Analysis of 2017 Trail Usage Patterns along the Great Allegheny Passage

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Executive Summary

- The Great Allegheny Passage trail system is well-used. I estimate the total number of trail visits to be in the range of 957,800 to 1,085,507 in 2017, with a mid-range estimate of 1,017,662. I estimate that overall trail use decreased by 7% between 2016 and 2017.

- The quality and quantity of trail use data collected was lower in 2017 than in 2016. The 2017 data include a total of 2,381 usable count days compared to 3,126 in 2016, a 24% decrease. In addition, the TrafX counters were considerably less reliable in 2017, with a total of 178 days of missing or "bad" days of TrafX counts in 2017. In 2016, there were only 38 such days. Finally, the number of usable synchronized count observations decreased by 29% from 72 observations in 2016 to 51 in 2017. The decrease in the quality and quantity of data collection in 2017 reduces the reliability of the trail use estimate.

- The 7% decrease in estimated trail use is driven by a large decrease in the count at the Hot Metal Bridge. Specifically, my estimate of trail use at Hot Metal bridge decreased by 38% in 2017 compared to 2016. Of the other 11 locations, 9 showed an increase in trail use between 2016 and 2017. Together, the 11 locations other than the Hot Metal Bridge showed an increase in trail use of 14%. This data suggests that trail use may very well have increased between 2016 and 2017.

- I recommend making every reasonable effort to gather the data in a consistent manner from year to year. Specifically, this would mean keeping the TrafX locations the same from year to year and continuing to conduct the synchronized counts at the TrafX locations.

- I also recommend collecting as much data as possible. With regard to the TrafX counters, this would mean setting up each counter in early March in order to provide a more complete set of TrafX data. With regard to the synchronized counts, this would mean making every effort to conduct counts at every location on each count date.

- Finally, I recommend that at least two of the synchronized counts be conducted on a weekend day (Saturday and/or Sunday). In 2017, only one synchronized count was conducted on a weekend day.

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 synchronized counts occurred on five dates in 2017: Tuesday, May 30, Monday, June 26, Thursday, July 20, Sunday, August 20, and Friday, September 15. In each case, these counts were conducted over a two-hour period (10-noon, 11-1, or noon-2).

I have conducted similar GAP trail use reports in previous years (2010, 2011, 2012, 2013, 2015, and 2016). 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. In addition, synchronized counts are now conducted at fewer locations (12 locations starting in 2015 versus 18 in prior to 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 2017 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 high-, middle-, and low-range estimates of total trail use along the GAP.

TrafX Data

In 2017, 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.[1]

The quantity and quality of count data declined between 2016 and 2017. The 2017 data include a total of 2,381 usable count days compared to 3,126 in 2016, a 24% decrease. This decrease is due to two factors. First, the TrafX counts started later in 2017. In 2016, all TrafX counters began operating in March. In 2017, only 8 of the 12 counters operated in March and those that did start counting in March started later in the month. Similarly, the 2017 data included fewer count days in December. As a result, I only consider TrafX count data for April through November, compared to March through December in 2016.[2] Second, the counters were considerably less reliable in 2017. Specifically, there were a total of 178 days of missing or "bad" days of TrafX counts in 2017. In 2016, there were only 38 such days.

The TrafX counters at Cumberland and Ohiopyle did not begin registering counts until July 19 and July 18, respectively. This was due to a mechanical failure of the dock, which made earlier data from these counters irretrievable.

[1] The milepost locations of the TrafX counters were provided by David Cotton in an email dated June 2, 2016.
[2] In Table 2, I list raw 2017 TrafX counts for March through December. I estimate the March and December counts using proportions from the 2016 data.

Table 1: Summary of TrafX Count Data (2017)

Location	Counter milepost	# Usable Count Days	First Date	Last Date
Cumberland	1.5	135	19-Jul	30-Nov
Frostburg	16.5	244	1-Apr	30-Nov
Deal	22.5	244	1-Apr	30-Nov
Garrett	34.5	221	1-Apr	28-Nov
Rockwood	45.5	142	1-Apr	20-Sep
Ohiopyle	69.0	136	18-Jul	30-Nov
Connellsville	85.0	241	1-Apr	30-Nov
Perryopolis	102.0	155	1-Apr	30-Nov
West Newton	111.5	210	5-May	30-Nov
Boston	122.0	244	1-Apr	30-Nov
Rankin Bridge	138.0	211	1-Apr	30-Nov
Hot Metal Bridge	146.0	198	16-May	30-Nov

Table 2 displays counts by month (March-December) at the 12 TrafX counter locations. The April through November counts are derived from the TrafX counts, with slight modifications for days in which a counter registers no data or registers a count that is unreasonably high or low. For each counter, I calculate an average weekday and weekend count for each month.[3] On days in which a counter has missing or "bad" data, I insert the average count for that location and month. Specifically, I interpolated counts in this manner for 21 days at Garrett, 31 days at Rockwood, 3 days at Connellsville, 89 days at Perryopolis, 33 days at Rankin Bridge, and 1 day at Hot Metal Bridge.

Because the 2017 TrafX counts for March and December were so sparse, I did not believe that I could make accurate count estimates for these months using TrafX. Instead, I used 2016 data to calculate estimates for these months. Specifically, I calculated the ratio of the 2016 March (and December) count for each location to the April through November count and then applied this fraction to the 2017 April through November count. Consider Boston, for example. Its 2016 TrafX counts were 2,620 in March, 352 in December, and a total of 36,485 for April through November. Its 2017 total TrafX count for April through November was 35,373. Using these numbers, I calculated Boston's March 2017 count as 2,540 = (2,620/36,485) x (35,373), and its December 2017 count as 342 = (352/36,485) x (35,373).

Furthermore, five TrafX counters (Cumberland, Rockwood, Ohiopyle, West Newton, and Hot Metal Bridge) produced no usable data for one or more entire month during the April-November period. Consider Cumberland, which had no usable data for April, May, and June. I sum the TrafX counts for Cumberland for the months in which it did have good data (July through November). This total is 23,939. I then sum the TrafX counts for a reference group of the seven TrafX counters that had usable data for all seven months. This total is 13,168. I take the ratio of the Cumberland total and the reference group total, which is 1.818 = (23,939/13,168). I apply this ratio to the reference group TrafX counts for the months that Cumberland is missing data (April, May, and June). These counts are 2,725 (April), 2,803 (May), and 3,430 (June). So Cumberland's estimated counts are 4,954 = (2,725 x 1.818) for April, 5,096 = (2,803 x 1.818) for May, and 6,236 = (3,430 x 1.818) for June. I used the same method for the other locations that had no usable data for a full month. Please note I have placed an asterisk (*) next to monthly data in Table 2 that has been interpolated.

Finally, it should be noted that the counters are intentionally located away from the trailheads, sometimes as much as 2 miles away. Because of this, many walkers are not included in the count. With these caveats in mind, Table 2 summarizes the raw TrafX counts for each location by month.

[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 2017, this applies to Memorial Day, July 3rd and July 4th (as July 4th fell on a Tuesday), Labor Day, Thanksgiving day, and the day after Thanksgiving.

Table 2: Raw TrafX Counts by Location and Month (2017)

Location	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Cumberland	4,041*	4,954*	5,096*	6,236*	5,103	4,952	5,282	6,081	2,521	2,301*	46,566
Frostburg	643*	1,779	1,697	2,701	1,508	847	932	876	474	457*	11,914
Deal	367*	604	1,717	2,534	2,237	1,464	1,197	1,024	230	39*	11,413
Garrett	512*	1,008	1,533	2,406	2,271	1,999	2,007	1,087*	303*	75*	13,200
Rockwood	227*	930	1,609	2,425	2,344	1,318	686	988	307	87*	10,922
Ohiopyle	1,266*	4,072*	4,189*	5,125*	5,997	6,546	4,425	2,334	374	142*	34,469
Connellsville	1,256*	2,220	2,350	1,698	2,039	1,430	1,972	2,243	480	107*	15,795
Perryopolis	531*	795	1,086	501	2,408	2,651	1,818	1,038	334	144*	11,306
West Newton	3,664*	5,332	5,797	7,389	6,742	7,244	6,356	3,461	970	517*	47,472
Boston	2,540*	4,470	4,699	5,900	6,375	6,891	5,073	1,626	339	342*	38,255
Rankin Bridge	10,194*	8,198	6,540	8,268	6,552	12,530	9,061	6,531	2,327	1,629*	71,830
Hot Metal Bridge	10,388*	8,554	10,695	9,605	6,440	7,989	9,140	9,265	7,771	4,229*	84,076
Total	**35,629**	**42,916**	**47,008**	**54,789**	**50,016**	**55,861**	**47,949**	**36,554**	**16,430**	**10,069**	**397,219**

Table 3: Synchronized Trail Counts (2017)

	30-May-17		26-Jun-17		20-Jul-17		20-Aug-17		15-Sep-17		Total		
Location	Manual	TrafX	Manual	TrafX	Manual	TrafX	Manual	TrafX	Manual	TrafX	Manual	TrafX	CP
Cumberland	-----	-----	-----	-----	26	28	65	31	43	24	134	83	1.614
Frostburg	20	6	57	30	25	2	65	9	18	17	185	64	2.891
Deal	33	14	40	24	32	6	48	16	37	6	190	66	2.879
Garrett	9	9	52	42	2	2	44	27	22	12	129	92	1.402
Rockwood	16	16	29	24	21	17	-----	-----	23	0	89	57	1.561
Ohiopyle	-----	-----	-----	-----	31	13	177	104	66	26	274	143	1.916
Connellsville	16	16	84	14	18	9	42	10	-----	-----	160	49	3.265
Perryopolis	-----	-----	-----	-----	24	17	62	37	27	2	113	56	2.018
West Newton	55	35	102	56	57	29	177	58	32	25	423	203	2.084
Boston	53	35	81	57	51	13	156	110	88	34	429	249	1.723
Rankin Bridge	69	52	81	50	-----	-----	253	161	68	47	471	310	1.519
Hot Metal Bridge	143	29	120	29	100	28	106	106	103	29	572	221	2.588
Total	**414**	**212**	**646**	**326**	**387**	**164**	**1,195**	**669**	**527**	**222**	**3,169**	**1,593**	**1.989**

Synchronized Counts

Synchronized counts were conducted on Tuesday, May 30, Monday, June 26, Thursday, July 20, Sunday, August 20, and Friday, September 15. In each case, these counts were conducted over a two-hour period (10-noon, 11-1, or noon-2).

Less synchronized count data was collected in 2017 compared to 2016. In 2016, a total of 72 synchronized count observations were collected (6 synchronized count dates at 12 locations). In 2017, only 51 usable synchronized count observations were collected. One reason for the reduction is that 2017 had 5 synchronized count dates, compared to 6 in 2016. Secondly, on 7 synchronized counts were unusable because the TrafX counter was not operating or was malfunctioning during the synchronized count (Cumberland, Ohiopyle, and Perryopolis on May 30 and June 26, and Rankin Bridge on July 20). Finally, two scheduled manual counts were not conducted (Rockwood on August 20 and Connellsville on September 15). Because synchronized counts provide information that is critical in developing a reliable estimate of trail use, every effort should be made to conducting a complete set of synchronized counts in future years.

Table 3 summarizes the Synchronized Count and TrafX count at each counter for the 51 usable count days. 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.

CP Factors

By their nature, the TrafX counters do not count trail users perfectly. Specifically, 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. Thus, the accuracy of a TrafX counter declines when trail use is heavy.

In order 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 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 2010-2017.[4]

Table 4: Historic CP Factors (2010-2017)

Year	Manual	TrafX	CP Factor
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
Total	17,762	9,649	1.841

[4] No manual counts were conducted in 2014.

Table 5 lists the CP Factors by locations for 2017 and for comparison purposes, for 2016 as well. This data highlights the fact that these factors varied considerably from location to location in 2017 (from 1.402 in Garrett to 3.265 at Connellsville).

Table 5: CP Factors by Location (2017)

Location	Manual	TrafX	CP Factor	2016 CP Factor
Cumberland	134	83	1.614	1.385
Frostburg	185	64	2.891	1.452
Deal	190	66	2.879	2.712
Garrett	129	92	1.402	1.345
Rockwood	89	57	1.561	1.574
Ohiopyle	274	143	1.916	2.364
Connellsville	160	49	3.265	1.640
Perryopolis	113	56	2.018	1.223
West Newton	423	203	2.084	1.240
Boston	429	249	1.723	2.477
Rankin Bridge	471	310	1.519	1.786
Hot Metal Bridge	572	221	2.588	3.226
Total	3,169	1,593	1.989	1.885

Adusted 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 1.614, and its raw count for March (listed in Table 2) is 4,041. Thus, the adjusted count for Cumberland in March in Table 6 is 4,383 = (1.614) x (4,041). All other counts listed for March through December in Table 6 are calculated in a similar manner. The TrafX did not operate during January and February, so I estimate trail use at 100 for each location during these months. This is consistent with what I have done for "off" months in the past.

Table 6 lists that total adjusted trail use in 2017 was 814,130. This is 7% lower than the estimate for 2016, which was 873,365. ***Thus, my analysis indicates that trail use along the Great Allegheny Passage (GAP) decreased by 7% between 2016 and 2017.***

Table 6: Adjusted Monthly TrafX Counts (2017)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Cumberland	100	100	6,627	8,193	8,613	10,508	8,238	7,995	8,528	9,818	4,070	3,773	**76,562**
Frostburg	100	100	1,858	5,142	4,905	7,808	4,359	2,448	2,694	2,532	1,370	1,322	**34,639**
Deal	100	100	1,055	1,739	4,943	7,295	6,440	4,215	3,446	2,948	662	113	**33,055**
Garrett	100	100	717	1,413	2,150	3,374	3,184	2,803	2,814	1,523	424	106	**18,709**
Rockwood	100	100	355	1,453	2,513	3,786	3,660	2,058	1,071	1,537	483	135	**17,251**
Ohiopyle	100	100	2,430	7,842	8,048	9,851	11,490	12,543	8,479	4,472	717	272	**66,343**
Connellsville	100	100	4,101	7,249	7,673	5,546	6,658	4,669	6,439	7,324	1,567	348	**51,776**
Perryopolis	100	100	1,072	1,604	2,190	1,012	4,858	5,349	3,668	2,095	674	291	**23,015**
West Newton	100	100	7,637	11,123	12,080	15,397	14,049	15,095	13,244	7,212	2,021	1,078	**99,135**
Boston	100	100	4,377	7,701	8,096	10,165	10,983	11,872	8,740	2,801	584	589	**66,109**
Rankin Bridge	100	100	15,488	12,456	9,937	12,562	9,955	19,037	13,767	9,923	3,536	2,475	**109,335**
Hot Metal Bridge	100	100	26,934	22,465	27,682	24,860	16,668	20,677	23,656	23,979	20,113	10,965	**218,201**
Total	1,200	1,200	72,651	88,381	98,830	112,163	100,544	108,762	96,547	76,165	36,221	21,467	**814,130**

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, trail use at 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 many 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.

So, given the data available, I view the last column of Table 6 as the best estimate of 2016 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 814,130 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%.[5] 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 1,017,662 = (814,130 ÷ 0.80). The low-range and high-range estimates are 957,800 = (814,130 ÷ 0.85) and 1,085,507 = (814,130 ÷ 0.75), respectively. As mentioned previously, I estimate that trail use along the GAP decreased by 7% between 2016 and 2017.

Further Discussion

In comparing the 2017 trail use estimate to the 2016 estimate, it worth noting the lower quality and quantity of data in 2017 compared to 2016. In terms of TrafX counts, 2017 had 2,381 usable count days (12 TrafX counters combined) compared to 3,126 in 2016, a 24% decrease. In terms of synchronized counts, 2017 had 51 synchronized count observations compared to 72 in 2016, a 29% decrease.

[5] These estimates are based on input and estimates by ATA.

Furthermore, the 7% decrease in estimated trail use is driven by a large decrease in the count at the Hot Metal Bridge. Specifically, my estimate of trail use at Hot Metal bridge decreased by 38% between 2016 and 2017. [6] Of the 11 TrafX locations other than Hot Metal Bridge, 9 showed an increase in trail use between 2016 and 2017, and together, these 11 locations showed an overall increase in trail use of 14%. This data suggests that trail use may very well have increased between 2016 and 2017. Table 7 lists trail use (as reported in Table 6) for 2016 and 2017.

Table 7: Estimated Trail Use by Location: 2016 and 2017

Location	2016	2017	% change
Cumberland	50,704	76,562	51%
Frostburg	33,368	34,639	4%
Deal	30,547	33,055	8%
Garrett	17,988	18,709	4%
Rockwood	19,293	17,251	-11%
Ohiopyle	48,856	66,343	36%
Connellsville	34,784	51,776	49%
Perryopolis	18,202	23,015	26%
West Newton	73,323	99,135	35%
Boston	97,936	66,109	-32%
Rankin Bridge	99,139	109,335	10%
Hot Metal Bridge	349,226	218,201	-38%
Total	873,365	814,130	-7%

To compound this, the Hot Metal Bridge data showed some substantial irregularities. First, no data was retrievable until May 16. Second, the CP Factors resulting from the synchronized counts were erratic. Table 8 provides a summary of the synchronized counts and resulting CP Factors at Hot Metal Bridge in 2017.

Table 8: Synchronized Counts at Hot Metal Bridge (2017)

Date	Manual	TrafX	CP Factor
30-May	143	29	4.931
26-Jun	120	29	4.138
20-Jul	100	28	3.571
20-Aug	106	106	1.000
15-Sep	103	29	3.552
Total	572	221	2.588

On May 30, the Hot Metal Bridge TrafX counter registered only 29 passes compared to the human count of 143 passes (CP = 4.931). In contrast, the TrafX counter performed perfectly on August 20, with both the TrafX count and human count registering 106 passes. The mean 2017 CP factor (averaged over the five Synchronized Count dates) was substantially lower than the 2016 CP Factor for Hot Metal Bridge (2.588 vs 3.226), and this directly leads to a lower adjusted count in Table 6. If we were to use the median CP Factor for Hot Metal in 2017 (which is 3.571, the CP Factor from the July 20 Synchronized Count) instead of the mean CP Factor, the Hot Metal count would increase by nearly 83,000. As a result, my total trail use estimate would show an increase in trail use of 3% between 2016 and 2017, as opposed to the 7% decrease in trail use that I estimate in this report.

[6] The trail use estimates cited in this section refer to the numbers listed in Table 6 of the 2016 and 2017 reports.

To summarize, the 7% decrease in estimated trail use between 2016 and 2017 reported in this paper is the result of applying a consistent methodology to the data available. However, the data available in 2017 was substantially less reliable than in 2016. This is particularly true at four of the busiest locations on the trail (Cumberland, Ohiopyle, Rankin Bridge, and Hot Metal Bridge). Depending on the assumptions that one makes, one could reasonably conclude that overall trail use showed a small increase or a small decrease between 2016 and 2017.