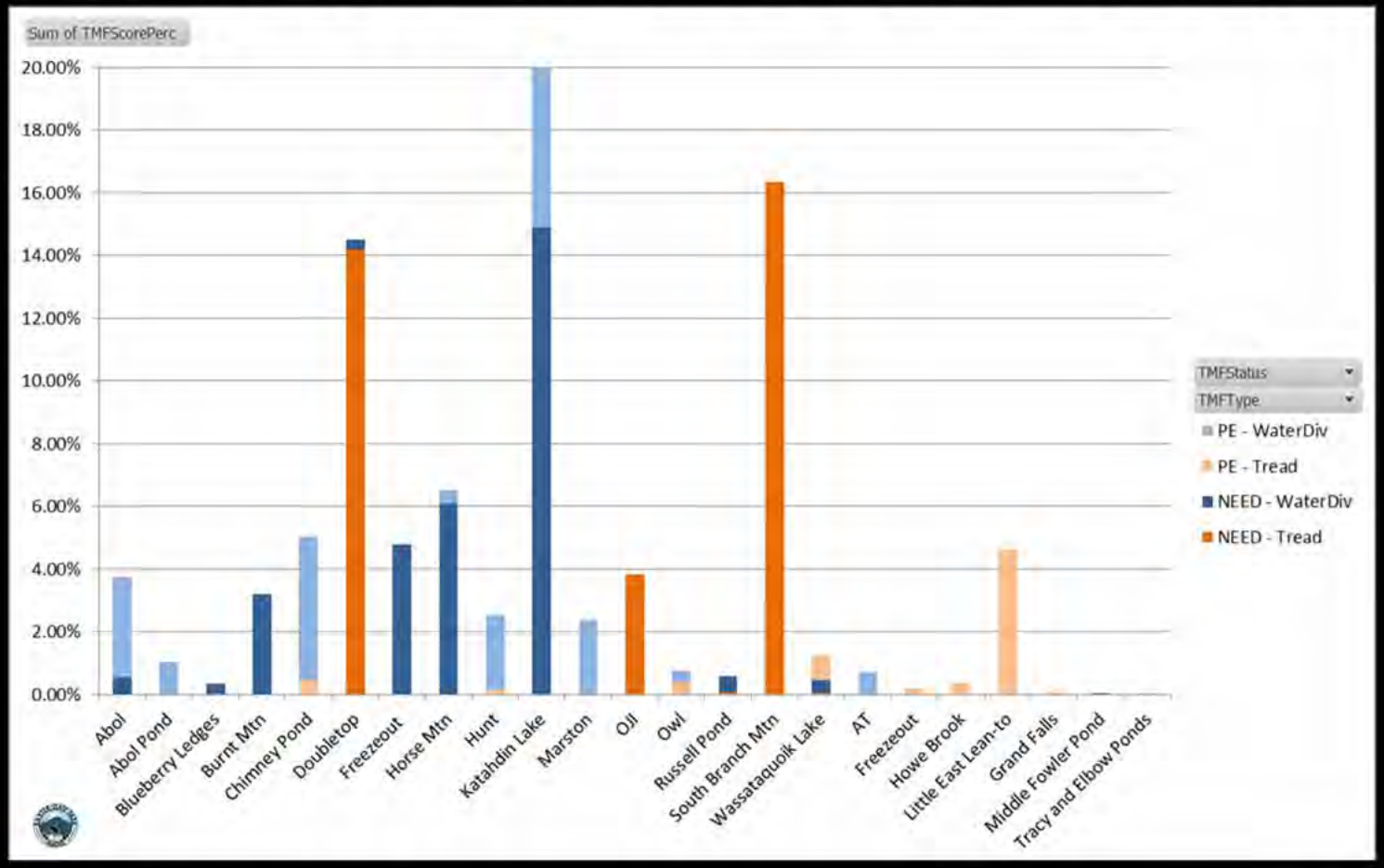
Combines: Avg slope, feature condition, & visitor use



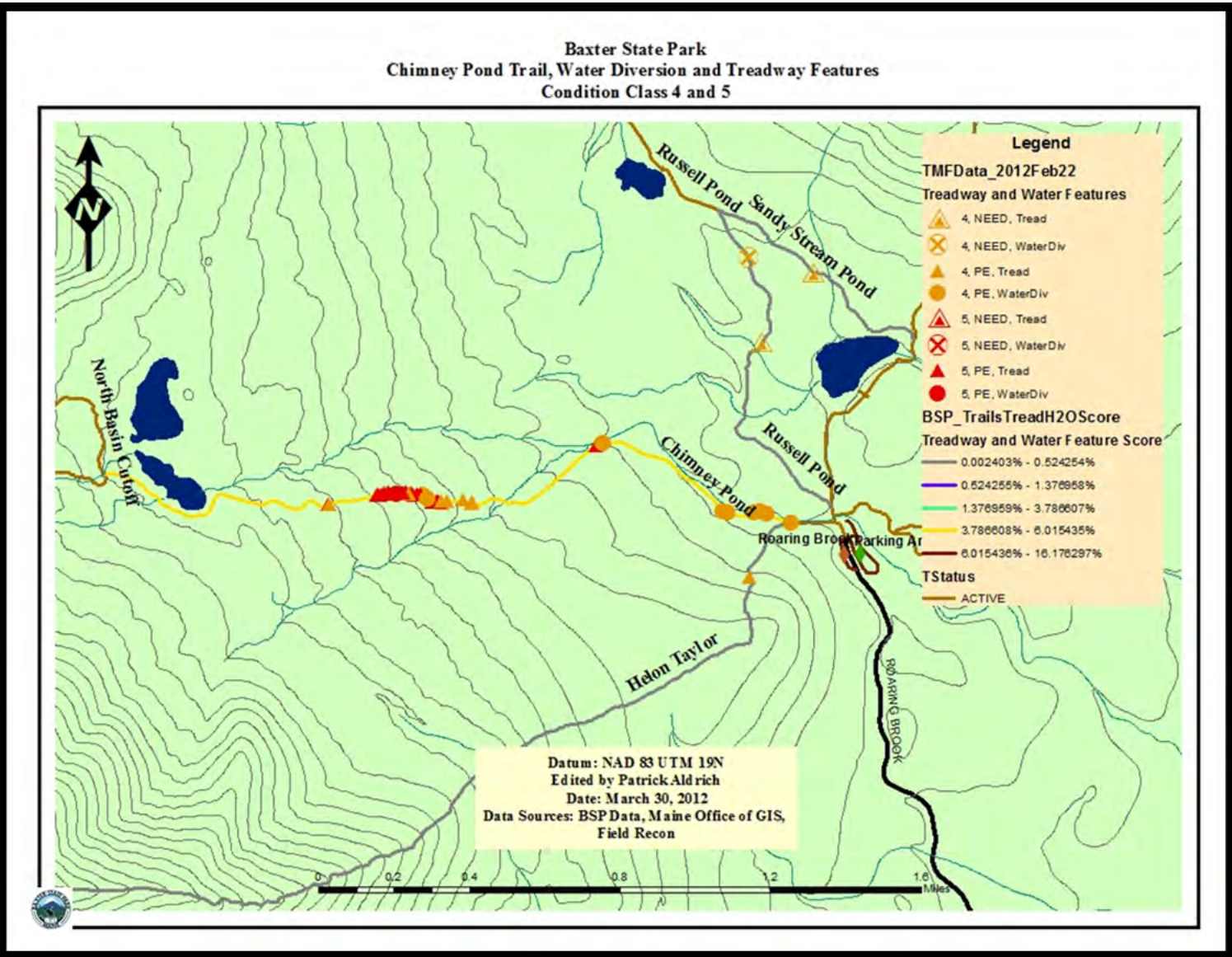
We can view these results in graph form here, with the score for all the trails represented by a blue bar. Based on this analysis the chimney Pond trail shows up as the trail with the most need. This makes sense as it receives the most use of any trail and has very high number of maintenance features and steady slope grades.

Trail Maintenance Feature Score

Focus on: Feature condition for Water Diversion & Treadway



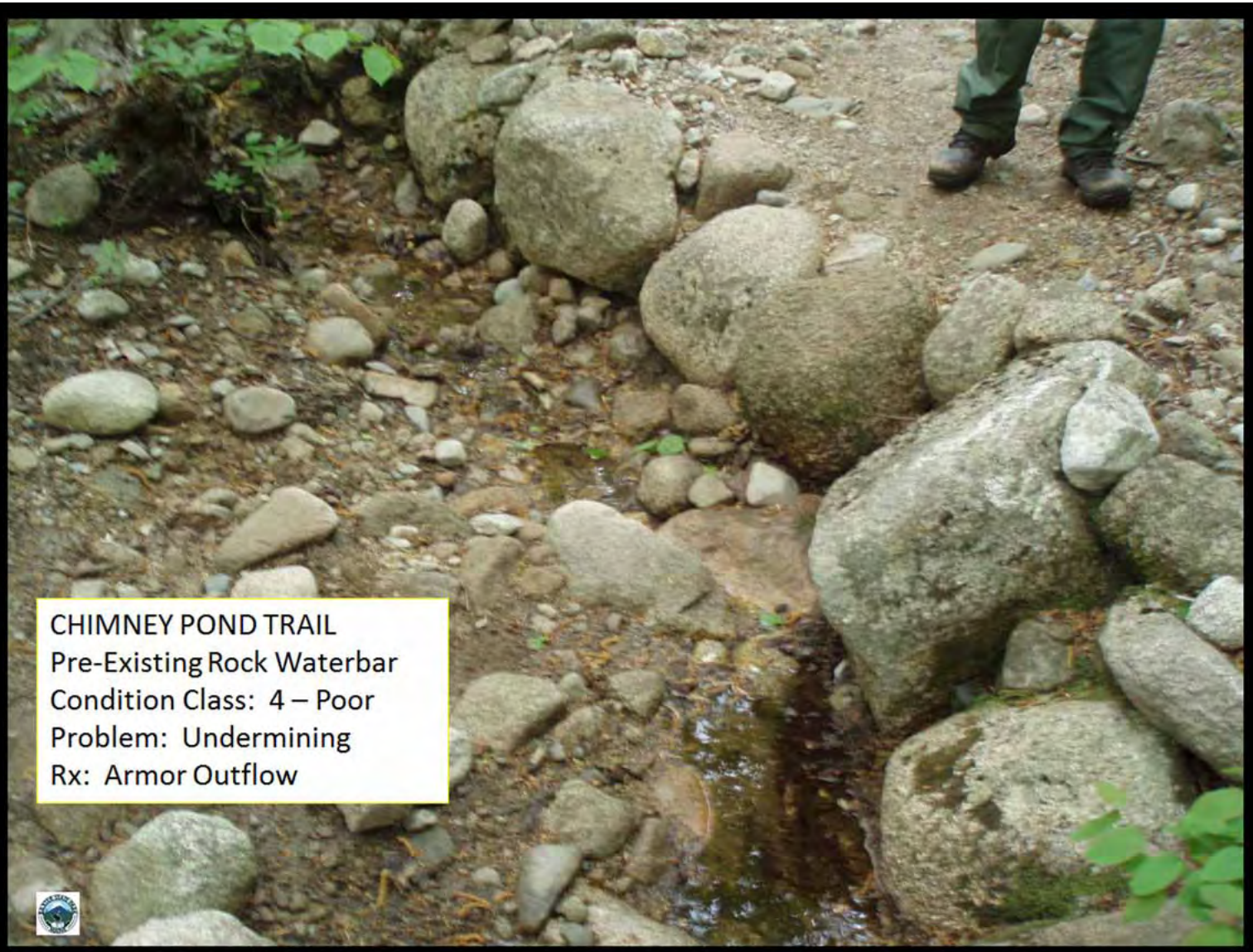
If we dig down a little deeper into the data and examine just the features in the water diversion and treadway categories a little different picture emerges. In this case the Double Top and Katahdin Lake trails show up with significant need. Also of interest are trails that we might not think about regularly but which might have maintenance needs like the Burnt Mt trail. The real value of this type of analysis is not that we end up with a prescriptive and quantified maintenance list that we can run out and implement. The value is more as an objective look at the maintenance needs that we can combine with staff knowledge and experience with the Park trails, in order to arrive at a well rounded and comprehensive maintenance plan.



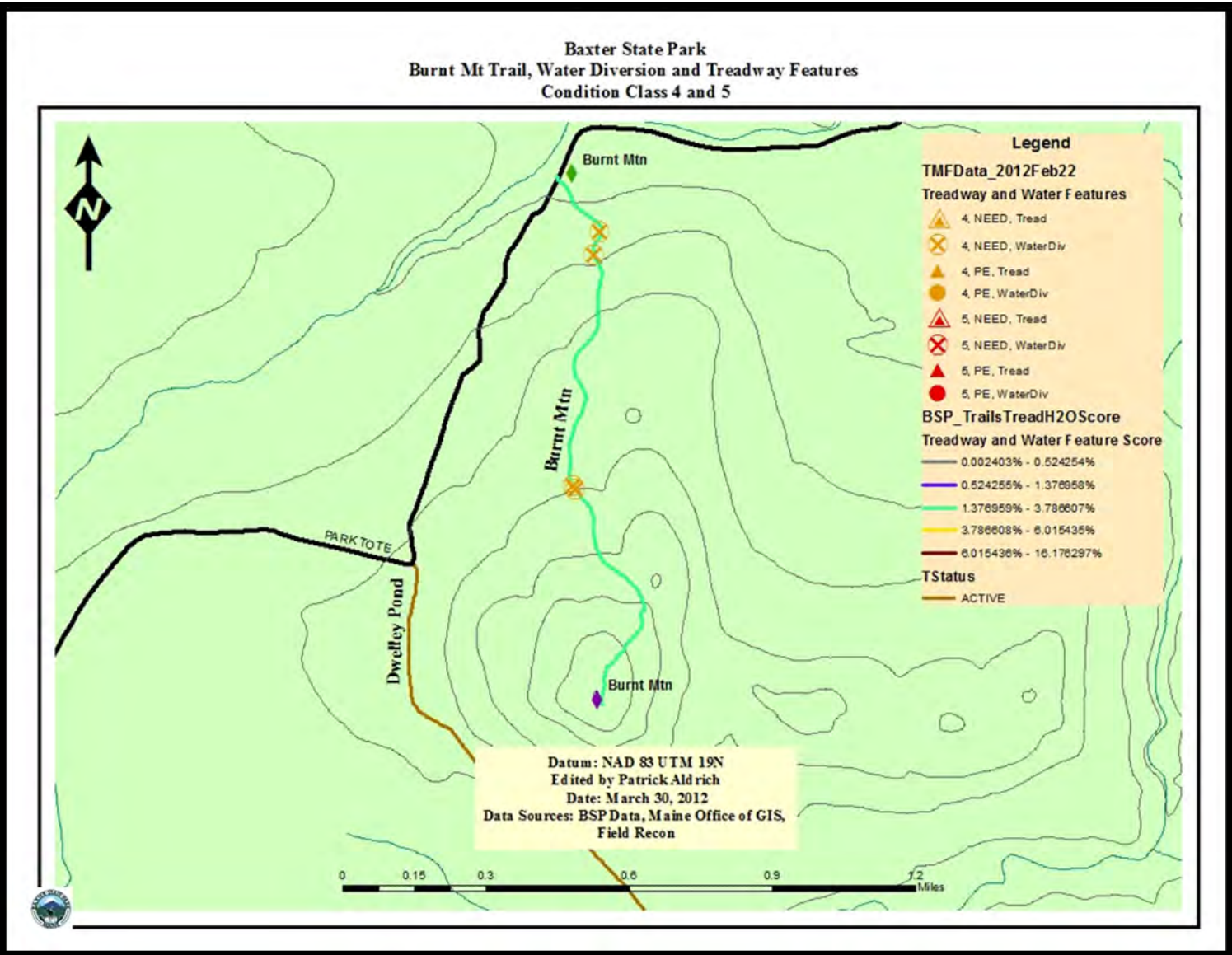
We can view these results spatial on this operational map which was produced by 2012 Intern Pat Aldrich.

TMFID	TID_1	TName_1	TSID_1	TMFCode	TMFCode2	RankbyType	CCCode	TMFStatus	TMFAction	Length	TMFCount	Slope	MatAvail
2	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
3	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
12	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
13	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
16	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
33	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
58	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
59	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	4	0	0	NA
61	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
67	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
77	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
82	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
89	69	Chimney Pond	T69TS1	WBL	WBL	1	5	PE	NA	10	0	0	NA
101	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
107	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
108	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
111	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
113	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
123	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
125	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
135	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
141	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
145	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
155	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
156	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
157	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
160	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
164	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
172	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
180	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
193	69	Chimney Pond	T69TS1	CSL	CSL	5	5	PE	NA	1	0	0	NA
202	103	Wassataquoik Lake	T103TS3	SS	SS	5	5	PE	NA	60	0	0	NA
280	103	Wassataquoik Lake	T103TS1	SHB	SHB	5	5	PE	RE	20	0	0	NA
308	15	Howe Brook	T15TS1	SHB	SHB	5	5	PE	NA	20	0	0	NA
453	77	Katahdin Lake	T77TS3	WBL	WBL	1	5	PE	RE	7	0	0	N
488	77	Katahdin Lake	T77TS3	WBL	WBL	1	5	PE	RE	12	0	0	N
541	103	Wassataquoik Lake	T103TS1	WBR	WBR	1	5	NEED	NA	0	0	0	Y
[illegible]	2	Grand Falls	T72TS4	SS	SS	5	5	PE	NA	15	0	0	NA
[illegible]	7	Katahdin Lake	T77TS3	WBL	WBL	1	5	PE	RE	18	0	0	NA

All this data is accessible in tabular format so Paul can look at individual features in the trail system.



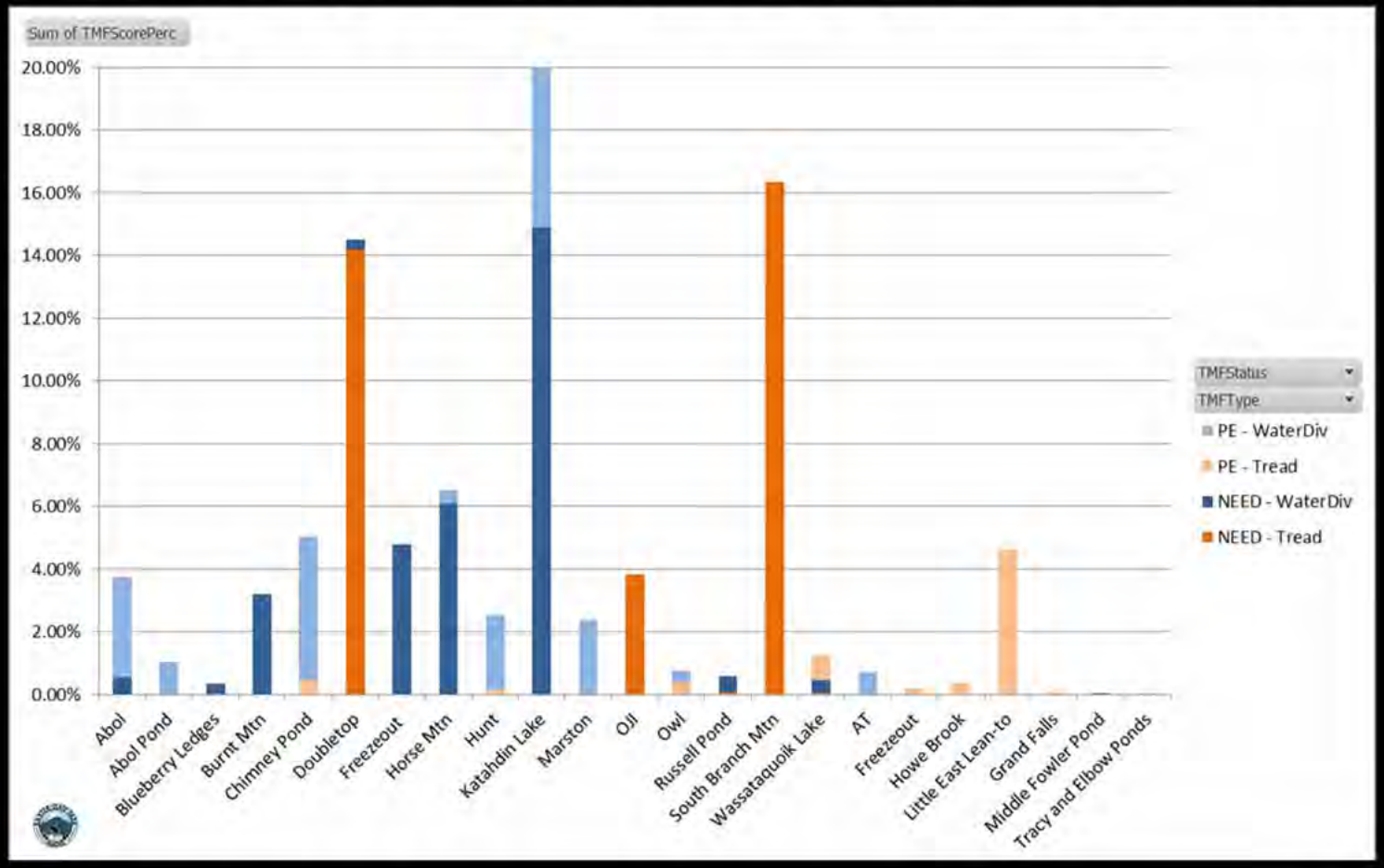
For example this rock water bar on the Chimney Pond trail, that is in poor condition. Paul can develop prescriptions for how to fix issues with this feature and then relay those to his staff in the field.



And here is a map of the Burnt Mt trail showing the features that need attention along its length.

Trail Maintenance Feature Score

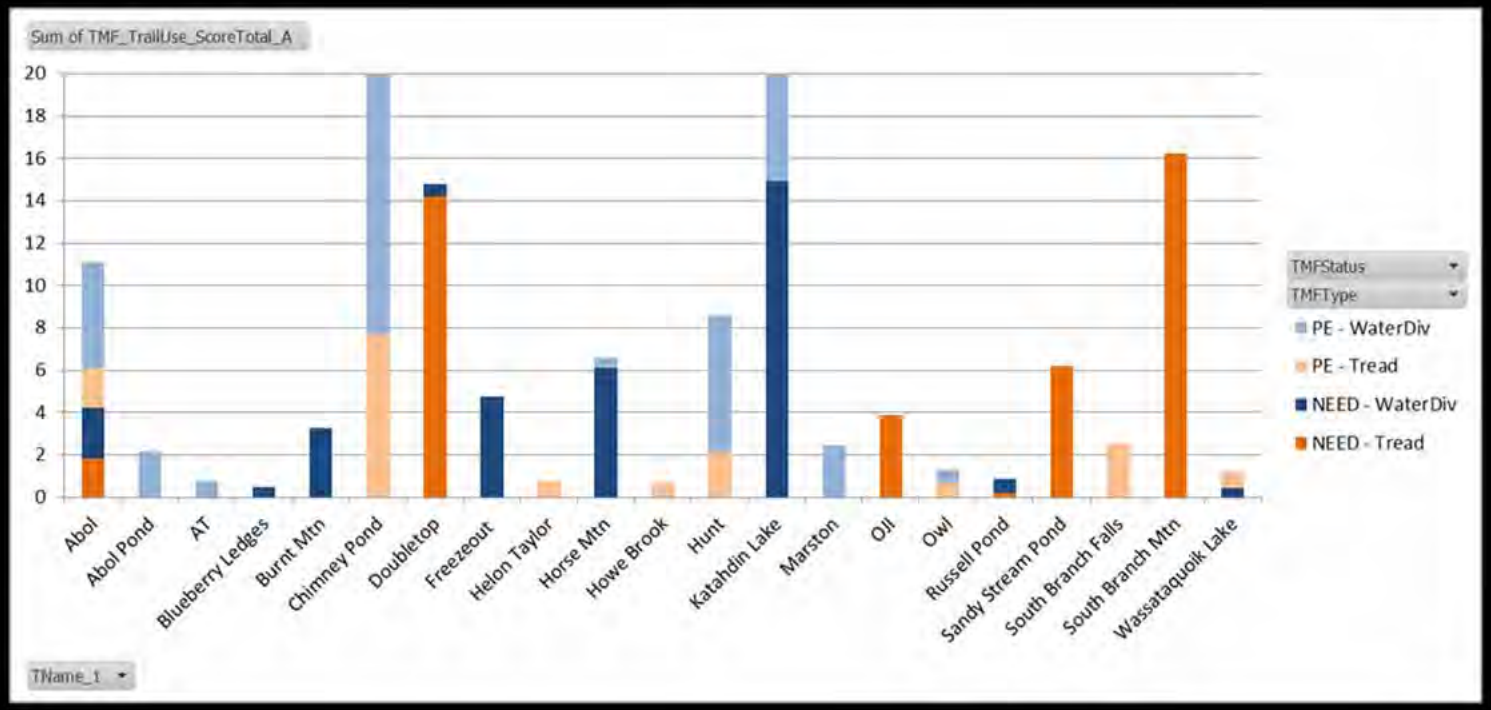
Focus on: Feature condition for Water Diversion & Treadway



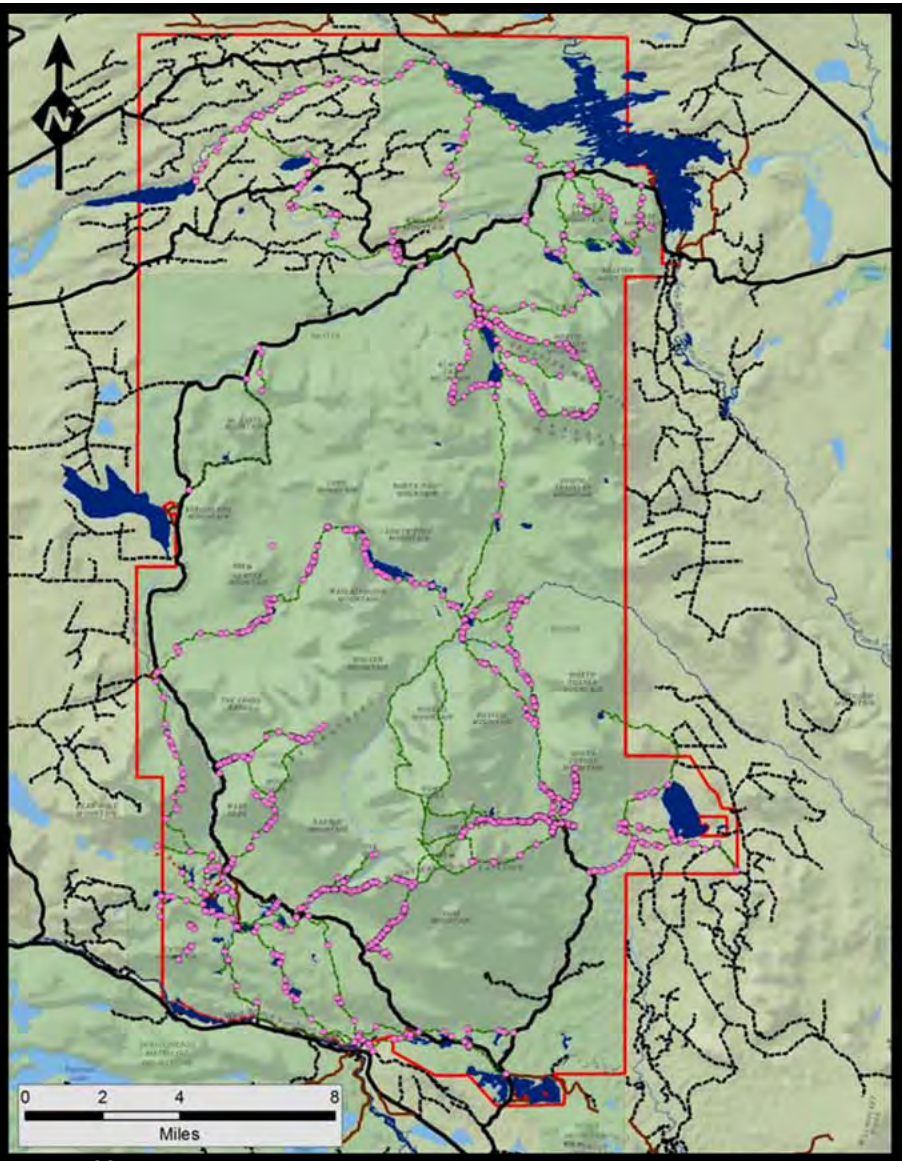
If we go back to this graph of the water diversion and treadway features and compare these results to a slight adjustment of this analysis…

Trail Maintenance Feature Score

Combines: Feature condition, & visitor use



In this case added the element of visitor use we get a slightly different result, one that reflects the level of use receive by each of these trails. Now the Chimney Pond trail rises higher on the list as does the Abol Slide trail. The point here is not that there is a single correct way to analyze these datasets and view the results. Rather there are many vantage points from which to look at the information we have about Park trails and use it to help inform our decision making about our maintenance.



As we look back at this effort it is a very impressive undertaking that has yielded important and useful products and results. This is also forms a baseline dataset upon which we can build. We anticipate continuously updating this data, so that over time Park managers will have multiple years of observations of the same features and be able to leverage that data to make even better decisions about where to spend limit resources.

The Park would like to thank the Staff who devoted significant energy to making this project a success, especially the interns Pat and Andy who logged many miles in summer heat to collect this data. And thanks to Friends of Baxter State Park who provided funds that helped support the equipment and staff time of this project.