Analysis of 2021 Trail Usage Patterns along the Great Allegheny Passage

Final Report to the Great Allegheny Passage Conservancy
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Executive Summary

- The Great Allegheny Passage is well used. I estimate the total number of visits to be in the range of 1.34 to 1.52 million in 2021, with a mid-range estimate of 1,421,042. This represents a decrease in trail use of 4.8% compared to 2020. It is worth noting that the 2020 count represented an increase of more than 50% compared to 2019. This increased trail use likely reflects the impact of COVID-19 restrictions, which has encouraged outdoor recreational activities.

- Volunteers identified "thru-riders" when conducting their synchronized counts. Based on this data, I estimate a total of 198,812 thru-riders on the GAP in 2021.

- This year's report is the seventh report since 2015, when the TRAFx locations and synchronized count protocol changed substantially. Trail use estimates have varied year-to-year since 2015, but the overall trend is an increase in trail use of approximately 11% per year.

Summary of Methodology

This report estimates trail use patterns along the Great Allegheny Passage (GAP), from Cumberland to Pittsburgh. These estimates are based on two primary data sources. The first is information gathered from TRAFx counters, infrared counters that track trail use at fixed locations along the trail. The second is information gathered from synchronized manual counts conducted at TRAFx counter locations. These counts occurred on six dates in 2021: Friday, May 27, Monday, June 21, Wednesday, July 21, Friday, August 13, Tuesday, September 14, and Wednesday, October 20. In each case, counts were conducted over a two-hour period (10-noon, 11-1, noon-2, or 1-3 pm).

I have conducted similar GAP trail use reports in previous years (2010–2013 and 2015–2021). The 2010-13 reports also relied heavily on information gathered from TRAFx counters and synchronized manual counts, but significant changes in data collection occurred in 2015. To start, three TRAFx counters were added, and several existing counters were relocated. In addition, the method for conducting synchronized counts changed substantially in 2015. Previously, synchronized counts were conducted close to trailhead locations, but the synchronized counts were moved to the TRAFx counter locations starting in 2015. **As a result of different data collection methods, trail count numbers for 2015 and later years are not directly comparable to those of previous years.**

I use the following methodology to estimate trail use along the GAP. First, I report raw TRAFx counts by location and month for March through December (Table 2). Next, I adjust these raw counts to account for the fact that the TRAFx counters typically under-count the actual number of people passing by the counters. I use the 2021 synchronized counts to derive a Count-to-Pass Factor (CP Factor) for each location (Tables 3 and 5). I then apply these CP Factors to derive adjusted TRAFx counts (Table 6) and use these adjusted TRAFx counts to derive low-, middle-, and high-range estimates of total trail use along the GAP.

TRAFx Data

In 2021, TRAFx counters collected data at 12 locations along the Great Allegheny Passage. Table 1 provides information on these counters and the data that they gathered.

Table 1: Summary of TRAFx Count Data (2021)

Location	Counter milepost	# Usable Count Days	First Date	Last Date
Cumberland	1.5	274	2-Mar	5-Dec
Frostburg	16.5	264	2-Mar	5-Dec
Deal	23.9	240	2-Mar	5-Dec
Garrett	34.5	266	2-Mar	5-Dec
Rockwood	45.5	233	2-Mar	5-Dec
Ohiopyle	69.5	213	2-Mar	5-Dec
Connellsville	85.5	271	3-Mar	2-Dec
Perryopolis	102.5	273	3-Mar	2-Dec
West Newton	111.5	266	3-Mar	2-Dec
Boston	122.5	199	16-May[1]	2-Dec
Rankin Bridge	138.3	304	3-Mar	31-Dec
Hot Metal Bridge	146.5	261	3-Mar	31-Dec

[1] The segment of the GAP adjacent to the Boston counter was closed for construction until April 30. We reinstalled the counter on May 16.

In 2021, the TRAFx counters provided a total of 3,064 usable count days, an average of 255 per counter location.

Table 2 displays counts by month (March-December) at the 12 TRAFx counter locations, with slight modifications for days in which a counter registers no data, a count of 0, or a count that is unreasonably high or low, indicating a possible malfunctioning of equipment.[2] For each counter, I calculate an average weekday and weekend count for each month.[3] On days in which a counter has missing or unreliable data, I insert the average count for that location and month.[4]

Finally, it should be noted that the counters are intentionally located away from the trailheads, sometimes as far as two miles away, in order to reduce the number of walkers included in the count. With these caveats in mind, Table 2 summarizes the raw TRAFx counts for each location by month.

Synchronized Counts

Volunteers conducted synchronized counts on six dates in 2021: Friday, May 27, Monday, June 21, Wednesday, July 21, Friday, August 13, Tuesday, September 14, and Wednesday, October 20. In each case, counts were conducted over a two-hour period (10-noon, 11-1, noon-2, or 1-3 pm).

Given 12 locations and 6 synchronized count dates, a full set of data would include 72 synchronized count observations. In fact, 71 observations occurred. The missing observation occurred at Perryopolis on September 14, when the volunteer was unable to show up.

In addition, three instances occurred in which a volunteer counted trail users, but the TRAFx counter registered 0 for the entire day (Rockwood on May 27, Ohiopyle on October 20, and Hot Metal Bridge on October 20). Furthermore, two partial counts occurred in which volunteers gathered one hour of data (rather than two). These occurred at Rankin Bridge on August 13 and Deal on September 14. Finally, a volunteer conducted a manual count at Connellsville on August 13, but that tally sheet was lost. I exclude from Table 3 any hours in which we are missing either the manual count or a reliable TRAFx count.

Table 3 summarizes the Synchronized Count and TRAFx count at each counter for each count day. The last column calculates the overall Count-to-Pass Factor (CP Factor) for each location. The CP Factor equals the manual count divided by the TRAFx count.

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[2] Despite frequent testing, the TRAFx counters can return bad data due to moisture, spider webs, insect infestations, vandalism, battery failure, or a sweatshirt hanging over the lens.

[3] I define "weekday" as Monday through Friday and "weekend" as Saturday and Sunday. I also count holidays as "weekend" days, even if they occur during the week. In 2021, I counted the following holidays as weekend days: Memorial Day, Labor Day, Thanksgiving day, and the day after Thanksgiving. July 4th was on a Sunday in 2021, so it already counted as a weekend.

[4] Specifically, I discounted the following data: Frostburg (10 days in March with unreasonably high counts), Deal (37 days of 0 counts), Garrett (8 days of 0 counts), Rockwood (41 days of 0 counts), Ohiopyle (60 days of 0 counts and 1 day in the middle of that period with a count of 1), Connellsville (2 days of 0 counts), West Newton (7 days of 0 counts), Hot Metal Bridge (43 consecutive days from October 1 – November 12, when counts were missing, 0, unreasonably low, or unreasonably high).

Table 2: Raw TRAFx Counts by Location and Month

Location	March	April	May	June	July	August	September	October	November	December	Total
Cumberland	3,394	3,477	4,228	4,353	4,862	3,719	4,709	4,364	2,675	3,573	39,354
Frostburg	1,580	2,181	2,841	2,575	2,464	2,096	2,828	2,579	1,356	922	21,421
Deal	155	502	1,256	1,271	1,023	720	1,169	841	197	315	7,450
Garrett	370	1,066	2,300	3,238	2,863	2,195	2,621	1,758	388	169	16,968
Rockwood	420	556	583	464	505	283	659	581	174	102	4,326
Ohiopyle	938	1,611	3,477	3,273	4,503	2,796	2,984	2,485	257	177	22,500
Connellsville	1,432	1,955	3,354	3,380	1,943	2,369	3,257	2,997	820	326	21,832
Perryopolis	1,212	1,427	2,014	1,643	1,612	1,197	1,980	1,374	722	248	13,429
West Newton	5,254	5,251	5,634	3,250	2,071	1,178	2,003	973	845	806	27,265
Boston	0	0	6,705	5,729	5,819	3,836	5,487	3,079	1,292	760	32,707
Rankin Bridge	7,380	8,813	12,170	10,799	10,017	7,529	9,170	6,396	2,939	2,495	77,708
Hot Metal Bridge	17,983	18,684	18,680	19,524	12,214	4,520	9,843	9,811	2,728	3,118	117,105
Total	**40,118**	**45,523**	**63,242**	**59,499**	**49,896**	**32,438**	**46,710**	**37,238**	**14,393**	**13,009**	**402,065**

Table 3: Synchronized Trail Counts (2021)

	27-May-21		21-Jun-21		21-Jul-21		13-Aug-21		14-Sep-21		20-Oct-21		Total		
Location	Man.	TRAFx	Man.	TRAFx	Man.	TRAFx	Man.	TRAFx	Man.	TRAFx	Man.	TRAFx	Man.	TRAFx	CP
Cumberland	62	24	55	15	48	14	25	29	62	14	54	49	306	145	2.110
Frostburg	37	10	33	5	45	13	33	5	43	13	62	29	253	75	3.373
Deal	41	5	36	4	46	3	47	1	20	1	77	2	267	16	16.688
Garrett	46	29	48	29	30	16	17	7	51	24	27	18	219	123	1.780
Rockwood	-----	-----	41	0	32	3	18	1	23	1	42	6	156	11	14.182
Ohiopyle	67	26	38	5	55	23	62	13	75	9	-----	-----	297	76	3.908
Connellsville	65	45	30	11	32	9	-----	-----	30	22	56	44	213	131	1.626
Perryopolis	73	19	24	3	30	11	15	5	-----	-----	23	14	165	52	3.173
West Newton	90	43	21	1	58	10	46	1	78	2	88	24	381	81	4.704
Boston	105	69	39	23	48	29	51	22	48	17	75	37	366	197	1.858
Rankin Bridge	100	84	42	27	85	65	12	8	66	46	67	46	372	276	1.348
Hot Metal Bridge	163	56	81	64	104	17	109	6	102	10	-----	-----	559	153	3.654
Total	**849**	**410**	**488**	**187**	**613**	**213**	**435**	**98**	**598**	**159**	**571**	**269**	**3,554**	**1,336**	**2.660**

Count-to-Pass (CP) Factors

By their nature, the TRAFx counters do not count trail users perfectly. For example, when cyclists ride side-by-side, follow close behind one another, or travel in a group, TRAFx counters tend to undercount the number of riders, because they do not have enough time to reset themselves between cyclists. Thus, the accuracy of a TRAFx counter declines when trail use is heavy.

To gauge the accuracy of each TRAFx counter, volunteers have conducted manual counts at the TRAFx counters for many years. These manual counts can be compared to the counts registered by the TRAFx counters during the same time period. I use this data to calculate a Count-to-Pass (CP) Factor by dividing the manual count by the TRAFx count and then use the CP Factors to derive adjusted TRAFx counts at each location. Table 4 exhibits this data for 2010-2021.[5] Note that the CP Factor in 2021 (2.660) is substantially higher than the average CP Factor since 2010 (2.034).[6]

Table 4: Historic CP Factors (2010-2021)

Year	Manual	TRAFx	CP
2010	2,564	1,524	1.682
2011	1,821	1,000	1.821
2012	882	468	1.885
2013	1,123	633	1.774
2014	NA	NA	NA
2015	2,345	1,324	1.771
2016	5,858	3,107	1.885
2017	3,169	1,593	1.989
2018	3,405	1,270	2.681
2019	4,893	2,538	1.928
2020	4,093	1,780	2.299
2021	3,554	1,336	2.660
Total	33,707	16,573	2.034

Table 5 lists the CP Factors by location for 2021. These factors range from 1.348 at Rankin Bridge to 16.688 at Deal.

[5] No manual counts were conducted in 2014.

[6] Using a t-test for difference in mean across all locations and years, the 2021 CP Factor is significantly higher, at the $\alpha = 0.01$ level, than the mean of the previous 10 years.

Table 5: CP Factors by Location (2021)

Location	Manual	TRAFx	CP Factor
Cumberland	306	145	2.110
Frostburg	253	75	3.373
Deal	267	16	16.688
Garrett	219	123	1.780
Rockwood	156	11	14.182
Ohiopyle	297	76	3.908
Connellsville	213	131	1.626
Perryopolis	165	52	3.173
West Newton	381	81	4.704
Boston	366	197	1.858
Rankin Bridge	372	276	1.348
Hot Metal Bridge	559	153	3.654
Total	3,554	1,336	2.660

Adjusted TRAFx Counts

As mentioned previously, the TRAFx counters tend to undercount trail users, particularly when cyclists ride side-by-side or in groups. For this reason, it is appropriate to apply CP Factors to the raw TRAFx counts to obtain a more accurate estimate of actual trail use.

Table 6 lists the adjusted TRAFx counts by location and month after applying the CP Factors. For the months of March through December, each count listed in Table 6 equals the corresponding count in Table 2 multiplied by the CP Factor for each location. For example, Cumberland's CP Factor is 2.110, and its raw count for March (listed in Table 2) is 3,394. Thus, the adjusted count for Cumberland in March in Table 6 is 7,162 = (2.110) x (3,394). All other counts listed for March through December in Table 6 are calculated in a similar manner.

Staff from the Great Allegheny Passage Conservancy remove the TRAFx counters each winter to prevent damage from freeze-thaw cycles and, therefore, they do not operate during the months of January and February. I estimated trail use for these months by assuming total trail use at all locations is 1,200. This is the same assumption that I have made for several years in this report. I then allocate the trail use at each location according to the patterns observed during the March-December period. For example, during the months of March through December, Cumberland accounted for 6.5% of total trail use. So for January and February, I estimate trail use at Cumberland as 6.5% of 1,200, which is 78. I do a similar calculation for all 12 locations.

Table 6 reports total adjusted trail use in 2021 as 1,136,833. This represents a 4.8% decrease compared to 2020, when total adjusted trail use was at 1,193,570. It is worth noting that trail increased by more than 50% in 2020 compared to 2019, presumably due to COVID-19 and the increased popularity of outdoor activities.

Interpreting the Adjusted TRAFx Counts

The adjusted TRAFx counts in Table 6 are derived by multiplying the raw TRAFx counts by the CP Factor for each location. As such, the adjusted TRAFx counts are a best estimate of the number of times a trail user passes a TRAFx counter. Moreover, the adjusted TRAFx counts at any location also represents a reasonable estimate of trail usage by those who enter at the trailhead closest to that counter.

Consider, for example, Ohiopyle. The TRAFx counter is located a couple miles down the trail toward Confluence. A rider traveling from Ohiopyle to Confluence and back will pass the counter twice, and the adjusted TRAFx count would, on average, double-count this trail user. But other trail users at Ohiopyle will go the opposite direction, toward Connellsville. These trail users will not pass the TRAFx counter at Ohiopyle. Some might be counted by the Connellsville counter, but some will not be counted by any TRAFx counter. In addition, most walkers who enter at Ohiopyle will not pass a TRAFx counter, even if they walk toward Confluence. As a result, we must balance those trail users who will double-counted with those who are not counted at all. It seems reasonable to assume that these two groups are roughly equal. If this is the case, then the adjusted TRAFx count provides a good estimate of trail usage at Ohiopyle.

Given the data available, I view the last column of Table 6 as the best estimate of 2021 trail use at each of the trailheads listed. These estimates will be better for some locations than others depending on how far the TRAFx counter is from the trailhead and the proportion of trail users who go in the direction toward the counter. These two factors vary between trailheads, so the estimates in Table 6 likely overestimate trail use at some trailheads and underestimate at others.

Total Trail Use Estimate

The bottom row of Table 6 estimates that trail users passed by the 12 TRAFx counter locations a total of 1,136,833 times. As I have argued above, this number is a reasonable estimate of the number of trail usage by those who enter the trail at the trailheads closest to the TRAFx counters. But these 12 locations are not the only places where users may enter the trail. As such, this number likely *underestimates* total trail use.

The locations of the TRAFx counters were chosen to capture as many as possible while minimizing the occurrence of trail users passing multiple counters on a single trip. I will assume as a midpoint estimate that 80% of trail visits begin at the trailheads closest to the TRAFx counters, with a range of 75% to 85%.[7] Put another way, I estimate that somewhere between 15% and 25% of trail visits begin at a trailhead other than the 12 trailhead locations where TRAFx counters are located.

If we assume the midpoint estimate of 80%, then the resulting mid-range estimate of total trail use is 1,421,042 = (1,136,833 ÷ 0.80). The low-range and high-range estimates are 1,337,451 = (1,136,833 ÷ 0.85) and 1,515,778 = (1,136,833 ÷ 0.75), respectively. I estimate that trail use along the GAP decreased by 4.8% between 2020 and 2021.

[7] These estimates are based on input and estimates by the Great Allegheny Passage Conservancy.

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Table 6: Adjusted Monthly TRAFx Counts (2021)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Cumberland	87	87	7,162	7,338	8,923	9,186	10,260	7,848	9,938	9,210	5,645	2,660	**78,345**
Frostburg	80	80	5,329	7,357	9,584	8,686	8,312	7,071	9,540	8,700	4,574	2,415	**71,728**
Deal[8]	39	39	3,160	3,237	3,937	4,053	4,527	3,463	4,384	4,063	2,491	1,174	**34,566**
Garrett	35	35	658	1,898	4,095	5,765	5,098	3,908	4,667	3,130	692	1,032	**31,012**
Rockwood[8]	26	26	2,096	2,147	2,611	2,688	3,003	2,297	2,908	2,695	1,652	779	**22,927**
Ohiopyle	101	101	3,665	6,296	13,588	12,791	17,597	10,926	11,660	9,711	1,003	2,757	**90,195**
Connellsville	45	45	2,578	3,519	6,037	6,084	3,497	4,264	5,863	5,395	1,476	1,316	**40,118**
Perryopolis	48	48	3,847	4,528	6,391	5,213	5,115	3,798	6,283	4,360	2,291	1,431	**43,354**
West Newton	144	144	24,714	24,699	26,501	15,287	9,741	5,541	9,422	4,576	3,975	4,171	**128,915**
Boston	0	0	0	0	12,457	10,644	10,811	7,127	10,194	5,720	2,400	2,540	**61,893**
Rankin Bridge	117	117	9,947	11,878	16,403	14,555	13,501	10,148	12,360	8,621	3,961	3,363	**104,971**
Hot Metal Bridge	479	479	65,702	68,264	68,249	71,333	44,625	16,514	35,962	35,847	9,965	11,392	**428,811**
Total	1,200	1,200	128,859	141,161	178,774	166,286	136,087	82,905	123,179	102,028	40,125	35,029	**1,136,833**

[8] As shown in Table 5, the 2021 CP Factors for Deal and Rockwood were extraordinarily high (16.688 and 14.182, respectively), suggesting that the TRAFx counters at these locations were not functioning properly. Applying these CP Factors to the Raw TRAFx counts in Table 2 yielded Adjusted Counts in Table 6 that were roughly 3 times higher at Deal and Rockwood than historical data would suggest. For this reason, I benchmarked the Deal and Rockwood in Table 6 to the Cumberland counts based on historical patterns.

Thru-Riders

The GAP offers the opportunity for cyclists to take lengthy, multi-day trips. Starting in 2018, the form that volunteers use to tally synchronized manual counts has included a section to mark "thru-riders." The Great Allegheny Passage Conservancy asked volunteers to use their judgment to determine whether a passing cyclist was on an extended ride, and provided examples, such as a cyclist riding with a substantial pack, one with two loaded panniers, or one carrying camping gear might be a thru-rider. Some volunteers take initiative to ask cyclists as they pass by.

Table 7 summarizes the number of riders identified as a thru-rider during manual counts for the years 2018-2021 and calculates a percentage of thru-riders relative to the total number of trail users. The data is broken down by weekday manual counts (Mon-Fri) versus weekend manual counts (Sat and Sun).

Table 7: Thru Riders Compared to All Users, Weekday and Weekend (2018-2021)
Calculated by Volunteer Judgment

	Weekday			Weekend		
Year	**Thru**	**Total**	**% Thru**	**Thru**	**Total**	**% Thru**
2018	121	783	15.5%	334	2,622	12.7%
2019	162	831	19.5%	208	4,064	5.1%
2020	351	2,918	12.0%	166	1,437	11.6%
2021	848	3,779	22.4%	NA	NA	NA
Total	1,482	8,311	17.8%	708	8,123	8.7%

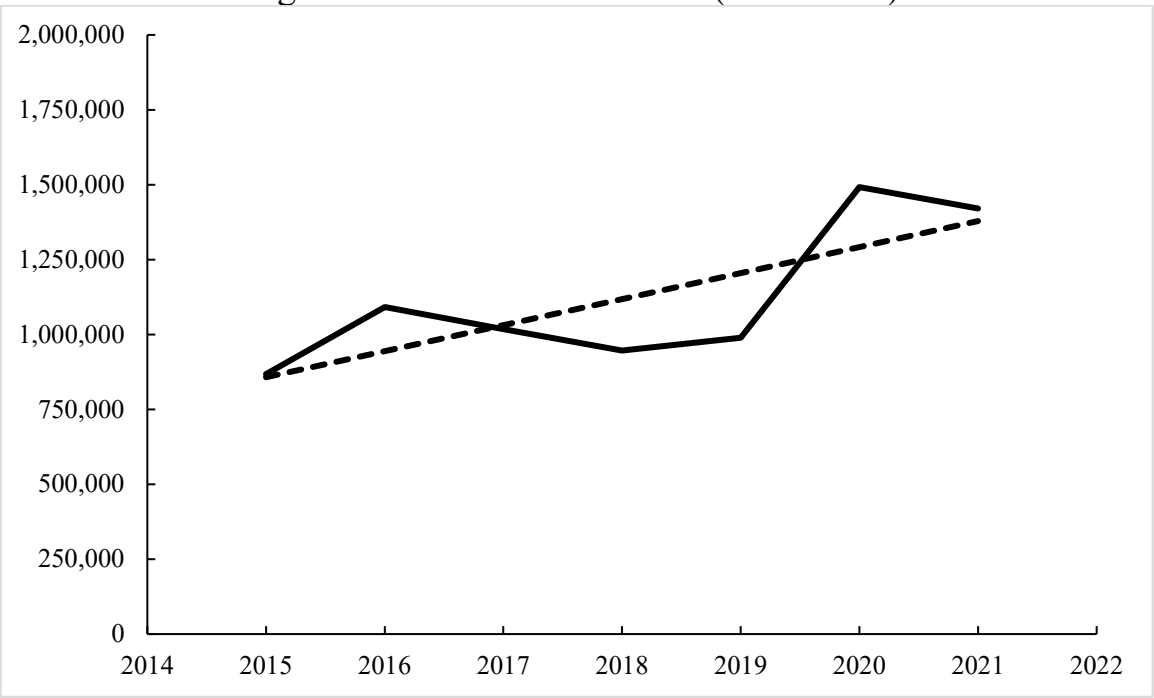
The data in Table 7 show that the percentage of thru riders is approximately twice as large during the week as compared to the weekend. This makes intuitive sense. By definition, thru-riders have set aside several days for their long trek. In contrast, day riders would more likely use the trail before work, after work, or on the weekend. So it is reasonable to assume that weekday manual counts conducted in the middle of the day would count a higher percentage of thru riders than weekend counts.

The mid-range estimate of total trail use is 1,421,042 for 2021. The raw TRAFx count data indicates that 57.9% of trail use occurs during the week and 42.1% on the weekend. This implies that the total trail in 2021 breaks down to 822,248 (57.9% of 1,421,042) during the week and 598,794 (42.1% of 1,421,042) during the weekend. Applying the thru riders percentages from Table 7 (17.8% weekday and 8.7% weekend) to these numbers yields an estimate of 146,621 thru riders during the weekdays and 58,054 on the weekends, for a total estimate of 198,812 for 2021.

Historical Perspective

This year's report is the seventh report since 2015, when the TRAFx locations and synchronized count protocol changed substantially. Given this, it worth looking back over the past five years for trends in GAP trail use.

Figure 1: Total GAP Trail Use (2015-2021)



Year	Total Trail Use
2015	867,719
2016	1,091,706
2017	1,017,662
2018	946,284
2019	989,455
2020	1,491,963
2021	1,421,042

Figure 1 shows the mid-range total trail use estimate for 2015-2021 along with a linear trendline. Clearly, trail use estimates have varied considerably year-to-year. Some of the fluctuation is likely due to fluctuations in the quality of data generated by the TRAFx counters, and some is likely due to true year-to-year fluctuations caused by factors such as the weather. The dramatic increase in trail use since 2019 undoubtedly reflects the impact of the COVID-19 pandemic combined, which has encouraged people to engage in outdoor recreational activities. Overall, the linear trendline shows an increase in trail use of approximately 11% per year from 2015-2021.