Using Atlas 14 Precipitation Data for State Aid Projects

MnDOT Bridge Hydraulics
August 15, 2013
Presenter: Rachel Hoff

Your Destination...Our Priority

Overview

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

Part I:

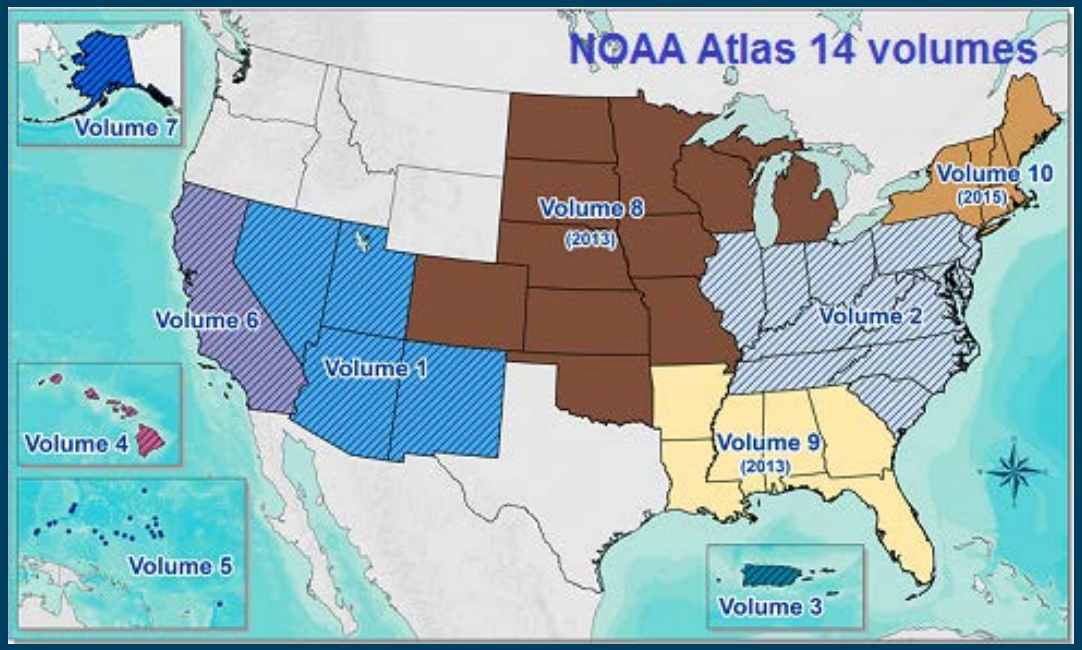
About Atlas 14

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

Atlas 14 Website Overview

- See webinar for demonstration of the Atlas 14 website

TP-40 vs. Atlas 14

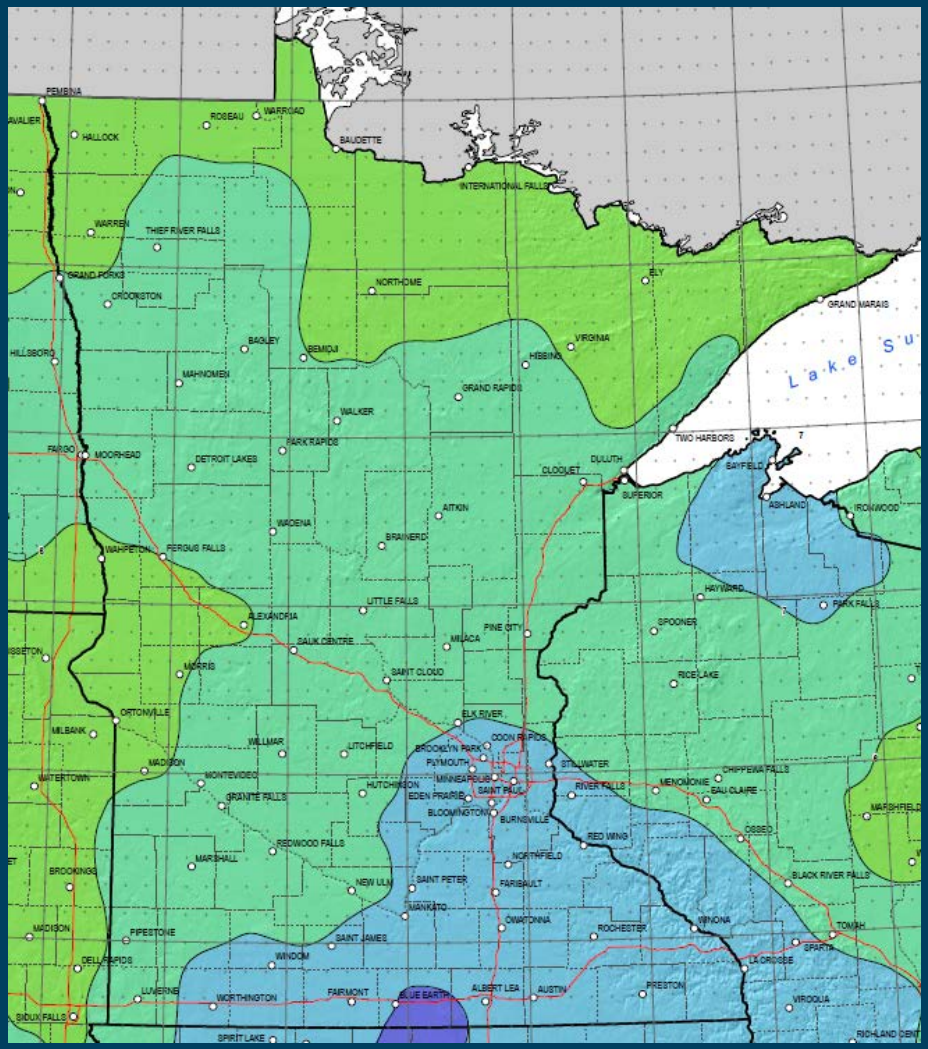
- TP-40 was published in 1961
  - Fewer stations
  - Less length of record
  - Included the Dust Bowl
  - Topographic effects were not accounted for

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



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.

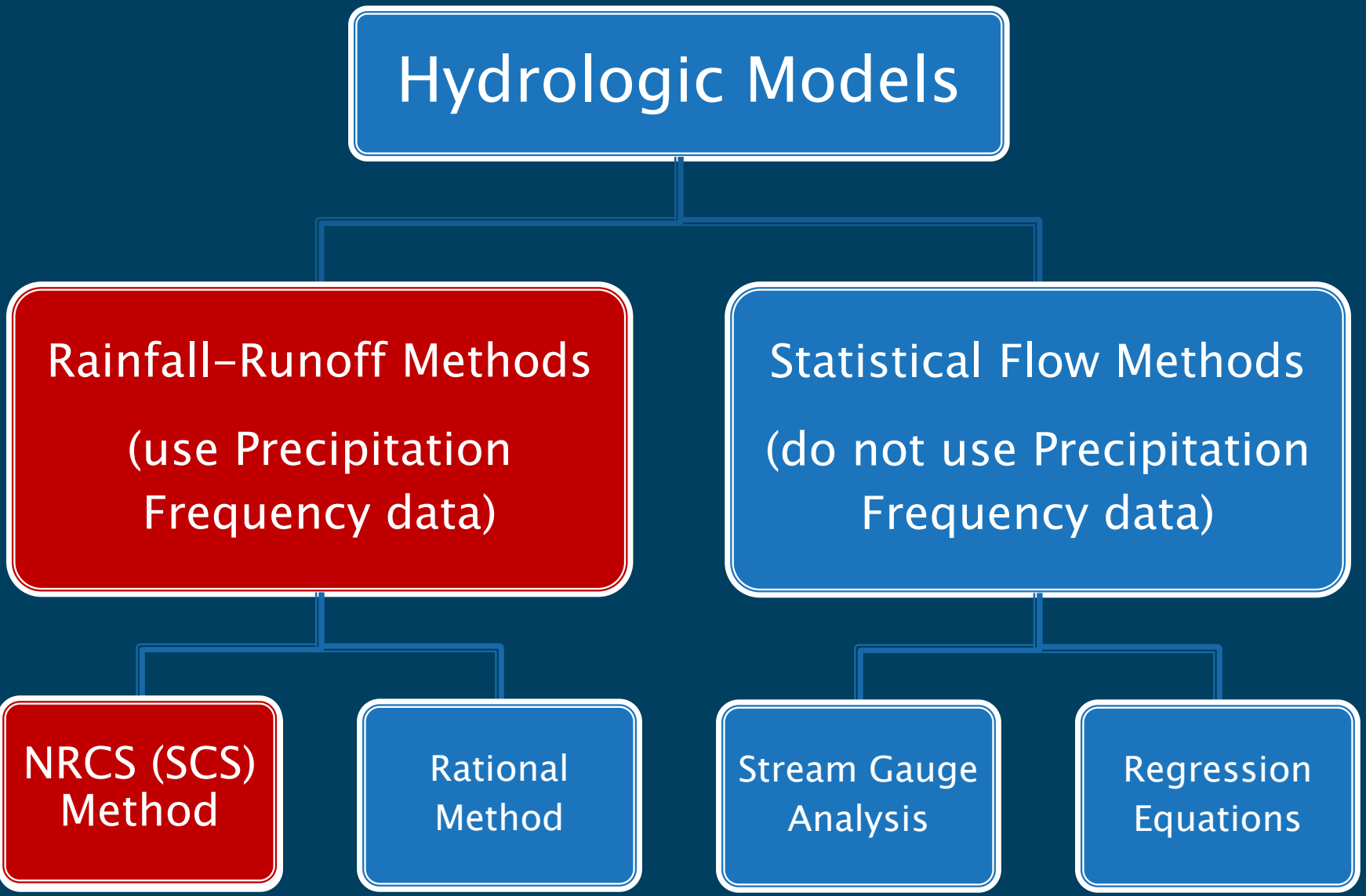
Hydrologic Models

Rainfall-Runoff Methods

(use Precipitation Frequency data)

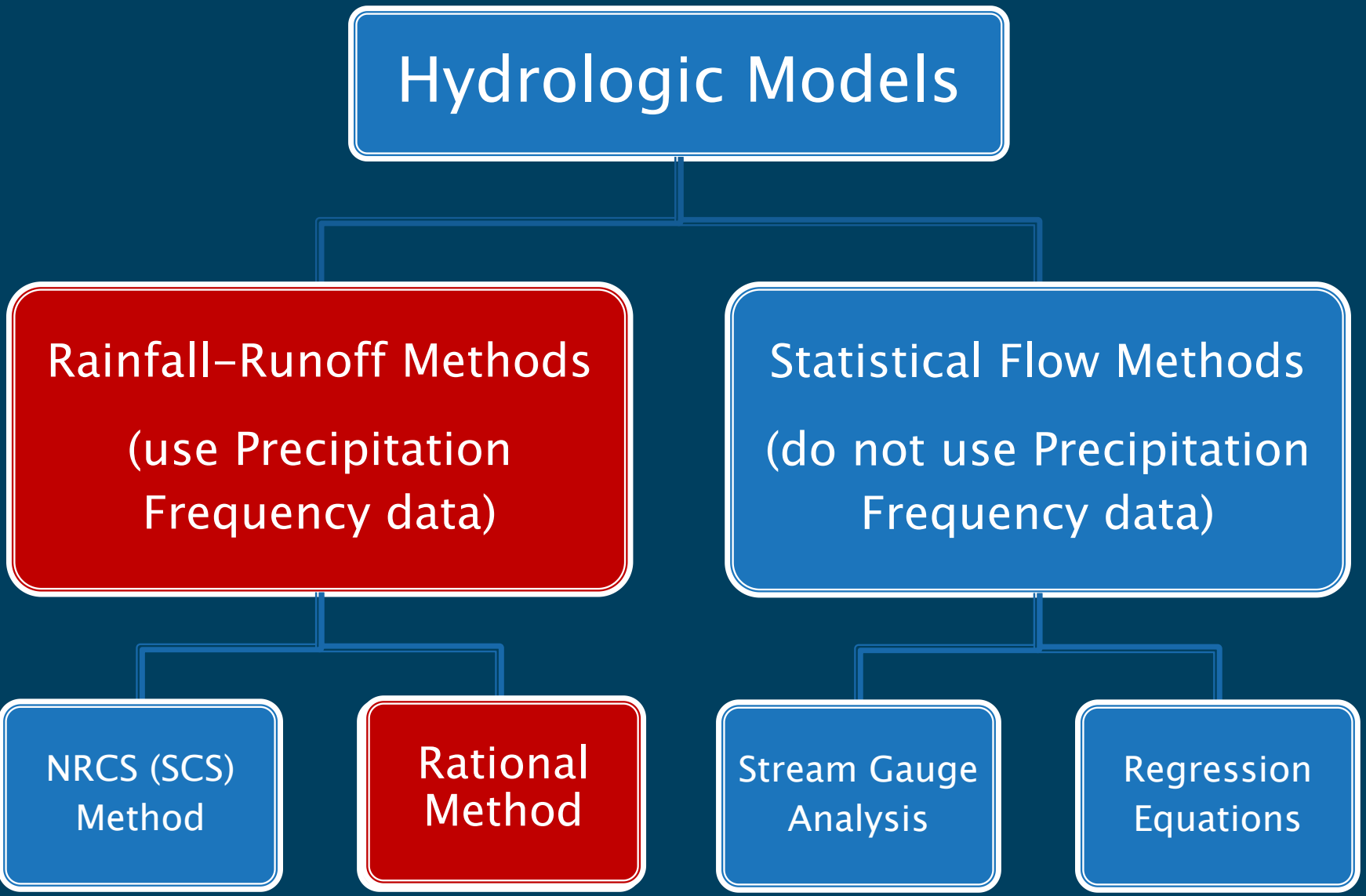
Statistical Flow Methods

(do not use Precipitation Frequency data)


Hydrologic Models
Rainfall-Runoff Methods
(use Precipitation Frequency data)
Statistical Flow Methods
(do not use Precipitation Frequency data)
NRCS (SCS) Method
Rational Method
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)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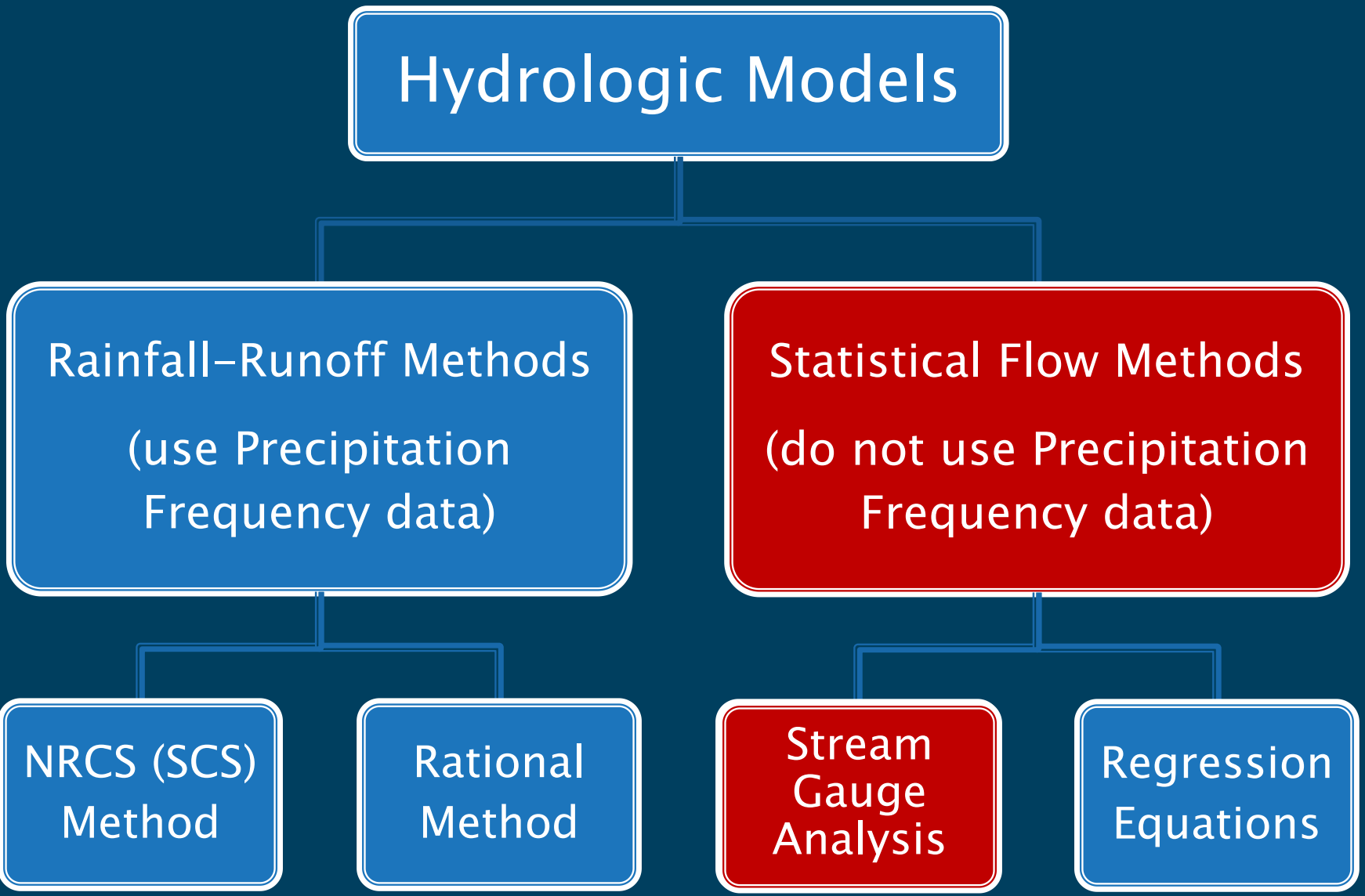
Rational Method

- 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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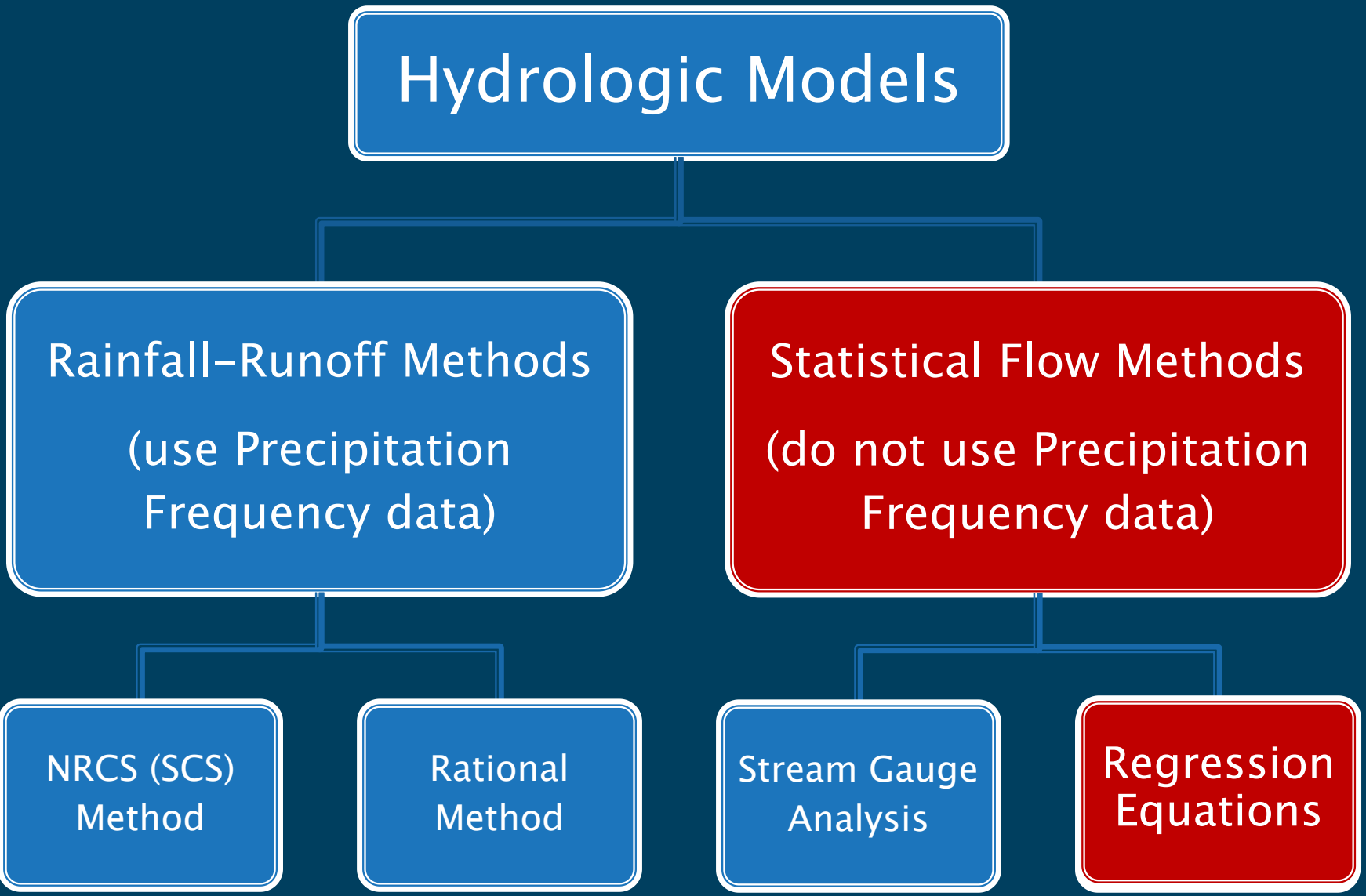
Stream Gauge Analysis

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

- New Tech Memo 13-08-B-04 for MnDOT projects
- Start using immediately if feasible
- Projects let after June 30, 2014 should use Atlas 14 data for hydrology
- If not feasible, evaluate impacts at critical locations and document

Feasibility Considerations

- Checklist created for situations where use of Atlas 14 data is not feasible

http://www.dot.state.mn.us/bridge/hydraulics/atlas14/pdf/atlas-14-feasibility-checklist8-5-13.docx

Implementation

- Drainage manual update to come in the future
- Other permitting authorities may require use of Atlas 14 data earlier

Impacts for State Aid Projects

- Storm drain cost share projects
  - Encouraged to use Atlas 14 data

- Cooperative Projects
  - Follow MnDOT Tech Memo 13-08-B-04
  - Confer with MnDOT Project Manager

Impacts for Local Projects

- Drainage Permits from MnDOT
  - Follow MnDOT Tech Memo 13-08-B-04
  - Final decision made by MnDOT District Office

Part II: Gathering & Using Atlas 14 Data

Downloading Data

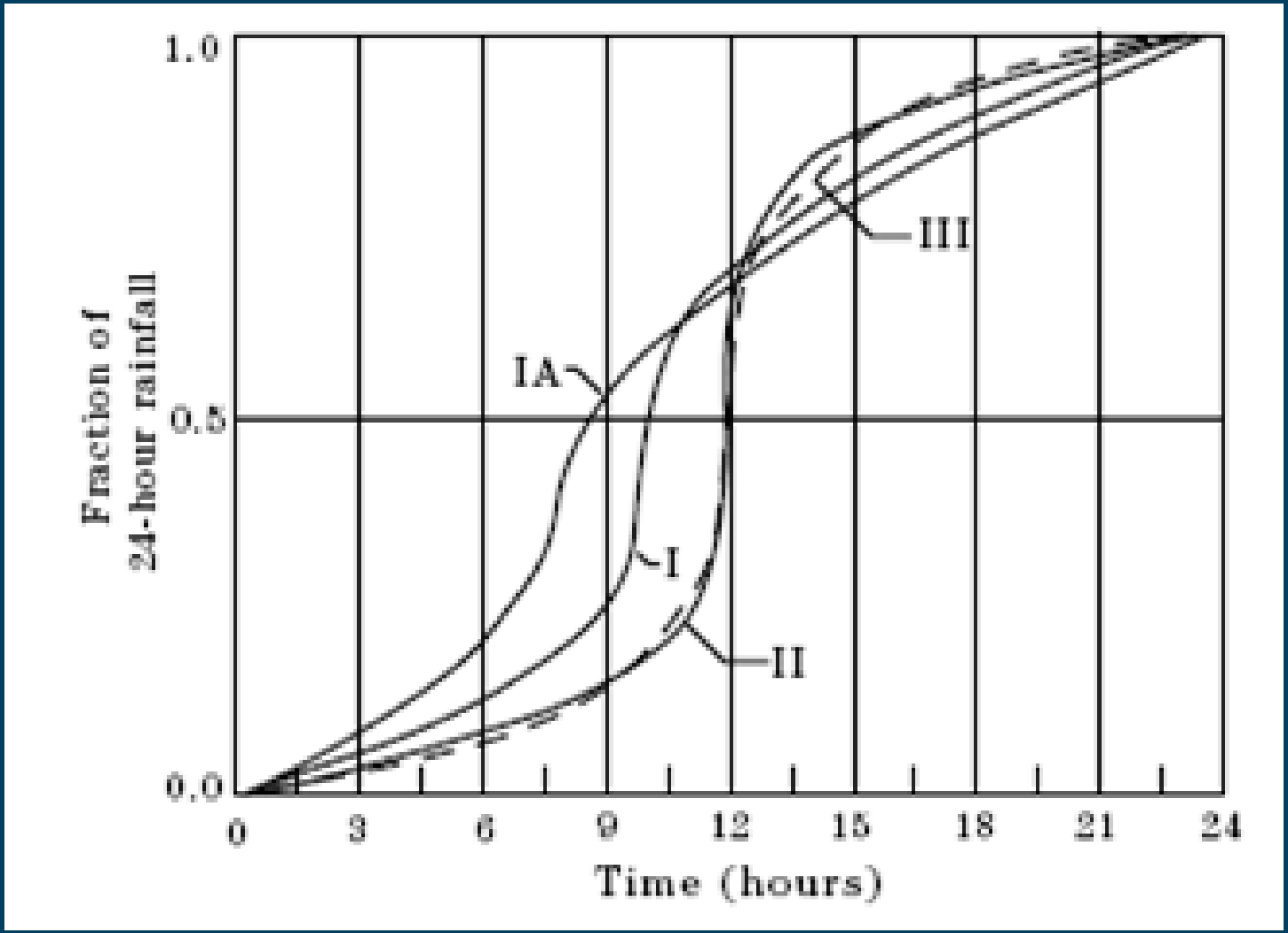
- Atlas 14 Precipitation Frequency Data Server (PFDS)

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

Atlas 14 Website Demonstration

- See Webinar for a demonstration of getting precipitation frequency estimates and downloading data.

Rainfall Distributions (SCS Method)



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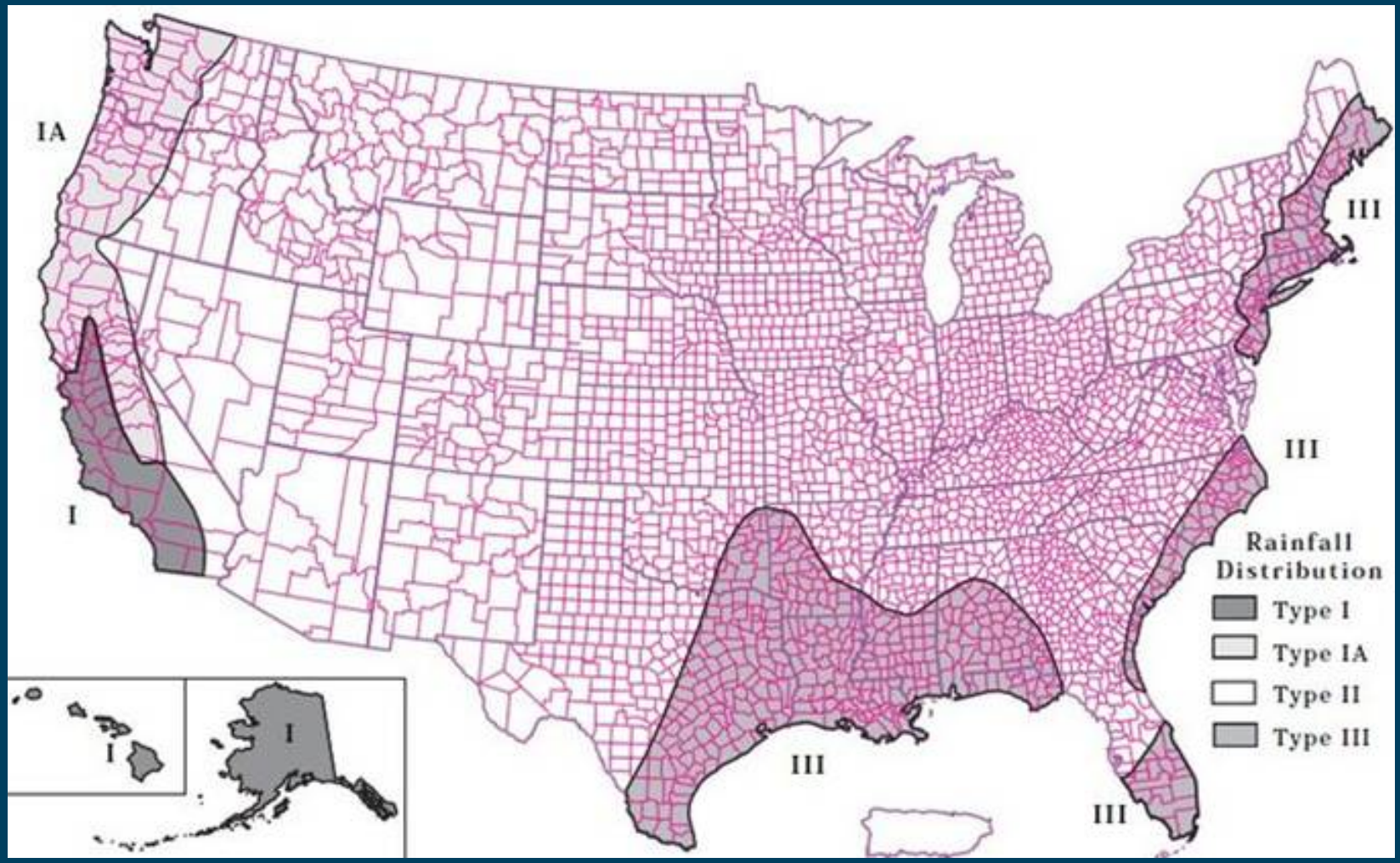


Rainfall Distributions (SCS Method)

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

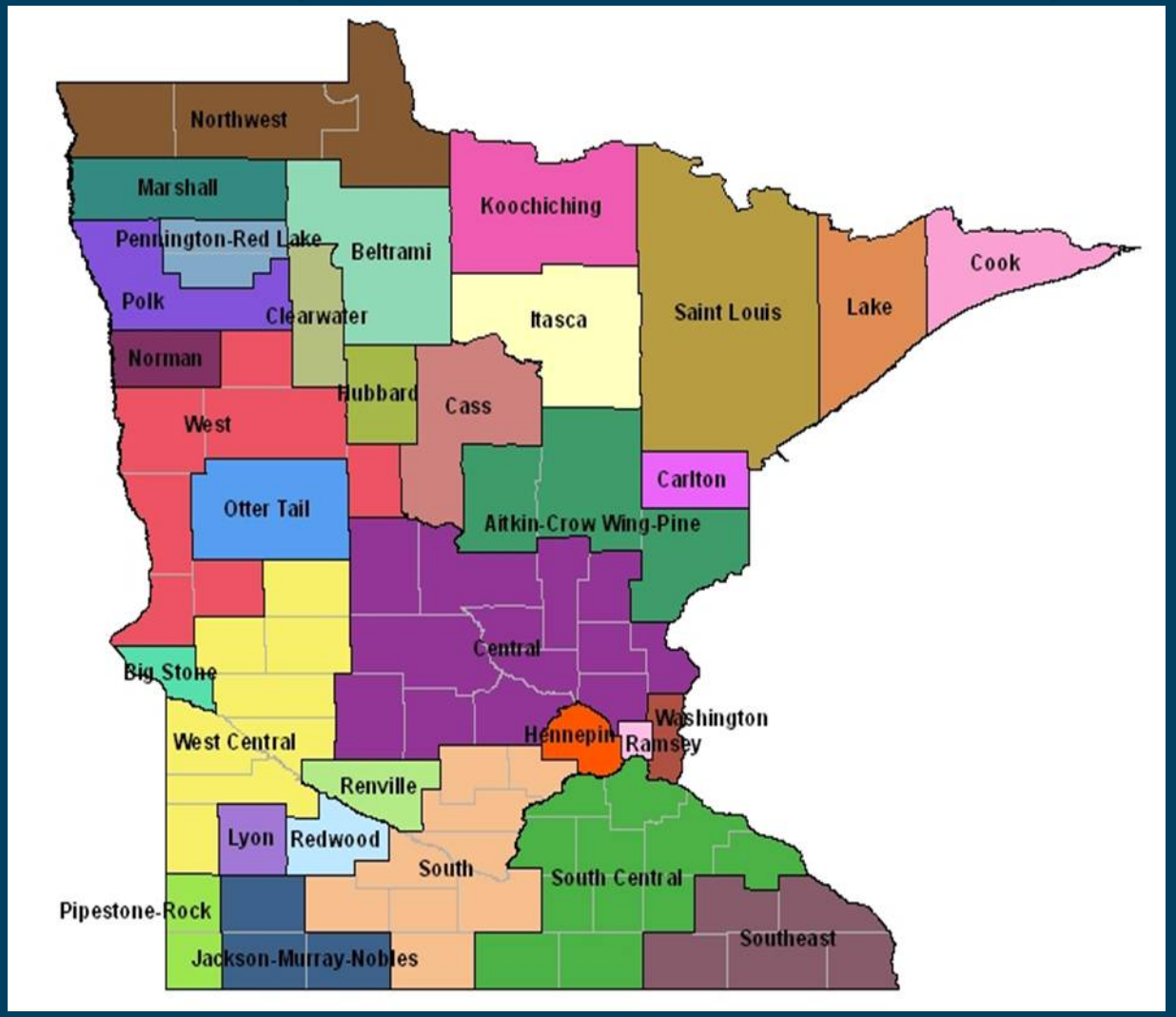
http://www.dot.state.mn.us/bridge/hydraulics/atlas14/pdf/Atlas14_RainfallDistributions.pdf

Rainfall Distributions (SCS Method)

- Use the NRCS Type II distribution when custom distribution is not feasible
- Type I Distribution not 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)

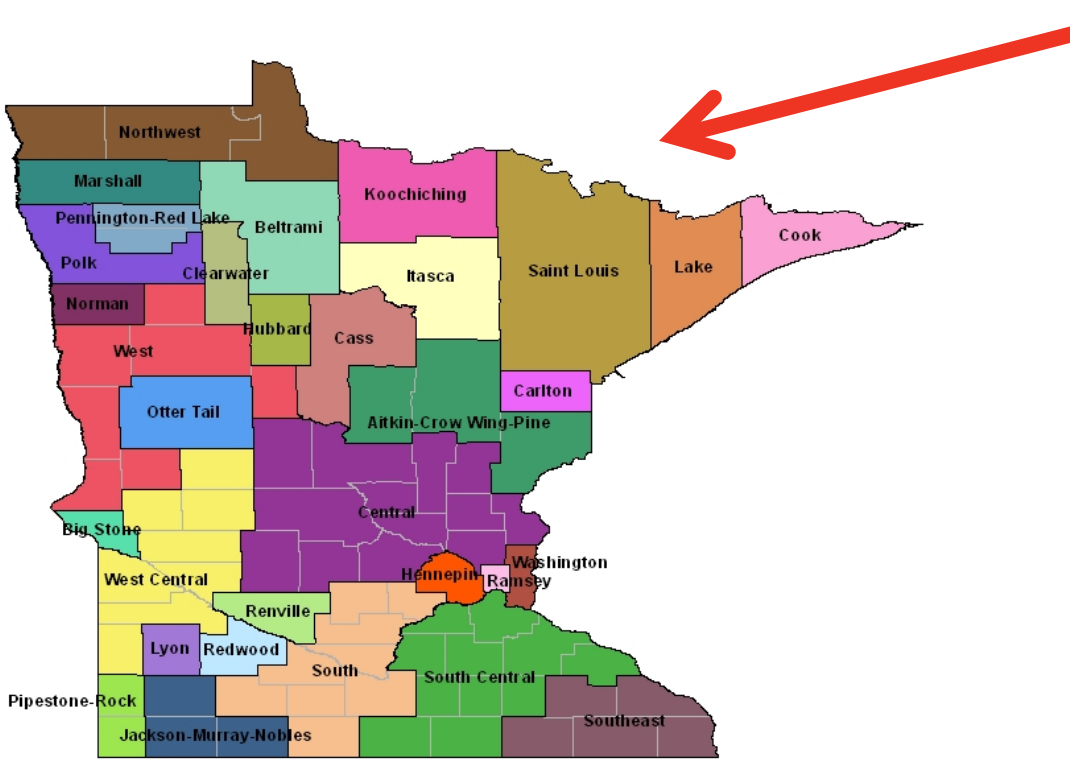
Hydraulics

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).



Time of Concentration	2 year
5 min	5.68
6 min	5.34
7 min	5.26
8 min	5.12
9 min	4.86
10 min	4.16
11 min	3.99
12 min	3.83
13 min	3.67
14 min	3.53
15 min	3.38
16 min	3.30
17 min	3.22
18 min	3.14
19 min	3.07
20 min	2.99
21 min	2.92
22 min	2.85

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

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 Hydrometerological Design Studies Centert (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 Memorandu[illegible]se 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

Contact Information

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  - Juanita.Voigt@state.mn.us

Question & Answer Session

- Adobe Connect Meeting
  - August 14, 2013
  - 10:30 AM – 11:30 AM

http://mndot.adobeconnect.com/atlas14_qa/

- Instructions:
  - Follow the link listed
  - Log in as a guest
  - Enter phone number to dial out (You will receive a call to this number to enable audio conference)