

# Rainfall Atlas 14: Replacement of Technical Paper 40

## Watershed Partner's Seventh Annual Boat Trip

June 12, 2013

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### Presentation Agenda

1. Discuss Technical Paper 40 and the development of Atlas 14
2. Discuss the results of Atlas 14
3. Discuss the possible impacts of Atlas 14
4. Discuss actions of various organizations to Atlas 14
  - a. Federal agencies have switched to Atlas 14
  - b. MnDOT has switched to Atlas 14
  - c. The cities of Woodbury, Farmington and Lakeview are gathering information to assess impacts on:
    - i. Storm sewers
    - ii. Detention ponds
    - iii. Overland flows

### Handouts

- TP 40/Atlas 14 comparison tables for Minnesota locations analyzed by Barr Engineering
- Map of Minnesota showing percent change from TP 40 to Atlas 14 at analyzed stations across the state
- Map of Twin Cities metro counties showing the locations of Atlas 14 stations Barr Engineering has analyzed
- Maps of Twin Cities metro counties comparing the TP 40 and Atlas 14 lines of constant rainfall depth for the 2- and 100-year, 24-hour events.



**Minnesota Locations**  
**TP 40/Atlas 14 comparisons by Barr Engineering**

**24-Hour Duration Event**  
**Final: Revised April 26, 2013**

| <b>Albert Lea</b>                        |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 3.0        | 3.0           | 0          |
| 5  | 3.8        | 3.8           | 0          |
| 10                                       | 4.4        | 4.6           | 5          |
| 50                                       | 5.6        | 6.8           | 21         |
| 100                                      | 6.3        | 7.8           | 24         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.9 - 10.3 |

| <b>Alexandria</b>                        |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.5        | 2.6           | 4         |
| 5  | 3.3        | 3.1           | -6        |
| 10                                       | 3.9        | 3.7           | -5        |
| 50                                       | 5.1        | 5.2           | 2         |
| 100                                      | 5.6        | 6.0           | 7         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.9 - 7.1 |

| <b>Arden Hills</b>                       |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.8        | 2.8           | 0          |
| 5  | 3.6        | 3.5           | -3         |
| 10                                       | 4.2        | 4.2           | 0          |
| 50                                       | 5.3        | 6.3           | 19         |
| 100                                      | 6.0        | 7.4           | 23         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.4 - 10.2 |

| <b>Austin</b>                            |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 3.0        | 3.0           | 0          |
| 5  | 3.8        | 3.8           | 0          |
| 10                                       | 4.4        | 4.5           | 2          |
| 50                                       | 5.6        | 6.7           | 20         |
| 100                                      | 6.3        | 7.8           | 24         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.8 - 10.4 |

| <b>Bloomington</b>                       |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.8        | 2.8           | 0          |
| 5  | 3.6        | 3.5           | -3         |
| 10                                       | 4.2        | 4.2           | 0          |
| 50                                       | 5.3        | 6.3           | 19         |
| 100                                      | 6.0        | 7.5           | 25         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.5 - 10.3 |

| <b>Brainerd</b>                          |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.5        | 2.7           | 8         |
| 5  | 3.3        | 3.3           | 0         |
| 10                                       | 3.9        | 3.9           | 0         |
| 50                                       | 5.0        | 5.5           | 10        |
| 100                                      | 5.5        | 6.3           | 15        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.7 - 8.2 |

| <b>Cedar/East Bethel</b>                 |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.7        | 2.8           | 4         |
| 5  | 3.5        | 3.6           | 3         |
| 10                                       | 4.1        | 4.2           | 2         |
| 50                                       | 5.3        | 6.1           | 15        |
| 100                                      | 5.9        | 7.0           | 19        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.3 - 9.2 |

| <b>Decker/St. Charles</b>                |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.9        | 3.0           | 3          |
| 5  | 3.7        | 3.7           | 0          |
| 10                                       | 4.3        | 4.5           | 5          |
| 50                                       | 5.4        | 6.7           | 24         |
| 100                                      | 6.1        | 7.8           | 28         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.8 - 10.4 |

| <b>Dodge Center</b>                      |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.9        | 2.9           | 0          |
| 5  | 3.7        | 3.7           | 0          |
| 10                                       | 4.3        | 4.5           | 5          |
| 50                                       | 5.5        | 6.7           | 22         |
| 100                                      | 6.1        | 7.9           | 30         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.9 - 10.7 |

| <b>Duluth Airport</b>                    |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.5        | 2.7           | 8         |
| 5  | 3.3        | 3.3           | 0         |
| 10                                       | 3.8        | 3.9           | 3         |
| 50                                       | 4.8        | 5.6           | 17        |
| 100                                      | 5.3        | 6.3           | 19        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.9 - 8.1 |

**Minnesota Locations**  
**TP 40/Atlas 14 comparisons by Barr Engineering**

**24-Hour Duration Event**  
**Final: Revised April 26, 2013**

| <b>Duluth Harbor</b>                     |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.5        | 2.6           | 4         |
| 5  | 3.3        | 3.3           | 0         |
| 10                                       | 3.8        | 3.9           | 3         |
| 50                                       | 4.8        | 5.5           | 15        |
| 100                                      | 5.3        | 6.3           | 19        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.8 - 8.0 |

| <b>Elgin</b>                             |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.9        | 3.0           | 3          |
| 5  | 3.7        | 3.8           | 3          |
| 10                                       | 4.3        | 4.5           | 5          |
| 50                                       | 5.4        | 6.8           | 26         |
| 100                                      | 6.1        | 7.9           | 30         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.9 - 10.7 |

| <b>Elk River</b>                         |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.7        | 2.9           | 7         |
| 5  | 3.5        | 3.6           | 3         |
| 10                                       | 4.1        | 4.2           | 2         |
| 50                                       | 5.3        | 6.1           | 15        |
| 100                                      | 5.9        | 7.0           | 19        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.2 - 9.1 |

| <b>Farmington</b>                        |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.8           | 0         |
| 5  | 3.6        | 3.5           | -3        |
| 10                                       | 4.2        | 4.2           | 0         |
| 50                                       | 5.3        | 6.3           | 19        |
| 100                                      | 6.0        | 7.4           | 23        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.6 - 9.8 |

| <b>Golden Valley</b>                     |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.9           | 4         |
| 5  | 3.6        | 3.6           | 0         |
| 10                                       | 4.2        | 4.3           | 2         |
| 50                                       | 5.3        | 6.4           | 21        |
| 100                                      | 6.0        | 7.4           | 23        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.7 - 9.7 |

| <b>Grand Marais</b>                      |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.4        | 2.4           | 0         |
| 5  | 3.1        | 3.0           | -3        |
| 10                                       | 3.5        | 3.5           | 0         |
| 50                                       | 4.5        | 4.9           | 9         |
| 100                                      | 4.8        | 5.6           | 17        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.2 - 7.3 |

| <b>Grand Rapids</b>                      |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.4        | 2.6           | 8         |
| 5  | 3.2        | 3.3           | 3         |
| 10                                       | 3.7        | 3.9           | 5         |
| 50                                       | 4.7        | 5.5           | 17        |
| 100                                      | 5.3        | 6.3           | 19        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.7 - 8.1 |

| <b>International Falls</b>               |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.3        | 2.4           | 4         |
| 5  | 3.0        | 2.9           | -3        |
| 10                                       | 3.5        | 3.4           | -3        |
| 50                                       | 4.5        | 4.7           | 4         |
| 100                                      | 5.0        | 5.3           | 6         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.1 - 6.7 |

| <b>Inver Grove Heights</b>               |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.8        | 2.8           | 0          |
| 5  | 3.6        | 3.5           | -3         |
| 10                                       | 4.2        | 4.2           | 0          |
| 50                                       | 5.3        | 6.3           | 19         |
| 100                                      | 6.0        | 7.4           | 23         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.5 - 10.3 |

| <b>Jordan</b>                            |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.9           | 4         |
| 5  | 3.6        | 3.6           | 0         |
| 10                                       | 4.2        | 4.2           | 0         |
| 50                                       | 5.4        | 6.3           | 17        |
| 100                                      | 6.0        | 7.3           | 22        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.4 - 9.8 |

**Minnesota Locations**  
**TP 40/Atlas 14 comparisons by Barr Engineering**

**24-Hour Duration Event**  
**Final: Revised April 26, 2013**

| <b>Mankato</b>                           |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.9        | 2.9           | 0         |
| 5  | 3.7        | 3.6           | -3        |
| 10                                       | 4.2        | 4.3           | 2         |
| 50                                       | 5.5        | 6.2           | 13        |
| 100                                      | 6.1        | 7.2           | 18        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.4 - 9.4 |

| <b>Minneapolis/St Paul International Airport</b> |            |               |           |
|--|------------|---------------|-----------|
| Frequency  | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.8           | 0         |
| 5  | 3.6        | 3.5           | -3        |
| 10   | 4.2        | 4.2           | 0         |
| 50   | 5.3        | 6.4           | 21        |
| 100  | 6.0        | 7.5           | 25        |
| 100yr/24hr 90% Confidence Interval [in]:         |            |               | 5.9 - 9.5 |

| <b>Minnnetonka</b>                       |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.8        | 2.9           | 4          |
| 5  | 3.6        | 3.6           | 0          |
| 10                                       | 4.2        | 4.3           | 2          |
| 50                                       | 5.3        | 6.4           | 21         |
| 100                                      | 6.0        | 7.4           | 23         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.5 - 10.0 |

| <b>Montevideo</b>                        |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.6        | 2.6           | 0         |
| 5  | 3.4        | 3.2           | -6        |
| 10                                       | 4.0        | 3.8           | -5        |
| 50                                       | 5.2        | 5.5           | 6         |
| 100                                      | 5.7        | 6.4           | 12        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.9 - 8.7 |

| <b>Moorhead</b>                          |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.3        | 2.5           | 9         |
| 5  | 3.1        | 3.1           | 0         |
| 10                                       | 3.6        | 3.8           | 6         |
| 50                                       | 4.6        | 5.6           | 22        |
| 100                                      | 5.3        | 6.5           | 23        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.8 - 8.5 |

| <b>Mound</b>                             |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.9           | 4         |
| 5  | 3.6        | 3.6           | 0         |
| 10                                       | 4.2        | 4.2           | 0         |
| 50                                       | 5.3        | 6.2           | 17        |
| 100                                      | 6.0        | 7.3           | 22        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.5 - 9.5 |

| <b>Pine Springs</b>                      |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.8           | 0         |
| 5  | 3.6        | 3.5           | -3        |
| 10                                       | 4.2        | 4.2           | 0         |
| 50                                       | 5.3        | 6.2           | 17        |
| 100                                      | 6.0        | 7.3           | 22        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.4 - 9.8 |

| <b>Rochester Airport</b>                 |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.9        | 2.9           | 0          |
| 5  | 3.7        | 3.7           | 0          |
| 10                                       | 4.3        | 4.5           | 5          |
| 50                                       | 5.5        | 6.7           | 22         |
| 100                                      | 6.1        | 7.8           | 28         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 6.0 - 10.4 |

| <b>Roesemount</b>                        |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.8        | 2.8           | 0          |
| 5  | 3.6        | 3.5           | -3         |
| 10                                       | 4.2        | 4.1           | -2         |
| 50                                       | 5.3        | 6.3           | 19         |
| 100                                      | 6.0        | 7.4           | 23         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.5 - 10.2 |

| <b>St Cloud</b>                          |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.6        | 2.7           | 4         |
| 5  | 3.4        | 3.4           | 0         |
| 10                                       | 4.1        | 4.0           | -2        |
| 50                                       | 5.2        | 5.6           | 8         |
| 100                                      | 5.8        | 6.4           | 10        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.0 - 7.9 |

**Minnesota Locations**  
**TP 40/Atlas 14 comparisons by Barr Engineering**

**24-Hour Duration Event**  
**Final: Revised April 26, 2013**

| <b>St. Paul</b>                          |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.8           | 0         |
| 5  | 3.6        | 3.5           | -3        |
| 10                                       | 4.2        | 4.2           | 0         |
| 50                                       | 5.3        | 6.3           | 19        |
| 100                                      | 6.0        | 7.4           | 23        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.6 - 9.9 |

| <b>Thief River Falls</b>                 |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.2        | 2.5           | 14        |
| 5  | 3.0        | 3.2           | 7         |
| 10                                       | 3.5        | 3.8           | 9         |
| 50                                       | 4.5        | 5.5           | 22        |
| 100                                      | 5.1        | 6.3           | 24        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.7 - 8.3 |

| <b>Warroad</b>                           |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.2        | 2.3           | 5         |
| 5  | 2.9        | 2.8           | -3        |
| 10                                       | 3.4        | 3.4           | 0         |
| 50                                       | 4.5        | 5.0           | 11        |
| 100                                      | 5.0        | 5.8           | 16        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 4.5 - 7.6 |

| <b>Winona</b>                            |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.9        | 2.9           | 0         |
| 5  | 3.7        | 3.6           | -3        |
| 10                                       | 4.3        | 4.3           | 0         |
| 50                                       | 5.4        | 6.3           | 17        |
| 100                                      | 6.1        | 7.3           | 20        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.5 - 9.6 |

| <b>Worthington</b>                       |            |               |           |
|--|------------|---------------|-----------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change  |
| 2  | 2.8        | 2.9           | 4         |
| 5  | 3.6        | 3.7           | 3         |
| 10                                       | 4.2        | 4.5           | 7         |
| 50                                       | 5.5        | 6.5           | 18        |
| 100                                      | 6.1        | 7.4           | 21        |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.8 - 9.2 |

| <b>Zumbrota</b>                          |            |               |            |
|--|------------|---------------|------------|
| Frequency                                | TP 40 [in] | Atlas 14 [in] | % Change   |
| 2  | 2.9        | 2.9           | 0          |
| 5  | 3.7        | 3.7           | 0          |
| 10                                       | 4.2        | 4.5           | 7          |
| 50                                       | 5.5        | 6.7           | 22         |
| 100                                      | 6.1        | 7.9           | 30         |
| 100yr/24hr 90% Confidence Interval [in]: |            |               | 5.9 - 10.7 |

**Sources: NOAA Atlas 14, Volume 8, Version 2, Midwestern States**  
**U.S. Weather Bureau Technical Paper No. 40, 1961**

# 24 Hour Rainfall

# Minnesota

Source: NOAA Atlas 14, Vol. 8, Ver. 2  
Midwestern States  
Final: April, 2013

