A PROPOSAL SUBMITTED TO:
**County of DuPage, Stormwater Management Department**

# Flood-Simulation System Support for Salt Creek, East Branch DuPage River, and West Branch DuPage River in DuPage County, Illinois through November 2026

U.S. Geological Survey
Central Midwest Water Science Center

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CENTRAL MIDWEST WATER SCIENCE CENTER

## Summary

The Salt Creek, East Branch DuPage River, and West Branch DuPage River are small headwater watersheds in northeastern Illinois. A near real-time streamflow simulation system has been developed and is being tested and enhanced by the USGS Central Midwest Water Science Center (CMWSC) in cooperation with the DuPage County Stormwater Management Department (DPC-SMD) to evaluate different rainfall amounts and/or structure operation scenarios.

## Background/Introduction

DuPage County, Illinois is highly urbanized and is one of five collar counties that border Chicago's Cook County in northeastern Illinois. The DuPage County Stormwater Management Department (DPC-SMD) selected continuous simulation and dynamic routing models for use in watershed analysis and floodplain mapping, instead of single-event steady-state models, so that the impacts of antecedent moisture on runoff volumes and peaks, non-uniform precipitation distributions, backwater, flood plain storage, and complex urban stream systems could be studied (County of DuPage, 2020). The County uses the Hydrologic Simulation Program – FORTRAN (HSPF) (U.S. Environmental Protection Agency, 2017) model for hydrologic modeling and the one-dimensional dynamic-wave model Full Equations (FEQ) (Franz, D.D., and Melching, C.S., 1997a) for hydraulic modeling and has developed models for the watersheds in the County.

The USGS CMWSC and DPC-SMD have continued a cooperative program that began in approximately 1985 to install and maintain a precipitation and streamflow gaging network. In 2025, the cooperative gaging network consisted of ten discharge sites (streamgages), three continuous stage sites, 30 tipping-bucket precipitation sites, and one Ott Pluvio precipitation gage site located throughout the county (fig 1). The DPC-SMD operates and maintains three

stage sites in the Salt Creek watershed at Irving Park Road, Elmhurst Quarry, and Harger Road; and one stage site in the West Branch DuPage River watershed at Fawell Dam.

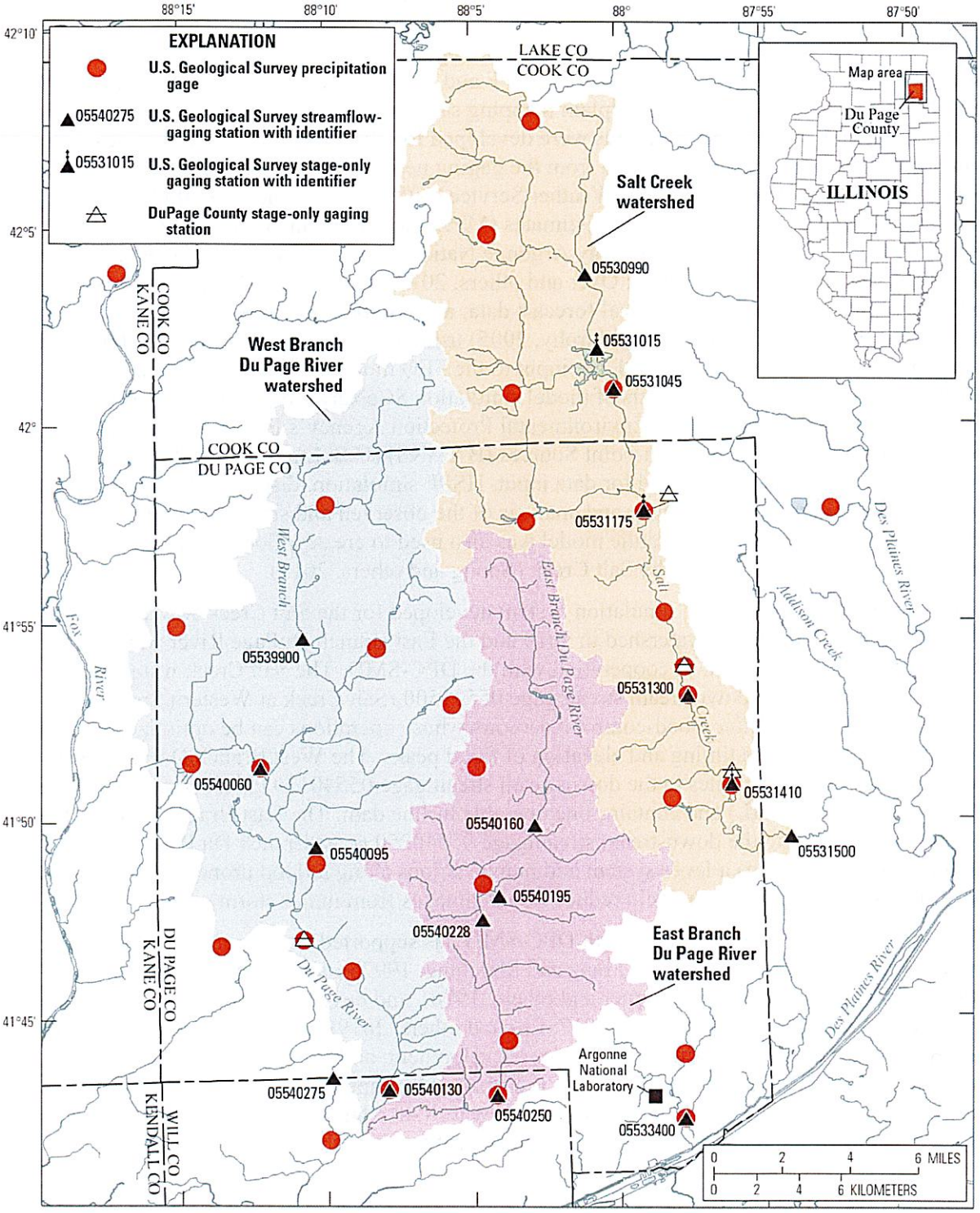

**Figure 1**. Salt Creek, East Branch DuPage River, and West Branch DuPage River watersheds in Northeastern, Illinois.

The USGS CMSWC in cooperation with DPC-SMD started development in approximately 1997 of a near real-time streamflow simulation system for the Salt Creek watershed to evaluate different rainfall amounts and/or hydraulic structure operation scenarios. The near real-time streamflow simulation system uses existing HSPF and FEQ models furnished and used by DPC-SMD in watershed analysis and floodplain mapping studies. The models were modified for use in the simulation system, and programs were developed for retrieving and processing near real-time streamflow and precipitation data from the gaging network (Ortel and Martin, 2010; Bera, ScienceBase data releases), National Weather Service (NWS) Next Generation Radar (NEXRAD) Multisensor Precipitation Estimates (MPE) data (Bera and Ortel, 2018; Ortel and Spies, 2015), U.S. Department of Energy Argonne National Laboratory (ANL) meteorological data (Murphy, 2005; Murphy, 2006; Over and others, 2010; Bera, ScienceBase data releases), NWS precipitation and meteorological forecast data, and computation of potential evapotranspiration (PET) estimates (Murphy, 2005) using the retrieved meteorological data. The runoff time series generated by HSPF are input to the FEQ model for routing (Ishii and others, 1998). The GENeration and analysis of model simulation SCeNarios (GENSCN) (Kittle and others, 1998) module of the U.S. Environmental Protection Agency's Better Assessment Science Integrating Point and Non-point Sources (BASINS) (U.S. Environmental Protection Agency, 2017) system was utilized for data input, HSPF simulation, display of the meteorologic and hydrologic data, and for display and analysis of the observed and simulated stage and discharge hydrographs. The hydraulic model was also used to create a flood inundation map library for a 1.6 mile section of the Salt Creek (Soong and others, 2012).

The near real-time streamflow simulation system developed for the Salt Creek was applied to the West Branch DuPage River watershed in 2010 and the East Branch DuPage River watershed in 2018 by the USGS CMWSC in cooperation with the DPC-SMD. The Salt Creek watershed is 115 square miles to the downstream streamgage 05531500 (Salt Creek at Western Springs, IL) and contains several offline flood-control reservoirs whose operations can be optimized by using accurate estimates of the timing and elevation of flood peaks. The West Branch DuPage River watershed is 123 square miles to the downstream streamgage 05540130 (West Branch Du Page River near Naperville, IL) and contains one operable in-line dam. The East Branch DuPage River is 75.8 square miles to the downstream streamgage 05540250 (East Branch Du Page River at Bolingbrook, IL) and has a levee system and pump stations along a flood prone area but does not have flood-control structures to help reduce flood damages from major storm events.

The USGS CMSWC in cooperation with DPC-SMD has supported and documented the FEQ model (Franz and Melching, 1997a; Franz and Melching, 1997b), applied it in verification studies (Ishii and Turner, 1996; Turner and others, 1996), and developed utility software for data input and review (Ancalle and others, 2017; Ern and others, 2019) from approximately 1996 to present. As part of the flood simulation system development, an FEQ output file of computed water surface elevations and flows has been reformatted for input and display in HEC-RAS software (Brunner, 2016). HEC-RAS can be used with RAS Mapper to create inundation maps of the streamflow-simulation system water-surface profiles from the FEQ simulations.

# Problem

The highly urbanized land use in DuPage County combined with extreme hydrologic events such as high intensity or long duration rainfall can produce flooding that is a risk to life and property. In August 1987, extreme rainfall in the Chicago area flooded thousands of homes along the Des Plaines River and Salt Creek resulting in $78 million in damages and parts of Cook and DuPage Counties being declared disaster areas (McCoppin, 2007). Continued urban growth in DuPage County since 1987 and the construction of additional flood control structures and updated hydrologic and hydraulic models necessitates ongoing testing, updates, and enhancements for a near real-time flood simulation system that utilizes real-time and forecast data to evaluate forecast precipitation and hydraulic structure operation scenarios. Real-time precipitation and streamflow data are needed to monitor local conditions and for streamflow simulation. This will allow for the simulation results to be based on the most current conditions in the watershed using up-to-date hydrologic and hydraulic models.

# Objectives and Scope

The USGS proposes to continue testing, updating, and enhancing flood-simulation systems for three watersheds in DuPage County according to the most current watershed conditions of Salt Creek, West Branch DuPage River, and East Branch DuPage River using updated hydrologic and hydraulic models and near real-time input data. The flood-simulation systems are comprised of furnished hydrologic (HSPF) and hydraulic (FEQ) models. The systems use real-time data from the USGS-DuPage County network streamgages, continuous stage gages, and precipitation gages. The system also utilizes NWS NEXRAD MPE precipitation data, NWS precipitation and meteorological forecast data, and ANL meteorological data in the simulations. Furnished stream stage data at DuPage County gages are compared to simulation results.

Study objectives include:

1. Maintain an existing USGS-DuPage County cooperative gage network of ten streamgages, three continuous stage gages, 31 precipitation gages, and one co-located webcam.
2. Testing and refinement of furnished hydrologic and hydraulic models for running in a near real-time continuous simulation system.
3. Update and enhance processes for real-time data acquisition, conversion, and filling of missing data from multiple agencies for input to hydrologic and hydraulic models and to verify model results.
4. Support for FEQ and FEQUTL, and support for HSPF recalibration processes.
5. Develop, update, and maintain web pages for custom data display.

# Relevance and Benefits

The gage network and flood simulation system updates will allow DuPage County managers and decision makers to evaluate alternative scenarios of forecast precipitation amounts and/or hydraulic structure operations to better prepare and respond to flooding risks and potentially reduce stormwater damages. It will provide emergency responders with a tool to protect life and property, and emergency responders and public works will have better anticipation of road

closures, evacuation areas, routes of egress, and overall planning during flooding. U.S. Geological Survey water mission goals addressed by this study include addressing the anticipation and response to water-related emergencies (flooding), prediction of changes in the quantity of water resources in response to land use and management changes and contributing to the advancement of hydrologic monitoring networks and delivery of timely hydrologic data (Everson and others, 2013).

# Approach

Five tasks will be completed to accomplish the objectives of this study. These tasks are: 1) network gage data collection and compilation, 2) model assessment and refinement, 3) near real-time scenario simulations and process updates, 4) hydraulic and hydrologic model updates and support, and 5) reporting. A general timeline for the completion of these tasks is provided in the Timeline and Budget section of this proposal.

Task 1: Network Gage Data Collection

The USGS and DuPage County will maintain a gage network consisting of ten streamgages, three continuous stage gages, and 31 precipitation gages (table 1). The gage data are critical for running forecast simulations in near real-time and for model calibration. The gage data are published according to USGS standards and provide water data for the nation. The USGS and DuPage County will maintain one webcam located at USGS streamgage 05531175, Salt Creek at Wood Dale, IL, to provide visual confirmation of stream stage at a critical location.

| Station Number and Name | Gage Code |
|---|---|
| 05531015 - SALT CREEK AT HIGGINS RD NR ELK GROVE VILLAGE, IL | STGCONT |
| 05531175 - SALT CREEK AT WOOD DALE, IL | STGCONT |
| 05531300 - SALT CREEK AT ELMHURST, IL | QCONT |
| 05531300 - SALT CREEK AT ELMHURST, IL | PRECIPCONT |
| 05531410 – SALT CREEK AT 22ND STREET AT OAK BROOK, IL | STGCONT |
| 05531410 – SALT CREEK AT 22ND STREET AT OAK BROOK, IL | PRECIPCONT |
| 05533400 - SAWMILL CREEK NEAR LEMONT, IL | QCONT |
| 05533400 - SAWMILL CREEK NEAR LEMONT, IL | PRECIPCONT |
| 05539900 - WEST BRANCH DU PAGE RIVER NEAR WEST CHICAGO, IL | QCONT |
| 05540060 - KRESS CREEK AT WEST CHICAGO, IL | PRECIPCONT |
| 05540060 - KRESS CREEK AT WEST CHICAGO, IL | QCONT |
| 05540130 - WEST BRANCH DU PAGE RIVER NEAR NAPERVILLE, IL | QCONT |
| 05540130 - WEST BRANCH DU PAGE RIVER NEAR NAPERVILLE, IL | PRECIPCONT |
| 05540160 - EAST BRANCH DU PAGE RIVER NEAR DOWNERS GROVE, IL | QCONT |
| 05540195 - ST. JOSEPH CREEK AT ROUTE 34 AT LISLE, IL | QCONT |
| 05540228 – EAST BRANCH DU PAGE RIVER AT SHORT ST AT LISLE, IL | QCONT |
| 05540250 - EAST BRANCH DU PAGE RIVER AT BOLINGBROOK, IL | QCONT |
| 05540275 - SPRING BROOK AT 87TH STREET NEAR NAPERVILLE, IL | QCONT |

| | |
|---|---|
| 414158088095600 - SPRING BROOK WWTF NR NAPERVILE, IL | PRECIPCONT |
| 414306088042100 - BOLINGBROOK WWTF AT BOLINGBROOK, IL | PRECIPCONT |
| 414411087575000 - MARIENBROOK WWTF AT DARIEN, IL | PRECIPCONT |
| 414430088035600 - WOODRIDGE WWTF AT WOODRIDGE, IL | PRECIPCONT |
| 414613088091000 - NAPERVILLE MUNICIPAL BUILDING AT NAPERVILLE, IL | PRECIPCONT |
| 414652088133800 - NAPERVILLE TOWNSHIP HWY DIVISION AT NAPERVILLE, IL | PRECIPCONT |
| 414702088104801 - RAIN GAGE AT NAPERVILLE, IL | PRECIPCONT |
| 414826088044501 - RAIN GAGE AT LISLE, IL | PRECIPCONT |
| 414903088101701 - RAIN GAGE AT WB DUPAGE RIVER AT WARRENVILLE, IL | PRECIPCONT |
| 415037087581700 - OAK BROOK WELL AT OAK BROOK, IL | PRECIPCONT |
| 415125088045700 - WHEATON SEWER DEPARTMENT AT WHEATON, IL | PRECIPCONT |
| 415131088143600 - NATIONAL ACCELERATOR LAB NR WEST CHICAGO, IL | PRECIPCONT |
| 415300088054600 - WHEATON WATER DEPARTMENT AT WHEATON, IL | PRECIPCONT |
| 415356087575000 - ELMHURST QUARRY AT ELMHURST, IL | PRECIPCONT |
| 415423088081500 - CAROL STREAM WWTF AT CAROL STREAM, IL | PRECIPCONT |
| 415457088150600 - DUPAGE COUNTY AIRPORT NEAR ST CHARLES IL | PRECIPCONT |
| 415518087583000 - ADDISON WWTF AT ADDISON, IL | PRECIPCONT |
| 415737088031100 - SPRING CREEK RESERVOIR NEAR BLOOMINGDALE, IL | PRECIPCONT |
| 415755087525300 - OHARE AIRPORT AT CHICAGO, IL | PRECIPCONT |
| 415801088095700 - BARTLETT WWTF NEAR BARTLETT, IL | PRECIPCONT |
| 415817087591901 - RAIN GAGE AT WOOD DALE, IL | PRECIPCONT |
| 420052088034200 - SCHAUMBURG PUBLIC WORKS AT SCHAUMBURG, IL | PRECIPCONT |
| 420057088001700 - BUSSE WOODS NEAR ELK GROVE VILLAGE, IL | PRECIPCONT |
| 420354088170500 - ELGIN WATER TREATMENT FACILITY AT ELGIN, IL | PRECIPCONT |
| 420453088043200 - RAIN GAGE AT HARPER COLLEGE AT PALATINE, IL | PRECIPCONT |
| 420745088025901 - RAIN GAGE AT SUNDLING JR HS AT PALATINE, IL | PRECIPCONT |

**Table 1**. Streamgages (QCONT), continuous stage gages (STGCONT), and precipitation gages (PRECIPCONT) in the USGS and the DuPage County – Stormwater Management Department cooperative program.

Task 2. Model Assessment and Refinement to Maintain Continuous Simulation

The continuous-simulation time period spans multiple years; to reduce the computer run time the hydrologic model initial conditions will be periodically moved forward in time to maintain a simulation time span of nine months or less. The start and end dates of the hydraulic model simulations will be moved forward in conjunction with the hydrologic model. The hydraulic models will be modified as needed to prevent numerical breakdowns during low flow periods or sudden changes in flow, by adding cross sections, changing baseflow, or changing the numerical solution parameters. The hydraulic and hydrologic models will be periodically reviewed to help determine causes for differences between simulated and observed elevations and flows at streamgage sites. The hydraulic models also create output files that can be reformatted and input to HEC-RAS and RASmapper for creating inundation surfaces.

Currently (September 2025), the Salt Creek simulation system consists of an old set (four models from approximately 1995) and a new set of hydraulic models (15 models from approximately 2015). The system will be updated to not run the old models of the upper Salt Creek and Spring Brook tributary because they are primarily in Cook County; however, the old hydraulic model of the lower Salt Creek in DuPage County that uses a streamgage as an upstream boundary condition will continue to be run for results comparison with the new hydraulic models of the same area. A copy of the new set of hydraulic models for the upper Salt Creek and Spring Brook tributary will be modified to use stream gage data at Rolling Meadows and Elk Grove Village, respectively, as the upstream boundary condition. In the modified models, the streamflow upstream of the stream gage will be represented by the stream gage data, and the streamflow downstream of the stream gage will be represented by the HSPF hydrologic model. The new hydraulic models that use HSPF hydrologic modeling for the entire watershed will be ran in addition to the modified models for results comparison. The FEQ input file of the old version of the lower Salt Creek model will be reformatted to run using the latest version of FEQ so that all the Salt Creek hydraulic models use the same FEQ version.

Task 3. Conduct Near Real-Time Scenario Simulations

The three forecast simulation systems (Salt Creek, East Branch DuPage River, and West Branch DuPage River) consist of scripts and programs that retrieve and process near real-time and forecast data, run hydrologic and hydraulic models, and create time-series graphs of the results at selected locations. The real-time scenario simulations consist of separate hydrologic simulations that are run using different precipitation data sources, precipitation gage data and NWS NEXRAD MPE data, and separate hydraulic simulations that use different upstream boundary conditions, for example data at different streamgage sites. The results can be compared between the two precipitation data sources and upstream boundary conditions. The simulation systems will be run daily using a scheduling program and the results will be reviewed two or more times per week by USGS CMWSC staff to check for data and simulation errors. Updates to resolve modeling issues will be sent to DPC-SMD staff. Annual updates of the Watershed Data Management (WDM) database of the processed input data will be published according to USGS standards.

The systems consist of 20-25 Perl scripts per system that retrieve and process data and/or execute other programs. Most of the scripts were developed more than 10 years ago and need to be refactored to remove obsolete code, reduce code complexity, and improve readability so that the scripts can be more easily maintained and/or updated to incorporate new functionality.

The USGS CMWSC maintains a Local Data Manager (LDM) connection with the NWS to receive NWS NEXRAD MPE data from the North Central River Forecast Center. The LDM connection is difficult to maintain and alternative methods for obtaining the NEXRAD MPE data are under review. The LDM may be replaced if a preferred alternative is found. Additionally, the CMWSC maintains a local web server and processed data are shared with the DPC-SMD using it. The use of the CMWSC web server will be replaced with a national USGS web server.

Task 4. Hydraulic and Hydrologic Model Support

Support for the FEQ (Franz, D.D., and Melching, C.S., 1997a) and FEQUTL (Franz, D.D, and Melching, C.S. 1997b) programs will be provided. The FEQ and FEQUTL code for the latest versions will be made available on the USGS Git website (https://code.usgs.gov) and the FEQ and FEQUTL latest manuals will be included. Support for the utility software previously

developed by the USGS for data input and review (FEQinput and FEQ-GDI) will be provided but problems requiring source code modification and/or program recompilation are beyond the scope. Support provided will be limited in scope, for example answering questions on model application or providing existing support programs; support requiring an extensive time commitment may be conducted under separate agreement. The CMWSC maintains a local web server with FEQ and FEQUTL resources web pages. These web pages will be moved from the CMWSC web server (https://il.water.usgs.gov/) to an USGS national web server (https://cm.water.usgs.gov/) because the CMWSC web server may be decommissioned at a future date.

The computer programs and Graphical User Interface (GUI) to assist with HSPF recalibration due to land-use and precipitation changes using DPC-SMD hydrologic procedures will be maintained. The GUI is used to retrieve, process, review, and store the input data in a Watershed Data Management (WDM) database; disaggregate daily rainfall totals to hourly values; edit and run HSPF model input files; process and review the HSPF model results; and create a list of storm events for FEQ simulation. The GUI will be made available on the USGS Git website and a user's manual will be published. The programs and GUI used in the periodic recalibration of the HSPF model will be transferable to other studies that use HSPF.

Task 5. Reporting

Network gage data collected under Task 1 will be available on the USGS Water Data for the Nation (WDFN) web sites. Processed data used in the hydrologic simulations will be published as annual updates to USGS ScienceBase data releases (Bera and Over, 2025; Bera, 2025a; Bera, 2025b). The USGS CMWSC will move existing project web pages developed for the DPC-SMD from a CMWSC web server to an USGS national web server. The USGS CMWSC will maintain and update a public web page at https://cm.water.usgs.gov/data/precip/il that contains USGS precipitation gage totals and NWS NEXRAD data for reviewing precipitation amounts and spatial distribution. The USGS CMWSC will also maintain web sites for sharing processed data for the streamflow simulation systems with DPC-SMD. The DPC-SMD maintains a public web page (County of DuPage, 2025) containing forecast discussions and recent simulation results for public dissemination.

# Quality Assurance Plan

Quality assurance (QA) measures will be followed to ensure the completeness of the information communicated during the study. The QA objectives for the collection and communication of information will:

- Withstand scientific scrutiny
- Be obtained by methods appropriate for its intended use, and
- Be representative and of known completeness and comparability.

Data used in the modeling process will be derived from reliable host sources, including the USGS WDFN system for precipitation, stage, and streamflow data, the U.S. Department of Energy ANL for meteorological data, and the NWS for forecast data. USGS streamflow and precipitation data will be collected and published as documented in Rantz (1982) and Office of

Surface Water (OSW) Technical Memorandum 2017.10. All digital data and models will be reviewed by USGS personnel to ensure proper documentation and technical standards documented in OSW Technical Notes 2015.03 and recent OSW guidance for hydraulic modeling studies documented in OSW Technical Notes 2015.37 and 2016.25. The models, modeling results, and data releases will be archived in accordance with OSW Technical Memorandum 2015.01 (Model Archive Memo). Policies and procedures for archiving Surface-Water data and project information also provided in the Central Midwest Water Science Center data management plans. The project and project budget will be reviewed by USGS management on a quarterly basis to ensure project timelines are met.

# Deliverables

USGS ScienceBase data releases will reflect annual updates for the Salt Creek database, West Branch DuPage River database, and Argonne National Laboratory meteorological database. Precipitation, stage, and streamflow data will be archived and available through the USGS WDFN web sites. Code repositories for the HSPF recalibration GUI, FEQ, and FEQUTL will be made available on https://code.usgs.gov/.

# Timeline and Budget

The columns in the timeline and the budget tables show the federal fiscal years running from October 1 through September 30 of the following year, and the period of this proposal covers the DuPage County fiscal year running from December 1 through November 30 of the following year. Thus, the proposal covers December 2025 in quarter 1 of federal fiscal year 2026 and October and November 2026 in quarter 1 of federal fiscal year 2027.

| Task | Federal FY2026 | | | | Federal FY2027 | | | |
|---|---|---|---|---|---|---|---|---|
| | Q1 (Dec) | Q2 (Jan-Mar) | Q3 (Apr-Jun) | Q4 (Jul-Sep) | Q1 (Oct-Nov) | Q2 | Q3 | Q4 |
| **Task 1: Network Gage Data Collection** | | | | | | | | |
| **Task 2: Model Assessment and Refinement** | | | | | | | | |
| **Task 3: Conduct Near Real-Time Scenario Simulations** | | | | | | | | |
| **Task 4: Hydraulic and Hydrologic Model Support** | | | | | | | | |
| **Task 5: Reporting** | | | | | | | | |

The budget consists of $314,600 for the network gage data collection (task 1) and $325,400 for the model assessment and refinement, near real-time scenario simulations, hydraulic and hydrologic model support, and reporting (tasks 2-5). The USGS Appropriations rate requested for this agreement represents an increase owing to a need to modernize processes and cross train staff on project activities.

| | FY2026 | FY2027 | Total |
|---|---|---|---|
| DuPage County | $292,800 | $100,600 | 393,400 |
| USGS Appropriations | $203,500 | $43,100 | $246,600 |
| Total | $496,300 | $143,700 | $640,000 |

# Personnel

Staff from the USGS CMWSC will work collaboratively with DuPage County Stormwater Management to meet the objectives of the proposed study.

A GS-13 Research Hydrologist, GS-12 Hydrologist, GS-11 Hydrologist, GS-11 Civil Engineer, and GS-9 Hydrologist will support the near real-time simulation system and reporting with

additional Hydrologist and Hydrologic Technician support to maintain the streamgage, continuous stage, and precipitation gage network.

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