PROJECT TITLE: **Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs.**

PROJECT MANAGER:	C. Bruce Wilson
AFFILIATION :	Minnesota Pollution Control Agency
MAILING ADDRESS:	520 Lafayette Road North
CITY/STATE/ZIP:	St. Paul, MN 55155-4194
PHONE:	651-757-2828
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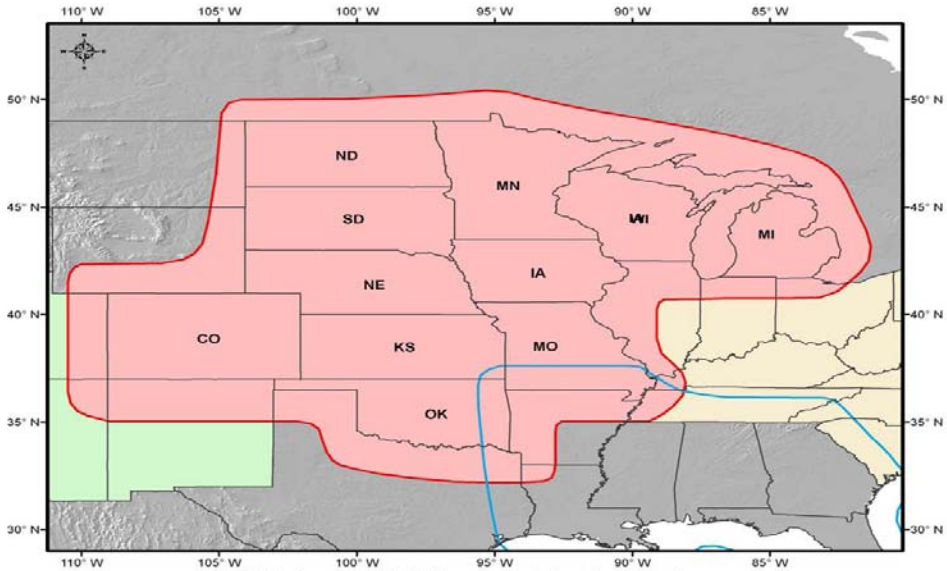
WEBSITES:	http://www.pca.state.mn.us/
	http://hdsc.nws.noaa.gov/hdsc/pfds/

FUNDING SOURCE:	Environment and Natural Resources Trust Fund
LEGAL CITATION:	M.L. 2008, Chp. 367, Sec 2, Subd. 5(c)
APPROPRIATION AMOUNT:	$100,000

Overall Project Outcome and Results

Checking the daily weather forecast for where and how bad the next storms will be has become a more important part of our daily routines. Recent variable climate (dry periods, intense storms and floods) have brought heightened awareness by farmers, engineers, cities and water managers of rainfall intensity (how fast) and duration (how long). Up to now, available summaries (done in the early 1960's) were based on relatively crude analyses of rainfall data collected through the 1950's. This project has updated precipitation intensities based on the compilation of hundreds of rainfall monitoring locations in and around Minnesota (including our neighboring Canadian and adjacent state partners) with continuous data collected through 2009 via a partnership with the National Oceanic and Atmospheric Administration, National Weather Service (NOAA/NWS). State-of-the-art computer-based statistical procedures have generated summary information and maps with a resolution of 4 km by 4 km (or about 2.5 miles by 2.5 miles). NOAA required one contract with all 11 Midwest states (Minnesota, North Dakota, South Dakota, Wisconsin, Michigan, Iowa, Missouri, Colorado, Nebraska, and Kansas) with pass-through funding via the Pooled Highway Fund. All Environment and Natural Resources Trust Fund dollars were expended by June 30, 2011 with additional funding provided by the Minnesota DOT being used to complete the final work components. This study has generated rainfall frequency estimates for durations from 15 minutes to 60 days and for average recurrence intervals from 1 to 1,000 years along with trend analyses. Final web-based products will be available in early 2012 due to delays associated with reducing huge amounts of data from about ½ of the contiguous United States. The results of this work are required for standard engineering practices associated with runoff routing, flood prevention and safe road & culvert designs - and will become part of our daily forecasts ('today's storm is called a hundred year event').

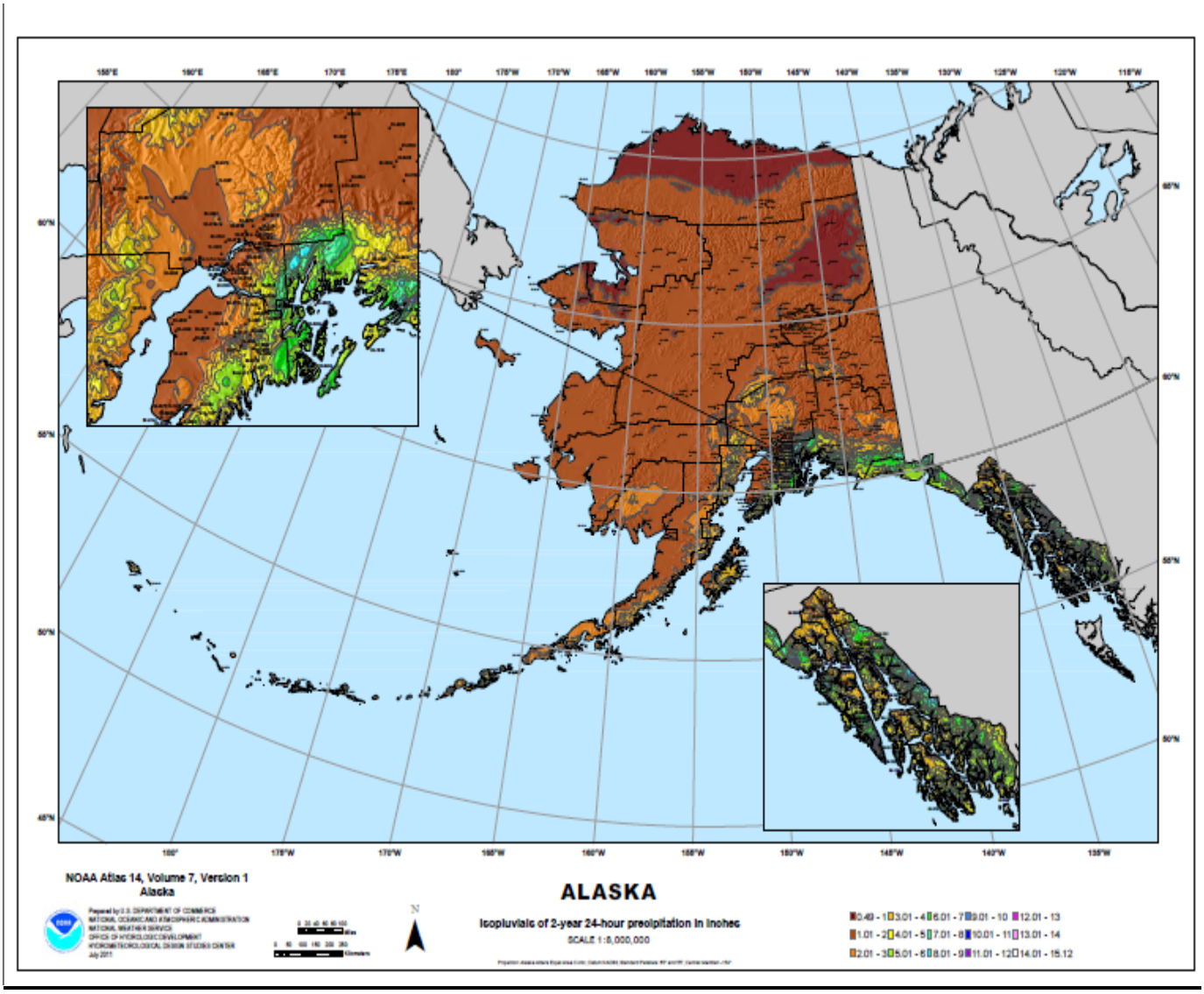


NOAA 14 Midwest Project Area

Project Results Use and Dissemination

1. Precipitation frequency information is required for standard engineering practices for building new roads, highways, bridges, and developments so as to minimize flooding and for water quality treatment, agricultural and other watershed management purposes.
2. This study has resulted in rainfall frequency estimates from 15 minutes to 60 day durations and for average recurrence intervals from 1 to 1,000 years. Data has been summarized in NOAA's nationally recognized standard engineering tables. New products have been developed for inclusion in GIS formats for a wide variety of computer-based applications and website distribution for watershed management purposes. Regional patterns and comparisons to old TP-40 rainfall frequency data will also be available.
3. Project products will be freely available from the NOAA website http://hdsc.nws.noaa.gov/hdsc/pfds including reports, maps and spatial data with precipitation frequency estimates and downloads of digital files including:
    - point estimates (via a point-and-click interface)
    - ArcInfo© ASCII grids
    - ESRI shapefiles
    - color cartographic maps for each state
    - associated Federal Geographic Data Committee-compliant metadata
    - data series used in the analyses: annual maximum series and partial duration series
    - temporal distributions of heavy precipitation (6-hour, 12-hour, 24-hour and 96-hour)
    - seasonal exceedance graphs: counts of events that exceed the 1 in 2, 5, 10, 25, 50 and 100 annual exceedance probabilities for the 60-minute, 24-hour, 48-hour, and 10-day durations.

State and regional examples from completed NOAA/NWS work for other US areas are included below. State precipitation frequency products. The below graphic depicts considerable variation in intensity in the typical storm that occurs once every 2 years over a 24 hour period across Alaska. In this example, lesser amounts associated with brown colors (e.g. less than 3 inches) with greater amounts shown in green (~ 5 to 9 inches) and yet greater amounts in blue/pink (e.g. 9 to 15 inches).



Example Regional Products. The above product for east-central US depicts the percent change in rainfall between the old TP-40 rainfall intensity data to the new NOAA Atlas 14 for a 100 year, 24 hour storm event with green colors showing increased amounts (up to 30% to 80 % (pocket by Chicago) increase from TP-40 values) and red shades depicting declining amounts (up to ~ 30% declines in the mountain areas from old TP-40 values). Hence, using TP-40 data could result in the use of significantly different

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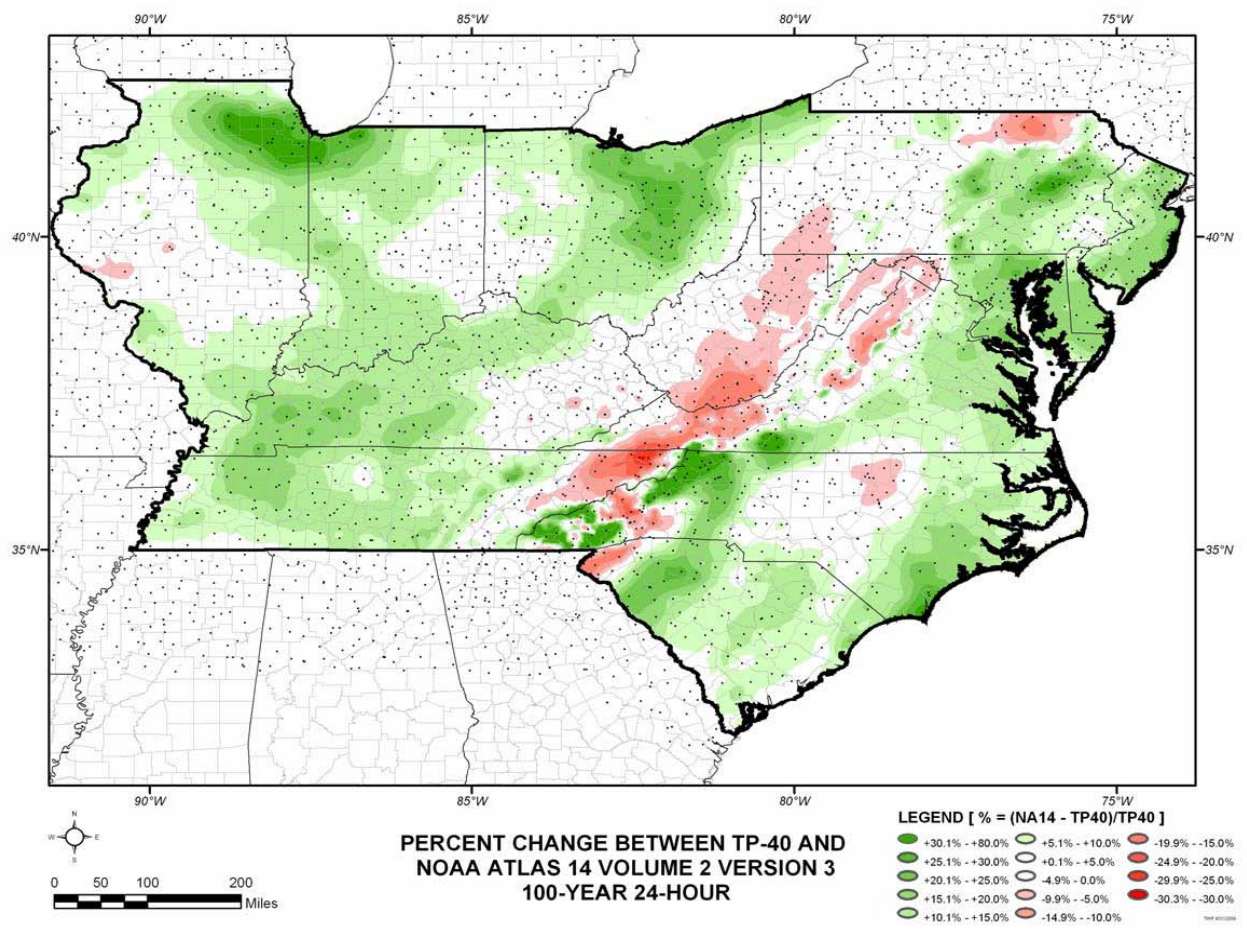


Summary of Final Deliverables to be Freely Disseminated by Spring 2012:

- Web-based Precipitation Frequency Data Server.
- Precipitation frequency estimates with 90% confidence intervals at rain gage locations for durations of 15, and 30 minutes,1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years.
- High resolution grids of average precipitation frequency estimates and 90% confidence intervals for each combination of duration and average recurrence intervals, as specified above. .
- Shapefiles of contours of the gridded estimates of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals specified above.
- Meta information in Federal Geographic Data Transfer Standard format.
- Cartographic maps of the estimates with one map for each combination of frequency and duration for the expected value and upper and lower 90%

confidence intervals or equivalent information delivered through an Internet map server.

- Probabilistic temporal distributions for 6, 12, 24 and 48 hour durations in both chart and digital form.
- Peer reviews of initial gridded frequency estimates for 1 and 24 hour durations and for 2-year and 100-year average recurrence intervals.
- Charts of the seasonal distribution of annual maxima.
- Documentation.
- Status reports.
- Final products will be provided on the NOAA/NWS website **www.nws.noaa.gov/ohd/hdsc**

Environment and Natural Resources Trust Fund
2008 Work Program Final Report

Date of Report: August 5, 2011
Final Report
Date of Work program Approval: June 10, 2008
Project Completion Date: June 30, 2011

I. PROJECT TITLE: **Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs.**

Project Manager: C. Bruce Wilson
Affiliation: Minnesota Pollution Control Agency
Mailing Address: 520 Lafayette Road North
City / State/Zip: St. Paul, MN 55155-4194
Telephone Number: 651-757-2828
E-mail Address: bruce.wilson@state.mn.us
Fax Number: 651-297-8337
Web Page address: http://www.pca.state.mn.us/
http://hdsc.nws.noaa.gov/hdsc/pfds/

Location: Statewide

Total Trust Fund Project Budget:	**Trust Fund Appropriation:**	**$ 100,000**
	Minus Amount Spent:	**$ 100,000**
	Equal Balance:	**$ 0**

Legal Citation: M.L. 2008, Chp. 367, Sec 2, Subd. 5(c)

Appropriation Language:

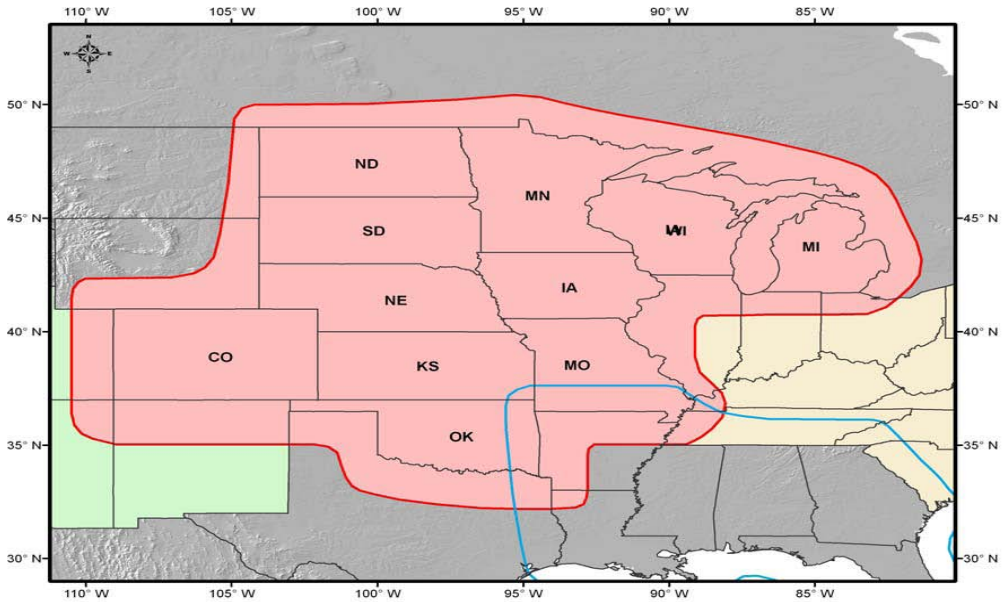
$100,000 is from the trust fund to the Commissioner of the Minnesota Pollution Control Agency (MPCA) for a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA) to partially fund a multi-state effort to obtain updated climate change related rainfall frequencies to enhance engineering of stormwater conveyance and treatment systems and roads. The acquired data shall be distributed free of charge. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II. and III. Final Project Summary and Results:

Checking the daily weather forecast for where and how bad the next storms will be has become a more important part of our daily routines. Recent variable climate (dry periods, intense storms and floods) have brought heightened awareness by farmers, engineers, cities and water managers of rainfall intensity (how fast) and duration (how long). Up to now, available summaries (done in the early 1960's) were based on relatively crude analyses of rainfall data collected through the 1950's. This project has updated precipitation intensities based on the compilation of hundreds of rainfall monitoring locations in and around Minnesota (including our neighboring Canadian and adjacent state partners) with continuous data collected to 2009 via a partnership with the National Oceanic and Atmospheric Administration, National Weather Service (NOAA/NWS). State-of-the-art computer-based statistical procedures have generated summary information and maps with a resolution of 4 km by 4 km (or about 2.5 miles by 2.5 miles). NOAA required one contract with all 11 Midwest states (Minnesota, North

Dakota, South Dakota, Wisconsin, Michigan, Iowa, Missouri, Colorado, Nebraska, and Kansas) with pass-through funding via the Pooled Highway Fund. All Environment and Natural Resources Trust Fund dollars were expended by June 30, 2011 with additional funding provided by the Minnesota Department of Transportation (Mn/DOT) being used to complete the final work components. This study has generated rainfall frequency estimates for durations from 15 minutes to 60 days and for average recurrence intervals from 1 to 1,000 years along with trend analyses. Final web-based products will be available in early 2012 due to delays associated with reducing huge amounts of data from about half of the contiguous United States. The results of this work are required for standard engineering practices associated with runoff routing, flood prevention and safe road and culvert designs and will become part of our daily forecasts (today's storm is called a 'hundred-year storm').

Progress Summary as of September 8, 2010:



NOAA 14 Midwest Project Area

Project Results Use and Dissemination

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2. This study has resulted in rainfall frequency estimates from 15 minutes to 60-day durations and for average recurrence intervals from 1 to 1,000 years. Data has been summarized in NOAA's nationally recognized standard engineering tables. New products have been developed for inclusion in GIS formats for a wide variety of computer-based applications and website distribution for watershed management purposes. Regional patterns and comparisons to old TP-40 rainfall frequency data will also be available.
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    - Color cartographic maps for each state

- Associated Federal Geographic Data Committee compliant metadata
- Data series used in the analyses: annual maximum series and partial duration series
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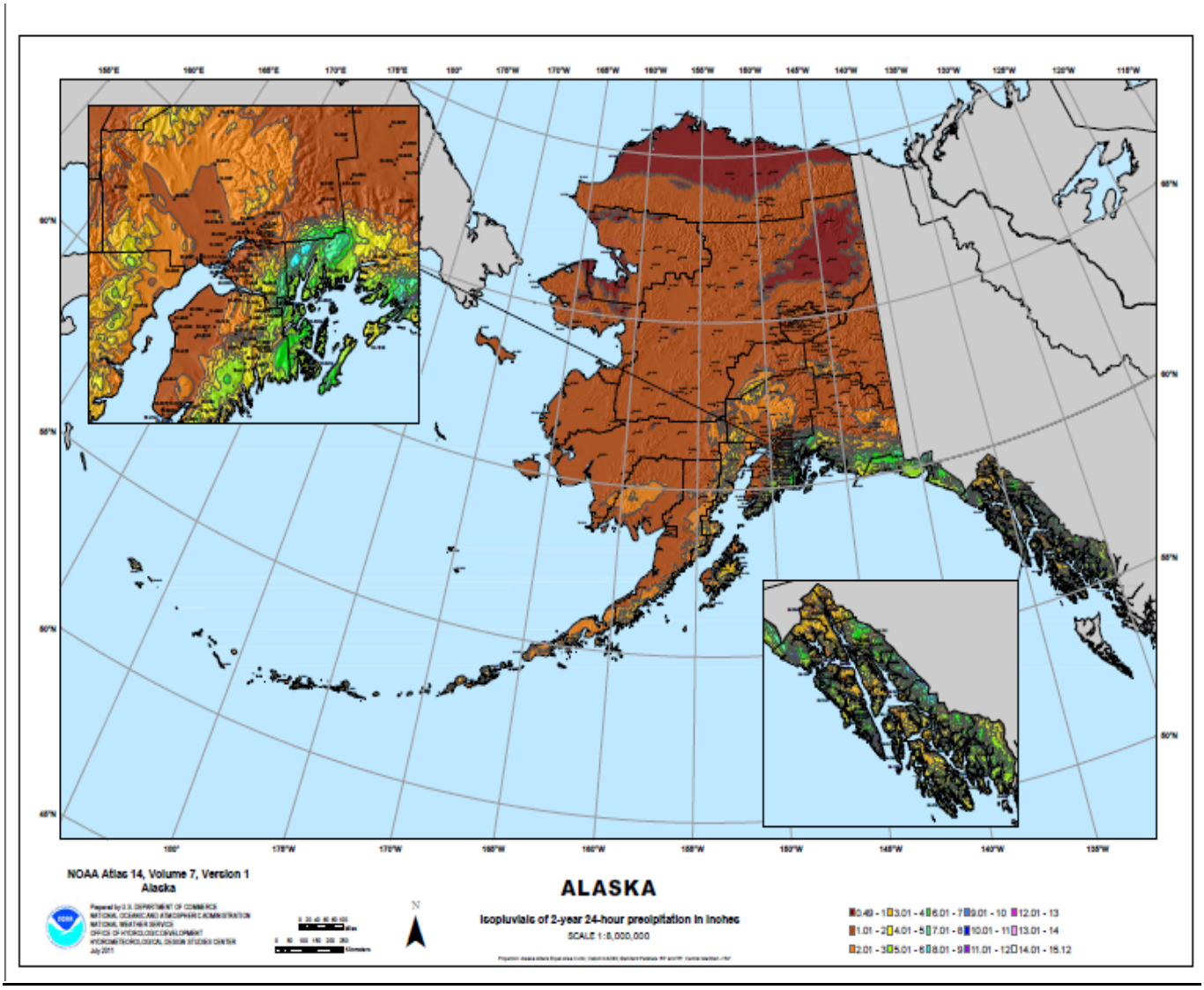
State and regional examples from completed NOAA/NWS work for other US areas are included below. The below graphic depicts considerable variation in intensity in the typical storm that occurs once every 2 years over a 24-hour period across the state of Alaska. In this example, lesser amounts associated with brown colors (e.g. less than 3 inches) with greater amounts shown in green (~ 5 to 9 inches) and yet greater amounts in blue/pink (e.g. 9 to 15 inches).



Example: Regional Products. The below graphic for the east-central US depicts the percent change in rainfall between the old TP-40 rainfall intensity data to the new NOAA Atlas 14 for a 100-year, 24-hour storm event with green colors showing increased amounts (up to 30% to 80% (pocket by Chicago)

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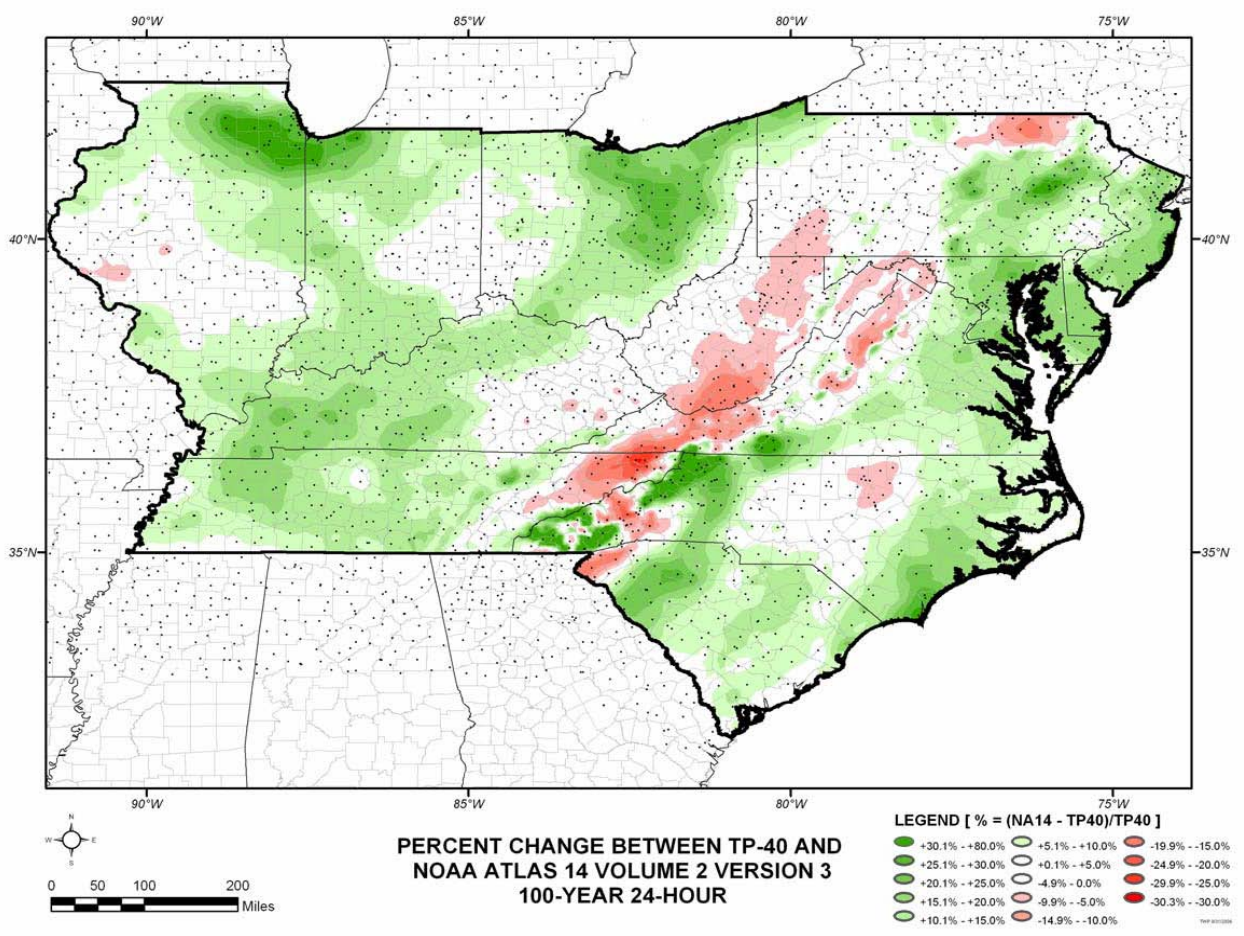


Summary of Final Deliverables to be freely Disseminated by Spring 2012:

- NOAA Web-based Precipitation Frequency Data Server
- Precipitation frequency estimates with 90% confidence intervals at rain gage locations for durations of 15 and 30 minutes,1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years
- High resolution grids of average precipitation frequency estimates and 90% confidence intervals for each combination of duration and average recurrence intervals, as specified above.
- Shapefiles of contours of the gridded estimates of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals specified above
- Meta information in Federal Geographic Data Transfer Standard format
- Cartographic maps of the estimates with one map for each combination of frequency and duration for the expected value and upper and lower 90% confidence intervals or equivalent information delivered through an Internet map server

- Probabilistic temporal distributions for 6, 12, 24 and 48 hour durations in both chart and digital form
- Peer reviews of initial gridded frequency estimates for 1 and 24 hour durations and for 2-year and 100-year average recurrence intervals
- Charts of the seasonal distribution of annual maxima
- Documentation
- Status reports
- Final products will be provided on the NOAA/NWS website **www.nws.noaa.gov/ohd/hdsc**

IV. Outline of Project Results:

Total Budget: $200,000; Environmental Trust Fund Contribution: $100,000

Deliverable Sequence	**Grand Completion Date: June 30, 2011**

Result 1: Data collection and quality control.

Description: Daily and hourly rain gauge data are the primary sources of information for this project. There were 344 daily Minnesota precipitation stations chosen from the MNDNR Climatology office (including three from just across the border in Wisconsin). Each of these stations had at least 10 years of data. The data period was from 1970 to January, 2009. The longest record in the file was 43 years beginning in 1966. In addition, 22 stations were used from the Metropolitan Council Environmental Services, Minnesota: Metering and Alarm Rainfall Database providing 15 minute data. Our Canadian partners (Environment Canada) contributed 284 daily stations that were included in the Midwest study. In addition, 35 stations provided hourly data, a significant amount of data, to help better define border patterns.

Rainfall data for other durations (5-min, 15-min) were collected and used to develop short-duration frequency estimates. The data has been assembled in digital form in a manner that is amenable to manipulation and collation in variety of different ways. The specific form of the storage will follow the techniques and formats refined during the development of NOAA Atlas 14 Volumes 1-3.

Data which may contribute to estimation of annual maximum series, partial duration series, or temporal distributions has been quality controlled. Data whose quality is not satisfactory was removed from the database and will not be used in subsequent analyses. In cases where data were changed, the change will be maintained in a log for future reference.

The data were analyzed to determine the seasonality of heavy rainfall. Seasonality was used as additional quality control measure by excluding years in which there are insufficient observations during the heavy rainfall months. The data records were also examined to ensure a minimum number of data years at each station. Stations with an insufficient number of data years will be excluded. The minimum number of data years is a tradeoff between a sufficient number of data years and a sufficient density of stations included in the analysis. Stations with large gaps in the period of record have been examined to ensure that there is no change in statistics across the gap. Nearby stations with complementary periods of record that would otherwise have an insufficient number of data years were examined as candidates for merging.

The data will be used to create annual maximum series (AMS) and partial duration series (PDS). Those series was examined for potential outliers and for trends in time series that may be caused by

urbanization, climate change, etc. It was found that there was insufficient data in Minnesota to evaluate the very short term duration events less than 15 minutes.

Summary Budget Information for Result 1: Trust Fund Budget: $50,000
Amount Spent: $50,000
Balance: $ 0

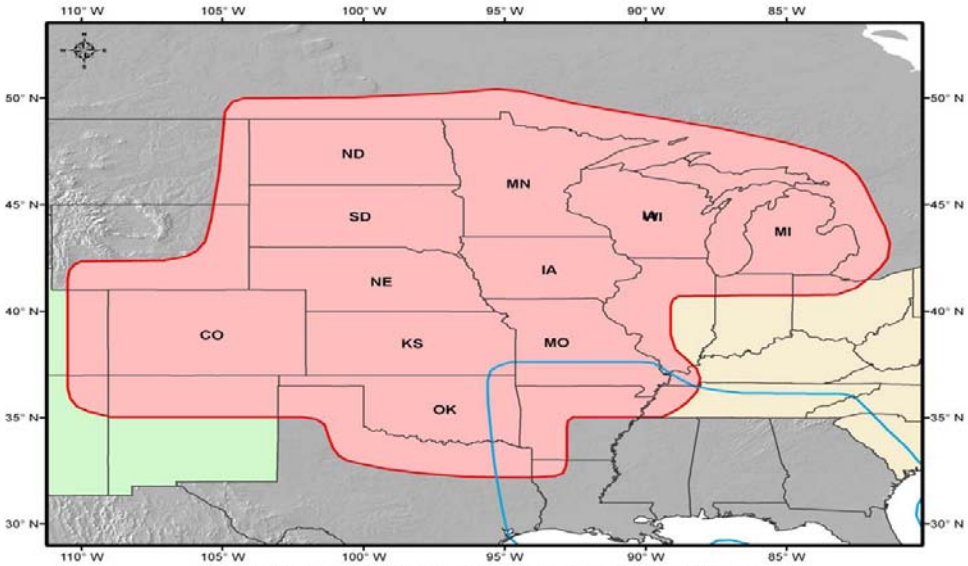
Deliverable	Completion Date	Budget	Status
1. This task resulted in development of a data base of observations and extracted time series that is the basis for subsequent analyses.	September 30, 2009.	$50,000	Spent

Final Report Summary

The last of 11 Midwest states entered into contracts with NOAA/NWS and submitted funds via the Federal Highway Administration Pooled Fund Program by April, 2009. The project, while more cost efficient with 11 states, got off to a slower start due to the extent of administrative details and sheer volume of data from about ½ of the contiguous United States.

The Hydrometeorological Design Studies Center of the National Weather Service Headquarters (Silver Spring, MD) began data transfer inquiries and distributing protocols in August, 2008. Preliminary data uploading from the Minnesota State Climatology Office (Greg Spoden) was initiated at that time.

Primary activities in this period focused on data reformatting, initial data quality control, and extraction of annual maximum series. The Minnesota Department of Natural Resources Office of Climatology submitted our Minnesota data which has been formatted. Minnesota contributed 344 stations having at least 10 years of daily data but NOAA rejected volunteer monitoring data that did not have at least 10 years of observations.



NOAA 14 Midwest Project Area

Data collection, formatting and initial quality control reviews were completed and reported by NOAA in their quarterly report through April, 2010. This work element was completed in November, 2010.

Result 2. Regionalization

Description: NWS's rainfall frequency analysis approach relies on the development of homogeneous climatological geographic areas. This step will result in the definition of regions that may be considered homogenous based on climatological characteristics and selected statistical criteria.

Summary Budget Information for Result 2: Trust Fund Budget: $25,000
Amount Spent: $25,000
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. Develop precipitation regions.	December 31, 2009	$25,000	Spent

Final Report Summary

The addition of the Southeast states (Arkansas, Louisiana, Mississippi, Alabama, Georgia and Florida to the effort slowed completion of the regionalization, but has improved the quality of the final products. NOAA reported that work was completed at this time for the Midwest state, subject to peer review of products.

Result 3. Frequency distribution selection and fitting studies

Description: A suite of probability distribution functions have been evaluated for best fit to data. The outcome of this task is the selection of the best frequency distribution for each region and each storm duration for both annual maximum and partial duration series. The parameters of the selected distributions were computed as were the ratios of average partial duration to annual maximum estimates for different exceedance probabilities.

Summary Budget Information for Result 3: Trust Fund Budget: $25,000
Amount Spent: $25,000
Balance: $ 0

Deliverable	Completion Date	Budget	Status
1. Statistical frequency distributions for each region	March 31, 2010	$25,000	Spent

Final Report Summary.

Work began in late 2009 looking at wet season frequency analyses. NOAA reports that this work has been completed for Minnesota with publication pending completion of review of the entire Midwest and Southeast US data (for outliers, trends and refining spatial patterns).

Other Related Results to be Completed Using Other Funds

- **Frequency calculations:** NWS has used the above determined best-fit probability distributions for each region and duration to compute the precipitation frequency estimates at each rain gage location. The product of this task is a set of precipitation frequency estimates for durations from 60 minutes to 60 days at each observation location.
- **Short Duration Estimates:** Due to the scarcity of data with duration of less than 1 hour, precipitation frequency estimates for sub-hourly durations was computed as a ratio of hourly duration estimates, for sites with adequate data. The final products of this task will be sub-hourly precipitation frequency estimates at each hourly station in the project area.

- **Internal Consistency at Observing Locations:** An extensive quality control continues to be performed on all frequency estimates. For example, for each average recurrence interval and location precipitation frequency estimates will be compared with longer-duration estimates to ensure that estimates are not higher for shorter durations than for longer durations. The product from this task will be a set of precipitation frequency values, for each duration, at each observing location that satisfy at-site internal consistency.
- **Spatial Interpolation and Consistency:** Precipitation frequency estimates computed at observing locations have been spatially interpolated to grids with a spacing of approximately 1 to 4 miles. The spatial interpolation process will account for variation in terrain and will produce grids which are consistent from one grid to the next. This task has produced spatially interpolated high resolution grid of precipitation frequency estimates for each combination of average recurrence interval and duration across the project area domain.
- **Mapping Products:** A variety of mapping products has been produced to assist users in interpreting and using the precipitation frequency estimates including: digital versions of spatially interpolated grids, vector representations of the contoured grids, and high quality cartographic maps in 'pdf' format. This availability will allow users to incorporate digital versions of the estimates directly in their applications without having to go through expensive and error prone digitizing steps as in past publications.
- **Temporal Distributions:** NWS has developed precipitation temporal distribution curves for 6-, 12-, 24-, and 96 hour durations and make data available in ASCII files through their website.
- **Peer Reviews:** The development of precipitation frequency estimates will be distributed to an invited list of local climate experts for peer review from our State Climatology Office and University of Minnesota. NOAA will analyze final comments, make appropriate actions and publish the results.
- **Documentation:** All aspects of the development has been documented in sufficient depth to allow the knowledgeable user to understand the basis of the estimates and their scope and applicability. The documentation developed for NOAA Atlas 14 Volumes 1-3 was approximately 250-300 pages for each volume, significantly more than provided in the past.
- **Status Reporting:** NOAA will continue to provide quarterly status reports as this part of the national effort winds down. Reports will document progress in the preceding quarter, status of the entire project, issues, activities expected in the coming quarter and expected completion schedule.

V. TOTAL TRUST FUND BUDGET

Staff or Contract Services: $100,000
$100,000 for contract with NOAA/NWS to accumulate updated precipitation intensities data.
TOTAL TRUST FUND PROJECT BUDGET: $100,000

VI. OTHER FUNDS and PARTNERS:

A. Project Partners: Minnesota Department of Transportation, Local Road Research Board

B. Other Funds Proposed to be spent during the Project Period: $100,000 from the Minnesota Department of Transportation, Local Road Research Board.

C. Past Spending: *Not applicable*

D. Time: Three years duration beginning July 1, 2008 and ending June 30, 2011

VII. DISSEMINATION:
This study will result in more reliable rainfall frequency estimates for rainfall durations from 15 minutes to 60 days and for average recurrence intervals from 1 to 1,000 years. All reasonably available rainfall data has been quality controlled and used in the analysis. State-of-the-art geographic-based statistical techniques have been used to produce maps, tables and graphics to nationally accepted standard protocols. Discrete data has been spatially interpolated to a resolution of 4 km by 4 km (or about 2.5 miles by 2.5 miles). Project products will be freely available from the NOAA website: http://hdsc.nws.noaa.gov/hdsc/pfds including reports, maps and spatial data with precipitation frequency estimates.

Summary of Final Deliverables to be Disseminated:
Summary listing of all reportables:

- Web-based Precipitation Frequency Data Server
- Precipitation frequency estimates with upper and lower 95% confidence limits (i.e., 90% confidence intervals) at rain gage locations for durations of 15, and 30 minutes, 1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years.
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- Charts of the seasonal distribution of annual maxima
- Documentation
- Status reports

Delivery of all final products on the NOAA/NWS website: **www.nws.noaa.gov/ohd/hdsc**

VIII. REPORTING REQUIREMENTS:
Periodic work program progress reports will be submitted beginning June 30, 2008 in this sequence:
Interstate Participation Summary and Project Status as of *June 30, 2008;*
Initial Work Effort Status as of *December 31, 2008;*
Status as of *June 30*, 2009;
Status as of *December 31,* 2009;
Status as of *June 30*, 2010;
Status as of *December 31, 2010; and*
Status as of *June 30, 2011.*

A final work program report and associated products will be submitted between June 30 and August 1, 2011 as requested by the LCCMR. *Quarterly update reports from NOAA/NWS shall be provided to the LCCMR in addition to the formal reporting sequence defined in this work plan. .*

IX. RESEARCH PROJECTS:

This is an applied research project using NOAA/NWS established protocols to develop standard precipitation duration and frequency estimates.

2008 Project Abstract
For the period ending June 30, 2011

PROJECT TITLE: **Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs**

PROJECT MANAGER:	C. Bruce Wilson
AFFILIATION :	Minnesota Pollution Control Agency
MAILING ADDRESS:	520 Lafayette Road North
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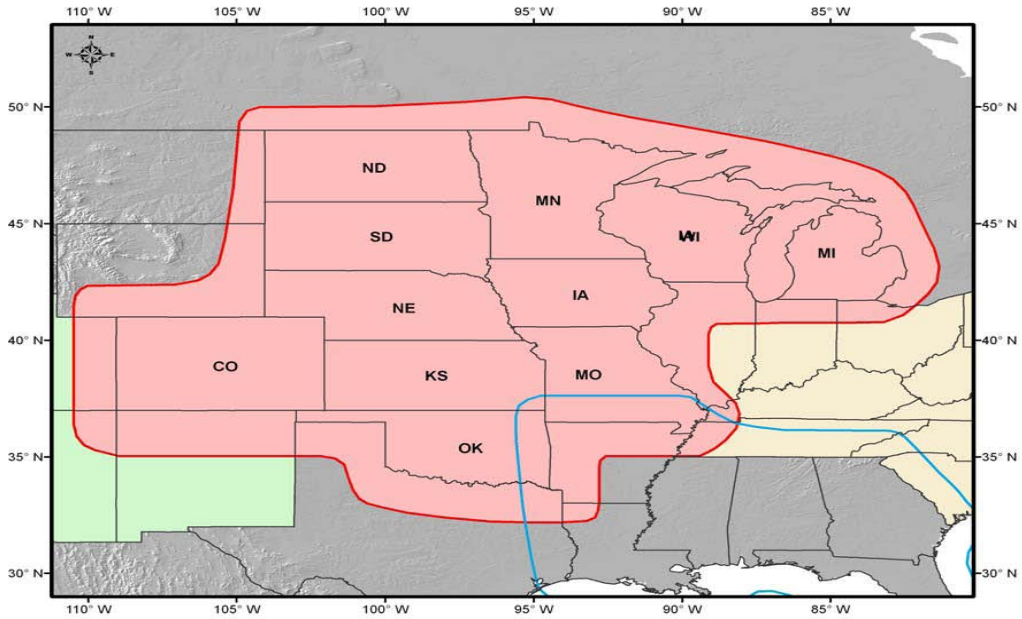

NOAA 14 Midwest Project Area

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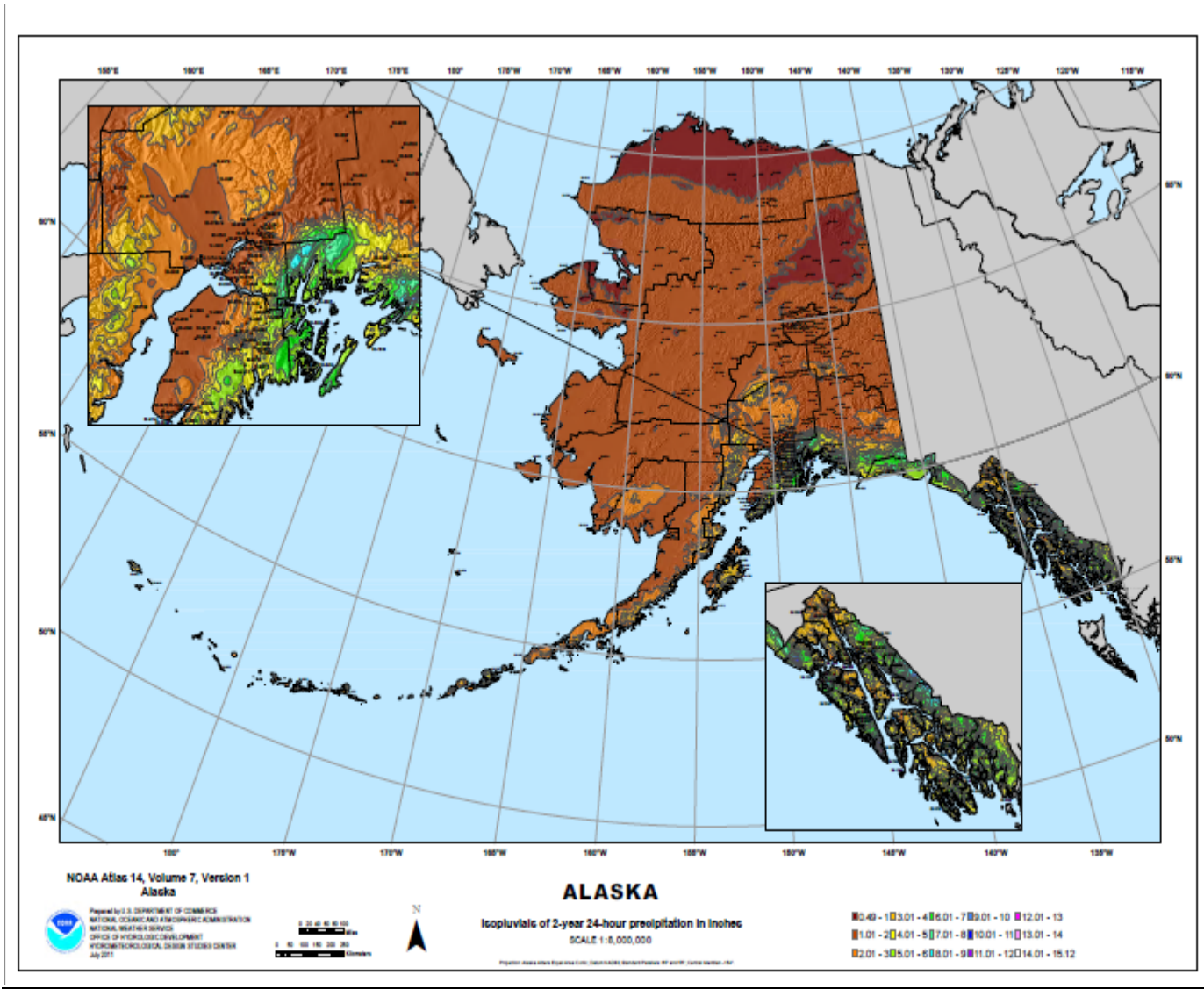
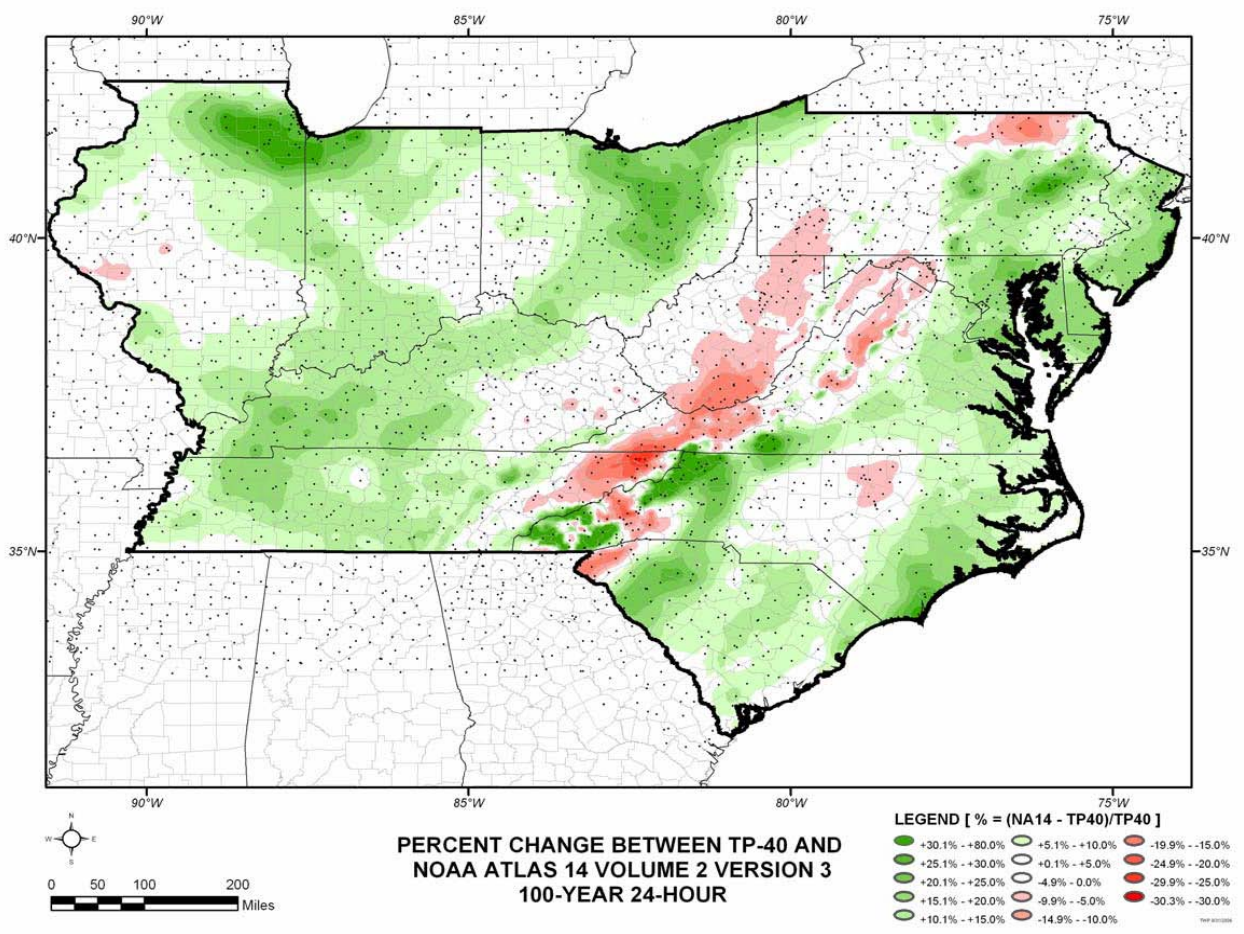
- data series used in the analyses: annual maximum series and partial duration series
- temporal distributions of heavy precipitation (6-hour, 12-hour, 24-hour and 96-hour)
- seasonal exceedance graphs: counts of events that exceed the 1 in 2, 5, 10, 25, 50 and 100 annual exceedance probabilities for the 60-minute, 24-hour, 48-hour, and 10-day durations

State and regional examples from completed NOAA/NWS work for other US areas are included below. State precipitation frequency products. The below graphic depicts considerable variation in intensity in the typical storm that occurs once every 2 years over a 24-hour period across Alaska. In this example,

lesser amounts associated with brown colors (e.g. less than 3 inches) with greater amounts shown in green (~ 5 to 9 inches) and yet greater amounts in blue/pink (e.g. 9 to 15 inches).



Example: Regional Products. The below product for east-central US depicts the percent change in rainfall between the old TP-40 rainfall intensity data to the new NOAA Atlas 14 for a 100-year, 24-hour storm event with green colors showing increased amounts (up to 30% to 80% (pocket by Chicago) increase from TP-40 values) and red shades depicting declining amounts (up to ~ 30% declines in the mountain areas from old TP-40 values). Hence, using TP-40 data could result in the use of significantly different rainfall amounts than current data would suggest, for the design of developments and associated infrastructure.



Summary of Final Deliverables to be Freely Disseminated by Spring 2012:

- NOAA web-based Precipitation Frequency Data Server
- Precipitation frequency estimates with 90% confidence intervals at rain gage locations for durations of 15, and 30 minutes,1, 2, 3, 6, 12 hours, and 1, 2, 4, 7, 10, 20, 30, 45, and 60 days and average recurrence intervals (return period)) of 1, 2, 5, 10, 25, 50, 100, 200, 500, and 1000 years
- High resolution grids of average precipitation frequency estimates and 90% confidence intervals for each combination of duration and average recurrence intervals, as specified above .
- Shapefiles of contours of the gridded estimates of average precipitation frequency estimates and 90% confidence intervals for each combination of durations and average recurrence intervals specified above
- Meta information in Federal Geographic Data Transfer Standard format
- Cartographic maps of the estimates with one map for each combination of frequency and duration for the expected value and upper and lower 90% confidence intervals or equivalent information delivered through an Internet map server
- Probabilistic temporal distributions for 6, 12, 24 and 48 hour durations in both chart and digital form
- Peer reviews of initial gridded frequency estimates for 1 and 24 hour durations and for 2-year and 100-year average recurrence intervals
- Charts of the seasonal distribution of annual maxima

- Documentation
- Status reports
- Final products will be provided on the NOAA/NWS website **www.nws.noaa.gov/ohd/hdsc**

Attachment A: Budget Detail for 2008 Projects - Summary and a Budget page for each partner (if applicable)

Project Title: Updating Precipitation Intensities for Runoff Estimation and Infrastructure Designs

Project Manager Name: C. Bruce Wilson (651-757-2828)

Trust Fund Appropriation: $ *100,000*

1) See list of non-eligible expenses, do not include any of these items in your budget sheet

2) Remove any budget item lines not applicable

2008 Trust Fund Budget	**Result 1 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 2 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**Result 3 Budget:**	**Amount Spent** *(date)*	**Balance** *(date)*	**TOTAL BUDGET**	**TOTAL BALANCE**
	Data Collection and Quality Control			*Regionalization*			*Frequency Distribution and Fitting Studies*				
BUDGET ITEM			0			0			0	0	0
PERSONNEL: wages and benefits			0			0			0	0	0
Contracts	50,000		50,000	25,000		25,000	25,000		25,000	100,000	100,000
Professional/technical *(NOAA, via FHWA Interstate Lockbox)*		50,000	-50,000		25,000	-25,000		25,000	-25,000	0	-100,000
Other contracts *(with whom?, for what?) list out: personnel, equipment, etc.*			0			0			0	0	0
Other direct operating costs *(for what? – be specific)*			0			0			0	0	0
Equipment / Tools *(what equipment? Give a general description and cost)*			0			0			0	0	0
Office equipment & computers - NOT ALLOWED unless unique to the project			0			0			0	0	0
Other Capital equipment *(list specific items)*			0			0			0	0	0
Land acquisition			0			0			0	0	0
Land rights acquisition *(less than fee)*			0			0			0	0	0
Professional Services for Acq.			0			0			0	0	0
Printing			0			0			0	0	0
Other Supplies *(list specific categories)*			0			0			0	0	0
Travel expenses in Minnesota			0			0			0	0	0
Travel outside Minnesota *(where?)*			0			0			0	0	0
Construction *(for what?)*			0			0			0	0	0
Other land improvement *(for what?)*			0			0			0	0	0
Other *(Describe the activity and cost) be specific*			0			0			0	0	0
COLUMN TOTAL	**$50,000**	**$50,000**	**$0**	**$25,000**	**$25,000**	**$0**	**$25,000**	**$25,000**	**$0**	**$100,000**	**$0**