Non-motorized transportation monitoring systems: A case study of Three Rivers Park District

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Purpose

Design a non-motorized transportation monitoring system for continuous and short-duration automated counters along Three Rivers Park District regional trails.
Objectives

• Background Information
• Existing System
• Design of a New System
• Alternatives and Costs
• Recommendations
• Next Steps
Background
Three Rivers Regional Trail Monitoring

• Existing system:
  – MET Council protocols
  – Short-duration manual counts

• Pilot Project:
  – 7 TRAFx continuous automated counters
  – Monitors only a portion of the RT system

• Potential:
  – Automated counter system for RT system
Count Method Comparison

**Short-term Manual**
- Characteristic data
- No maintenance
- Low upfront investment
- Large error to extrapolate short term counts to metrics
- Limited information for detailed analysis

**Long-term Automated**
- Mode-split data possible
- Maintenance and calibration required
- Significant upfront investment
- More accurate data possible
- Provides detailed information
Long Term Continuous Counts
Existing Trail System:

- 16 Trails Total
  - 5 incomplete
  - 3 No Count Data
- 133 miles of existing trails
- 270 Count Locations on 15 Trails
- Each segment: 0.55 miles
- MET Council estimated 3.7 million visits to Three Rivers Park District Regional trails in 2012
MET Council System: Short-Duration Manual Counts

- 16-24 two-hour counts per Park or Trail
- Conducted Memorial Day – Labor Day
- Count locations at every trail entrance/exit
- Counts selected randomly to cover 1\textsuperscript{st}/2\textsuperscript{nd} half of summer, weekends/weekdays, and high/medium/low volume times
- Counts multiplied by expansion factor, then by number of weekday or weekend days to obtain summer totals
- Current year’s data is combined with previous three years’ data
- Fall, winter, and spring estimates obtained using seasonal multipliers derived from survey data
- Results in metric of Annual User Visits
- TRPD augments counts with additional data
Existing System:
Continuous Automated Counters

- Pilot Project – 7 TRAFx Passive Infrared Counters
## Continuous Counter Data

<table>
<thead>
<tr>
<th>Location</th>
<th>AADT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLT - Beltline to Wooddale</td>
<td>483</td>
</tr>
<tr>
<td>CLT - Wooddale to Blake</td>
<td>517</td>
</tr>
<tr>
<td>CLT - Blake to Depot</td>
<td>481</td>
</tr>
<tr>
<td>CLT - Depot to 5th Ave</td>
<td>337</td>
</tr>
<tr>
<td>North Cedar Lake (NCL)</td>
<td>341</td>
</tr>
<tr>
<td>Lake Minnetonka (LMT)</td>
<td>191</td>
</tr>
<tr>
<td>Minnesota River Bluffs (MRB)</td>
<td>181</td>
</tr>
</tbody>
</table>
Designing a New System for Automated Counters

• Identify Segments for Automated Counters
  – Calculate AADTs for each location using TRPD manual count data (two-hour totals)
  – Validate AADTs using continuous count data
  – Compare AADTs at adjacent count locations
  – Estimate segments where trail volumes are consistent

• Identify Locations for Continuous Count Reference Sites
Segmentation Methods – Estimate AADT

Obtain two-hour adjustment factors from long-term automated counts

Multiply each two-hour manual count by the appropriate adjustment factor to obtain estimates of daily totals

Obtain weekday and weekend averages for each count location. Multiply by ratio of weekend and weekdays that occur during the summer time and add to obtain a weighted average, which represents summer ADT

Divide by ratio of summer ADT to annual average daily traffic (AADT) obtained from continuous count data.
AADTs

- 1066 counts for 243 locations along 13 trails
  - Mean Counts per Location: 4
  - Median Counts per Location: 2

- Small sample size, need to validate AADTs

- Continuous counter data useful resource
  - TRAFx counters to undercount during periods of high temp, so calibration required for meaningful comparison
Continuous Count Adjustments

Overall Calibration

- $y = 2.0959x$
- $y = 1.5655x + 29.104$

Graph showing the relationship between Actual Visitors and Counter Events.
Continuous Count Adjustments

Temp Adjusted Calibration

- $y = 2.5849x$
- $y = 1.8468x$

- >80° F
- <80° F

Actual Visitors vs. Counter Events
Validate AADT Estimates

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>CLT - Beltline to Wooddale</td>
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<td>1013</td>
<td>939</td>
<td>1239</td>
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<td>CLT - Wooddale to Blake</td>
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<td>965</td>
<td>1014</td>
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<tr>
<td>CLT - Blake to Depot</td>
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<td>*650</td>
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<tr>
<td>Lake Minnetonka (LMT)</td>
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<td>401</td>
<td>357</td>
<td>*426</td>
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<tr>
<td>Minnesota River Bluffs (MRB)</td>
<td>181</td>
<td>379</td>
<td>332</td>
<td>424</td>
</tr>
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</table>
AADT Relative Magnitude
- Represents 194 of 243 MET Council count locations along 13 trails
- No counts were taken between 2009 and 2012 for remaining 49 locations
- Min AADT: 8
- Max AADT: 1758
- Mean AADT: 376
Summary

- 16 Trails
- 155 miles
- 109 Segments
- 1.23 miles avg length

Criteria: 20% volume differentiation/professional judgment
## Alternatives

### Alternative 1 – Prioritize Cost

**PYRO Sensor**

- **5 Day Planned Counts**
- **1 May – 30 Oct**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Labor</td>
<td>$2,420/yr</td>
</tr>
<tr>
<td>Mobile Counters (3)</td>
<td>$1,800</td>
</tr>
<tr>
<td>Permanent Counters – PYRO (9)</td>
<td>$22,500</td>
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<tr>
<td>Maint/Calibration</td>
<td>$1,000/yr</td>
</tr>
</tbody>
</table>

### Alternative 2 – Maximize Data

**Eco-Multi Detector**

- **10 Day Planned Counts**
- **Memorial Day – Labor Day**

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<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Labor</td>
<td>$2,442/yr</td>
</tr>
<tr>
<td>Mobile Counters (11)</td>
<td>$6,600</td>
</tr>
<tr>
<td>Permanent Counters - Eco-Multi (9)</td>
<td>$63,000</td>
</tr>
<tr>
<td>Maint/Calibration</td>
<td>$1,000/yr</td>
</tr>
</tbody>
</table>
## Comparison of Costs

<table>
<thead>
<tr>
<th></th>
<th>Alternative 1</th>
<th>Alternative 2</th>
<th>MET Council System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Annual Cost</strong></td>
<td>$5970</td>
<td>$10,842</td>
<td>$8,180</td>
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<tr>
<td><strong>NPV (30 Years, 3.5%)</strong></td>
<td>$121,074</td>
<td>$224,625</td>
<td>$155,713</td>
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</tbody>
</table>
Recommendation

- Alternative 2 – Maximize Data
- Options for Reducing Costs
  - Extend monitoring season from May to October
  - Select less expensive permanent counters
  - Reduce number of permanent count stations
  - Implement phased purchase and replacement plan for permanent counters
Future Steps

• Implement automated counting across all 109 segments
• Analyze continuous count data to understand trail system traffic patterns
• Consider relocation of permanent counters to best represent all traffic patterns
• Periodically to calibrate equipment to validate accuracy/error