PROPOSAL
for
City of Harrisburg Flood Inundation Map Tool
Pennsylvania Silver Jackets Pilot Project

PROBLEM:

The City of Harrisburg (City) is situated on the banks of the Susquehanna River in Dauphin County, Pennsylvania. Flood risk in the City is related to both Paxton Creek and the Susquehanna River. More than 1,100 National Flood insurance policies are in place providing coverage of nearly $230,000,000 (ref. Dauphin County Hazard Mitigation Plan). Large portions of the City are within the 100 year floodplain and there is no structural flood protection for the City. Attachment 1 includes a map that displays the 100-year and 500-year floodplains within the City of Harrisburg, illustrating the City's vulnerability.

The City of Harrisburg has a long history of flooding from the Susquehanna River. Flooding as a result of heavy rain, snow melt and ice jams have all been observed. Dating back to 1746 there have been an estimated 46 floods observed (source: Middle Atlantic River Forecast Center). Of these floods several have been major enough to cause significant disruption to this state capital city. A major flood in 1936 brought a reported four to fifteen foot depth of water which covered almost a third of the city. Flooding from Hurricane Agnes in 1972 brought a peak discharge of over 1 million cubic feet per second through Harrisburg! The Susquehanna River was more than a half-mile out of its banks, inundating the capitol's downtown streets and flooding the new riverfront Governor's mansion. Similar flooding was observed from Hurricane Eloise in 1975 and a rain on snow flood in January 1996. Even the minor floods have impacts on Harrisburg, as impacts that affect commerce are noted at locations such as City Island, a hub for recreation and leisure activities.

PROPOSAL:

This project would involve developing a non-structural flood hazard mitigation tool to inform the general public, local officials, and emergency managers of risk associated with relative flood hazard. The tool is a stage inundation map library for the City of Harrisburg and adjacent communities based on the National Oceanagraphic and Atmospheric Administration National Weather Service (NWS) flood forecast point on the Susquehanna River at Harrisburg (USGS Gage No. 01570500). The stage inundation map library will be displayed digitally for general consumption on various map viewer websites (likely the SRBC Susquehanna Inundation Map Viewer website, the USACE SimSuite site, and possibly the USGS and NWS map viewer sites). The SRBC map viewer website is a part of the Susquehanna Flood Forecast and Warning System. Geographic Information System (GIS) datasets will be supplied to local officials and emergency managers with GIS capability. Upon deploying the stage inundation map library a broad outreach campaign will target both local authorities and the general public to inform them of the maps existence and where to obtain them.

The reach of the inundation mapping will span over 20 miles, extending from the Juniata River downstream to Swatara Creek (Attachment 2). The project will provide mapping for the City of

Harrisburg as well as several adjacent communities such as East Pennsboro Township, West Fairview, Wormleysburg, Lemoyne, and New Cumberland to the west of the Susquehanna River.

BENEFITS:

Understanding and communicating flood risk are paramount to mitigating flood risk. The developed stage inundation library will provide expected extent of flooding relative to the stage at the local forecast point as well as associated depth of flooding. The developed library will provide local officials, emergency managers, and the general public web access to mapped information. During times of flooding or predicted flooding, these data will be used by emergency managers for evacuation purposes and identification of potential road closure points for emergency vehicles. The general public will have access to the maps and can make informed decisions about threat to life and property based on NWS forecast. Specifically, this gives the public the opportunity to elevate valuables, move vehicles, prepare for evacuations and take other proper precautions to reduce their flood damage.

The proposed project leverages several agencies resources, builds upon on an existing initiative and complements several ongoing activities not only within the watershed, but also within a state and national context. The project will provide a graphical extension to river forecasts issued by NOAA's National Weather Service in partnership with the Susquehanna Flood Forecast and Warning System (SFFWS). The SFFWS, in place in the Susquehanna basin since 1986 protects lives and property by providing advanced warning of main stem river flooding through an interagency partnership of many including USGS, NOAA, USACE, SRBC, PA DEP, NY DEC, MD MDE, emergency managers and community officials. The SFFWS partnership has been producing stage inundation maps in recent years and is currently displaying 18 libraries in the Susquehanna basin online (maps.srbc.net). The SFFWS lost congressionally directed funding in FY 11 effectively halting all future mapping projects. At the time of the funding loss, SFFWS partners had identified the Harrisburg map project as a top priority and were preparing to undertake the project with the FY 11 funding. Successful completion of the project will reinvigorate an important interagency partnership allowing this vital effort to continue the mission of protecting property and saving lives.

The project is also consistent with goals and actions within the Commonwealth of Pennsylvania’s Hazard Mitigation Plan (HMP). The project specifically addresses goal 2 of the HMP, “to enhance consistent coordination, collaboration, and communications among stakeholders” and action 2-5b, “improve cooperation/coordination of agencies with real time data”.

On the national level the proposed project supports the Integrated Water Resources Science and Services (IWRSS) Program, Integrated Water Resources Management, and the Urban Waters Federal Partnership. This project will involve leveraging resources and collaborating between agencies to share technology, information, models and best practices to create a new water resources tool for the public. This pilot project will meet a number of the objectives of the IWRSS.

The Urban Waters Federal Partnership consists of eleven Federal agencies including USACE. The partnership is intended to promote more efficient and effective use of Federal resources through better coordination and collaboration to improve the nation’s water systems and promote economic and social benefits. Leveraging several Federal agencies dollars and in-kind resources in this project mirrors the intent of the partnership. The process and methodologies used during this pilot project could be applied to other urban areas.

PROJECT TEAM:

The project team will be interagency and will consist of numerous Federal, regional, state, and local agencies. The agencies that will be actively involved in conducting the study and will contribute funding or "in-kind" resources include USACE, USGS, NWS, the Susquehanna River Basin Commission (SRBC), FEMA and PEMA. The other Silver Jackets agencies that will participate include NRCS, PADEP, PennDOT, PA DCED, PA Association of Floodplain Managers (PAFPM), the Keystone Emergency Management Association (KEMA) and the American Rivers Organization (ARO). The Silver Jackets team will provide input to the project and will be kept apprised of the study progress. As part of the outreach component, the team will coordinate with numerous other agencies such as the City of Harrisburg, adjacent counties, and the Paxton Creek Watershed Association which is a highly active organization.

WORK TASKS:

Work tasks to be completed are described below and are in accordance with the Flood Inundation Map Library Guidelines. Existing LiDAR elevation data, Flood Insurance Studies (FISs), and USGS streamgages will be pre-requisites for the stage inundation mapping effort. North American Vertical Datum of 1988 (NAVD88) will be used in the development of the inundation maps.

1.0 **Data Collection -** Identify and quantify significant changes in river corridor since completion of detailed FIS to include additional hydraulic structures, etc. Field data collection to include surveying of additional cross-sections to supplement existing FIS data and new hydraulic structures, as necessary. Field survey data will be collected at easily identifiable locations to quality control previous FIS model and LiDAR data. Digital pictures will be taken of study reach including, but not limited to structures, channel banks, floodplain (which will aid in the determination of appropriate roughness coefficient values). LiDAR data compilation and digital elevation model development.

2.0 **Hydrologic Data Development** – Data such as rating curves, gage datum elevation, historic flood peaks, gage heights associated with flooding from USGS streamgage 01570500 - Susquehanna River at Harrisburg will be reviewed and compiled. New hydrology will be developed as necessary.

3.0 **Hydraulic Model Development** – Compile and develop complete HEC-RAS model for existing study reach of Susquehanna River based on HEC 2 models (provided by SRBC) used for previously determined FIS and LiDAR data. A quality-control check will be completed to ensure consistency between the HEC model and the FIS. The HEC-RAS model will be calibrated based on streamgage data and roughness coefficient values will be adjusted as necessary.

4.0 **Develop Flood Inundation Layers** – Using water surface elevations obtained from HEC-RAS modelled profiles, create water surface profile to intersect with LiDAR bare earth ground surface profile to create inundation layer. Project will use base topographic elevation data from a high resolution digital elevation model developed from LiDAR elevation data collected as part of the PaMAP project.

5.0 **Develop Depth Grid** – Using methods detailed in Flood Inundation Map Library Guidelines or other acceptable standard, develop depth grids for each of the inundation layers to display expected depth of flooding to the nearest 0.5'.

6.0 **Report –** A short report will be produced summarizing the assumptions, methods and results associated with the development of the flood inundation maps.

7.0 **Outreach/Education –** To ensure that the maps are understood and utilized such that appropriate action is taken during a flood event, the maps will be promoted in a number of ways. Potential methods include include media campaigns, web-based education, meetings and/or flyers/brochures. All of the project partners will participate in the outreach effort.

8.0 **Project Management, Coordination and Quality Control Review –** Each participating agency will coordinate with the other partners as necessary and review the deliverables for quality control. USACE will manage the project and be the overall lead coordinator.

DELIVERABLES:

- Inundation Map Libray - A complete map library for the Susquehanna River forecast point to include stage-based inundation layers, depth grids, street names and location, orthophotography, and all associated shapefiles and metadata. The total number of inundation layers is to be determined. Maps will be produced for each 1-2 foot of stage beginning at the NWS-defined "Action" stage with a probable maximum near the Tropical Storm Agnes stage. The inundation layers will be overlain on USGS Digital Orthophoto Quarter Quadrangles (DOQQ) or PAMAP aerial photography.

- HEC-RAS Model – A complete HEC-RAS model in one project file and a separate GIS shapefile of all cross-sections (geo-referenced) included in the model. Model should include pictures of hydraulic structures as they appear in the field. All supporting data used to develop model shall be submitted with model during QA/QC review of the model.

- Public Information and Outreach – To include outreach materials such as pamphlets, hardcopy maps, and/or web-based education.

- A short report will be prepared summarizing the HEC-RAS model development, the flood inundation mapping methods, and study results.

SCHEDULE:

The estimated time to complete the project is 12 months.

COST and RESOURCES:

The total estimated cost to complete this project is $235,000. The total estimated cost will deliver a complete digital high resolution stage inundation library for more than 20 miles of mainstem Susquehanna River beginning at the downstream confluence with the Swatara Creek and reaching upstream to the confluence with the Juniata River. Approximately $130,000 dollars of the total estimated cost will be contributed "in kind" by those agencies described under "Project Team" section. In kind resources may include labor, material goods, computer software and hardware, technical data, or otherwise sub-contracted cost to the agency for items related to the project. A break down showing which agency will conduct the work by task is shown below. This breakdown shows the primary agencies involved, however, there will be numerous other agencies and stakeholders who will be coordinated with and will provide input to the project.

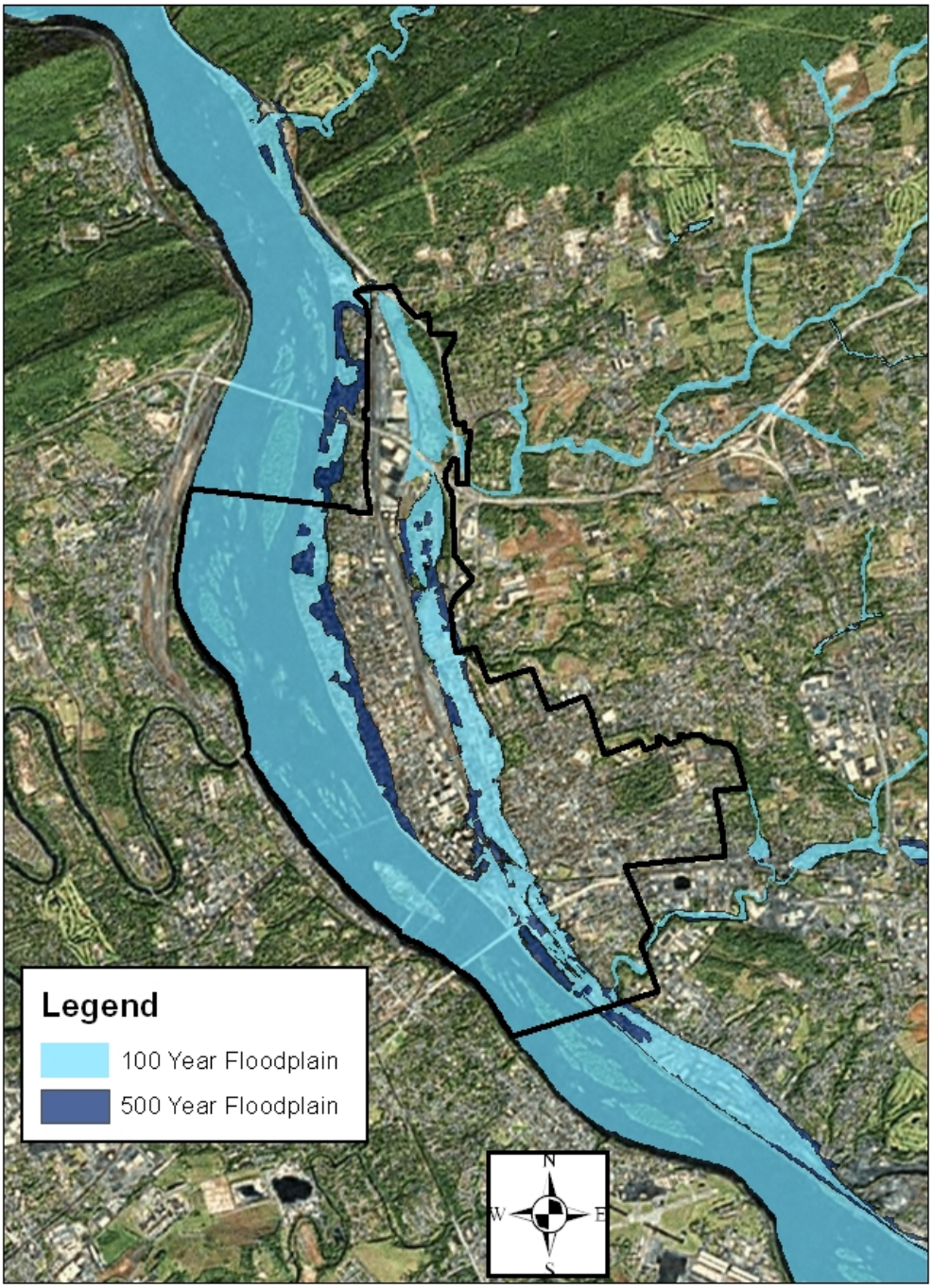
Task	Agency to Conduct Work
Task 1 - Data Collection	USGS (in collaboration with USACE)
Task 2 – Hydrologic Data Development	USGS
Task 3 – Hydraulic Model Development	USACE (in collaboration with USGS)
Task 4 – Develop Flood Inundation Layers	USACE
Task 5 – Develop Depth Grid	USACE
Task 6 - Report	USACE
Task 7 – Outreach/Education	SRBC (lead role) NWS (lead role) USACE (participate) USGS (participate) FEMA (participate) PEMA (participate) Stakeholder community (participate)
Task 8 –Coordination, QC review and Project Mgmt	SRBC NWS USGS USACE FEMA PEMA Stakeholder Community (participate)

Contributions leveraged by each agency:

USACE - $105k
USGS/local - $50k
SRBC - $30k in-kind services
NWS - $30k in-kind services
FEMA - $10k in-kind services
PEMA - $10k in-kind services

Attachment 1: Floodplain Map

City of Harrisburg Floodplain Map



Attachment 2: Map Reach