



# Using Atlas 14 Precipitation Data for State Aid Projects

MnDOT Bridge Hydraulics  
Updated December 2015

*Your Destination...Our Priority*



# Overview

- ▶ Part I: About Atlas 14
  - Background
  - Implementation
  - Impacts to State Aid Local Transportation projects
- ▶ Part II: Gathering & Using Atlas 14 Data
  - Downloading Data
  - Rainfall Distributions
  - Regionalization for Rational Method



# Part I:

# About Atlas 14



# Background

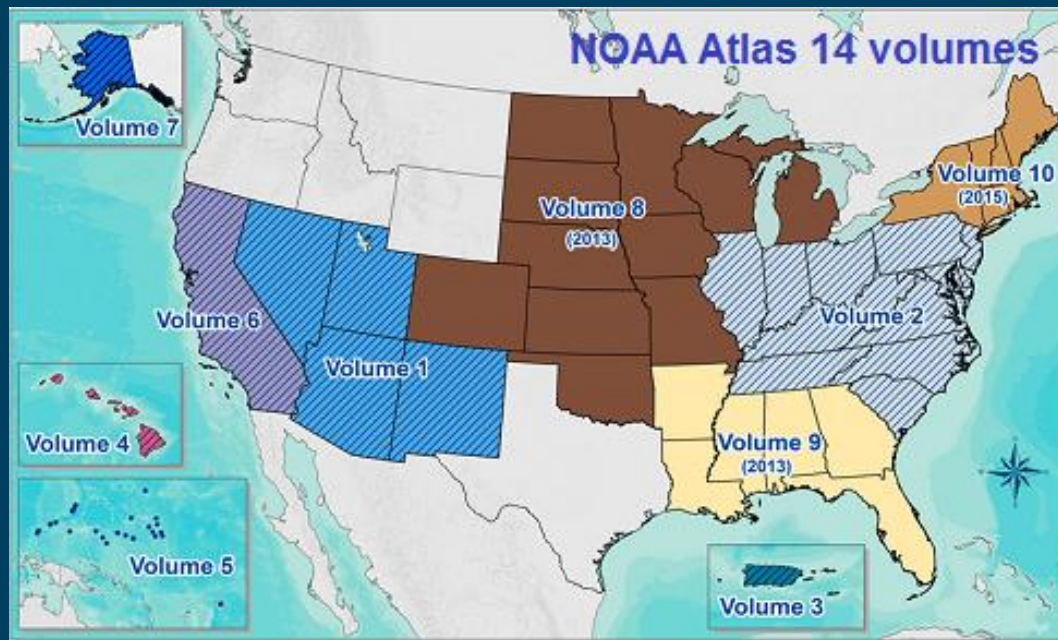
- ▶ The current MnDOT Drainage Manual uses TP-40 (1961) and Hydro-35 (1977) for rainfall
- ▶ Concern within the state that TP-40 was not representative of the precipitation we've been seeing





# Background

- ▶ NOAA is nationally accepted as a source of precipitation data and analysis
- ▶ Worked through a FHWA pooled fund with 10 other states to fund a regional study



# Background

- ▶ Within Minnesota, project funded by:
  - MPCA using a Legislative Citizen Commission of Minnesota Resources (LCCMR) Grant
  - MnDOT Research
  - City State Aid





# What is Atlas 14?

- ▶ Atlas 14 provides precipitation frequency estimates
- ▶ Precipitation Frequency Data Server (PFDS)  
<http://hdsc.nws.noaa.gov/hdsc/pfds/>
- ▶ Interactive Map





# TP-40 vs. Atlas 14

- ▶ TP-40 was published in 1961
  - Fewer stations
  - Less length of record
  - Included the Dust Bowl
  - Topographic effects were not accounted for



# TP-40: 100 year-24 hour

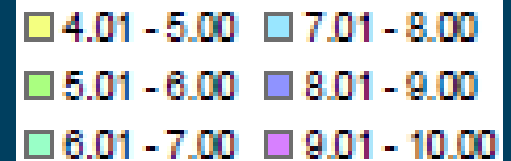
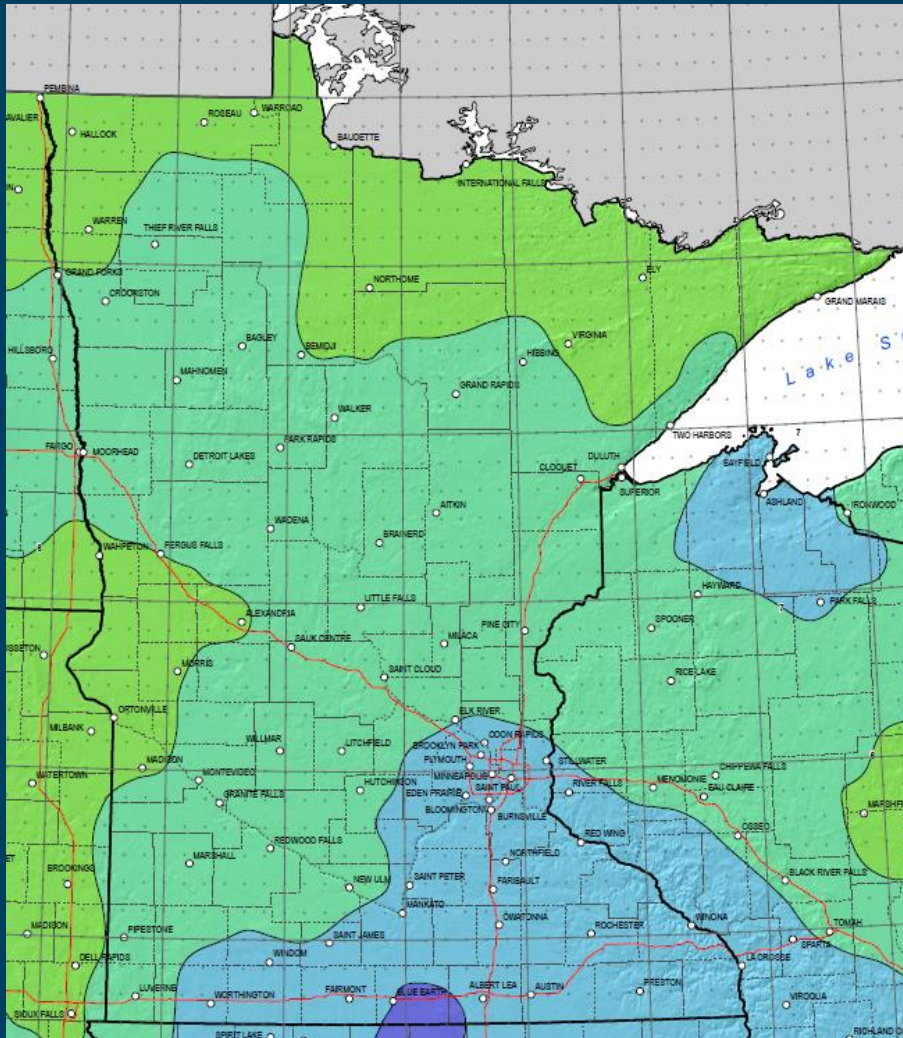


# TP-40 vs. Atlas 14

- ▶ Atlas 14 was released April 2013
  - Includes 50 more years of data
  - More stations



# Atlas 14: 100 year–24 hour



Volume 8 project area.



# Impacts of Atlas 14

- ▶ Some precipitation frequency estimates are going up, some are not changing, a few are going down. Depends on:
  - Frequency = how often it happens
  - Duration = length of event
  - Location
  - What you are comparing it to, TP-40 (depth of rainfall) or MnDOT IDF curves (intensity of rainfall)





# Is Atlas 14 Evidence of Climate Change?



# Is Atlas 14 Evidence of Climate Change?

- ▶ Atlas 14 is based on historical data and was not meant to analyze climate change
- ▶ The impact of potential changes in climate on precipitation frequency estimates is uncertain.





# Hydrologic Models

```
graph TD; A[Hydrologic Models] --> B[Rainfall-Runoff Methods<br/>(use Precipitation Frequency data)]; A --> C[Statistical Flow Methods<br/>(do not use Precipitation Frequency data)];
```

Rainfall-Runoff Methods  
(use Precipitation  
Frequency data)

Statistical Flow Methods  
(do not use Precipitation  
Frequency data)



# Hydrologic Models

Rainfall–Runoff Methods  
(use Precipitation  
Frequency data)

NRCS (SCS)  
Method

Rational  
Method

Statistical Flow Methods  
(do not use Precipitation  
Frequency data)

Stream Gauge  
Analysis

Regression  
Equations



# NRCS (SCS) Method

- ▶ Based on precipitation depth (inches)
- ▶ Typically used for designing small culverts, pond outfalls, ...
- ▶ Atlas 14 data shows increasing trend for 24 hour duration less frequent events (e.g. 100 year), and less impact for more frequent events (e.g. 5 year)



# Hydrologic Models

**Rainfall–Runoff Methods**  
(use Precipitation  
Frequency data)

NRCS (SCS)  
Method

**Rational  
Method**

**Statistical Flow Methods**  
(do not use Precipitation  
Frequency data)

Stream Gauge  
Analysis

Regression  
Equations



# Rational Method

- ▶ Based on precipitation intensity (inches/hour)
- ▶ Typically used for storm drains and catch basin spacing
- ▶ Atlas 14 data shows not much increase for typical design durations and frequencies, decreases in some situations



# Hydrologic Models

Rainfall–Runoff Methods  
(use Precipitation  
Frequency data)

NRCS (SCS)  
Method

Rational  
Method

Statistical Flow Methods  
(do not use Precipitation  
Frequency data)

Stream  
Gauge  
Analysis

Regression  
Equations



# Stream Gauge Analysis

- ▶ Based on historical stream gauge data
- ▶ Used for bridges and large culverts
- ▶ Already using most current data available





# Hydrologic Models

Rainfall–Runoff Methods  
(use Precipitation  
Frequency data)

NRCS (SCS)  
Method

Rational  
Method

Statistical Flow Methods  
(do not use Precipitation  
Frequency data)

Stream Gauge  
Analysis

Regression  
Equations



# Regression Equations

- ▶ Used for Bridges and large culverts
- ▶ Does not use precipitation frequency data
- ▶ Equations have been updated approximately every 10 years
- ▶ Streamstats uses these equations



# Flood Insurance Studies (FIS)

- ▶ Can be based on a number of different methods
- ▶ Could be based on out of date rainfall or stream gauge data
- ▶ Will need to look at particular study to find out



# MnDOT Design Criteria

- ▶ Based on specified event frequency, not a specific model
- ▶ Should use the most appropriate method for the specific site



# Implementation

- ▶ Tech Memo [15-10-B-02](#) issued Dec 8, 2015 has current MnDOT guidelines for use of Atlas 14 data
  - Supersedes Original Tech Memo 13-08-B-04 issued May 2013
  - Applies to MnDOT projects, local authorities encouraged to adopt these or similar guidelines.
  - Continue to use Atlas 14 Precipitation Depths
  - Changes between original and current tech memo are when using NRCS (National Resources Conservation Service) methods



# Implementation

- ▶ Drainage manual update to come in the future
- ▶ Check with other permitting authorities regarding their requirements for Atlas 14 data



# Impacts for State Aid Projects

- ▶ Storm drain cost share projects
  - Encouraged to use Atlas 14 data
- ▶ Cooperative Projects
  - Follow MnDOT Tech Memo 15-10-B-02
  - Confer with MnDOT Project Manager





# Impacts for Local Projects

- ▶ Drainage Permits from MnDOT
  - Follow MnDOT Tech Memo 15-10-B-02
  - Final decision made by MnDOT District Office



# Part II: Gathering & Using Atlas 14 Data



# Downloading Data

- ▶ Atlas 14 Precipitation Frequency Data Server (PFDS)

<http://hdsc.nws.noaa.gov/hdsc/pfds/index.html>



# Rainfall Distributions (NRCS Method)

- ▶ Site specific distributions can be created based on Atlas 14 data when using the NRCS method

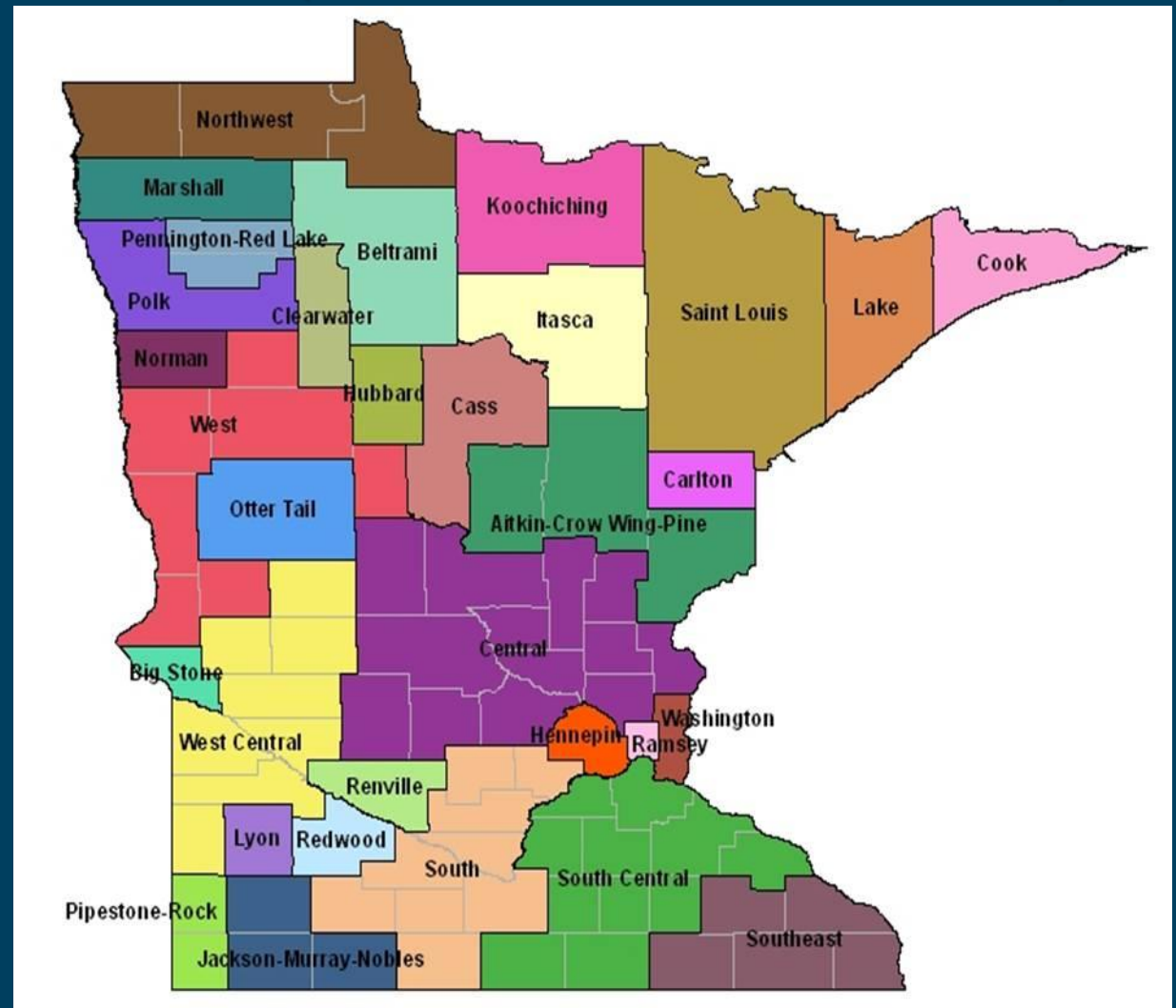
[http://www.dot.state.mn.us/bridge/hydraulics/atlas14/pdf/Atlas14\\_RainfallDistributions.pdf](http://www.dot.state.mn.us/bridge/hydraulics/atlas14/pdf/Atlas14_RainfallDistributions.pdf)

- ▶ Or use MSE 3 rainfall distribution developed by NRCS.
- ▶ What resource to link to?
- ▶ Do not use NRCS/SCS Type I or Type II Distributions. These are based on TP-40 data and no longer recommended.



# Regionalization (Rational Method)

- ▶ 32 regions



# Regionalization (Rational Method)

- ▶ IDF (Intensity–Duration–Frequency) Tables were created for each region
- ▶ Designed to be used with the Rational method (typically storm drain design and catch basin spacing)

<http://www.dot.state.mn.us/bridge/hydraulics/atlas14/atlas14regions/atlas14regions.html>



# Regionalization (Rational Method)

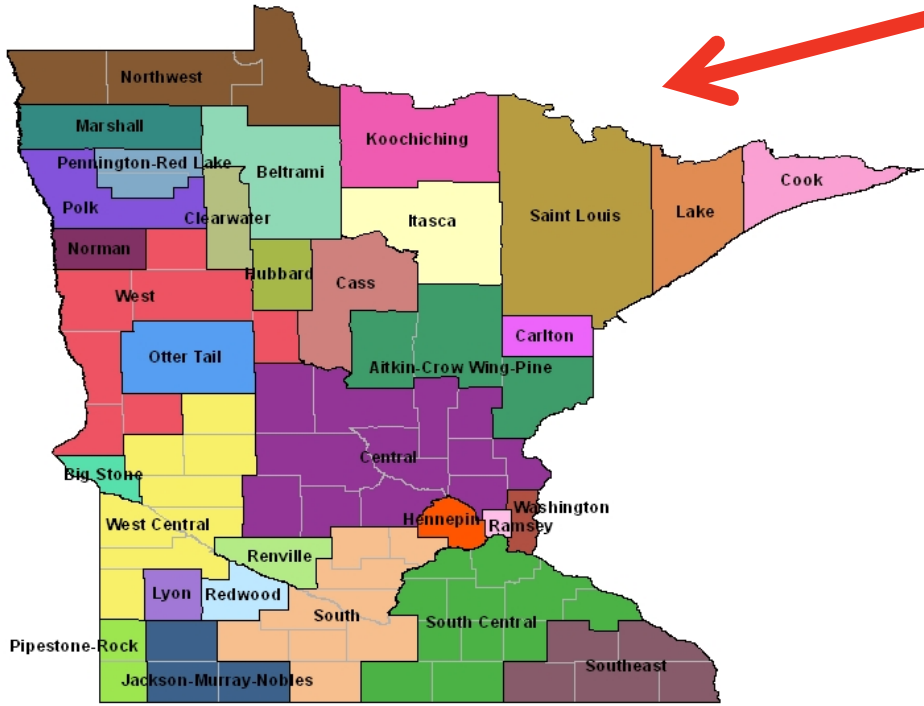
## Hydraulics

Atlas 14

[Hydraulics Home](#) | [Drainage Manual](#) | [HydInfra](#) | [Bridge Scour](#) | [Atlas 14](#) | [Bridge Home](#) | [Contact Us](#)

### Atlas 14 IDF Regionalization

To assist in using Atlas 14 data with the Rational Method, MnDOT has created 32 Atlas 14 Rainfall Intensity-Duration-Frequency (IDF) Regions. These regions supersede the 3 regions specified in the drainage manual. These tables were designed to be used with the Rational Method which is typically used for storm drain design and catch basin spacing. (click on region to locate IDF link).



	A	B
1		
2	(Blue Earth, Brown, Ca	
3		
4	Time of	
5	Concentration	2 year
6	5 min	5.68
7	6 min	5.34
8	7 min	5.26
9	8 min	5.12
10	9 min	4.86
11	10 min	4.16
12	11 min	3.99
13	12 min	3.83
14	13 min	3.67
15	14 min	3.53
16	15 min	3.38
17	16 min	3.30
18	17 min	3.22
19	18 min	3.14
20	19 min	3.07
21	20 min	2.99
22	21 min	2.92
23	22 min	2.85

Sheet1 Sheet2 Sheet3

[Frequently Asked](#)

AutoSum

Fill

Clear

Sort & Filter

Find & Select

Editing

Q

R





# Regionalization (Rational Method)

- ▶ These values may be conservative for some locations

<http://www.dot.state.mn.us/bridge/hydraulics/atlas14/pdf/atlas-14-IDF-regionalization-documentation.pdf>

- ▶ There is always the option to create a location/project specific IDF table

<http://www.dot.state.mn.us/bridge/hydraulics/atlas14/pdf/custom-IDF-table.xlsx>





## Hydraulics

Atlas 14

[Hydraulics Home](#) | [Drainage Manual](#) | [HydInfra](#) | [Bridge Scour](#) | [Atlas 14](#) | [Bridge Home](#) | [Contact Us](#)

### Atlas 14

Use NOAA Atlas 14 Frequency Estimates in rainfall-runoff models to compute hydrology for the design of hydraulic infrastructure.

- [NOAA Atlas 14 Precipitation Frequency Data Server](#) Data for Volume 8 (Midwest including MN) published April 19, 2013.
- The Hydrometeorological Design Studies Center (HDSC) has released [documentation to accompany Volume 8](#) and 9 of NOAA Atlas 14.

**[MnDOT Webinar: Using Atlas 14 Precipitation Data for State Aid Projects \(August 14, 2013\)](#) *Registration is not required.***

Information on how to connect to webinar will be provided by August 7, 2013.

[MnDOT Atlas 14 IDF Regionalization](#)

[MnDOT Technical Memorandum: Use of Atlas 14 Volume 8 Precipitation Frequency Estimates](#)

#### Guidance

- [Implementation Feasibility Checklist](#) (.docx)
- [Tips for Using Atlas 14 - Precipitation Data Frequency Server](#) (PDF)
- [Atlas 14 Downloading Data using Internet Explorer 8 \(Helpsheet\)](#) (PDF) (updated May 28, 2013)
- [Using Atlas 14 Precipitation Data Frequency Server](#) (April 23, 2013) (PDF)
- [Atlas 14 - Rainfall Distributions](#) (April 23, 2013) (PDF)
- [Customized IDF Table Tool](#) (.xlsx)
- [Importing Atlas 14 into HydroCAD](#) (May 2, 2013) (PDF)
- [Geopak Drainage - Import IDF](#) (May 8, 2013) (PDF)
- [Frequently Asked Questions](#) (PDF)

#### Other Resources

DNR



# Resources

- ▶ Atlas 14 website

<http://hdsc.nws.noaa.gov/hdsc/pfds/index.html>

- ▶ Atlas 14 Volume 8 Documentation

[http://www.nws.noaa.gov/oh/hdsc/PF\\_documents/Atlas14\\_Volume8.pdf](http://www.nws.noaa.gov/oh/hdsc/PF_documents/Atlas14_Volume8.pdf)



# Contact Information

- ▶ Andrea Hendrickson, State Hydraulics Engineer
  - [Andrea.Hendrickson@state.mn.us](mailto:Andrea.Hendrickson@state.mn.us)
- ▶ Lisa Sayler, Hydraulics Automation Engineer
  - [Lisa.Sayler@state.mn.us](mailto:Lisa.Sayler@state.mn.us)
- ▶ Juanita Voigt, State Aid Hydraulic Specialist
  - [Juanita.Voigt@state.mn.us](mailto:Juanita.Voigt@state.mn.us)

