COMPREHENSIVE FLOOD MANAGEMENT PLAN

MONTGOMERY COUNTY 17 76 GARDEZ BIEN MARYLAND

Jacobs

May 2023

TABLE OF CONTENTS

VOLUME 1: STRATEGY

VOLUME 2: WATERSHED FLOOD EXPOSURE ASSESSMENT SUMMARY

VOLUME 3: ATTACHMENTS

ATTACHMENT 1: GOVERANCE AND POLICY REVIEW REPORT

ATTACHMENT 2: HISTORIC FLOOD CONDITIONS AND DATA GAPS TECHNICAL MEMORANDUM

COMPREHENSIVE FLOOD MANAGEMENT PLAN:

STRATEGY

VOLUME 1

Jacobs

February 2023

FLOOD MANAGEMENT NEED

Montgomery County (the County) has experienced an increase in flooding events, causing impacts to property and people. The County's Office of Legislative Oversight notes that "there has been an upward trend of urban flooding, from 2 to 4 occurrences per year before 2010 to 11 to 39 occurrences per year since 2010."

Montgomery County Office of Legislative Oversight, Measuring Climate Resilience Report 2021

- Average of **nine flash flood warnings** per year.
- Increase in **complaints** related to flooding.
- Without significant policy interventions, it is likely climate change and the subsequent increase of extreme weather events will **reinforce and amplify current socioeconomic disparities**.

Significant factors contributing to the increase in local flooding occurrences are increased precipitation and change in the nature of that precipitation, increased impervious surface area from new development, infill development, redevelopment, and aging stormwater drainage and management infrastructure built to older design standards that are unable to handle the large volumes of water associated with higher levels of imperviousness and more intense precipitation events.

The County is subject to flooding from intense rainfall producing local flooding (referred to as **"urban flooding"**, **"interior flooding"** or **"pluvial flooding"**) and from streams and rivers overtopping their banks (referred to as **"riverine flooding"** or **"fluvial flooding"**). The spectrum of impact of flooding within the County varies from nuisance to fatal flooding events.

The University of Maryland's Center for Disaster Resilience has characterized urban flooding as a **"significant source of economic loss, social disruption, and housing inequality."**

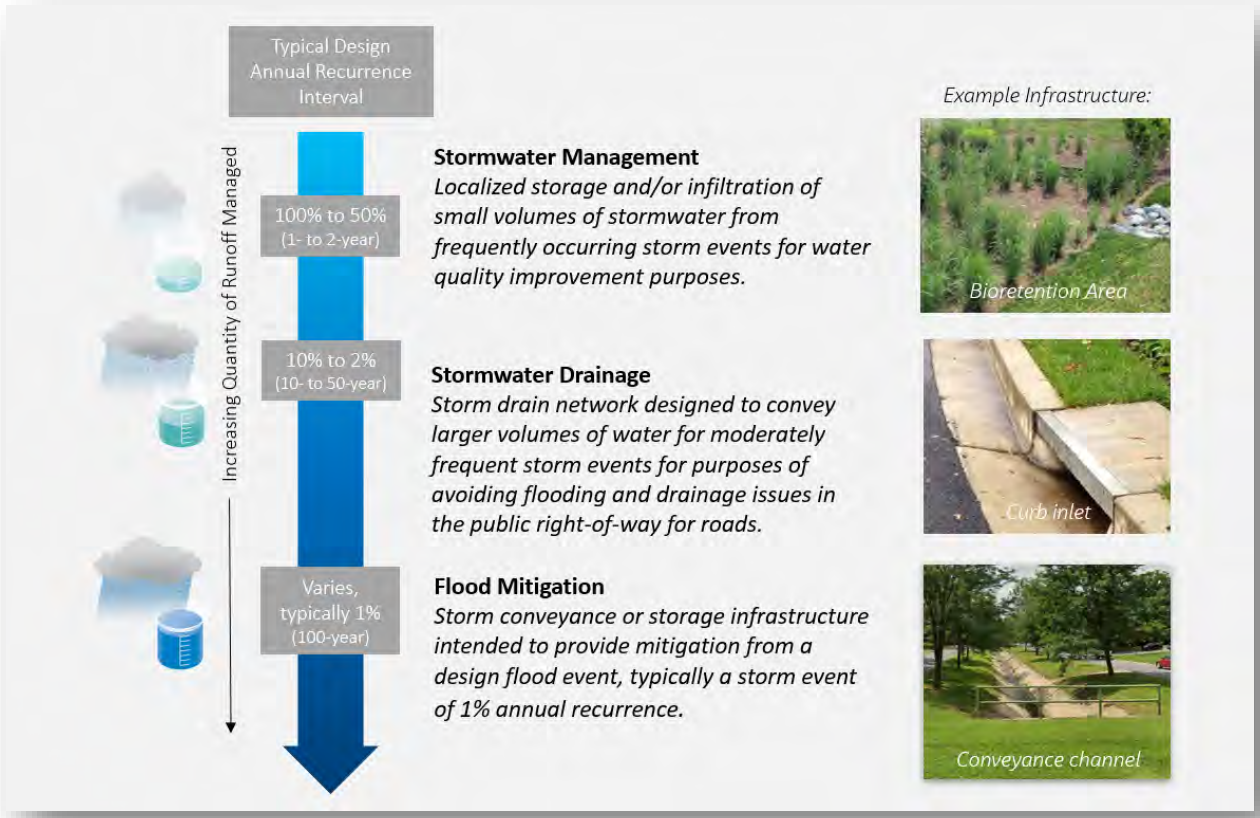
Maryland's Stormwater Management Climate Change Action Plan FY 2021

A variety of laws, regulations, policies, and procedures govern the development of the built environment that contributes to stormwater runoff and the infrastructure that is designed to handle this runoff; however, those regulations, policies, and procedures have not been modified to keep up with the continued development in the County or the increase in frequency and intensity of rainfall.

Montgomery County's 311 Call System

- **8900 flooding- and drainage-related calls** from January 19, 2010 to June 3, 2022
- **87%** related to maintenance and information
- Remaining calls are focused on roadway (2%), private property (4%), lot-to-lot (6%), and groundwater (1%) flooding

Regulations and infrastructure related to stormwater runoff management fall into roughly three categories. Regulations and related infrastructure that focus on management of comparatively small volumes of stormwater runoff to improve water quality are typically called **"stormwater management"** infrastructure. In contrast, infrastructure designed for conveyance of larger volumes of water for drainage of roadways is typically called **"stormwater drainage"** or **"storm drain"** infrastructure. Finally, regulations and infrastructure related to management of extreme storm events is typically described as **"flood management"** or **"flood mitigation"** infrastructure. Within this document, the term **"stormwater and flood mitigation infrastructure"** is used to describe infrastructure that may serve any of these purposes. Refer to the image below for examples.



Several County departments and agencies have a role in the planning, design, review, approval, installation, maintenance, and management of both the built environment, stormwater infrastructure, and flood mitigation infrastructure. In some cases, the roles and responsibilities are very clear and the processes well-defined. In other cases, they are not so clear, and the County can be perceived as nonresponsive to complaints from residents and businesses about flooding concerns.

The combination of physical challenges, due to aging infrastructure and high-intensity rainfall events, and organizational challenges, due to dispersed responsibilities and regulations, produce an urgent need for more comprehensive flood management planning.

DOCUMENT INTENT

The County initiated a set of questions in recognition of the needs and risks associated with flooding. What constitutes a flood? How does and should the County respond to flooding? To consider these questions, the County initiated a Comprehensive Flood Management Plan engagement. Three phases have been structured to carry the County through this planning effort.

The Strategy document is the culmination of this Phase 1 effort. It is designed to set the direction for comprehensive flood-related efforts within the County. This direction includes the actions and the priority and timing of those actions that the subsequent phases will focus upon. This Strategy document focuses on:

- Recognizing that flooding is a complicated issue and the solutions are complex
- The need for better cross-departmental coordination and collaboration
- The need for community outreach, specifically focused on historically marginalized groups who have received fewer flooding mitigation and recovery resources
- Understanding of flooding history based upon available data and identification of data gaps
- Recognition of potential future flooding challenges
- Identification and agreement of a flooding responsibility structure within the County
- Recommendations for organizational and policy change to accomplish the agreed-upon responsibility structure

Additional documents have also been produced as part of the Phase 1 effort. Those documents focus on the specific detail of the data collection and assessment in response to the elements listed above and should be referenced for further clarification. *The Comprehensive Flood Management Plan Phase 1 Governance & Policy Review Report* (Jacobs, 2023) provides a summary of Phase 1 approach, roles and responsibilities, existing regulations and policy, and a framework for defining outcomes necessary for management of flooding. The *Historic Flood Conditions and Data Gaps Technical Memorandum* (Jacobs, 2022) provides a review of available data, discussion of County watershed flood exposure, and assessment of data required for detailed flood studies. This document summarizes those results and focuses on the suggested direction.

STAKEHOLDER ENGAGEMENT

Flood-related activities include planning, implementation, management, and response responsibilities. This breadth of responsibilities requires many roles to be fulfilled. Roles differ depending on the type and location of infrastructure and regulatory and policy guidance. For the County, this breadth of responsibilities is met by employing a group of agencies. In order for a comprehensive flood management plan to both be developed and take root, representation from the appropriate collection of agencies must be present. Seven agencies agreed to be the core group of representatives for this comprehensive effort: Montgomery County Department of Transportation (MCDOT), Montgomery County Department of Environmental Protection (MCDEP), Office of Emergency Management and Homeland Security (OEMHS), Montgomery County Department of Permitting Services (MCDPS), Office of the County Executive (OCE), Montgomery County Planning Department of the Maryland-National Capital Park and Planning Commission (PLANNING), and Montgomery County Parks Department of the Maryland-National Capital Park and Planning Commission (PARKS). This group is referred to as the Core Team.

Agency Engagement

- **Seven agencies** comprised the Core Team: MCDOT, MCDEP, OEMHS, MCDPS, OCE, PLANNING, and PARKS.
- **20 hours** of workshop sessions
- **Over a dozen** in-depth interviews

Core Team - This Core Team participated in a structured series of ten 2-hour workshops. Their consistent engagement assured the broad representation of the multiple elements of flood management. The expectations associated with their involvement included developing content through workshop engagement, review and commentary on draft products, and committing to the resulting language of the effort.

In addition to the workshop setting, interviews were conducted with those Core Team member agencies and other advisory agencies. Questions covered in these interviews included clarifying items related to their flooding-related responsibilities: roles, asset ownership, data collection and management, funding, and regulatory and policy drivers.

Community Survey

- Over **500** responses
- **98%** of responses from County residents
- Over **700** reported flooding locations mapped from survey
- **87%** are at least somewhat concerned about future impacts
- **63% of the responses** indicated urban flooding contributed to flooding events they have experienced

The effort did not end with just engaging County agencies. The effort extended to engaging with the community. The objective of community stakeholder engagement was to gather information related to historic flooding events and impacts and educate stakeholders on key aspects of the flood management effort. The engagement strategy included community interaction and peer engagement.

Community Survey - An online community survey was held to gather feedback from the community on past flooding events. Questions included a request to identify locations of flooding impacts, type and magnitude of impact, and some demographic information. The survey was launched September 19, 2022 and remains open at the date of this writing.

Pop-up Events - To aid in increasing awareness of the survey and perform outreach to multilingual communities survey pop-up events

were held at five locations throughout the County. Informational materials were provided in English and Spanish. Later events included materials translated to Chinese (Mandarin), Vietnamese, Amharic, and Korean. Bilingual personnel were provided by the consultant and MCDEP (Vietnamese, Spanish) to aid in reaching non-English-speaking populations.

Pop-up Events

- **5 events** scattered throughout the County
- **370 total engagements** at the events
- **Over 60% of total engagements** with persons identifying as Spanish speakers
- **Over 75% of total engagements** with persons identifying as Black, Indigenous, and Persons of Color

Community Forums - Two virtual online forums were held in October 2022 to describe the intention of the comprehensive flood management planning, gain insight on community flooding issues, understand community expectations, and ask for participation and sharing of the Community Survey. Events also provided a venue for anecdotal data collection from community members.

Peer Engagement

- **8 jurisdictions** interviewed
- **Anne Arundel County**
- **Charlotte-Mecklenburg Stormwater**
- **City of Baltimore**
- **Metropolitan Water Reclamation District of Greater Chicago (MWRD)**
- **City of Denver & Mile High Flood District**
- **District of Columbia**
- **City of Fort Worth**
- **Pittsburgh Water and Sewer Authority**

Peer Engagement - The final stakeholder engagement was performed with peer organizations—other municipal governments comparable in size and scale to the County who could offer some insight into how they have or are approaching comprehensive flood management. Eight jurisdictions were approached with questions, including the following: What is your jurisdiction's structure/organization with respect to flood management? How is your jurisdiction working to integrate understanding of non-Federal Emergency Management Agency (FEMA) flood hazard areas into management?

The combination of internal County agency participants, community members, and peer organizations provide a broad sense of need and opportunity considered in the Comprehensive Flood Management Strategy.

OBSERVATIONS

The delivery of flood-related efforts is a complex and intertwined choreography of multiple regulations, asset ownership, and agency responsibility across the flood-related life cycle.

While the County is performing flood-related activities and functions as required by current regulations and policies, it recognizes that a more systematic and comprehensive approach is needed going forward. Recent intense storm events have illustrated that current County regulations, policies, and management systems may need to be re-evaluated to maintain the expected levels of service. The assessment of the current responsibilities, policies, and systems, conducted as part of this Phase 1, served to produce a set of observations. These observations provide context for defining improvements to support the County's advancement toward more comprehensive flood planning and management. These 10 observations were reviewed and improved with the Core Team and are discussed in further detail within the *Comprehensive Flood Management Plan Phase 1 Governance & Policy Review Report* (Jacobs, 2023).

1

There is no functional County-wide definition of flooding.

- Varied characterizations of flooding and/or diverse definitions of what constitutes flooding may lead to conflicting planning, management, and/or response
- Clarification between County responsibilities on public and private areas – and addressing public expectation with respect to these responsibilities - is needed
- May lead to inequitable identification, planning, and/or response to flooding

2

Regulations for flooding-related planning, engineering, and permitting activities are related to specific *sources* of flooding rather than *effects* due to flooding.

- Regulations are based on understanding of flood risk from sources causing historic impacts and climatic conditions and predicted hydrology within the County at the time of policy formation
- Quality-focused regulations have some impact on quantity management
- The stated desire of the Core Team is to focus more on management of stormwater quantities and associated areas of inundation
- New or additional agency organizational structures may be warranted to support comprehensive management of flooding

3

Management of stormwater quantities in the County is limited to requirements for achieving water quality and roadway drainage goals. There is limited watershed level assessment of flooding impacts due to extreme storm events.

- Watershed level assessment to understand existing and future quantities of stormwater runoff are not carried out
- It is unclear if existing infrastructure is adequate to meet current levels of service
- Agencies are driven by different criteria dictated by specific regulations or policies
- Agencies focus on specific asset types and/or location/rights-of-way (ROWs)
- Currently there are no agreements among agencies to recognize, share, or distribute responsibilities for flood management
- Several agencies are responsible for management of stormwater and flood mitigation infrastructure

4 **There is no County-wide assessment of flood risk outside of FEMA and County-studied riverine areas.**

- This results in limited County-wide characterization of flood vulnerabilities
- The Floodplain District contains a significant amount of unmapped floodplain areas

5 **Available data do not allow conclusions regarding the location, cause, and/or effect of flooding.**

- Quality of available data results in questions on actual source and/or effect of a recorded event or impact
- Data has limited characterization of resident impacts
- Location information on data is questionable or not available
- Available data is not representative of all residents/communities as some populations are less likely to report and engage with available County resources (MC311, MCDOT Drainage Assistance Requests , MCDEP calls)

6 **Flood management data and information resources are neither collated nor coordinated across agencies.**

- There is no regulatory requirement for this
- Coordination of data is expected to be increasingly important for assessment of climate change impacts
- Information sharing between agencies is ad hoc
- MCDPS plan submittals only recently have required GIS/CAD information, thus a large amount of legacy information is not readily/easily accessible
- MCDPS, which has historically received floodplain studies, does not have dedicated GIS staff
- Rainfall data is used by several agencies, to achieve agency-specific goals, (MCDEP, MCDOT, OEMHS) yet is not coordinated among them

7 **County currently has limited ability to incorporate knowledge of recurrent flood impacts in permitting and development reviews.**

- Fluvial flooding is considered in permitting and development review based on the County's limited 100-year average return period floodplain maps, and in some cases new site-specific 100-year floodplain mapping where existing floodplain mapping is inadequate
- Pluvial flood risk, which is unmapped in the County, is generally not considered during permitting and development reviews

8 **There is currently no means to support consideration of watershed-wide impacts to runoff volumes as a result of stormwater management permit applications (for example, using watershed level quantity planning).**

- The "reasonableness of use" doctrine of the State-modified Civil Law Rule allows the higher landowner to discharge across a lower landowner's property
- No assessment of the impact of Zoning changes on flood risk

9 **Public outreach related to flood risk and management is not coordinated.**

- There is no agency with sole responsibility for public outreach related to flooding
- There is no coordinated effort to define, for the public, the multi-faceted issues that can result in flood risk increase. Likewise, there has been limited outreach to educate residents on the purpose and associated limitations of existing County regulations. Comprehensive flood risk information is currently not available

10 **There is currently no process for integrating knowledge of existing and future urban flood risk in the land use planning process.**

- Impacts to existing flood risk and/or network-level (versus local) storm drain capacity are not typically a consideration for land use planning
- As a standard practice, master plans don't always review and analyze flooding issues. Areas with historical flooding impact are considered in certain cases where new development is being proposed in floodplain areas known for severe flooding impacts
- ZTA/Special Exceptions/Mandatory Referrals (which occur after the general planning process) may have impacts to local flooding; storm drain design capacity is assumed to be sufficient
- Climate change will potentially magnify the uncertainty of these impacts

DEFINITION OF FLOODING

Montgomery County initiated this effort to produce a comprehensive flood management strategy. Yet as noted by Observation 1 above, there is no unifying nor universal definition of what constitutes a flood in the County. This lack of uniform definition presented a challenge to the Core Team – without an understanding of what the County defines as flooding, it was difficult to assess whether the Core Team was focused on the same challenge and producing an appropriate comprehensive flood management plan. To remedy the challenge, the Core Team produced a definition of flooding. This definition served the Core Team in its effort to produce this Comprehensive Flood Management Strategy.

Flooding is defined as the…

Accumulation or conveyance of water exceeding planned volume, levels, or timing having a significant disruptive or destructive impact on built infrastructure, environment, operations, and/or intended use

…impacting residents, businesses, or visitors.

This definition differs from the FEMA definition and is more expansive than the existing narrow definition within the County's Floodplain Regulations. The collective wisdom of the Core Team focused their interest and concern more toward defining a flood by the effect of flooding within the County rather than the sources of flooding.

The conversation and ultimate wording choice of a flooding definition was carried out to focus the comprehensive flood management planning effort. This definition is inadequate, by itself, to forestall all the potential issues mentioned in Observation 1. With progression to the next phase of this comprehensive flood management planning effort, this definition should be revisited.

VISION OF FLOODING MANAGEMENT

The vision is the aspirational goal for the County relative to flooding. It sets the agreed upon direction of the organization and what it strives to achieve relative to a comprehensive flood management outcome. As with the lack of a flooding definition, the Core Team lacked a collective direction, or vision, for the comprehensive flood management planning effort. As a remedy, the Core Team created this vision. It is not a characterization of the County's responsibilities. Rather, it is intended to serve as the aspirational goal of the comprehensive planning effort. It encompasses the entire flood-related 'life cycle' from land use planning and zoning to avoid floods, design and implementation of infrastructure to manage flooding, and to response and recovery in the event of flooding. All agencies with responsibility for some part of the flood-related life cycle should see themselves within the vision and recognize how they may contribute to its accomplishment. As suggested for the flooding definition, this vision should be reviewed and refreshed as the comprehensive flood management activities continue.

Flooding Management Vision:

Montgomery County leads the nation in reducing existing and future flooding through well informed residents and sustainable and equitable mitigation, planning, and adaptive development.

OUTCOMES

The County recognizes that it must improve policies, processes, and systems in order to advance to an organization capable of accomplishing comprehensive flood management. The assessment of the current regulations, policies and distributed responsibilities; the synthesis of observations; the engagement of multiple stakeholders (in particular, agency representation through the Core Team); the review of peers' performance; and the professional knowledge of the consultant team all contributed to a collection of Outcomes that encapsulate what is needed to reach comprehensive flood management performance. With attainment of these Outcomes, the County will have created an organization capable of comprehensive flood management.

Seventeen Outcomes characterize conditions that are necessary for the County to reach comprehensive flood management. Together, these Outcomes describe the breadth of activities, processes, and information needed to adequately and proactively plan for, prepare for, respond to, and recover from a flooding event. Capabilities, or competencies, associated with these Outcomes are discussed within the referenced *Governance & Policy Review Report* (Jacobs, 2023).

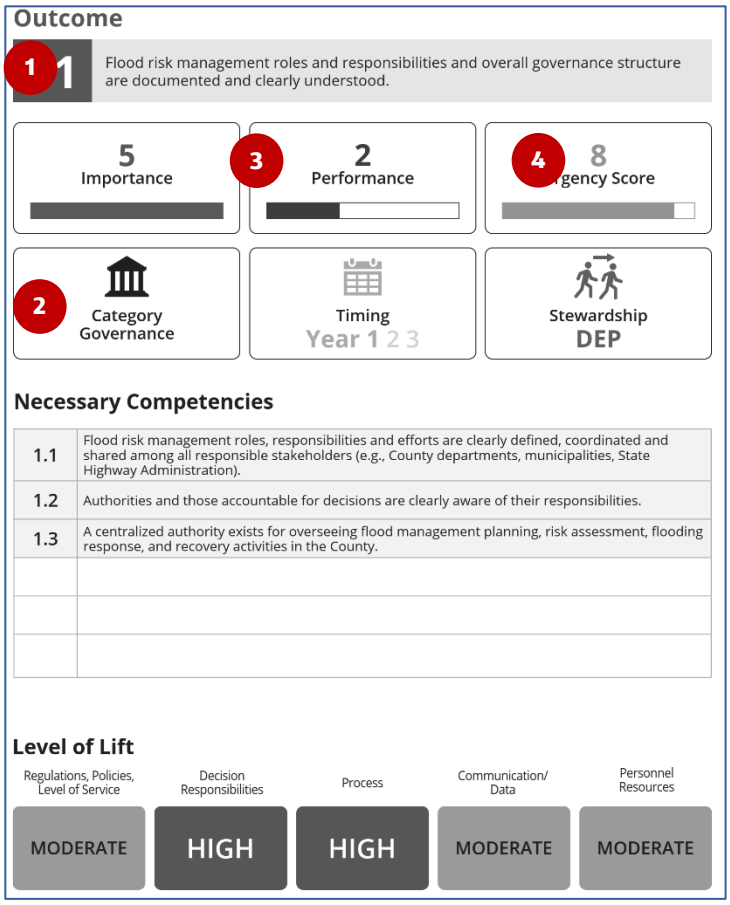
The numbers associated with the Outcomes do not infer any type of priority. These Outcomes are grouped into categories to provide a clear method of organization and a general sense of the topic in which the Outcome focuses. This set of Outcomes was reviewed and improved by the Core Team.

#	Category	Outcome
1	**Governance**	Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood.
2	**Flood Management Planning**	Comprehensive land use plans reflect flood risk.
3		Development and redevelopment standards and building codes are updated to reflect established levels of service and current and future climate conditions for areas of riverine and urban flooding.
4		Clear permit process and enforcement of development and redevelopment standards reflecting flood risk exists.
5	**Flood Hazard and Risk Information**	Flood management information is universally accessible and uniformly utilized by all County agencies.
6		Flood risk and mitigation information is readily available and widely communicated to the public.
7		Flood Insurance options are well-defined and communicated to the public.
8		Flood risk data and analyses are developed and periodically updated.

#	Category	Outcome
9		Urban Flood Zones/ Riverine Floodplain are defined/mapped.
10	Flood Mitigation	Capital Improvement Program incorporates flood mitigation needs.
11		County environmental, sustainability, and equity goals are incorporated in flood mitigation activities.
12	Asset Management	Asset management principles are followed to ensure infrastructure assets continuously deliver established levels of service (LOS) at an acceptable risk of failure while minimizing lifecycle costs of owning and maintaining the assets.
13		O&M of drainage and flood control infrastructure is proactive to maintain LOS.
14	Emergency Management	The County has an emergency management plan that addresses preparedness, response, and recovery for flood events.
15		The County's emergency management plan includes early warning systems for high-risk areas.
16	Budget and Finance	Financing options are well defined and communicated.
17		County budget and staffing needs are comprehensively collated, communicated, and decided upon.

STRATEGY ACTION PLAN

The 17 Outcomes represent the comprehensive flood management strategy; however, that strategy requires more details to allow the County to set in motion the activities to achieve the Outcomes. Moving forward with all seventeen Outcomes at once is daunting. There must be a timing designation to ensure appropriate focus. Achieving the Outcomes will be dependent on the expertise among the multiple flood management related agencies. The movement from the current County conditions to the achievement of the Outcomes differs, i.e., some Outcomes are closer to accomplishment than others. Each Outcome is presented as an individual page with eight defining elements. The 17 pages that follow, in combination, present the Action Plan for accomplishing the Outcomes. As noted in the previous section, detailed discussion of each of the outcomes can be reviewed in the *Governance & Policy Review Report* (Jacobs, 2023).



Each Outcome follows this structure:

1. *The number designation and phrase of the Outcome lead the page.*
2. *The Outcome Category is referenced. Categories serve to group similarly focused Outcomes and generally highlight the type of Outcome.*
3. *The Outcomes were presented to the Core Team. The team rated the 17 Outcomes relative to importance and performance:*

IMPORTANCE				
1- No urgency to Improve	2 - Minimal urgency to improve	3 - Some Urgency to improve	4 - Moderate urgency to Improve	5 - Very urgent to improve

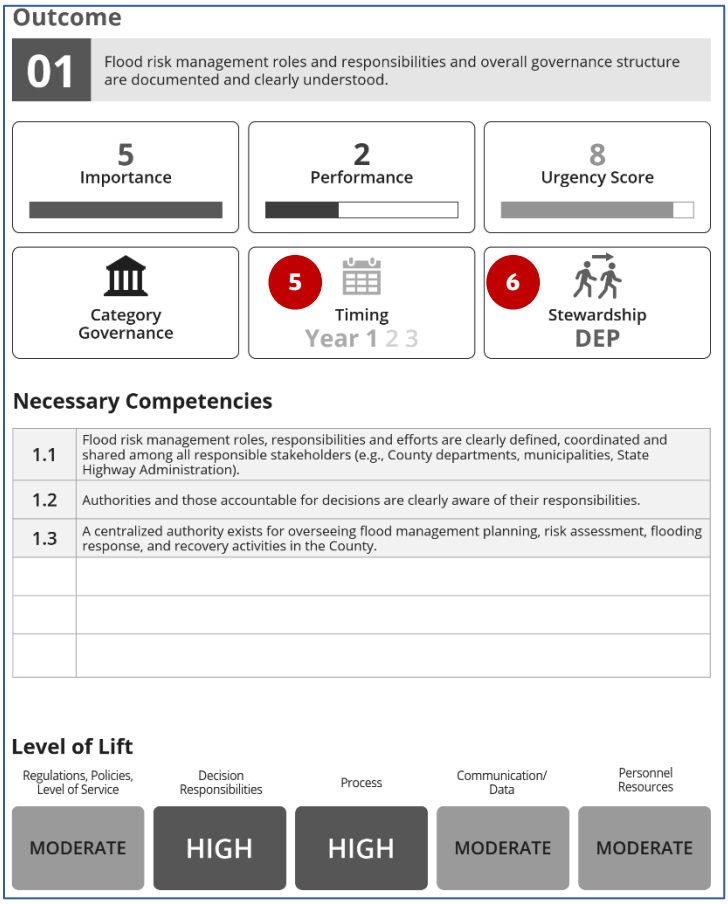
PERFORMANCE				
1 - We don't do this	2 - Lots of room to improve	3 - Some room to improve	4 - We're pretty good but should improve	5 - We do very well but can always improve

Both the number and a bar represent the numerical rating on a 1 to 5 scale.

4. *Importance and Performance ratings serve as inputs to the Urgency Score calculation:*

$$\text{Urgency Score} = \text{Importance Score} + (\text{Importance Score} - \text{Performance Score})$$

This calculation provides a sense of the more urgent need to advance the Outcome. The higher the number the more relative urgency. Highest Urgency Score is 9.

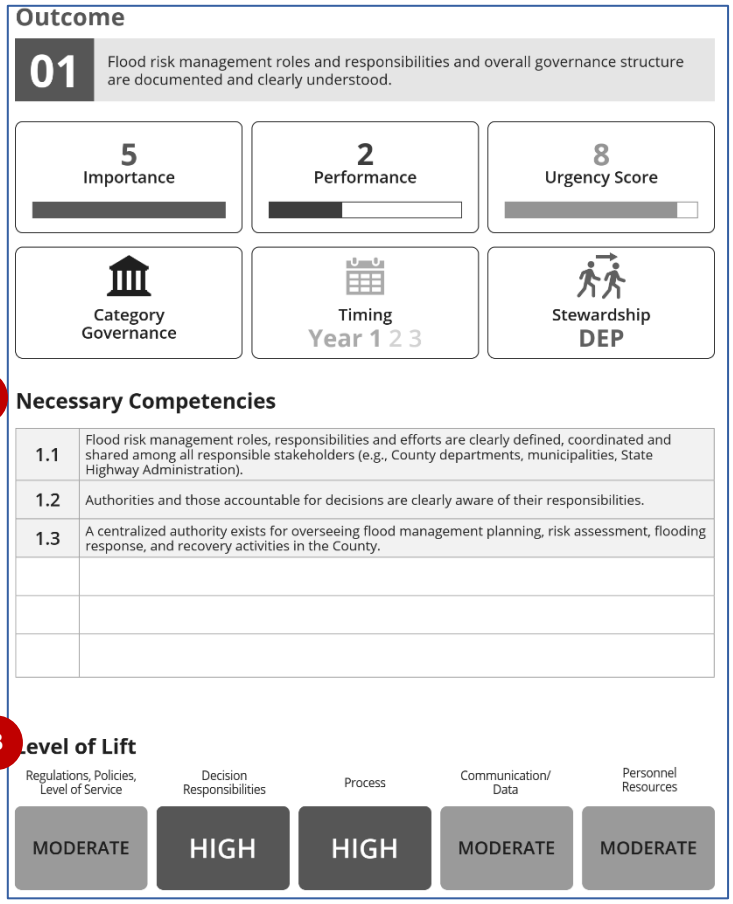


5 *A total of 17 Outcomes is a large number, requiring focus and investment. The Urgency Score does provide a sense of need, but many of the Outcomes have leading and lagging relationships where one or more Outcomes are needed in order to effectively accomplish another Outcome. For these reasons, initiation of Outcomes should be placed on a logical time horizon. This cell suggests the year in which the Outcomes should be initiated: Year 1, 2, or 3. Note that the suggestion for initiation does not imply that the Outcome would be completed in that year timeframe. The initial timing suggestions were presented and reviewed by the Core Team.*

6 *The breadth of capabilities across the multiple flooding-associated agencies must be shared to implement the improvements required to achieve the Outcomes; however, management of an effort by committee leads to inefficiency and missed milestones. This cell designates one agency as the steward of the Outcome. Stewardship implies the following:*

- *Taking on the responsibility of engaging a team*
- *Initiating and driving the effort to accomplish the Outcome*
- *Determining scope, schedule, and budget*
- *Requesting resources and investments*
- *Monitoring and reporting progress, and*
- *Promulgating the results*

Performing the Steward role does NOT imply that the agency in that role is performing all the effort to



accomplish the Outcome. The stewarding agency likely has either current capabilities or knowledge that supports accomplishing the Outcome, but it cannot be assumed that the entirety of the capabilities are housed solely within that agency, thereby the need for collaboration among multiple agencies.

7 *The Outcomes are collectively comprehensive but are not defined in enough detail to provide actionable results. Necessary Competencies are the refinement of the Outcomes that provide specific direction in achieving the Outcome through specific actions or activities and, as the name implies, are necessary for advancing the Outcome. If an organization evokes the stated Necessary Competencies, it is advancing the intended Outcome. A total of 73 Necessary Competencies are scattered across the 17 Outcomes.*

8 *Level of Lift characterizes the level of change and effort required to move from the current baseline of Montgomery County performance to accomplishment of the Necessary Competencies and advancement of the Outcome. Five categories of 'lift' are characterized for each Outcome as either HIGH, MODERATE, or LOW. The following table lists the five lift categories and defines the high, moderate, and low designations within each category. The lift required to advance an Outcome may vary across the five categories as reflected by the subject of the Outcome (that is, Outcomes with a focus upon information management would likely have more association with the Communication/Data category). The level of lift also provides a sense of the areas in which the stewarding agency should focus (that is, higher level of lift denotes more emphasis in expertise or focus required in that category to accomplish the Competencies and advance the Outcome).*

	Regulations, Policies, Levels of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
	What level of lift is required to reach agreement and/or accomplish modification of written policy or the interpretation of a regulation or a changed and/or formalized agreement on levels of performance or service?	What level of lift is necessary to clarify or change who has responsibility and/or authority to drive results and/or reach conclusions?	What level of lift is suggested to codify a process(es) or the improvement to process(es) within or among agencies and/or with outside stakeholders?	What level of lift is necessary to determine data needs, collection of the data, collation, access, ownership, distribution and/or use of data and the communication of information in which formats or forums and by whom?	What level of personnel resourcing is required to accomplish the necessary competencies?
HIGH	*Regulation, policy, or level of service does not exist, requiring high or significant level of lift for a new regulation, policy or level of service agreement.*	*Significant shift or establishment of new roles, authorities, or responsibilities and agreement to those roles.*	*Processes or procedures do not exist and must be created.*	*New data collection and management systems need to be created and/or implemented.*	*Significant investment and/or dedication of new personnel and/or resources needed to accomplish the Outcome.*
MODERATE	*Significant modification to existing regulatory, policy language, and/or level of service agreement.*	*Moderate shift of existing roles, authorities, or responsibilities.*	*Significant modification of existing processes or procedures.*	*Improvement to existing data management systems and/or data collection and availability.*	*Moderate investment in new resources and/or dedication of existing resources needed to accomplish the Outcome.*
LOW	*Minor changes to existing regulation, policy and/or existing level of service agreement.*	*Minor modification or clarification of existing roles, authorities, or responsibilities.*	*Minor modification of existing processes.*	*Minimal modification to data availability and access within existing systems.*	*Current compliment of resources capable of absorbing the actions and accomplishing the Outcome.*

Outcome

01 Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood.

5 Importance	2 Performance	8 Urgency Score
Category: Governance	Timing: Year 1 2 3	Stewardship: DEP

Necessary Competencies

1.1	Flood risk management roles, responsibilities and efforts are clearly defined, coordinated and shared among all responsible stakeholders (e.g., County departments, municipalities, State Highway Administration).
1.2	Authorities and those accountable for decisions are clearly aware of their responsibilities.
1.3	A centralized authority exists for overseeing flood management planning, risk assessment, flooding response, and recovery activities in the County.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	HIGH	HIGH	MODERATE	LOW

Outcome

02 Comprehensive land use plans reflect flood risk.

3	1.5	4.5
Importance	Performance	Urgency Score

Category	Timing	Stewardship
Flood Management Planning	Year 1 2 3	Planning

Necessary Competencies

2.1	County master plans incorporate flood risk information, including flood risk for historically vulnerable populations and Equity Emphasis Areas.
2.2	A community-wide flood risk management plan is used to inform zoning and land use changes.
2.3	Areas that provide natural flood conveyance, storage, and/or mitigation functions are identified and protected.
2.4	Flood risk for culturally and historically significant areas and structures is well understood and geolocated.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	LOW	LOW	MODERATE	LOW

Outcome

03 Development and redevelopment standards and building codes are updated to reflect established levels of service and current and future climate conditions for areas of riverine and urban flooding.

5	1	9
Importance	Performance	Urgency Score

Category	Timing	Stewardship
Flood Management Planning	Year 1 2 3	DPS

Necessary Competencies

3.1	A watershed plan that evaluates future (climate and land use) conditions and short- and long-duration storms is used to implement stormwater management and development regulations. Such a plan addresses wetlands/natural areas and stream channel protection and potential for infill development/re-development impacts.
3.2	Watershed plan flood risk information is used to inform building code and development standard updates in areas of known or projected future flood risk.
3.3	Stormwater and flood control infrastructure Levels of Service (LOS) are established, communicated and periodically measured and reported, for each part of drainage/stormwater system.
3.4	Staff members know where to find climate data and can utilize it in their current roles.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
HIGH	HIGH	HIGH	MODERATE	MODERATE

Outcome

04 Clear permit process and enforcement of development and redevelopment standards reflecting flood risk exists.

3 Importance	4 Performance	1 Urgency Score
Category: Flood Management Planning	Timing: Year 1 2 3	Stewardship: DPS

Necessary Competencies

4.1	All development in the Floodplain District is reviewed through the Floodplain District Permit review process.
4.2	The County's Floodplain Management regulations are uniformly enforced.
4.3	All development in areas of urban flood risk are reviewed through a permit review process.
4.4	Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed pre-development runoff.
4.5	The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff members are responsible for activities and approvals associated with stormwater and flood management.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
HIGH	LOW	HIGH	LOW	MODERATE

Outcome

05 Flood management information is universally accessible and uniformly utilized by all County agencies.

4.5 Importance	2 Performance	7 Urgency Score
Category: Flood Hazard and Risk Information	Timing: Year 1 2 3	Stewardship: DEP

Necessary Competencies

5.1	Staff reviewing new development and redevelopment applications have access to geographic locations of, and information on, previously flooded areas.
5.2	Standards exist and are used to ensure that flood management GIS data, detailed studies, and reporting are produced in a uniform manner to support end uses.
5.3	A standardized set of baseline and projected future climate data has been collected and made available.
5.4	Staff members know where to find climate data and can utilize it in their current roles.
5.5	Data sharing processes are established to enable agencies to achieve other outcomes.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	MODERATE	MODERATE	HIGH	HIGH

Outcome

06 Flood risk and mitigation information is readily available and widely communicated to the public.

5	2	8
Importance	Performance	Urgency Score

Category	Timing	Stewardship
Flood Hazard and Risk Information	Year 1 2 3	DEP

Necessary Competencies

6.1	The public knows how and where to find information about their current and future flood risk.
6.2	Information on flood insurance is readily available in hardcopy form and on the County website.
6.3	An on-going program of public outreach to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain is coordinated among agencies involved in County flood management.
6.4	Flood hazard mapping is available and used in disclosure of flood hazard information during real estate transactions.
6.5	Information to assist residents in protecting their properties is available in County libraries and on the County website.
6.6	All entities conducting development or redevelopment in the Floodplain District are made aware of the Floodplain District Permit process.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	LOW	MODERATE	HIGH	MODERATE

Outcome

07 Flood Insurance options are well-defined and communicated to the public.

3 Importance	2 Performance	4 Urgency Score
Category: Flood Hazard and Risk Information	Timing: Year 1 2 3	Stewardship: DEP

Necessary Competencies

7.1	The level of available insurance coverage is known and aligned with flood risk areas.
7.2	There is a plan for increasing flood insurance use among property owners.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
LOW	HIGH	LOW	HIGH	MODERATE

Outcome

08 Flood risk data and analyses are developed and periodically updated.

4.5 Importance	2 Performance	7 Urgency Score
Category: Flood Hazard and Risk Information	Timing: Year 1 2 3	Stewardship: DEP

Necessary Competencies

8.1	Building elevation certificates are collected as part of a permit review process, certificates are reviewed for accuracy and completeness, and are catalogued and available for reference.
8.2	Flood risk geospatial data used for flood risk assessment is kept up-to-date. Geospatial data is defined as georeferenced data sets (environmentally sensitive areas, socially vulnerable areas, commercial/economic impacts areas, but not including stormwater infrastructure asset data - see Outcome #1) that inform flood risk.
8.3	There is a well-defined and documented process for assessing and estimating damages following a flood event by type and extent of impact.
8.4	Critical facilities and critical infrastructure have been identified and geolocated on GIS.
8.5	The County has and maintains a community-wide flood risk management plan (including definition of areas of riverine and urban flood risk).
8.6	Flood risk impact for historically vulnerable populations and Equity Emphasis Areas is well understood.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	LOW	MODERATE	HIGH	HIGH

Outcome

09 Urban Flood Zones/ Riverine Floodplain are defined/mapped.

5	2	8
Importance	Performance	Urgency Score

Category	Timing	Stewardship
Flood Hazard and Risk Information	Year 1 2 3	DEP

Necessary Competencies

9.1	Riverine and pluvial/urban flood hazard areas are clearly mapped for different levels of service (storm recurrence). Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined.
9.2	The County has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms.
9.3	Floodplain Districts for the entire county are developed with consistent details.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	LOW	MODERATE	HIGH	HIGH

Outcome

10 Capital Improvement Program incorporates flood mitigation needs.

5 Importance	1 Performance	9 Urgency Score
Category: Flood Mitigation	Timing: Year 1 2 3	Stewardship: DOT

Necessary Competencies

10.1	The County has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development).
10.2	Future considerations (e.g., climate change impacts, development, increased impervious areas) are included in storm drainage infrastructure design.
10.3	Flood mitigation projects that reduce County flood risk have been identified.
10.4	A mitigation plan for repetitive loss areas has been developed and is being carried out.
10.5	Buildings within areas of high flood risk are acquired or relocated.
10.6	There is a comprehensive capital improvement program for addressing drainage problems.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	MODERATE	HIGH	MODERATE	HIGH

Outcome

11 County environmental, sustainability, and equity goals are incorporated in flood mitigation activities.

5	2	8
Importance	Performance	Urgency Score

Category	Timing	Stewardship
Flood Mitigation	Year 1 2 3	DEP

Necessary Competencies

11.1	The County's water quality improvement efforts and regulatory compliance are integrated with flood risk management programs.
11.2	County sustainability goals are considered in development of flood mitigation activities.
11.3	County equity goals are considered in development of flood mitigation activities.
11.4	Erosion and sediment control regulations exist for all construction sites for protection of water quality and drainage systems.
11.5	WQPC credit is provided for implementing flood mitigation beyond water quality requirements.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
HIGH	LOW	MODERATE	MODERATE	LOW

Outcome

12 Asset management principles are followed to ensure infrastructure assets continuously deliver established levels of service (LOS) at an acceptable risk of failure while minimizing lifecycle costs of owning and maintaining the assets.

4	2.5	5.5
Importance	Performance	Urgency Score

Category	Timing	Stewardship
Asset Management	Year 1 2 3	DOT

Necessary Competencies

12.1	A frequently updated asset management plan and program built on a reliable asset inventory and characterizing resources and timescales requirements for all stormwater and flood control infrastructure exists.
12.2	The Asset Management Program establishes and periodically reviews and updates the levels of service to be met by stormwater and flood control systems. Actual levels of service provided are measured and reported.
12.3	A reliable, accurate, and regularly updated inventory of stormwater and flood control infrastructure assets, with their attributes, exists. The inventory is accessible to all parties that inform the inventory or use it for planning purposes.
12.4	The condition and likelihood of failure, along with the consequences of failure, of all stormwater and flood control infrastructure is periodically updated and is easily accessible by staff.
12.5	The risk due to failure of stormwater and flood control infrastructure assets to meet established LOS is periodically updated and used to develop maintenance schedules, needed rehabilitation, replacement, and additional infrastructure assets.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
HIGH	MODERATE	HIGH	MODERATE	HIGH

Outcome

13 O&M of drainage and flood control infrastructure is proactive to maintain LOS.

Importance	Performance	Urgency Score
3	4	2

Category	Timing	Stewardship
Asset Management	Year 1 2 3	DEP

Necessary Competencies

13.1	Natural channels on both public and private property are inspected and debris is removed.
13.2	Known problem sites are recorded and given additional attention, as appropriate.
13.3	Regulations prohibiting dumping in streams exist and are publicized and enforced.
13.4	Private stormwater storage facilities are inspected and maintained on a regular basis, or enforcement measures exist if they are not maintained.
13.5	Public stormwater [infrastructure and] storage facilities are inspected and maintained on a regular basis.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	LOW	LOW	LOW	LOW

Outcome

14 The County has an emergency management plan that addresses preparedness, response, and recovery for flood events.

3 Importance	5 Performance	1 Urgency Score
Category: Emergency Management	Timing: Year 1 2 3	Stewardship: OEMHS

Necessary Competencies

14.1	The County has failure recognition procedures for dams and levees.
14.2	Response operations for failure of critical infrastructure and critical facilities are planned and practiced through periodic exercises.
14.3	Dam and levee failure planning is coordinated with owners and operators of critical facilities and infrastructure.
14.4	The County encourages owners and operators of critical facilities located in high risk areas to have their own flood response plan.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
LOW	LOW	LOW	MODERATE	MODERATE

Outcome

15 The County's emergency management plan includes early warning systems for high risk areas.

Importance	Performance	Urgency Score
3	3	3

Category	Timing	Stewardship
Emergency Management	Year 1 2 3	OEMHS

Necessary Competencies

15.1	The County has an effective flood warning system based on flood prediction.
15.2	Planning for dissemination of flood warnings is coordinated with owners and operators of critical facilities and critical infrastructure.
15.3	The County is designated by NWS as StormReady.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
LOW	MODERATE	LOW	MODERATE	MODERATE

Outcome

16 Financing options are well defined and communicated.

4.5 Importance	2 Performance	7 Urgency Score
Category: Budget and Finance	Timing: Year 1 2 3	Stewardship: DEP

Necessary Competencies

16.1	Grant and loan resources for capital improvements and flood preparedness are known and planned for.
16.2	Grant and loan resources for flood event recovery are known and there are resources to apply for these funds.
16.3	Flood protection resources and financial assistance is communicated to property owners by staff trained in retrofitting and grants availability information.
16.4	County grant program exists for acquisition of flood prone properties.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
MODERATE	MODERATE	MODERATE	LOW	HIGH

Outcome

17 County budget and staffing needs are comprehensively collated, communicated, and decided upon.

5 Importance	2 Performance	8 Urgency Score
Category: Budget and Finance	Timing: Year 1 2 3	Stewardship: DEP

Necessary Competencies

17.1	Operations and maintenance funding needs for stormwater and flood control infrastructure (e.g., green infrastructure, dams, levees) are known and planned for.
17.2	A flooding centered capital improvement plan is developed and updated annually.
17.3	Decisions regarding adequacy of flooding centered staffing and resources is performed by the collection of responsible County agencies.

Level of Lift

Regulations, Policies, Level of Service	Decision Responsibilities	Process	Communication/ Data	Personnel Resources
LOW	HIGH	HIGH	MODERATE	HIGH

PROGRAMMATIC DELIVERY

The County is meeting flooding-related requirements as stipulated by current regulations and policies; however, the needs identified in the first section of this document point to significant increased development along with the increased frequency and intensity of storms that result in a much higher likelihood of flooding. County leadership realizes it can and must better plan for avoid, mitigate, manage, and recover from flooding. The Outcomes recommended in this Strategy document outline the technical needs such as data collection and communication, risk and impact assessment, as well as stormwater and flood mitigation infrastructure capital improvement planning and delivery. These technical needs must be integrated with land use planning policies and procedures along with development standards and permitting procedures. To advance the technical, land use, site development, and permitting elements associated with the Outcomes, the County must be organizationally structured and functional to effectively and efficiently use data, modify policies, and reach agreements. The following organizationally focused recommendations are designed to support the County in being fully capable of meeting the Outcomes. The overarching recommendation is to institute a Programmatic Delivery approach. Six specific recommendations follow:

Maintain the Current Agency Structure.

- The current agency structure, which is clearly regulatory driven, is meeting regulatory requirements and is allowing the County to move forward to more comprehensive flood management. Thus, there is no short-term need to adjust the current agency structure.
- Modifications of the structure and organization may result from advancing the Outcomes.

Institute a Steering Committee.

- In order for the comprehensive flood management effort to both be initiated and take hold within the County, reliance upon the current agency structure is not enough.
- A Steering Committee formulated to represent the agencies and provide guidance and provide coordinated, unified advice and recommendations to County leadership is paramount.
- This Steering Committee will be responsible for answering comprehensive flood management questions such as: Where are we going? What are we doing? What needs to be done? What are the required leading investments? Are we consistent across agencies? Are we effectively using staff among these multiple agencies to produce the result associated with the Competencies and Outcomes?
- The Core Team, as part of the Phase 1 effort, was purposedly designed to incorporate representation from seven agencies who engage, in some way, with flood-related efforts. The Steering Committee should reflect this same complement of agency representation – MCDOT, MCDEP, OEMHS, MCDPS, OCE, PLANNING, and PARKS.
- The Steering Committee should meet in frequently cadenced meetings, at least once a quarter.

- This Committee serves to initiate the comprehensive flood management program, but equally important it learns of the influences and requests upon resources being asked of their agencies and aims to reach consensus in recommendations made to County leadership.
- This Steering Committee must have the direction and authority to move the entire Montgomery County organization to achieve the recommended Outcomes, including pressing upon individual agencies to advance specific investments and improvements. For this reason, the representative from each agency should be the agency's Director.
- The Steering Committee should select a chair who will lead the Committee and also select a vice-chair who will lead the Committee in the chair's absence.

Develop a Program Construct.

- An overarching purview, or umbrella view, must be developed and maintained that takes advantage of the expertise and experience among the agencies. The proposal is to formulate a programmatic approach that gathers the experience and resources from the appropriate agencies and tackles the accomplishment of the Outcomes together.
- Since the current agency construct is remaining, it is crucial to take a programmatic approach that gathers the experience and resources across agencies to manifest capabilities, skills, and expertise to achieve the Outcomes.
- A programmatic approach will provide the functional processes needed to engage, communicate, manage, and produce results and support the advancement of the Outcomes. At a minimum, the following three functions must be put into place:
    - Performance Management – includes the development of key performance indicators (KPIs) and targets, plus the collection, collation, reconciliation, packaging, reporting and communicating the progress toward the KPI targets, along with needs, and challenges of the programmatic effort.
    - Documentation and Communication – the means to develop and distribute appropriate documents, from reporting templates to public information to Council presentations.
    - Budgeting and Funding - the methodology to calculate cost estimates, designating possible funding mechanisms, and appropriation of operations and capital budgets to achieve the initiation and implementation of the Outcomes.
- The Steering Committee must guide the development, implementation, and progress of this programmatic construct.

Form a Program Delivery Team.

- While the Steering Committee is tasked with advising and guiding, the Program Delivery Team delves into the details of developing the program functions and delivering the Outcomes.
- The Program Delivery Team should be comprised of representation from the agencies involved in delivery of the Outcomes; that is, representation from MCDOT, MCDEP, OEMHS, MCDPS, OCE, PLANNING, and PARKS.

- Members of the Program Delivery Team must stay abreast of Steering Committee activities and decisions, and coordinate with their Director to ensure consistency in messaging and decision-making.
- The Program Delivery Team also ensures the operational relationships among the representative agencies are further developed.
- The Program Delivery Team should select a chair who will lead the Team and also select a vice-chair who will lead the Team in the Chair's absence.

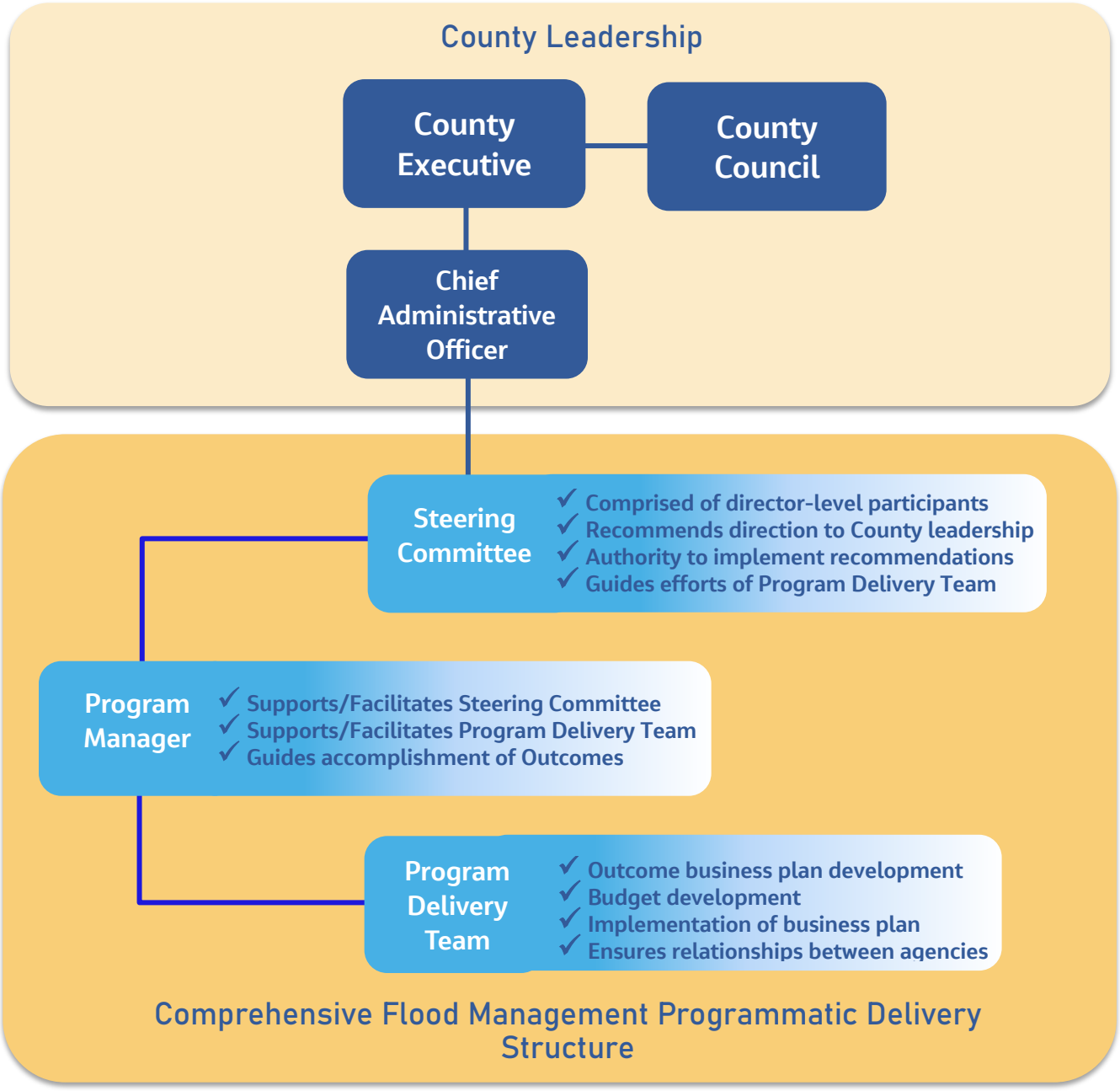
Produce a Business Plan.

- A Business Plan should be produced and annually updated to characterize details of the comprehensive flood management delivery for the upcoming year's budgeting process.
- This Business Plan is produced by the Program Delivery Team and validated by the Steering Committee.
- The Business Plan includes details on the following:
  - Designation of the priority Outcomes on which to focus .
  - Characterization of specific personnel needs to deliver the Outcomes.
  - Estimates of the costs and investment requirements to reach the desired Competencies and advance the Outcome (includes the breakdown of costs for both agency resources and the external costs for contracted support and tools).
  - Characterization of the funding opportunities for specific Outcome investments.
  - Validation of the stewarding agency and designation of additional agencies and specific resources to support the fulfillment of the Outcomes.
  - Scheduling of the activities throughout the Year 1 time horizon, and subsequently future years.
- The Business Plan document is the primary submittal to the County's leadership characterizing project-level details of accomplishing the Competencies and advancing the Outcomes.

Structure Program Manager Role.

- Designate a program manager who will have responsibility across the entire programmatic effort of advancing the comprehensive flood management Outcomes, not just a single Outcome.
- The program manager is not intended to have authority over operations of any agency, but rather to focus on advancing the interagency program utilizing and supporting the agency representatives embedded in the Program Delivery Team and Steering Committee.
- The program manager must be able to guide the activities associated with implementing the programmatic approach, accomplishing multiple Outcomes, maintain the energy and focus of those efforts, request program administration funding through the appropriate channels, document results, collate performance data, manage the interactions of the Program Delivery Team, support facilitation of the Steering Committee, and report progress.

The resulting recommended organizational construct for programmatic comprehensive flood management delivery is captured in the simple graphic below.



Comprehensive Flood Management Programmatic Delivery Structure

REFERENCES

Jacobs, 2023. *Comprehensive Flood Management Plan Phase 1 Governance & Policy Review Report*. February 10, 2023.

Jacobs, 2022. *Historic Flood Conditions & Data Gaps Technical Memorandum.* December 5, 2022.

COMPREHENSIVE FLOOD MANAGEMENT PLAN:

WATERSHED FLOOD EXPOSURE ASSESSMENT

VOLUME 2

Jacobs

May 2023

PURPOSE

An initial ranking of watersheds based on flood exposure was developed to aid in planning for completion of detailed watershed studies that will include hydrologic and hydraulic modeling, followed by risk assessments. The results of this assessment are intended to provide an understanding of potential flood exposure using available information. Detailed vulnerability and risk assessments are anticipated to be performed as part of Phase 2 watershed studies, which will include modeling and analysis of current drainage system capacity under a range of scenarios for future land use and climate conditions. The modeling will allow a site-specific analysis of flood risk and mitigation strategies to reduce that risk for neighborhoods, property, vulnerable communities and critical infrastructure.

This document is a summary of the Watershed Flood Exposure Assessment further documented in the *Historic Flood Conditions & Data Gaps Technical Memorandum* (Jacobs, 2023), included within Volume 3 of this report.

WATERSHEDS

Watershed delineations used to summarize historic flood conditions and engineering data gaps were obtained from the Montgomery County (County or MC) Department of Environmental Protection (MCDEP). The watersheds are United States Geological Survey (USGS) 12-digit watersheds[1], with some MCDEP improvements to watershed boundaries based on review of LiDAR[2] topographic data (see Figure 1).

[1] https://water.usgs.gov/GIS/huc.html

[2] https://www.americangeosciences.org/critical-issues/faq/what-lidar-and-what-it-used

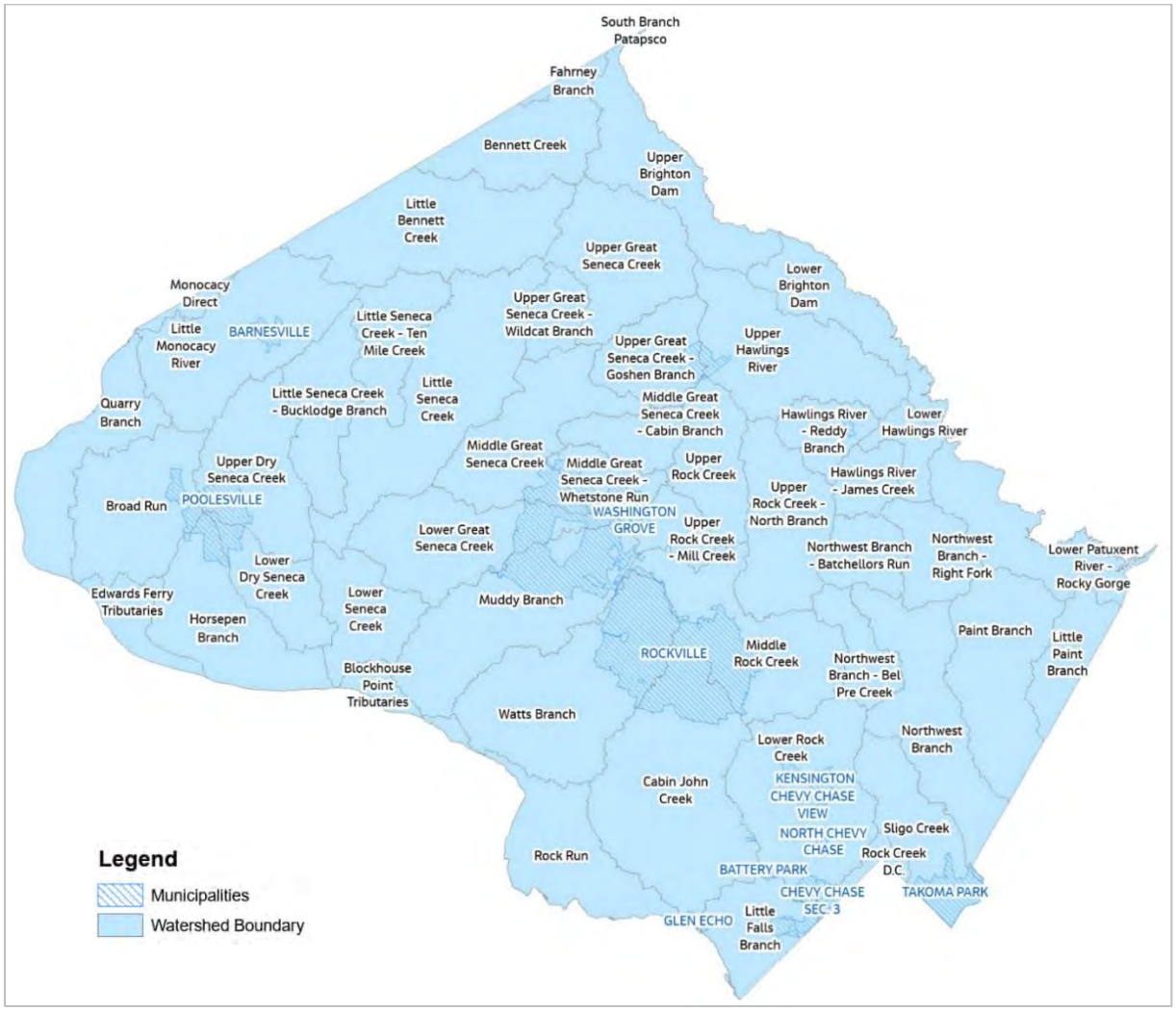


Figure 1 Watersheds Used for Flood Exposure Assessment (Source: MCDEP - adapted from USGS 12-Digit Watershed)

FLOOD EXPOSURE DATA

Data were collected from County agencies and Montgomery-National Capital Park and Planning Commission (M-NCPPC) in Spring and Summer of 2022. Several data sets were collected to assist in characterizing past flood conditions in the County, shown in Figure 2. Data are generally organized according to whether they inform an understanding of flood hazards (mapping of flood hazard areas), flood receptors (areas or locations that may be vulnerable to flood impacts) or observed impacts (flood event or flood impact information from County records).

These data come from several sources within the County, from public sources, and from existing Jacobs work. While none of these data sets offer a clear and comprehensive picture of flood hazards, exposures, or past flood impacts, together – and along with a knowledge of their limitations – they have been used to generate a watershed-level summary that can be found in Volume 3 of this report (*Historic Flood Conditions & Data Gaps Technical Memorandum* (Jacobs, 2023)). The flood hazards and flood receptors data were used to develop the watershed flood exposure ranking.

Flood Hazards	**Receptors**	**Observed** Impacts
• FEMA and County Floodplains • Jacobs simplified flood model (ADI Flood Modeller) 100-year 2065 preliminary flood zone for WSSC Water	• Critical Facilities • Areas of Social Vulnerability • Non-residential Buildings • Residential Buildings • Impervious Area • Environmentally Sensitive Areas	• DOT DAR program project/solution calls • DEP erosion calls • Flooding related 311 calls • 911 flood response calls • Frequently flooded roads (DOT and MCFRS) • Survey results

Figure 2 Summary of Data Collected for Watershed Flood Exposure Assessment

ADI = Alternating Direction Implicit [solver]
MCDOT DAR = Department of Transportation Drainage Assistance Request
FEMA = Federal Emergency Management Agency
MCFRS = Montgomery County Fire and Rescue
WSSC Water = Washington Suburban Sanitary Commission

FLOOD EXPOSURE RANKING OF WATERSHEDS

The methodology described below was used to develop an initial prioritized list of watersheds based on flood exposure for further analysis in Phase 2 of the Comprehensive Flood Management Plan. Flood exposure, rather than observed and reported flooding, forms the basis for an initial ranking because a prioritization based on observed flooding information may skew the results towards those watersheds where residents are more knowledgeable about and familiar with methods for reporting to, and requesting services from, the County.

The flood-exposure based approach includes the following steps (illustrated in Figure 3):

- Identify attributes that describe flood exposure of the watersheds.
- Measure these attributes using two sources of flood hazard areas information:
  - FEMA 100- and 500-year floodplains, which define areas of **riverine flooding**, which are areas where flood waters overtop stream and river banks, and
  - Flood Modeller 100-year 2065 flood zones, which define areas of both riverine flooding as well as local **pluvial flooding (Jacobs, 2020)**. Pluvial flooding is also sometimes referred to as **interior** flooding or **urban** flooding or **flash** flooding, where direct rainfall runoff exceeds capacity of saturated soils and drainage systems resulting in overland flow upstream of defined stream and river channels. Pluvial flooding can happen in any location, not necessarily near a water body. This modeling was done using future rainfall conditions projected under one scenario of climate conditions in 2065.
- Normalize scores for individual attributes using a 5-point scale and apply overall exposure scoring and weighting using a multi-attribute rating technique (MART, also referred to Multi-Objective Decision Analysis [MODA]) to each flood hazard scenario.
- Conduct a sensitivity analysis for each flood hazard scenario to understand impacts of various weighting scenarios.
- Combine the sensitivity analysis results for both flood hazard sources (FEMA and Flood Modeller) to produce a list of prioritized watersheds, differentiated by tier.

Figure 3 Flood Exposure Assessment Flowchart

The watershed flood exposure analysis was used to develop an initial watershed ranking in order to prioritize the next phase of work based on measures of flood exposure of non-residential buildings, residential buildings, socially vulnerable areas, total impervious areas, number of critical facilities and infrastructure, environmentally sensitive areas. A summary of the various attributes is included Table 1.

The extent of FEMA-studied riverine floodplain information is good throughout the County. The Flood Modeller analysis was previously conducted for WSSC Water and provides combined riverine and pluvial flood zone mapping in most of Montgomery County where WSSC Water provides water/wastewater service; but did not include modeling in some areas without water/sewer service. To make use of both sources of information, the following two flood exposure scenarios were calculated:

1. Flood exposure based on draft FEMA (September 2022) 100-year and 500-year floodplain extent
2. Flood exposure based on draft Jacobs and WSSC Flood Modeller 100-year 2065 flood extents

Measures for each of these attributes were calculated for both the FEMA (100-year and 500-year floodplain extent via draft FEMA NFHL) and available Flood Modeller 100-year 2065 flood zone area. Measured values for each attribute for both flood hazard scenarios are included in Volume 3 Appendices: Historic Flood Conditions & Data Gaps TM (Jacobs, 2023).

Table 1 Description of Attribute Measurements for Flood Exposure Assessment

Attribute	Measure of Attribute within Mapped Flood Hazard Areas[a]
Non-Residential Buildings	Number of non-residential buildings (categorized as non-residential from property land use designations)
Residential Buildings	Number of residential buildings (categorized as residential from property land use designations)
Socially Vulnerable Areas	Socially vulnerable areas (CDC SVI greater than 0.5)
Total Impervious Area	Total impervious area (i.e. total flooded impervious area for each modeling output)
Critical Facilities and Infrastructure	Number of critical facilities and infrastructure
Environmentally Sensitive Areas	USFWS National Wetlands Inventory area

[a] The noted measurements were made for both the FEMA 100- and 500-year floodplain extent (riverine exposure) and the available Flood Modeller 100-year 2065 flood zone extent (combined riverine/pluvial exposure).

RECOMMENDED TIERED RANKING OF WATERSHEDS

Tier designations for each flood hazard data set were combined to generate a single recommended prioritization list for completing detailed watershed studies. The maximum of either flood exposure score sum (FEMA or Flood Modeller) was used to identify a tier designation. The combined list is presented in Table 2. The methods and results presented here were discussed with a Core Team of Montgomery County staff representing a range of County agencies. Figure 4 provides mapping of watersheds by tier. Table 2 represents a recommendation for prioritization of watershed studies for the purpose of identifying flood hazards and mitigations.

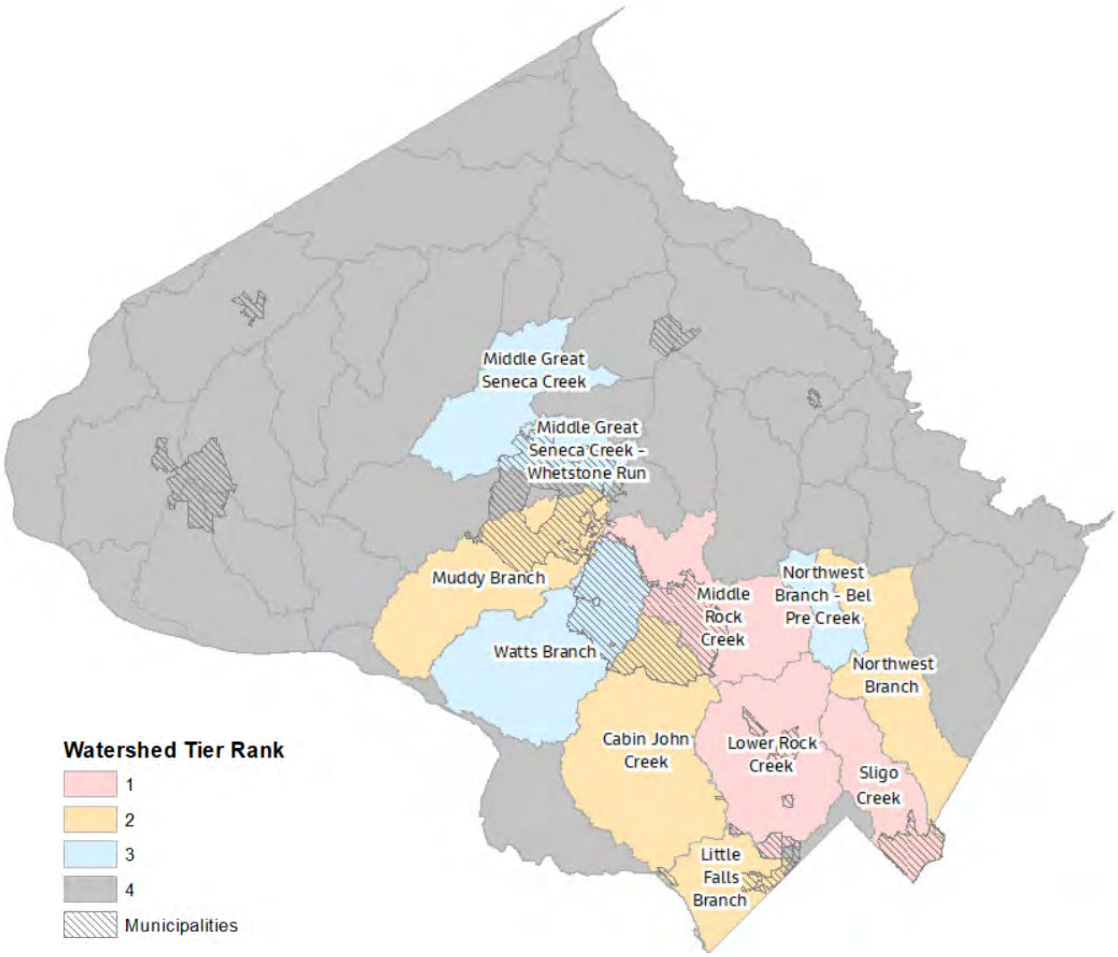


Figure 4 Recommended Tiered Ranking of Watersheds Based on Maximum Flood Exposure Score

Table 2 Recommended Tiered Ranking of Watersheds Based on Maximum Flood Exposure Score

Tier	Watershed	Maximum of Flood Exposure Score[a]	Tier	Watershed	Maximum of Flood Exposure Score[a]
1	Middle Rock Creek	26.31	4	Edwards Ferry Tributaries	1.41
	Lower Rock Creek	24.59		Blockhouse Point Tributaries	1.13
	Sligo Creek	19.96		Hawlings River - James Creek	1.01
2	Cabin John Creek	17.41		Upper Rock Creek	0.93
	Little Falls Branch	12.75		Broad Run	0.88
	Northwest Branch	12.38		Hawlings River - Reddy Branch	0.87
	Muddy Branch	11.95		Northwest Branch - Batchellors Run	0.76
3	Middle Great Seneca Creek	11.69		Upper Dry Seneca Creek	0.75
	Middle Great Seneca Creek - Whetstone Run	10.23		Upper Great Seneca Creek - Goshen Branch	0.74
	Northwest Branch - Bel Pre Creek	9.74		Lower Patuxent River - Rocky Gorge	0.59
	Quarry Branch*	9.61		Lower Brighton Dam	0.53
	Watts Branch	8.01		Bennett Creek	0.52
4	Little Seneca Creek	7.68		Little Seneca Creek - Bucklodge Branch	0.47
	Paint Branch	7.47		Little Monocacy River	0.46
	Northwest Branch - Right Fork	6.82		Upper Hawlings River	0.46
	Lower Great Seneca Creek	5.13		Lower Dry Seneca Creek	0.45
	Little Paint Branch	4.37		Upper Brighton Dam	0.40
	Middle Great Seneca Creek - Cabin Branch	3.98		Lower Hawlings River	0.40
	Rock Run	3.12		Upper Great Seneca Creek - Wildcat Branch	0.35
	Upper Rock Creek - North Branch	3.06		Little Seneca Creek - Ten Mile Creek	0.32
	Rock Creek D.C.	2.96		Little Bennett Creek	0.26
	Upper Great Seneca Creek	1.95		Monocacy Direct	0.04
	Lower Seneca Creek	1.67		Fahrney Branch	0.00
	Upper Rock Creek - Mill Creek	1.45		South Branch Patapsco	0.00
	Horsepen Branch	1.45			

Note:

a. Maximum of Flood Exposure Score is the maximum of the sum of flood exposure

* This watershed is not recommended for detailed modeling as the high score is due to the location of a single critical facility (Dickerson Power Plant Intake). Watershed-scale detailed hydraulic modeling is not appropriate for determining flood vulnerabilities at a single facility. See Section 4.4.2 of the Historic Flood Conditions & Data Gaps TM (Volume 3) for further discussion.

REFERENCES

Jacobs, 2020. *WSSC Climate Change Vulnerability Assessment Adaptation and Mitigation Plan (CCVAAMP) Linear Assets Future Flood Screening Analysis – Preliminary 100-year 2065 Flood Zone Development Background Technical Memorandum*. December 23, 2020.

Jacobs, 2023. *Historic Flood Conditions & Data Gaps Technical Memorandum.* May 5, 2023.

COMPREHENSIVE FLOOD MANAGEMENT PLAN:

ATTACHMENTS

VOLUME 3

February 2023

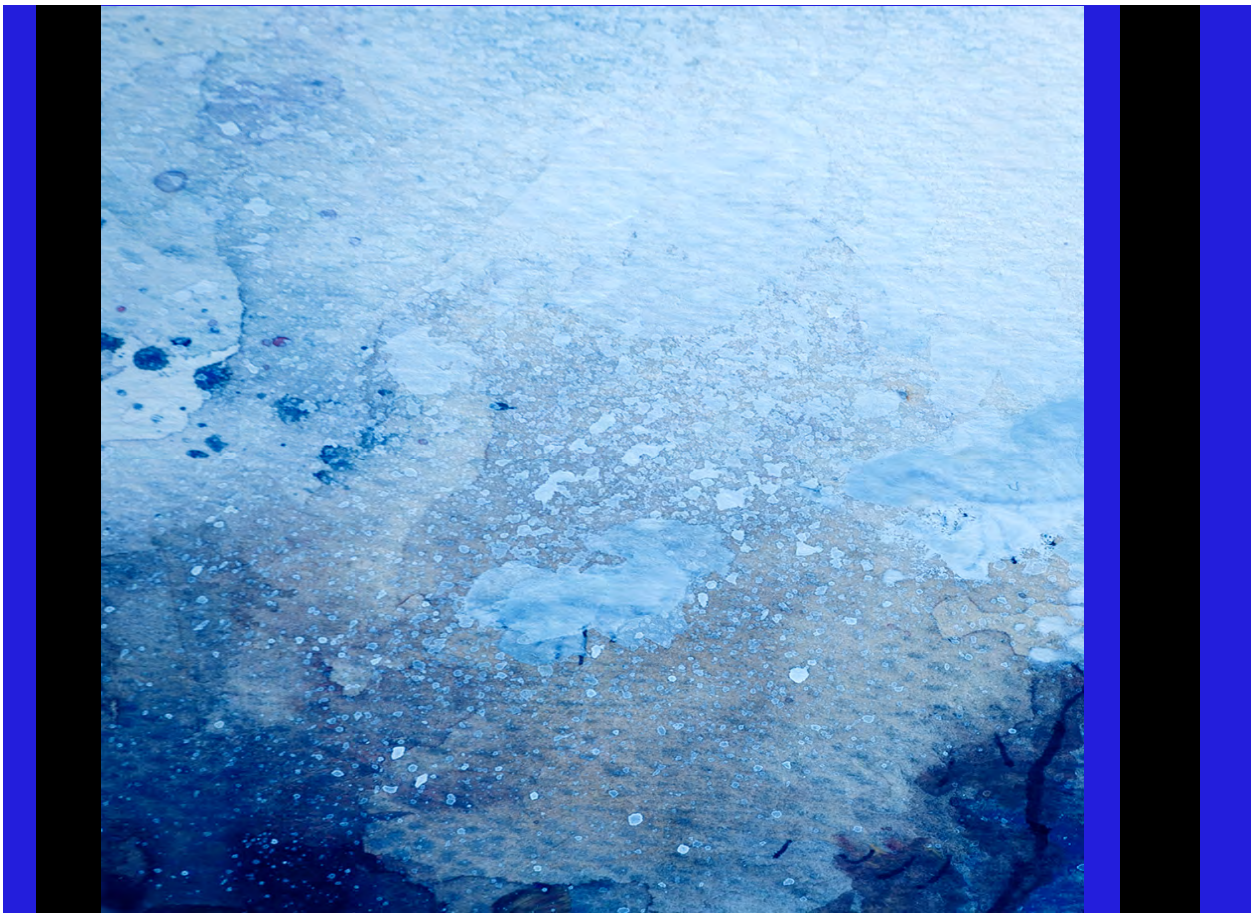
ATTACHMENT 1
GOVERANCE AND POLICY REVIEW REPORT

Jacobs

Governance and Policy Review Report

Montgomery County Department of Environmental Protection

Comprehensive Flood Management Plan Phase 1
February 10, 2022



Governance and Policy Review Report

Client name: Montgomery County, Maryland

Project name: Comprehensive Flood Management Plan, Phase 1

Project no: E4X56703 & E4X56704

Date: December 22, 2022

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
A	12/30	For review	MS	AI	LvdT	MS
B	2/10	Draft final	MS	AI	LvdT	MS

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments

Jacobs Engineering Group

1010 Wayne Avenue, Suite 1150
Silver Spring, MD 20910

T +1.301.495.8840

Copyright Jacobs Engineering Group, Inc. © 2023.

All rights reserved. The concepts and information contained in this document are the property of the Jacobs group of companies. Use or copying of this document in whole or in part without the written permission of Jacobs constitutes an infringement of copyright. Jacobs, the Jacobs logo, and all other Jacobs trademarks are the property of Jacobs.

NOTICE: This document has been prepared exclusively for the use and benefit of Jacobs' client. Jacobs accepts no liability or responsibility for any use or reliance upon this document by any third party.

Contents

Acronyms and Abbreviations ..... **vi**
1. Purpose **1-1**
2. Introduction and Background **2-1**
3. Governance Review Methods **3-1**
3.1 Approach 3-1
3.1.1 Framework for Outlining Flood Management Roles and Responsibilities 3-1
3.2 Involving the Stakeholders 3-2
3.2.1 Core Agency Workshops 3-2
3.2.2 Agency Interviews and Questionnaires 3-2
3.3 Community Engagement 3-3
3.4 Peer Engagement 3-3
3.5 Review of Relevant State and County Documentation 3-3
4. Statutes, Regulations and Ordinances **4-1**
4.1 Introduction 4-1
4.2 Floodplain Management Regulations 4-1
4.2.1 National Flood Insurance Program 4-1
4.2.2 County Floodplain Regulations 4-2
4.3 Stormwater Management and Water Quality Regulations 4-2
4.3.1 Maryland Stormwater Management Regulations 4-2
4.3.2 Maryland's Modified Civil Law Rule (Lot-to-Lot Surface Drainage) 4-3
4.3.3 County Erosion and Sediment Control Regulations 4-3
4.3.4 County Stormwater Management Regulations 4-3
4.4 Building Code 4-4
4.4.1 Adequate Public Facilities Ordinance 4-4
4.4.2 Building Drainage Plan Permit 4-5
4.5 Subdivision and Development Review Processes 4-5
4.6 Land Use/Zoning 4-6
4.6.1 General Plan 4-6
4.6.2 Zoning Code 4-8
4.7 Other Regulations 4-8
4.7.1 Regulation of Dams and Reservoirs 4-8
5. Current Situation **5-1**
5.1 Agency Roles and Responsibilities 5-1
5.2 Current Budgets and Projects 5-6
5.2.1 Operating Budget 5-6
5.2.2 Capital Budget 5-7
6. Desired Outcomes from Comprehensive Management of Flooding **6-1**

6.1 Outcomes from Comprehensive Flood Management 6-1
6.2 Necessary Competencies to Advance the Outcomes 6-1
7. Observations and Recommendations 7-1
7.1 Observed Performance and Importance of Outcomes 7-1
7.2 Observations and Recommendations Related to Outcomes 7-2
7.2.1 Governance 7-2
7.2.2 Flood Management Planning 7-4
7.2.3 Flood Hazard and Risk Information 7-9
7.2.4 Flood Mitigation 7-15
7.2.5 Asset Management 7-18
7.2.6 Emergency Management 7-21
7.2.7 Budget/Personnel 7-23
8. Conclusions and Next Steps 8-1

Appendixes

A Core Agency Roles and Responsibilities Matrix
B Core Team Workshop Summaries
C Core Agency Interview Summaries
D Core Agency Questionnaire Responses
E Community Outreach Summary
F Other Jurisdiction Review Summary
G Core Agency Organizational Charts

Tables

3-1 Roles for Flood Management 3-1
3-2 Flooding Sources 3-2
5-1 Summary of Core Team Agency Roles Related to SWM and Flood Management 5-1
5-2 Summary of Advisory Agency Roles Related to SWM and Flood Management 5-5
5-3 Revenue Sources 5-7
5-4 Stormwater and Flood Management Projects – FY23 through FY28 Capital Budget 5-8
5-5 Bridge Projects with a Stormwater or Flood Management Component – FY23 through FY28 Capital Budget 5-9
6-1 Outcomes Necessary for Comprehensive Management of Flood Risk 6-1
6-2 Necessary Competencies to Advance Comprehensive Flood Management Outcomes 6-1
7-1 Scoring for Performance Ranking 7-1
7-2 Scoring for Importance Ranking 7-1
7-3 Outcomes Necessary for Comprehensive Management of Flood Risk 7-1
7-4 Observations Related to the Flood Risk Governance Structure Outcome 7-3

7-5 Observations Related to the Comprehensive Land Use Outcomes 7-5
7-6 Observations Related to the Development Standards and Building Code Outcome 7-6
7-7 Observations Related to the Development and Permit Process Outcome 7-8
7-8 Observations Related to County Staff Access and Use of Flood Management Information Outcome 7-9
7-9 Observations Related to Public Access and Use of Flood Management Information Outcome 7-11
7-10 Observations Related to the Flood Insurance Coverage Outcome 7-12
7-11 Observations Related to the Development of Flood Risk Data 7-13
7-12 Observations Related to the Mapping of Urban and Riverine Flood Zones Outcome 7-15
7-13 Observations Related to Flood Mitigation Capital Improvement Program Outcome 7-16
7-14 Observations Related to Other Benefits of Flood Management Outcome 7-17
7-15 Observations Related to Use of Asset Management to Maintain LOS Outcome 7-19
7-16 Observations Related to Proactive O&M Planning Outcome 7-21
7-17 Observations Related to Emergency Response Planning Outcome 7-22
7-18 Observations Related to Early Warning System Outcome 7-23
7-19 Observations Related to Knowledge of Funding Options Outcome 7-24
7-20 Observations Related to Knowledge of Budget Needs Outcome 7-25

Figures

2-1 Approach to Development of a CFMP Strategy for the County 2-1
2-2 Core, Advisory, and Informing Agencies and Non-agency Stakeholders 2-2
5-1 Water Quality Protection Fund Revenues and Expenditures 5-7
7-1 Calculation of the Outcome Urgency Score 7-1

Acronyms and Abbreviations

APFO	Adequate Public Facilities Ordinance
CFMP	Comprehensive Flood Management Plan
CIP	capital improvement plan
CoF	consequences of failure
COMAR	*Code of Maryland Register*
COMCOR	*Code of Montgomery County Regulations*
CRS	Community Rating System
County	Montgomery County
DAR	Drainage Assistance Requests
DEP	Montgomery County Department of Environmental Protection
DOT	Montgomery County Department of Transportation
DPS	Montgomery County Department of Permitting Services
DRC	design rule checking
EAP	Emergency Action Plan
EPA	U.S. Environmental Protection Agency
ESD	Environmental Site Design
FEMA	Federal Emergency Management Agency
FY	fiscal year
GIS	geographic information system
GIP	*Growth and Infrastructure Policy*
HSD	Highway Services Division
KBA	Knowledge Base Article
LoF	likelihood of failure
LOS	levels of service
MCFRS	Montgomery County Fire and Rescue Service
MCPD	Montgomery County Police Department
MCPS	Montgomery County Public Schools
MDE	Maryland Department of the Environment
MDOT	Maryland Department of Transformation

MDP	Maryland Department of Planning
M-NCPPC	Maryland-National Capital Park and Planning Commission
MS4	Municipal Separate Storm Sewer System Permit
MSCD	Montgomery Soil Conservation District
NPDES	National Pollutant Discharge Elimination System
NWS	National Weather Service
O&M	operations and maintenance
OEMHS	Office of Emergency Management and Homeland Security
ORESJ	Office of Racial Equity and Social Justice
P1	Phase 1
SHA	State Highway Administration
SWM	stormwater management
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
WQPC	Water Quality Protection Charge
WQPF	Water Quality Protection Fund
WR Plan	*Water Resources Functional Plan of 2010*
WRE	Water Resources Element

1. Purpose

This report has been prepared as part of Comprehensive Flood Management Plan (CFMP) Phase 1 (P1) Task 4.2 (Task Order #3 of Contract 1127041) and summarizes work completed in Task 4.2. Following Montgomery County (County) review and receipt of comments, this report will be revised.

This report is intended to provide a summation of the existing flood management governance condition. The documentation is purposely designed to cover the regulatory, organizational, and governance elements at a level to inform and provide clarity to the collective understanding of existing flood management responsibilities, actions, and investments. Building on the findings of this document, the Core Team has developed a vision for future flood management within the County, which is documented separately in a Comprehensive Flood Management Strategy Report.

The report has been organized into the following subsections:

- **Governance Review Methods:** Provides an overview of the methods used to obtain information on current roles and responsibilities as well as observations related to existing flood management activities within the County.
- **Policy and Regulations Review:** Provides an outline of relevant policy and regulations guiding current flood management and related activities.
- **Current Roles and Responsibilities Related to Flood Management:** Provides description of current agency roles and responsibilities, along with an overview of current budgets.
- **Outcomes of Comprehensive Flood Management:** Introduces and describes a set of outcomes associated with comprehensive management of flooding.
- **Observations and Recommendations:** Summarizes observations related to existing flood management and opportunities for improvement to achieve stated outcomes.
- **Conclusions and Next Steps:** Briefly summarizes next steps for the CFMP.

2. Introduction and Background

Montgomery County has experienced an increase in flooding events, causing adverse impacts to public safety and to public and private properties. According to an April 2021 report from the Office of Legislative Oversight, "there has been an upward trend of urban flooding in the County, from two to four occurrences per year before 2010, increasing to 11 to 39 occurrences per year since 2010."[1]

There are several factors contributing to this trend. The primary factor is increased precipitation and changes in the nature of that precipitation. According to the U.S. Environmental Protection Agency, precipitation in Maryland has increased by about 5 percent in the last century, but precipitation from extremely heavy storms has increased in the eastern United States by more than 25 percent since 1958.[2] The County's Climate Action Plan predicts that these trends will continue.[3] Other significant factors contributing to the change include increased development and the associated increase in impervious surface area from new development, infill development, and redevelopment. In addition, stormwater infrastructure built to older design standards is unable to handle the large volumes of water caused by more intense precipitation events in addition to increased impervious area.

A variety of laws, regulations, policies, and procedures govern the development of the built environment that contributes to stormwater runoff and the infrastructure that is designed to handle this runoff. In addition, a number of County departments and agencies have a role in the planning, design, review, approval, installation, maintenance, and management of both the built environment and the stormwater infrastructure, in addition to emergency response to storm events.

The purpose of CFMP P1 was to work with County agencies to develop a shared understanding of existing policy and regulations for flood management. This included understanding the current roles and responsibilities of County agencies, the data available for understanding flooding conditions, and historical flooding events. This shared understanding was then used to develop a CFMP strategy intended to aid long-term planning for flood mitigation. The 5-step overall approach to generating the governance strategy is illustrated in Figure 2-1.

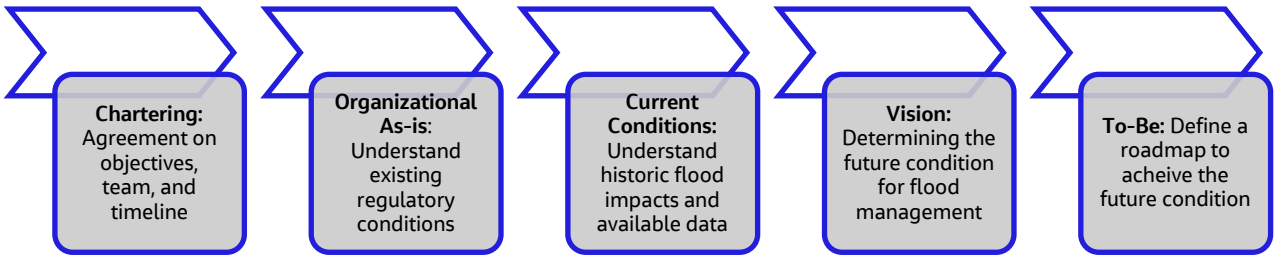


Figure 2-1. Approach to Development of a CFMP Strategy for the County

The County has identified certain "Core" agencies which, because of their current role in flood management, are critical to lending guidance, data, and decision-making for the development of the CFMP strategy. These agencies have contributed significantly to this report in the form of input and review. Many other County agencies and some non-County entities are identified as "Advisory" members. These stakeholders also provided varying levels of input, data and involvement throughout the process.

[1] Office of Legislative Oversight. 2021. *Measuring Climate Resilience – A Review of Select Critical Infrastructure Sectors in Montgomery County.* April. https://www.montgomerycountymd.gov/OLO/Resources/Files/2021_Reports/OLOReport2021-5.pdf.

[2] U.S. Environmental Protection Agency. 2016. *What Climate Change Means for Maryland.* August. https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-md.pdf.

[3] Montgomery County Government. 2021. *Montgomery County Climate Action Plan*. June. https://www.montgomerycountymd.gov/green/Resources/Files/climate/climate-action-plan.pdf.

Finally, some County and non-County entities were identified as "Inform/Informing" members. These stakeholders have an interest in understanding the CFMP objectives and staying informed as the study progresses. Figure 2-2 lists the agencies in each of the three categories.

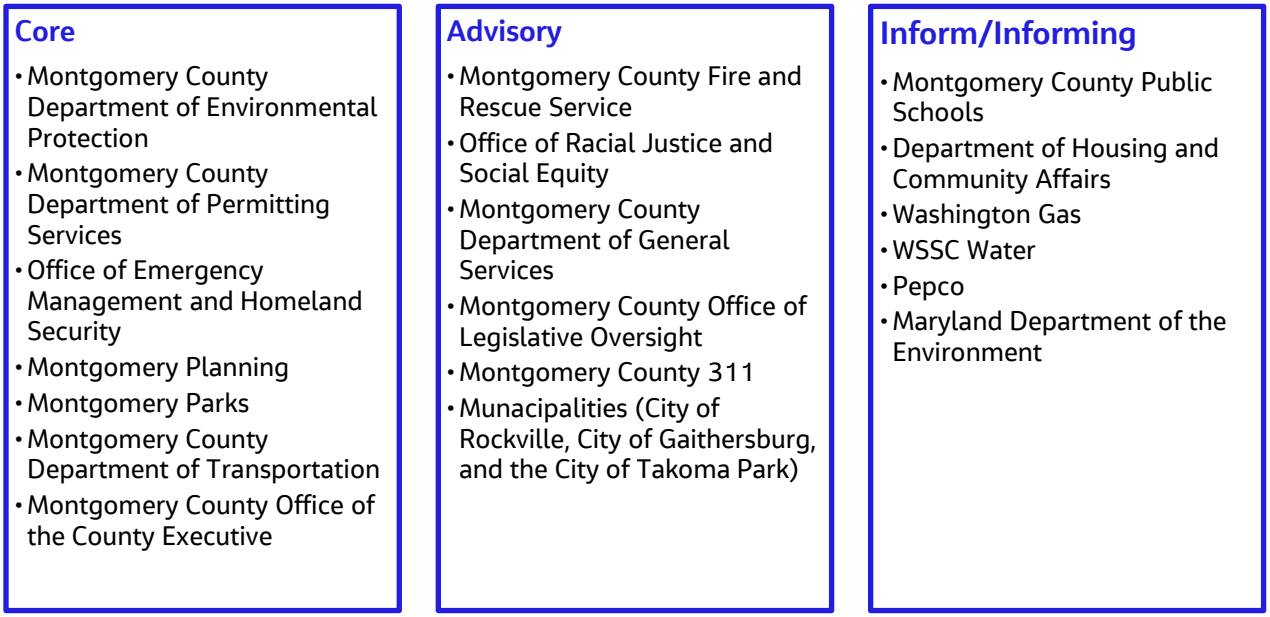


Figure 2-2. Core, Advisory, and Informing Agencies and Non-agency Stakeholders

3. Governance Review Methods

3.1 Approach

The objective of Task 4.2 of CFMP P1 was to identify existing state and County regulations, policy, roles, and responsibilities as well as understand existing funding and budgets related to flood planning, response, and mitigation. The approach involved engagement of County agency and department stakeholders and of the community to gather information about the existing conditions. Engagement of other jurisdictions through peer interviews was also used to provide insight into flood management approaches taken by comparable public entities.

3.1.1 Framework for Outlining Flood Management Roles and Responsibilities

Flood management includes many roles that span the life cycle of stormwater infrastructure and related land use planning activities. Roles differ depending on type of infrastructure (for example, dam versus storm drain versus open channel), ownership of infrastructure (for example, public versus private), regulatory boundaries (for example, inside or outside of the regulated floodplain), and jurisdictional boundaries (for example, in unincorporated parts of the County, or in roads owned or operated by Maryland Department of Transportation [MDOT] State Highway Administration [SHA]). To assist in illustrating where the various Core Agencies are operating, and where the division of responsibilities fall, the framework shown in Table 3-1 was used.

Table 3-1. Roles for Flood Management

	Roles	Role Notes
Proactive Roles	Land use planning	Master planning and development controls at the County, watershed, or area plan level
	Stormwater infrastructure system planning	Engineering planning studies at the system level corresponding to the mission of a specific agency (stormwater, wastewater)
	Engineering design	Publicly-owned infrastructure engineering/design, review of design submittals
	Permitting	Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections
	Construction support	In-house and external construction support (stormwater, flood control, and infrastructure projects)
	Operations	Responsibility for operation of infrastructure
	Maintenance	Maintaining stormwater infrastructure (ponds, culverts, dams, etc.)
	Preparedness	Emergency response preparedness, planning of logistics of response, training and conducting exercises, interagency communications strategy
Reactive Roles	Response	Carrying out response activities for a flooding event
	Recovery	Supporting post-event activities such as debris removal, repairs, addressing impacts, and completing or supporting post-disaster/hazard mitigation grant applications

The framework also considered the flooding source and whether the agencies' roles and responsibilities were different among the differing sources, as listed in Table 3-2.

Table 3-2. Flooding Sources

Flooding Source	–Designation
Riverine Flooding *(High stream and river water levels causing regional overbank flooding)*	Not in FEMA or County floodplain
	In FEMA of County floodplain
Pluvial/Interior/Urban/"Lot-to-Lot" Flooding[4] *(Flooding* because of *local rainfall and subsequent surface drainage and exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to and from other public (for example, Prince George's County, federal lands, parkland, incorporated areas such as Rockville, Gaithersburg, and Takoma Park)

FEMA = Federal Emergency Management Agency

Input from agency interviews, workshop exercises, and questionnaires—each described in the following subsections—was used to generate an indication of whether these agencies characterized their role and responsibility as either "primary" or "supporting." The results of this framework are presented in Appendix A.

3.2 Involving the Stakeholders

3.2.1 Core Agency Workshops

Several of the Core Team workshops, using a virtual collaboration application, explored existing roles and responsibilities, current performance, and desired future outcomes associated with comprehensive flood management. Summaries of these workshops are included in Appendix B.

3.2.2 Agency Interviews and Questionnaires

Interviews were conducted with staff from Core and some Advisory Agencies. Issues covered in these interviews varied depending on the agency but generally followed an agenda including the following aspects of flood management:

- Roles and responsibilities related to flooding
- Responsibilities for physical assets impacted by flooding
- Data developed and managed related to flooding
- Funding for flood management roles
- Historical impacts of flooding on agency roles

Although most interviews followed this agenda, several agencies brought up additional topics of interest as well. Further, some of the Advisory agency discussions differed from the agenda because of the nature of the agency's work (for example, the Office of Legislative Oversight and the Office of Racial Equity and

[4] "**Urban flooding**" refers to flooding from direct rainfall runoff that exceeds the capacity of local drainage systems and is distinguished from "**riverine flooding**" which results when excess flow in a river or creek from upstream rainfall overtops the channel banks. Urban flooding is often also referred to as "**pluvial flooding**," "**local flooding**," "**interior flooding,**" or, at times, "**Lot-to-lot flooding**."

Social Justice). A list of sample interview questions, as well as interview summaries, are included in Appendix C.

Following the June 2, 2022 Core Team Workshop (Workshop #2), a questionnaire was sent to each agency with a request to provide additional detail regarding responsibilities and clarity of specific regulations or policy references for the indicated flood management roles. The agencies' responses to these questionnaires are included in Appendix D. Some follow up discussions were carried out upon receipt of the responses to further clarify roles and responsibilities.

3.3 Community Engagement

The objective of community stakeholder engagement was to gather information related to historical flooding events and their impacts, and to inform stakeholders on the approach the County is taking to establish the Flood Management Strategy. The engagement activities included carrying out the following:

- An online community survey
- Survey pop-up events in communities
- Virtual online community forums

Forums and pop-up events focused on general education regarding the Flood Management Plan project, types of flooding, and the current understanding of historical flood events and their impacts. Forums and pop-up events also provided a venue for anecdotal data collection from community members. A summary of the community engagement events and online survey results is provided in Appendix E.

3.4 Peer Engagement

Two primary methods were used to understand the ways other jurisdictions have addressed flood management in their localities: (1) a desktop study and (2) an informal interview with representatives from select jurisdictions. Interviews were conducted virtually using a prepared list of questions (Appendix F).

3.5 Review of Relevant State and County Documentation

Based on recommendations provided in agency interviews and Core Team workshops a review of relevant literature (including state statutes and regulations) and County codes and regulations, policies, plans, and reports was completed. The review informed the existing conditions of the County's Core agency roles and responsibilities.

4. Statutes, Regulations and Ordinances

4.1 Introduction

The following section contains detail on existing regulations at the federal, state, and County level related to flood management. This documentation is intended to provide a summation of relevant regulations and policies and to broadly identify the documents guiding County flood management roles. Regulations are broadly categorized by subject (floodplain, stormwater, building code, land use, and zoning). This section lists a selection of documents reviewed:

- *Montgomery County Code, Part II, Ch 19, Articles I and II* including County Attorney Opinions dated 9/22/99-A[5] and 12/13/99[6]
- The Implementation Report: Streamlining Montgomery County's Development Authorization Process (1992) – Referenced in the 2021 Environmental Guidelines as the "lead agency protocols"[7]
- The Maryland-National Capital Park and Planning Commission (M-NCPPC) General Plan (1964, 1969, 1993, 2022)
- Maryland Stormwater Design Manual (2000, revised 2009)
- The M-NCPPC Water Resources Functional Plan (2010)
- Montgomery County Department of Environmental Protection (DEP) County-wide-Coordinated Implementation Strategy (2012, will be replaced by individual watershed implementation plans beginning November 2022)
- Montgomery County Comprehensive Water Supply and Sewerage Systems Plan (2018)
- Montgomery Planning Environmental Guidelines (2021)
- Montgomery County Office of Legislative Oversight Report 2021-5: Measuring Climate Resilience – A Review of Select Critical Infrastructure Sectors in Montgomery County (April 2021)
- Montgomery County Climate Action Plan (June 2021)

4.2 Floodplain Management Regulations

As noted in Montgomery County Executive Regulation 24-06AM, the County has the authority under the Flood Control and Watershed Management Act, Section 5-801 through 5-809, Environment Article of the Annotated Code of Maryland to control floodplain development.

4.2.1 National Flood Insurance Program[8]

The County participates in the National Flood Insurance Program, which is a voluntary program to provide federally backed flood insurance in exchange for adoption of floodplain regulations. As a participant, the County is required to adopt and enforce regulations for development within the Special Flood Hazard Area defined as the 100-year floodplain (1 percent annual chance of flooding). Minimum requirements are found within the National Floodplain Management Regulations Title 44 *Code of Federal Regulations* Part 59, 60, 65, and 70. Note that Montgomery County is not part of the Community Rating System (CRS),

[5] Montgomery County Office of the County Attorney. 1999. *Montgomery County Code, Part II, Chapter 19, Articles I and II, County Attorney Opinion 09-22-1999a*. http://files.amlegal.com/pdffiles/MCMD/09-22-1999a.pdf.

[6] Montgomery County Office of the County Attorney. 1999. *Montgomery County Code, Part II, Chapter 19, Articles I and II, County Attorney Opinion 12-12-1999*. http://files.amlegal.com/pdffiles/MCMD/12-13-1999.pdf.

[7] Montgomery County Planning Department. 2021. *Environmental Guidelines: Guidelines for Environmental Management of Development in Montgomery County.* p. 25.

[8] *Code of Federal Register* Title 44 Part 59, 60, 65, and 70

which provides insurance premium discounts based on exceeding minimum National Flood Insurance Program regulations. The County floodplain manager resides in the Montgomery County Department of Permitting Services (DPS) Water Resources Section.

The latest effective Flood Insurance Study and Flood Insurance Rate Mapping for Montgomery County is September 2006. An update to the FEMA mapping is currently underway, with release of preliminary mapping anticipated for winter 2023

4.2.2 County Floodplain Regulations

The County controls development and other activities in the floodplain via the Floodplain District Permit delineated in Article III of the *Montgomery County Code*, *Code of Montgomery County Regulations* (COMCOR) Chapter 19. Further definition of the regulations can be found in Executive Regulation 24-06AM/COMCOR 19.45.01. The Floodplain District is defined in the code as any area subject to inundation in a 100-year storm with a drainage area of 30 acres or more. This includes mapped (FEMA, M-NCPPC, or DPS 100-year floodplain maps) as well as unmapped areas.

A permit is required for any land-disturbing activity within a Floodplain District or 25-feet of a boundary, unless the activity (1) disturbs less than 5,000 square feet of surface, (2) is an exempted state or federal project, or (3) is an agricultural land management practice. For approximate floodplain areas (where base flood elevations are not noted), the regulation indicates that DPS will review any available 100-year flood elevation from federal, state, or other sources (those listed include U.S. Army Corps of Engineers [USACE], Soil Conservation Service, Maryland Department of the Environment [MDE], M-NCPPC). When mapping is not available, DPS, in concert with MDE, determines an approximate 100-year elevation using FEMA methods. For those cases in which the proposed development is in the vicinity of an unmapped stream, a 100-foot buffer may be applied. Depending on the nature of the application, a Floodplain Study may be required to establish the 100-year flood elevation.[9]

4.3 Stormwater Management and Water Quality Regulations

Many of the existing County regulations related to stormwater management focus on surface water quality improvements. These include state requirements for NPDES MS4 Permits, and erosion and sediment control, stormwater management (SWM) and ESD requirements. Although the focus of these regulations is not to provide management of runoff during severe rainfall events, they do include requirements for storage and conveyance of smaller quantities of runoff and are therefore mentioned here.

4.3.1 Maryland Stormwater Management Regulations

The U.S. Environmental Protection Agency (EPA) has authority to administer the National Pollutant Discharge Elimination System (NPDES) permit, which includes Municipal Separate Storm Sewer System Permit (MS4) (*Code of Federal Regulations* Title 40 Part 122).[10] The intent of this Clean Water Act program is to reduce stormwater pollution by preventing pollution, capturing and treating stormwater runoff, performing stream restoration work, and community education. EPA has delegated authority for management of the MS4 in the State of Maryland to MDE (*Code of Maryland* Register [COMAR] Chapter 26 Part III Subtitle 17).[11] The County has a 5-year NPDES MS4 permit, most recently re-issued on November 5, 2021.[12] The County's Clean Water Montgomery Program covers many activities, including Total Maximum Daily Load (TMDL) implementation planning, required by the permit. DEP is the lead agency responsible for coordinating planning for, at a watershed level, how watershed restoration projects will be implemented County-wide to achieve the TMDL targets stipulated in the NPDES permit.

[9] Executive Regulation 24-06AM (2007)

[10] *Code of Federal Regulations* (CFR). Title 40 Chapter 1 Part 122 EPA Administered Permit Programs: the National Pollutant Discharge Elimination System

[11] *Code of Maryland Register* (COMAR). Chapter 26 Part III Subtitle 17 Chapter 02, Stormwater Management

[12] Maryland Department of the Environment (MDE). 2021. NPDES MS4 Permit Number 20-DP-3320 MD0068349.

The regulations contained in COMAR 26.17.02 Stormwater Regulations require local jurisdictions to implement Environmental Site Design (ESD) to the maximum extent practicable. They also contain minimum control requirements for SWM facilities. For areas determined to have historical flooding issues, design for management of runoff quantities from the 2- and 10-year storm events may be required.[13] The Maryland Stormwater Design Manual, adopted by reference, further indicates "safe conveyance" of the 100-year storm event through the SWM system shall be provided in these circumstances. No duration is indicated for the referenced storm events, although the Maryland Stormwater Design Manual typically references a 24-hour duration design event.

4.3.2 Maryland's Modified Civil Law Rule (Lot-to-Lot Surface Drainage)

In the State of Maryland, the law applying to drainage of surface runoff from one property to another is known as the Civil Law Rule (*Michie's Annotated Code of Maryland*: Agriculture, Title 8 Soil Conservation, Subtitle 6 Drainage). The Civil Law Rule has been interpreted to mean that landowners are entitled to have surface water flow naturally from higher land to lower land, as long as the drainage passes a "reasonableness of use test." Generally, the higher landowner or their design professional cannot increase the quantity or volume of water discharges; alter the natural course of drainage via redirection or use of an artificial channel, causing dirt, debris, or pollutants to be discharged; or otherwise create a health hazard.[14]

DPS offers guidance and clarification in the sediment control permit review process, with the objective to mitigate negative environmental impacts caused by land disturbance, including minimizing soil erosion and preventing off-site sedimentation.[15] Although the permit review process does not assess adherence to the state Modified Civil Law Rule, it does not exempt the permittee or design professional from satisfying the Rule's requirements. Currently, SWM practices within the permit review process are intended to safeguard environmental quality rather than control the volume or quantity of stormwater runoff, including lot-to-lot surface drainage.

4.3.3 County Erosion and Sediment Control Regulations

The County manages erosion and sediment impacts of proposed development through *Montgomery County Code* Chapter 19 Article I Erosion and Sediment Control. An erosion and sediment control permit, administered by DPS, is required for any land disturbance equal to or greater than 5,000 square feet. The permit application must include such information as narrative and overlay SWM plan information, including velocities and peak flow rates at outfalls for 2- and 10-year storm events, for review by DPS.

As of November 1, 2020, all applications for sediment control permits are required to include a Drainage Statement on the first page of the plan sheet. The statement, drafted by DPS, must be signed and dated by the design engineer prior to approval by DPS, indicating that the design engineer has considered post-development drainage patterns and understands that DPS review is related to environmental runoff treatment standards only.

4.3.4 County Stormwater Management Regulations

County SWM regulations can be found in *Montgomery County Code* Chapter 19 Article II. The purpose of Article II is to maintain predevelopment runoff characteristics, reduce channel erosion, pollution, siltation and sedimentation, and local flooding by implementing ESD to the maximum extent practicable. The Article provides for review of progressive SWM and Erosion Control plans by DPS for disturbance of land greater than 5,000 square feet, to ensure consistency with the regulation (Sections 19-22A and 19-23) and provide for authority to develop Watershed Management Plans for management of stormwater

[13] *Code of Maryland Register* (COMAR). Chapter 26 Part III Subtitle 17 Chapter 02 Section 07 Minimum Control Requirements

[14] Everhart and Ellixson. 2020. *When Does Surface Drainage Become a Trespass?*

[15] Montgomery County Department of Permitting Services (DPS). "Lot to Lot Surface Drainage." Accessed August 15, 2022. https://www.montgomerycountymd.gov/DPS/Resources/Files/Land_Development/LotToLotRunoffFactSheet.pdf.

quality (Section 19-22) by DEP in coordination with DPS and the Planning Board. The County has not generated a Watershed Management Plan to date, but this section of the code outlines specific facets of such a plan, and indicates it would specify where, within the watershed, DPS may grant waivers of on-site SWM controls.

Waivers for SWM requirements may be granted by DPS if the applicant can show that ESD has been implemented to the maximum extent practicable and that proposed development will not adversely impact stream quality. [16]

The County has published a Lot-to-Lot Surface Drainage Fact Sheet (DPS, undated) to provide education and clarification to property owners regarding the limitations of County reviews related to stormwater: the County reviews plans for compliance with environmental runoff treatment criteria, which have a minimal impact on reduction of runoff volumes during large storm events. The Maryland Stormwater Design Manual is adopted by reference; thus, the minimum control requirements described in this manual for areas within the 100-year regulatory floodplain also apply.[17]

4.4 Building Code

Article II Chapter 8 of the *Montgomery County Code* contains the construction codes for the County. COMCOR Section 08.00.02 and 08.00.03 indicate that the 2018 versions of the following codes have been adopted, with amendments:

- International Building Code
- International Residential Code
- International Fuel Gas Code
- International Mechanical Code
- International Existing Building Code
- International Green Construction Code
- International Energy Conservation Code
- International Swimming Pool and Spa Code

Within the building code, the following subsections are relevant to management of water quantities for some building projects.

4.4.1 Adequate Public Facilities Ordinance

The Adequate Public Facilities Determination Ordinance (APFO) (*Montgomery County Code* Chapter 8 Article IV) outlines a process to ensure development does not occur before adequate facilities (transportation, public safety, and schools) are available. Review of plan submittals required under Chapter 50, Chapter 59, and Chapter 8 are included. The ordinance indicates that Montgomery County Department of Transportation (DOT), Montgomery County Fire and Rescue Service (MCFRS), and Montgomery County Police Department (MCPD), and Montgomery County Public Schools (MCPS) will review submittals.[18] The section is applicable to development requiring a building permitthat will generate 30 or more peak hour vehicle trips or increase the number of public school students by more than 5.

[16] *Montgomery County Code*. Chapter 19 Article II Section 24.

[17] *Montgomery County Code*. Chapter 19 Article II Section 20.

[18] Montgomery County Planning Board. 2017. Administrative Procedures for Development Review 17-01.

References to "Adequate Public Facilities" and "Adequate Public Facilities Determination" can be found in several places in the County code, including the following:

- *Montgomery County Code* Chapter 50, Article IV, Division 10, Section 3, Establishment of APFO Guidelines. This section details the process for County Council to adopt a Growth and Infrastructure Policy, which provides detailed guidance for APFO reviews.
- *Montgomery County Code* Chapter 59, Section 7, Administration and Procedures, further references APFO within the Division 7.3 wherein APFO determinations are noted to include "schools, police and fire protection, water, sanitary sewer, public roads, storm drainage, and other public facilities."[19]

Depending on the development project, APFO reviews may be completed at the subdivision or site plan review stage. For those projects that do not require subdivision review but include a building permit, the APF review, if necessary, would be completed prior to issuance of a building permit.

4.4.1.1 Growth and Infrastructure Policy

The 2020-2024 *Growth and Infrastructure Policy* (GIP) was adopted through Council Resolution 19-655 on November 16, 2020. The GIP provides guidelines for administration of the APFO (*Montgomery County Code* Chapter 8 Article IV). The document provides guidelines that describe the methods and criteria that the Planning Board and its staff must use in determining the adequacy of public facilities, including public school, transportation, water and wastewater, police, fire, and health facilities mainly during the review and approval of subdivision plans by the Planning Board. **Consideration of stormwater infrastructure capacity is not currently part of this policy.**

4.4.2 Building Drainage Plan Permit

Building Code (Chapter 8, Article III Section 8-29) sets a requirement for a drainage plan for new single--family dwellings, additions to single-family dwellings, or accessory dwelling units on properties with lot size of less than 15,000 square feet where a SWM plan has not been approved. For these projects, a building permit can be withheld "unless the plans provide for safe conveyance or control of any increased water runoff…that would drain onto adjacent or nearby private property". The County has published the *Guidelines for Control of Water Runoff on Small Lots*[20] to provide owners and their consultants with assistance in complying with requirements of the code. The general design criteria included in this guide is for sizing control or conveyance facilities to handle 1.5 inches of rainfall over a 24-hour period. This is roughly equivalent to the 1-year annual recurrence storm per the *Maryland Stormwater Design Manual.*[21]

4.5 Subdivision and Development Review Processes

Development in the County, inside and outside the regulated floodplain, is determined through several different processes and is subject to one or more sections of the *Montgomery County Code*. Generally, sizable new developments that include subdivision of land or a site plan are reviewed by the Planning Board for compliance with the Subdivision Code (Chapter 50, Article II. Subdivision Plans) and the County's Zoning Ordinance (Chapter-59,). Development or redevelopment of properties not requiring a subdivision or a site plan review by the Planning Board generally move through specific DPS permitting processes.

[19] Montgomery County Code. 2014. Part II Chapter 59 Article VII Division 7.3.

[20] Montgomery Department of Permitting Services. 2009. *Guidelines for Control of Water Runoff on Small Lots.*

[21] Maryland Department of the Environment. 2009. *Maryland Stormwater Design Manual.*

4.6 Land Use/Zoning

4.6.1 General Plan

Under Maryland Land Use Code Annex § 21, the M-NCPPC is responsible for updating the County's General Plan and any amendments to the General Plan (including countywide functional master plans and local area master plans).[22] The County's General Plan provides a framework for guiding development of land that will protect resources while accommodating projected growth.

The latest version, approved unanimously by the County Council on October 25, 2022, is titled *Thrive Montgomery 2050*.

The overall guidance provided in the General Plan is further refined through County-wide functional master plans such as the *Master Plan of Highways and Transitways*, area master plans called master plans or sector plans, and park master plans. These master plans fill in the details and provide more specific recommendations about land use (housing, office, retail, industrial, recreation, agriculture, open space, natural areas, etc.); zoning; infrastructure (roads and highways, parks, open spaces, recreation facilities, schools and other public facilities); urban design; preservation of sensitive historic, cultural and environmental resources and other aspects of land use and development in the plan area. From a legal point of view each functional plan, master plan, sector plan, or park master plan is an amendment to the County's General Plan and follows the same process prescribed in Chapter 33-A of the *Montgomery County Code*.

4.6.1.1 Environmental Guidelines

Montgomery Planning's environmental guidelines for protection of stream buffers, steep slopes, and other environmentally sensitive areas was originally approved in 1983 as *Staff Guidelines for the Protection of Steep Slopes and Stream Valleys.* The current version, approved by the Montgomery County Planning Board in 2021, satisfies the Sensitive Areas element of the 1992 Economic Growth, Resource Protection, and Planning Act. It offers guidance to "staff, applicants, and residents regarding appropriate techniques to protect natural resources during the development review process,"[23] adds "specific environmental protection guidelines for land development located in a portion of the Ten Mile Creek watershed" and "provides technical updates to reflect changes approved at the County and state level since the last revision of the Guidelines in 2000."[24] The *Environmental Guidelines* were developed considering "existing policies and practices in other jurisdictions" with the aim to "consolidate and coordinate environmental site development issues that impact and are impacted by land use decisions." It encourages interagency cooperation at the earliest planning stage[25] and recognizes the negative impacts that development can have in disturbing the natural landscape, which include contributing to erosion and sedimentation as well as water quantity and quality problems.[26]

4.6.1.2 MDE 2007 *Water Resources Element Guidance*

The Water Resources Element (WRE) was one of several major new local planning requirements added to state law in 2006 mandated in House Bill 1141, Land Use – Local Government Planning (2006), requiring "counties and municipalities that exercise planning and zoning authority to adopt a WRE in their comprehensive plans by October 1, 2009." [27] The WRE should answer the following questions for a County

[22] Maryland Land Use Code Annex § 21-104. 2021. Accessed August 17, 2022. https://law.justia.com/codes/maryland/2021/land-use/division-ii/title-21/subtitle-1/section-21-104/.

[23] Maryland-National Capital Park and Planning Commission. 2021. *Environmental Guidelines.* Front cover.

[24] Maryland-National Capital Park and Planning Commission. 2021. *Environmental Guidelines.* p.1.

[25] Maryland-National Capital Park and Planning Commission. 2021. *Environmental Guidelines.* p.14.

[26] Maryland-National Capital Park and Planning Commission. 2021. *Environmental Guidelines.* p.3.

[27] The Water Resources Element: Planning for Water Supply and Wastewater and Stormwater Management, Preface. Accessed August 18, 2022. https://planning.maryland.gov/Pages/OurWork/envr-planning/water-resources-mg/home.aspx.

or municipality: "Is there adequate water, wastewater, and septic supply to meet current and future needs?" and "What is the impact on water resources in meeting these needs?"[28]

The Water Resources Element: Models and Guidelines: Planning for Water Supply and Wastewater and Stormwater Management (2007) offers counties and municipalities guidance regarding incorporating a WRE in their comprehensive plans as well as a model WRE with the necessary components that could be adopted.

4.6.1.3 MDE 2022 Proposed *Water Resources Element Guidance* Update

The 2022 proposed update to the *WRE Guidance* provides best practices for protecting water quality of receiving waters during local land use planning and development and "integrating climate change considerations, particularly flood risks, into the drinking water, wastewater and stormwater assessments in the WRE."[29] The WRE should describe how stormwater will be managed, consider the system's capacity to convey runoff to support planned growth, and "include strategies focused on improving local understanding of current or expected water-related climate change impacts at the local level" as well as strategies to address impacts if sufficient information is available. [30]

The 2022 Proposed Guidance Update also addresses when a local WRE should be updated, such as when land use changes are planned in a watershed prone to flooding. The updated WRE should "indicate the extent of current local knowledge concerning flood-prone areas and should discuss whether implementation of the land use plan will increase, decrease or have no effect on those flood-prone areas." [31] If this information is not available, the WRE should call for a study to understand the impacts the implementation will have.

4.6.1.4 The *Water Resources Functional Plan of 2010*

The approved and adopted *Water Resources Functional Plan of 2010* (the WR Plan) satisfies the WRE requirement in House Bill 1141 (2006). The WR Plan describes County water and sewer service capacity in terms of growth projected to 2030, estimates existing and future watershed nutrient loadings, and provides recommendations for General Plan revisions to maintain adequate water and sewer service and stormwater nutrient management through 2030.

The WR Plan does not explicitly address stormwater runoff quantity concerns but recognizes the connection between stormwater runoff and stormwater quality. The WR Plan notes that, with the County near buildout conditions, improvement in water quality will require retrofitting older developments, implementing ESD, and accommodating growth through redevelopment and infill. It further notes that design of redevelopment and infill projects to reduce impervious cover and improving stormwater management can be expected to improve water quality."[32]

The County is not yet undergoing a formal update to their WRE at the time of this writing as many key efforts to show how the County will meet the 2022 WRE Guidance updates are under development, including the CFMP.[33]

[28] The Water Resources Element: Planning for Water Supply and Wastewater and Stormwater Management, Preface. Accessed August 18, 2022. https://planning.maryland.gov/Pages/OurWork/envr-planning/water-resources-mg/home.aspx.

[29] 2022 Water Resources Element Update: Introduction and What's New in this Guidance. Accessed August 18, 2022. https://planning.maryland.gov/Pages/OurWork/envr-planning/water-resources-mg/2022/01/update-introduction.aspx.

[30] 2022 Water Resources Element Update: Checklist: Determining Whether the Local WRE Needs to be Updated. Accessed August 18, 2022. https://planning.maryland.gov/Pages/OurWork/envr-planning/water-resources-mg/2022/01/update-introduction.aspx.

[31] 2022 Water Resources Element Update: Checklist: Determining Whether the Local WRE Needs to be Updated. Accessed August 18, 2022. https://planning.maryland.gov/Pages/OurWork/envr-planning/water-resources-mg/2022/01/update-introduction.aspx.

[32] Maryland-National Capital Park and Planning Commission. 2010. *Environmental Guidelines.* p. 31. September.

[33] Email correspondence with Montgomery County Planning Department, July 29, 2022.

4.6.2 Zoning Code

Montgomery County Zoning Ordinance is Chapter 59 of the *Montgomery County Code*. The Zoning Ordinance was comprehensively updated by the County Council in 2014 and became effective on October 30, 2014. Zoning related recommendations of the County's land use plans are incorporated in zoning code through subsequent updates called Zoning Text Amendments. Requirements of specific zones (such as coverage, impervious area, setbacks) are set with the intent of achieving the vision set forth in the general and area master plans. Zoning ordinance can be updated through a Local Map Amendment, Corrective Map Amendment, Sectional or District Map Amendment, or through Zoning Text Amendment (ZTA). Each type of amendment is reviewed and recommended by the Planning Director, the Planning Board, and ultimately approved through the County Council. Variance or Conditional Use approvals can also be petitioned for, these applications are for development outside the typical zoning ordinance development standards.[34]

4.7 Other Regulations

4.7.1 Regulation of Dams and Reservoirs

Regulation of dams and reservoirs (including small ponds) is defined at the state level (*Code of Maryland*, Environmental Article 5-501 through 5-514). MDE is responsible for implementing a comprehensive dam safety program and has promulgated regulations to implement comprehensive Waterway Construction and Dam Safety programs which administer Dam Safety Permits (COMAR 26.17.04). In the County, small pond review and approvals have historically been carried out by the Montgomery Soil Control District (MSCD). Pond reviews on private land have, historically, been carried out jointly by DPS and National Resource Conservation Service through a Memorandum of Understanding with MSCD. However, as of January 2022, the National Resource Conservation Service has returned that authority to MSCD because of lack of staffing and because MSCD no longer has engineering staff sufficient to address reviews; therefore, pond reviews are currently being conducted through MDE.[35] The County defines the floodplain, within Section 19-36 of the County Code (Floodplain District Requirements Definitions), in terms of both areas of typical riverine inundation and inundation due to dam failure.

Owners of dams, including high-hazard dams, (County high-hazard dam owners include DEP and Montgomery Parks) are responsible for permitting the dam, inspecting and maintenance, preparation and annual update of an Emergency Action Plan (EAP), participation in EAP exercises, and financial planning for long-term dam maintenance and repair.

[34] Montgomery County Code. 2014. Part II Chapter 59 Article 59-7 Section 7.1

[35] Interview with DPS Staff, May 27, 2022.

5. Current Situation

5.1 Agency Roles and Responsibilities

Numerous County departments along with two departments of M-NCPPC (Montgomery Planning and Montgomery Parks) and their governing M-NCPPC Planning Board are involved in various functions related to stormwater and flood management in the County. Several of these County and the M-NCPPC departments provide significant review, evaluation, analysis, inspection, and decision-making regarding flood management, as well as the operation and maintenance of stormwater and flood control infrastructure. These departments are referred to as the Core Agencies. Other agencies provide valuable information and insights into the management of floods. These departments are referred to as Advisory Agencies.

Core Agencies within the Montgomery County government include the Department of Transportation (DOT), Department of Environmental Protection (DEP), Department of Permitting Services (DPS), Office of Emergency Management and Homeland Security (OEMHS) and the Office of the County Executive (OCE). Also included as Core Agencies are two departments of the Montgomery County arm of the M-NCPPC, Montgomery Parks and Montgomery Planning. M-NCPPC is a state agency responsible for land use planning and management of parks in Montgomery and Prince George's Counties. The two departments, headed by the Director of Parks and Director of Planning, respectively, report to the Montgomery Planning Board. The Planning Board is comprised of five members appointed by the County Council and confirmed by the County Executive and service in staggered, four-year terms.

Table 5-1 lists the Core Agencies with a summary of their roles and responsibilities with respect to stormwater and flood management. Sources: Montgomery County department websites (2022); Montgomery County Emergency Operations Plan (Oct. 2017); Montgomery County Approved FY23 Operating Budget; Interviews with County and M-NCPPC (Montgomery Parks and Montgomery Planning) staff (2022).

Table 5-2 lists the Advisory Agencies and their roles and responsibilities with respect to stormwater and flood management. Organizational charts for the Core Agencies are included in Appendix G.

Table 5-1. Summary of Core Team Agency Roles Related to SWM and Flood Management

	Core Team Agency	Summary of Roles Related to SWM and Flood Management
Departments of Montgomery County Government	DEP	▪ Responsible for inspecting and ensuring maintenance of all public and private SWM facilities (where agreements exist) within the County (excluding the municipalities of City of Rockville, Gaithersburg and Takoma Park). ▪ Responsible for the County's MS4 permit compliance, including impervious area restoration goals, developing TMDLs, and for designing, constructing, inspecting, and maintaining County watershed projects. ▪ Responsible for monitoring, inspecting, and maintaining eight County-owned dams and two levees. One dam is identified as a high-hazard dam. ▪ Assists OEMHS with maintaining the Dams Program Standard Operating Guide and dam EAPs for County-owned and DEP-operated dams and provides periodic exercises of these plans, as required. ▪ Monitors County-owned and operated dams during storm events or other dam emergencies and performs emergency mitigation as appropriate. ▪ Recommends evacuations if warranted by conditions/assessment of structural integrity for County-owned dams. ▪ Performs detailed inspections of at-risk dams to assess structural integrity and provides advice to the Disaster Manager in evaluating conditions at other dams to determine whether conditions allow for return of evacuees after a breach.

Core Team Agency	Summary of Roles Related to SWM and Flood Management
	▪ Provides substantial damage assessment, reports, and certifications as required and in accordance with FEMA protocols for dam incidents on County-owned facilities. ▪ After a storm, implements debris management plan and coordinates debris removal operations with DOT. ▪ Coordinates damage assessment and mitigation on County-maintained drainage and impoundment systems with DOT, MCPS, Montgomery Parks, and MDOT SHA.?? ▪ Lead coordinator for a multi-department Military Installation Resiliency Review planning study with National Security Agency Bethesda and Department of Defense. ▪ Lead agency working with USACE to identify target areas for Planning Assistance to States Program flood-study project. ▪ Reviews development plans and participates in design rule checking (DRC) process as appropriate.
DPS	▪ Lead agency for administering the County's Floodplain District Permit. ▪ Co-lead with M-NCPPC for updating the County's floodplain maps. ▪ Determines location of floodplains and serves in primary role for permitting activity in the County-defined floodplain within the Floodplain District. ▪ Inspects permitted construction in the floodplain to determine that the work is in compliance with the permit and with all applicable laws and ordinances. ▪ Maintains a record or log of all Floodplain District Permit actions and provides to FEMA or MDE upon request. ▪ Ensures compliance with the Maryland Stormwater Design Manual. ▪ Coordinates preconstruction inspections with Montgomery Planning Department to ensure requirements for SWM do not conflict with requirements for forest conservation and protection of environmentally sensitive areas. ▪ Lead for approving design and construction of SWM infrastructure, review of public storm drain systems designed by developers. ▪ Reviews designs of private SWM systems and authorizes connection to the County's storm drain system for approved private systems. ▪ Issues permits for developer SWM systems, approves design drawings, inspects their construction, and accepts approved systems for County maintenance. ▪ Reviews building and site drainage plans for compliance with regulations and approves or rejects plans as appropriate. ▪ Reviews and approves SWM concept before development plats are submitted. ▪ Co-lead with OEMHS for recommending updates to building codes for a 500-year storm and banning SWM requirement waivers. ▪ Primary agency for initial damage assessment operations that include inspection and assessment of residential, commercial, and industrial structures. ▪ Co-lead with OEMHS for damage assessment operations after a storm/flood, and for determining need to request state support. ▪ Reviews Zoning Text Amendments and provides comments and recommendations to County Council. ▪ Reviews development plans and participates in DRC process as appropriate.
DOT	▪ Responsible for storm drain capacity and impact analyses at the preliminary plan stage of development to determine improvements needed to downstream County storm drain system. ▪ Responsible for the operation, maintenance, rehabilitation, and replacement of the storm drain systems within County rights-of-way and easements. ▪ Prepares the capital improvement plan (CIP) for the storm drain system within County rights-of-way and easements, along with the storm drain system planning, design, and construction. ▪ Considers flood mitigation opportunities in the planning and design of road and bridge capital projects.

Core Team Agency	Summary of Roles Related to SWM and Flood Management
	▪ Prepares and updates the County's Drainage Design Criteria for design of public storm drain systems. ▪ Ensures compliance with the DOT Drainage Design Manual. ▪ Evaluates how roadway design affects existing drainage patterns in the surrounding area and ensures adequate subsurface drainage and erosion control are provided. ▪ Administers two main programs aimed at public storm drains: the drainage system maintenance request program and the Drainage Assistance Request Program. ▪ Coordinates with MDOT SHA for connection of storm drains in state rights-of-way to storm drains in County rights-of-way. ▪ Provides and coordinates transportation support to assist in evacuations. ▪ Assists MCPD in traffic control, providing barricades, signs, and other devices in establishing a secure perimeter around flooded areas and manages vehicular and pedestrian traffic access/egress. ▪ After a storm/flood, implements debris management plan and coordinates debris removal operations with DEP. ▪ Collects, analyzes, and distributes information on the impact and status of the County's transportation systems and infrastructure. ▪ Coordinates damage assessment and mitigation on County-maintained drainage and impoundment systems with DEP, MCPS, Montgomery Parks and MDOT SHA. ▪ Reviews development plans and participates in DRC process as appropriate.
OEMHS	▪ Primary agency for County-level emergency preparedness, emergency response planning, and emergency response support. ▪ Recommends declarations of emergency to the County Executive for emergency powers under local, state, or federal authority. ▪ Responsible for updating the County's Hazard Mitigation Plan every five years or following a disaster. ▪ Lead agency in emergency planning, response, and recovery for County-owned and maintained significant and high-hazard dams. ▪ With assistance from DEP, maintains the Dams Program Standard Operating Guide and dam EAPs for County-owned and DEP-operated dams and provides periodic exercises of these plans, as required. ▪ Co-lead with DPS for recommending updates to building codes for a 500-year storm and banning SWM requirement waivers. ▪ Co-lead with DPS for damage assessment operations after a storm/flood, and for determining need to request state support. ▪
Office of the County Executive	▪ Implements and enforces the County's laws and provides executive direction to all County departments. ▪ Sets the vision and supporting policies for County departments. ▪ Primary authority for declaring an emergency in the event of significant storms/flooding under the powers under local, state, or federal authority.

	Core Team Agency	Summary of Roles Related to SWM and Flood Management
Departments of M-NCPPC	Maryland-National Capital Park and Planning Commission Montgomery Planning, (reporting to the M-NCPPC Planning Board)	▪ The Planning Board has primary responsibility for land use planning including the development of the General Plan, Area Plans and Functional Master Plans. The Plans are prepared by Planning and Parks reviewed and approvedrecommended by the Planning Board, and then transmitted to the County Council for final approval. ▪ Manages the development review process for all proposed development within the County in accordance with Chapter 50 of the County Code(Subdivision of Land Regulations) and provides recommendations to the Planning Board. ▪ AdministersChapter 59 of the County Code (Zoning Ordinance) and makes recommendations to the County Council. ▪ Reviews Zoning Text Amendments and makes recommendations to the Planning Board. ▪ Organizes, convenes, and leads the Development Review Committee (DRC), and makes recommendations to the Planning Board. ▪ Updates the guidelines for environmental management of development in the County: "Environmental Guidelines." ▪ Co-lead with DPS for updating the County's floodplain maps and for mapping small drainage areas which are currently unmapped. ▪ Coordinates preconstruction inspections with DPS to ensure requirements for SWM do not conflict with requirements for forest conservation and protection of environmentally sensitive areas. ▪ Supports DEP in storm/flood damage assessment and mitigation on County--maintained drainage and impoundment systems along with DOT, MCPS, and MDOT SHA. ▪
	Maryland-National Capital Park and Planning Commission Montgomery Parks, (reporting to the M-NCPPC Planning Board) -	▪ Montgomery Parks manages the development review process for any proposed public or private development activity on parkland, or any activity that may impact parkland, for approval by the Planning Board through the Concept Plan Review Process. ▪ Responsible for planning, design, construction, operation, and maintenance of all SWM facilities in parks. ▪ Oversees operations on parkland, including the completion of stream restoration projects to comply with their MS4 permit. ▪ Issues Park Construction Permits, inspections of pedestrian bridges, culverts, and vehicular roadway bridges with support from DOT. ▪ Responsible for damage assessment and debris management of parkland resulting from storms and floods. ▪ Supports flood response such as limiting access to flooded areas.

Sources: Montgomery County department websites (2022); Montgomery County Emergency Operations Plan (Oct. 2017); Montgomery County Approved FY23 Operating Budget; Interviews with County and M-NCPPC (Montgomery Parks and Montgomery Planning) staff (2022).

Table 5-2. Summary of Advisory Agency Roles Related to SWM and Flood Management

	Advisory Agency	Summary of Roles Related to SWM and Flood Management
Departments of Montgomery County Government	MCFRS	▪ First responders for flooding events. ▪ Participates in preparedness training with OEMHS. ▪ Responsible for water rescues by the Swift Water Rescue Teams, whose members are trained and skilled in open water rescue techniques. ▪ Provides emergency medical care, triage, and transportation in accordance with standard operating policies and procedures. ▪ Coordinates search, rescue, and recovery with MCPD for the location of flood victims. ▪ Monitors meteorological information from National Weather Service (NWS) and from County gauge data to track weather and high stream levels to prepare for potential storm/flood event responses. ▪ Maintains "frequently flooded" road locations to aid responders in the event that access around those locations is needed. ▪ Primary agency for assessing storm/flood-related damage to MCFRS property supported by Department of General Services if needed. ▪ Primary agency for managing hazardous material clean-up including coordinating the County's efforts in decontaminating public and private properties and the environment. ▪
	Montgomery County Police Department	▪ First responders for flooding events. ▪ Responsible enforcing road closures in coordination with DOT because of floods and obstructions from storms. ▪ Participates in preparedness training with OEMHS, maintains records of 911 calls, and categorizes flood-related calls. ▪ Establishes a secure perimeter around flooded areas and manages vehicular and pedestrian traffic access/egress with support from DOT. ▪ Coordinates search, rescue, and recovery with MCFRS for the location of flood victims. ▪
	Montgomery County 311	▪ Responsible for directing resident inquiries related to flooding to the appropriate agencies for resolution. ▪ Maintains a set of online "Knowledge Base Articles" (KBAs), developed by each agency, to provide call center representatives a means of directing resident inquiries. ▪ Maintains a database of calls including information such as call date, address/location, agency the call was directed to, and potential solution type (via KBA).
	Department of General Services	▪ Lead for planning County facilities and ensuring facilities are not located in areas of known flood risk. ▪ Responsible for designing, maintaining, and renewing SWM facilities for County facilities. ▪ Maintains a list of County properties and has the responsibility for debris removal and monitoring of utility restoration at these locations after a storm/flood. ▪ Maintains a generator list and manages the availability of mobile generators. ▪ Assesses damage to all County buildings and facilities after a storm/flood. ▪ Supports MCFRS, as needed, in assessing storm/flood-related damage to MCFRS properties. ▪ Supports DPS and other departments in initial and detailed evaluation and inspection of damage to residential and commercial structures and critical infrastructure.
	Office of Racial Justice and Social Equity	▪ Responsible for training County staff in advancing racial equity and dismantling structural racism within County Government. ▪ Develops tools and methods and provides technical assistance to County departments with the goal of reducing racial disparities in decision-making.

Advisory Agency	Summary of Roles Related to SWM and Flood Management
	▪ Maintains the Capital Improvements Program Budget Equity Tool to assist departments and decision-makers consider the racial equity and social justice impacts of their projects, project amendments, and budget decisions. ▪ Maintains the Operating Budget Equity Tool to provide decision-makers with information on how budget decisions may advance racial equity and social justice in the County and to guide development of the operating budget.

Sources: Montgomery County department websites (2022); Montgomery County Emergency Operations Plan (Oct. 2017); Montgomery County Approved FY23 Operating Budget; Interviews with County staff (2022).

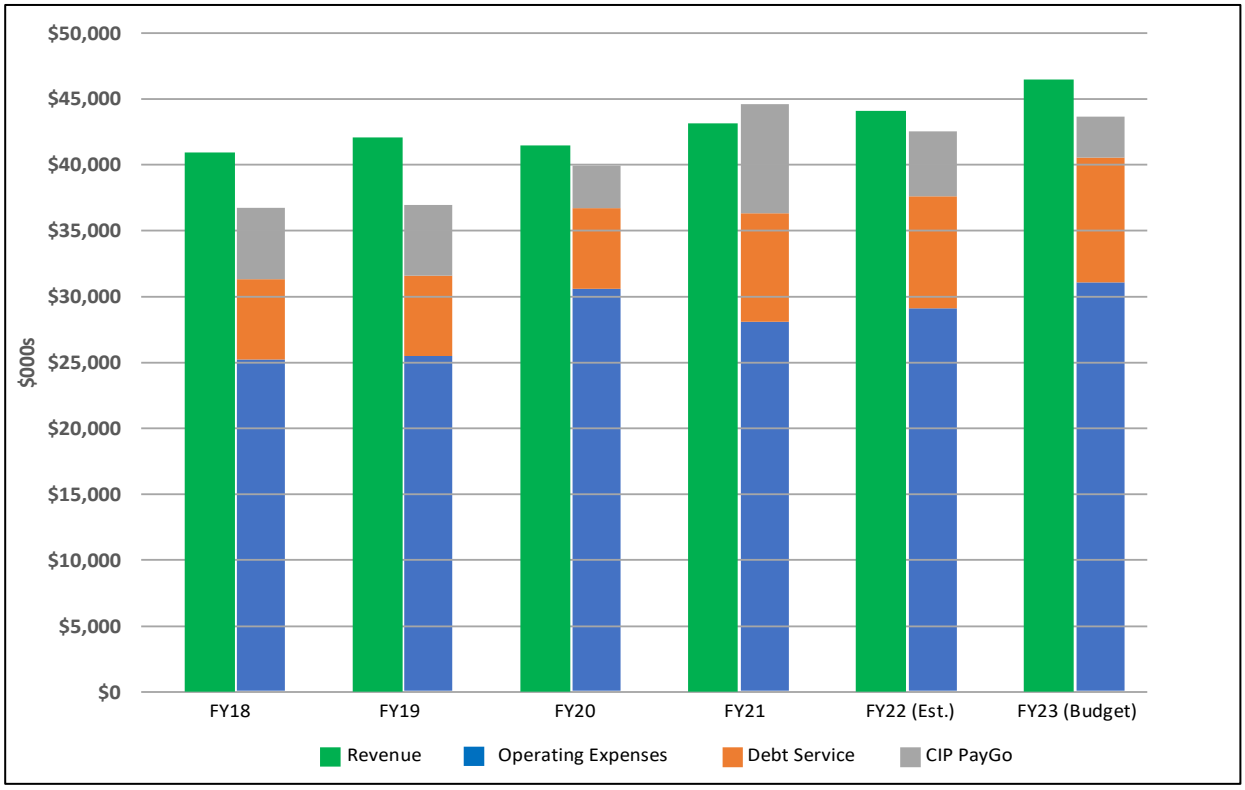
5.2 Current Budgets and Projects

5.2.1 Operating Budget

The County's operating budget for stormwater and flood management-related activities are primarily funded from the Water Quality Protection Fund (WQPF). DEP and DOT receive the most operating funds from the WQPF with a portion going to the County's general fund for overhead costs. The County also appropriates approximately 10 percent of annual WQPF revenues to Montgomery Planning and Montgomery Parks for review of SWM designs and for inspection and maintenance of stormwater infrastructure and streams on parkland, as well as MS4 permit compliance.

Sources for the WQPF are as follows: (1) the Water Quality Protection Charge (WQPC) which is a fee collected as a separate line item on the County's property tax bill and is based on the property's impervious surface area; (2) the bag tax of 5 cents on all plastic and paper bags from groceries, restaurants, and other retail establishments; (3) other charges and fees; and (4) investment income. Revenues from the WPQF are also used to fund street sweeping operations and to pay debt service on Water Quality Protection Bonds issued by the County for capital projects. Revenues from the WPQF may also be used pay-go for capital projects.

Because County budgets do not assign distributions from the WQPF to specific activities associated with stormwater and flood management, annual revenues to, and expenditures from, the WQPF are shown in Figure 5-1 as a proxy for such activities from FY18 through the FY23 budget. Figure 5-1 does not show inter-department transfers (for example, to the General Fund and the M-NCPPC Montgomery Planning and Montgomery Parks Departments), nor does it show the amount of rollovers to the next budget year. For such information readers are directed to the individual fiscal year's budget.



Source: Montgomery County Operating Budgets for FY18 through FY23

Figure 5-1. Water Quality Protection Fund Revenues and Expenditures

5.2.2 Capital Budget

The County's capital budget for fiscal year 2023 (FY23) through FY28 includes nine projects focused on improving stormwater and flood management, totaling $34.3 million in FY23, and $155.6 million over the 6-year period of the CIP. These projects, listed in Table 5-3, are proposed to be funded by one or more of the following revenue sources:

Table 5-3. Revenue Sources

▪ Current Revenue from the WQPC	▪ SWM Waiver Fees
▪ Water Quality Protection Bonds	▪ Federal Aid
▪ Other Long-term financing	▪ State Aid

In addition to the nine capital projects listed in Table 5-4, there are four bridge projects that have a stormwater or flood management component. These projects, listed in Table 5-4, total $5.1 million in FY23 and $18.7 million over the 6-year period covered by the CIP. These four projects are proposed to be funded from a combination of two or three of the following: Federal aid, General Obligation Bonds, and Intergovernmental funds.

Table 5-4. Stormwater and Flood Management Projects – FY23 through FY28 Capital Budget

Project/Description	Expenditure Schedule ($000s)								
	Admin. Agency	Prior	FY23	FY 24	FY 25	FY 26	FY 27	FY 28	Total
Facility Planning: Storm Drains (P508180) Investigation and analysis of storm Drainage Assistance Requests (DAR) Program where flooding and erosion occur. Includes preliminary and final design and land acquisition for storm drain projects.	DOT	$7,086	$480	$480	$480	$480	$480	$480	$9,966
Outfall Repairs (P509948) Repair of existing storm drain outfalls into stream valleys. Design of corrective measures where in-kind replacement of original outfall structures is not feasible	DOT	$8,981	$924	$924	$924	$924	$924	$924	$14,525
Storm Drain Culvert Replacement (P501470) Replacement of failed storm drain pipes, culverts, headwalls, and end sections, or culvert extensions to assure positive flow of stormwater and channeling into existing ditch-lines or structures.	DOT	$13,200	$5,000	$1,700	$1,700	$1,700	$1,700	$1,700	$26,700
Storm Drain General (P500320) Provides for retrofitting existing storm drains systems and right-of-way acquisition and construction for new storm drain projects resulting from the DAR Program.	DOT	$16,515	$4,275	$2,000	$2,000	$2,000	$2,000	$2,000	$30,790
Facility Planning: SWM (P809319) Facility planning, watershed assessments, and implementation planning to evaluate watershed conditions and to identify stream restoration projects, and other alternative best management practices.	DEP	$15,936	$1,018	$1,037	$1,057	$1,077	$1,098	$1,120	$22,343
Flood Control Study (P802202) Development of a Comprehensive Flood Management Strategy and watershed/subwatershed specific Flood Management Plans and to understand the resources required to develop comprehensive solutions	DEP	$100	$1,200	–	–	–	–	–	$1,300
SWM Facility Major Structural Repair (P800700) Design and construction of major structural repairs to County-maintained SWM facilities to comply with MS4 permit.	DEP	$27,307	$8,577	$4,360	$3,075	$3,135	$2,795	$2,985	$52,234

Project/Description	Expenditure Schedule ($000s)								
	Admin. Agency	Prior	FY23	FY 24	FY 25	FY 26	FY 27	FY 28	Total
SWM Retrofit: County-wide (P808726) Design and construction of new and upgraded SWM facilities throughout the County under the County's MS4 permit.	DEP	$64,053	$10,929	$10,485	$23,895	$14,242	$12,208	$11,319	$147,131
Wheaton Regional Dam Flooding Mitigation (P801710) Excavation and expansion of the stream channel upstream of the Wheaton Regional Pond and modification of the pond's riser structure to mitigate road and property flooding.	DEP	$997	$1,909	$1,870	–	–	–	–	$4,776
Total	**–**	**$154,175**	**$34,312**	**$22,856**	**$33,131**	**$23,558**	**$21,205**	**$20,528**	**$309,765**

Source: Montgomery County Capital Budget FY23–FY28

Table 5-5. Bridge Projects with a Stormwater or Flood Management Component – FY23 through FY28 Capital Budget

Project/Description	Expenditure Schedule ($000s)							
	Prior	FY23	FY 24	FY 25	FY 26	FY 27	FY 28	Total
Brink Road Bridge (P502104) Replacement of the existing bridge with new longer approach roadway to reduce frequency of flooding.	$0	–	–	$2,379	$3,172	–	–	$5,551
Dennis Avenue Bridge Replacement (P501701) Project will mitigate frequent flooding of properties and streets and flooding of Dennis Avenue which causes significant traffic delays	$634	$4,505	$2,711	–	–	–	–	$7,850
Brighton Dam Road Bridge Rehabilitation of road supported by the Brighton Dam and improvements to existing storm inlets.	$672	$302	$1,276	–	–	–	–	$2,250
Glen Road Bridge Replacement of the existing Glen Road Bridge including design and construction required to reduce frequency of flooding of Glen Road.	$16,515	$4,275	$2,000	$2,000	$2,000	$2,000	$2,000	$30,790
Total	**$1,506**	**$5,117**	**$5,712**	**$4,729**	**$3,172**	**$0**	**$0**	**$20,236**

Source: Montgomery County Capital Budget FY23–FY28

6. Desired Outcomes from Comprehensive Flood Management

6.1 Outcomes from Comprehensive Flood Management

The following 17 outcomes (Table 6-1) are intended to characterize conditions that are necessary for comprehensive flood management in the County. Together, these outcomes are intended to describe the breadth of activities, processes, and information needed to adequately and proactively plan for, prepare for, respond to, and recover from, flooding events. The outcomes are organized into seven categories.

Table 6-1. Outcomes Necessary for Comprehensive Management of Flood Risk

#	Category	Outcomes
1	Governance	Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood.
2	Flood Management Planning	Land use master plans reflect flood risk.
3		Development and redevelopment standards and building codes are updated to reflect established levels of service and current and future climate conditions for areas of riverine and urban flooding.[a]
4		Clear permit process and enforcement of development and redevelopment standards reflecting flood risk exists.
5	Flood Hazard and Risk Information	Flood management information is universally accessible and uniformly used by all County agencies.
6		Flood risk and mitigation information is readily available and widely communicated to the public.
7		Flood insurance options are well-defined and communicated to the public.
8		Flood risk data and analyses are developed and periodically updated.
9		Urban Flood Zones/Riverine Floodplain are defined/mapped.
10	Flood Mitigation	CIP incorporates flood mitigation needs.
11		County environmental, sustainability, and equity goals are incorporated in flood mitigation activities.
12	Asset Management	Asset management principles are followed to ensure infrastructure assets continuously deliver established levels of service (LOS) at an acceptable risk of failure and minimize life cycle costs of owning and maintain the assets.
13		Operations and maintenance (O&M) of drainage and flood control infrastructure is proactive to maintain LOS.
14	Emergency Management	The County has an emergency management plan that addresses preparedness, response, and recovery for flood events.
15		The County's emergency management plan includes early warning systems for high-risk areas.
16	Budget and Finance	Financing options are well-defined and communicated.
17		County budget and staffing needs are comprehensively collated, communicated, and decided upon.

[a] "**Urban flooding**" refers to flooding from direct rainfall runoff that exceeds the capacity of local drainage systems and is distinguished from "**riverine flooding**" which results when excess flow in a river or creek from upstream rainfall overtops the channel banks. Urban flooding is often also referred to as "**pluvial flooding**," "**local flooding**," or "**interior flooding**."

6.2 Necessary Competencies to Advance the Outcomes

Associated with each of the 17 competencies is a series of Necessary Competencies to Advance the Outcomes, which are listed in Table 6-2.

Table 6-2. Necessary Competencies to Advance Comprehensive Flood Management Outcomes

#	Category	Outcomes	Necessary Competencies to Advance the Outcomes
1	Governance	Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood.	1.1 Flood risk management roles, responsibilities and efforts are clearly defined, coordinated and shared among all responsible stakeholders (for example, County departments, municipalities, MDOT SHA).
			1.2 Authorities and those accountable for decisions are clearly aware of their responsibilities.
			1.3 A centralized authority exists for overseeing flood management planning, risk assessment, flooding response, and recovery activities in the County.
2	Flood Management Planning	Comprehensive land use master plans reflect flood risk.	2.1 County master plans incorporate flood risk information, including flood risk for historically vulnerable populations and Equity Emphasis Areas.
			2.2 A community-wide flood risk management plan is used to inform zoning and land use decisions.
			2.3 Areas that provide natural flood conveyance, storage, and mitigation functions are identified and protected.
			2.4 Flood risk for culturally and historically significant areas and structures is well-understood and geolocated.
3		Development and redevelopment standards and building codes are updated to reflect established LOS and current and future climate conditions for areas of riverine and urban flooding.	3.1 A watershed flood management plan that evaluates future (climate and land use) conditions and short- and long-duration storms is used to implement SWM and development regulations. Such a plan addresses wetlands/natural areas and stream channel protection and potential for infill development/redevelopment impacts.
			3.2 Watershed flood management plan flood risk information is used to inform building code and development standard updates in areas of known or projected future flood risk.
			3.3 Stormwater and flood control infrastructure LOS are established, communicated, and periodically measured and reported, for each part of drainage/stormwater system.
			3.4 Staff members know where to find climate data and can use it in their current roles.
4		Clear permit process and enforcement of development and redevelopment standards reflecting flood risk exists.	4.1 All development in the Floodplain District is reviewed through the Floodplain District Permit review process.
			4.2 The County's Floodplain Management Regulations are uniformly enforced.
			4.3 All developments in areas of urban flood risk are reviewed through a permit review process.
			4.4 Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed predevelopment runoff.
			4.5 The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff positions are responsible for activities and approvals associated with stormwater and flood management.
5	Flood Hazard and Risk Information	Flood management information is universally accessible and uniformly used by all County agencies.	5.1 Staff reviewing new development and redevelopment applications have access to geographic locations of, and information on, previously flooded areas.
			5.2 Standards exist and are used to ensure that flood management geographic information system (GIS) data, detailed studies, and reporting are produced in a uniform manner to support end uses.
			5.3 A standardized set of baseline and projected future climate data has been collected and made available.
			5.4 Staff members know where to find climate data and can use it in their current roles.

#	Category	Outcomes	Necessary Competencies to Advance the Outcomes
			5.5 Data sharing processes are established to enable agencies to achieve other outcomes.
6		Flood risk and mitigation information is readily available and widely communicated to the public.	6.1 The public knows how and where to find information about their current and future flood risk.
			6.2 Information on flood insurance is readily available in hard copy form and on the County website.
			6.3 An ongoing program of public outreach to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain is coordinated among agencies involved in County flood management.
			6.4 Flood hazard mapping is available and used in disclosure of flood hazard information during real estate transactions.
			6.5 Information to assist residents in protecting their properties is available in County libraries and on the County website.
			6.6 All entities conducting development or redevelopment in the Floodplain District are made aware of the Floodplain District Permit Process.
7		Flood insurance options are well-defined and communicated to the public.	7.1 The level of available insurance coverage is known and aligned with flood risk areas.
			7.2 The County has a plan for increasing flood insurance use by potentially impacted property owners.
8		Flood risk data and analyses are developed and periodically updated.	8.1 Building elevation certificates are collected as part of a permit review process, certificates are reviewed for accuracy and completeness, and are cataloged and available for reference.
			8.2 Flood risk geospatial data used for flood risk assessment is kept up-to-date. Geospatial data is defined as georeferenced data sets (environmentally sensitive areas, socially vulnerable areas, commercial/economic impacts areas, but not including stormwater infrastructure asset data – refer to Outcome #1) that inform flood risk.
			8.3 The County has a well-defined and documented process for assessing and estimating damages following a flood event by type and extent of impact.
			8.4 Critical facilities and critical infrastructure have been identified and geolocated on GIS.
			8.5 The County has and maintains a community-wide flood risk management plan (including definition of areas of riverine and urban flood risk).
			8.6 Flood risk impact for historically vulnerable populations and Equity Emphasis Areas is well-understood.
9		Urban Flood Zones/Riverine Floodplain are defined/mapped.	9.1 Riverine and pluvial/urban flood hazard areas are clearly mapped for different LOS (storm recurrence). Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined.
			9.2 The County has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms.
			9.3 Floodplain Districts for the entire County are developed with consistent details.
10	Flood Mitigation	CIP incorporates flood mitigation needs.	10.1 The County has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development).

#	Category	Outcomes	Necessary Competencies to Advance the Outcomes
			10.2 Future considerations (for example, climate change impacts, development, increased impervious areas) are included in storm drainage infrastructure design.
			10.3 Flood mitigation projects that reduce County flood risk are identified.
			10.4 The County has a mitigation plan for repetitive loss areas.
			10.5 Buildings within areas of high flood risk are acquired or relocated.
			10.6 The County has a comprehensive capital improvement program for addressing drainage problems.
11		County environmental, sustainability, and equity goals are incorporated in flood mitigation activities.	11.1 The County's water quality improvement efforts and regulatory compliance are integrated with flood risk management programs.
			11.2 County sustainability goals are considered in development of flood mitigation activities.
			11.3 County equity goals are considered in development of flood mitigation activities.
			11.4 There are Erosion and sediment control regulations for all construction sites for protection of water quality and drainage systems.
			11.5 WQPC credit is provided for implementing flood mitigation beyond water quality requirements.
12	Asset Management	Asset management principles are followed to ensure infrastructure assets continuously deliver established LOS at an acceptable risk of failure and minimize life cycle costs of owning and maintaining the assets.	12.1 The County maintains a frequently updated asset management plan and program built on a reliable asset inventory and characterizing resources and timescales requirements for all stormwater and flood control infrastructure.
			12.2 The Asset Management Program establishes and periodically reviews and updates the LOS to be met by stormwater and flood control systems. Actual LOS provided are measured and reported.
			12.3 The County has a reliable, accurate, and regularly updated inventory of stormwater and flood control infrastructure assets, with their attributes.
			12.4 The condition and likelihood of failure, along with the consequences of failure, of all stormwater and flood control infrastructure is periodically updated and is easily accessible by staff.
			12.5 The risk due to failure of stormwater and flood control infrastructure assets to meet established LOS is periodically updated and used to develop maintenance schedules, needed rehabilitation, replacement, and additional infrastructure assets.
13		O&M of drainage and flood control infrastructure is proactive to maintain LOS.	13.1 Natural channels on both public and private property are inspected and debris is removed.
			13.2 Known problem sites are recorded and given additional attention, as appropriate.
			13.3 Regulations prohibiting dumping in streams exist and are publicized and enforced.
			13.4 Private stormwater storage facilities are inspected and maintained on a regular basis, or enforcement measures exist if they are not maintained.
			13.5 Public stormwater [infrastructure and] storage facilities are inspected and maintained on a regular basis.
14			14.1 The County has failure recognition procedures for dams and levees.

#	Category	Outcomes	Necessary Competencies to Advance the Outcomes
	Emergency Management	The County has an emergency management plan that addresses preparedness, response, and recovery for flood events.	14.2 Response operations for failure of critical infrastructure and critical facilities are planned and practiced through periodic exercises.
			14.3 Dam and levee failure planning is coordinated with owners and operators of critical facilities and infrastructure.
			14.4 The County encourages owners and operators of critical facilities located in high-risk areas to have their own flood response plan.
15		The County's emergency management plan includes early warning systems for high-risk areas.	15.1 The County has an effective flood warning system based on flood prediction.
			15.2 Planning for dissemination of flood warnings is coordinated with owners and operators of critical facilities and critical infrastructure.
			15.3 The County is designated by NWS as StormReady.
16	Budget and Finance	Financing options are well-defined and communicated.	16.1 There exists a strategy for obtaining grant and loan resources for flood management capital improvements and flood preparedness.
			16.2 Grant and loan resources for flood event recovery are known and there are resources to apply for these funds.
			16.3 Flood protection resources and financial assistance is communicated to property owners by staff trained in retrofitting and grants availability information.
			16.4 The County has a grant program for acquisition of flood-prone properties.
17		County budget and staffing needs are comprehensively collated, communicated, and decided upon.	17.1 O&M funding needs for stormwater and flood control infrastructure (for example, green infrastructure, dams, levees) are known and planned for.
			17.2 Flood management CIP items are collated and reviewed annually.
			17.3 Decisions regarding adequacy of flooding-centered staffing and resources are performed by the collection of responsible County agencies.

7. Observations and Recommendations

7.1 Observed Performance and Importance of Outcomes

This framework of "outcomes" and "competencies necessary to advance the outcomes" was presented to the CFMP Core Team on Thursday, September 15, 2022. After the introduction of the framework, the team was asked to score the 17 outcomes and competencies relative to the County's current performance and the relative Importance. The scales used for this assessment are shown in Table 7-1 and Table 7-2. The resulting scoring of Performance and Importance is displayed in Table 7-3. The characterization of Performance and Importance is the first step in determining the current conditions relative to the capabilities, identifying what gaps exist, and providing some direction on where the organization should focus.

Table 7-1. Scoring for Performance Ranking

Score	1	2	3	4	5
Description	We do not do this	Lots of room to improve	Some room to improve	We are pretty good but should improve	We do very well but can always improve

Table 7-2. Scoring for Importance Ranking

Score	1	2	3	4	5
Description	Low importance to improve	Minimal importance to improve	Some importance to improve	Moderate importance to improve	Very important to improve

Both the Importance and Performance Scores were used to calculate an Urgency Score (Figure 7-1). The Urgency Score is intended to demonstrate where there is the most difference between indicated Importance and indicated current Performance of an outcome to provide a sense of greater need to advance the outcome. A higher Urgency Score indicates more relative urgency. The highest Urgency Score is 9.

$$\text{Urgency Score} = \text{Importance Score} + (\text{Importance Score} - \text{Performance Score})$$

Figure 7-1 Calculation of the Outcome Urgency Score

Table 7-3. Outcomes Necessary for Comprehensive Management of Flood Risk

#	Category	Outcomes	Importance	Performance	Urgency[a]
1	Governance	Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood.	5	2	8
2	Flood Management Planning	Land use master plans reflect flood risk.	3	1.5	4.5
3		Development and redevelopment standards and building codes are updated to reflect established LOS and current and future climate conditions for areas of riverine and urban flooding.	5	1	9
4		Clear permit process and enforcement of development and redevelopment standards reflecting flood risk exists.	3	4	2
5	Flood Hazard and	Flood management information is universally accessible and uniformly used by all County agencies.	4.5	2	7

#	Category	Outcomes	Importance	Performance	Urgency[a]
6	Risk Information	Flood risk and mitigation information is readily available and widely communicated to the public.	5	2	8
7		Flood insurance options are well-defined and communicated to the public.	3	2	4
8		Flood risk data and analyses are developed and periodically updated.	4.5	2	7
9		Urban Flood Zones/Riverine Floodplain are defined/mapped.	5	2	8
10	Flood Mitigation	Capital Improvement Program incorporates flood mitigation needs.	5	1	9
11		County environmental, sustainability, and equity goals are incorporated in flood mitigation activities.	5	2	8
12	Asset Management	Asset management principles are followed to ensure infrastructure assets continuously deliver established LOS at an acceptable risk of failure and minimize life cycle costs of owning and maintain the assets.	4	2.5	5.5
13		O&M of drainage and flood control infrastructure is proactive to maintain LOS.	3	4	2
14	Emergency Management	The County has an emergency management plan that addresses preparedness, response, and recovery for flood events.	3	5	1
15		The County's emergency management plan includes early warning systems for high-risk areas.	3	3	3
16	Budget and Finance	Financing options are well-defined and communicated.	4.5	2	7
17		County budget and staffing needs are comprehensively collated, communicated, and decided upon.	5	2	8

[a] Urgency is calculated as follows: Urgency Score = (Importance Score – Performance Score) + Importance Score

7.2 Observations and Recommendations Related to Outcomes

Each of the 17 outcomes for comprehensive flood management are discussed in more detail in this section. Each outcome is presented in terms of the benefit it provides for flood management and associated competencies. Observations and discussion from the consultant team regarding current action within each competency are provided as well as recommendations related to each outcome.

7.2.1 Governance

The County is subject to worsening flood impacts because of climate change, increasing impervious area, and aging infrastructure. Intense rainfall events are increasing, causing exceedance of storm drain systems not designed to accommodate them. The shift in climate conditions alters the level of service delivered by installed County storm drainage and flood control assets. These pressures, along with aging infrastructure, have caused many jurisdictions, including the County, to consider what organizational change is needed to proactively plan for the future.

7.2.1.1 Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood

Outcome Benefits and Necessary Competencies

Because flood management requires collaboration from so many County departments and agencies, having a clear understanding of roles and responsibilities is critical to managing operations and effective communication with the public. The following activities and competencies (Table 7-4) are intended to further describe the outcome:

- Flood risk management roles, responsibilities and efforts are clearly defined, coordinated and shared among all responsible stakeholders.

  Clearly defined roles and responsibilities facilitate cross-agency coordination, planning, and communication with County residents and business owners regarding capabilities and limitations of County services.

- Authorities and those accountable for decisions are clearly aware of their responsibilities

  Outside of regulatory flood management activities and requirements (the Floodplain District Permit Process), authority and accountability for flood management activities are less defined. Providing clarification for those other roles not driven by current regulation or policy, and aligning them with a Flood Management Program goal, will aid in developing a County-wide awareness of responsibility and associated authority.

- A centralized authority exists for overseeing flood management planning, risk assessment, flooding response, and recovery activities in the County.

  Given the complexity of flood management, and the need for ongoing cross-departmental and cross-agency collaboration, a centralized authority for such a program can aid in information sharing and provide internal and external accountability.

Discussion

Roles and responsibilities for flood management are dispersed across various agencies. It is understood that although roles and responsibilities related to some aspects of flood management are clear, others are less so. Agency stakeholders have indicated that there is a lack of understanding by residents of the capabilities and limitations of County services related to flood management. Clear communication with the public regarding the breadth and limitations of Planning and County responsibilities is needed.

Table 7-4. Observations Related to the Flood Risk Governance Structure Outcome

Competency	Observations
Flood risk management roles, responsibilities and efforts are clearly defined, coordinated and shared among all responsible stakeholders	Although some roles and responsibilities are clearly defined in regulatory language, others are less defined. Coordination for the purposes of flood management is limited because of a lack of adequate labor resources, as well as lack of defined regulatory mandate and funding associated with flood management.
Authorities and those accountable for decisions are clearly aware of their responsibilities	Although regulation-driven flood management roles of specific agencies may be well-defined and thereby more clearly managed, some roles are not.
A centralized authority exists for overseeing flood management planning, risk assessment, flooding response, and recovery activities in the County.	There is currently no centralized authority for flood management planning, response, and recovery activities in the County. Although some roles (response, for example) are clearly defined, these are not incorporated with the planning and recovery roles for the purposes of mitigating flood risk on a County-wide basis.

Recommendations

The current agency structure has been highly successful to achieve outcomes once clear authorities and dedicated funding exists. It is recommended that the County consider a program delivery structure that will aid in

maintaining momentum in cross-agency participation as well as maintaining accountability and facilitating data sharing among contributing agencies. One such delivery structure might include the following components:

- Cross-agency program delivery team
- Centralized program management
- Director-level steering committee

Flood management activities are spread across several agencies. It is not possible nor productive to centralize all such responsibilities under one agency. Although not necessarily required, a centralized authority for the Flood Management Program will provide internal and external accountability for activities related to maintaining the program (measuring performance, collecting data from contributing agencies, etc.). Finally, a director-level steering committee, with regular reviews and briefings on flood management actions and regulatory changes, can maintain momentum at an agency level and centralize accountability to the highest level (for instance, the County Executive and the public).

7.2.2 Flood Management Planning

7.2.2.1 Comprehensive land use master plans reflect flood risk

Outcome Benefits and Necessary Competencies

Flooding is a result of rainfall runoff from land surfaces and is therefore intrinsically linked to land use. Incorporation of flood risk into the land use planning process could provide another means for the County to mitigate flood risk in certain communities.

The following activities and competencies are intended to further describe the outcome:

- County master plans incorporate flood risk information, including flood risk for historically vulnerable populations and Equity Emphasis Areas.
- A community-wide flood risk management plan is used to inform zoning and land use decisions.
- Areas that provide natural flood conveyance, storage, and mitigation functions are identified and protected.
- Flood risk for culturally and historically significant areas and structures is well-understood and geolocated.

Discussion

Some observations related to the County and Montgomery Planning's current activities related to this outcome are presented in Table 7-5.

Master plans provide a goal for land use to achieve growth. Guidance set forth in a general or area plan is used to update or amend the zoning ordinance, which is used to regulate development and re-development of land. As a standard practice, master plans don't always review and analyze flooding issues. The process typically includes consideration of protecting regulatory floodplain and other sensitive areas. However, pluvial flood risk and/or network-level (versus local) storm drain capacity are not typically a consideration for land use planning because it is assumed that public drainage infrastructure is adequate to manage the design storms at build-out conditions (based on the general plan).

The County has proactively protected floodplain areas since the 1970s, which has led to protection from development of a large number of these areas. While this is a positive achievement, growth in the region has led to increased urban flooding issues due to the combination of increased impervious area, more high-intensity rainfall events, and aging infrastructure.

The County is now almost completely built-out under the general plan, with extremely little greenfield development capacity left. Based on the recently passed comprehensive plan update, *Thrive Montgomery 2050*

(October 25, 2022), almost all future growth will have to be accommodated through redevelopment, along with some infill development. Redevelopment and infill development can provide opportunities to improve capacity existing drainage infrastructure if that development is occurring in areas with aged or undersized infrastructure. However, without watershed-level understanding of flood risk and/or regulations addressing local flood risk impacts, the impact of redevelopment and infill development projects on local flood risk may not be quantified and managed. Likewise, without watershed-level understanding of existing and future flood risk, it will not be possible for the County to evaluate the potential impact of proposed amendments to zoning ordinance to local flood risk.

Maryland Department of Planning (MDP) has published its 2022 *Water Resources Element (WRE) Guidance Update: Integrating Water-related Climate Change Adaptation into Local Comprehensive Plans*. The current County WRE was updated by Montgomery Planning in September 2010. MDP recommends update of WRE Plans if there is significant new water resource information, significant land use plan updates or changes, or when water and sewer demand will exceed 80 percent of the available wastewater capacity or water appropriation.

Table 7-5. Observations Related to the Comprehensive Land Use Outcomes

Competency	Observations
County master plans incorporate flood risk information, including flood risk for historically vulnerable populations and Equity Emphasis Areas.	Currently the General Plan (or area master plans) nor the WRE functional plan do not focus on flood related issues and therefore do not incorporate flood risk information.
The County has a community-wide flood risk management plan to inform zoning and land use decisions.	A community-wide flood risk management plan does not currently exist.
Areas that provide natural flood conveyance, storage, and mitigation functions are identified and protected.	The County and Montgomery Planning have historically set aside stream buffer areas as park lands and have further restricted development within mapped floodplains and the County Floodplain District.
Flood risk for culturally and historically significant areas and structures is well-understood and geolocated.	Although the County understand some, but not all, riverine flood hazard areas. For areas at risk to pluvial flooding, and unmapped riverine areas, there is not information that can be used to identify vulnerable cultural and historically significant feature and structures.

Recommendation

Based on the MDP recommendation that the WRE be updated when significant land use plan updates, it is recommended that Montgomery Planning consider updating the WRE once comprehensive flood risk information is available. Furthermore, once County-wide flood risk information is available, the County should consider incorporating the information into existing zoning and land use update procedures. It is also recommended that comprehensive vulnerability assessment, including assessment of vulnerability of culturally and historically significant areas and structures be considered.

7.2.2.2 Development and redevelopment standards and building codes are updated to reflect established LOS and current and future climate conditions for areas of riverine and urban flooding

Outcome Benefits and Necessary Competencies

Update of development standards and building codes for areas of high flood risk can be a useful tool in mitigating future flood risk. A comprehensive understanding of flood risk enables a community to decide whether such an update will reduce risk. The following activities and competencies are intended to further describe the outcome:

- A watershed flood management plan that evaluates future (climate and land use) conditions and short- and long--duration storms is used to implement SWM and development regulations. Such a plan addresses wetlands/natural areas and stream channel protection and potential for infill development/redevelopment impacts.
- Watershed flood management plan flood risk information is used to inform building code and development standard updates in areas of known or projected future flood risk.
- Stormwater and flood control infrastructure LOS are established, communicated, and periodically measured and reported, for each part of drainage/stormwater system.
- Staff members know where to find climate data and can use it in their current roles.

Discussion

Current County development standards do not consider flood risk except in areas of known historical impact. The County's GIP, which provides guidance for completion of Adequate Public Facilities Ordinance reviews, includes consideration of water and sewer capacity but does not address storm drain capacity, for example. County SWM regulations address high frequency storm event runoff (small volume storms) to meet water quality targets. These regulations do not address management of flows from larger events.

Localized climate projections indicate an increase in total rainfall for storm events of a given recurrence interval. This change results in a decrease in level of service of existing infrastructure. For example, an inlet designed for the 10-year storm, as determined based on historical rainfall events may, with current and projected rainfall, only have capacity for more frequent storm events (such as 5-year current storm, and 2-year storm projected for future rainfall conditions). For this reason, knowledge of baseline and projected future rainfall conditions is needed to understand projected decreases in level of service.

Because of increasing pluvial flooding impacts, and anticipated future decrease in level of service, some jurisdictions have initiated building code updates (District of Columbia, DOEE Proposed Code Change) and SWM code updates (City of Pittsburgh and Pittsburgh Water proposed code changes) to assist in overall flood risk reduction. Both of these entities have conducted a review of the impacts of such a change and worked with impacted stakeholders (residents, developers, etc.) to identify an acceptable revision.

Regarding access and use of climate data – there are many stakeholders within the County that use climate data and although some uses are coordinated, there is room to expand. As noted in Table 7-6, OEMHS, DOT, DEP, and MCFRS all either use, or could use, climate data regularly. The County has installed a number of flood sensors that are being used for monitoring real-time river levels. With respect to rainfall - numerous rain gauges exist in the County, some of these reporting real-time data at a regular interval. But there is no protocol for accessing this information. Particularly given the recent impact of highly localized intense rainfall events, having a good understanding of recent rainfall events, and how they compare to statistical storms (LOS) may be helpful for County staff. A wealth of data is likely available, and some further coordination and collation of this data, and communication regarding its suitable uses and limitations, could benefit several agencies.

Table 7-6. Observations Related to the Development Standards and Building Code Outcome

Competency	Observations
A watershed *flood mitigation* plan that evaluates future (climate and land use) conditions and short- and long duration storms is used to implement SWM and development regulations. Such a plan addresses wetlands/natural areas and stream channel protection and potential for infill development/redevelopment impacts.	This sort of watershed *flood mitigation* plan does not exist to inform County flood risk management operations. Although watershed planning for MS4 (NPDES water quality permit) reporting is carried out, the long-term impacts of climate change and development/redevelopment are not incorporated to provide an understanding of how volumes of runoff are expected to change over time.
Watershed *flood mitigation* plan flood risk information is used to inform building code and development standard updates in areas of known or projected future flood risk.	A watershed *flood mitigation* plan including flood risk information does not currently exist. The County Floodplain District Permit provides a pathway for consideration of riverine flood risk in the application of building code. For a structure identified as within a mapped or unmapped floodplain, certain more stringent

Competency	Observations
	requirements exist. However, the County currently lacks information on pluvial flood risk and does not incorporate an understanding of future riverine or pluvial flood risk in applying or enforcing these regulations.
Stormwater and flood control infrastructure LOS are established, communicated, and periodically measured and reported, for each part of drainage/stormwater system.	Although DOT maintains storm drainage design criteria that provides clear communication of design requirements for public storm drain assets, existing LOS of all County infrastructure is not known. DOT has been building knowledge of storm drain assets through extensive field investigations and feeding this information into its storm drain GIS database.
Staff members know where to find climate data and can use it in their current roles.	The County currently has not developed and adopted localized rainfall projections incorporating climate change impacts, though such projections exist from work done by the Washington Suburban Sanitary Commission and jurisdictions in DC and VA. In terms of using knowledge of recent precipitation events to inform their work, although numerous rain gauges exist in the County, there is no protocol for access and use of the data. OEHMS has installed a series of flood sensors across the County that report stream levels on a varying, but typically, 5-minute interval. This data is currently not stored for longer than a few days but can be accessed and saved by OEHMS. DEP maintains several river gauges in target environmental areas to understand impacts of development. Precipitation and OEHMS flood sensor information is also reviewed in terms of monitoring dams that require emergency response. MCFRS uses NWS forecasts and monitors several local river gauges for the purposes of staffing forecasts and understanding whether roads with known flooding problems may impact responses.

Recommendation

Once comprehensive flood hazard information is available, it is recommended that the County review whether update to the existing development standards, development review process, and building code for areas found to be high-risk may reduce future flood risk. Furthermore, the County should consider exploring how County agencies may benefit from greater access to rainfall data and whether development of tools to access rainfall data may be useful.

7.2.2.3 Clear permit processes and enforcement of development and redevelopment standards reflecting flood risk exists

Outcome Benefits and Necessary Competencies

Permitting processes and development review processes that are transparent and equally enforced provide a benefit to County-wide flood risk reduction. The following activities and competencies (Table 7-7) are intended to further describe the outcome:

- All development in the Floodplain District is reviewed through the Floodplain District Permit review process.
- The County's Floodplain Management Regulations are uniformly enforced.
- All development in areas of urban flood risk are reviewed through a permit review process.
- Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed predevelopment runoff.

- The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff positions are responsible for activities and approvals associated with stormwater and flood management.

Discussion

Although the County has fairly robust Floodplain Management Regulations, the understanding of flood risk areas feeding these regulations are not uniform nor are they developed with an understanding of climate change impacts. Furthermore, areas of current and projected future urban flood risk are presently unmapped. Existing SWM reviews are carried out for water quality control purposes and are not intended to address runoff quantities generated by more significant rainfall events; however, there is reportedly ongoing misunderstanding among the public regarding this limitation.

Table 7-7. Observations Related to the Development and Permit Process Outcome

Competency	Observations
All development in the Floodplain District is reviewed through the Floodplain District Permit review process.	Land-disturbing activity conducted within the Floodplain District or within 25-feet of the District must be permitted. Minor land disturbances (under 5,000 square feet) and certain agricultural practices are excepted. DPS has mapped streams and buffer areas within the Floodplain District and uses this geographic information to identify development that would trigger the Floodplain District Permit Process.
The County's Floodplain Management Regulations are uniformly enforced.	The Floodplain Management Regulations are uniformly enforced however the floodplains with the Floodplain District are not uniformly mapped with the same level of detail. The County has FEMA, Montgomery Planning, and County floodplain delineations for approximately 1/3 of streams within the defined Floodplain District. Approximate methods must be used to establish a 100-year flood elevation for unmapped areas.
All development in areas of urban flood risk is reviewed through a permit review process.	Areas of urban flood risk are currently not mapped. There is no reference to urban flood areas within the existing Floodplain Management Regulations.
Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed predevelopment runoff.	Peak flows for stated water quality storms are reviewed. Peak flows for extreme events are only reviewed for those developments with SWM facilities located within a mapped riverine floodplain. Although DPS, in the context of the SWM review, requires designers to sign a statement indicating that design has been conducted with consideration of the 10-year rainfall event, a SWM permit cannot be denied based on this requirement.
The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff members are responsible for activities and approvals associated with stormwater and flood management.	Although the development review process is described via Montgomery Planning's website, the objectives and limitations of the SWM reviews are still somewhat unclear to the public. For example, County stakeholders indicated that there is persistent misunderstanding that SWM reviews are used to address runoff from large storm events.

Recommendation

Understanding that the County's existing Floodplain District Permit Process is well-communicated and enforced, there is room to make the permit process more readily understandable to the public. It has been noted during the agency stakeholder engagement that the public often has difficulty understanding the limitations of existing permit and development reviews (for example, understanding the SWM permit is intended to address water quality targets). Thus, it may be helpful to address this common misunderstanding.

It is recommended that the County should continue to develop better detail for unmapped areas of the County 100-year floodplain through detailed study or, when appropriate, through the Floodplain Study requirement (for

those developments where approximate determination of the 100-year flood elevation is not possible). Finally, it is recommended that the County pursue delineation/determination of urban flood risk areas and associated vulnerability and risk assessments to better understand whether flood management-related development review within these areas is warranted.

7.2.3 Flood Hazard and Risk Information

7.2.3.1 Flood management information is universally accessible and uniformly usedd by all County agencies

Outcome Benefits and Necessary Competencies

Flood management on a County-wide scale requires reliable information and a shared understanding of that information. The following activities and competencies (Table 7-8) are intended to further describe the outcome:

- Staff reviewing new development and redevelopment applications have access to geographic locations of, and information on, previously flooded areas

  Building the database of known flooding impacts is helpful in ensuring the County continued to build institutional knowledge of problem areas. Allowing permit review staff to access this information may allow them to identify properties associated with past flooding issues.
- Standards exist and are used to ensure that flood management GIS data, detailed studies, and reporting are produced in a uniform manner to support end uses.
- Development of data production standards can help ensure that updates are of comparable quality.
- A standardized set of baseline and projected future climate data has been collected and made available.

  Understanding historical and projected future climate conditions is necessary for the County to understand how flood risk may change and enable proactive planning.
- Staff members know where to find climate data and can use it in their current roles.

  Access and understanding of climate data can be valuable for managing resident expectation to be able to report, for example, how a recent rainfall event related to design service life. Making this information, as well as knowledge of its limitations, available to staff will allow them to communicate with residents more clearly.
- Data sharing processes are established to enable agencies to achieve other outcomes.

  Having established processes can facilitate efficient sharing of high-value data (flood reports or complaints, for example) that will aid all agencies in achieving their goals.

Discussion

The County currently demonstrates a number of these competencies but could aid in further dedication of resources in this area.

Table 7-8. Observations Related to County Staff Access and Use of Flood Management Information Outcome

Competency	Observations
Staff reviewing new development and redevelopment applications have access to geographic locations of, and information on, previously flooded areas	Multiple County agencies collect data on past flood impacts, but this data is not centralized thus is not easily shared among agencies. DEP has begun development, in coordination with DPS, of a flood viewer tool enabling viewing of County, Montgomery Planning, and FEMA mapping with DEP road flooding locations, for example.
Standards exist and are used to ensure that flood management GIS data, detailed studies, and reporting are	The Floodplain District Permit Process may result in a detailed study requirement for development within the County Floodplain District. Requirements for these studies are provided in guideline and checklist form.

Competency	Observations
produced in a uniform manner to support end uses.	DPS and DOT have enabled consultants to enter as-built storm drain GIS features and associated database items for new construction.
A standardized set of baseline and projected future climate data has been collected and made available.	Understanding local baseline climate data and using this data to develop climate projections using the best available information will be helpful in understanding the anticipated climate conditions.
Staff members know where to find climate data and can use it in their current roles.	Although there are a multitude of rain gauges in the County, accessing and making use of the raw data from these gauges is a time-consuming process.
Data sharing processes are established to enable agencies to achieve other outcomes.	As noted previously, multiple agencies gather data related to flood management. For some, such as DOT's storm drain GIS database, protocols are established for data sharing and updates. Data sharing, though helpful, can be very labor-intensive and thus has largely not been carried out as agencies focus on Core regulatory responsibilities.

Recommendations

Recommendations for this outcome are to improve capabilities and resources associated with the previously noted competencies. It is recommended that the County continue to work to collate flood management information, particularly flood report and complaint data, to aid in their operations. Where possible, efforts to standardize data sharing processes and data development are recommended to aid in efficiency. Finally, it is recommended that the County work to understand the breadth of available climate data, use this data to understand baseline conditions and develop localized climate projections. This data will be critical in ascertaining existing and projected future level of service of County assets and in communicating with the public.

7.2.3.2 Flood risk and mitigation information is readily available and widely communicated to the public

Outcome Benefits and Necessary Competencies

Making information available to the public on flood hazards and flood risk mitigation options allows residents to make informed decision and mitigate their risk when possible. The following activities and competencies (Table 7-9) are intended to further describe the outcome:

- The public knows how and where to find information about their current and future flood risk.
- Information on flood insurance is readily available in hard copy form and on the County website.
- An ongoing program of public outreach to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain is coordinated among agencies involved in County flood management.
- Flood hazard mapping is available and used in disclosure of flood hazard information during real estate transactions.
- Information to assist residents in protecting their properties is available in County libraries and on the County website.
- All entities conducting development or redevelopment in the Floodplain District are made aware of the Floodplain District Permit Process.

Each of these competencies is intended to bring more complete information to the public.

Discussion

County agency stakeholders have indicated that there is a lack of understanding by residents of the scope of County services and appropriate interventions related to drainage and flood management. Clear communication

with the public regarding the breadth and limitations of County responsibilities is needed. Outreach specific to flood management is not currently carried out in the County, namely because development of such a program requires resources not presently available. Development of a public information program and community outreach program are FEMA CRS-creditable activities because they empower the community to mitigate flood risk. This benefit will be relevant to the County regardless of whether CRS accreditation is pursued.

Table 7-9. Observations Related to Public Access and Use of Flood Management Information Outcome

Competency	Observations
The public knows how and where to find information about their current and future flood risk.	Information about future flood risk is currently not available within the County. The FEMA NFHL is available online but it is unknown whether most residents are able to locate this resource. Results of the community survey conducted for this study indicate that the public is minimally aware of County services related to flooding (for example, 8 percent of respondents knew that flooding could be reported via MC311).
Information on flood insurance is readily available in hard copy form and on the County website.	The County currently provides information about flood insurance on the County flooding website.
An ongoing program of public outreach to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain is coordinated among agencies involved in County flood management.	There is no ongoing and dedicated public outreach program related to flood hazard awareness.
Flood hazard mapping is available and used in disclosure of flood hazard information during real estate transactions.	There is currently no requirements for disclosure of flood hazard information during real estate transactions.
Information to assist residents in protecting their properties is available in County libraries and on the County website.	The County flooding website provides some tips for immediate steps to protect property. Furthermore, the linked FEMA FloodSmart website provides additional tips.
All entities conducting development or redevelopment in the Floodplain District are made aware of the Floodplain District Permit Process.	Reportedly, the Floodplain District Permit Process is well-communicated to permit applicants.

Recommendation

It is recommended that the County establish a program of public information and community outreach on flood risk coordinated among agencies/departments. Such a program should seek to provide community stakeholders with reliable consistent information on their flood risk, means through which to mitigate risk, and County capabilities and limitations related to mitigation of flood risk.

7.2.3.3 Flood insurance options are well-defined and communicated to the public

Outcome Benefits and Necessary Competencies

Flood insurance is an important tool for mitigation of flood risk; however, it is often not marketed to, nor affordable to, those residents who can benefit most. Understanding current coverage and a strategy for increasing coverage is helpful in mitigating flood risk for county residents. The following competencies (Table 7-10) are intended to describe the outcome:

- The level of available insurance coverage is known and aligned with flood risk areas.

Understanding where there is insurance coverage and whether that aligns with areas of known flood risk, particularly pluvial flood risk, clarifies the areas that might benefit most from increases in coverage.

- The County has a plan for increasing flood insurance use by potentially impacted property owners.

  Understanding existing coverage and risk areas allows development of a strategy for increasing coverage. This may involve targeted outreach and increased insurance-specific public information to educate residents to the benefits of flood insurance.

Discussion

Although the number of flood insurance policies within the County is known, a comprehensive understanding of flood vulnerability is needed to understand which areas and populations may benefit most from holding flood insurance. FEMA-reported County coverage and claim payout indicated that 66 percent of paid claims were outside the mapped riverine flood hazard area.[36] It is understood the flood insurance often favors riverine-type flood impacts (that is, impacts because of localized or pluvial flooding are more difficult to claim). It is unknown how the current coverage compare with current mapped floodplain extent.

Table 7-10. Observations Related to the Flood Insurance Coverage Outcome

Competency	Observations
The level of available insurance coverage is known and aligned with flood risk areas.	Although there is a general understanding of the total number of flood insurance policies, this information is not analyzed in a geographic manner to understand whether current coverage is most lacking.
There is a plan for increasing flood insurance use among property owners.	There is not currently a plan for increasing flood insurance coverage.

Recommendation

It is recommended that as information on pluvial flood risk areas becomes available, the County continue working with FEMA to understand the breadth of coverage and any specific areas or populations where increases in coverage may be most impactful in mitigating risk.

7.2.3.4 Flood risk data and analyses are developed and periodically updated

Outcome Benefits and Necessary Competencies

Understanding flood risk in a meaningful way requires development, management, and periodic update of a large amount of information. Analyses used to determine flood risk have many inputs (for example, topography, land use and impervious area, storm drain features) that are subject to change over time. For comprehensive and proactive management of flood risk, developing the flood risk information, and ensuring that it is periodically updated, is necessary to ensure the County understands the geographic extent of current and projected future flood risk. The following competencies (Table 7-11) are intended to describe the outcome:

- Building elevation certificates are collected as part of a permit review process, certificates are reviewed for accuracy and completeness, and are cataloged and available for reference.

  Building elevation certificates provide a verified record of finished first floor elevations for buildings in the vicinity of the FEMA Special Flood Hazard Area (SFHA). An Elevation Certification is needed to know a building's elevation compared to the estimated height floodwaters will reach in a major flood, which helps provide a true picture of the status of compliance with floodplain ordinances, to determine flood risk and the cost of flood insurance premium for a given structure.

- Flood risk geospatial data used for flood risk assessment is kept up-to-date.

[36] Federal Emergency Management Agency (FEMA). 2021. RiskMap Flood Risk Review Meeting. April 27.

Geospatial data is defined as georeferenced data sets (environmentally sensitive areas, socially vulnerable areas, commercial/economic impacts areas, but not including stormwater infrastructure asset data – refer to Outcome #1) that inform flood risk.

- The County has a well-defined and documented process for assessing and estimating damages following a flood event by type and extent of impact.
- Critical facilities and critical infrastructure have been identified and geolocated on GIS.
- The County has the technical capability to assess current flood risk.
- Flood risk impact for historically vulnerable populations and Equity Emphasis Areas is well-understood.

Discussion

The County currently has an understanding of some, but not all, areas of existing riverine flood hazard but has not developed County flood vulnerability and risk assessment. For example, WSSC Water has assessed riverine flood risk in the vicinity of its facilities in the County.

Furthermore, it is acknowledged by several agency stakeholders that understanding of flood risk to socially vulnerable populations is not well known. The County needs to have a comprehensive understanding of both riverine and pluvial flood hazards in order to develop comprehensive risk assessments. With such information, County decisions makers can understand where flood risk is in the County and how it is expected to change. Thus development of comprehensive flood hazard information (Outcome #9) is a needed antecedent to addressing this outcome.

The FEMA CRS is a voluntary program that provides flood insurance rate discounts in exchange for community floodplain management that exceeds National Flood Insurance Program minimum requirements. Communities apply to the CRS program and are awarded credits based on their efforts to reduce and avoid property damage, support insurance coverage, and foster comprehensive floodplain management. Based on a credit audit performed by FEMA, a community can achieve a certain credit class (1 through 10, with 1 being the highest credit associated with up to 45 percent reduction in insurance premium costs within the SFHA and 10 percent reduction outside the SFHA). This program, as noted, is relevant to riverine floodplain management, and therefore not necessarily aimed at providing credit for actions reducing flood risk in areas subject to pluvial flooding.

The County is not currently participating in the CRS program, mainly due to the resources required to conduct interviews, credit accounting, outreach, and ongoing CRS reporting. As it relates to this, and many other outcomes, the County is currently carrying out a number of creditable activities. As participation in the CRS program may make flood insurance more affordable for residents, there may be overall risk mitigation benefits.

Table 7-11. Observations Related to the Development of Flood Risk Data

Competency	Observations
Building elevation certificates are collected as part of a permit review process, certificates are reviewed for accuracy and completeness, and are cataloged and available for reference.	Building certificates are reviewed by FEMA and not currently maintained by the County. The County has not applied for CRS participation.
Flood risk geospatial data used for flood risk assessment is kept up-to-date.	The County currently generates and maintains a vast amount of data pertinent to understanding flood risk. There is currently some cross-agency collaborations such as the ongoing DEP/DPS flood viewer that uses data from several agencies (Montgomery Planning, DOT, DEP). DOT and DPS also coordinate to ensure that approved permit engineering data is moved into the DOT storm drainage GIS database. However, outside of these collaborations, the County could still benefit from centralizing and standardizing such data to ensure that all users have appropriate access and understand data limitations (such as update frequency, etc.).

Competency	Observations
There is a well-defined and documented process for assessing and estimating damages following a flood event by type and extent of impact.	Such information is currently collected in an as-needed basis. Historic impact data in terms of overall County flood insurance claims (number, amount of claim, amount of payout) is publicly available through FEMA. It is noted that impacts to those residents that do not hold flood insurance policies, or do not submit claims, are not included in such reporting.
Critical facilities and critical infrastructure have been identified and geolocated on GIS.	Although the County currently does not have this feature, OEMHS is currently working to develop a GIS layer including critical facilities and infrastructure.
The County has the technical capability to assess current flood risk.	Comprehensive flood hazard information, providing a County-wide understanding of both riverine and pluvial flood hazards, does not exist. This information is needed to perform vulnerability and risk assessments. Currently the County has one staff member dedicated to administration of the Floodplain District Permit. Although this staff member is capable of assessing risk in areas where flood hazard information exists, this is done for the specific purpose of review of permit applications.
Flood risk impact for historically vulnerable populations and Equity Emphasis Areas is well-understood.	Understanding flood risk of vulnerable populations and within Equity Emphasis Areas requires comprehensive flood hazard information (both riverine and pluvial hazards). The County currently lacks this comprehensive coverage, and therefore is not able to accurately characterize flood risk in these areas.

Recommendation

It is recommended that, when comprehensive current and future riverine and pluvial flood hazard information is available, the County use this information to complete vulnerability and risk assessments that will provide decisions makers with an understanding of geographic areas with the most risk due to flooding. It is further recommended that the County consider the benefits and costs of participation in the FEMA CRS program, particularly to lower-income residents that may have difficulty paying for flood insurance.

7.2.3.5 Urban Flood Zones/Riverine Floodplain are defined/mapped

Outcome Benefits and Necessary Competencies

The County is subject to flooding from both riverine and pluvial ("urban" or "local flooding") sources. Understanding the geographic limits of these hazard areas, and how they are expected to change over time is critical to managing risk. The following competencies (Table 7-12) are intended to describe the outcome:

- Riverine and pluvial/urban flood hazard areas are clearly mapped for different LOS (storm recurrence). Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined.
- The County has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms.
- Flood hazard areas within the County Floodplain District are developed with consistent detail.

Discussion

The County is subject to flooding from both riverine and pluvial ("urban" or "local flooding") sources. The County currently has both FEMA and County studies defining riverine flood risk in many, but not all areas. However, the County does not have a comprehensive understanding of areas at risk of pluvial or urban flooding.

The County has participated in the NFIP since 1975 and conducted several updates to its Flood Insurance Studies, the most recent one being still underway at the time of this report. Through participation in the NFIP, the County has continued to expand its understanding of existing riverine flood hazard areas and has enacted progressive Floodplain Management Regulations which includes limiting all development within the FEMA SFHA, defined as

the 100-year flood extent. The County Floodplain Management Regulations define a Floodplain District as the floodplain generated by any stream with a drainage area of 30 acres or greater. But mapping of the floodplains within this District are not consistent. FEMA studies are available for less than 30 percent of the identified District streams. Furthermore, there is no mapping of existing pluvial flood hazards areas.

Although the Floodplain Detailed Studies the County requires within the Floodplain District Permit Process specify consideration of buildout conditions these are not incorporating potential changes suggested in the recently passed Thrive Montgomery 2050 General Plan. Furthermore, the County does not currently have rainfall projections incorporating climate change impacts, therefore all mapping of riverine hazards areas represents conditions current only as of when the studies were completed. As the County moves forward to programmatic strategies to mitigate flood risk, understanding how climate change and land use patterns will likely impact both riverine and pluvial flood hazards will be critical to prioritizing those strategies that will be more effective in reducing risk.

Table 7-12. Observations Related to the Mapping of Urban and Riverine Flood Zones Outcome

Competency	Observations
Riverine and pluvial/urban flood hazard areas are clearly mapped for different LOS (storm recurrence). Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined.	The County currently has mapping for some, but not all, riverine flood hazard areas. Mapping has been completed by FEMA for approximately 508 miles of stream (341 detailed and 167 approximate). Mapping is limited to existing climate conditions (that is, not incorporating rainfall projections due to climate change). There is currently no mapping of pluvial flood risk areas.
The County has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms.	There is currently no flood hazard mapping that incorporates future climate projections. It has been indicated that FEMA studies, past County studies, and studies required through the Floodplain District Permit Process, incorporate buildout hydrologic conditions. However, land use buildout conditions are expected to become more intensive in some areas making it uncertain whether these considerations are adequately conservative.
Riverine flood hazard areas within the County Floodplain District are developed with consistent detail.	The County reportedly has mapped less than 30 percent of streams (approximately 500 miles of a total 1,800 miles) that fall within the defined Floodplain District (streams with drainage areas of 30 acres or more). The remainder of these streams are managed using elevations determined by approximate means and a 100-foot stream buffer area.

Recommendation

It is recommended that the County develop rainfall projections to incorporate climate change impacts and land use scenarios to represent likely buildout scenarios incorporating land use guidance within the recently approved Thrive Montgomery 2050 General Plan. This information should be used to develop flood hazard mapping for both urban and riverine areas.

7.2.4 Flood Mitigation

7.2.4.1 Capital Improvement Program incorporates flood mitigation needs

Outcome Benefits and Necessary Competencies

The County CIP is used to provide financial planning to ensure that the County can carry on the established LOS. A CIP that incorporates flood mitigation projects makes sure that this critical and growing need is addressed in a systematic nature. To build and validate a CIP, information on current and future flood risk is needed. Based on this information, a flood mitigation CIP can help the County communicate investment needs for flood mitigation as well as demonstrate need for climate resilience and flood mitigation funding. The following competencies (Table 7-13) are intended to outline what is needed to achieve the stated outcome:

- The County has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development).
- Future considerations (for example, climate change impacts, development, increased impervious areas) are included in storm drainage infrastructure design.
- Flood mitigation projects that reduce County flood risk have been identified.
- The County has a mitigation plan for repetitive loss areas.
- Buildings within areas of high flood risk are acquired or relocated.
- The County has a comprehensive capital improvement program for addressing drainage problems.

Discussion

Although individual agencies put together CIP plans on an annual basis, there has not been an effort to collate or coordinate a CIP specific to flood management.

Table 7-13. Observations Related to Flood Mitigation Capital Improvement Program Outcome

Competency	Observations
The County has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development).	The County currently lacks information on both current and future flood risk. Although the County has information on some, but not all, current riverine flood risk, information (extent, depth, etc.) on current pluvial (urban) and future riverine and pluvial flood risk is not available.
Future considerations are included in storm drainage infrastructure design	The County currently does not incorporate local, state, or national climate projections into storm drainage design criteria.
Flood mitigation projects that reduce County flood risk have been identified.	The County currently identifies flood mitigation projects within individual agency CIP plans. That is, where a road project may alleviate flooding concerns, it has been indicated. However, identification of flood mitigation projects that will address overall watershed level or County-wide flood risk requires an understanding of flood risk information at this scale, which is currently not available.
A mitigation plan for repetitive loss areas has been developed and is being carried out.	The County currently does not have a plan for addressing repetitive loss properties owned by other institutions or residents.
Buildings within areas of high flood risk are acquired or relocated.	Reportedly, the Department of General Services does not own any facilities located in areas of known flood risk. As noted above, there is no mitigation plan for repetitive losses that includes policy suggestions such as acquisition of flood-prone properties.
There is a comprehensive capital improvement program for addressing drainage problems.	Although individual agencies put together CIP plans on an annual basis, and flood mitigation benefits of individual projects are often noted, there has not been an effort to collate or coordinate a prioritized CIP specific to flood management. The County currently provides operating funding for the Drainage Assistance Request Program (DOT) that assist residents in identifying and addressing drainage issues related to public storm drainage infrastructure. Some of these program funds are used to address smaller issues (projects under $500,000). Larger issues are included in the DOT storm drainage CIP.

Recommendation

Coordinating or collating CIP project related to and benefiting flood mitigation can help the County illustrate to stakeholders (leadership, the public), what efforts are being taken to address flooding. It can also aid the County

in demonstrating need and applying for funding. The County should consider whether organizing a flood mitigation CIP will be beneficial for addressing stakeholders and for applying for grant/loan resources specific to climate change resiliency, and flood preparedness and mitigation.

7.2.4.2 County environmental, sustainability, and equity goals are incorporated in flood mitigation activities

Outcome Benefits and Necessary Competencies

It is acknowledged that mitigating flood risk may positively impact other County goals. This outcome is intended to prioritize coordination between a Flood Management Program and other programs. The following competencies (Table 7-14) are intended to outline what is needed to achieve the stated outcome:

- The County's water quality improvement efforts and regulatory compliance are integrated with flood risk management programs.
- County sustainability goals are considered in development of flood mitigation activities.
- County equity goals are considered in development of flood mitigation activities.
- There are erosion and sediment control regulations for all construction sites for protection of water quality and drainage systems.
- WQPC credit is provided for implementing flood mitigation beyond water quality requirements.

Discussion

Existing County programs for management of water quality (erosion and sediment control and SWM), though not providing flood mitigation or management themselves, are vectors through which the County exerts authority over development on private land and involves, at times, installation of stormwater infrastructure. Coordination of any flood management activities with this program would be beneficial for information sharing purposes. Likewise, existing County sustainability and equity initiatives may benefit from coordination with flood management activities. Because flood management is not a current County program, there is little formal coordination carried out between agencies on this subject.

Table 7-14. Observations Related to Other Benefits of Flood Management Outcome

Competency	Observations
The County's water quality improvement efforts and regulatory compliance are integrated with flood risk management programs.	The County currently enforces water quality focused SWM regulations. As there is no comprehensive plan for flood risk management, there are currently no opportunities for integration or coordination.
County sustainability goals are considered in development of flood mitigation activities.	Presently flood mitigation projects are not coordinated with sustainability initiatives.
County equity goals are considered in development of flood mitigation activities.	The Office of Racial Equity and Social Justice (ORESJ) has recently worked with agencies to integrate a CIP budget equity review tool. ORESJ also completes equity reviews on supplemental appropriation requests. Past reviews have been conducted for projects related to flood management.
Erosion and sediment control regulations exist for all construction sites for protection of water quality and drainage systems.	The County currently enforces strict erosion and sediment control regulations for construction sites with disturbance of 5,000 square feet of soil or greater.
WQPC credit is provided for implementing flood mitigation beyond water quality requirements.	Currently WQPC credits are provided for installing infiltration or water re-use techniques on an individual or commercial property but are capped at 50% for managing the "Water Quality Volume" or 80% for managing the "Environmental Site Design Volume" as required by the Maryland Stormwater Design Manual. There is no

Competency	Observations
	incentive to manage larger volumes for larger storms to mitigate flood risk.

Recommendation

As the Flood Management Program develops, it is recommended that the County consider what level and frequency of coordination is needed to ensure that flood mitigation activities are incorporated in other County goals.

7.2.5 Asset Management

7.2.5.1 Asset management principles are followed to ensure infrastructure assets continuously deliver established LOS at an acceptable risk of failure and minimize life cycle costs of owning and maintain the assets

Outcome Benefits and Necessary Competencies

Like most urban and suburban areas of the nation, the County owns and manages storm drain and flood control assets of varying age, condition, and performance. Some such assets are more than 100 years old and nearing (or already exceeding) the end of their service lives. Some assets, due to materials available at the time of design may, in fact, have service lives that are much lower than anticipated (e.g., corrugated metal drainage pipe). Understanding the location, condition and level of service of delivered by these assets are key to managing current and future flood risk. Furthermore, efficient programming of capital dollars to proactively avoid asset failure requires an understanding of likelihood and consequence of failure of these assets. The following asset management competencies (Table 7-15) are intended to outline what is needed to achieve the stated outcome:

- The County maintains a frequently updated asset management plan and program built on a reliable asset inventory and characterizing resources and timescales requirements for all stormwater and flood control infrastructure.

  An Asset Management Program will guide the County in gaining the most value from its stormwater drainage and flood control infrastructure by ensuring the right maintenance is performed at the right time and infrastructure renewal investments are optimized with respect to timing and cost.

- The Asset Management Program establishes and periodically reviews and updates the LOS to be met by stormwater and flood control systems. Actual LOS provided are measured and reported.

  Infrastructure must be designed and constructed to meet defined needs (that is, established LOS) over a specified time-period. However, due to natural conditions (such as climate change) and anthropogenic activities (such as development) the LOS originally provided by the infrastructure may no longer be adequate. Therefore, knowing and reporting actual LOS to stakeholders, and updating LOS is crucial to planning for infrastructure renewal and infrastructure expansion.

- The County has a reliable, accurate, and regularly updated inventory of stormwater and flood control infrastructure assets, with their attributes.

  An organization and its staff cannot effectively manage its assets if it does not know what assets it owns, where those assets are, what those assets consist of, what condition they are in, and how they are performing. Staff members responsible for operating and maintaining the assets and planning for their renewal (e.g., rehabilitation and replacement) must have access to all asset information.

- The condition and likelihood of failure, along with the consequences of failure, of all stormwater and flood control infrastructure is periodically updated and is easily accessible by staff.

  The risk of asset failure is defined as the product of an asset's likelihood of failure (LoF) and that asset's consequences of failure (CoF). The LoF is driven by the asset's physical condition, performance and remaining useful life. The CoF is driven by its established LOS and the severity of the asset's failure. By quantifying LoF

and CoF the relative risk of failure of each asset can be calculated to be used for establishing maintenance protocols and planning for renewal of infrastructure.

- The risk due to failure of stormwater and flood control infrastructure assets to meet established LOS is periodically updated and used to develop maintenance schedules, needed rehabilitation, replacement, and additional infrastructure assets.

  Periodically updating the risk of asset failure and using that information to optimize maintenance and renewal of infrastructure will provide for a more streamlined and reliable process in preparing both the operational and capital improvement budgets, along with mitigating flooding due to infrastructure failure.

These competencies will lead to a solid understanding of existing assets, risk of failure (the product of likelihood and consequence of failure), and comprehensive understanding of existing LOS to be provided throughout the County. All of this information is needed to be able to do the following:

- Proactively plan for O&M needs
- Provide staff with information to consider risk of failure as a capital planning input for requesting and programming of replacement and rehabilitation budgets
- Build and update accurate hydraulic modeling of storm drain networks

Discussion

Management of assets is spread across several agencies, including DOT (storm drain assets within public ROW), DEP (public SWM assets and private SWM assets with service agreements), and Montgomery Parks (storm drain infrastructure on parkland).

Presently DOT is the primary owner of storm drainage database information. DOT has dedicated survey staff over the past 10 years to validate and update the GIS storm drainage database. Although database information was predominantly digitized from design drawings, rather than as-built information, there are significant differences in some areas between the database and actual conditions. DOT has developed asset database management GIS routines that allow the survey department to update "master" layers with field-verified layer information, including changes in geometry, and consultant as-built information, provided by permit applicants. For field survey and verification, DOT has consultant resources dedicated to filling database gaps and is proceeding with this work in a systematic manner, addressing areas with older and larger assets first. As noted in the *Historic Flooding Conditions and Data Gaps Technical Memo* (Jacobs, 2022), developed as part of Task 3 of CFMP P1 activities, there remain significant gaps in database information. The data gaps review conducted focused on data needed for hydraulic analysis and did not investigate other asset data, such as pipe condition information. Such information is critical to understanding LoF.

It is noted that, in addition to being needed to understand existing LOS, asset data will be important to achieve other outcomes, such as Outcome #9.1, "Riverine and pluvial/urban flood hazard areas are clearly mapped for different levels of service (storm recurrence). Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined."

Table 7-15. Observations Related to Use of Asset Management to Maintain LOS Outcome

Competency	Observations
A frequently updated asset management plan and program built on a reliable asset inventory and characterizing resources and timescales requirements for all stormwater and flood control infrastructure exists.	DOT has a Storm Drain General CIP fund that covers the DAR program project construction costs. Projects with construction costs exceeding $500,000 are completed as stand-alone CIP projects.
The Asset Management Program establishes and periodically reviews and updates the LOS to be met by stormwater and flood control systems. Actual LOS provided are measured and reported.	Storm drain assets are of varying ages with a large number installed by the Washington Suburban Sanitary Commission before 1966. Thus the level of service of these assets is not well-understood. DOT has completed storm drain hydraulic models for limited areas (Twinbrook Parkway and River Falls areas).

Competency	Observations
	DOT publishes the Drainage Design Criteria which includes design rainfall and rainfall return period requirements for specific infrastructure.
A reliable, accurate, and regularly updated inventory of stormwater and flood control infrastructure assets, with their attributes, exists. The inventory is accessible to all parties that inform the inventory or use it for planning purposes.	DOT has made significant gains in developing and increasing the accuracy of a geospatial database of storm drain assets. It is acknowledged that the database was, in good part, built on design drawings and thus there exist inaccuracies in both the features (presence of assets) and database attributes. DOT dedicates resources to completing field verification of the database and has automated moving this field-verified data into the "master" database.
The condition and LoF, along with the CoF, of all stormwater and flood control infrastructure is periodically updated and is easily accessible by staff.	CoF and LoF information is not well-understood for all storm drain assets.
The risk due to failure of stormwater and flood control infrastructure assets to meet established LOS is periodically updated and used to develop maintenance schedules, needed rehabilitation, replacement, and additional infrastructure assets.	Risk of failure information has not been developed for storm drain assets.

Recommendations

Although the County, specifically DOT, has made excellent gains in managing storm drain database information and ensuring the information is controlled and updated, efforts to improve data quality should be continued. Furthermore, there are opportunities to improve asset information to feed an understanding of likelihood and consequence of failure for drainage assets and flood control infrastructure (e.g., dams). Such analyses can assist in CIP programming, allowing the County to dedicate funds to those projects to address assets having the greatest risk of failure and adverse impact to residents, business owners, and County operations. While continuing the storm drain asset data management activities already ongoing, the County should consider applying asset management principles to provide further maintenance and capital planning benefits.

7.2.5.2 O&M of drainage and flood control infrastructure is proactive to maintain LOS

Outcome Benefits and Necessary Competencies

It is critical that routine O&M activities be carried out to maintain established LOS. Such activities include the following:

- Natural channels on both public and private property are inspected and debris is removed.
- Known problem sites are recorded and given additional attention, as appropriate.
- Regulations prohibiting dumping in streams exist and are publicized and enforced.
- Private stormwater storage facilities are inspected and maintained on a regular basis, or enforcement measures exist if they are not maintained.
- Public stormwater storage facilities are inspected and maintained on a regular basis.

Proactive O&M is necessary to keep maintain assets at an acceptable condition grade, proactively address problems before they worsen, prevent recurring problems, and inform the capital planning process.

Discussion

Responsibilities for stormwater infrastructure O&M is spread across various agencies depending on the asset type and location. As noted in Section 5, agencies responsible for O&M include the following: DEP (public SWM assets and private SWM assets with service agreements), Montgomery Parks (assets on Parks lands), and DOT (storm drain within the public right-of-way). Refer to Table 7-16 for details.

Table 7-16. Observations Related to Proactive O&M Planning Outcome

Competency	Current Agency Actions
Natural channels on both public and private property are inspected and debris is removed.	Both DEP and Montgomery Parks carry out debris removal on public property. It is understood that inspection and debris removal on private property is not necessarily carried out as County staff cannot access private property without an agreement.
Known problem sites are recorded and given additional attention, as appropriate	DOT Highway Services Division (HSD) is responsible for maintenance of the public storm drain system. HSD depots maintain lists of known problem sites and prioritize these for inspection prior to storm events when advance notice is available. DEP carries out a similar process for public and those private SWM systems within their program. DEP also has a Debris Removal Program that helps address removal of debris in stream channels.
Regulations prohibiting dumping in streams exist and are publicized and enforced.	Regulations prohibiting dumping exist and are enforced by DEP.
Public stormwater storage facilities are inspected and maintained on a regular basis.	DEP currently addresses this. It is responsible for inspecting and maintaining public SWM facilities.
Private stormwater storage facilities are inspected and maintained on a regular basis, or enforcement measures exist if they are not maintained.	DEP is responsible for inspecting and maintaining public SWM facilities. Private facilities where DEP has a service agreement are also included. Efforts have been made to bring more SWM facility owners into the program but this is a purely voluntary program, and some residents do not want to participate.

Recommendations

County agencies are currently planning for and carrying out stormwater infrastructure O&M activities. Data sharing between agencies on known problem areas could be improved and may aid in understanding recurrent drainage issues that may require cross-agency solutions. A computerized asset inventory and maintenance management system can facilitate this objective.

7.2.6 Emergency Management

7.2.6.1 The County has an emergency management plan that addresses preparedness, response, and recovery for flood events

Outcome Benefits and Necessary Competencies

Emergency management planning addressing preparedness, response, and recovery activities for flooding events is a critical facet of flood management. The following activities and competencies (Table 7-17) are intended to further describe the outcome:

- The County has failure recognition procedures for dams and levees.
- Response operations for failure of critical infrastructure and critical facilities are planned and practiced through periodic exercises.
- Dam and levee failure planning is coordinated with owners and operators of critical facilities and infrastructure.

- The County encourages owners and operators of critical facilities located in high-risk areas to have their own flood response plan.

Discussion

The County includes a number of dams categorized as "high hazard" or "significant hazard." Some of these structures are owned by the County, others are operated by the County, and still others are neither owned nor operated by the County. For those dams under County operation, dam safety operations and financial planning are currently being carried out and coordinated.

Table 7-17. Observations Related to Emergency Response Planning Outcome

Competency	Current Agency Actions
The County has failure recognition procedures for dams and levees.	MDE is responsible for administering the Dam Safety Program and ensuring compliance by dam owners with the requirements of the program. The County performs dam safety operations for the dams under its operation.
Response operations for failure of critical infrastructure and critical facilities are planned and practiced through periodic exercises.	OEMHS carries out periodic Emergency Operation Center trainings and exercises for extreme weather scenarios. These exercises can include dam failure incidents.
Dam and levee failure planning is coordinated with owners and operators of critical facilities and infrastructure.	Utility partners are typically included in emergency training exercises coordinated through OEMHS.
The County encourages owners and operators of critical facilities located in high-risk areas to have their own flood response plan.	Utility partners are typically included in emergency training exercises coordinated through OEMHS.

Recommendation

The County should consider the benefit of performing outreach to encourage owners and operators of critical facilities within high-risk areas to develop their own flood response plan. However, critical facilities are not consistently identified or categorized based on criticality in the County or based on flood risk. These typically include a wide range of both public and private facilities including first responder facilities, hospitals, schools, public shelters, key utilities (water, wastewater plants, electrical power facilities and substations, communication facilities), hospice facilities, public housing, prisons, hazardous materials storage sites, transportation hubs, national security installations, etc.

7.2.6.2 The County's emergency management plan includes early warning systems for high-risk areas

Outcome Benefits and Necessary Competencies

An effective flood early warning system can mitigate damage and threat to public safety by allowing impacted stakeholders time to evacuate and implement flood protection measures. The following competencies (Table 7-18) are intended to describe the outcome:

- The County has an effective flood warning system based on flood prediction.
- Planning for dissemination of flood warnings is coordinated with owners and operators of critical facilities and critical infrastructure.
- The County is designated by NWS as StormReady.

Discussion

The County has an emergency notification system that is customizable for specific types and locations of alerts. This system operates using NWS forecast information.

Table 7-18. Observations Related to Early Warning System Outcome

Competency	Current Agency Actions
The County has an effective flood warning system based on flood prediction.	Montgomery County administers the "Alert Montgomery" system for localized notifications of weather events (flooding, but also winter weather, winds, temperatures, etc.) and for government alerts (police, school, parks notifications, etc.). The system uses NWS forecast information. The system is voluntary.
Planning for dissemination of flood warnings is coordinated with owners and operators of critical facilities and critical infrastructure.	The "Alert Montgomery" system is available to anyone within a 75 mile radius of McClean Virginia (center of the National Capital Region) but there is currently no targeted outreach to ensure owners/operators of critical facilities are subscribed to the system.
The County is designated by NWS as StormReady.	Montgomery County is a NWS "StormReady" community.

Recommendation

It is recommended that the County continue to publicize the Alert Montgomery system to attract new resident users, particularly focusing on raising awareness for more socially vulnerable residents. Coordination with owners and operators of critical facilities, to ensure their understanding of flood warnings and participation in the Alert Montgomery system, should continue to be prioritized.

7.2.7 Budget/Personnel

7.2.7.1 Financing options are well-defined and communicated

Outcome Benefits and Necessary Competencies

Funding and finance options for flood management, including preparedness, response, and recovery, as well as flood mitigation through adequately maintaining, renewing, and constructing infrastructure can come from diverse sources. Understanding the variety of potential funding sources and labor required to manage a long-term Flood Management Program requires the following activities and competencies (Table 7-19) to achieve the desired outcome:

- A strategy exists for obtaining grant and loan resources for flood management capital improvements and flood preparedness.
- Grant and loan resources for flood event recovery are known and there are resources to apply for these funds.
- Flood protection resources and financial assistance is communicated to property owners by staff trained in retrofitting and grants availability information.
- The County has a grant program for acquisition of flood-prone properties.

Discussion

The County has a WQPC that is included on the property tax bill. The WQPC provides the funding of the WQPF which is used, along with some other sources, for planning, design, construction, operation, and maintenance of SWM facilities, as well as for debt service on its Water Quality Protection Charge Revenue Bonds. Several projects with flood mitigation benefits, most notably the Wheaton Regional Flood Mitigation Project and the Facility Planning Storm Drain/Drainage Assistance Program, use the WQPF. Further use of this fund to serve flood mitigation purposes should be explored.

Grant and loan resources, although offering attractive funding sources, can require significant staff time and consultant assistance to identify and complete the grant application or debt financing process. Nevertheless, the County has successfully obtained both federal and state grants, as well as a loan from the Maryland Water Quality Financing Administration, for flood management-related projects. In addition, the County periodically draws down proceeds from the Water Quality Protection Revenue Bonds issued in 2016.

Since funding sources for flood management type projects and programs can come from a large variety of sources, it is helpful for the County to understand the universe of potential funding and finance options for flood preparedness, mitigation, and recovery. Furthermore, there can be grant and loan resources aimed at residential property owners and small businesses. For example, FEMA BRIC grants can be used for a variety of flood risk reduction activities.

Because the County lacks personnel dedicated to flood management role, there is no entity with the mission to pursue and administer grant funds specifically for flood mitigation projects. Departments such as DEP and DOT have staff familiar with submitting grant applications, but these staff are fully dedicated to supporting MS4 permit activities.

Table 7-19. Observations Related to Knowledge of Funding Options Outcome

Competency	Current Agency Actions
Grant and loan resources for capital improvements and flood preparedness are known and planned for.	Because the County lacks personnel dedicated to flood management role, there is no entity with the mission to pursue and administer grant funds specifically for flood mitigation projects. Departments such as DEP and DOT have staff familiar with submitting grant applications, but these staff are fully dedicated to supporting MS4 permit activities. OEMHS does dedicate some labor to identifying and applying for grant resources related to flood preparedness. Typically, the County focuses solely on federal programs with continual funding.
Grant and loan resources for flood event recovery are known and there are resources to apply for these funds.	
Flood protection resources and financial assistance is communicated to property owners by staff trained in retrofitting and grants availability information.	DOT Division of Transportation Engineering administers the DAR program which assists residents in resolving flooding and drainage issues cause by problems or capacity limitations in the public storm drain system. This program does not address drainage issues due to flooding from private property.
County grant program exists for acquisition of flood-prone properties.	There is currently no program for acquisition of flood-prone properties.

Recommendation

The County should consider development of staff specifically focused on understanding the current and anticipated availability of available federal (FEMA, others) and state grant and loan options for flood preparedness, response, and mitigation activities. Consideration should also be given to increasing efforts at the state and federal level to encourage additional low-interest loan and grant opportunities through legislation and regulation. This effort should include technical assistance programs to aid residents in floodproofing, offering flood insurance subsidies for low-income residents, and acquiring flood-prone properties. The County should also consider applying to the FEMA CRS program, participation in which can increase access to federal recovery funds. Further, the County should develop an estimate of labor hours required for staff to explore availability of loans and grants, report on successes, and engage with legislators and regulators to work on development of new funding options.

7.2.7.2 County budget and staffing needs are comprehensively collated, communicated, and decided upon

Outcome Benefits and Necessary Competencies

Understanding of capital and operational resources needed to achieve flood management objectives will be very important to ensuring that decisions makers have the information needed to support a Flood Management

Program. The following activities and competencies The following competencies (Table 7-20) are intended to describe the outcome are intended to further describe the outcome:

- O&M funding needs for stormwater and flood control infrastructure (e.g., green infrastructure, dams, levees) are known and planned for.
- Flood management CIP items are collated and reviewed annually.
- Decisions regarding adequacy of flooding-centered staffing and resources are performed by the collection of responsible County agencies.

Discussion

Capital and operational planning are activities carried out by each of the Core County agencies on an annual basis. Each agency is familiar with this budget planning process, but these processes have not been carried out in a cross-agency manner for flood management planning purposes.

To define the budget and staffing needs, a County-wide understanding of the goals of flood management is required. For example, development of a flood mitigation CIP projects will require defining a LOS for mitigation projects to achieve. LOS, set at a County-wide or more local scale, will ultimately determine whether existing infrastructure is performing adequately or not. New or replacement infrastructures projects will be sized and ultimately costed based on an established LOS. Likewise, quantification of the adequacy of flood management staffing levels will benefit from developing a business plan to attain flood management outcomes. For example, a business plan for a public outreach program will identify the staffing (full time equivalent, for example) required to carry out planned engagement activities.

Table 7-20. Observations Related to Knowledge of Budget Needs Outcome

Competency	Current Agency Actions
O&M funding needs for stormwater and flood control infrastructure (e.g., green infrastructure, dams, levees) are known and planned for.	O&M funding needs are generally known for flood control infrastructure (specifically County-maintained BMPs and dams) but less well-understood for legacy storm drain systems. DOT has annual funds allotted for storm drain repair in addition to the DAR program funds, but this is reportedly not adequate for addressing known issues.
A flooding-centered CIP is developed and updated annually.	Although each individual agency develops a CIP on an annual basis, this information is not coordinated and collated to support development of a flood management CIP. Where individual projects have flood mitigation benefits, this is typically noted.
Decisions regarding adequacy of flooding-centered staffing and resources is performed by the collection of responsible County agencies.	Typically, adequacy of staffing is currently carried out at an agency level and in support of agency mandates.

Recommendation

It is recommended that the County develop a business plan detailing the action plan to support each of the 17 outcomes. Such a plan would include activity-specific goals, staffing levels and a responsibility assignment matrix, as well as capital and operating budget estimates. The business plan would provide a detailed roadmap to achieve the Outcomes of the Comprehensive Flood Management Program.

8. Conclusions and Next Steps

Based on the information presented in this report, a Draft Final Comprehensive Flood Management Strategy (Task 6 deliverable) has been developed. The Strategy presents the outcomes identified here as well as a high-level understanding of timeline and department stewardship. Most importantly, the Strategy outlines program delivery recommendations intended to achieve the comprehensive flood management outcomes identified in this report.

The CFMP Strategy is intended to be followed by development of a business plan including timeline and budget information at the competency level. The strategy will be reviewed by the Core Team before being distributed to agency and department leadership.

Appendix A
Core Agency Roles and Responsibilities Matrix

Appendix A: Core Agency Roles and Responsibilities Matrix

Primary Roles

	Land-Use Planning	Stormwater/ Flood Infrastructure Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding										
Not in County/FEMA floodplain	MNCPPC Planning	MC DEP MC DOT	MC DOT MNCPPC Parks MC DEP	MC DPS MNCPPC Parks	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC OCE	MC DOT MNCPPC Parks MC DEP
In County/FEMA floodplain	MNCPPC Planning	MC DEP MC DOT	MC DOT MNCPPC Parks MC DEP	MC DPS MNCPPC Parks	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP MC OCE	MC DOT MNCPPC Parks MC DEP
Pluvial/Lot-to-Lot Flooding										
All Private Land	MNCPPC Planning	MC DEP	MC DEP	MC DPS	MC DEP	MC DEP	MC DEP	MC DEP	MC DOT MNCPPC Parks MC DEP MC OCE	MC DEP
All Public Land	MNCPPC Planning	MC DEP MC DOT	MC DOT MNCPPC Parks MC DEP	MC DPS MNCPPC Parks	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP MC OCE	MC DOT MNCPPC Parks MC DEP
From Public to Private	MNCPPC Planning	MC DEP MC DOT	MC DOT MNCPPC Parks MC DEP	MC DPS MNCPPC Parks	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MC DOT MNCPPC Parks MC DEP MC OCE	MC DOT MNCPPC Parks MC DEP
From Private to Public	MNCPPC Planning	MC DEP	MC DEP MNCPPC Parks	MC DPS MNCPPC Parks	MC DEP MNCPPC Parks	MC DEP	MC DEP	MC DEP	MC DOT MNCPPC Parks MC OCE	MC DOT MC DEP

Appendix A: Flood Management Roles Matrix

Supporting Roles

	Land-Use Planning	Stormwater/ Flood Infrastructure Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding										
Not in FEMA floodplain	MC DEP MC DOT MC OCE MNCPPC Parks MC DPS	MNCPPC Parks MC DPS		MC DOT MC DEP	MC DPS MC DEP			MC OEMHS	MC OEMHS	MC OEMHS MC DEP
In FEMA floodplain	MC DEP MC DOT MNCPPC Parks MC DPS	MNCPPC Parks MC DPS		MC DOT MC DEP	MC DPS MC DEP			MC OEMHS	MC OEMHS MC OCE	MC OEMHS MC DEP
Pluvial/Interior/Lot-to-Lot Flooding										
All Private Land	MC OCE MC DEP			MC DEP	MC DPS MC DEP			MC OEMHS	MC OEMHS	MC OEMHS MC DEP MC DOT
All Public Land	MC DOT MNCPPC Parks MC OCE MC DEP	MNCPPC Parks		MC DOT MC DEP	MC DPS MC DEP			MC OEMHS	MC OEMHS	MC OEMHS MC DEP
From Public to Private	MC DOT MC DEP MC OCE			MC DOT MC DEP	MC DPS MC DEP			MC OEMHS	MC OEMHS	MC OEMHS MC DEP
From Private to Public	MC OCE MC DEP			MC DEP	MC DEP MC DPS			MC OEMHS	MC OEMHS MC OCE MNCPPC Parks	MC OEMHS MNCPPC Parks MC DEP

Appendix B
Core Team Workshop Summaries

Phase 1 Chartering Meeting

Date:	May 19, 2022
Project name:	Comprehensive Flood Management Plan Phase 1
Project no:	E4X56703
Location:	Microsoft Teams
Participants:	Frank Dawson/MC DEP Stan Edwards/MC DEP Miranda Reid/MC DEP Darian Copiz/MC DEP Ho-Ching Fong/MC DEP Amy Stevens/MC DEP Krystal Reifer/MC DEP Enrique Lopezcalva/Jacobs Miranda Santucci/Jacobs Dan Speicher/Jacobs Laurens van der Tak/Jacobs Steph Marvin/Jacobs Khalid Afzal/MNCPPC Planning Mark Symborski/MNCPPC Planning Matt Harper/MNCPPC Parks Erin McArdle/MNCPPC Parks Matthias Miziorko/MC OEMHS Tina Laboy/MC OEMHS Michael Boldosser/MC OEMHS Mark Etheridge/MC DPS William Musico/MC DPS Tim Cupples/MC DOT

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this chartering meeting is to provide the core stakeholder team the opportunity to begin collaborating on defining project expectations, roles and responsibilities of each agency, and what is meant by *flooding* for the Comprehensive Flood Management Plan Phase 1.

Summary of Discussion

Introductions & Meeting Objectives

- Jacobs hosted a Mural tutorial and introductions. The Mural canvas resulting from meeting collaboration is included as **Attachment B**.
- Jacobs reviewed the meeting objectives, namely chartering of the Core Team, revisiting the approach, roles and responsibilities, and operation details. The meeting also serves as an initial discussion of flood definitions and flood management roles in the County.

Project Context and Expectations

- Jacobs provided some context for the work and reviewed the overall and Phase 1 approach.
- Jacobs presented project expectations summarized from the April 27 Project Initiation/ DEP-only kickoff meeting. Core team members were invited to discuss expectations and note their comments using Mural.
- Jacobs reviewed the project approach and schedule and reviewed the various engagement levels anticipated for the work. Attendees of the meeting are all categorized as Core members.

Communications Details

- Jacobs noted that communications with the Core team will include the planned workshops as well as interview sessions. Scheduling of the initial interviews is underway, with the first few being carried out week of May 23.
- Jacobs noted that an initial data request had been shared with DEP. Replies to that request can be sent directly to Jacobs (Miranda Santucci). Jacobs will maintain a data log and keep track of items still needed.
- MNCPPC inquired regarding timeline of the data needs. It was noted that for the stream network for example, MNCPPC is aware that the state is generating a high-accuracy data set that will not be available until Fall 2022. Jacobs noted that awareness of this sort of timeline is most helpful and there is no need to secure a preliminary set of data. The data that will be most labor-intensive to review is the pipe/culvert data requested of MC DOT.

Flooding Definitions

- Jacobs proceeded to provide some background on flooding definitions. The three main mechanisms for flooding were discussed (Attachment B, Section 9), two of which pertain to the County: fluvial (riverine) and pluvial (aka interior flooding, urban flooding, cloudburst flooding, lot to lot flooding). It was noted that FEMA only maps a subset of riverine flood risk. Determining what constitutes flooding for the County will include exploring the bound of flooding but define this according to an acceptable level of risk (level of service, or design standards). The timeframe and magnitude of a flooding event will be a part of this determination.
- Typical planning and mitigation responsibilities for various types of flooding were discussed. DEP noted that responsibilities associated with the localized, "lot to lot" flooding is a particularly important discussion, with County responsibility typically limited to managing infrastructure in public right of way up to design level of service. Impacted landowners may argue that the County has some responsibility for this due to regulations allowing development and allowing additional impervious surfaces.
- MNCPPC inquired, Is the landowner responsible for flooding due to roadway drainage particularly in urban areas, for example? Jacobs noted that, presently, those impacted are the ones addressing necessary mitigations. For example, in Washington D.C., WMATA has begun hardening/flood proofing its facilities (metro entrances and air shafts) due to continued issues with pluvial flooding. They have chosen not to wait for the City to address the problem.
- MNCPPC asked when public engagement was planned. The County is anticipated to grow. Growth has always raised concerns such as traffic, but flooding is quickly becoming a top concern as well. Many developments were completed prior to there being any requirements for stormwater management. As the County continues to process site plan approvals, the question of whose responsibility is the stormwater quantity management will remain. Even with requirements established recently, the measure approved in the recent past may not be sufficient for accommodating future rainfall changes. Getting recommendations to the County Council on how to address this will be important because infill and re-development are the predominant scenarios in the future as there are very few greenfield areas.

- MNCPPC noted that projects and properties that go through the site plan process have maintenance and management agreements. These agreements are kept with DPS.
- MC DEP noted that "planning" as noted in Attachment B, Section 9, should be separated from mitigation. These are distinct roles. It will be most helpful to distinguish between each role and outline the multiple entities within each role. Jacobs noted that Section 10 includes the first draft of such a breakdown but that additional detail will need to be added as the work progresses.
- MC DEP asked whether a definition of flooding should include inches of flooding. Jacobs noted that the considerations for level of service (duration and magnitude of the flood event, acceptable risk) must be discussed to make this determination and is a function of the types of infrastructure and where they are in the drainage system, e.g., drainage inlets in roads, drainage conveyance, culverts, bridges, floodplains. Also, an understanding of actual risk posed should be discussed, and these are components of the work Jacobs is doing to eventually achieve that definition or a recommendation for that. This definition may include inches of flooding, and details such as the communications around certain events will need to be discussed.
- MC DOT asked whether the work is focusing on urban area or the County as a whole. DOT infrastructure is in urban, suburban, and rural areas of the County. MC DEP replied that the effort is intended to address flooding across the County. Jacobs noted that there are partners at the state level too. Level of service should be discussed in terms of the long service life of pipe/culvert assets.
- MNCPPC brought up consideration of industry best practices. For example, the County may assess a minimum level of service based on safety as well as higher levels of service and consideration of how those may change in the future. DEP further noted that defining these levels of service will be important to put into context how planning may differ for storms of different magnitudes. For example, infrastructure necessary to mitigate the impact of the rainfall experienced last fall in Rockville would be massive. The County will have to evaluate level of service based on risk and available resources. Jacobs will advise the County based on industry best practice; the scope of Phase 1 also includes exploring how similar and neighboring jurisdictions are approaching this.
- MNCPPC further noted that development in the County will continue. Much of this development will be infill/re-development and flooding considerations are only likely to grow. The County needs to reach a decision on how to approach this. This project aims to define the scope of the issues and potential solutions, with various levels of service, for discussion with decision makers and the public.
- DEP noted that while addressing future regulations is critical, there are also existing issues that may need to be solved with investment. The County also needs clarity and prioritization for these areas.

Flood Management Roles

- Jacobs introduced a table with flood management roles spanning planning and design through flood response and recovery (Attachment B Section 10). MC DEP noted that additional explanation of each category and examples will help agencies comment on this table. MC DEP noted that county-level planning should probably be distinguished from system-level planning as well.
- MC DOT asked whether ordinances, as indicated in the "planning" category, would include design standards. An ordinance is a rule or regulation versus a County standard or guideline. Jacobs agreed that further clarity needs to be provided for the categories.
- MNCPPC asked regarding the scope of community engagement. Jacobs noted that initially, the Core members will be involved in confirming the objectives of this engagement and developing an engagement plan. The work was scoped out assuming initial engagement will focus on education

of the public as well as providing some opportunity for input and data gathering related to historic events. This material will be discussed in upcoming workshops.

Action Items

1. Jacobs to complete scheduling of initial interview sessions with Core members.
2. Jacobs to make noted adjustments to flood management roles table, for continued use in agency interview sessions.
3. Jacobs and Core team to work on refining definitions of flooding and level of service definitions currently in use in the County.

Attachments

A. Meeting Agenda

B. Mural Canvas

Phase 1 Chartering Meeting

Date: May 19, 2022
Time: 1:00PM to 3:00PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56703
Prepared by: Dan Speicher/Jacobs
Location: Microsoft Teams
Participants:
Frank Dawson/MC DEP
Stan Edwards/MC DEP
Enrique Lopezcalva/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Khalid Afzal/MNCPPC Planning
Mark Symborski/MNCPPC Planning
Matt Harper/MNCPPC Parks
Erin McArdle/MNCPPC Parks
Matthias Miziorko/MC OEMHS
Tina Laboy/MC OEMHS
Michael Boldosser/MC OEMHS
Mark Etheridge/MC DPS
William Musico/MC DPS

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Item	Time
Mural	1:00
Introductions	1:10
Meeting Objectives and Context	1:20
Phase 1 Expectations	1:30
Approach/Schedule	1:45
Roles	2:00
Operating Protocols	2:15
What is Flooding?	2:30
Authorities Matrix	2:50
Next Steps	2:55

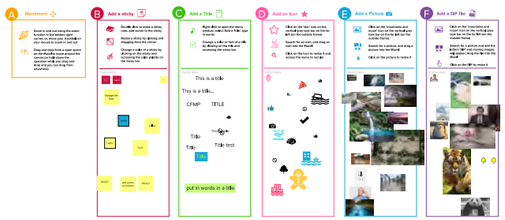
Comprehensive Flood Management Plan Phase 1

CORE TEAM, Session 1, May 19, 2022

1 MURAL PRACTICE

10 MINUTES

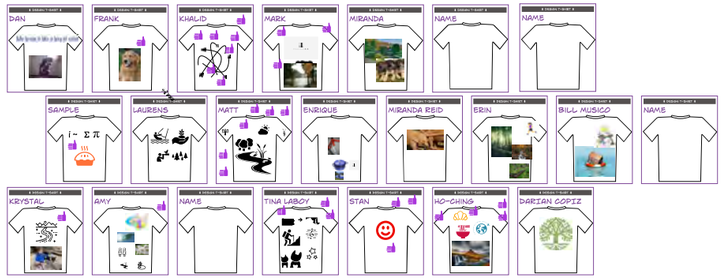
MURAL is a collaboration tool that allows for any participant to contribute. We will use this tool for all interactive sessions.



2 INTRODUCTIONS

10 MINUTES Recording?

Pick a panel, add your name, design a T-shirt



3 TODAY'S OBJECTIVES

5 MINUTES

Items we will achieve.

- Further Partnership
- Charter the team on:
  - Context, expectations, objectives and outcomes for the work
  - Approach and schedule
  - Roles and responsibilities
  - How the team will operate
- Initiate Flooding definition
- Begin recognition of responsibilites

4 CONTEXT

5 MINUTES

Comprehensive Flood Management Planning for Montgomery County in three phases

- Phase 1: Governance and data gaps
  - Shared understanding of existing conditions with respect to flood management
  - Clarity on responsibilities with respect to management of flood risk
  - Clear path forward for Phases 2 and 3
- Phase 2a: Data collection, detailed modeling, vulnerability assessment
- Phase 2b: Alternatives analysis for priority watersheds
- Phase 3: Implementation of alternatives

5 EXPECTATIONS

15 MINUTES

What do we expect from Phase I?

6 APPROACH/SCHEDULE

10 MINUTES

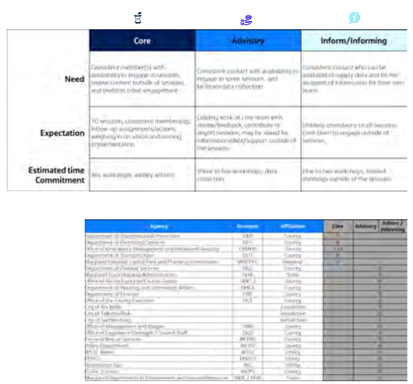
Five stages are the core of the approach. Ten workshop sessions are suggested.

	Stage	Meeting Name	Purpose/Content	Outcomes	
1	Chartering	Kick-off 1	Review of drivers and challenges; Review of project construct and approach; Validation of team participants; Review initial list of additional agency and stakeholder participants	Consensus on intended outcomes of project effort; Validation of project schedule	Thursday, May 19
		Kick-off 2	Finalize agency engagement; Define flooding for Montgomery County; Analysis of stakeholder engagement, influence and interest; Clarification of participant roles, deliverables, and communication protocols; Finalize Core Team meeting schedule	Written definition of flooding for Montgomery County; Complete charter of Core Team	Thursday, June 2
2	Organizational As-Is	County As-Is	Review and synthesis of organizational charts, policy documentation, budgets, and processes associated with flooding responsibilities and management within the County	Universal recognition of current construct and gaps within County flooding accountabilities and budgets	Thursday, June 16
		Stakeholder As-Is	Characterize accountabilities and budgets of stakeholders and municipalities; Review community engagement breath, bounds, intention, and approach	Understanding current responsibilities; Initial recognition of non-County stakeholders and their influence/understanding/engagement with flooding; Consensus on objectives of community engagement	
3	Current Conditions	Data Review	Review available mapping, studies, and other materials documenting the physical County flooding and historical conditions; Review of community information	Understanding and consumption of available data	July
		Data Comparison	Review of neighboring jurisdictions	Understanding of neighbors relationship with and direction for flooding	
4	Vision	Possible Future	Recognition of flooding organization and activities taken by peer jurisdictions; Characterization of potential future for flooding	Feedback and discussion on potential organizational future	August
		Flooding Direction	Review and amend preferred direction	Agreement on policy direction, decision authorities, and responsibility distribution within the County	
5	To-Be	Gaps	Define gaps from current conditions compared with what is needed to achieve vision; Characterize activities needed to achieve agreed upon direction	Detailed "to do" list for each County to address gaps and meet needs for vision	September
		Roadmap	Development of pathway that characterizes responsibilities and activities to advance the direction	Roadmap to achieving agreed upon outcomes	

7 ROLES

10 MINUTES

How participants are involved



8 OPERATING DETAILS

5 MINUTES

Details of delivery.

INTERVIEWS

- Schedule
- Questions

COMMUNICATION

- Among Core Team

Physical Responsibilities
1. What physical assets are responsible for?
2. What historic challenges?
3. What isyour role?
4. "Level of service"?

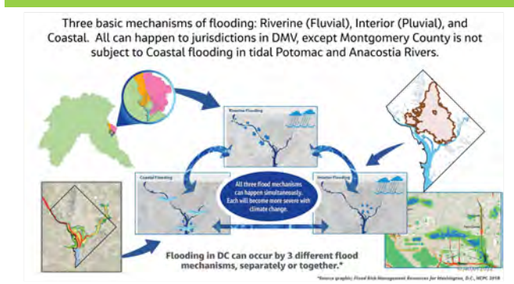
Organizational Structure/Governance
1. Definition of flooding?
2. Align organizational chart against identified flood management roles.
3. What are their relationships with other agencies w.r.t. flood management?
4. Do you have any specific processes (triggers/threholds) related to flood events?
5. What steps are following in the event of a flooding issue?
6. Do you have staffing dedicated to their flood management role? Shared responsibilities?
7. Can you describe past challenges in addressing responsibilities related to flooding or gaps in flood management?
8. Funding

9 FLOODING DEFINED

15 MINUTES

What is flooding?

Notes from Session →
- define bounds of flooding and how it is defined
- what time frame or lifecycle should be accounted for
- define the temporal aspect and magnitude of flooding
- define acceptable level of risk
- Level of service needs to be included
- Industry best practices should be included
- how is severity or order of magnitude included here



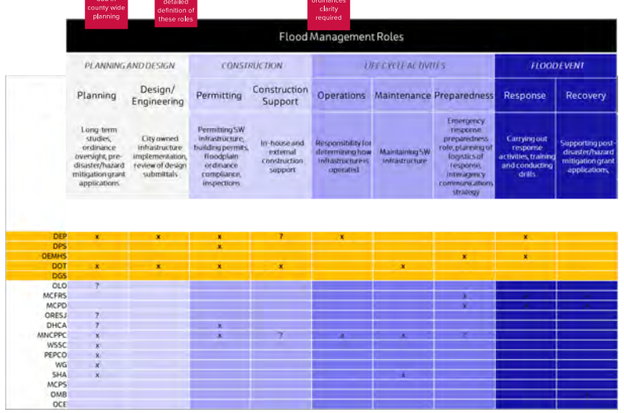
Flooding Terms Glossary

- Fluvial flooding, also knowns as riverine flooding, is due to high river water levels that may cause flooding in the overbank areas. FEMA floodplains delineate some of the areas of fluvial flooding associated with 100-year return period design storms.
- Pluvial Flooding, know also as local flooding or interior flooding, refers to flooding caused by intense rainfall overwhelming infiltration capacity and local stormwater infrastructure.
  - Flash flooding or cloudburst flooding is due to very high intensity rainfall, occurring in areas with significant impervious are as causing quick accumulation of runoff.
- Coastal flooding involves flooding due to tropical storm surge and/or due to high tide levels. *This mechanisms of flooding is relevant in the District of Columbia and Prince George's County but not Montgomery County.*
  - Tidal flooding, also known as sunny day flooding, is recurrent high tide flooding due to sea level rise.

10 RESPONSIBILITY MATRIX

15 MINUTES

What is the flooding responsibility



Phase 1 Core Team Meeting #2

Date:	June 2, 2022
Time:	1:00 to 3:00 PM
Project name:	Comprehensive Flood Management Plan Phase 1
Project no:	E4X56703
Prepared by:	Dan Speicher/Jacobs
Location:	Microsoft Teams
Participants:	Frank Dawson/MC DEP Stan Edwards/MC DEP Miranda Santucci/Jacobs Dan Speicher/Jacobs Laurens van der Tak/Jacobs Steph Marvin/Jacobs Khalid Afzal/MNCPPC Planning Mark Symborski/MNCPPC Planning Matt Harper/MNCPPC Parks Erin McArdle/MNCPPC Parks Matthias Miziorko/MC OEMHS Daniel Sheridan/MC DOT Tim Cupples/MC DOT Maricela Cordova/MC DOT Mark Etheridge/MC DPS Adriana Hochberg/MC DEP Amy Stevens/MC DEP Ho-Chin Fong/MC DEP Krystal Reifer/MC DEP Claire Iseli/MC OCE William Musico/MC DPS Ben Carlson/Nspiregreen Karen Armendariz/Nspiregreen Mercy Iyere/Nspiregreen

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this chartering meeting is to provide the Core stakeholder team the opportunity to continue collaborating on defining project expectations, roles and responsibilities of each agency, and *flooding* for the Comprehensive Flood Management Plan Phase 1.

Summary of Discussion

Introductions & Meeting Objectives

- Mural was used to facilitate discussion. Key outputs of the workshop, captured from Mural, have been included as **Attachments B and C**.

- Jacobs reviewed the meeting objectives, namely chartering of the Core Team, revisiting the approach, roles and responsibilities, and operation details. The meeting also provided a high-level discussion of flood definitions and flood management roles in the County.

Flood Management Bounds

- Attendees indicated in the Source Matrix (see Attachment C – Flood Management Roles) where their agency had primary responsibility and supporting influence in pro-active and reactive roles regarding flooding from five sources: riverine, pluvial, groundwater, water main break, and sewer overflow.
- Jacobs qualified "System level" as infrastructure-related (ex: road network) while "County level" is broader in scope.
- In discussion of these roles and responsibilities, it was noted that:
    - What is meant by "System level' may need to be further qualified by defining what the systems are.
    - More clarity was recommended in defining the primary and secondary roles of agencies.
    - Planning, though not directly involved in stormwater management, has a wide spanning scope through its involvement with the County's master plans. Impervious surfaces and where roads are constructed fall under Planning's purview.
    - Planning plans for growth and development, which ends up being a factor that adds to flooding but Planning is not typically involved in addressing or mitigating flooding.
- Historically, agencies have been reactive rather than proactive, a reason for undergoing this Comprehensive Flood Management process.

Flooding Definitions – Continued

- Attendees were split into four groups and each provided a definition of flooding:
    - *Accumulation or conveyance of water exceeding planned volume/levels, often - though not necessarily always - having a significant "negative" (disruptive or destructive) impact on infrastructure, environment, and/or operations.*
    - *The temporary inundation of typically dry land with water to the point where the intended use of the land by humans is limited. The source and amount of water is irrelevant to the definition.*
    - *Excess flow exceeding capacity (exceeding level or service) and causing impacts, where it's not desirable.*
    - *Overflows of natural and built systems designed to capture or manage excessive water, both built system and natural environment, with a repeated negative influence on human activities and values.*
- Participants ranked the definitions (see Attachment B: Mural Canvas - Flooding Definitions) to come up with the following merged result:

  Accumulation or conveyance of water exceeding planned volume, levels, or timing having a significant disruptive or destructive impact on built infrastructure, environment, operations, and/or intended use.
- MC DEP mentioned that *flooding* may be defined by others in such a way that it is outside of the scope of work they are tackling.

Action Items

1. Jacobs to continue interviewing agencies, focusing on existing organizational conditions to report back on at the next Core team workshop in two weeks.

Attachments

A. Meeting Agenda

B. Mural Canvas – Flooding Definitions

C. Mural Canvas – Flood Management Roles

Phase 1 Core Team Meeting #2

Date: June 2, 2022
Time: 1:00PM to 3:00PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56703
Prepared by: Dan Speicher/Jacobs
Location: Microsoft Teams
Participants:
Frank Dawson/MC DEP
Stan Edwards/MC DEP
Enrique Lopezcalva/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Paul Moyer/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Khalid Afzal/MNCPPC Planning
Mark Symborski/MNCPPC Planning
Matt Harper/MNCPPC Parks
Erin McArdle/MNCPPC Parks
Matthias Miziorko/MC OEMHS
Tina Laboy/MC OEMHS
Michael Boldosser/MC OEMHS
Daniel Sheridan/MC DOT
Tim Cupples/MC DOT
Mark Etheridge/MC DPS
Adriana Hochberg/MC DEP
Amy Stevens/MC DEP
Darian Copiz/MC DEP
Ho-Chin Fong/MC DEP
Krystal Reifer/MC DEP
Claire Iseli/MC OCE
Meredith Wellington/MC OCE
William Musico/MC DPS

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Item	Time
Introductions	1:00
Meeting Objectives	1:10
Flood Management Bounds	1:15
Flooding Definitions, Continued	1:45
Community Stakeholders	2:15
Community Engagement Objectives & Strategy	2:50
Next Steps	2:55

1 Each person write their own definition

2 Teams merged their individual definitions into one

4 Each participant asked to force rank their definition preference

5 MERGED DEFINITION BASED UPON RANK ORDER

TEAM A	Any accumulation of water where we don't want it that creates a hazard to safety or property	Water where you do not want it.	Drainage inundation that negatively impacts infrastructure	Water at unexpected levels/ places given current design standards due to precipitation events	Rainfall runoff to cause impact to built and natural environments	Inundation of water that takes longer than average time to infiltrate.	Accumulation of water that impacts residents/those moving through the County	Accumulation or conveyance of water exceeding planned volume/levels, often - though not necessarily always - having a significant "negative"(disruptive or destructive) impact on infrastructure, environment, and/or operations.	
TEAM B				inundation of normally dry areas regardless of the source or cause of the inundation	Overflowing of water onto land that is normally dry			The temporary inundation of typically dry land with water to the point where the intended use of the land by humans is limited. The source and amount of water is irrelevant to the definition.	
TEAM C	A temporary inundation of normally dry land areas.	Excess water overflowing on land and impacting a property or asset	Undesired water in terms of quantity, location, timing, and duration	River or stream overtopping banks and causing flooding	Excess runoff that exceeds drainage conveyance capacity			Excess flow exceeding capacity (exceeding level or service) and causing impacts, where it's not desirable.	
TEAM D	too much water, in the wrong place	Water overflows systems designed to capture the flow	The presence of water in an unexpected and undesirable location	Water temporarily exceeding it's normal bounds and entering into areas formerly dry	Water accumulation that deviates from the norm in excessive way.			Overflows of natural and built systems designed to capture or manage excessive water, both built system and natural environment, with a repeated negative influence on human activities and values	

Accumulation or conveyance of water exceeding planned volume, levels, or timing having a significant disruptive or destructive impact on built infrastructure, environment, operations, and/or intended use.

Cause = a volume of water to a certain source, depth, in a specific location, or for a specific amount of time

All Cause

3 Teams placed the colored letter representing their definition on the spectrum

Even

C D

A B

All Effect

Effect = regardless of the cause, the result is loss of access and/or intended purpose of the affected property/facility

(1) = Primary Responsibility (2) = Supporting Influence

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain (1 Moving towards primary role for some initiatives (USACE, DOD))	2, 1, 2, 2	2, 2, 2, 1	1, 1	1, 2	2, 1	1, 1	1, 1	1, 1	1, 1, 1	1, 1
	In FEMA floodplain	2, 1, 2	2, 2, 2, 1	1 (County High Hazard Dam (Wheaton) Dam portion design), 1, 1	1, 2	2, 1	1 (County High Hazard Dam Operations), 1, 1	1 (County High Hazard Dam Maintenance), 1, 1	1 (County High Hazard Dam Preparedness), 1, 1	1, 2, 1	1, 1
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land	1 (Watershed studies/water quality), 2	2 (Via regulatory approval of site plans), No Prime	2 (Raincapes - quality focused), No Prime	2, 1	2, No Prime	2 (SW facility), No Prime	2 (SW facility), No Prime	No Prime, 2	2, 1, 1	No Prime, 2
	Entirely on public land	1 (Watershed studies/water quality), 2, 2	2 (Via mandatory referral approvals by the Planning Board (advisory only)), 2, 1	1, 1	1, 2	1, 2, 1	2 (SW facility), 1, 1	2 (SW facility), 1, 1	Only DOT, 1	2, 1, 1, 1	1, 1
	From public to private	1 (Watershed studies/water quality), 2	Only DOT, 1	Only DOT, 1	1, 2	2, 1	2 (SW facility), 1	2 (SW facility), 1	Only DOT, 1	2, 1, 1, 1	1, 1
	From private to public	1 (Watershed studies/water quality), 2	2 (Via regulatory reviews of site plans), 1	Only DOT, 1	1, 2	2, No Prime, 2	2 (SW facility), No Prime, 2	2 (SW facility), No Prime, 2	Only DOT, 1	2, 1, 2, 1	1, 1
	Public to other public (PG, Howard, Federal lands)	No Prime	No Prime, 2	Only DOT, 1	No Prime, 2, 2	2, No Prime, 2	No Prime, 2	No Prime, 2	No Prime, 2	2, 2, 1, 2	2, 1
Groundwater flooding		No Prime	No Prime	No Prime	No Prime	Only DOT, 1	No Prime	Only DOT, 1	No Prime	1, 1	1
Water main break					2	2		2		2, 2, 2, 2	1, 2
Sewer overflow					2	2		2		2, 2, 2, 2	1, 2

Strong response and recovery responsibility in most sources (exception is entirely on private)

Does a primary agency need to be identified? (for those cells identified with a gold diamond)

Does DOT have sole responsibility? (for those cells identified with a red diamond)

County does not have primary responsibility for pro-active efforts in water and sewer overflows, but are involved as supporting and/ or responding. Is this relationship and responsibility codified in an agreement?

LEGEND 1/2 MC DEP 1/2 MNCPPC PLANNING 1/2 MNCPPC PARKS 1/2 MC DPS 1/2 MC OCE 1/2 MC DOT 1/2 MC OEMHS

Phase 1 Core Team Meeting #3

Date:	June 16, 2022
Time:	1:00 to 3:00 PM
Project name:	Comprehensive Flood Management Plan Phase 1
Project no:	E4X56703
Prepared by:	Dan Speicher/Jacobs
Location:	Microsoft Teams
Participants:	Stan Edwards/MC DEP Enrique Lopezcalva/Jacobs Miranda Santucci/Jacobs Dan Speicher/Jacobs Laurens van der Tak/Jacobs Steph Marvin/Jacobs Khalid Afzal/MNCPPC Planning Mark Symborski/MNCPPC Planning Matt Harper/MNCPPC Parks Erin McArdle/MNCPPC Parks Tina Laboy/MC OEMHS Michael Boldosser/MC OEMHS Daniel Sheridan/MC DOT Mark Etheridge/MC DPS Adriana Hochberg/MC DEP Krystal Reifer/MC DEP Claire Iseli/MC OCE Meredith Wellington/MC OCE William Musico/MC DPS Najila Ahsan/MC DEP Ho-Ching Fong/MC DEP Darian Copiz/MC DEP Kristina Campbell/MC DEP Rachel Whiteheart/MC DEP

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this Organizational As-Is meeting is to provide the Core team the opportunity to gain further clarity on expectations, roles and responsibilities of each agency, to identify gaps in County flooding accountability, and discuss potential outcomes of the Phased approach and stakeholder engagement strategies.

Summary of Discussion

Introductions & Meeting Objectives

- Mural was used to facilitate discussion. Key outputs of the workshop, captured from Mural, have been included as **Attachment B.**

- Jacobs reviewed the meeting objectives, offered clarity on the meaning of County-level versus System-level planning:
    - **County-level planning or "Land Use planning"**: Master planning (land use, master planning, other than water/wastewater/stormwater) at the County, watershed, or area plan level
    - **Systems-level planning or "Stormwater/Flood Infrastructure Planning"**: Engineering planning studies at the system level corresponding to the mission of a specific agency (Stormwater, Wastewater)
- The meeting also invited the Core Team to complete a questionnaire to describe in greater detail their flood management roles in the County.

Potential Outcomes of Phase 1

- More organized structure and approach:
    - More coordination among the agencies; a strategy working across departments
    - Understand who will manage flood data; centralized database
    - Understanding data, existing conditions, gaps
    - To prioritize locations based on socially vulnerable neighborhoods; involve stormwater management best practices; identify funding and staff resources
- County will be able to prioritize which areas are most at risk and vulnerable to different types of flooding issues
    - Equity emphasis. "Are communities of color experiencing flooding more?"
- The biggest impact(s) to public safety; if there is anything the County can do to prevent/mitigate flooding and where; increase public safety and rescue capabilities and swift water rescues (Phase 3).
- Want the public and stakeholders to understand that comprehensive flood management is a complicated issue with complex solutions and not a quick fix; flooding can happen anywhere.
- There may need to be building code updates to address new property built (flooding in basements, first floor) to design property to avoid flooding.

Reviewing Responsibilities, Questionnaire Exercise

- See **Attachment C: Responsibilities Questionnaire DEP Sample** for an example of the questionnaire that was sent to each Core team agency to complete

Stakeholder Engagement Strategies

- The intention behind stakeholder engagement was discussed with the consensus being to:
    - Identify the locations experiencing flooding and extent/frequency
    - Provide general education on flood risk, its complexity and drivers
    - Hear from or represent those who do not typically engage with or influence County activities
- See **Attachment D: Mural Canvas – Stakeholder Engagement Intention** for all intentions submitted

Action Items

- Each Core Agency to complete responsibilities questionnaire and forward to miranda.santucci@jacobs.com by July 5, 2022.

Attachments

A. Meeting Agenda

B. Mural Canvas - Potential Outcomes

C. Responsibilities Questionnaire DEP Sample

D. Mural Canvas – Stakeholder Engagement Intention

Phase 1 Core Team Meeting #3

Date: June 16, 2022
Time: 1:00PM to 3:00PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56703
Prepared by: Dan Speicher/Jacobs
Location: Microsoft Teams
Participants:
Frank Dawson/MC DEP
Stan Edwards/MC DEP
Enrique Lopezcalva/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Paul Moyer/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Khalid Afzal/MNCPPC Planning
Mark Symborski/MNCPPC Planning
Matt Harper/MNCPPC Parks
Erin McArdle/MNCPPC Parks
Matthias Miziorko/MC OEMHS
Tina Laboy/MC OEMHS
Michael Boldosser/MC OEMHS
Daniel Sheridan/MC DOT
Tim Cupples/MC DOT
Mark Etheridge/MC DPS
Adriana Hochberg/MC DEP
Amy Stevens/MC DEP
Krystal Reifer/MC DEP
Claire Iseli/MC OCE
Meredith Wellington/MC OCE
William Musico/MC DPS
Rondez Green
Najila Ahsan/MC DEP

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Item	Time
Introductions	1:00
Meeting Objectives	1:15
Potential Outcomes of Phase 1	1:20
Reviewing Responsibilities, Questionnaire Exercise	1:40
Refine Stakeholders and Means of Communication	2:25
Next Steps	2:55

Potential Outcomes characterized in Session #3

Phase 1: Governance and Data Gaps (6-9 months)

- Recognition of the complicated flooding issue and the generally complex solutions
- Better cross-departmental coordination and collaboration
- Initial community outreach, specifically focused on historically marginalized groups who have received flooding mitigation/recovery resources
- Understanding of flooding history based upon available data and identification of data gaps
- Identification and agreement to organized flooding responsibility structure within the county
- Recommendations for organizational and/or policy change to accomplish the agreed upon responsibility structure

Phase 2a: Countywide data collection, screening level modeling and vulnerability assessment (1-2+ years)

- Understanding of the potential 'spectrum and scale of flooding damage'
- Inventory of flood management infrastructure and the capacity of that infrastructure
- Determine, map , quantify, and characterize what parts of the county are most at risk of flooding
- Priority placed on the recognition and characterization of flooding potential upon socially vulnerable neighborhoods/locations

Phase 2b: Risk Assessments and Alternatives Analysis for Priority Watersheds (1-2+ years)

- Perform watershed studies on highest risk basins to identify critical infrastructure and recognize risk management gaps
- Identify and consider multiple and varied strategies for flooding risk management, including urban green development
- Prioritize projects and resource allocation to decrease risk

Phase 3: Implementation

- Implementation of legislative/ regulatory changes that result in zoning and building codes that provide greater protection from flooding, and are flexible to accommodate future impacts from climate change
- Assure clear communication, awareness, and education to the public
- Improve public safety in response to flooding events
- Revised stormwater management design criteria and standards
- Installation of stormwater and flood management practices and appropriated funding and resources to address the risks

©Jacobs 2022

DEP Responsibilities Questionnaire

Purpose: Designed to gather details of Montgomery County agency current primary and supporting responsibilities across all flooding sources and roles

Completion: **July 5, 2022**

Forward to: Miranda.santucci@jacobs.com

Instructions:

1. Reference the Responsibilities Matrix noting your agency's primary and supporting responsibility (last page of this document)
2. Complete this questionnaire assuring that characterization of your agency's responsibility is completed for all cells noted in the Responsibility Matrix
3. Assure that the complement of completed questionnaires cover the entirety of your agency's responsibility in the matrix
4. Forward completed questionnaire to Miranda Santucci of Jacobs by end of day July 5th (to be reviewed in July 7th session)

Definitions:

For consistency, these are the definitions for 'Roles' and 'Sources'

Roles:

Pro-active Roles								Reactive Roles	
Land Use Planning	**Engineering/ Utilities Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Master planning (land use, master planning, other than water/ wastewater/ stormwater) at the County, watershed, or area plan level	*Engineering planning studies at the system level corresponding to the mission of a specific agency (SW, WW)*	*County-owned infrastructure engineering/ design, review of design submittals*	*Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections*	*In-house and external construction support (stormwater, flood control, and infrastructure projects)*	*Responsibility for determining how infrastructure is operated*	*Maintaining SW infrastructure (ponds, culverts, dams, etc.)*	*Emergency response preparedness role, planning of logistics of response, interagency communications strategy*	*Carrying out response activities, training and conducting drills*	*Supporting post-disaster/ hazard mitigation grant applications*

Sources:

Riverine Flooding *(High stream and river water levels causing regional overbank flooding)*	Not in FEMA floodplain
	In FEMA floodplain
Pluvial/ Interior flooding/Urban flooding/"Lot to Lot" *(flooding due to local rainfall and subsequent surface drainage and/or exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to other public (PG, Howard, Federal lands, County land to parkland and vice versa)
Groundwater flooding *(high GW table causing structure sublevel flooding)*	
Water main break	
Sewer overflow *(backup of sewers due to stormwater inflow from open manholes or cracked pipes)*	

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Engineering/ Utilities Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain										
	IN FEMA floodplain										
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private										
	Entirely on public land										
	From public to private										
	From private to public										
	Public to other public										
Groundwater flooding											
Water main break											
Sewer overflow											

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*
   - Words
   - Words

2. *Characterize your agency's supporting role.*
   - Words
   - Words

3. *What regulations or policies dictate responsibilities or authorities?*
   - Words
   - Words

4. *What codified standard operating procedures structure actions?*
   - Words
   - Words

5. *Describe how external stakeholders are engaged.*
   - Words
   - Words

6. *Describe the funding sources, budgeting, and staff resources.*
   - Words
   - Words

1 = Primary Responsibility 2 = Supporting Influence

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain										
	In FEMA floodplain										
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land										
	Entirely on public land										
	From public to private										
	From private to public										
	Public to other public (PG, Howard, Federal lands)										
Groundwater flooding											
Water main break											
Sewer overflow											

LEGEND MC DEP MNCPPC PLANNING MNCPPC PARKS MC DPS MC OCE MC DOT MC OEMHS

explain the role and limitations of storm drain system
Learn about issues that we may not be aware of
Provide information on flood relief
Gain information on historic flooding impacts from as many residents as possible - building our dataset of historic impacts.
Obtain information about existing drainage or floodong issues
Learn what are the highest priorities for stakeholders
identify problems/ concerns
Provide information on capital improvement projects
comment on impacts to private property as part of remediation projects
Identify source(s) of flooding
provide consistent message about scope and purpose of project to set expectations
inform residents about what they can do to protect their property from flooding
inform County residents about this effort (what it is, what we intend to accomplish)
Learn about the community's understanding of flooding.
identify County residents/ organizations that can help us keep equity front and center of this effort
listen to what they are most concerned about regarding flooding
Educate about types of flooding and evolution of risk with climate change
let the public know that this effort is happening to help protect them
Educate about NFIP and what it is and isn't
Meeting communities where they are
Get different points of view for consideration
Gather site specific information following flood events
Get Buy In
Leverage Data Across Many Institutions.
Overall effort has higher potential for success with support of stakeholders
understand impacts of flooding on various groups (qualitatively)
Identify the locations experiencing flooding and extent/frequency
Hear from (or represent) those that do not typically engage with or influence County activities.
General education on flood risk. Complexity of and important drivers for flood risk.
Understand breadth of impact to residents of various communities and backgrounds to inform future prioritization efforts.
Identify and engage with Socially Vulnerable communities' representatives and advocates
Give stakeholders an opportunity to be heard
General education/ management of expectations w.r.t. the objectives, outcomes, and timeline of the Comprehensive Flood Management Plan

Phase 1 Core Team Meeting #4

Date:	July 7, 2022
Time:	1:00 to 3:00 PM
Project name:	Comprehensive Flood Management Plan Phase 1
Project no:	E4X56703
Prepared by:	Dan Speicher/Jacobs
Location:	Microsoft Teams
Participants:	Miranda Santucci/Jacobs Dan Speicher/Jacobs Laurens van der Tak/Jacobs Steph Marvin/Jacobs Paul Moyer/Jacobs Frank Dawson/MC DEP Krystal Reifer/MC DEP Amy Stevens/MC DEP Cindy Marie Pena/MC DEP Rachel Whiteheart/MC DEP Kristina Campbell/MC DEP Khalid Afzal/MNCPPC Planning Matt Harper/MNCPPC Parks Erin McArdle/MNCPPC Parks Tina Laboy/MC OEMHS Michael Boldosser/MC OEMHS Daniel Sheridan/MC DOT Mark Etheridge/MC DPS Claire Iseli/MC OCE Meredith Wellington/MC OCE Mercy Iyere/Nspiregreen Laura Connelly/Nspiregreen Karen Armendariz/Nspiregreen Ben Carlson/Nspiregreen

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this Stakeholder As-Is meeting is to review the stakeholder engagement strategy, to share a summary of the interviews, review the as-is framework, and reflect further upon the current roles and regulations.

Summary of Discussion

Introductions & Meeting Objectives

- Mural was used to facilitate discussion. Key outputs of the workshop, captured from Mural, have been included as **Attachments A, B and C.**

Stakeholder Engagement

- Nspiregreen gave an overview of the objectives of the Project's Stakeholder Engagement (see **Attachment B: Stakeholder Engagement**), which include the following:
    - Identify the locations experiencing flooding and extent/frequency
    - Hear from those who do not typically engage with or influence County activities, especially from those who are from socially vulnerable communities
    - Provide general education on flood risk and complexity of its important drivers
    - Understand the breadth of impacts
- Additional sources of feedback include
    - 311 calls, which can be filtered by removing general information requests
    - 911 calls from those who were stranded on the road
- Stakeholder Groups identified by Nspiregreen and the Core Team:
    - Housing and food assistance – CASA, Catholic charities
    - Local environmental organizations – CAP groups, watershed groups and stormwater partners
    - Places of worship – Canaan Church, as an example
    - Racial Justice and Equality – Overlay of County Equity Focus Areas
    - Library Associations – as a potential location for surveys
    - Home-Owner Associations
    - Recreation Centers
    - Health groups - through HHS
    - Schools – Connect with Montgomery County Public Schools communications to leverage existing channels of communication
    - Office of Community Partnership
    - Climate Action Plan organizations. DEP/Nspiregreen
    - Citizen Advisory Boards
    - Civic associations, local governments that are subject to County
    - Community Partners/advisory groups – to help make connections, visit https://www.montgomerycountymd.gov/partnerships/advisory-groups/index.html
- Communication Vehicles:
    - Citizen Advisory Boards, all 5 send out newsletters
    - MC DOT website, Twitter
    - Social media
    - MCPS
    - County and County Executive newsletters
    - Executive committees - diverse communities
    - GovDelivery – massive contact list to send reminders of trash pick-up
    - Neighborhood listservs and Nextdoor

    - For popups: County Fair,
      Wheaton event in September,
      Poolesville Day on 9/17,
      Community festivals

- To collect this feedback, spatial surveys and in-person pop-ups for those without tech access will be utilized.
- Surveys
    - Nspiregreen mentioned that the surveys could be pre-populated to help give community groups an idea of where there are current issues. It was noted that participants will be encouraged to report an issue even if it had been previously reported.
- Pop-ups
    - Ideally located where the public will have a good opportunity to attend and where there are high concentrations of people from vulnerable communities.
    - The set up can vary. One example is a booth that includes large posters. To help publicize spatial survey, Nspiregreen can place enlarged maps on easels for participants to stick notes on. Input can also be collected via a tech map.
- In considering reaching out to the Press to raise awareness of this effort, Jacobs will coordinate with DEP (Cindy Marie Pena), keeping in mind the sensitive nature of the issue amidst the election season.

Review as-is framework

- Jacobs presented a heat map of 311 calls (see **Attachment C: Historic Impacts in Heat Map**) made in the County.
    - Calls for general information requests were filtered out
    - Color scheme reflects the density, i.e., the number of calls per acre. The darker the color, the more calls per square mile area
- Can overlay over stormwater infrastructure information to help prioritize future watershed assessments and may help also with projections of future flooding.

Reflect upon current roles and regulations

- Jacobs presented two working spreadsheets (Matrix-ROLES [See **Attachment D: Roles/Responsibilities Matrix**] and Matrix-REGS), the first capturing existing conditions of the Core agency roles as reflected in the Mural as well as any gaps in primary roles in flood management, and the second, regulations that guide agencies and give authority to address flooding for pro-active and reactive roles.
- Cells with more than one primary agency solicited further discussion.
- It was noted that the Matrix would be updated to reflect the answers to the questionnaires that were recently submitted to Jacobs from each of the Core agencies.

Action Items

- DEP to provide list of watershed groups and stormwater partners to Jacobs.

Attachments

A. Stakeholder Engagement

B. Historic Impacts in Heat Map

C. Roles/Responsibilities Matrix

6

30 MINUTES

STAKEHOLDER ENGAGEMENT

Roles, intention, forums, targets, materials

DEFINITION

Individual residents and/or organizations located within the County that may:
- provide historical flooding impacts
- represent individuals or organizations who have experienced flooding
- have influence upon the County's definition and/or direction associated with flooding
- be influenced by the County's decisions and direction concerning flooding

INTENTION OF ENGAGING

ROLES

- Jacobs
- NSpire Green/CH Planning
- DEP and County Communications

Purpose of engagement

Spatial Survey

- Design a spatial survey / interactive map that asks participants the following:
  - Where have you experienced flooding in your neighborhood, work area, or other recreation location?
  - How these experiences with flooding have affected their quality of living?
- Supplement already available data such as FEMA Flood Risk Data, 311 calls, etc.

In-person Pop-ups

- 6 pop-ups at busy areas around the county or by partnering up with community organizations.
- Educational posters that provide information about:
  - What is flooding?
  - Flooding Safety
  - Preparing for Flooding
- Conducted to supplement online map with in-person outreach that can help reach:
  - Individuals with English Limited Proficiency
  - Individuals with lack of internet
  - People of Color, People with Low-income

Community events (Poolesville Day, Wheaton Event, County Fair)

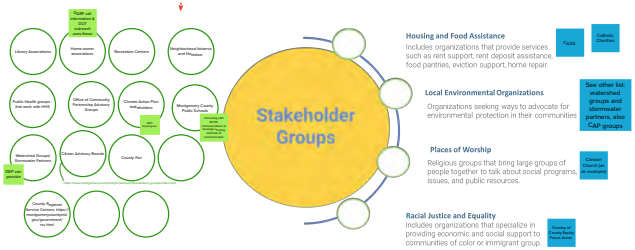
Community Forums

- 2 Virtual 90-minute meetings
- First half: flooding education and information about the Flooding Management Plan Project
- Second half: Break out rooms to gather qualitative narratives about resident's experience with flooding. This data will supplement quantitative data gathered throughout the data gathering phase.

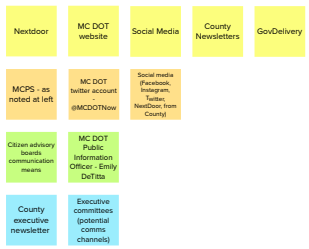
Platforms

- Virtual Forum: Webex or Teams
- In-person pop-ups: events hosted by community groups, transit stations or bus stops, grocery stores, parks, community fairs or festivals.
- Mapping: Wikimapping, Mapsocial, ArcGIS Hub

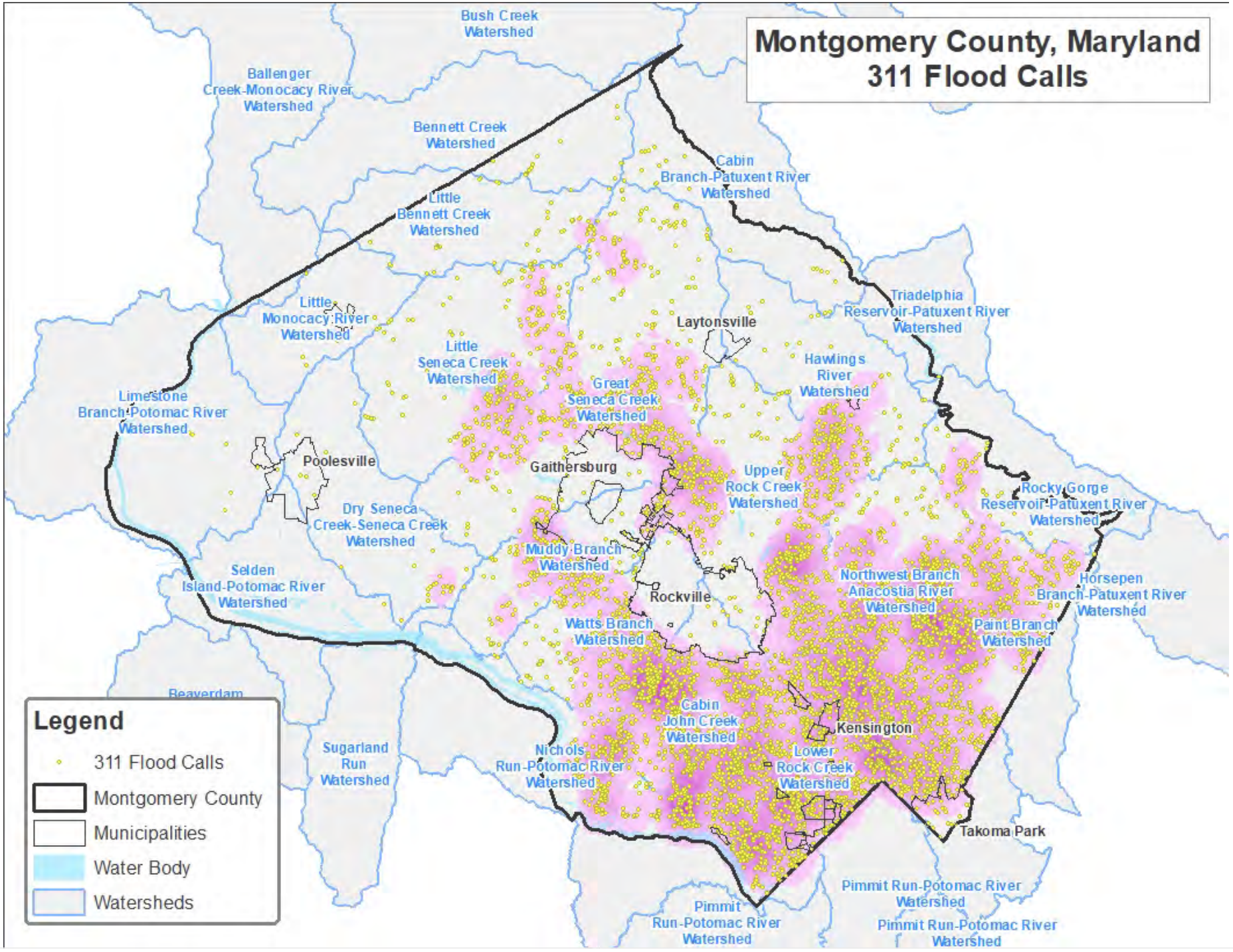
What additional categories of Stakeholder Groups?



What additional resources and/or communication vehicles exist?



Historic Impacts in Heat Map



Roles/Responsibilities

		Land-Use Planning		Stormwater/Flood Infrastructure Planning		Design/Engineering		Permitting		Construction Support		Operations		Maintenance		Preparedness		Response		Recovery	
		Roles																			
	Flooding Source	Primary	Support	Primary	Support	Primary	Support	Primary	Support	Primary	Support	Primary	Support	Primary	Support	Primary	Support	Primary	Support	Primary	Support
Riverine Flooding	Not in FEMA floodplain	MC DEP1	MC DEP MC OCE MNCPPC Planning	MC DEP1	MC DEP MNCPPC Parks11	MC DEP		MC DPS MNCPPC Parks11, 12	MC DEP	MC DEP	MC DPS MNCPPC Parks11	MC DEP	MNCPPC Parks11	MC DEP		MC DEP		MC DEP MNCPPC Parks11 MC OCE	MC DEP MC OCE MNCPPC Parks	MC DEP	MC DEP MNCPPC Parks11
	In FEMA floodplain	MNCPPC Planning	MC DEP MC DEP1 MC DPS MC DPS	MC DEP	MC DEP MNCPPC Parks11	MC DEPS	MC DEP MNCPPC Parks11	MC DPS MNCPPC Parks11, 12	MC DEP	MC DEP	MC DPS MNCPPC Parks11	MC DEP7 MC DEP MNCPPC Parks11		MC DEP9 MC DEP MNCPPC Parks11		MC DEP10 MC DEP MNCPPC Parks11		MC DEP MC OCE MNCPPC Parks11	MC DEP MC OCE MNCPPC Parks	MC DEP MC OCE MNCPPC Parks11	MC DEP MC OCE
Pluvial/Interior/Lot-to-Lot Flooding	All Private Land	MC DEP2 MNCPPC Planning	MC OCE	MC DEP	MNCPPC Planning3		MC DEP6	MC DPS MNCPPC Parks11, 12	MC DEP	MC DEP	MC DPS MNCPPC Parks11	MC DEP8		MC DEP8	MC DEP8		MC DEP	MC DEP MC OCE MNCPPC Parks11	MC DEP MC OCE MNCPPC Parks	MC DEP MC OCE MNCPPC Parks11	MC DEP MC OCE
	All Public Land	MC DEP2 MNCPPC Planning	MC DEP MC OCE	MC DEP	MNCPPC Planning4 MNCPPC Parks11	MC DEP MNCPPC Parks11		MC DPS MNCPPC Parks11, 12	MC DEP	MC DEP MNCPPC Parks11	MC DPS MNCPPC Parks11	MC DEP MNCPPC Parks11	MC DEP8	MC DEP MNCPPC Parks11	MC DEP8	MC DEP MNCPPC Parks11		MC DEP MNCPPC Parks11 MC OCE	MC DEP MC OCE MNCPPC Parks	MC DEP MNCPPC Parks11	MC DEP MC OCE
	From Public to Private	MC DEP2 MNCPPC Planning	MC DEP MC OCE	MC DEP		MC DEP MNCPPC Parks11		MC DPS MNCPPC Parks11, 12	MC DEP	MC DEP MNCPPC Parks11	MC DPS MNCPPC Parks11	MC DEP	MC DEP8	MC DEP MNCPPC Parks11	MC DEP8	MC DEP MNCPPC Parks11		MC DEP MNCPPC Parks11 MC OCE	MC DEP MC OCE MNCPPC Parks	MC DEP MNCPPC Parks11	MC DEP MC OCE
	From Private to Public	MC DEP2 MNCPPC Planning	MC OCE	MC DEP	MNCPPC Planning	MC DEP MNCPPC Parks		MC DPS MNCPPC Parks11, 12	MC DEP	MNCPPC Parks	MC DEP MC DPS MC DPS		MC DEP8		MC DEP8		MC DEP	MC DEP MC OCE MNCPPC Parks	MC DEP MC OCE	MC DEP MNCPPC Parks
	From Public to Public	MNCPPC Planning	MC DEP		MC DEP	MC DEP MNCPPC Parks13		MNCPPC Parks11,12	MC DEP MC DPS		MC DEP MC DPS MNCPPC Parks13		MC DEP		MC DEP		MC DEP	MC OCE	MC DEP MC OCE MNCPPC Parks13	MC DEP	MC DEP MNCPPC Parks13
	Groundwater Flooding									MC DEP				MC DEP				MC DEP MC OCE	MC DEP MC OCE	MC DEP	MC DEP
	Water Main Break								MNCPPC Parks		MC DEP				MC DEP				MC DEP MC OCE MC OCE MNCPPC Parks	MNCPPC Parks	MC DEP MC OCE
	Sewer Overflow								MNCPPC Parks		MC DEP				MC DEP				MC DEP MC OCE MC OCE MNCPPC Parks	MNCPPC Parks	MC DEP MC OCE

Color Legend

- MC DEP
- MNCPPC Planning
- MNCPPC Parks
- MC DEPS
- MC OCE
- MNCPPC
- MC DEP/MC

Footnotes

1 Moving towards primary roles for some initiatives (USACE, DOD)
2 Watershed studies/water quality
3 Via regulatory approval of site plans
4 Via mandatory referral approvals by the Planning Board (advisory only)
5 County High Hazard Dam (Wheaton); Dam portion design
6 Rainscapes quality focused
7 County High Hazard Dam Operations
8 SW Facility
9 County High Hazard Dam Maintenance
10 County High Hazard Dam Preparedness
11 Parks' role only applies on Parkland
12 Issue park permits
13 County land to parkland and vice versa

Phase 1 Core Team Meeting #5

Date:	July 28, 2022
Time:	1:00 to 3:00 PM
Project name:	Comprehensive Flood Management Plan Phase 1
Project no:	E4X56704
Prepared by:	Steph Marvin/Jacobs Miranda Santucci/Jacobs Dan Speicher/Jacobs
Location:	Microsoft Teams
Participants:	Stan Edwards/MC DEP Miranda Santucci/Jacobs Dan Speicher/Jacobs Laurens van der Tak/Jacobs Steph Marvin/Jacobs Paul Moyer/Jacobs Khalid Afzal/MNCPPC Planning Mark Symborski/MNCPPC Planning Matt Harper/MNCPPC Parks Erin McArdle/MNCPPC Parks Daniel Sheridan/MC DOT Mark Etheridge/MC DPS Amy Stevens/MC DEP Adriana Hochberg/MC DEP Krystal Reifer/MC DEP Claire Iseli/MC OCE Ho-Ching Fong/MC DEP Darian Copiz/MC DEP Karen Armendariz/Nspiregreen Frank Dawson/MC DEP Matthias Miziorko/MC OEMHS

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this Core Team meeting is to review the stakeholder engagement and data of current conditions towards comprehensive flood management. This meeting is the fifth Core Team Workshop, delivered as part of Task 4.1 of the Comprehensive Flood Management Plan Phase 1 work (Task Orders #3 and #4 of Contract 1127041). Five additional Core Team Workshops are planned to follow this meeting.

Summary of Discussion

Introductions & Meeting Objectives

DEP shared request to focus on next steps for watershed assessments.

Stakeholder engagement (see Attachment A)

Karen Armendariz (Nspiregreen) presented a definition of stakeholder to include individual residents and/or organizations located with the County that may: provide historical flooding impacts, represent individuals or organizations who have experienced flooding, have influence upon the County's definition and/or direction associated with flooding, and be influenced by the County's decision and direction concerning flooding.

She gave an overview of the public engagement which will include a survey that will be administered in person and virtually, described the outreach pop-ups which will be in five locations around the County, shared virtual forum dates and the proposed agenda, and reviewed the roles/responsibilities of the Consultant Team and County. The goal is to reach those who may not already engage in discussion on flooding with the County as other population groups. Multi-lingual staff will be present. Locations were

selected by a combination of factors: high risk of flooding, where 311/911 calls originated from, and where vulnerable populations might be.

Pop-up locations suggested by Core team included East County locations, such as Wheaton mall/Costco in White Oak, and in areas that would reach those hard-hit communities who don't call 311.

Impacts (see Attachment B)

Understanding the historic occurrence of flooding provides a recognition of the influence of that flooding and insight into what areas within the County are most impacted.

Regulations/Policies (see Attachment C)

Review of the current regulations and policies across sources and roles provides an understanding of what actions are required and who is responsible for those actions. They serve as drivers for action.

Planning: 2007 State legislation passed a law saying that all comprehensive plans (like the general plan) must include a water resources element (WRE). The element must have language with respect to adequate water supply and sewage treatment capacity for existing and future development, receiving streams, stormwater management, flood control and water quality. Water Resources Functional master plan (how Planning amended comprehensive plan) described all the roles of different agencies that met the intent of the WRE. State has recently updated WRE guidance. Local jurisdictions anticipate updating water resources plans (for Montgomery County, the Water Resources Functional master plan) to address new guidance with climate change and equity concerns. Planning is responsible for updating the existing plan and the CFMP will be reflected in it.

Responsibilities (see Attachment D)

Clarity of primary and supporting responsibilities across sources and roles provides a collective understanding of the extent of the County's flooding focus.

Levels of Service (see Attachment E)

Levels of capacity dictated in regulations and policies. Core Team was encouraged to review.

Action Items

Mark Symborski (Planning) to send Miranda (Jacobs) flood aspect of Water Resources Element Guidance.

Attachments

A. Stakeholder Engagement

B. Impacts

C. Regulations/Policies

D. Responsibilities

E. Levels of Service

STAKEHOLDER ENGAGEMENT

Roles, intention, forums, targets, materials

DEFINITION

Individual residents and/or organizations located within the County that may:

- provide historical flooding impacts
- represent individuals or organizations who have experienced flooding
- have influence upon the County's definition and/or direction associated with flooding
- be influenced by the County's decisions and direction concerning flooding

INTENTION OF ENGAGING

ROLES

- Jacobs
- NSpire Green/CH Planning
- DEP and County Communications

A

Public Engagement Overview

- **Purpose** of the engagement is to gather geographic and qualitative data from the community to supplement data collected from existing data sets.
- Additionally, public engagement will include educational materials to help the community understand the causes of flooding, potential approaches to addressing flooding and flood management strategies.
- The Public Engagement Plan includes 3 primary activities:
  - Survey
  - In-person pop-up events (5)
  - Virtual Community Forums (2)

B

Survey

- Survey will be administered both in person and virtually.
- Virtual survey will be conducted through an online tool that allows residents to answer some questions and mark on a map location of flooding events that they have encountered/experienced.
- Hard copy versions of the survey will be available at the in-person pop-ups. Participants will also have the option to use a table at this pop-ups to complete the survey.

C

In-person Pop-Up Events

- Consultant team will conduct up to 5 pop-up events in locations around the county.
- Pop-ups will include (poster and handouts) including maps, educational materials, and other supporting materials.
- Consultant team will have 3 staff at each pop-up event.

D

Potential Locations

- **Gaithersburg (1)**
  - Montgomery Village Crossing (Ethnic market with East Asian and African stores)
  - Gaithersburg Farmers Market
- **Germantown (1)**
  - LOTTE Plaza Market (African and Latino stores + other restaurants)
- **Olney (1)**
  - Olney Farmers and Artist Market
- **Pop-up with Community Organizations (2)** - These pop-ups will consist of working with these community organizations to host pop-ups at their office or be guests at any events already planned by those organizations.
  - Ethiopian Community Center (Silver Spring)
  - CASA (Rockville)

Link to impacts as per the 311 calls

east county locations should be part of this

Wheaton mall/ costco might be a potential / white oak / ensure coverage

language capability

E

Other options

- Silver Spring Arts and Crafts End of Summer Celebration: September 11, 2-7 pm. Veterans Plaza.
- Bethesda Metro Station
- Rockville Farmers Market
- Aspen Hill Shopping Center
- Hot Air Balloon Festival September 17 and 18
- Hillandale Shopping Mall
- Gaithersburg Community Flea Market and Marc Rail Station
- 30th annual Poolesville Day festival: September 17 10:00 am to 4 pm

F

Virtual Community Forum

- Zoom Virtual Meeting – September 27
- Zoom Virtual Meeting - October 10

The consultant team will work with DEP's communications team to set up the Zoom meetings using DEP's Zoom account.

G

Proposed Agenda

6:30 – 6:35 pm	Setting in
6:35 – 6:50 pm	What is a floodplain and how does it affect Montgomery County? General education about flooding, the 100-year floodplain, and projections for the County. [Presentation materials done by Nspire/green and Jacobs]
6:55 - 7:15 pm	Flooding Management Plan & Findings of Existing Conditions
7:15 - 7:45 pm	Presenting information about the Flooding Management Plan Process Information from what was learned during the first phase, primarily what the county is doing regarding flooding. [Presentation materials done by Jacobs]
7:45-7:55 pm	Breakout groups: Flooding in your neighborhood?
7:55- 8:00 pm	Debrief Next steps and adjourn

H

Roles and Responsibilities

Consultant Team

- Consultant team will develop materials for all public engagement events following the County standards.
- Translate materials into Spanish
- Staff all public engagement events
- Coordinate dates and locations with County Staff/ County

County

- Create and host project website.
- Disseminate project information and advertising materials across social media, website and stakeholder lists
- Review advertising, all public engagement materials.

IMPACTS

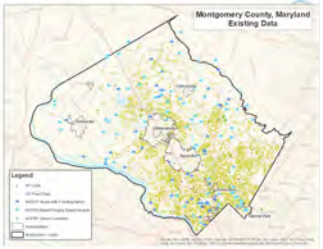
Flooding Data

Impacts

Understanding the historic occurrence of flooding provides a recognition of the influence of that flooding and provides insight into what areas within the County are most impacted.

Several data sets have been collected to characterize historic flooding impacts

- Flooding event calls (311 and 911) and frequently flooded locations (MCFRS, DOT)
  - 911 flood calls from December 4, 2020 through June 2, 2022 (22 calls)
  - 311 flood calls from January 19, 2010 to June 3, 2022 (8,912 calls)
- County 311 calls provide some insight into call type/likely source
  - Limitations in presenting impact by all residents, particularly those who are renters/more transient, are unfamiliar with County services, lack accessibility to the Internet, and/or do not speak English
- Gaithersburg and Rockville do not maintain this type of searchable information

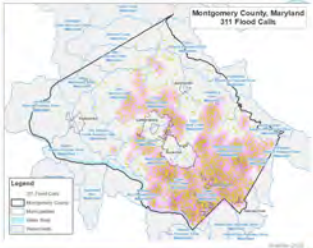


MC311 call data for drainage and flooding issues was generalized according to type of call

- Calls were generalized using the identified solution type
- Calls related to maintenance and information are 87% of all calls
- The remaining 13% are roadway (2%), private property (4%), lot-to-lot (6%)and groundwater flooding (1%) calls

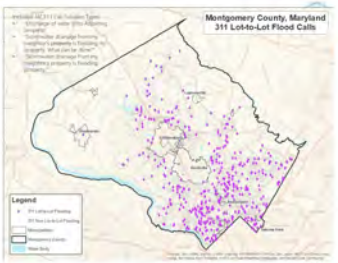
Calls to 311 related to flooding and drainage issues mapped according to call density per acre

- Calls were filtered to remove those related to general information requests and maintenance issues
- The pink color is varied to indicate density of calls (calls/acre) across the area (the darker the color, the higher density of calls)
- Call density is greatest in the southern areas of the County



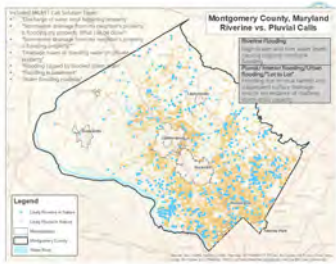
Plotting 311 calls that are identified as likely lot-to-lot

- Of the 8,912 311 calls, 6% can be identified as private lot-to-lot flooding
- Indicates a concentration of this type of call in more urban/impervious and earlier-developed areas



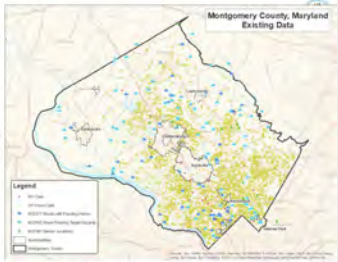
Using stream proximity to categorize calls as "likely riverine" vs. "likely pluvial"

- Approximately 15% of calls are in within 100 feet of a stream – "likely riverine" (blue)
- Approximately 85% of calls are located more than 100 feet from a stream – "likely pluvial" (yellow)
- Explore:
  - Relative impact (significant damage, health & safety issues vs. nuisance flooding) not indicated with these data
  - Impacts not captured by 311, part of planned community engagement



Historic flood impacts assessment & vulnerabilities - next steps to inform prioritization of Phase II activities

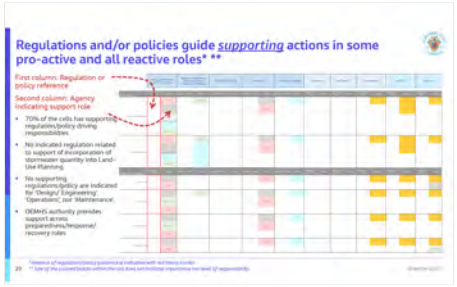
- Gather additional data through community outreach
- Develop watershed level summaries of historic impacts, including summaries of impacts to socially vulnerable areas
- Develop watershed level summary of vulnerabilities using available information (critical facilities, environmental areas, commercial areas, etc.)
- Serves to define Phase II assessment



10

REGULATIONS/POLICIES

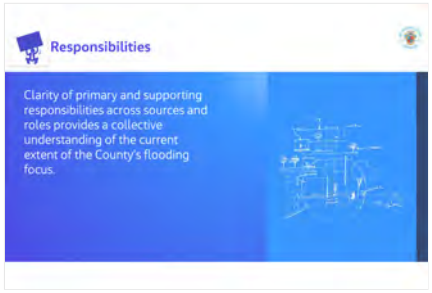
Items that drive responsibilities



11

RESPONSIBILITIES

Primary and supporting activities



12

LEVELS OF SERVICE (new)

Levels of capacity dictated in regulations/policies

Initial look at level of service across agency regulatory

Notes:

1. Stormwater management practice control volumes vary, but generally fall at or below the pre-development 1-year 24-hour storm event. [MDE Stormwater Management Manual Chapter 2 Unified Sizing Criteria]
2. M-NCPPC Parks Site Design Criteria not yet reviewed, presently presumed to follow MCDOT guidance for pavement drainage, storm drain, culvert, and bridge sizing criteria.
3. Bridges are assumed to fall primarily into the "within County/FEMA floodplain" category for riverine flooding source. Thus 100-year capacity requirements, applying to bridges, are shown only in these cells.
4. Activities within the "pluvial" flooding category are assumed to be specific to design/permitted infrastructure outside the County/FEMA floodplain. I.e. for the "All public land" category, it is assumed this is "All public land outside the County/FEMA floodplain" in order to more clearly denote level-of-service related solely to stormwater management sized for pluvial impacts only.

- 100-year capacity
- 50-year capacity
- 25-year capacity
- 10-year capacity
- 1-year capacity

	Land-Use Planning	Stormwater/ Flood Infrastructure Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding										
Not in County/FEMA floodplain		MC DEP	MC DEP	MC DPS	MNCPPC Parks	MNCPPC Parks	MNCPPC Parks	MC DEP	MNCPPC Parks MC OCE	MNCPPC Parks MC DEP
In County/FEMA floodplain		MC DEP	MC DEP	MC DPS MNCPPC Parks	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP MC OCE	MNCPPC Parks MC DEP
Pluvial/Lot-to-Lot Flooding										
All Private Land		MC DEP	MC DEP	MC DPS	MC DEP	MC DEP	MC DEP	MC DEP	MC DOT MC OCE	MC DEP
All Public Land		MC DEP	MC DEP	MC DPS MNCPPC Parks	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP MC OCE	MNCPPC Parks MC DEP
From Public to Private		MC DEP	MC DEP	MC DPS MNCPPC Parks	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP	MNCPPC Parks MC DEP MC OCE	MNCPPC Parks MC DEP
From Private to Public		MC DEP	MC DEP MNCPPC Parks	MC DPS MNCPPC Parks	MC DEP MNCPPC Parks	MC DEP	MC DEP	MC DEP	MC DOT MNCPPC Parks MC OCE	MC DOT MC DEP

©Jacobs 2022

Phase 1 Core Team Meeting #6

Date: September 15, 2022
Time: 1:00 to 3:00 PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56704
Prepared by: Steph Marvin/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Location: Microsoft Teams
Participants: Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Khalid Afzal/MNCPPC Planning
Mark Symborski/MNCPPC Planning
Matt Harper/MNCPPC Parks
Erin McArdle/MNCPPC Parks
Daniel Sheridan/MC DOT
Mark Etheridge/MC DPS
William Musico/MC DPS
Stan Edwards/MC DEP
Steven Shofar/MC DEP
Amy Stevens/MC DEP
Darian Copiz/MC DEP
Krystal Reifer/MC DEP
Ho-Ching Fong/MC DEP
Adriana Hochberg/MC DEP
Rachel Whiteheart/MC DEP
Najila Ahsan/MC DEP
Kristina Campbell/MC DEP
Frank Dawson/MC DEP
Cindy Marie Pena/MC DEP
Claire Iseli/MC OCE
Meredith Wellington/MC OCE
Kristina Laboy/MC OEMHS
Maryam Akhavan/MC OEMHS
Matthias Miziorko/MC OEMHS
Michael Boldosser/MC OEMHS

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this Core Team meeting is to review ten high-level observations of the County's existing conditions towards comprehensive flood management. This meeting is the sixth Core Team Workshop, delivered as part of Task 4.1 of the Comprehensive Flood Management Plan Phase 1 work (Task Orders #3 and #4 of Contract 1127041). Four additional Core Team Workshops are planned to follow this meeting.

Summary of Discussion

Introductions & Meeting Objectives

Workshop flow/date changes

- Jacobs noted that several changes to workshop dates have been made to support generating pieces of the final deliverable reports (interim deliverables) that will help document the engagement process. The noted schedule revisions are included in the Mural canvas (**Attachment B: Mural – Approach for remaining sessions**).

Existing conditions memo

- Jacobs presented ten main observations on the County's existing conditions regarding comprehensive flood management, summarized from input gathered from interviews and meetings with Core, Advisory, and Informing agencies, regulations, and reports for feedback from the Core Team. Refer to **Attachment C: Mural – Observations**. Core Team was asked to indicate their agreement or disagreement in the Mural sessions.
- Regarding Observation 7: *County currently has limited ability to incorporate knowledge of recurrent flood impacts in permitting and development reviews.*
    - DEP: Since we don't know all the areas impacted by pluvial events and to what extent, we are unable to incorporate them into permitting reviews.
- Overall Response
    - Planning is in general agreement with the 10 observations.
    - DEP: The County agencies (County) have a different viewpoint from residents: the County takes a systematic approach, while residents look at flooding at a micro level. The County does not have the resources and staff to look at property-to-property issues, but residents believe government should provide solutions that address those local flooding issues.
    - OCE: Planning Dept has always relied on stormwater management concepts that come from DPS. Climate change is changing the landscape. People are concerned that in development (like in Kensington), regulations focus on quality and not quantity. One big area of complaint involves a development in Pike and Rose, where there was an improvement to the old Toys 'R Us parking lot but it increased quantity of runoff into Old Farm Creek, which caused devastating damage. Pieces are there to figure out what's not working. These observations are helpful.
    - Planning: Historically, we've addressed stormwater management quality. General Plan will speak to infill/redevelopment/existing sites. There remains concern for lot-to-lot flooding. Planning Dept. is looking to this CFMP study to determine how Planning will manage that.
    - DPS: In agreement with Planning. A lot of problems we have are in bad engineering in subdivision but also caused by individuals – companies, property owners – who are not committing crimes (i.e., in violation of regulations). A lot of times, it's a periodic change – such as flipping a house in an old community and raising it – that causes downstream runoff. DPS is limited in what they can do. The individual perceives the problem is caused by the adjacent property owner.
    - DEP: We have more severe storms that we are now dealing with. People perceive flooding in their basement as due to the uphill property and believe County government should have had something in place to stop it from being built.
    - OCE – Excited to hear discussion surrounding lot-to-lot drainage. However, some of the worst flooding problems are occurring in streets and are more universal. Not sure there is a single way to address both problems.

- DEP – Addressing water quantity will help address water quality. They're not mutually exclusive. Addressing issues from larger perspective: storm drains, addressing flooding at source, etc., will do a lot to address localized, lot-to-lot flooding. And letting the community know that's what County is addressing will help.
- DEP – To respond to OCE's comments, ultimately, more detailed studies will be needed at a watershed scale to understand the cause/effect of flooding. That's the next step in this process. Between now and then, there's a lot of speculation as to cause. We need to do studies almost everywhere in the County.
- Planning: Even with comprehensive watershed studies, there will always be flooding events due to storms that are unpredictable with regard to location, intensity, and duration. So it will be necessary for all to come to grips with this fact. Associated with this will be the need to educate the public regarding this. For example, flooding that follows a redevelopment may not be due to the redevelopment, but a storm event of a severity that we have not seen there before.
- DOT: The comprehensive study would identify sub-areas within a watershed that are more vulnerable to flooding.
- DEP: Related to Planning's comment, the general public has limited ability to understand the magnitude of different rain events. There are "heavy storms" that result in significant rainfall over short durations that may result in worse impacts than rainfall associated with a hurricane.

Discussion of Comprehensive Flood Management Outcomes Framework

- Jacobs presented a framework of outcomes intended to provide a structure for defining a potential "to-be" flood management condition for the County. The presented framework consists of 18 outcomes necessary for comprehensive management of flood risk. Within each outcome are capability statements that provide a selection of specific capabilities or solutions associated with the outcome (see **Attachment D: Mural – Flood Management Plan Framework: Outcomes, Capabilities Ratings**).
- As each outcome was discussed, Core Team stakeholders were asked to collectively rank both current performance (Performance and Importance columns were ranked by Core Agencies collectively; see **Attachment E: Mural – Flood Management Plan Framework: Scatterplot**).

- **Outcome No. 1: Asset management principles from inventory to condition assessment to levels of service standards are applied**.
    - Parks and DEP noted that a lot of asset data is available via the MS4 program.
    - DOT inquired regarding the mention of "likelihood of failure" in Statement 1.3 and "risk of failure" in Capability 1.4. DOT noted that while the location of storm drains and culverts are generally known, condition information is not. It is known there is a large amount of aging corrugated pipe and DOT has conducted analyses to help locate high risk pipes. Jacobs replied that, in the instance of Capability 1.3 the "likelihood of failure" is an asset condition characteristic, related to the age and material of the asset. Risk of failure mentioned in Capability 1.4 is related to the use of that information to perform rehabilitation and replacement projects. There is a separate Outcome and Capabilities related to generating that information.
- **Outcome No. 2: Flood risk data and analyses are developed, maintained, and readily accessible.**
    - DEP: No more than a score of 2 in Performance; Importance is at least a score of 4 because we are talking about risk to populations.

- **Outcome No. 3: County has emergency management plan for all critical facilities in flood zones.**
    - DEP: We do this pretty well. Critical dams (4-5 in Performance). Not a lot of urgency to improve but 3 in importance because if you have a dam failure, that's a big issue.
- **Outcome No. 4: Emergency response plan includes early warning systems for high-risk areas.**
    - DEP: We have a good system for alerting people, but whether or not people take advantage of that is optional.
- **Outcome No. 5: Financing options are well defined and communicated.**
    - DEP: We do a lot of financing on stormwater management facilities but not on flooding facilities. Room to improve, Performance is a 2. Urgent need to figure this out.
- **Outcome No. 6: Flood risk and mitigation information is easily accessible, widely disseminated, and uniformly utilized by all County agencies.**
    - DEP: We have lots of room to improve. Level 4-5 urgency.
    - DPS: We have lots of room to reform/improve in outreach.
- **Outcome No. 7: Flood risk and mitigation information is communicated easily, widely, and uniformly to the public.**
    - DEP: Extremely important and lots of room to improve.
- **Outcome No. 8: Urban Flood Zones/ Riverine Floodplain are defined/mapped.**
    - DEP: A lot of room to improve in urban flooding.
    - DPS: We have a process when a map is required. But should they be mapped? We are in a developed County. Cost of mapping of that many miles of streams… Performance: 2. Importance: Low.
    - DEP: Capability 8.2 – requires modeling in small watersheds which has not been done.
    - DEP: Think it's very important. Urgent (5).
    - Planning: Has land-use planning implications. Very important.
- **Outcome No. 9: County budget and staffing needs are clearly understood.**
    - DEP: We don't have a funding mechanism.
- **Outcome No. 10: Flood risk management roles/responsibilities and overall governance structure are clearly understood for whole infrastructure/development life cycle.**
    - DEP: Performance (2). Urgent (5). If we don't get this one figured out, we'll be ineffective in the others.
- **Outcome No. 11: CIP incorporates flood mitigation needs.**
    - DEP: Performance (1), Urgent (5).
- **Outcome No. 12: Comprehensive land use plans reflect flood risk.**
    - DEP: Performance (1-2), Critically important.
    - Planning: 12.1: Need to distinguish the General Plan from Thrive Montgomery 2050. The General Plan is Thrive Montgomery as amended by the other functional master plans. Nuance. Suggest re-wording: "County master plans" incorporate flood risk information, instead of "General plans".
- **Outcome No. 13: Development/redevelopment standards and building codes are updated to reflect LOS goals and current/future climate.**
    - DEP: Performance (1). Standards are not keeping up. Greater urgency to look at this as soon as possible.
    - Planning: LOS data is not established which is critical.
- **Outcome No. 14: Insurance options are well-defined and communicated.**

    - DEP: We don't know level of flood insurance due to it being a private choice. We are reaching out to let community know they can get flood insurance. Performance (2), Importance (3).
    - OEMHS (in chat): We do have the ability to find out how many flood insurance policies are in effect in the County.
- **Outcome No. 15: O&M is proactive to maintain LOS for all high-risk areas.**
    - DEP: O&M has done well with the resources that the County has, but we need more resources. The issue is more LOS than maintenance. DEP also highlighted that stormwater inspections occur every 3 years by permit and not annually.
- **Outcome No. 16: Clear permit process and enforcement of Development/Redevelopment Standards reflecting flood risk.**
    - DPS: Done well (4). There's always a possibility of a plan being snuck through such as a small house adjacent to a small stream – the engineer hasn't alerted DPS to the risk, a human-error risk. The policies and procedures in place are very good at catching redevelopment issues; example: when a delineation study is required, provided initial information is given to DPS.
    - DEP: People are complying with laws and regulations, but County regulations aren't keeping up with the times. It's more an updating of standards issue.
    - DPS: When DPS directs action that is outside their regulatory authority, they receive pushback/quick correction.
    - Planning: Most development projects are reviewed and approved by planning board. Process is there but as DEP said, what Planning is required to review is constrained by regulations we have now.
    - DPS: Higher regulatory standard can be a double edge sword – the Drainage Ordinance, for example. Sometimes there are unintended consequences.
- **Outcome No. 17: Co-benefits of flood management are integrated in the permit review process.**
    - DEP: In response to Capability 17.1, noted that there is currently no flood risk management program. Water quality vs. flood management is more of a "Standards issue" than a "process issue." Importance (5).
    - Planning: We do well for new development.
    - DPS: Think we want to separate water quality from quantity improvements. Quality is targeted at smaller storms. Flood risks are an order of magnitude more. Water quality shouldn't be integrated with flood risk – two competing programs with competing interest.
    - Jacobs noted that there are co-benefits due to flood management and water quality can be one of them. For example: detention of some portion of stormwater runoff will also help improve water quality. The intent of this outcome is to ensure that there is an acknowledgement of the quality-focused stormwater management targets, requirements and reviews in order to identify areas where both needs can be met.
- **Outcome No. 18: Urban and riverine flood risk management and mitigation options are readily available and widely communicated with the public.**
    - DPS: Performance (2) with lots of room to improve. Potential property buyers aren't educated about their risk. Critically important; we need to help people understand their risks.

Review of public engagement details

- Jacobs reviewed the planned community engagement, which includes a survey, survey support pop-up events, and two virtual community forums. DEP requested participation by the Core Team in the sessions and noted that assistance may be needed to manage event breakout rooms.

- The survey, survey pop-ups, and community forum events are intended to reach those from underrepresented communities and capture their feedback on where flooding hotspots occur. DEP noted that it is anticipated there will be multiple studies and outreach events for each; no single event will be a be-all and end-all, but a step in the right direction.
- Link to Survey
- OCE inquired about how the community will know about the events. DEP replied that the outreach events will be announced through social media channels, newsletters, notification to all partners to share on their newsletters, and regional community centers. There will be a flier that is self-explanatory with a QR code to the website with the survey embedded and a calendar of events. (Website is not live yet.) The HOA database will also be utilized.

Validation of peer engagement

- Jacobs presented a discussion of jurisdictions identified to be included in the peer engagement work. Jurisdictions have been identified based on a review of those that are pursuing various means of addressing urban flood risk. Jacobs presented an overview of questions/topics of discussions for the planned interviews (**see Attachment F: Mural – Peer Engagement**). The objective of the engagement is to identify industry solutions that can be mapped to the framework of outcomes and capabilities set forth in the previous exercise, for discussion with the Core Team as the group moves into defining a "to be" condition for management of flooding.
- Jacobs encouraged Core Team to add any subjects of interest to the interview questions. Due to lack of time in the meeting, it was noted that the Mural link would be distributed for participants to add thoughts through the next few days. Jacobs to send the link in an email.

Action Items

- Jacobs to send Core agencies a link to the Mural.
- Core Team to review Mural: Section 9: Peer Engagement and fill in circles with any other topics to focus upon and/or subjects to add.

Attachments

A. Meeting Agenda

B. Mural – Approach for remaining sessions

C. Mural – Observations

D. Mural – Flood Management Plan Framework: Outcomes, Capabilities Ratings

E. Mural – Flood Management Plan Framework: Scatterplot

F. Mural – Peer Engagement

Phase 1 Core Team Meeting #6

Date: September 15, 2022
Time: 1:00PM to 3:00PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56704
Prepared by: Dan Speicher/Jacobs
Location: Microsoft Teams
Participants:
Frank Dawson/MC DEP
Stan Edwards/MC DEP
Enrique Lopezcalva/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Paul Moyer/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Khalid Afzal/MNCPPC Planning
Mark Symborski/MNCPPC Planning
Matt Harper/MNCPPC Parks
Erin McArdle/MNCPPC Parks
Cindy Marie Pena/MC DEP
Ana Arriaza/MC DEP
Matthias Miziorko/MC OEMHS
Tina Laboy/MC OEMHS
Michael Boldosser/MC OEMHS
Daniel Sheridan/MC DOT
Tim Cupples/MC DOT
Mark Etheridge/MC DPS
Adriana Hochberg/MC DEP
Amy Stevens/MC DEP
Darian Copiz/MC DEP
Ho-Chin Fong/MC DEP
Krystal Reifer/MC DEP
Claire Iseli/MC OCE
Meredith Wellington/MC OCE
William Musico/MC DPS

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Item	Time
Workshop flow/date changes	1:00
Existing conditions memo (~30 m)	1:10
Elements/Ranking and gap characterization of observations (~60 m)	1:40
Review of public engagement details (~10-15m)	2:30
Validation of peer engagement (~10m)	2:40
Next steps / Watershed data	2:55
Adjourn	3:00

Approach for remaining sessions

Stage	#	Outcome	Review Meeting Deliverable (Preceding the Workshop)	Task Reference	Original Schedule	Proposed Revisions
Organizational As-Is	6	Understanding current responsibilities, non-County stakeholders flooding engagement; Consensus on objectives of community engagement	**Draft Governance Review TM**	4.2	8/25/2022	9/15/2022
Current Conditions	7	Understanding of available data and potential watershed prioritization	**Draft Mapping** and **Draft Historic Flood Conditions and Data Gaps TM**	3	9/15/2022	9/29/2022
Vision	8	Understanding of neighbor's relationship with and direction for flooding	**Draft Other Jurisdiction Review TM**	4.2	9/29/2022	10/20/2022
		Feedback and discussion on potential organizational future	Mural content and exercises for this session	4.1		
To-Be	9	Agreement on policy direction, decision authorities, and responsibility distribution within the County	Mural content and exercises for this session	4.2	11/3/2022	11/10/2022
	10	Detailed "to do" list for each County to address gaps and meet needs for vision	Mural content and exercises for this session, **Draft Conclusions & Recommendations TM**	4.2 / 6	12/1/2022	12/8/2022
		Roadmap to achieving agreed upon outcomes	Mural content for this session	6		

OBSERVATIONS

	Vehemently Disagree	Disagree	Neutral	Agree	Strongly Agree
Organizational Observations 1 **There is no county-wide definition of flooding.** • Varied characterizations of flooding and/or diverse definitions of what constitutes flooding may lead to conflicting planning, management, and/or response • May lead to inequitable identification, planning, and/or response to flooding "Levels of Service (LOS) are established, measured, and periodically reassessed and reported for each part of drainage/stormwater system (ROW, ie road culverts and bridges)		✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	I think the County government often has a different definition than the public - Stan ✓
Organizational Observations 2 **Flooding related agency responsibilities in the pro-active space (planning, engineering, and permitting) are driven by source-related regulations, not by flooding effects.** • Quality focused regulations have some impact on quantity management • Yet the stated desire of the Core Team is to focus more on flooding effects				✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓
Organizational Observations 3 **There is little comprehensive and coordinated county-wide stormwater quantity management.** • Agencies are driven by different criteria dictated by specific regulations or policies • Agencies focus on specific asset types and/or location/ROW • No inter-agency agreements centralizing responsibilities • Several agencies responsible for management of stormwater infrastructure, depending on ROW			✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓
Information/Data Observations 4 **No county-wide assessment of flood risk outside of FEMA and County-studied riverine areas.** • Resulting in limited county-wide characterization of flood vulnerabilities			✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Information/Data Observations 5 **Available data do not allow conclusions regarding cause/effect of flooding.** • Quality of given data sets result in questions on actual source and/or effect of a recorded event or impact • Data have limited characterization of resident impacts What do other similar jurisdiction do?			✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓
Information/Data Observations 6 **Flood management data and information resources are not collated nor coordinated across agencies.** • Information sharing between agencies is ad-hoc, although DEP and DPS are piloting a data map • DPS plan submittals only recently have required GIS/CAD information, thus a large amount of legacy information is not readily/easily accessible • DPS, which has historically received floodplain studies, does not have dedicated GIS staff • Rainfall data is used by several agencies (DEP, DOT, DEMHS, MCFRS)				✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Regulations Observations 7 **County currently has limited ability to incorporate knowledge of recurrent flood impacts in permitting and development reviews.** awareness of recurrent flooding reported by [illegible] flooding risk data [illegible] coordination		✓	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓	✓ ✓
Regulations Observations 8 **There is currently no means to support consideration of watershed-wide impacts to runoff volumes as a result of stormwater management permit applications (e.g. using watershed level quantity planning)** **The "reasonableness of use" doctrine of the State modified Civil Law Rule allows the higher landowner to discharge across a lower landowner's property.**			✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓
Public Outreach/Public Information Observations 9 **Public outreach related to flood risk and management are not coordinated.** • No agency with sole responsibility for public outreach • Limited success of sharing comprehensive flood risk information • Community stakeholder outreach on flooding is not a defined role for any agency				✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
Land Use Planning Observations 10 **There is limited focus on addressing runoff quantity impacts through land use planning.** • Impacts to existing flood risk and/or network-level (vs. local) storm drain capacity is not typically a consideration for land use planning • Areas with historic impact are only ones where flooding is considered not been a specific focus on SWM at a geography basis		✓	✓ ✓	✓ ✓ ✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓ ✓

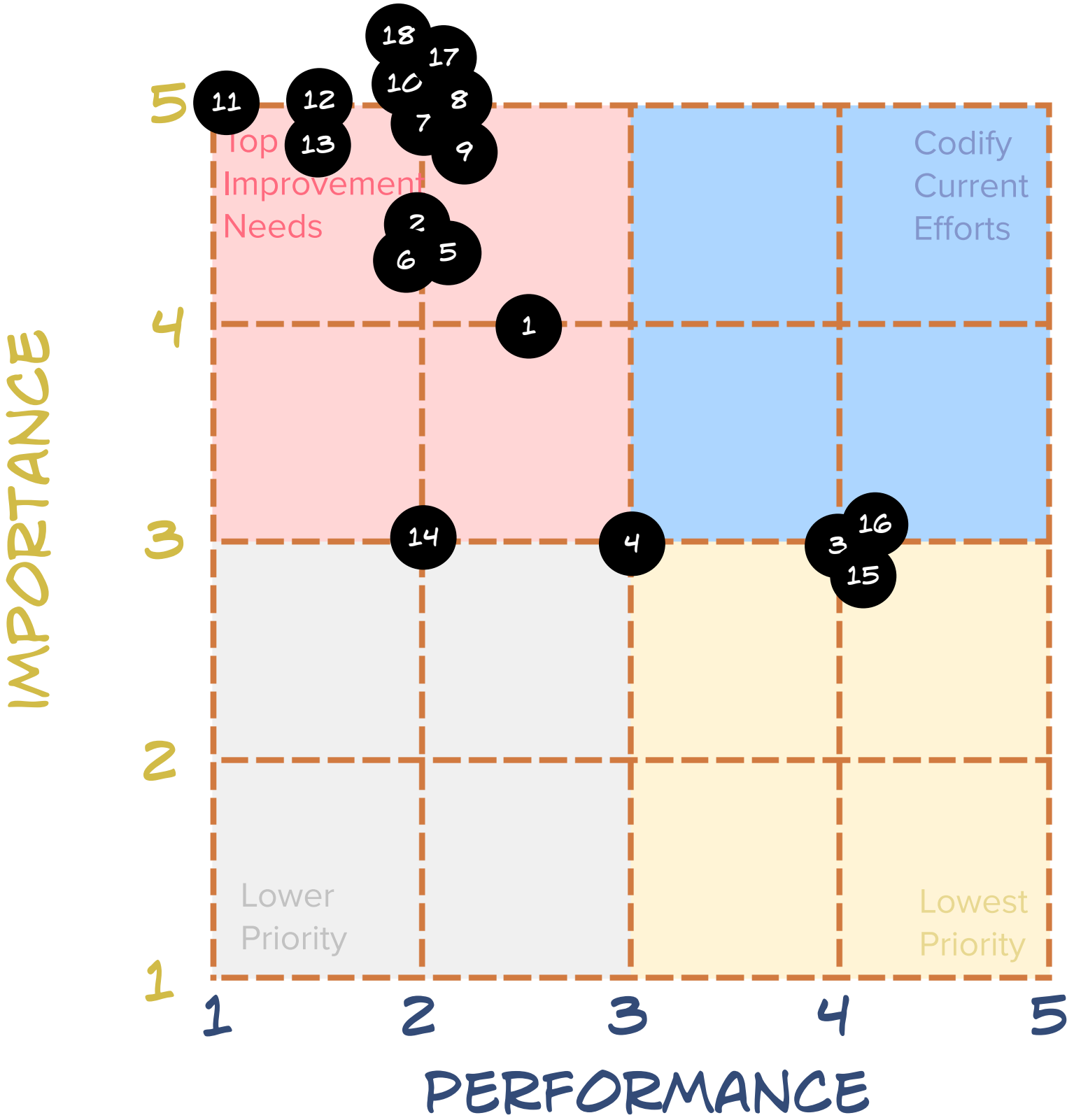
FLOOD MANAGEMENT PLAN FRAMEWORK

Structuring elements that are necessary for a comprehensive plan

Outcome Category Designation	Outcomes necessary for comprehensive management of flood risk	Capability statements refining each Outcome	PERFORMANCE					IMPORTANCE				
			1 - We don't do this	2 - Lots of room to improve	3 - Some room to improve	4 - We're pretty good but should improve	5 - We do very well but can always improve	1 - No urgency to improve	2 - Minimal urgency to improve	3 - Some urgency to improve	4 - Moderate urgency to improve	5 - Very urgent to improve
1	Asset management principles from inventory to condition assessment to levels of service standards are applied	1.1 An Asset Management Program, aligned to ISO 55000, exists for stormwater infrastructure including GI, dams, levee, etc. 1.2 An up-to-date inventory of all stormwater and flood control infrastructure exists, including drains, piping, GI, dams, levees, etc. and is easily accessible. 1.3 The condition and likelihood of failure of all stormwater and flood control infrastructure is periodically updated, and is easily accessible. 1.4 The risk of failure of stormwater and flood control infrastructure to meet established LOS is periodically updated and used to develop needed rehabilitation, replacement and additions.		✓							✓	
2	Flood risk data and analyses are developed, maintained, and readily accessible	2.1 Elevation certificates are reviewed and maintained. 2.2 Geospatial data is kept up-to-date. 2.3 There is a well-defined process for assessing and estimating damages following a flood event. 2.4 Critical facilities have been identified and geolocated on GIS. 2.5 The County currently has the technical capability to assess current flood risk. 2.6 Incidence of flooding are characterized and recorded in accordance with the type of impact. 2.7 Flood risk impact for vulnerable populations is well understood.		✓							✓	
3	County has emergency management plan for all critical facilities in flood zones	3.1 The community has a dam failure threat recognitions system. 3.2 Response operations for dam failure are planned and carried out. 3.3 Dam failure planning is coordinated with operators of critical facilities.					✓			✓		
4	Emergency response plan includes early warning systems for high risk areas.	4.1 The County has an effective flood warning system where appropriate. (Flood prediction and disseminating flood warning). 4.2 Flood warnings are coordinated with operators of critical facilities. 4.3 Community is designated by NWS as StormReady.			✓					✓		
5	Financing options are well defined and communicated	5.1 Grant and loan resources for capital improvements and flood preparedness are known and planned for. 5.2 Grant and loan resources for flood event recovery are known and there are resources to apply for these funds. 5.3 Flood protection resources and financial assistance is provided to property owners by staff trained in retrofitting and grants availability information. 5.4 County grant program exists for acquisition of flood prone properties.		✓							✓	
6	Flood risk and mitigation information is easily accessible, widely disseminated, and uniformly	6.1 Staff reviewing new development and redevelopment applications have access to locations and information on previously flooded areas.		✓							✓	
7	Flood risk and mitigation information is communicated easily, widely and uniformly to the public	7.1 The public knows how/where to find information about their flood risk (current and future). 7.2 Information on flood insurance is readily available in hard copy form and online. 7.3 All entities conducting development in the Floodplain District are aware of the Floodplain District Permit process.		✓								✓
8	Urban Flood Zones / Riverine Floodplain are defined/mapped	8.1 Riverine and pluvial/urban flood hazard areas are clearly mapped for different levels of service (storm recurrence). (Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined.) 8.2 The County currently has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms. 8.3 Floodplain Districts are comprehensively developed.		✓								✓
9	County budget and staffing needs are clearly understood	9.1 Operations and maintenance funding needs for stormwater and flood control infrastructure, including GI, dams, levees, etc. are known and planned for. 9.2 Capital improvement plans are developed, and updated annually, to mitigate flood risks and adequately funded. 9.3 Technical assistance programs have sufficient funding. 9.4 There is adequate staffing and skill levels to operate and maintain stormwater and flood control infrastructure.		✓								✓
10	Flood risk management roles/responsibilities and overall governance structure are clearly understood for whole infrastructure/development life cycle.	10.1 Flood risk management roles and responsibilities are clearly defined and coordinated among County departments and other agencies. 10.2 Flood risk management efforts are coordinated and shared among all responsible stakeholders, such as other County departments, municipalities, SWA, etc. 10.3 Authorities and those accountable for decisions are clearly aware of their responsibilities. 10.4 A centralized authority exists for providing flood risk management in the County.		✓								✓
11	CIP incorporates flood mitigation needs	11.1 The County currently has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development). 11.2 Future considerations are included in storm drainage infrastructure design. 11.3 Flood mitigation projects that reduce County flood risk have been identified. 11.4 A mitigation plan for repetitive loss areas has been developed and is being carried out. 11.5 Buildings within areas of high flood risk are acquired or relocated. 11.6 There is a capital improvement program for addressing drainage problems.	✓									✓
12	Comprehensive land use plans reflect flood risk	12.1 The County General Plan incorporates flood risk information. 12.2 A community-wide floodplain management plan has been developed and maintained. 12.3 Areas that provide natural flood mitigation functions are identified and protected. 12.4 Flood risk for culturally and historically significant areas and structures are well understood and geolocated.		✓								✓
13	Development/redevelopment standards and building codes are updated to reflect LOS goals and current/future climate.	13.1 A watershed master plan that evaluation future conditions and long-duration storms is used to implement stormwater management regulations. Such a plan addresses wetlands/natural areas and stream channel protection. 13.2 Levels of Service (LOS) are established, communicated and periodically measured and reported, for each part of drainage/stormwater system (ROW, to road culverts and bridges). 13.3 Staff members know where to find climate data and can utilize it in their current roles.	✓									✓
14	Insurance options are well defined and communicated	14.1 The current level of insurance covered is known. 14.2 There is a plan for increasing flood insurance coverage.		✓						✓		
15	O&M is proactive to maintain LOS for all high risk areas.	15.1 Natural channels on both public and private property are inspected and debris is removed. 15.2 Known problem sites are recorded and given additional attention, as appropriate. 15.3 Regulations prohibiting dumping in streams exist and are publicized. 15.4 Private stormwater storage facilities are inspected and maintained on an annual basis. 15.5 Public stormwater storage facilities are inspected and maintained on an annual basis.				✓				✓		
16	Clear permit process and enforcement of Development/Redevelopment Standards reflecting flood risk	16.1 All development in the Floodplain District is reviewed through the Floodplain District Permit review process. 16.2 The County's Floodplain Management regulations are uniformly enforced. 16.3 The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff members are responsible for activities and approvals associated with stormwater and flood management. 16.4 Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed pre-development runoff.				✓				✓		
17	Co-benefits of flood management are integrated in the permit review process	17.1 The County's water quality improvement efforts are integrated with flood risk management programs. 17.2 Strong stormwater management regulations minimize the contribution to interior flooding from new developments. 17.3 Erosion and sediment control regulations exist for all construction sites for protection of water quality and drainage systems. 17.4 Water quality credit is provided for implementing best management practices to protect water quality.		✓								✓
18	Urban and riverine flood risk management and mitigation options are readily available and widely communicated with the public	18.1 Flood risk mapping information is provided for community use by request. 18.2 There is coordinated outreach to communicate with the public to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain. 18.3 Disclosure of flood hazard information are made during real estate transactions. 18.4 Information related to flood protection measures is available in County libraries and/or on a County website.		✓								✓

FLOOD MANAGEMENT PLAN FRAMEWORK

Structuring elements that are necessary for a comprehensive plan



Phase 1 Core Team Meeting #7

Date: September 29, 2022
Time: 1:00 to 3:00 PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56704
Prepared by: Steph Marvin/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Location: Microsoft Teams
Participants: Laurens van der Tak/Jacobs
Dan Speicher/Jacobs
Miranda Santucci/Jacobs
Steph Marvin/Jacobs
Nicole Forney/Jacobs
Stan Edwards/MC DEP
Michael Boldosser/MC OEMHS
Claire Iseli/MC OCE
Darian Copiz/MC DEP
Mark Etheridge/MC DPS
Kristina Laboy/MC OEMHS
Maryam Akhavan/MC OEMHS
Steven Shofar/MC DEP
Adriana Hochberg/MC DEP
William Musico/MC DPS
Erin McArdle/MNCPPC Parks
Ho-Ching Fong/MC DEP
Khalid Afzal/MNCPPC Planning
Cindy Marie Pena/MC DEP
Matt Harper/MNCPPC Parks
Mark Symborski/MNCPPC Planning
Meredith Wellington/MC OCE
Amy Stevens/MC DEP
Frank Dawson/MC DEP

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this meeting is to introduce the Core team to the prioritization of watersheds towards comprehensive flood management as well as discuss further the comprehensive flood management outcomes from the previous meeting. This is the seventh Core Team Workshop, delivered as part of Task 4.1 of the Comprehensive Flood Management Plan Phase 1 work (Task Orders #3 and #4 of Contract 1127041). Three additional Core Team Workshops are planned to follow.

Summary of Discussion

Introductions & Meeting Objectives

Prioritization of watersheds

- Item A: *How might detailed hydrology and hydraulic (H&H) studies improve County flood management?* Purpose for Phase 2 studies at the watershed level:

  - To understand flood risk from both riverine and pluvial flooding and the lot-scale impact
  - To integrate future conditions (development, anticipated impervious areas, climate change) into planning
  - To understand the impact on communities and manage and target resources
  - To serve as the basis for detailed risk assessment (how technical decisions are made and to validate expenditures towards mitigating risk across County)

- Item B: *Flood Risk Tool*
  - Combine riverine and pluvial modeling to understand what's happening on the surface
  - Flood Modeler is a screening tool for a high-level study. It is not highly accurate hydraulically as it doesn't include culverts, bridges, etc., but includes surface data and streamflow lines to understand where pluvial impacts might be
- Item C: *Information used to characterize flood exposure at a watershed level and prioritize watersheds*
  - Flood hazards – Studies done by FEMA, the County, historic parks and planning, and other flood studies
  - Receptors – Anything impacted by flooding
  - Observed risk – Calls, complaints, information gathered from agencies to understand how flooding impacts their mission with the acknowledgment that the information through these sources is limited but still very helpful
  - Other considerations – Detailed hydraulic modeling and any data needed for completeness and accuracy
- Item D: *Information used to characterize flood exposure at a watershed level and prioritize watersheds*
  - The map is to give a flavor of watershed characterization. Blue dots are proportional dots that show impervious percentage of each watershed. Smaller black dots show a dot density of socially vulnerable areas.
  - DEP recognized correlation between socially vulnerable and higher impervious areas
- Item E: *Information used to characterize flood exposure at a watershed level and prioritize watersheds*
  - Map shows flood hazard information. Legend in top right of pastel colors shows extents of various modeling outputs currently available to analyze. Darker blue/green bar graphs show flood hazard acreage from the pluvial model.
  - Quantifies receptors in terms of flood hazards (the amount acceptable within a flood zone).
  - Data source not from National Hydrography data set but similar to the 12-digit Hydrological Unit Code
- Item F: *Exposure assessment overall process*
- Item G: *Objectives of Phase 1 and 2 vulnerability assessments*
  - Phase 1: Answers, "How should the work be sequenced out for Phase 2?"
  - Phase 2: Provides more detailed vulnerability assessment

Discussion of Comprehensive Flood Management Outcomes – Urgency Score

- Outcomes have been re-ordered by urgency to help the County prioritize where to invest energies first. There have been some updates and changes from the last Core team meeting. Jacobs asked clarifying questions to improve outcomes and capabilities.
    - Orange column represents the Categories necessary to develop the assessment. Ex: Category 10.1, *Flood risk assessments are only helpful if we have clearly defined roles.*
    - Green column represents Capabilities that may/can be done more effectively with the risk assessment. Ex: Category 2.5, *With a detailed risk assessment, we can assess current flood risk more effectively.*
    - "Needed" does not imply currently lacking.
    - Blank cells imply the outcome didn't rise to the status of "will help" (helpful) or "needed" (necessary).

Discussion of Comprehensive Flood Management Outcomes – Clarity

- Agencies ranked the clarity of the outcomes and capabilities. See **Attachment A: Mural – Clarity**. One suggestion was to make a distinction among flooding types and permutations (pluvial & urban; riverine & nonurban, etc.). Another was to add language to Co-benefits to clarify how quantity and quality are related.

Discussion of Comprehensive Flood Management Outcomes – Suitability (Fit)

- Core team responded with the assumption that the capability was present. See **Attachment B: Mural – Fit**.

Review of public engagement details

- Some community engagement occurring now; the survey is live and there's a link on County website. One community pop-up event has been completed at the Flea Market, which went well. Another pop-up is scheduled this weekend at Latte Plaza and will be staffed by DEP and Jacobs Engagement.
- There have been 300 responses thus far to the survey.
- Virtual forums are scheduled October 12th and 20th to solicit interest; DEP and Jacobs will inform community of effort and request feedback
- The County Executive newsletter went out last week, which included the flooding website release announcement.

Validation of peer engagement

- Jacobs will engage with other jurisdictions to learn what they're doing in similar space, acknowledging context such as drivers and hydrography will differ
- Jacobs has identified list of jurisdictions

Action Items

- DEP (Steven Shofar) to send the WSSC basement-backup dataset to Jacobs (Miranda Santucci).
- DEP (Cindy Marie Pena) to correspond and collaborate with OCE (Claire Iseli) regarding the Community newsletter input

Attachments

A. Mural – Clarity

B. Mural – Fit

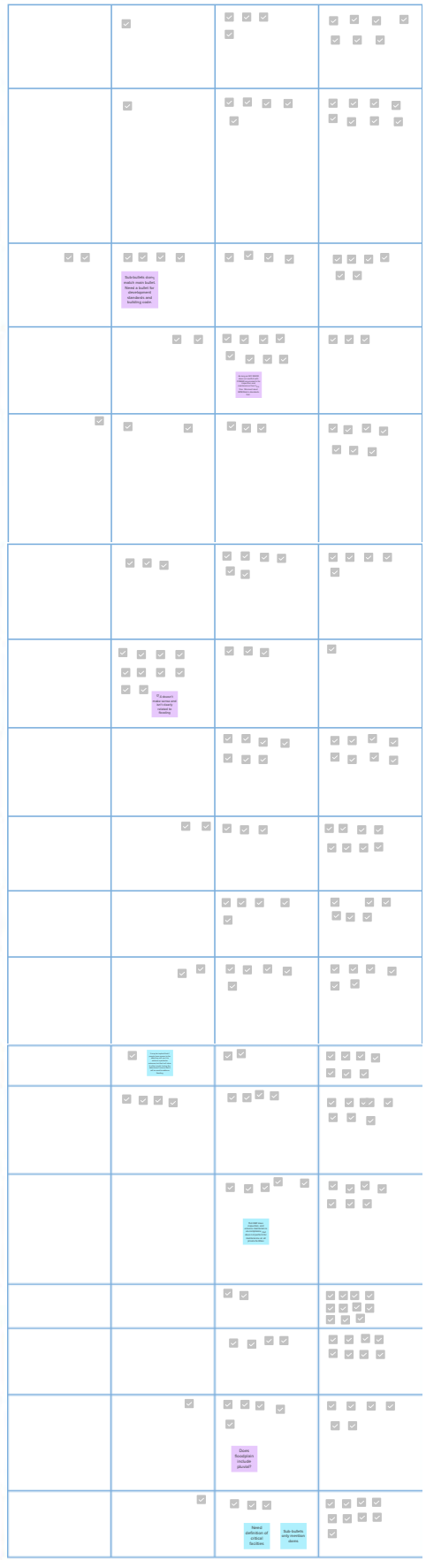
Unnamed area

Needs/Impacts (not performance assessments)

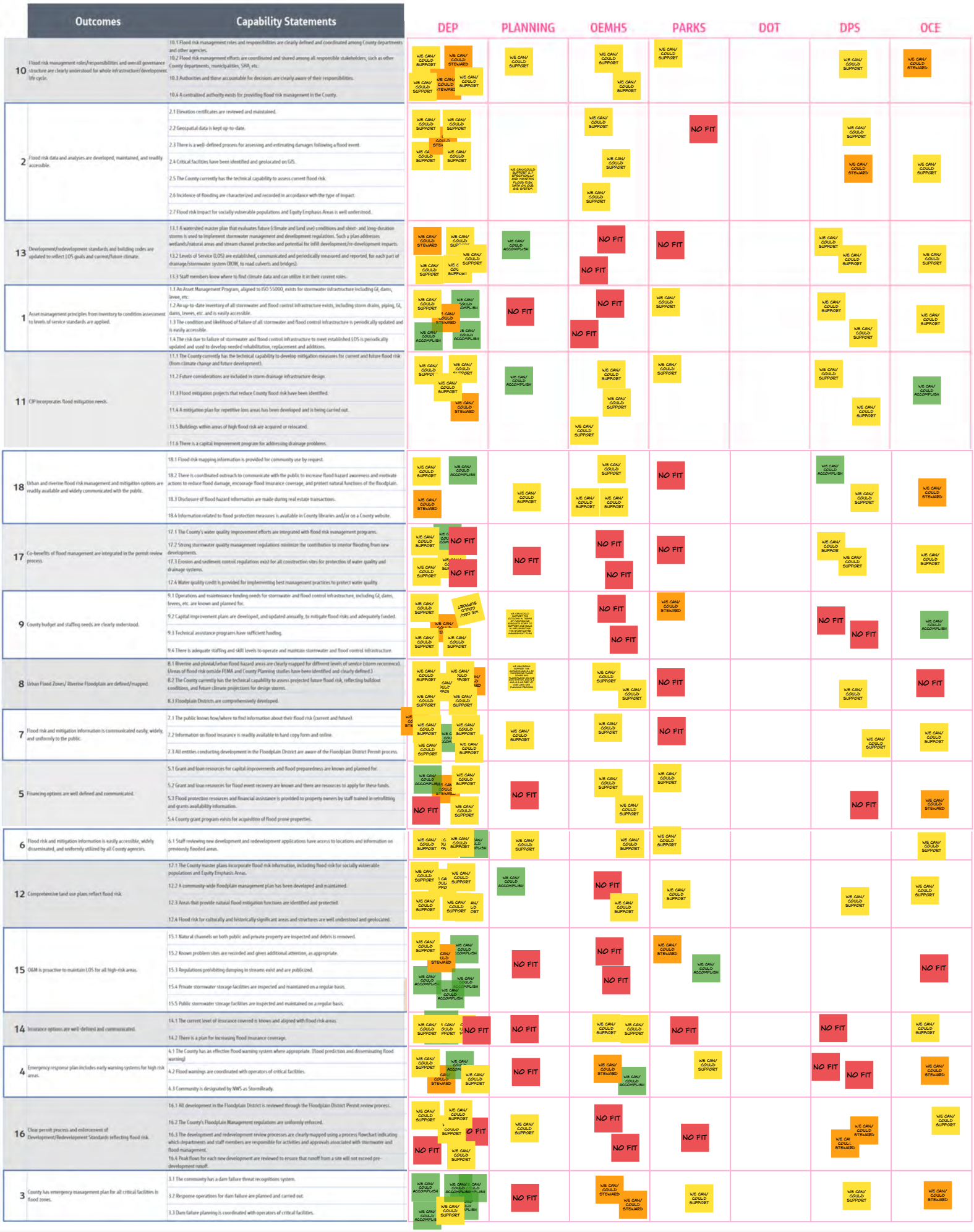
Outcomes	Capability Statements	This capability is needed/will help develop detailed flood risk assessment (needed/will help develop OR utilize the output of detailed assessment)	This capability can/may be performed more effectively or efficiently with risk assessment	Urgency (1 to 5)	Performance (1 to 5)	Imp+Gap+ Risk Need
10 Flood risk management roles/responsibilities and overall governance structure are clearly understood for whole infrastructure/development life cycle.	10.1 Flood risk management roles and responsibilities are clearly defined and coordinated among County departments and other agencies.	Needed		5	2	15
	10.2 Flood risk management efforts are coordinated and shared among all responsible stakeholders, such as other County departments, municipalities, SHA, etc.	Needed				
	10.3 Authorities and those accountable for decisions are clearly aware of their responsibilities.	Needed				
	10.4 A centralized authority exists for providing flood risk management in the County.	Will help				
2 Flood risk data and analyses are developed, maintained, and readily accessible.	2.1 Elevation certificates are reviewed and maintained.			4.5	2	10
	2.2 Geospatial data is kept up-to-date.	Will help				
	2.3 There is a well-defined process for assessing and estimating damages following a flood event.					
	2.4 Critical facilities have been identified and geolocated on GIS.	Needed				
	2.5 The County currently has the technical capability to assess current flood risk.		Can			
	2.6 Incidence of flooding are characterized and recorded in accordance with the type of impact.					
	2.7 Flood risk impact for socially vulnerable populations and Equity Emphasis Areas is well understood.		Can			
13 Development/redevelopment standards and building codes are updated to reflect LOS goals and current/future climate.	13.1 A watershed master plan that evaluates future (climate and land use) conditions and short- and long-duration storms is used to implement stormwater management and development regulations. Such a plan addresses wetlands/natural areas and stream channel protection and potential for infill development/re-development impacts.		Can	5	1	10
	13.2 Levels of Service (LOS) are established, communicated and periodically measured and reported, for each part of drainage/stormwater system (ROW, to road culverts and bridges).	Will help				
	13.3 Staff members know where to find climate data and can utilize it in their current roles.		May			
1 Asset management principles from inventory to condition assessment to levels of service standards are applied.	1.1 An Asset Management Program, aligned to ISO 55000, exists for stormwater infrastructure including GI, dams, levee, etc.			4	2.5	9.5
	1.2 An up-to-date inventory of all stormwater and flood control infrastructure exists, including storm drains, piping, GI, dams, levees, etc. and is easily accessible.	Needed				
	1.3 The condition and likelihood of failure of all stormwater and flood control infrastructure is periodically updated and is easily accessible.	Needed				
	1.4 The risk due to failure of stormwater and flood control infrastructure to meet established LOS is periodically updated and used to develop needed rehabilitation, replacement and additions.		Can			
11 CIP incorporates flood mitigation needs.	11.1 The County currently has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development).			5	1	9
	11.2 Future considerations are included in storm drainage infrastructure design.		Can			
	11.3 Flood mitigation projects that reduce County flood risk have been identified.		May			
	11.4 A mitigation plan for repetitive loss areas has been developed and is being carried out.					
	11.5 Buildings within areas of high flood risk are acquired or relocated.					
	11.6 There is a capital improvement program for addressing drainage problems.					
18 Urban and riverine flood risk management and mitigation options are readily available and widely communicated with the public.	18.1 Flood risk mapping information is provided for community use by request.			5	2	8
	18.2 There is coordinated outreach to communicate with the public to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain.		May			
	18.3 Disclosure of flood hazard information are made during real estate transactions.					
	18.4 Information related to flood protection measures is available in County libraries and/or on a County website.					
17 Co-benefits of flood management are integrated in the permit review process.	17.1 The County's water quality improvement efforts are integrated with flood risk management programs.			5	2	8
	17.2 Strong stormwater quality management regulations minimize the contribution to interior flooding from new developments.					
	17.3 Erosion and sediment control regulations exist for all construction sites for protection of water quality and drainage systems.					
	17.4 Water quality credit is provided for implementing best management practices to protect water quality.					
9 County budget and staffing needs are clearly understood.	9.1 Operations and maintenance funding needs for stormwater and flood control infrastructure, including GI, dams, levees, etc. are known and planned for.		May	5	2	8
	9.2 Capital improvement plans are developed, and updated annually, to mitigate flood risks and adequately funded.		May			
	9.3 Technical assistance programs have sufficient funding.		May			
	9.4 There is adequate staffing and skill levels to operate and maintain stormwater and flood control infrastructure.					
8 Urban Flood Zones/ Riverine Floodplain are defined/mapped.	8.1 Riverine and pluvial/urban flood hazard areas are clearly mapped for different levels of service (storm recurrence). (Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined.)		Can	5	2	8
	8.2 The County currently has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms.		Can			
	8.3 Floodplain Districts are comprehensively developed.		May			
7 Flood risk and mitigation information is communicated easily, widely, and uniformly to the public.	7.1 The public knows how/where to find information about their flood risk (current and future).		May	5	2	8
	7.2 Information on flood insurance is readily available in hard copy form and online.					
	7.3 All entities conducting development in the Floodplain District are aware of the Floodplain District Permit process.					
5 Financing options are well defined and communicated.	5.1 Grant and loan resources for capital improvements and flood preparedness are known and planned for.		May	4.5	2	7
	5.2 Grant and loan resources for flood event recovery are known and there are resources to apply for these funds.					
	5.3 Flood protection resources and financial assistance is provided to property owners by staff trained in retrofitting and grants availability information.					
	5.4 County grant program exists for acquisition of flood prone properties.					
6 Flood risk and mitigation information is easily accessible, widely disseminated, and uniformly utilized by all County agencies.	6.1 Staff reviewing new development and redevelopment applications have access to locations and information on previously flooded areas.			4.5	2	7
12 Comprehensive land use plans reflect flood risk	12.1 The County master plans incorporate flood risk information, including flood risk for socially vulnerable populations and Equity Emphasis Areas.		Can	3	1.5	4.5
	12.2 A community-wide floodplain management plan has been developed and maintained.		Can			
	12.3 Areas that provide natural flood mitigation functions are identified and protected.		May			
	12.4 Flood risk for culturally and historically significant areas and structures are well understood and geolocated.		Can			
15 O&M is proactive to maintain LOS for all high-risk areas.	15.1 Natural channels on both public and private property are inspected and debris is removed.			3	4	4
	15.2 Known problem sites are recorded and given additional attention, as appropriate.					
	15.3 Regulations prohibiting dumping in streams exist and are publicized.					
	15.4 Private stormwater storage facilities are inspected and maintained on a regular basis.	Will help				
	15.5 Public stormwater storage facilities are inspected and maintained on a regular basis.	Will help				
14 Insurance options are well-defined and communicated.	14.1 The current level of insurance covered is known and aligned with flood risk areas.		May	3	2	4
	14.2 There is a plan for increasing flood insurance coverage.					
4 Emergency response plan includes early warning systems for high risk areas.	4.1 The County has an effective flood warning system where appropriate. (flood prediction and disseminating flood warning)		May	3	3	3
	4.2 Flood warnings are coordinated with operators of critical facilities.		Can			
	4.3 Community is designated by NWS as StormReady.					
16 Clear permit process and enforcement of Development/Redevelopment Standards reflecting flood risk	16.1 All development in the Floodplain District is reviewed through the Floodplain District Permit review process.			3	4	2
	16.2 The County's Floodplain Management regulations are uniformly enforced.					
	16.3 The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff members are responsible for activities and approvals associated with stormwater and flood management.					
	16.4 Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed pre-development runoff.					
3 County has emergency management plan for all critical facilities in flood zones.	3.1 The community has a dam failure threat recognitions system.			3	5	1
	3.2 Response operations for dam failure are planned and carried out.					
	3.3 Dam failure planning is coordinated with operators of critical facilities.					

How clear is the Outcome and Capabilities?

Very Fuzzy | Little Fuzzy | Somewhat Clear | Clear



Unnamed area



Phase 1 Core Team Meeting #8

Date: October 20, 2022
Time: 1:00 to 3:00 PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56704
Prepared by: Steph Marvin/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Location: Microsoft Teams
Participants: Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Enrique Lopezcalva/Jacobs
Nicole Forney/Jacobs
Paul Moyer/Jacobs
Hung Truong/Nspiregreen
Stan Edwards/MC DEP
Frank Dawson/MC DEP
Amy Stevens/MC DEP
Darian Copiz/MC DEP
Steven Shofar/MC DEP
Ho-Ching Fong/MC DEP
Khalid Afzal/MNCPPC Planning
Mark Symborski/MNCPPC Planning
William Musico/MC DPS
Mark Etheridge/MC DPS
Matthias Miziorko/MC OEMHS
Meredith Wellington/MC OCE

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this vision meeting is to allow the Core team the opportunity to define the County's vision regarding flooding, share with the Core team updates from the stakeholder engagement efforts and provide results from initial watershed assessments. This meeting is the eighth Core Team Workshop, delivered as part of Task 4.1 of the Comprehensive Flood Management Plan Phase 1 work (Task Orders #3 and #4 of Contract 1127041). Two additional Core Team Workshops are planned to follow.

Summary of Discussion

Introductions & Meeting Objectives

Stakeholder Engagement

Nspiregreen (Hung Truong) shared updates from the pop-up efforts:

- 5 pop-ups have been completed
- Comprehensive floodplain efforts were communicated
- Targeted hard-to-reach communities; set-up at flea markets and grocery stores

- Spoke with 300 people in total, about 550 survey responses

Core Team expressed importance of engaging stakeholder groups prior to finalizing the Comprehensive Flood Plan.

Strategy Document

The intent of this document is to encapsulate the Core Team advice and guidance into a direction with specific actions and recommended structure.

Planning expressed sharing the document before finalizing to the Planning Board.

Overall, Core Team recommended the document be shared "undoubtedly" with the Directors of Core Team Agencies, County Executive, and County Council. All Core Team Agency and All County staff were recommended as "should be informed" while some suggested the latter would "not be a group to focus upon".

DEP mentioned that ultimately, Jacobs will share recommendations and that it will be up to the County to determine next steps given the information provided by Jacobs. There's a desire to avoid conveying the message, "the government knows best for the public" by including the public early on.

Vision Statement

Core Team members split into groups to come up with an initial vision statement:

Montgomery County leads the nation in reducing existing and future flooding through well informed residents and sustainable and equitable mitigation, planning, and adaptive development.

Watershed Assessments

Purpose of the watershed assessment was to understand past flood impacts using available data, understand gaps in stormwater infrastructure data needed for detailed hydraulic modeling, and to provide input for the Comprehensive Flood Management Strategy outline of Phase 2 watershed study activities:

- Understand relative priorities to begin to develop phasing and budget planning
- Identify significant data gaps that may prolong study for priority watersheds
- Work with stakeholders to incorporate knowledge of existing conditions, impacts of data gaps, and on-going community survey output to inform the prioritization

Ranking methods for comparing watershed flood exposure had multiple attributes with various weighting scenarios developed for the sensitivity analysis: high social vulnerability area within flood zone, Wetlands area within flood zone, Amount of commercial area within flood zone, and Number of critical facilities within flood zone. Measurements and scorings were developed for both FEMA (100- and 500-year) and the available pluvial/riverine flood extent (100-year flood extent for 2065).

Following the sensitivity analysis, Watersheds were categorized into one of three tiers:

- Tier 1: Consistently in the top 2 regardless of weighted factor changes
- Tier 2: Consistently in the top 5 regardless of weighted factor changes
- Tier 3: Consistently in the top 10 regardless of weighted factor changes

See **Attachment A** for the results of the assessment.

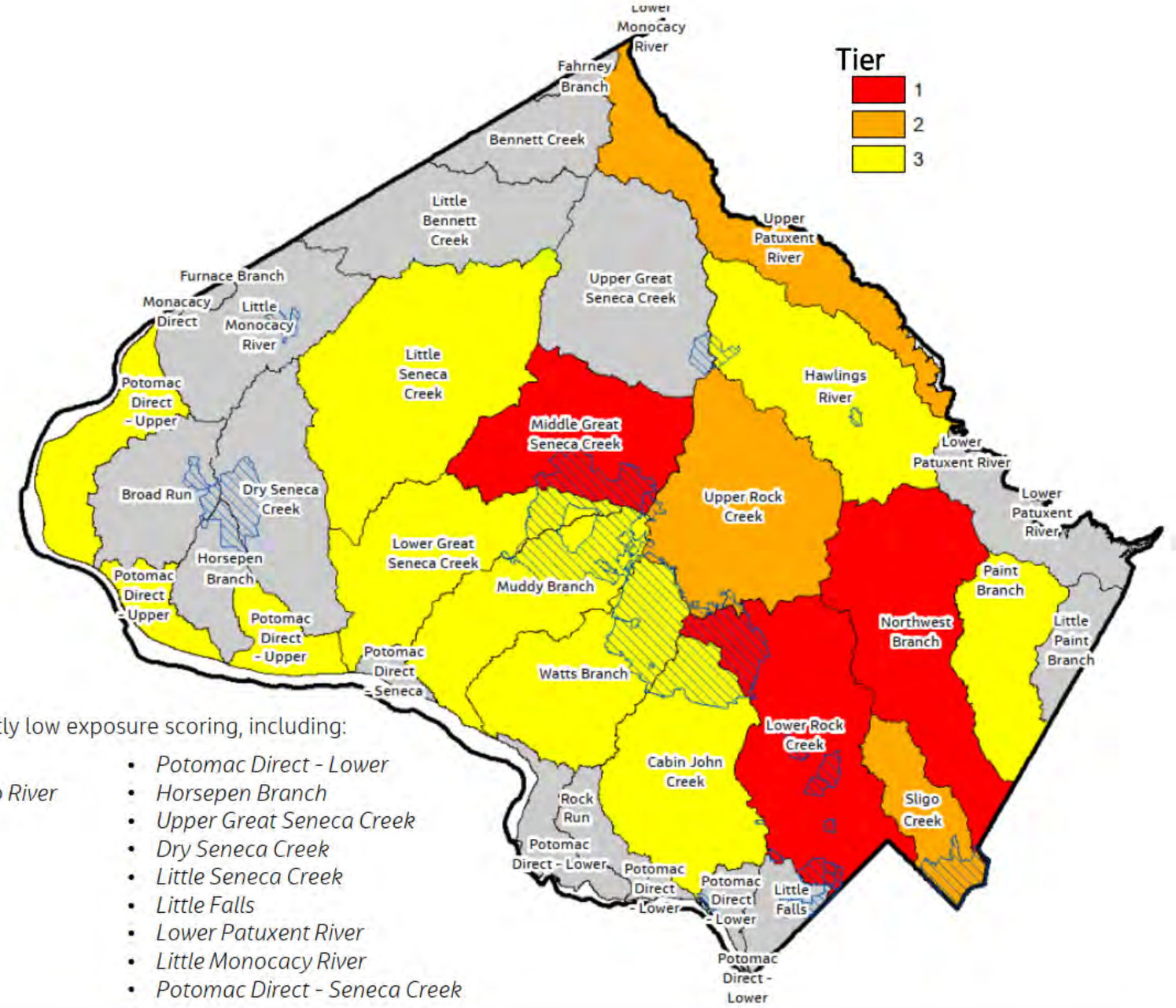
DEP (Steven Shofar) shared that perhaps Sligo Creek could be in Tier 1 rather than Tier 2.

Attachments

A. Mural Canvas Item: Results of assessment

Results of assessment

Tier	Watershed
1	Middle Great Seneca Creek
	Lower Rock Creek
	Northwest Branch
2	Sligo Creek
	Upper Rock Creek
	Upper Patuxent River
3	Potomac Direct - Upper
	Watts Branch
	Cabin John Creek
	Hawlings River
	Little Seneca Creek
	Lower Great Seneca Creek
	Paint Branch
	Muddy Branch



19 watersheds had consistently low exposure scoring, including:

- *Broad Run*
- *South Branch Patapsco River*
- *Lower Monocacy River*
- *Furnace Branch*
- *Fahrney Branch*
- *Monacacy Direct*
- *Little Bennett Creek*
- *Bennett Creek*
- *Rock Run*
- *Little Paint Branch*
- *Potomac Direct - Lower*
- *Horsepen Branch*
- *Upper Great Seneca Creek*
- *Dry Seneca Creek*
- *Little Seneca Creek*
- *Little Falls*
- *Lower Patuxent River*
- *Little Monocacy River*
- *Potomac Direct - Seneca Creek*

©Jacobs 2022

Phase 1 Core Team Meeting #9

Date: November 11, 2022
Time: 1:00 to 3:00 PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56704
Prepared by: Steph Marvin/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Location: Microsoft Teams

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Participants:
Stan Edwards/MC DEP
Frank Dawson/MC DEP
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Khalid Afzal/MNCPPC Planning
Mark Symborski/MNCPPC Planning
Claire Iseli/MC OCE
Steven Shofar/MC DEP
Matt Harper/MNCPPC Parks
Erin McArdle/MNCPPC Parks
Michael Boldosser/MC OEMHS
Daniel Sheridan/MC DOT
Mark Etheridge/MC DPS
Amy Stevens/MC DEP
Kristina Laboy/MC OEMHS
Adriana Hochberg/MC DEP
Krystal Reifer/MC DEP
Meredith Wellington/MC OCE
William Musico/MC DPS
Darian Copiz/MC DEP
Matthias Miziorko/MC OEMHS

Purpose

The purpose of this meeting is to review with the Core team the timeline and stewardship of the 17 outcomes necessary for the County to comprehensively manage flooding. This meeting is the ninth Core Team Workshop, delivered as part of Task 4.1 of the Comprehensive Flood Management Plan Phase 1 work (Task Orders #3 and #4 of Contract 1127041). One additional Core Team Workshop is planned to follow this meeting.

Summary of Discussion

Introductions & Meeting Objectives

Methods for Watershed Prioritization

Purpose: To give understanding of where to focus on Phase 2. Revisions were made since the last assessment with the inclusion of new criterion (total inundated area) and with the environmental area criterion de-emphasized in weighting scenarios. See **Attachment A: Prioritization**.

OEMHS: Data from sensors showed Sligo Creek watershed was the "flashiest" watershed of the County.

Planning: Do they take into account future growth by the time initiatives come out of general plan?

Jacobs: Criteria are more focused on existing conditions for vulnerability assessments in watershed; there's not an overlay of focus areas from Thrive. Prioritization not intended for emergency response. This is a

screening step; prioritize based on available budgets. Next project would be risk assessment; look at future development then.

DEP: Prioritization: if rain were to fall here, based on factors to evaluate each watershed, this is where there would likely be the greatest impact on vulnerable populations, economic/commercial areas, total area inundated. Areas we should study first.

DEP: Gut-feeling from past experience that Sligo Creek should be a higher priority.

Jacobs: There is a lot of channelized stream sections in Sligo Creek. Relatively low number of critical facilities compared to other watersheds.

Scores vary within the tier. Trying to understand higher exposure and potential risk; would need flood depth information to understand more.

Timeline and Stewardship of elements of Comprehensive Flood Management Action Plan

See **Attachments B: Timing and C: Stewardship**. The year specified (i.e., Year 1, 2, 3 or 4) is the year recommended to *initiate* working on the outcome. Core agencies responded to the timing assigned by Jacobs for each outcome. Stewardship: agency responsible for moving a particular outcome forward; shepherding efforts – does not imply having complete authority for that outcome.

17 outcomes are the goals necessary for the County to advance in order to accomplish the comprehensive flood management plan. The competencies advance the outcomes.

Stakeholder Engagement

See **Attachment D: Stakeholder Engagement**. Close to 600 respondents. Most from County residents.

Action Items

OEMHS to speak offline with Jacobs. DEP to share TM on the watershed assessment evaluation from Jacobs with Core members.

Attachments

A. Prioritization

B. Timing

C. Stewardship

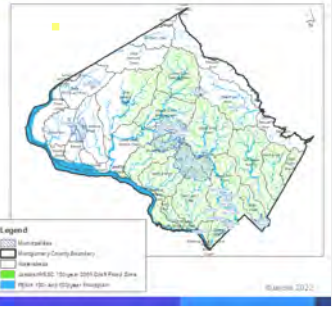
D. Stakeholder Engagement

9 PRIORITIZATION

Reviewing the means to prioritize watersheds/basins for risk studies

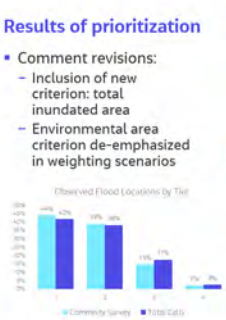
Methods for Watershed Prioritization

- Using a multi-criteria rating technique (aka Multi-Objective Decision Analysis or MODA), calculate flood exposure scores for two scenarios:
  - FEMA 100-year and 500-year floodplain
  - Jacobs/WSSC Flood Modeller 100-year 2065 flood zone *[not available for all watersheds]*
- For each scenario:
  1. Calculate measures for 5 criteria 1
  2. Compute watershed scores for each of 6 weighting scenarios 2
  3. Review results of each weighting scenario to understand sensitivities
  4. Generate tiered list of watersheds based on outcome of sensitivity assessment
- Generate combined tiered list of watersheds based on outcome of both scenarios



Results of prioritization

- Comment revisions:
  - Inclusion of new criterion: total inundated area
  - Environmental area criterion de-emphasized in weighting scenarios



Results of prioritization - comparison

Revisions based on review:
1. *Inclusion of new criterion: total inundated area*
2. *Environmental area criterion de-emphasized in weighting scenarios*

Preliminary
October 20, 2022

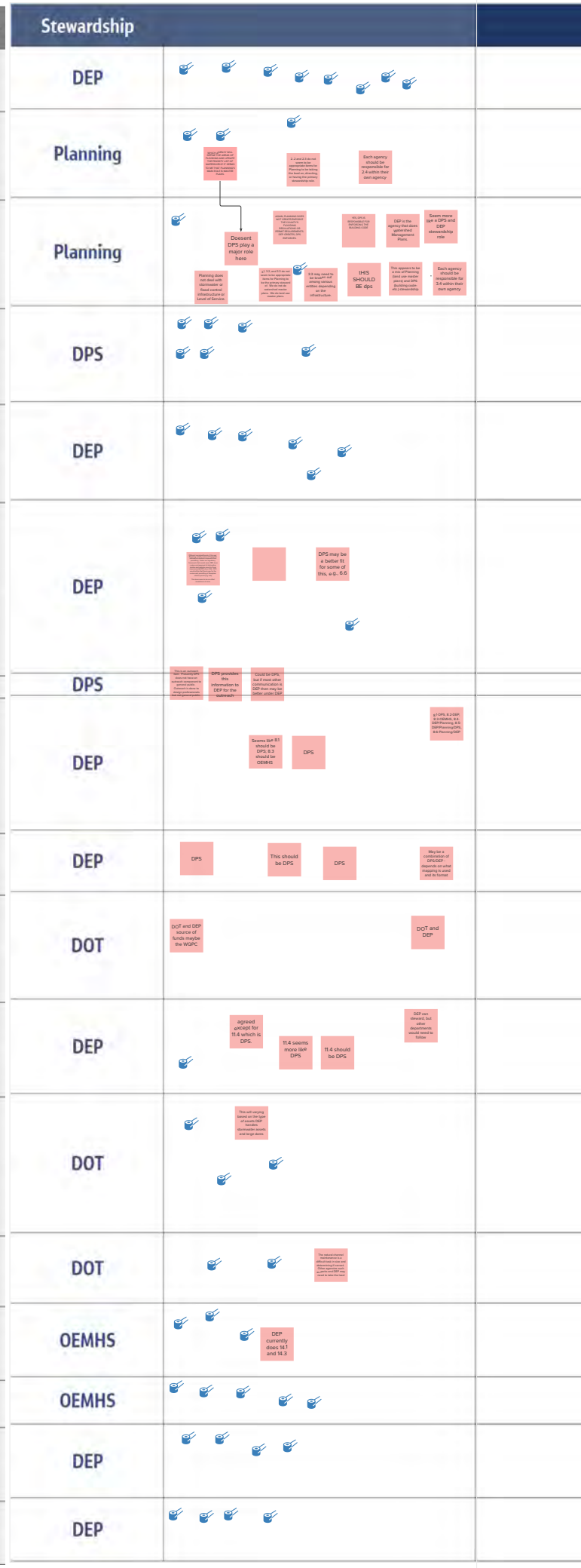
Revised
November 10, 2022

1 Criteria for Watershed Ranking

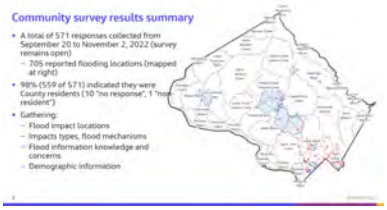
2

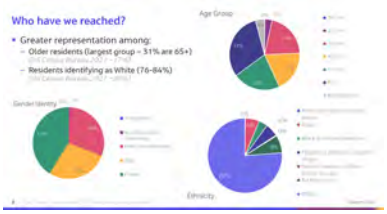
#	Category	Outcomes	Necessary Competencies to advance the Outcomes	Imp	Perf	Urgency Score
1	Governance	Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood.	1.1 Flood risk management roles, responsibilities and efforts are clearly defined, coordinated and shared among all responsible stakeholders (e.g., County departments, municipalities, State Highway Administration). 1.2 Authorities and those accountable for decisions are clearly aware of their responsibilities. 10.3 A centralized authority exists for overseeing flood management planning, risk assessment, flooding response, and recovery activities in the County.	5	2	8
2	Flood Management Planning	Comprehensive land use plans reflect flood risk.	2.1 County master plans incorporate flood risk information, including flood risk for historically vulnerable populations and Equity Emphasis Areas. 2.2 A community-wide flood risk management plan has been developed and maintained (including definition of areas of riverine and urban flood risk) and is used to inform zoning and land use changes. 2.3 Areas that provide natural flood conveyance, storage, and/or mitigation functions are identified and protected. 2.4 Flood risk for culturally and historically significant areas and structures is well understood and geolocated.	3	1.5	4.5
3		Development and redevelopment standards and building codes are updated to reflect established levels of service and current and future climate conditions for areas of riverine and urban flooding.	3.1 A watershed master plan that evaluates future (climate and land use) conditions and short- and long-duration storms is used to implement stormwater management and development regulations. Such a plan addresses wetlands/natural areas and stream channel protection and potential for infill development/re-development impacts. 3.2 Watershed master plan flood risk information is used to inform building code and development standard updates in areas of known or projected future flood risk. 3.3 Stormwater and flood control infrastructure Levels of Service (LOS) are established, communicated and periodically measured and reported, for each part of drainage/stormwater system. 3.4 Staff members know where to find climate data and can utilize it in their current roles.	5	1	9
4		Clear permit process and enforcement of development and redevelopment standards reflecting flood risk exists.	4.1 All development in the Floodplain District is reviewed through the Floodplain District Permit review process. 4.2 The County's Floodplain Management regulations are uniformly enforced. 4.3 All development in areas of urban flood risk are reviewed through a permit review process. 4.4 Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed pre-development runoff. 4.5 The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff members are responsible for activities and approvals associated with stormwater and flood management.	3	4	2
5	Flood Hazard and Risk Information	Flood management information is universally accessible and uniformly utilized by all County agencies.	5.1 Staff reviewing new development and redevelopment applications have access to geographic locations of, and information on, previously flooded areas. 5.2 Standards exist and are used to ensure that flood management GIS data, detailed studies, and reporting are produced in a uniform manner to support end uses. 5.3 A standardized set of baseline and projected future climate data has been collected and made available. 5.4 Staff members know where to find climate data and can utilize it in their current roles. 5.5 Data sharing processes are established to enable agencies to achieve other outcomes.	4.5	2	7
6		Flood risk and mitigation information is readily available and widely communicated to the public.	6.1 The public knows how and where to find information about their current and future flood risk. 6.2 Information on flood insurance is readily available in hardcopy form and on the County website. 6.3 An on-going program of public outreach to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain is coordinated among agencies involved in County flood management. 6.4 Flood hazard mapping is available and used in disclosure of flood hazard information during real estate transactions. 6.5 Information to assist residents in protecting their properties is available in County libraries and on the County website. 6.6 All entities conducting development or redevelopment in the Floodplain District are made aware of the Floodplain District Permit process.	5	2	8
7		Flood insurance options are well-defined and communicated to the public.	7.1 The level of available insurance coverage is known and aligned with flood risk areas. 7.2 There is a plan for increasing flood insurance use among property owners.	3	2	4
8		Flood risk data and analyses are developed and periodically updated.	8.1 Building elevation certificates are collected as part of a permit review process, certificates are reviewed for accuracy and completeness, and are catalogued and available for reference. 8.2 Flood risk geospatial data used for flood risk assessment is kept up-to-date. Geospatial data is defined as georeferenced data sets (environmentally sensitive areas, socially vulnerable areas, commercial/economic impacts areas, but not including stormwater infrastructure asset data - see Outcome #1) that inform flood risk. 8.3 There is a well-defined and documented process for assessing and estimating damages following a flood event by type and extent of impact. 8.4 Critical facilities and critical infrastructure have been identified and geolocated on GIS. 8.5 The County has the technical capability to assess current flood risk. 8.6 Flood risk impact for historically vulnerable populations and Equity Emphasis Areas is well understood.	4.5	2	7
9		Urban Flood Zones/ Riverine Floodplain are defined/mapped.	9.1 Riverine and pluvial/urban flood hazard areas are clearly mapped for different levels of service (storm recurrence). Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined. 9.2 The County has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms. 9.3 Floodplain Districts for the entire county are developed with consistent details.	5	2	8
10	Flood Mitigation	Capital Improvement Program incorporates flood mitigation needs.	10.1 The County has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development). 10.2 Future considerations (e.g., climate change impacts, development, increased impervious areas) are included in storm drainage infrastructure design. 10.3 Flood mitigation projects that reduce County flood risk have been identified. 10.4 A mitigation plan for repetitive loss areas has been developed and is being carried out. 10.5 Buildings within areas of high flood risk are acquired or relocated. 10.6 There is a comprehensive capital improvement program for addressing drainage problems.	5	1	9
11		County environmental, sustainability, and equity goals are incorporated in flood mitigation activities.	11.1 The County's water quality improvement efforts and regulatory compliance are integrated with flood risk management programs. 11.2 County sustainability goals are considered in development of flood mitigation activities. 11.3 County equity goals are considered in development of flood mitigation activities. 11.4 Erosion and sediment control regulations exist for all construction sites for protection of water quality and drainage systems. 11.5 WQPC credit is provided for implementing flood mitigation beyond water quality requirements.	5	2	8
12	Asset Management	Asset management principles are followed to ensure infrastructure assets continuously deliver established levels of service (LOS) at an acceptable risk of failure while minimizing lifecycle costs of owning and maintain the assets.	12.1 A frequently updated asset management plan and program built on a reliable asset inventory and characterizing resources and timescales requirements for all stormwater and flood control infrastructure exists. 12.2 The Asset Management Program establishes and periodically reviews and updates the levels of service to be met by stormwater and flood control systems. Actual levels of service provided are measured and reported. 12.3 A reliable, accurate, and regularly updated inventory of stormwater and flood control infrastructure assets, with their attributes, exists. The inventory is accessible to all parties that inform the inventory or use it for planning purposes. 12.4 The condition and likelihood of failure, along with the consequences of failure, of all stormwater and flood control infrastructure is periodically updated and is easily accessible by staff. 12.5 The risk due to failure of stormwater and flood control infrastructure assets to meet established LOS is periodically updated and used to develop maintenance schedules, needed rehabilitation, replacement, and additional infrastructure assets.	4	2.5	5.5
13		O&M of drainage and flood control infrastructure is proactive to maintain LOS.	13.1 Natural channels on both public and private property are inspected and debris is removed. 13.2 Known problem sites are recorded and given additional attention, as appropriate. 13.3 Regulations prohibiting dumping in streams exist and are publicized and enforced. 13.4 Private stormwater storage facilities are inspected and maintained on a regular basis, or enforcement measures exist if they are not maintained. 13.5 Public stormwater storage facilities are inspected and maintained on a regular	3	4	2
14	Emergency Management	The County has an emergency management plan that addresses preparedness, response, and recovery for flood events.	14.1 The County has failure recognition procedures for dams and levees. 14.2 Response operations for failure of critical infrastructure and critical facilities are planned and practiced through periodic exercises. 14.3 Dam and levee failure planning is coordinated with owners and operators of critical facilities and infrastructure. 14.4 The County encourages owners and operators of critical facilities located in high risk areas to have their own flood response plan.	3	5	1
15		The County's emergency management plan includes early warning systems for high risk areas.	15.1 The County has an effective flood warning system based on flood prediction. 15.2 Planning for dissemination of flood warnings is coordinated with owners and operators of critical facilities and critical infrastructure. 15.3 The County is designated by NWS as StormReady.	3	3	3
16	Budget and Finance	Financing options are well defined and communicated.	16.1 Grant and loan resources for capital improvements and flood preparedness are known and planned for. 16.2 Grant and loan resources for flood event recovery are known and there are resources to apply for these funds. 16.3 Flood protection resources and financial assistance is communicated to property owners by staff trained in retrofitting and grants availability information. 16.4 County grant program exists for acquisition of flood prone properties.	4.5	2	7
17		County budget and staffing needs are comprehensively collated, communicated, and decided upon.	17.1 Operations and maintenance funding needs for stormwater and flood control infrastructure (e.g., green infrastructure, dams, levees) are known and planned for. 17.2 A flooding centered capital improvement plan is developed and updated annually. 17.3 Decisions regarding adequacy of flooding centered staffing and resources is performed by the collection of responsible County agencies.	5	2	8

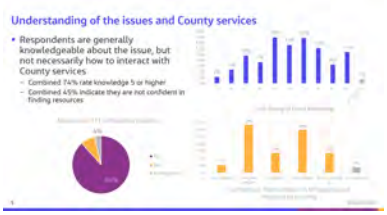
#	Category	Outcomes	Necessary Competencies to advance the Outcomes	Imp	Perf	Urgency Score
1	Governance	Flood risk management roles and responsibilities and overall governance structure are documented and clearly understood.	1.1 Flood risk management roles, responsibilities and efforts are clearly defined, coordinated and shared among all responsible stakeholders (e.g., County departments, municipalities, State Highway Administration) 1.2 Authorities and those accountable for decisions are clearly aware of their responsibilities. 10.3 A centralized authority exists for overseeing flood management planning, risk assessment, flooding response, and recovery activities in the County.	5	2	8
2	Flood Management Planning	Comprehensive land use plans reflect flood risk.	2.1 County master plans incorporate flood risk information, including flood risk for historically vulnerable populations and Equity Emphasis Areas. 2.2 A community-wide flood risk management plan has been developed and maintained (including definition of areas of riverine and urban flood risk) and is used to inform zoning and land use changes. 2.3 Areas that provide natural flood conveyance, storage, and/or mitigation functions are identified and protected. 2.4 Flood risk for culturally and historically significant areas and structures is well understood and geolocated.	3	1.5	4.5
3		Development and redevelopment standards and building codes are updated to reflect established levels of service and current and future climate conditions for areas of riverine and urban flooding.	3.1 A watershed master plan that evaluates future (climate and land use) conditions and short- and long-duration storms is used to implement stormwater management and development regulations. Such a plan addresses wetlands/natural areas and stream channel protection and potential for infill development/re-development impacts. 3.2 Watershed master plan flood risk information is used to inform building code and development standard updates in areas of known or projected future flood risk. 3.3 Stormwater and flood control infrastructure Levels of Service (LOS) are established, communicated and periodically measured and reported, for each part of drainage/stormwater system. 3.4 Staff members know where to find climate data and can utilize it in their current roles.	5	1	9
4		Clear permit process and enforcement of development and redevelopment standards reflecting flood risk exists.	4.1 All development in the Floodplain District is reviewed through the Floodplain District Permit review process. 4.2 The County's Floodplain Management regulations are uniformly enforced. 4.3 All development in areas of urban flood risk are reviewed through a permit review process. 4.4 Peak flows for each new development are reviewed to ensure that runoff from a site will not exceed pre-development runoff. 4.5 The development and redevelopment review processes are clearly mapped using a process flowchart indicating which departments and staff members are responsible for activities and approvals associated with stormwater and flood management.	3	4	2
5	Flood Hazard and Risk Information	Flood management information is universally accessible and uniformly utilized by all County agencies.	5.1 Staff reviewing new development and redevelopment applications have access to geographic locations of, and information on, previously flooded areas. 5.2 Standards exist and are used to ensure that flood management GIS data, detailed studies, and reporting are produced in a uniform manner to support end uses. 5.3 A standardized set of baseline and projected future climate data has been collected and made available. 5.4 Staff members know where to find climate data and can utilize it in their current roles. 5.5 Data sharing processes are established to enable agencies to achieve other outcomes.	4.5	2	7
6		Flood risk and mitigation information is readily available and widely communicated to the public.	6.1 The public knows how and where to find information about their current and future flood risk. 6.2 Information on flood insurance is readily available in hardcopy form and on the County website. 6.3 An on-going program of public outreach to increase flood hazard awareness and motivate actions to reduce flood damage, encourage flood insurance coverage, and protect natural functions of the floodplain is coordinated among agencies involved in County flood management. 6.4 Flood hazard mapping is available and used in disclosure of flood hazard information during real estate transactions. 6.5 Information to assist residents in protecting their properties is available in County libraries and on the County website. 6.6 All entities conducting development or redevelopment in the Floodplain District are made aware of the Floodplain District Permit process.	5	2	8
7		Flood insurance options are well-defined and communicated to the public.	7.1 The level of available insurance coverage is known and aligned with flood risk areas. 7.2 There is a plan for increasing flood insurance use among property owners.	3	2	4
8		Flood risk data and analyses are developed and periodically updated.	8.1 Building elevation certificates are collected as part of a permit review process, certificates are reviewed for accuracy and completeness, and are cataloged and available for reference. 8.2 Flood risk geospatial data used for flood risk assessment is kept up-to-date. Geospatial data is defined as georeferenced data sets (environmentally sensitive areas, socially vulnerable areas, commercial/economic impacts areas, but not including stormwater infrastructure asset data - see Outcome #1) that inform flood risk. 8.3 There is a well-defined and documented process for assessing and estimating damages following a flood event by type and extent of impact. 8.4 Critical facilities and critical infrastructure have been identified and geolocated on GIS. 8.5 The County has the technical capability to assess current flood risk. 8.6 Flood risk impact for historically vulnerable populations and Equity Emphasis Areas is well understood.	4.5	2	7
9		Urban Flood Zones/ Riverine Floodplain are defined/mapped.	9.1 Riverine and pluvial/urban flood hazard areas are clearly mapped for different levels of service (storm recurrence). Areas of flood risk outside FEMA and County Planning studies have been identified and clearly defined. 9.2 The County has the technical capability to assess projected future flood risk, reflecting buildout conditions, and future climate projections for design storms. 9.3 Floodplain Districts for the entire county are developed with consistent details.	5	2	8
10	Flood Mitigation	Capital Improvement Program incorporates flood mitigation needs.	10.1 The County has the technical capability to develop mitigation measures for current and future flood risk (from climate change and future development). 10.2 Future considerations (e.g., climate change impacts, development, increased impervious areas) are included in storm drainage infrastructure design. 10.3 Flood mitigation projects that reduce County flood risk have been identified. 10.4 A mitigation plan for repetitive loss areas has been developed and is being carried out. 10.5 Buildings within areas of high flood risk are acquired or relocated. 10.6 There is a comprehensive capital improvement program for addressing drainage problems.	5	1	9
11		County environmental, sustainability, and equity goals are incorporated in flood mitigation activities.	11.1 The County's water quality improvement efforts and regulatory compliance are integrated with flood risk management programs. 11.2 County sustainability goals are considered in development of flood mitigation activities. 11.3 County equity goals are considered in development of flood mitigation activities. 11.4 Erosion and sediment control regulations exist for all construction sites for protection of water quality and drainage systems. 11.5 WQPC credit is provided for implementing flood mitigation beyond water quality requirements.	5	2	8
12	Asset Management	Asset management principles are followed to ensure infrastructure assets continuously deliver established levels of service (LOS) at an acceptable risk of failure while minimizing lifecycle costs of owning and maintain the assets.	12.1 A frequently updated asset management plan and program built on a reliable asset inventory and characterizing resources and timescales requirements for all stormwater and flood control infrastructure exists. 12.2 The Asset Management Program establishes and periodically reviews and updates the levels of service to be met by stormwater and flood control systems. Actual levels of service provided are measured and reported. 12.3 A reliable, accurate, and regularly updated inventory of stormwater and flood control infrastructure assets, with their attributes, exists. The inventory is accessible to all parties that inform the inventory or use it for planning purposes. 12.4 The condition and likelihood of failure, along with the consequences of failure, of all stormwater and flood control infrastructure is periodically updated and is easily accessible by staff. 12.5 The risk due to failure of stormwater and flood control infrastructure assets to meet established LOS is periodically updated and used to develop maintenance schedules, needed rehabilitation, replacement, and additional infrastructure assets.	4	2.5	5.5
13		O&M of drainage and flood control infrastructure is proactive to maintain LOS.	13.1 Natural channels on both public and private property are inspected and debris is removed. 13.2 Known problem sites are recorded and given additional attention, as appropriate. 13.3 Regulations prohibiting dumping in streams exist and are publicized and enforced. 13.4 Private stormwater storage facilities are inspected and maintained on a regular basis, or enforcement measures exist if they are not maintained. 13.5 Public stormwater storage facilities are inspected and maintained on a regular	3	4	2
14	Emergency Management	The County has an emergency management plan that addresses preparedness, response, and recovery for flood events.	14.1 The County has failure recognition procedures for dams and levees. 14.2 Response operations for failure of critical infrastructure and critical facilities are planned and practiced through periodic exercises. 14.3 Dam and levee failure planning is coordinated with owners and operators of critical facilities and infrastructure. 14.4 The County encourages owners and operators of critical facilities located in high risk areas to have their own flood response plan.	3	5	1
15		The County's emergency management plan includes early warning systems for high risk areas.	15.1 The County has an effective flood warning system based on flood prediction. 15.2 Planning for dissemination of flood warnings is coordinated with owners and operators of critical facilities and critical infrastructure. 15.3 The County is designated by NWS as StormReady.	3	3	3
16	Budget and Finance	Financing options are well-defined and communicated.	16.1 Grant and loan resources for capital improvements and flood preparedness are known and planned for. 16.2 Grant and loan resources for flood event recovery are known and there are resources to apply for these funds. 16.3 Flood protection resources and financial assistance is communicated to property owners by staff trained in retrofitting and grants availability information. 16.4 County grant program exists for acquisition of flood prone properties.	4.5	2	7
17		County budget and staffing needs are comprehensively collated, communicated, and decided upon.	17.1 Operations and maintenance funding needs for stormwater and flood control infrastructure (e.g., green infrastructure, dams, levees) are known and planned for. 17.2 A flooding centered capital improvement plan is developed and updated annually. 17.3 Decisions regarding adequacy of flooding centered staffing and resources is performed by the collection of responsible County agencies.	5	2	8

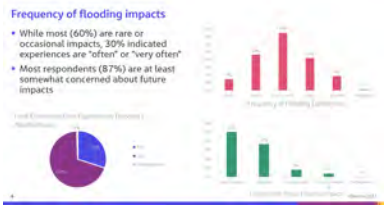


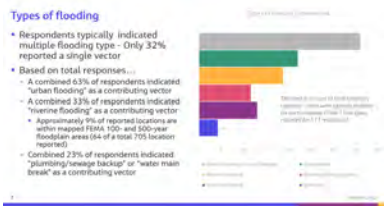
6 STAKEHOLDER ENGAGEMENT

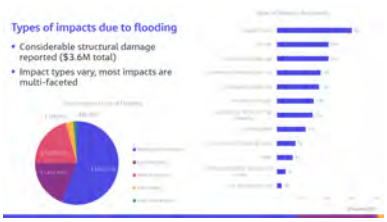












Phase 1 Core Team Meeting #10

Date: December 8, 2022
Time: 1:00 to 3:00 PM
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56704
Prepared by: Steph Marvin/Jacobs
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Location: Microsoft Teams
Participants: Stan Edwards/MC DEP
Frank Dawson/MC DEP
Miranda Santucci/Jacobs
Dan Speicher/Jacobs
Laurens van der Tak/Jacobs
Steph Marvin/Jacobs
Claire Iseli/MC OCE
Darian Copiz/MC DEP
Mark Etheridge/MC DPS
Matt Harper/MNCPPC Parks
Kristina Laboy/MC OEMHS
Erin McArdle/MNCPPC Parks
William Musico/MC DPS
Krystal Reifer/MC DEP
Steven Shofar/MC DEP
Meredith Wellington/MC OCE
Amy Stevens/MC DEP
Mark Symborski/MNCPPC Planning
Adriana Hochberg/MC DEP

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this meeting is to review the upcoming Phase 2 structure. This meeting is the tenth Core Team Workshop, delivered as part of Task 4.1 of the Comprehensive Flood Management Plan Phase 1 work (Task Orders #3 and #4 of Contract 1127041).

Summary of Discussion

Introductions & Meeting Objectives

Review plan for Phase 2. Spanning FY23 and FY24, depending on budget/level of funding and procurement processes. Recommend more frequent briefings to City Council and stakeholder groups. See **Attachment A: Phase 2**

- Governance and Strategic Plan Delivery. Includes establishment of Program Delivery Team and Strategic Plan Delivery (initiation of Year 1 Outcomes).
- Pilot Watershed Detailed Study. Move through the process of data collection, detailed modelling, vulnerability and risk assessment and alternatives analysis to inform the studies that follow that will ultimately help with selection of watersheds.
- Watershed Detailed Studies. Staggered as appropriate.

- Community Engagement. Study specifics, spans across whole lifespan of Phase 2 work.

Review Action Plan Details

- A way to compile what the Core team proposed in terms of outcomes and competencies necessary for advancing that outcome. It presents a roadmap incorporating timing, stewardship, and focus (level of lift) in accomplishing the necessary competencies and advancing the outcomes.
    - Timing is based on urgency and sequencing of activities.
    - Stewardship: Agency serves as the focal point to move an outcome forward.
    - Level of Lift: **See Attachment B: Level of Lift**. "Where we need to focus brain power in the next phase." *High* infers the County doesn't have significant things already in play. *Low* infers the County just needs some tweaks. Core agencies were split into breakout sessions to discuss levels of effort for each outcome, focusing on an assigned category of lift from one of the following: Regulations, Policies, Levels of Service; Decision Responsibilities; Process; Communication/Data; Personnel Resources.

Ownership, Commitment

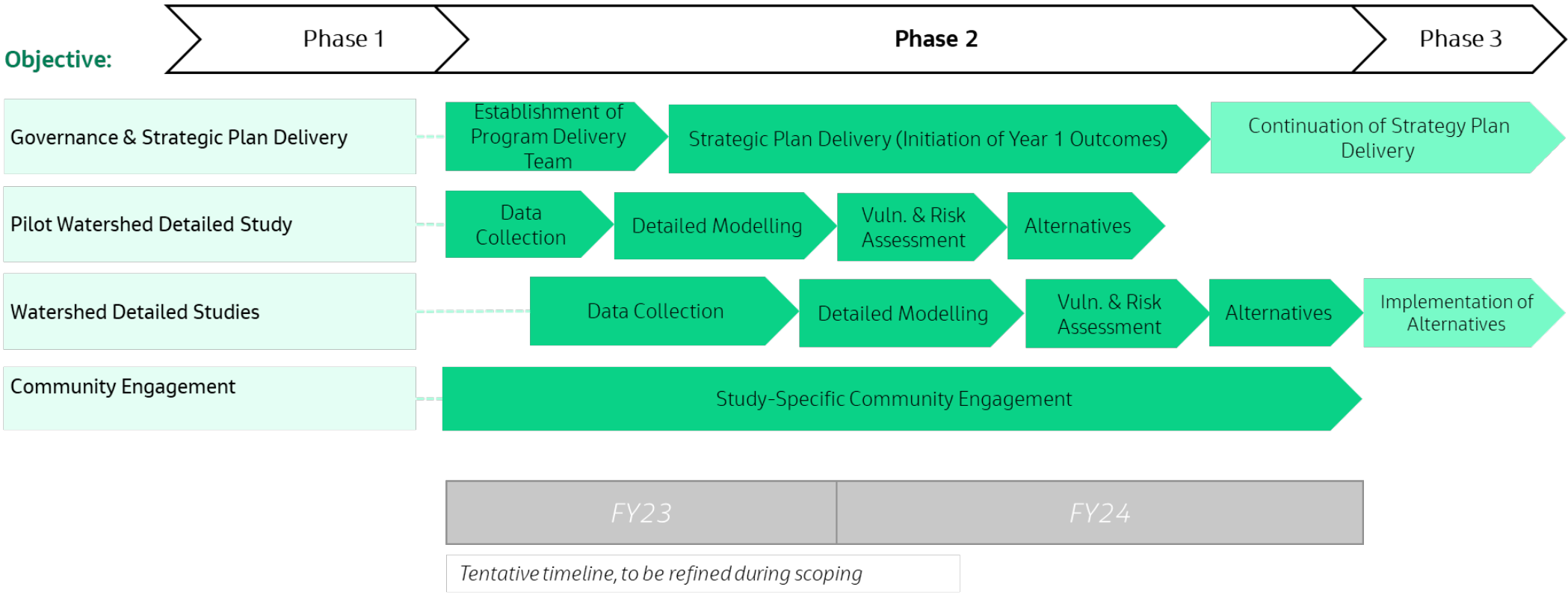
Core Agencies were invited to share their thoughts on what they liked about the Phase 1 process, what they wish for and wonder about. See **Attachment C: Thank You**.

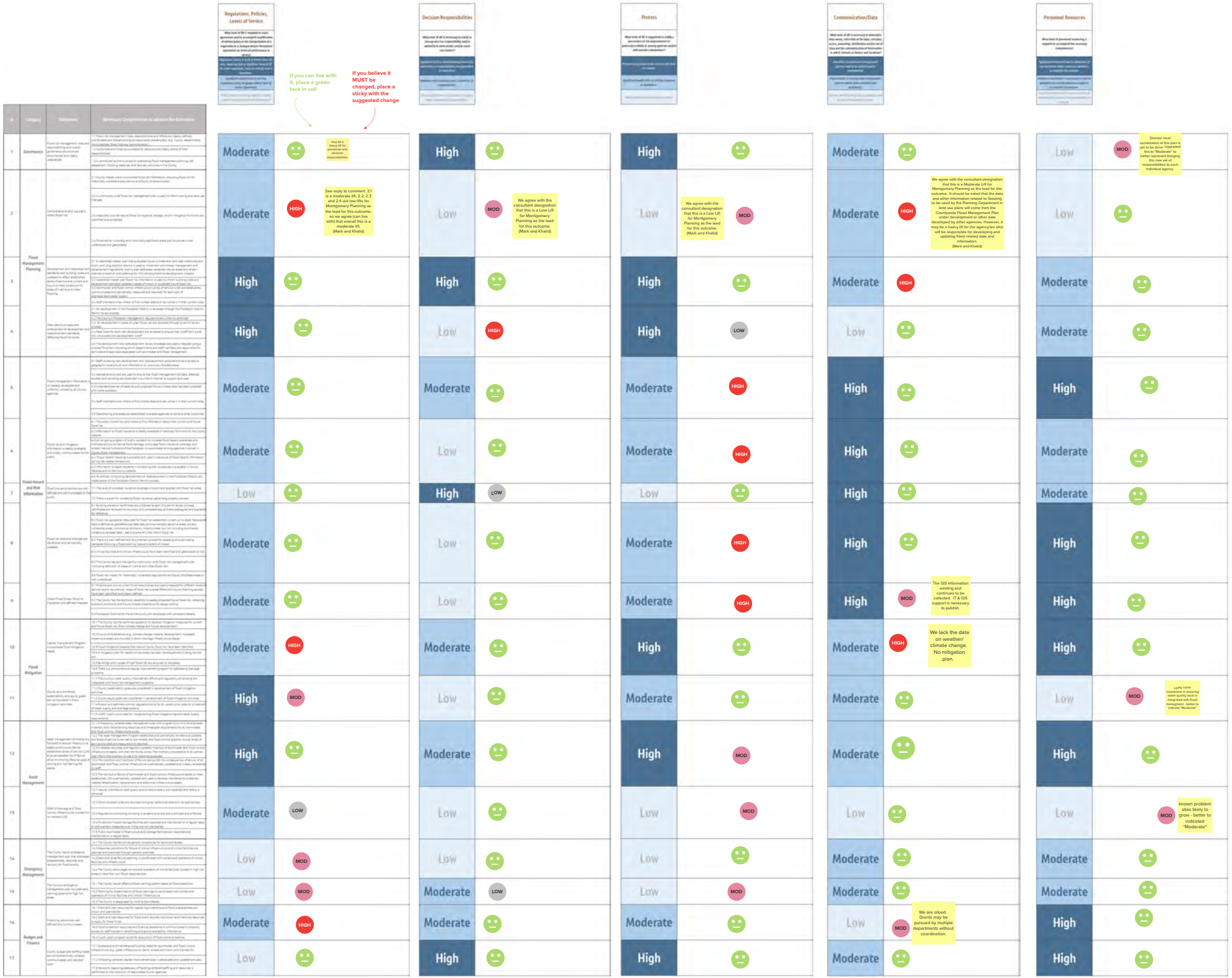
Action Items

- Core team to review and provide comments on Task 3 – Characterization of Historic Flood Condition and Data Gaps Review
- Jacobs to send Core team Task 4.2 – Governance and Policy Review Report, and Task 6 Strategy document by Dec 23rd.

Attachments

A. Phase 2
B. Level of Lift
C. Thank You


Objective:
Phase 1
Phase 2
Phase 3
Governance & Strategic Plan Delivery
Establishment of Program Delivery Team
Strategic Plan Delivery (Initiation of Year 1 Outcomes)
Continuation of Strategy Plan Delivery
Pilot Watershed Detailed Study
Data Collection
Detailed Modelling
Vuln. & Risk Assessment
Alternatives
Watershed Detailed Studies
Data Collection
Detailed Modelling
Vuln. & Risk Assessment
Alternatives
Implementation of Alternatives
Community Engagement
Study-Specific Community Engagement
FY23
FY24
Tentative timeline, to be refined during scoping


Regulations, Policies, Levels of Service
Decision Responsibilities
Process
Communication/Data
Personnel Resources
If you can live with it, place a green face in cell
If you believe it MUST be changed, place a sticky with the suggested change
Moderate
may be a heavy lift for personnel and decision responsibilities.
High
Low
MOD
We agree with the consultant designation that this is a Low Lift for Montgomery Planning as the lead for this outcome. (Mark and Khalid)
Moderate
HIGH
See reply to comment. 2.1 is a moderate lift. 2.2, 2.3 and 2.4 are low lifts for Montgomery Planning as the lead for this outcome, so we agree (can live with) that overall this is a moderate lift. (Mark and Khalid)
High
High
High
Low
HIGH
Moderate
Moderate
High
LOW
Low
Moderate
Moderate
Moderate
HIGH
Moderate
Low
Moderate
HIGH
Low
High
LOW
Moderate
Low
Moderate
HIGH
Moderate
Moderate
HIGH
High
MOD
The GIS information existing and continues to be collected. IT & GIS support is necessary to publish.
Moderate
HIGH
We lack the data on weather/ climate change. No mitigation plan.
High
MOD
High
Moderate
Low
MOD
Lastly some investment in ensuring water quality work is integrated with flood management - better to indicate "Moderate"
High
Moderate
Low
MOD
known problem sites likely to grow - better to indicated "Moderate"
Low
Moderate
Moderate
Moderate
Low
MOD
We are siloed. Grants may be pursued by multiple departments without coordination.
High
High
Moderate
High
Director level socialization of this plan is yet to be done. Upgraded this to "Moderate" to better represent bringing this new set of responsibilities to each individual agency
Low
Moderate
Moderate
Moderate
High
Moderate
High
High
High
High
High
Low
Low
Moderate
Moderate
High
High

8

THANK YOU

I Like...

- Great process it now depends on us to evaluate this plan and implement it
- process was really well run. thank you
- The collaboration with the variety of County departments
- tapping into the collective wisdom of my colleagues
- working with so many different dept. within the County
- inclusion across many county agencies
- seeing where the gaps in understanding and responsibilities exist
- Being able to hear the different agency viewpoints
- using the Miro board to organize the effort
- breaking down silos just a bit
- Collaboration among all entities that play a role in flooding.
- I like the fact that we had such broad agency representation and commitment to this process. Glad to be part of this.
- participants were somewhat forced/ encouraged to provide input

I Wish...

- this effort was easier to accomplish
- there was more tie to absorb what we are trying to do
- the messaging to leadership and the community was more easily accomplished
- There was a better understanding of the resources we need becaue we have already begun FY24 budget
- we had started on this process years ago, but better late than never.
- I wish I could use Mural the way you do Dan!
- we had more time to provide input
- we had more data to use to make good decisions

I Wonder...

- where we will be on this in 2025
- how and when we should brief our director on this
- Where is the feedback on the survey and the community meetings
- how we can get more stakeholders involved
- I wonder what the watershed studies will tell us and how that will influence the governance recommendations.
- how we can keep the silo from forming after this work
- if we can maintain the momentum I feel this Phase I effort has given us.
- How funds will be allocated to accomplish meaningful preventative flood mitigation
- I wonder what Danny DeVito woudl think of this process.
- how this collaboration will continue and expand to more stakeholders
- if we'll be able to accomplish all of this

Appendix C
Core Agency Interview Summaries

Flood Management Organizational Interview

Date:	TBD
Time:	TBD
Project name:	Comprehensive Flood Management Plan Phase 1
Project no:	E4X56703
Prepared by:	M. Santucci

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose:

The objective of agency interviews, and subsequent data collection, is to establish a clear summary of existing County flood management roles and funding, interagency interactions, and agency-identified gaps. Agency interviews are being conducted as part of Task 4.2 of the Comprehensive Flood Management Plan Phase 1 (Task Order #3 of Contract #1127041).

Initial Interview Topics:

1. **Physical Responsibilities**
    a. What physical assets either related to stormwater management or potentially impacted by flooding does your agency maintain or is responsible for in some way?
    b. What historic challenges has the agency had with respect to their physical assets/systems and flooding?
        i. Can you indicate whether damages or response was required for any specific historic events?
    c. Does your agency have any "level of service" associated with design of physical assets (design criteria/guidelines)?
    d. Does your agency have any "level of service" type response thresholds built into your current response protocol? Is there any public expectation related to "level of service" or response?
2. **Organizational Structure/Governance**
    a. Does your organization have a definition of flooding, design procedures or guidelines that the agency uses?
    b. Can you describe each of the roles your agency has with respect to flood management?
        i. Can you describe any standard procedures related to these roles?
        ii. Can you describe funding and staffing associated with these roles?
    c. Please describe relationships with other agencies w.r.t. flood management.
    d. Does your agency have any specific processes (triggers/threholds) related to flood events?

e. What steps are following in the event of a flooding issue?

f. Does your agency have staffing dedicated to their flood management role? Are these responsibilities shared with other agencies?

3. Funding

a. Is existing funding sufficient to accomplish agency goals with respect to flood management?

b. Is funding dependent on approvals/decisions outside your agency?

c. Please describe agency operating and capital budget items related to flood management.

4. Closing

a. Can you describe past challenges in addressing responsibilities related to flooding?

b. Have historic events allowed for any insights into gaps in flood management?

c. Are there agency ideas for improvements to division of responsibilities, funding, staffing?

Department of Environmental Protection (DEP) – Takeaways…

- Role: Current planning/engineering/construction support roles focus on water quality issues related to MS4 permit, Some response and recovery roles, particularly w.r.t. dam responsibilities
- Someone has to own flood management and planning. This person/office needs
  - Clear assignment of responsibilities
  - Authority in networking with other agencies to achieve these
  - Supporting staff to facilitate gathering/maintaining data, coordinating studies and planning, etc.
- Improvements to the 311 system may allow for better understanding/expectation for residents of County offerings and better response
- Infill development flooding complaints are growing and are politically significant (complaints to CE)
- County has good understanding of hazard-category dams, privately-owned dams pose more of a challenge given lack of funding for upgrades needed to be eligible for County maintenance agreements
- Outreach specific to flood risk and flood management could improve community's understanding of risk and options for management
- Planned "Flood Manager" position and support GIS staff will facilitate more broad role in water quantity management, however this position is not program level management and does not have dedicated staff, writ for position is large

©Jacobs 2022

Office of Emergency Management and Homeland Security (OEMHS) – Takeaways…

- Role: Responsible for preparedness planning and response for hazards
- How do we go to the community to talk about flood insurance? How many are insured?
  - There is no existing flood insurance outreach for community members.
- Using Ellicott City as an example, limiting options for recovery of historic buildings prone to flooding is politically sensitive challenge
- Data
  - Critical infrastructure GIS layer is in production, likely available late 2022
  - County flood webpage in development
- Funding is heavily Homeland Security based, new federal framing will allow more expansive definition of hazards
  - Hydrologist will be added to the staff utilizing some FEMA grants

©Jacobs 2022

M-NCPPC Planning – Takeaways…

- Role: County master planning, stewardship for development review process
- Flooding impacts are not considered as part of the master planning process (e.g. area plans or the Thrive2050 plan)
- Site plan review process captures a portion of development/re-development
  - Those following this process generally meet or exceed stormwater management requirements
  - Areas with historic impact are really only ones where flooding is considered
  - Chapter 19 indicated development not allowed in the floodplain, but Planning can approve this. Typically recommend denial but not always.
  - Planning can disagree with agency reviews if reviews recommend more quantity management than required, for example
- One-size-fits all likely not appropriate, given current understanding of areas with recurrent flood risk. County-level understanding of risk would allow understanding of where to focus flood-related policy changes, for example.
- Climate Impact Assessment (County Bill 322) may provide for additional review requirements in the future. Additional staff may be needed to accommodate these reviews.
  - May include climate impact assessment for master plans and ZTAs
- Data: M-NCPPC Floodplain Studies (not digitized), refined high-resolution stream line via MDE likely fall 2022

©Jacobs 2022

Department of Permitting Services (DPS) – Takeaways…

- There is lack of understanding at many levels (design engineer, other agency, community) on the limitations of reviews in terms of water quantity.
  - State-level “safe conveyance” code put onus for quantity management on design engineer
- County defines floodplain as flooded areas for stream with drainage area > 30 acres.
  - County has mapped approximately 800 miles of 1800 miles of eligible streams.
- Data from DPS is historically paper-based, thus DPS is not able to easily access historic permit information very efficiently. This information is not georeferenced. Floodplain studies now require geolocated information for results, but DPS relies on DEP GIS staff to facilitate maintaining these records.
- DPS is understaffed when it comes to floodplain regulation.
  - Staffing has shrunk since earlier eras, but responsibilities have increased.
  - Floodplain review is highly complex, requires additional training to complete.

©Jacobs 2022

Department of Transportation (DOT) – Takeaways…

- Role: Planning, engineering, permitting support/reviews, O&M, preparedness, response, and recovery roles for stormwater within the public storm drain system as well as County culverts and bridges (jurisdiction bridge inspections as well)
- Management of Drainage Assistance Program provides some technical assistance for known public ROW flooding issues but limited to issues due to insufficient capacity and reliant on DAP funding
- DOT is actively filling gaps in storm drain and culvert databases. (eventually channels will be addressed as well). Large (36”+) culverts complete, working on <36” culverts. Older areas of County prioritized based on density of data gaps.
- Improvement to transfer of data from DPS to DOT could facilitate having a more complete database by ensuring new information is being imported fully. Only in the last year have developers been required to provide CAD to DPS
- Depots have lists of frequently flooded locations. These lists are used to triage inspections before storm events.
- DOT cannot always meet criteria indicated by functional classification due to site constraints, particularly for bridges over very wide floodplains
- Overall, some programs not sufficiently funded to fully address identified need: culvert rehabilitation program, bridge program, DAP.

©Jacobs 2022

M-NCPPC Parks

- Role: Comprehensive management of County park lands (~13% of County lands), including planning, engineering, construction, preparedness, response, and recovery activities
  - High hazard (3) and significant hazard dams (1), stream valleys, bridges/culverts/outfalls/SD network, buildings
  - Due to nature of stream valley park system, have frequently flooded roads (Beach Drive, Slide Creek Parkway, Meadowbrook Park, Kensington areas) as well as erosion complaints in or adjacent to parks
- Interagency and community coordination is frequent given nature of park properties (many borders, downstream of public stormwater system)
- Noted past challenges: Debris removal is an area of overlap with other agencies, no defined program for this in Parks and Issues with legacy systems and agreements
- Data/Key resources: Parks SWM infrastructure GIS database

©Jacobs 2022

Office of the County Executive (OCE)

- Role: OCE is often at the forefront of community complaints related to flooding.
- Many complaints throughout the community of life-safety related flooding issues on private property. County is struggling to provide a response for these issues.
- County Executive office concerned over pace of the study given the noted issues.

©Jacobs 2022

Appendix D
Core Agency Questionnaire Responses

DPS Responsibilities Questionnaire

Purpose: Designed to gather details of Montgomery County agency current primary and supporting responsibilities across all flooding sources and roles

Completion: **July 5, 2022**

Forward to: Miranda.santucci@jacobs.com

Instructions:

1. Reference the Responsibilities Matrix noting your agency's primary and supporting responsibility (last page of this document)
2. Complete this questionnaire assuring that characterization of your agency's responsibility is completed for all cells noted in the Responsibility Matrix
3. Assure that the complement of completed questionnaires cover the entirety of your agency's responsibility in the matrix
4. Forward completed questionnaire to Miranda Santucci of Jacobs by end of day July 5th (to be reviewed in July 7th session)

Definitions:

For consistency, these are the definitions for 'Roles' and 'Sources'

Roles:

Pro-active Roles								Reactive Roles	
Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Master planning (land use, master planning, other than water/ wastewater/ stormwater) at the County, watershed, or area plan level	*Engineering planning studies at the system level corresponding to the mission of a specific agency (SW, WW)*	*County-owned infrastructure engineering/ design, review of design submittals*	*Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections*	*In-house and external construction support (stormwater, flood control, and infrastructure projects)*	*Responsibility for determining how infrastructure is operated*	*Maintaining SW infrastructure (ponds, culverts, dams, etc.)*	*Emergency response preparedness role, planning of logistics of response, training and conducting drills interagency communication s strategy*	*Carrying out response activities for a flooding event*	*Supporting post-event activities such as repairs/ addressing impacts and/or completing or supporting post-disaster/ hazard mitigation grant applications*

Sources:

Riverine Flooding *(High stream and river water levels causing regional overbank flooding)*	Not in FEMA floodplain
	In FEMA floodplain
Pluvial/ Interior flooding/Urban flooding/"Lot to Lot" *(flooding due to local rainfall and subsequent surface drainage and/or exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to other public (PG, Howard, Federal lands, County land to parkland and vice versa)
Groundwater flooding *(high GW table causing structure sublevel flooding)*	
Water main break	
Sewer overflow *(backup of sewers due to stormwater inflow from open manholes or cracked pipes)*	

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. A questionnaire does not have to be completed for each individual cell (but you can if you want), yet each cell must be covered in a description. Consider ways to organize your primary and supporting responsibilities by SOURCE and/or ROLES. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain				X						
	IN FEMA floodplain				X						
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private				X						
	Entirely on public land				X						
	From public to private				X						
	From private to public				X						
	Public to other public				X						
Groundwater flooding											
Water main break											
Sewer overflow											

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*

- DPS Water Resources reviews proposed construction activity for compliance with County floodplain requirements. This may include coordination with Federal and State permitting requirements.

2. *Characterize your agency's supporting role.*

- At times we offer compliance guidance for projects that are being considered for development. This includes providing input to the Planning Board for projects that are being considered for Board approval.
- Construction support is provided through field inspection of projects during construction.
- DPS provides customer/resident support in terms of guidance on the potential risk of existing non-conforming structures or structures in or near floodplains. This support also includes referral to flood mitigation companies for owners of structures at risk of flood damage.

3. *What regulations or policies dictate responsibilities or authorities?*

- Montgomery County Code Section 19, Article III
- Executive Regulation 24-06AM
- Guidelines For The 100-Year Floodplain Delineation As Part Of The Subdivision Review And Floodplain District Permit Requirement – 04/09/91
- Set the compliance standards, following MDE

4. *What codified standard operating procedures structure actions?*

- Code, Regulation and submission review checklists.
- Floodplain District Permit and Floodplain Delineations Studies Plan Review Checklists.

5. *Describe how external stakeholders are engaged.*

- We answer questions from property owners and other interested parties as to whether a property includes a mapped FEMA or Montgomery County floodplain.
- With the exception of the City of Rockville and Gaithersburg, Montgomery County is the FEMA floodplain manager for all incorporated and unincorporated areas of the county. We assist with and meet with all municipalities that fall under the county's Model Floodplain Ordinance. This includes FEMA Community Assistance Visit (CAV). The CAV is a visit to a community by FEMA, the Maryland Department of the Environment (MDE), and Montgomery County staff on behalf of FEMA that serves the dual purpose of providing technical assistance to the community and assuring that the community is adequately enforcing its floodplain management regulations.
- We can answer questions about regulatory requirements that affect development.
- State and Federal Agency coordination.

6. *Describe the funding sources, budgeting, and staff resources.*

- DPS is an enterprise fund and its budget is based on the revenue it collects through permit review.
- DPS is a permitting agency that does not engage in contract procurement and therefore does not have the means to pursue Federal Grants. Though we will partner with other agencies that perform capital or environmental improvement projects that can be leveraged to apply for Federal Grants.
- Additionally, DPS does not engage in land use planning. Though applicants and agencies will consult with DPS for the review of Floodplain Delineation Studies used in the mapping of natural resources. As the lead agency in the determination of floodplain locations and regulatory compliance DPS serves an advisory function in Land Use Planning, Stormwater/ Flood Infrastructure Planning, and with Design/Engineering.

1 = Primary Responsibility 2 = Supporting Influence

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain	2	1		1	2					
	In FEMA floodplain	2	1		1	2					
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land				1	2					
	Entirely on public land				1	2					
	From public to private				1	2					
	From private to public				1	2					
	Public to other public (PG, Howard, Federal lands)				1	2					
Groundwater flooding											
Water main break											
Sewer overflow											

LEGEND 1 2 MC DEP 1 3 MNCPPC PLANNING 1 2 MNCPPC PARKS 1 5 MC DPS 1 3 MC OCE 5 MC DOT 2 5 MC OEMHS

DEP Responsibilities Questionnaire

Purpose: Designed to gather details of Montgomery County agency current primary and supporting responsibilities across all flooding sources and roles

Completion: **July 5, 2022**

Forward to: Miranda.santucci@jacobs.com

Instructions:

1. Reference the Responsibilities Matrix noting your agency's primary and supporting responsibility (last page of this document)
2. Complete this questionnaire assuring that characterization of your agency's responsibility is completed for all cells noted in the Responsibility Matrix
3. Assure that the complement of completed questionnaires cover the entirety of your agency's responsibility in the matrix
4. Forward completed questionnaire to Miranda Santucci of Jacobs by end of day July 5th (to be reviewed in July 7th session)

Definitions:

For consistency, these are the definitions for 'Roles' and 'Sources'

Roles:

Pro-active Roles								Reactive Roles	
Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Master planning (land use, master planning, other than water/ wastewater/ stormwater) at the County, watershed, or area plan level	*Engineering planning studies at the system level corresponding to the mission of a specific agency (SW, WW)*	*County-owned infrastructure engineering/ design, review of design submittals*	*Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections*	*In-house and external construction support (stormwater, flood control, and infrastructure projects)*	*Responsibility for determining how infrastructure is operated*	*Maintaining SW infrastructure (ponds, culverts, dams, etc.)*	*Emergency response preparedness role, planning of logistics of response, training and conducting drills interagency communication s strategy*	*Carrying out response activities for a flooding event*	*Supporting post-event activities such as repairs/ addressing impacts and/or completing or supporting post-disaster/ hazard mitigation grant applications*

Sources:

Riverine Flooding *(High stream and river water levels causing regional overbank flooding)*	Not in FEMA floodplain
	In FEMA floodplain
Pluvial/ Interior flooding/Urban flooding/"Lot to Lot" *(flooding due to local rainfall and subsequent surface drainage and/or exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to other public (PG, Howard, Federal lands, County land to parkland and vice versa)
Groundwater flooding *(high GW table causing structure sublevel flooding)*	
Water main break	
Sewer overflow *(backup of sewers due to stormwater inflow from open manholes or cracked pipes)*	

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. A questionnaire does not have to be completed for each individual cell (but you can if you want), yet each cell must be covered in a description. Consider ways to organize your primary and supporting responsibilities by SOURCE and/or ROLES. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain										
	IN FEMA floodplain										
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private										
	Entirely on public land										
	From public to private										
	From private to public										
	Public to other public										
Groundwater flooding											
Water main break											
Sewer overflow											

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*

- Land Use Planning – DEP does not have a primary role in land use planning.
- Stormwater/Flood Infrastructure Planning – DEP has primary responsibility for watershed assessments. The assessments provide an understanding of watershed conditions and changes in the County, guide us where to focus restoration efforts, and identify potential water quality restoration implementation approaches and targeted areas. Assessments collect and prioritize information that is used to develop a management strategy (e.g. TMDL implementation plans). DEP has primary responsibility for Total Maximum Daily Load (TMDL) Implementation Plans as well as other planning efforts use watershed assessments to determine what projects will be most effective and efficient at meeting TMDL targets and other objectives. County Code, Chapter 19, Article II, Section 19-22, DEP, in cooperation with the DPS, the MNCPPC Board, and other appropriate agencies, may develop watershed management plans to implement stormwater management policies that apply individually to specific watersheds in the County.
- Design/Engineering – DEP has primary responsibility for designing new and retrofitted stormwater management facilities focused on both water quantity (e.g., stormwater ponds) and water quality (e.g., stormwater ponds, stream restorations, green streets, RainScapes) to fulfill the County's MS4 permit Stormwater Restoration requirements. DEP also designs major structural repairs of existing stormwater management facilities as part of the MS4 permit requirements to inspect and maintain stormwater management BMPs.
- Permitting – DEP does not have a primary role in issuing permits. DEP applies for permits for restoration and major structural repair projects.
- Project Construction Support – DEP has primary responsibility for the construction of certain stormwater management facilities to fulfill the County's 2021 MS4 Stormwater Restoration requirements focused on both water quantity (e.g., stormwater ponds) and water quality (e.g., stormwater ponds, stream restorations, green streets, RainScapes). This also includes major structural repairs.
- Operations – DEP has primary responsibility for the inspection of all SW management BMPs under County jurisdiction. DEP has primary responsibility for structural maintenance of BMPs on County properties, and in some cases (especially ESD on County properties, performs all required maintenance. DEP is also responsible for structural maintenance of SW management BMPs on HOA or Community Association properties that have been transferred to the County's Stormwater Facility Maintenance Program.
- Maintenance – DEP has primary responsibility for structural maintenance of BMPs on County properties, and in some cases (especially ESD on County properties), performs all required maintenance. DEP has primary responsibility for the structural maintenance of SW management facilities on HOA or Community Association properties that have been transferred to the County's Stormwater BMP Inspection and Maintenance Program (nonstructural maintenance, including grass cutting, trash removal, and landscaping, is the responsibility of the property owner). The Stormwater BMPInspection and Maintenance Section in the Watershed Restoration Division inspects all stormwater BMPs in the County at least every three years in order to make sure the facilities are functioning properly. Property owners are advised if a facility needs maintenance. Any contractor performing structural maintenance on a stormwater facility in the County must attend DEP's Stormwater Facility Maintenance Contractor Training.

- Preparedness – DEP's Watershed Restoration Division maintains remote monitoring equipment and annually trains personnel for monitoring of 10 high hazard dams and levees in the County. DEP's Recycling and Resource Management Division is responsible for developing and maintaining the County's Debris Management Plan, which "establishes the framework within which the County will respond and coordinate the management of debris generated by potential manmade and natural disasters." The County is also in the process of installing 35 new flood sensors through a Partnership between the Department of Homeland Security (DHS) and the Department of Environmental Protection (DEP), Office of Emergency Management and Homeland Security (OEMHS), Department of Transportation (DOT), Fire and Rescue (MCFRS), and the Maryland National Capital Park and Planning Commission (M-NCPPC).The flood sensors are being deployed at sites identified by DEP and OEMHS, including high or significant hazard dams, low-lying roads and flood-prone areas. These real-time sensors complement and extend the capabilities of the County's existing operations that include DEP's remote monitoring stations that are part of existing Dam Safety Operations, and OEMHS's tracking and monitoring of water levels at streams and rivers across the County through the existing US Geological Survey (USGS) gauges.
- Response – DEP is responsible for monitoring 10 high hazard dams and levees in the County during extreme weather events. DEP SWIM program also conducts annual inspections of all County owned and maintained dams.
- Recovery – DEP assesses the condition of high hazard dams and levees, as well as other significant SW management infrastructure, following severe storm events to assess the need for structural repairs.

2. *Characterize your agency's supporting role.*

- Land Use Planning – DEP reviews various environmental aspects of planning documents, including issues related to stormwater management, green infrastructure, and forests/trees.
- Stormwater/Flood Infrastructure Planning – DEP. See primary role description.
- Design/Engineering – DEP. See primary role description
- Permitting – DEP. We are required to obtain all relevant permits for our stormwater management and flood control projects. DEP does not issue any permits.
- Project Construction Support – DEP provide onsite construction oversite and daily inspections for the construction stormwater bmp's to meet the County's MS4 permit Stormwater restoration requirements.
- Operations – DEP. See primary role description.
- Maintenance – DEP. See primary role description.
- Preparedness – DEP. See primary role description.
- Response – DEP's Stream Monitoring Section in the Watershed Restoration Division assesses the environmental impact on aquatic life of water main breaks and sewer overflows. DEP's Environmental Compliance Group in the Division of Energy, Climate, and Compliance supports the Stream Monitoring Section's assessment, and also ensures notices are posted and remediation actions are taken by the responsible wastewater utility when sewer overflows occur.
- Recovery – DEP's Recycling and Resource Management Division supports post-storm recovery operations (generally conducted by the Department of Transportation) through the implementation of the Debris Management Plan.

3. *What regulations or policies dictate responsibilities or authorities?*

- Land Use Planning – Section 33A-5 of the County Code dictates the process for Executive Branch review of master plans.
- Stormwater/Flood Infrastructure Planning – There are no requirements for watershed assessments, although this is considered a best practice for restoration planning. MS4 permit requires the development of TMDL Implementation plans within one year after MDE and EPA issues a TMDL. County Code, Chapter 19, Article II, Section 19-22, DEP, in cooperation with the DPS, the MNCPPC Board, and other appropriate agencies, may develop watershed management plans to implement stormwater management policies that apply individually to specific watersheds in the County.
- Design/Engineering – Section 19-28 of the County Code and Section 19.00.01.06 of the Code of Montgomery County Regulations covers inspection and maintenance of new and existing SW management facilities.
- Permitting – N/A
- Project Construction Support – DEP provides onsite construction management for all projects until final completion on a daily basis. This includes consultation with the design engineer as required.
- Operations – DEP – Section 19-28 of the County Code, Section 19.00.01.16 of the Code of Maryland Regulations. Environment Article, Title 4, Subtitle 2, Annotated Code of Maryland. County's MS4 Permit
- Maintenance – Section 19-28 of the County Code and Section 19.00.01.06 of the Code of Montgomery County Regulations covers inspection and maintenance of new and existing SW management BMPs. Environment Article, Title 4, Subtitle 2, Annotated Code of Maryland. County's MS4 Permit
- Preparedness – The Annotated Code of MD Environment Article, Section 5-503.1 and MD House Bill 125 requires owners of high and significant hazard dams to have Emergency Action Plan (EAP) in place and make annual updates. EAP lays out emergency levels that trigger monitoring of the 10 high and significant hazard dams. The authorities governing the development of the County's Debris Management Plan are provided on Page 1-8 of the Plan.
- Response – DEP – The Annotated Code of MD Environment Article, Section 5-503.1 and MD House Bill 125 requires owners of high and significant hazard dams to have Emergency Action Plan (EAP) in place and make annual updates. EAP lays out emergency levels that trigger monitoring of the 10 high and significant hazard dams.
- Recovery – DEP

4. *What codified standard operating procedures structure actions?*

- Land Use Planning – N/A
- Stormwater/Flood Infrastructure Planning – DEP – No codified SOPs for watershed assessments. MDE provide guidance documentation for developing TMDL Implementation plans. County Code Chapter 19, Article II, Section 19-22 provides recommendations for what should be included in a watershed management plan.

- Design/Engineering – DEP - - *2000 Maryland Stormwater Design Manual* and the provisions of Maryland's *Stormwater Management Act of 2007* (Act).
- Permitting – N/A
- Project Construction Support – DEP - - *2000 Maryland Stormwater Design Manual* and the provisions of Maryland's *Stormwater Management Act of 2007* (Act).
- Operations – DEP - *2000 Maryland Stormwater Design Manual* and the provisions of Maryland's *Stormwater Management Act of 2007* (Act).
- Maintenance – DEP - *2000 Maryland Stormwater Design Manual* and the provisions of Maryland's *Stormwater Management Act of 2007* (Act).
- Preparedness – DEP – Montgomery County Emergency Operations Plan and DEP's Dam Monitoring Procedures
- Response – DEP – Montgomery County Emergency Operations Plan and DEP's Dam Monitoring Procedures
- Recovery – DEP

5. *Describe how external stakeholders are engaged.*

- Land Use Planning – N/A
- Stormwater/Flood Infrastructure Planning – DEP - DEP provides opportunity for external stakeholder to be involved in the review of the watershed assessments. Typically, this was done via public meeting. MS4 permit requires all TMDL implementation plans have a 30 public comment period.
- Design/Engineering – DEP coordinates with property owners and community organizations at the beginning of design and as more detailed components of the design are developed through the permitting process. This could include calls, meetings, site walks, and/or informational updates through email or web.
- Permitting – DEP fulfills stakeholder/property owner outreach/notification requirements of relevant permits.
- Project Construction Support – DEP provides updates on construction progress and responds to community questions.
- Operations – DEP – All inspections and maintenance related activities are conducted in coordination with the appropriate property owners
- Maintenance – DEP - – All inspections and maintenance related activities are conducted in coordination with the appropriate property owners
- Preparedness – DEP - EAP activation and dam monitoring are conducted in coordination with MDE and other stakeholders as listed in each EAP.
- Response – DEP – EAP activation and dam monitoring are conducted in coordination with MDE and other stakeholders as listed in each EAP.
- Recovery – DEP

6. *Describe the funding sources, budgeting, and staff resources.*

- DEP's activities are funded by three different funding sources. The DEP Watershed Restoration Division utilizes funding from the Water Quality Protection Charge, State loans, grants from the Chesapeake Bay Trust, National Fish and Wildlife Foundation and State and Federal grants. The primary funding source is the Water Quality Protection Charge.

1 = Primary Responsibility 2 = Supporting Influence

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain										
	In FEMA floodplain										
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land										
	Entirely on public land										
	From public to private										
	From private to public										
	Public to other public (PG, Howard, Federal lands)										
Groundwater flooding											
Water main break											
Sewer overflow											

LEGEND MC DEP MNCPPC PLANNING MNCPPC PARKS MC DPS MC OCE MC DOT MC OEMHS

DOT Responsibilities Questionnaire

Purpose: Designed to gather details of Montgomery County agency current primary and supporting responsibilities across all flooding sources and roles

Completion: **July 5, 2022**

Forward to: Miranda.santucci@jacobs.com

Instructions:

1. Reference the Responsibilities Matrix noting your agency's primary and supporting responsibility (last page of this document)
2. Complete this questionnaire assuring that characterization of your agency's responsibility is completed for all cells noted in the Responsibility Matrix
3. Assure that the complement of completed questionnaires cover the entirety of your agency's responsibility in the matrix
4. Forward completed questionnaire to Miranda Santucci of Jacobs by end of day July 5th (to be reviewed in July 7th session)

Definitions:

For consistency, these are the definitions for 'Roles' and 'Sources'

Roles:

Pro-active Roles								Reactive Roles	
Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Master planning (land use, master planning, other than water/ wastewater/ stormwater) at the County, watershed, or area plan level	*Engineering planning studies at the system level corresponding to the mission of a specific agency (SW, WW)*	*County-owned infrastructure engineering/ design, review of design submittals*	*Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections*	*In-house and external construction support (stormwater, flood control, and infrastructure projects)*	*Responsibility for determining how infrastructure is operated*	*Maintaining SW infrastructure (ponds, culverts, dams, etc.)*	*Emergency response preparedness role, planning of logistics of response, training and conducting drills interagency communication s strategy*	*Carrying out response activities for a flooding event*	*Supporting post-event activities such as repairs/ addressing impacts and/or completing or supporting post-disaster/ hazard mitigation grant applications*

Sources:

Riverine Flooding *(High stream and river water levels causing regional overbank flooding)*	Not in FEMA floodplain
	In FEMA floodplain
Pluvial/ Interior flooding/Urban flooding/"Lot to Lot" *(flooding due to local rainfall and subsequent surface drainage and/or exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to other public (PG, Howard, Federal lands, County land to parkland and vice versa)
Groundwater flooding *(high GW table causing structure sublevel flooding)*	
Water main break	
Sewer overflow *(backup of sewers due to stormwater inflow from open manholes or cracked pipes)*	

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. A questionnaire does not have to be completed for each individual cell (but you can if you want), yet each cell must be covered in a description. Consider ways to organize your primary and supporting responsibilities by SOURCE and/or ROLES. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain	X	X	X	X	X	X	X			
	IN FEMA floodplain	X	X	X	X	X	X	X			
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private										
	Entirely on public land	X	X	X	X	X	X	X			
	From public to private	X	X	X	X	X	X	X			
	From private to public										
	Public to other public	X	X	X	X	X	X	X			
Groundwater flooding											
Water main break											
Sewer overflow											

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*

- Riverine flooding impacts the transportation network that includes roads, bridges, storm drain, bike and pedestrian facilities
- MC DOT is responsible for planning, designing, construction and maintenance of the transportation network.
- MC DOT regularly shares project design information with DPS and DEP. Also coordination with SHA is required for almost all bridge projects.

2. *Characterize your agency's supporting role.*

- MC DOT provides supporting role during the master plan process conducted by MNCPPC. MC DOT provides comments to MNCPPC during master plan updates. Major infrastructure such as the road network is developed during the master plan process.

3. *What regulations or policies dictate responsibilities or authorities?*

- SHA mandates that all federal aid bridge projects must meet federal standards including conveyance of design storm.
- MD DNR is responsible for approving any impacts to the FEMA floodplain.
- Maryland Department of Environment has required storm water quality since 2000. DPS is the agency responsible for review and approval. The 2000 MDE Stormwater Design Manual is used.

4. *What codified standard operating procedures structure actions?*

- MC DOT has a Drainage Design Criteria manual that was revised in 2014. The manual provides sizing criteria for infrastructure components such as culverts, storm drains and inlets.
- Highway Services has standard procedures for closing roads during flood events.
- Highway Services also has procedures to check and clear debris from storm drains and bridges that are frequently flooded.

5. *Describe how external stakeholders are engaged.*

- The 311 system is used to collect input from residents regarding issues related to the infrastructure. No follow up to requests are provided.
- The Drainage Assistance Request program will investigate flooding and storm drain related calls and issues. The DAR program will complete a site visit within three weeks of receiving a DAR. The residents are then contacted through email with a response to the issue.

6. *Describe the funding sources, budgeting, and staff resources.*

- There are four Capital Improvement Project PDFs that cover storm drains, outfall and culvert repair. The four are the following: CIP 508180 – Facility Planning: Storm Drains - $480K/year; CIP 500320 – Storm Drain General - $2,000K/year; CIP 509946 – Outfall Repairs - $924K/year and CIP 501470 – Storm Drain Culvert Replacement - $1,800k/year.
- There are various bridge CIPs that encompass the County's bridge repair and replacement program.
- The Division of Highway Services has both operating and capital funds to cover operation and maintenance costs for various infrastructure components.

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. A questionnaire does not have to be completed for each individual cell (but you can if you want), yet each cell must be covered in a description. Consider ways to organize your primary and supporting responsibilities by SOURCE and/or ROLES. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain									X	X
	IN FEMA floodplain									X	X
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private									X	X
	Entirely on public land									X	X
	From public to private									X	X
	From private to public									X	X
	Public to other public									X	X
Groundwater flooding										X	X
Water main break										X	X
Sewer overflow										X	X

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*

- Division of Highway Services have depot crews that respond to floods and provide equipment and man-power.
- Division of Traffic Operations operate the traffic signal network and modify operations to assist in emergency situations.
- Division of Transportation Engineering provides post flood inspections of bridges and culverts to determine if the transportation infrastructure is functional and safe.

2. *Characterize your agency's supporting role.*

-

3. *What regulations or policies dictate responsibilities or authorities?*

- SHA policy mandates that all scour prone bridges be inspected following flood events. DTE utilizes consultants to conduct bridge inspections.
- MD DNR is responsible for approving any impacts to the FEMA floodplain including emergency repairs.
- Maryland Department of Environment has required storm water quality since 2000. DPS is the agency responsible for review and approval.
- MC DOT has a Drainage Design Criteria manual that was revised in 2014. The manual provides sizing criteria for infrastructure components such as culverts, storm drains and inlets.

4. *What codified standard operating procedures structure actions?*

- Highway Services has standard procedures for closing roads during flood events.
- Highway Services also has procedures to check and clear debris from storm drains and bridges that are frequently flooded.

5. *Describe how external stakeholders are engaged.*
■ Individual are engaged through direct communication either by phone or email. ■ Regular coordination meetings with SHA and MNCPPC occur on a monthly basis. ■ Review agencies are contacted on an as needed basis for projects. ■ Highway Services has communications with SHA counterparts

6. *Describe the funding sources, budgeting, and staff resources.*
■ Emergency operations and expenditures are submitted to state or federal agencies for reimbursement. ■ Highway Services and Traffic Operations have operating budgets. ■ Capital budgets are used to cover inspection services for bridges and culverts.

1 = Primary Responsibility 2 = Supporting Influence

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain										
	In FEMA floodplain										
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land										
	Entirely on public land										
	From public to private	2									
	From private to public										
	Public to other public (PG, Howard, Federal lands)	2									
Groundwater flooding											
Water main break											
Sewer overflow											

LEGEND MC DEP MNCPPC PLANNING MNCPPC PARKS MC DPS MC OCE MC DOT MC OEMHS

OEMHS Responsibilities Questionnaire

Purpose: Designed to gather details of Montgomery County agency current primary and supporting responsibilities across all flooding sources and roles

Completion: **July 5, 2022**

Forward to: Miranda.santucci@jacobs.com

Instructions:

1. Reference the Responsibilities Matrix noting your agency's primary and supporting responsibility (last page of this document)
2. Complete this questionnaire assuring that characterization of your agency's responsibility is completed for all cells noted in the Responsibility Matrix
3. Assure that the complement of completed questionnaires cover the entirety of your agency's responsibility in the matrix
4. Forward completed questionnaire to Miranda Santucci of Jacobs by end of day July 5th (to be reviewed in July 7th session)

Definitions:

For consistency, these are the definitions for 'Roles' and 'Sources'

Roles:

Pro-active Roles								Reactive Roles	
Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Master planning (land use, master planning, other than water/ wastewater/ stormwater) at the County, watershed, or area plan level	*Engineering planning studies at the system level corresponding to the mission of a specific agency (SW, WW)*	*County-owned infrastructure engineering/ design, review of design submittals*	*Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections*	*In-house and external construction support (stormwater, flood control, and infrastructure projects)*	*Responsibility for determining how infrastructure is operated*	*Maintaining SW infrastructure (ponds, culverts, dams, etc.)*	*Emergency response preparedness role, planning of logistics of response, training and conducting drills interagency communication s strategy*	*Carrying out response activities for a flooding event*	*Supporting post-event activities such as repairs/ addressing impacts and/or completing or supporting post-disaster/ hazard mitigation grant applications*

Sources:

Riverine Flooding *(High stream and river water levels causing regional overbank flooding)*	Not in FEMA floodplain
	In FEMA floodplain
Pluvial/ Interior flooding/Urban flooding/"Lot to Lot" *(flooding due to local rainfall and subsequent surface drainage and/or exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to other public (PG, Howard, Federal lands, County land to parkland and vice versa)
Groundwater flooding *(high GW table causing structure sublevel flooding)*	
Water main break	
Sewer overflow *(backup of sewers due to stormwater inflow from open manholes or cracked pipes)*	

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. A questionnaire does not have to be completed for each individual cell (but you can if you want), yet each cell must be covered in a description. Consider ways to organize your primary and supporting responsibilities by SOURCE and/or ROLES. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain										
	IN FEMA floodplain										
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private										
	Entirely on public land										
	From public to private										
	From private to public										
	Public to other public										
Groundwater flooding											
Water main break											
Sewer overflow											

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*

-

2. *Characterize your agency's supporting role.*

- Preparedness (for dams): Supporting Dam Owners/Operators in planning efforts as it relates to mapping and notification of evacuations for communities downstream.
- Preparedness (All sources): Maintain the Alert Montgomery/ Internal Alerts Standard Operating Procedure and System for internal and external emergency notifications.
- Response: In the event of a severe enough flood incident, we would activate our Emergency Operations Center to coordinate resources and unmet needs, no matter the source of the flooding. At times, it may also be appropriate for OEMHS to provide similar field-level support to response partners and dam owners/operators.
- Recovery: As defined above, our support role is "*Supporting post-event activities such as repairs/ addressing impacts and/or completing or supporting post-disaster/ hazard mitigation grant applications".* If flood events meet certain thresholds, OEMHS may liaise with the state and federal government to open/operate SBA Disaster Loan Assistance Centers or a County-run Disaster Assistance Center for residents to understand what recovery resources are available to them.

3. *What regulations or policies dictate responsibilities or authorities?*

- County: Montgomery County Chapter 2 section 17
- State: Annotated Code of Maryland, Public Safety Article, § 14-101, et. seq.
- Federal:
  - The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended. The Act is codified at 42 U.S.C. 5121, et. seq.
  - The Disaster Mitigation Act of 2000, Public Law 106-390.
  - "Emergency Management and Assistance, "Code of Federal Regulations, Title 44

4. *What codified standard operating procedures structure actions?*

- We have SOPs but they are not codified. OEMHS Plans:
  - Emergency Operations Plan
  - Hazard Mitigation Plan
  - Alert Montgomery Standard Operating Procedure
  - Pre-Disaster Recovery Plan
- Dam Owner/Operation Emergency Action Plans

5. *Describe how external stakeholders are engaged.*

- State and Federal Liaisons coordinate with us in our Emergency Operations Centers to fulfill Maryland Intrastate Emergency Management Assistance Compact (MIEMAC) requests and Emergency Management Assistance Compact (EMAC) requests.
- The U.S. Small Business Administration may coordinate with us to determine if a specific event meets thresholds to offer Disaster Assistance Loans to affected residents and businesses.
- We have a Volunteer and Donations Management Plan that dictates how we engage volunteers and manage donations.
- We have a Community Organizations Active in Disaster (COAD) group which coordinates how external non-profits and businesses respond to community needs post-incident.
- As defined by our Emergency Operations Plan, external stakeholders engage with our Emergency Operations Center (EOC) and Disaster Manager to communicate, coordinate, and fulfill needs for other stakeholders in the EOC.

6. *Describe the funding sources, budgeting, and staff resources.*

- The Office of Emergency Management and Homeland Security has a mix of County and grant funding. Many of our employees are grant-funded by the Urban Areas Security Initiative (UASI) grants that require that they primarily work on items that have a nexus to terrorism and homeland security; which we do through our All-hazards approach to emergency planning, which is standard in the emergency management field. These grant-funded employees also must spend a fixed percentage of their time working on a regional committee supporting projects in this subject area as well. Our projects are funded by these same grants with similar requirements. Most of our County funding goes to employee salary and benefits with another pot to cover general office operating expenses.

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain									2	2
	In FEMA floodplain									2	2
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land									2	2
	Entirely on public land									2	2
	From public to private									2	2
	From private to public									2	2
	Public to other public (PG, Howard, Federal lands)									2	2
Groundwater flooding										2	2
Water main break										2	2
Sewer overflow										2	2

LEGEND 2 MC DEP 1 2 MNCPPC PLANNING 1 2 MNCPPC PARKS 1 2 MC DPS 1 2 MC OCE 1 MC DOT 2 MC OEMHS

PLANNING Responsibilities Questionnaire

Purpose: Designed to gather details of Montgomery County agency current primary and supporting responsibilities across all flooding sources and roles

Completion: **July 5, 2022**

Forward to: Miranda.santucci@jacobs.com

Instructions:

1. Reference the Responsibilities Matrix noting your agency's primary and supporting responsibility (last page of this document)
2. Complete this questionnaire assuring that characterization of your agency's responsibility is completed for all cells noted in the Responsibility Matrix
3. Assure that the complement of completed questionnaires cover the entirety of your agency's responsibility in the matrix
4. Forward completed questionnaire to Miranda Santucci of Jacobs by end of day July 5th (to be reviewed in July 7th session)

Definitions:

For consistency, these are the definitions for 'Roles' and 'Sources'

Roles:

Pro-active Roles								Reactive Roles	
Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Master planning (land use, master planning, other than water/ wastewater/ stormwater) at the County, watershed, or area plan level	*Engineering planning studies at the system level corresponding to the mission of a specific agency (SW, WW)*	*County-owned infrastructure engineering/ design, review of design submittals*	*Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections*	*In-house and external construction support (stormwater, flood control, and infrastructure projects)*	*Responsibility for determining how infrastructure is operated*	*Maintaining SW infrastructure (ponds, culverts, dams, etc.)*	*Emergency response preparedness role, planning of logistics of response, training and conducting drills interagency communication s strategy*	*Carrying out response activities for a flooding event*	*Supporting post-event activities such as repairs/ addressing impacts and/or completing or supporting post-disaster/ hazard mitigation grant applications*

Sources:

Riverine Flooding *(High stream and river water levels causing local to regional overbank flooding)*	Not in FEMA floodplain
	In FEMA floodplain
Pluvial/ Interior flooding/Urban flooding/"Lot to Lot" *(flooding due to local rainfall and subsequent surface drainage and/or exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to other public (PG, Howard, Federal lands, County land to parkland and vice versa)
Groundwater flooding *(high GW table causing structure sublevel flooding or local surface flooding where rainfall raises GW tables to the ground surface)*	
Water main break	
Sewer overflow *(backup of sewers due to stormwater inflow from open manholes or cracked pipes or due to groundwater infiltration)*	

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. A questionnaire does not have to be completed for each individual cell (but you can if you want), yet each cell must be covered in a description. Consider ways to organize your primary and supporting responsibilities by SOURCE and/or ROLES. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain	X									
	IN FEMA floodplain	X									
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private	X	?								
	Entirely on public land	X									
	From public to private	X									
	From private to public	X									
	Public to other public	X									
Groundwater flooding											
Water main break											
Sewer overflow											

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*

- Montgomery Planning is responsible for preparing master plans that determine land use and growth of all public and private land in the county (except for certain [seven] municipalities that have their own planning and zoning powsers). These master plans are implemented primarily through County Code such as the Zoning Ordinance, Subdivision, Adequate Public Facilities Ordinance (growth policy), Forest Conservation Law, Building Code, etc.
- Unlike traffic and school capacity issues, flooding/SWM is not typically considered during master plan development process. Only in rare cases where flooding in known to be a severe existing condition (e.g. Montgomery Village) the impacts of future growth on flooding are considered. Typically, the master plans assume that SWM will be addressed during the regulatory review process.

2. *Characterize your agency's supporting role.*

- Montgomery Planning receives and manages development review applications for projects that go through Planning Board review and approval such as site plans (for private projects) or mandatory referrals (for public projects). Planning staff gathers comments and conditions of approval from county and state agencies based on their role in reviewing specific parts of development applications. For example, DPS is responsible for SWM review and conditions of approval; DOT is responsible for Storm Drain Analysis; DEP is responsible for Forest Conservation and Water Quality, etc. Planning Staff prepares the staff report for Planning Board's review. The report contains the staff's analysis of the development proposal and how it complies with the applicable laws, guidelines and regulations. Each report also includes staff's recommendations for approval, approval with conditions, or denial of the application, and incorporates other agencies' recommendation and conditions of approval.
-

3. *What regulations or policies dictate responsibilities or authorities?*

- County Code Chapter 19, Erosion, Sediment Control and SWM
- Chapter 22A, Forest Conservation
- Chapter 33A, Planning Procedures (master planning)
- Chapter 49, Streets and Roads (DOT)
- Chapter 50, Subdivision of Land (planning board)
- Chapter 59, Zoning Ordinance (building and lots regulations)

-

4. *What codified standard operating procedures structure actions?*

- Various provisions of the County Code.
- MOUs between Montgomery Planning and outside agencies

5. *Describe how external stakeholders are engaged.*

- County and State agencies are required to provide comments/recommendations/conditions of approval to the Planning Board during development review process pursuant to County Code or State Law requirements. After Montgomery Planning accepts and distributes a development application to all relevant parties, a staff-level Development Review Committee (DRC) meeting is held to gather initial comments from all agencies and any questions/conflicts are discussed before agencies submit their final comments on the record.
- Any differences or conflicts between other agencies' comments/recommendations are resolved by the Planning Board during their public hearing and review of the project.
- Community comments and feedback are received by staff during the development review process. Staff try to address community concerns by working with them and the applicant as best they can. Citizens also have the opportunity to testify at the Planning Board public hearing on the project.

6. *Describe the funding sources, budgeting, and staff resources.*

- Montgomery Planning's work program and staff resources are approved and funded by the County Council
-

1 = Primary Responsibility 2 = Supporting Influence

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain	1									
	In FEMA floodplain	1									
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land	1	2								
	Entirely on public land	1	2								
	From public to private	1									
	From private to public	1	2								
	Public to other public (PG, Howard, Federal lands)	1									
Groundwater flooding											
Water main break											
Sewer overflow											

LEGEND 1 2 MC DEP 1 2 MNCPPC PLANNING 1 2 MNCPPC PARKS 1 3 MC DPS 1 2 MC OCE 1 3 MC DOT 1 3 MC OEMHS

PARKS Responsibilities Questionnaire

Purpose: Designed to gather details of Montgomery County agency current primary and supporting responsibilities across all flooding sources and roles

Completion: **July 5, 2022**

Forward to: Miranda.santucci@jacobs.com

Instructions:

1. Reference the Responsibilities Matrix noting your agency's primary and supporting responsibility (last page of this document)
2. Complete this questionnaire assuring that characterization of your agency's responsibility is completed for all cells noted in the Responsibility Matrix
3. Assure that the complement of completed questionnaires cover the entirety of your agency's responsibility in the matrix
4. Forward completed questionnaire to Miranda Santucci of Jacobs by end of day July 5th (to be reviewed in July 7th session)

Definitions:

For consistency, these are the definitions for 'Roles' and 'Sources'

Roles:

Pro-active Roles								Reactive Roles	
Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Master planning (land use, master planning, other than water/ wastewater/ stormwater) at the County, watershed, or area plan level	*Engineering planning studies at the system level corresponding to the mission of a specific agency (SW, WW)*	*County-owned infrastructure engineering/ design, review of design submittals*	*Permitting SW infrastructure, building permits, floodplain ordinance compliance, inspections*	*In-house and external construction support (stormwater, flood control, and infrastructure projects)*	*Responsibility for determining how infrastructure is operated*	*Maintaining SW infrastructure (ponds, culverts, dams, etc.)*	*Emergency response preparedness role, planning of logistics of response, training and conducting drills interagency communication s strategy*	*Carrying out response activities for a flooding event*	*Supporting post-event activities such as repairs/ addressing impacts and/or completing or supporting post-disaster/ hazard mitigation grant applications*

Sources:

Riverine Flooding *(High stream and river water levels causing regional overbank flooding)*	Not in FEMA floodplain
	In FEMA floodplain
Pluvial/ Interior flooding/Urban flooding/"Lot to Lot" *(flooding due to local rainfall and subsequent surface drainage and/or exceedance of roadway storm drain capacity)*	Entirely on private property
	Entirely on public land
	From public to private
	From private to public
	Public to other public (PG, Howard, Federal lands, County land to parkland and vice versa)
Groundwater flooding *(high GW table causing structure sublevel flooding)*	
Water main break	
Sewer overflow *(backup of sewers due to stormwater inflow from open manholes or cracked pipes)*	

Sources/Roles:

Mark on this table the sources and roles that are covered in this response. (Note that all primary and supporting responsibilities must be characterized through the combination of completed questionnaires. A questionnaire does not have to be completed for each individual cell (but you can if you want), yet each cell must be covered in a description. Consider ways to organize your primary and supporting responsibilities by SOURCE and/or ROLES. Refer to your agency's matrix at the end of this document.)

		Pro-active Roles								Reactive Roles	
		Land Use Planning	**Stormwater/ Flood Infrastructure Planning**	**Design/ Engineering**	**Permitting**	**Project Construction Support**	**Operations**	**Maintenance**	**Preparedness**	**Response**	**Recovery**
Riverine Flooding	Not in FEMA floodplain	?									
	IN FEMA floodplain										
Pluvial/ Interior flooding/ Urban flooding/ "Lot to Lot"	Entirely on private										
	Entirely on public land										
	From public to private										
	From private to public										
	Public to other public										
Groundwater flooding											
Water main break											
Sewer overflow											

Questions:

Respond to the questions below. Incorporate as much detail as necessary to allow a reader unfamiliar with your agency to understand your current responsibilities relative to flooding.

1. *Characterize your agency's primary role (including how engagement with other MC agencies is accomplished).*

- Riverine: Montgomery Parks is a stream valley Park system and owns over 490 miles of stream channels. We complete restoration projects on those stream channels ourselves as well as permit outside groups (DEP, DOT, SHA, private developers) to restore them via Park Construction Permits. We own bridges (pedestrian) and culverts, which are inspected regularly and replaced via our CIP PLAR program. We share responsibility for vehicular roadway bridges with DOT. Parks staff clears debris blockages under bridges and culverts. Staff work to close roads and facilities as necessary when riverine flooding threatens infrastructure. Park police respond to flooding emergency calls, and other Parks staff respond to non-emergency flooding calls.
- Pluvial/interior: Parks are planned and designed to county standards to avoid pluvial flooding (storm drain conveyance systems, stormwater management etc.). When pluvial flooding does occur on our land, Parks staff will react to close facilities and notify adjacent property owners, as needed. Parks owns 4 high/significant hazard dams that are inspected regularly and regulated by MDE, each of which has a dam Emergency Action Plan. Parks also has almost 800 stormwater management facilities on our land, some of which are inspected and structurally maintained by the county, and others of which are inspected, structurally, and non-structurally maintained by Park staff. Parks is consistently implementing stormwater retrofit, outfall enhancement and stream restoration projects to comply with our MS4 permit. Parks staff responds to citizen flooding complaints and reacts either via project implementation to rectify the situation or education regarding flood preparation and mitigation. Park police respond to flooding emergency calls.
- Although WSSC is primarily responsible for preventing and managing water and sewer main breaks (and does so under a Park Construction Permit when on Parkland), we do occasionally implement protection to their assets while completing nearby projects. Parks often is the first to identify a break on our property (and upstream of our land). We also work with them after the fact as we require mitigation when a break impacts our assets.

2. *Characterize your agency's supporting role.*

- Riverine: Parks develops master plans for large parks and park facility plans for new parks that account for system level planning within land that we own and manage. Parks provides comment on Countywide Planning initiatives as it relates to relevant parkland.
- Pluvial/interior: Parks provides comment on Countywide Planning initiatives as it relates to relevant parkland and comment on stormwater plans going through development review. We work with private landowners and HOA's to address runoff issues that end up on parkland and support response and recovery to remediate problem off parkland. Similarly, we work with other public agencies (MC DOT and other neighboring jurisdictions) to react to and address failing stormwater infrastructure or damage that results from storm flows crossing these boundaries.

- WSSC: Parkland contains significant amounts of both water and sewer infrastructure as a result of our stream valley ownership. We often identify water main breaks and sewer overflow events on parkland, respond by coordinating response and overseeing work done by WSSC to ensure compliance with our standards, and monitor areas for long term impacts.

3. *What regulations or policies dictate responsibilities or authorities?*

- Parks must follow County regulations and policies, as well as those of the state. On Parkland, we require all outside entities wanting to do work to get a Park Construction Permit from us. Prior to issuance of a Park Construction Permit, the plans undergo a technical review by Parks staff. Parks has standards we maintain to ensure projects meet our goals and are sustainable, have a stable conveyance of water and consider necessary water controls.

4. *What codified standard operating procedures structure actions?*

- Operations and maintenance staff have pre- and post- storm procedures focused on determining if facilities need to close related to weather events. Maintenance staff in each region of the park system are aware of problematic areas where flooding has occurred in the past and will monitor these areas closely when storm events occur. Dam operators follow EAP procedures as they apply.

5. *Describe how external stakeholders are engaged.*

- Parks meets with Montgomery County agencies and other local and federal jurisdictions on a regular basis to discuss implementation strategies and coordination of impervious area restoration activities, management of stormwater runoff, construction of new infrastructure, and rehab/replacement of aging infrastructure. As a steward of more than 37,000 acres of land that is spread across all of Montgomery County, Parks directly abuts and interacts with Montgomery County, MDOT SHA, City of Gaithersburg, City of Takoma Park, City of Rockville, and U.S. General Services Administration properties. Similar coordination also occurs at a finer scale with private property owners and HOAs.
- Residents contact our customer service staff with concerns related to parkland flooding, debris dams, clogged stormwater infrastructure, etc. Work orders are issued and follow up occurs following assessment and remediation.

6. *Describe the funding sources, budgeting, and staff resources.*

- A portion of funding for the Parks NPDES Program is provided by the Montgomery County Water Quality Protection Fund (WQPF), which is raised in part by a fee on impervious acreage in the county aimed at improving the water quality of county streams and reducing the impacts of stormwater runoff.

- As stewards of Montgomery County's most significant stream valleys, Parks' Mission and operational responsibilities support impervious restoration, stormwater retrofit, and drainage improvement projects to provide safe and meaningful recreational opportunities to the residents of this County. Parks' General Funds contribute to these water management related efforts and initiative as this work is so complimentary to our Mission and general Operational standards.
- A portion of our CIP is dedicated to water quality projects (stream protection PDF and pollution prevention PDF) and are used for stormwater retrofits, outfall stabilization, and stream restoration projects, as well as reforestation and NNI control related to those projects.

1 = Primary Responsibility 2 = Supporting Influence

Flooding Sources		Pro-Active Roles								Reactive Roles	
		County Level Planning	System Level Planning	Design/ Engineering	Permitting	Construction Support	Operations	Maintenance	Preparedness	Response	Recovery
Riverine Flooding	Not in FEMA floodplain (our role only applies on Parkland (across this row))		2	1	1 (issue park permits)	1	1	1	1	1	1
	In FEMA floodplain (our role only applies on Parkland (across this row))		2	1	1 (issue Park permits)	1	1	1	1	1	1
Pluvial/Interior flooding/Urban flooding/"Lot to Lot"	Entirely on private land										
	Entirely on public land (our role only applies on Parkland (across this row))	1	2	1	1 (issue Park Permits)	1	1	1	1 (on Parkland)	1	1
	From public to private (when public means Parkland)			1		1		1	1	1	1
	From private to public			1	1 (issue Park Permit)	1				2	2
	Public to other public (PG, Howard, Federal lands) (we consider this row to also be county land to parkland and vice versa)			1	1 (issue Park Permit)	2				3	3
Groundwater flooding											
Water main break					3					2	1
Sewer overflow					2					2	1

LEGEND 1 2 MC DEP 1 3 MNCPPC PLANNING 1 2 MNCPPC PARKS 1 3 MC DPS 1 2 MC OCE 3 MC DOT 1 3 MC OEMHS

Appendix E
Community Outreach Summary

CFMP Phase 1 Community Stakeholder Engagement Activities Summary

Date:	November 28, 2022
Project name:	Comprehensive Flood Management Plan Phase 1
Project no:	E4X56703 & E4X56704
Attention:	Edwards, Stan/MC DEP
Prepared by:	Santucci, Miranda/Jacobs
Reviewed by:	Moyer, Paul/Jacobs

Jacobs Engineering Group Inc.
1100 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Purpose

The purpose of this technical memorandum (TM) is to document the community stakeholder engagement activities completed under Task 5 of Phase 1 of the Comprehensive Flood Management Plan (TO#4). The engagement was carried out in accordance with the *CFMP Phase 1 Engagement Plan*, included here as **Attachment A**.

Objective of Community Engagement Activities

The purpose of public engagement was to provide initial outreach to educate residents about the need for and purpose of a comprehensive flood management plan. The outreach also included a resident survey in order to supplement present understanding on flooding impacts in the County.

Engagement Team

Engagement was a joint effort by the consultant team (Jacobs / Nspiregreen LLC) and DEP staff. Jacobs/Nspiregreen developed engagement materials (announcements, flyers, posters, presentation, and online survey), translated materials to Spanish, identified pop-up event locations, carried out pop-up events with DEP support, and presented at the virtual forums. DEP Communications staff played a key role in facilitating the engagement. DEP staff reviewed announcement materials, coordinated translation services for non-Spanish foreign languages (Chinese, Amharic, Vietnamese, Korean, and French) and distributed announcements. DEP staff also assisted in staffing survey pop-up events to provide additional foreign language capabilities.

Communications & Language Accessibility

Announcements for events were distributed via DEP emailed newsletter, County Executive newsletter, and other County scheduled email notifications. Events were also listed in the DEP and County flooding websites. Translations for the online survey and print materials were made to Spanish, Chinese, Amharic, Vietnamese, Korean, and French. Announcement materials, including translated versions, are included in **Attachment B**.

Summary of Activities

Activities are summarized in **Table 1** and included a community survey, survey pop-up events and virtual forum events, described in the following sections.

Community Survey

An online community survey was held to gather feedback from the community on past flooding impacts. Questions included a request to identify locations of flooding impacts, type and magnitude of impact, and some demographic information. The survey was launched September 19, 2022, and remains open at the date of this writing. Survey results from November 7, 2022, were extracted for review. A printout of the survey questions can be found in **Attachment C**.

To aid in increasing awareness of the survey, and perform outreach to communities with language barriers, survey pop-up events were held at five locations throughout the County. Informational materials were provided in English and Spanish. Later events included materials translated to Chinese (Mandarin), Vietnamese, Amharic, French, and Korean. Bilingual personnel were provided by the consultant and DEP (Vietnamese, Spanish) to aid in reaching non-English-speaking populations.

Table 1 Community Engagement Events

Date	Location	Engagement Notes
September 26	Gaithersburg Flea Market 501 Perry Parkway, Gaithersburg, Maryland 20877	Approximately 90 engagements (40% Spanish speaking, 50% BIPOC)
October 1	LOTTE Plaza Market 13069 Wisteria Dr, Germantown, MD 20874	Approximately 50 engagements (15% Spanish speaking, 80% BIPOC)
October 5	Crossroads Farmer's Market Anne St. at University Blvd. East Takoma Park, MD 20912	Approximately 60 engagements (80% Spanish speaking, 80% BIPOC)
October 9	Westfield Wheaton Costco 11160 Veirs Mill Rd Suite DPT4, Wheaton, MD 20902	Approximately 80 engagements (70% Spanish speaking, 80% BIPOC)
October 18	CHEER Food Distribution New Hampshire Estates Elementary School 8720 Carroll Ave, Silver Spring, MD 20903	Approximately 90 engagements (99% Spanish speaking, 99% BIPOC)
October 12	Virtual forum (via DEP Zoom)	24 attendees, no major connectivity issues on the part of attendees indicating Zoom is a good tool for virtual engagement, good discussion/engagement among attendees
October 20	Virtual forum (via DEP Zoom)	26 attendees, no major connectivity issues on the part of attendees, good discussion/engagement among attendees

Notes:

BIPOC = Black, Indigenous, and Persons of Color, CHEER = Community Health and Empowerment through Education and Research

While the Community Survey remains open at the writing of this report, survey results from November 7, 2022, were extracted for review. A summary of the observations are included in **Attachment D**.

Virtual Community Forums

Two virtual on-line forums were held (Wednesday, October 12, and Thursday, October 20, 2022, from 6:30-8:00pm) to describe the intention of the CFMP, gain insight on community flooding issues,

understand community expectations, and ask for participation and sharing of the Community Survey. Summaries of the community forums and presentation slides can be found in **Attachment E**.

Conclusions

Based on attendance at the virtual forum events and pop-up events, the pop-up style outreach event (in-person, located at an existing location of interest) was more effective in reaching a diverse resident community. Future engagement may benefit from early planning to focus in-person events in areas already frequented by the population and ensuring translated materials and foreign language speakers are available.

Attachments

A. Engagement Plan

B. Event announcements

C. Survey questions

D. Online survey results graphics

E. Community forum summaries and presentation

Draft Community Engagement Plan

Montgomery County Comprehensive Flood Management Plan Phase 1

Introduction

Due to increases in the frequency and intensity of extreme storm events, more impervious surfaces due to development, and an aging stormwater drainaige system, Montgomery County has become more susceptible to urban flooding. The Flood Management plan serves as a comprehensive guide to educating the public about flood risks and mitigation strategies, and a well-coordinated approach to provide early warning to potentially affected residents and businesses.

Purpose of Engagement

The purpose of public engagement is to gather geographic and qualitative data that supplements available datasets on flooding risks in the county. By allowing residents to provide specific information and narratives about their experience with flooding, the project team will be able to supplement quantitaive data, and consequently create an a holistic picture of the impact that flooding has in the county. The engagement activities will also include educational components that help inform residents about the nature and strategies to prepare for future flooding risks. This education component will also explain the process of flood management and its complexity to be transperant long-term nature of this project.

Desired Outcomes of Engagement

To empower a diverse community of residents to identify flooding events and resident impacts that aren't captured by currently available datasets.

Engagement Activities

1. Survey

The Survey will be designed to gather spatial and quantitative information about flooding issues in the County. The survey will start by asking participants a series of questions that measure awareness of flooding. These questions may include:

1. How much, if at all, do you know about flooding?
2. Have you experienced or do you currently experience flooding in your neighborhood?
3. How concerned are you about flooding impacting you in the future?
4. How confident do you feel about finding resources and information that can help you prepare or deal with flooding?
5. How much do you agree with the following statement? Flooding risk management should be considered in decision making in Montgomery County?

The survey will then present an interactive map where people are asked to pin in locations where they have seen and/or experienced flooding. As people pin their locations, they will also have the option to supplement the pin with a comment and/or with a photo.

The survey will end with a series of optional demographic questions that will help the consultant team measure engagement levels throughout the County and within different population groups, including underrepresented groups.

The survey will be hosted through the ESRI Survey123 app. The ESRI application allows the survey to be available in different languages. The "Translations" section below will have more information about translating the survey. Hard copies of the survey will also be available to people during the pop-up events.

A sample of the DRAFT spatial survey can be found here: https://arcg.is/1SPH9m0

Materials: The consultant team will develop marketing materials that help advertise the survey. The materials will follow DEP's branding guidelines. These materials will include:

- Flyers with QR code linking to the survey and public meeting registration
- Postcards with QR code linking to the public meeting registration
- Social Media Graphics with QR codes
- Copy for emails and social media to share with DEP, PIOs, and other agencies, for them to share on their communication platforms

Advertising: The consultant team will work with the DEP communications team and Montgomery County's PIO to share these materials across different social media accounts, stakeholder distribution lists, and county agency's newsletters. The consultant team can also make the materials available to members of the Stakeholder Group to find out if there are other newsletters, social media accounts, and distribution lists that should be considered for advertising the meeting and online map survey.

Non-virtual advertising will include emailing flyers to community engagement leads at public libraries, recreation centers, and parks and recreation departments with request to post flyers in their facilities.

Community Partnerships

The consultant team will email a list of community groups, homeowners and civic associations, and environmental and business associations to provide information about the project and ask for their assistance in disseminating the information across their stakeholder lists.

The list of these community organizations can be found as part of the appendix. The consultant team can provide the list to DEP for their communications department to disseminate the information via a blast email.

Translations

The consultant team will translate the survey, graphics, and marketing materials into Spanish. Based on the County's demographic information, the consultant team recommends that materials also be made

available in Chinese, Amharic, and French. Translation of materials to these languages would happen at an additional cost and/or could happen through collaboration with DEP/Jacobs staff.

Timeline

Online survey will be open from September 1 – October 10. Hard copies of the survey will be available during the in-person events.

2. In-person Pop-up Events

The consultant team will conduct a series of pop-ups (up to 5). The purpose of the pop-ups is to provide an opportunity to engage in person with community groups that might have limited access to a computer, internet, or face other barriers in gathering information from social media and other government communication platforms.

The consultant team conducted a vulnerability study to understand where it would be beneficial to hold pop-ups that would help spread information about this project in areas that have high risk of flooding and high social vulnerability. From this study, we selected locations that have scored high in social vulnerability and flooding risk and locations considered to be rural and with high flooding risk.

Pop-up logistics

The pop-ups will consist of setting 3 posters on easels. Two will provide educational information that will be similar to that information that is provided during the community forum. Some of the information that will be described will include:

- What is a flooding?
- Flood risk and how it is changing
- What is the Comprehensive Flood Management Plan

The third poster will be a large map where people can put sticky notes to indicate places where they have experienced flooding.

Potential Locations

Gaithersburg (1)

- Montgomery Village Crossing (Ethnic market strip/ East Asian and African Market)
- Gaithersburg Farmers Market

Germantown (1)

- LOTTE Plaza Market featuring East Asian, African, and Latino Stores

Olney (1)

- Olney Farmers and Artist Market

Pop-ups with Community Organizations (2)

These pop-ups will consist of working with these community organizations to host pop-ups at their offices or be guests at any events already planned by these organizations.

- Ethiopian Community Center (Silver Spring)
- CASA (Rockville)

Other options:

- Silver Spring Arts and Crafts End of Summer Celebration September 11 2- 7 pm. Veterans Plaza.
- Bethesda Metro Station
- Rockville Farmers Market
- Aspen Hill Shopping Center
- Hot Air Balloon Festival September 17 and 18
- Hillandale Shopping Mall
- Gaithesburg Community Flea Market and MARC Rail Station
- 30th annual Poolesville Day Festival: September 17 10:00 am to 4pm

Materials needed for the Pop-ups

- Easels
- Printed map
- Educational Posters
- Sticky notes and clipboards
- Printed versions of the survey
- (Optional: tent and weights)
- (Optional: DEP swag if available)

Timeline

- 3 pop-pups before the first community meeting (Late August – September 25)
- 2 pop-ups after 1st community forum/before second community forum (September 29 – October 5)

3.Community Forums

The consultant team Will be conducting two (2) virtual community forums. The community forums will last 90 minutes.

Virtual Platforms and Dates

- Zoom Virtual Meeting – September 27
- Zoom Virtual Meeting - October 10

The consultant team will work with DEP's communications team to set up the Zoom meetings using DEP's Zoom account.

Registration

- Participants will be able to sign up to participate via Eventbrite. Through Eventbrite, participants will be asked their preferred attendance date and other optional demographic information that will help the project team evaluate who's engaging with the project.
- Registration will inquire about any language interpretation needs.
- Participants will be able to participate without registering online. Project staff will provide a link to a survey monkey to provide demographic information if they decide to do so at the end of the meeting.

Proposed Agenda
See Attachment C for proposed agenda.

Potential Breakout Rooms and Agenda:

People will be separated into sessions (based by geographic if participation allows for it) to discuss themes from the presentation. The agenda for the breakout session includes:

- Where is flooding happening right now? (10 mins)
- What are concerns and barriers that people face when preparing and/or dealing with flooding? (10 minutes)
- What's currently working in flooding management/preparedness? (Circle back to presentation by Jacobs). (10 mins)

Materials needed:

- Duplicate of ESRI engagement map for public meeting use
- Presentation created by Jacobs and Nspiregreen
- Zoom Account
- SurveyMonkey participation form
- (1) Primary Host; (1) Person handling Zoom/PowerPoint; (2) Breakout room facilitators

Responsibilities

Consultant team:

- Develop and manage the survey
- Translate survey into Spanish and create hard copies of survey
- Design and develop the advertising materials
- Provide list of community organizations in Montgomery County
- Design and host pop-up meetings and create materials including:
    - Large maps
    - Printed copies of the survey
    - Flooding Educational Posters
- Design and Host Virtual Community Forums and materials for the meeting including:
    - Eventbrite registration form
    - Surveymonkey participant form
    - Powerpoint Presentation

County Responsibilities:

- Create and host website that provides general information about the project and hosts links to the survey and the community forum registration page
- Dessiminate project information and advertising materials across social media, website, and stakeholder lists
- Review advertising and pop-up materials
- Provide additional translated materials

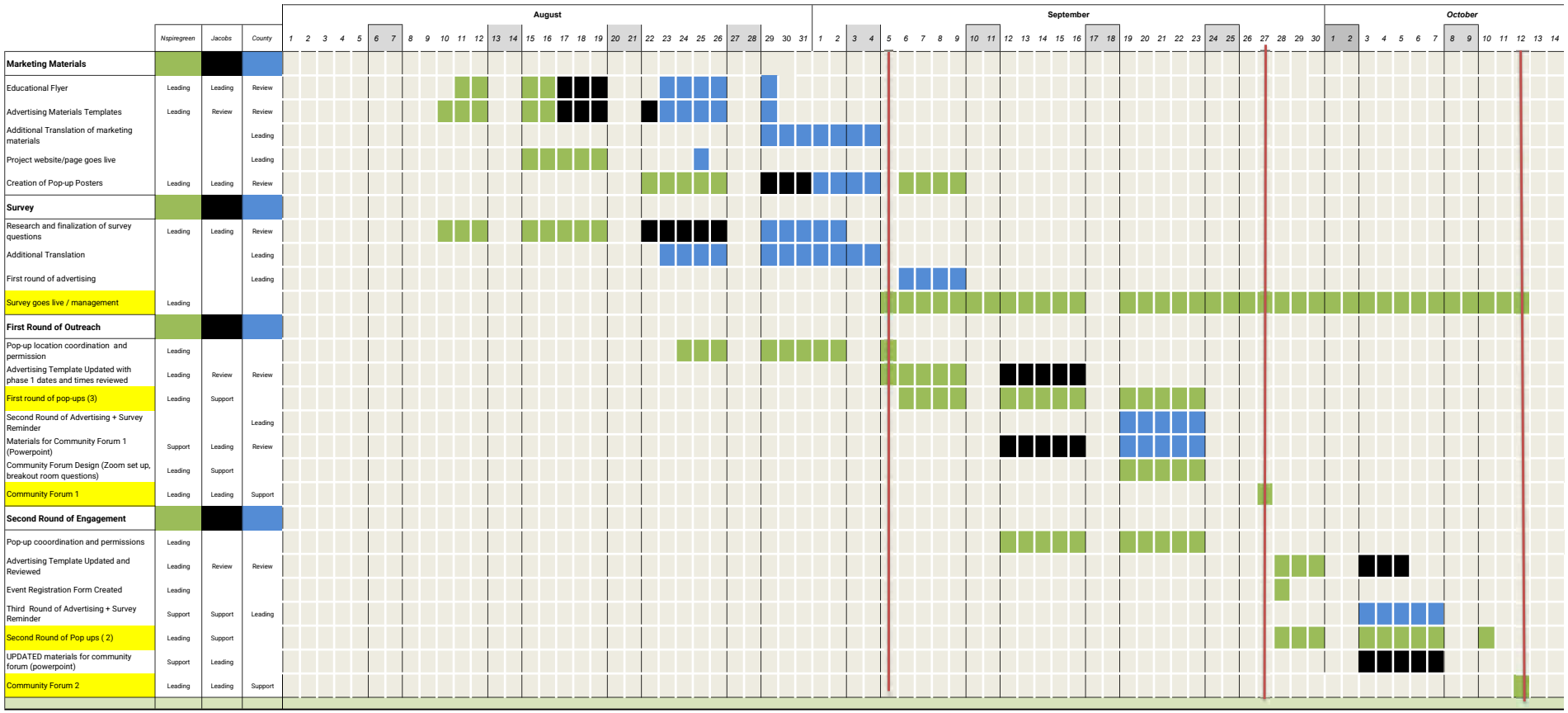
Attachments

A. Implementation Timeline

B. Communications Outline

C. Proposed Virtual Session Agenda

D. Proposed Pop-up Location Mapping


August
September
October
Nspiregreen
Jacobs
County
Marketing Materials
Educational Flyer Leading Leading Review
Advertising Materials Templates Leading Review Review
Additional Translation of marketing materials Leading
Project website/page goes live Leading
Creation of Pop-up Posters Leading Leading Review
Survey
Research and finalization of survey questions Leading Leading Review
Additional Translation Leading
First round of advertising Leading
Survey goes live / management Leading
First Round of Outreach
Pop-up location coordination and permission Leading
Advertising Template Updated with phase 1 dates and times reviewed Leading Review Review
First round of pop-ups (3) Leading Support
Second Round of Advertising + Survey Reminder Leading
Materials for Community Forum 1 (Powerpoint) Support Leading Review
Community Forum Design (Zoom set up, breakout room questions) Leading Support
Community Forum 1 Leading Leading Support
Second Round of Engagement
Pop-up cooordination and permissions Leading
Advertising Template Updated and Reviewed Leading Review Review
Event Registration Form Created Leading
Third Round of Advertising + Survey Reminder Support Support Leading
Second Round of Pop ups (2) Leading Support
UPDATED materials for community forum (powerpoint) Support Leading
Community Forum 2 Leading Leading Support

Draft Survey and Community Forum Communication Strategy

Montgomery County Department of Environmental Protection
Comprehensive Flood Management Plan Phase 1

Website

- County General Website
- DEP Website – Project Specific
    - Provide place to communicate about the project
    - Way for people to sign up to receive future communications

County Social Media (send announcements and link to the project website)

- Instagram
- Snapchat
- Facebook
- Others

Email Blast Lists:

- General County-wide
- DEP
- Community Organizations (request that they forward to their organization email lists)
- Other email lists

Virtual Community Forum Agenda – DRAFT

Montgomery County Department of Environmental Protection
Comprehensive Flood Management Plan Phase 1

Meeting Details

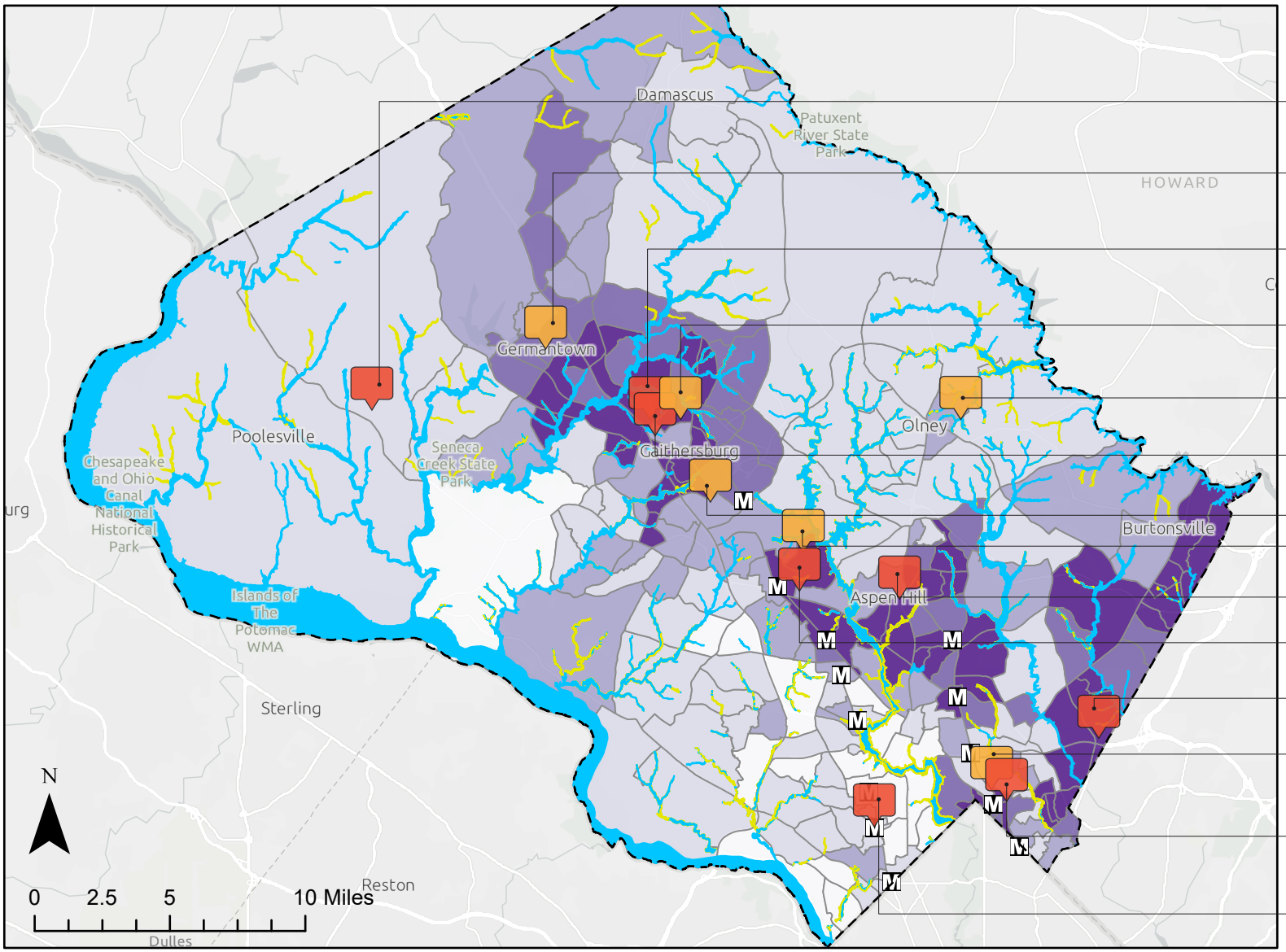
Meeting: CFMP P1 Virtual Community Forum

Date & Time: To be scheduled

Location: Virtual / DEP-hosted Zoom

Agenda

#	Item	Notes
1	**Introduction**	What is the Comprehensive Flood Management Plan? And why do we need it?
2	**Comp. Flood Mgmt. Plan Phase 1 Overview**	What is happening in Phase 1? How will the output of this meeting be used?
3	**Flooding Defined**	What do we mean by "flooding"? What are drivers for flooding within Montgomery County?
4	**Breakout Groups**	Facilitated map markup and discussion. How have you been impacted by flooding? Where and when? What was the nature of the impact?
5	**Wrap-up**	What are the next steps? How will information gathered today be used?



30th annual Poolesville Day Festival: September 17 10:00 am to 4pm

LOTTE Plaza Market featuring East Asian, African, and Latino Stores

Hot Air Balloon Festival September 17 and 18

Montgomery Village Crossing [Ethnic market strip/ East Asian and African Market]

Olney Farmers and Artist Market

Gaithesburg Community Flea Market and MARC Rail Station

Gaithersburg Farmers Market

CASA [Rockville]

Aspen Hill Shopping Center

Rockville Farmers Market

Hillandale Shopping Mall

Ethiopian Community Center [Silver Spring]

Silver Spring Arts and Crafts End of Summer Celebration September 11 2- 7 pm. Veterans Plaza.

Bethesda Metro Station

Sources: 2020 Census Data, Data Montgomery Portal, FEMA Flood Maps

Pop-up Locations within Areas with Flooding Risk and Vulnerable Populations

- Pop-Ups Locations
- Pop-Ups Locations /Optional
- M Metro Stations

FEMA Flood Map

- 100 yr Flood
- 500 yr Flood
- Montgomery County Boundary

Vulnerability Index :[Poeple of Color , Low Income Population]

- 1
- 2
- 3
- 4
- 5

GOT FLOODING?

Come learn more about the Montgomery County Comprehensive Flood Management Plan during our virtual meeting!

The County is working to develop a Comprehensive Flood Management Plan that will aid long-term strategic planning for flood mitigation. We want to hear from you to better understand the location and type of flooding impacts residents are experiencing.

Wednesday, October 12
Thursday, October 20
6:30 - 8:30 PM via Zoom

To register scan the QR code or visit https://mocofloodplan.eventbrite.com/

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

蒙哥馬利郡「全面性水患管理計畫」(Comprehensive Flood Management Plan)

為什麼要制訂水患管理計劃？

蒙郡持續增長的各類淹水及水患事件，對公共和私人財產造成影響。雖然導致水患事件增長的原因各不相同，但部分主因是來自土地開發和高強度降雨狀況的增加，使地表積水難以排去。由於持續的經濟成長和氣候變化，預計這兩種影響都會加劇。

什麼是「水患管理計畫」？

蒙郡環境保護部(Department of Environmental Protection)正在擬定一份全面性的水患管理計畫。水患管理計畫列出步驟，本郡可據此研擬相關資訊以告知民眾，並期最終解決此一日益嚴重的風險。本計畫會分成幾個階段的工作，橫跨未來數年、弱點評估、詳細的水患研究、適應性設計，減災方案的實施，及結合對這些計畫的反饋。

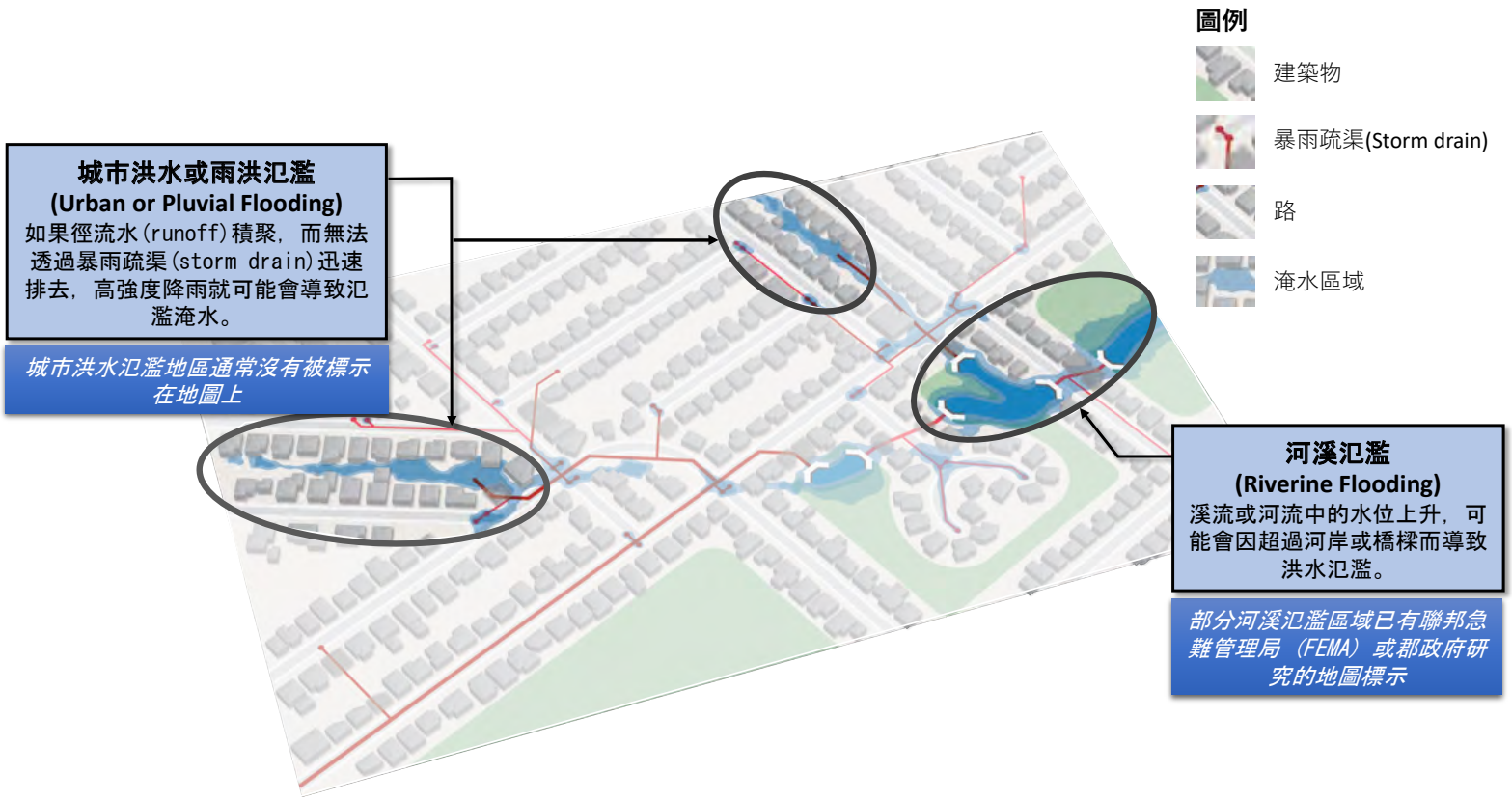
參加調查

開始策畫前，我們期望能徵求您的意見！我們想了解您是否曾在何處、何時以及是如何受到水患影響的。根據本郡各地居民提供的意見來構建此資料庫，對於了解過去以來水患影響的位置、範圍和類型至關重要。您的回應都是保密的。

請掃描二維碼或使用以下連結完成調查。

https://bit.ly/MocoFloodSurvey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND



水患從何而來？

由於當地降雨逕流量(rainfall-runoff)，已超過當地的暴雨疏渠(storm drainage)系統或地表滲透力(infiltration capacity)的負荷，這可能是造成蒙郡水患的原因。這叫「雨洪氾濫」(pluvial flooding)，也稱為「城市洪水氾濫」(urban flooding)，或是「一地淹向他地」(lot to lot flooding)。溪流或河流的水位超過河岸，也會引發淹水氾濫。我們稱這種類型的水患為「河溪氾濫」(riverine flooding)。任何來自這些原因而受到的影響，其範圍從危及生命到滋擾生活都有。

持續關注最新消息

請瀏覽本計畫網站，以了解更多相關資訊，並隨時得知即將進行的計畫或項目！

www.montgomerycountymd.gov/flooding

DEPARTMENT OF
ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Montgomery County Comprehensive Flood Management Plan

Why a Flood Management Plan?

Montgomery County has experienced an increase in flooding events causing impacts to public and private property. While the reasons for this increase are varied, increases to impervious surface due to development and increases in high-intensity rainfall events are some of the top reasons. The impacts of both are expected to increase due to continued growth and climate change.

What's a Flood Management Plan?

The Montgomery County Department of Environmental Protection (DEP) is in the process of developing a Comprehensive Flood Management Plan. A flood management plan lays out the steps by which the County can develop the information to inform and ultimately address this growing risk. This plan will consist of several phases of work, spanning the next few years, vulnerability assessments, detailed flood studies, adaptation design, and implementation of mitigation project and programmatic responses.

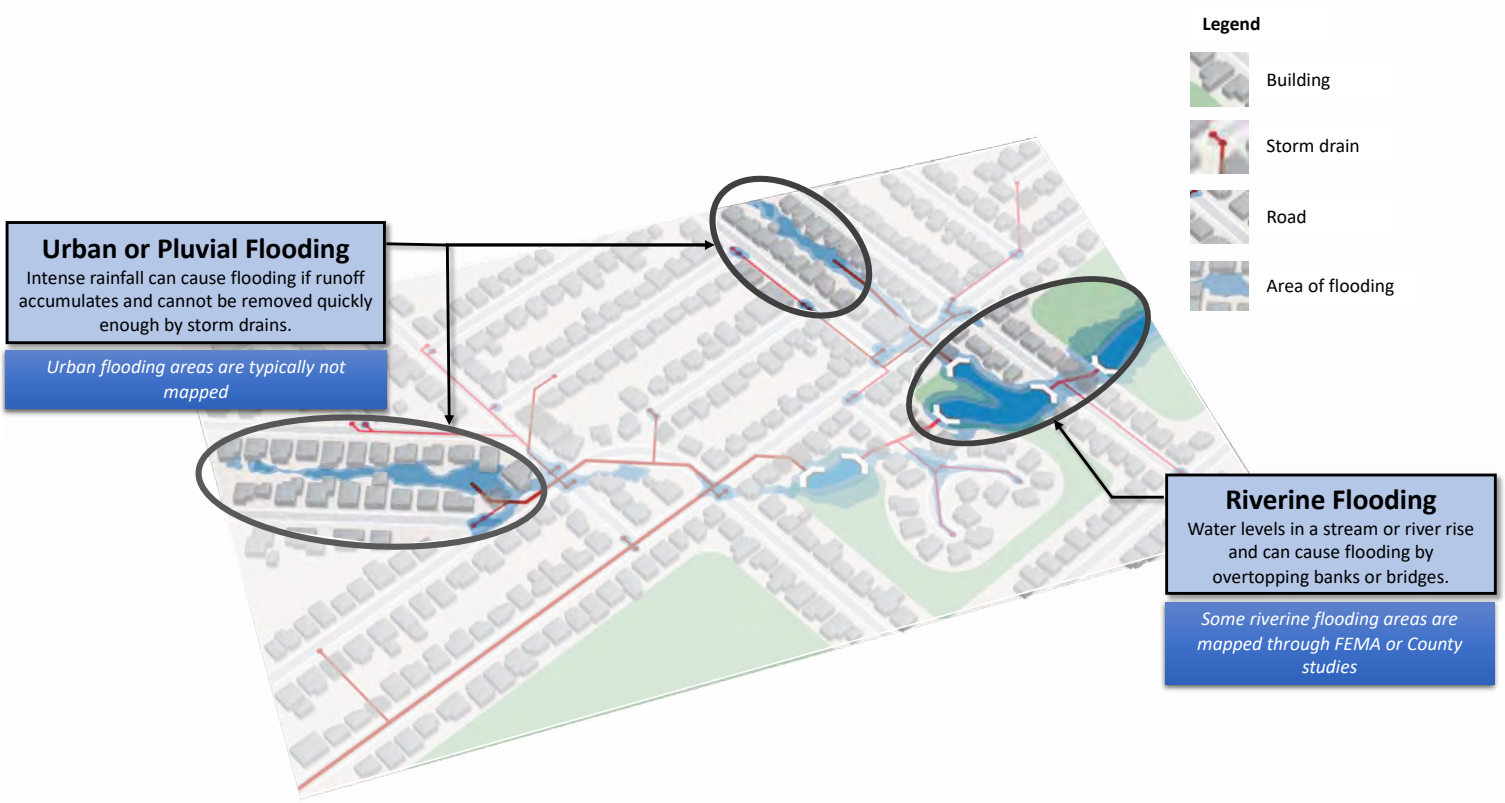
Take the Survey

To begin this process, we want to hear from you! We want to learn where, when, and how you may have been impacted by flooding. Building this dataset with input from residents from all parts of the County will be critical in understanding locations, extent, and type of histoic flooding impacts. All answers will remain confidential.

Scan the QR Code or use the link below to complete the survey.

https://bit.ly/MocoFloodSurvey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND



What are the sources of Flooding?

Flooding in the County can occur due to local rainfall runoff exceeding the capacity of the local storm drainage system or infiltration capacity of the ground. This is termed pluvial flooding, otherwise known as "urban flooding" or "lot to lot flooding". Flooding can also occur due to stream or river levels exceeding the banks. This type of flooding is known as riverine flooding. Impacts from either of these sources can range from life hazard to nuisance impacts.

Stay updated

Visit the project's website to learn more about the project and stay updated about upcoming events!

www.montgomerycountymd.gov/flooding

DEPARTMENT OF
ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Comté de Montgomery: Plan d'ensemble de gestion des inondations

Pourquoi un plan de gestion des inondations ?

Le comté de Montgomery connaît une augmentation des inondations affectant des biens tant publics que privés. Diverses raisons sont à l'origine de cette augmentation ; toutefois, parmi les plus importantes, on citera l'augmentation de la surface imperméable due au développement et l'augmentation des événements pluvieux de haute intensité. Les impacts de ces deux phénomènes devraient s'accentuer, au vu de la croissance économique continue et du changement climatique.

Qu'est-ce qu'un plan de gestion des inondations ?

Le département de la protection de l'environnement (de son acronyme en anglais, DEP) du comté de Montgomery est en train d'élaborer un plan d'ensemble de gestion des inondations. Un tel plan définit les étapes permettant au comté d'établir les éléments requis pour en informer le public, puis gérer ce risque croissant. Il plan comprendra les différentes phases de travail ci-après, lesquelles s'étaleront sur les prochaines années: évaluations de la vulnérabilité, études détaillées sur les inondations, concepts d'adaptation et mise en œuvre de projets d'atténuation, et réponses programmatiques.

Participez à l'enquête

Pour entamer ce processus, nous souhaitons vous donner la parole ! Nous voulons savoir où, quand et comment vous avez été touchés par des inondations. Il est essentiel d'établir cet ensemble de données avec la contribution des résidents des quatre coins du comté, afin de comprendre les lieux, l'étendue et le type d'impacts des inondations historiques. Toutes les réponses resteront confidentielles.

Scannez le code QR ou utilisez le lien ci-dessous pour participer à l'enquête.

https://bit.ly/MocoFloodSurvey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Légende

- Bâtiment
- Collecteurs d'eaux pluviales
- Route
- Zone d'inondation

Inondations urbaines ou pluviales
Les pluies intenses peuvent provoquer des inondations si les eaux de ruissellement qui s'accumulent ne sont pas évacuées rapidement par les collecteurs d'eaux pluviales.

En général, les zones d'inondations urbaines ne sont pas cartographiées

Inondations fluviales
Le niveau d'eau d'un cours d'eau ou d'une rivière augmente et peut provoquer des inondations en débordant de ses berges ou des ponts.

Certaines zones d'inondation riveraines sont cartographiées par la FEMA ou par des études du comté

Quelles sont les causes des inondations ?

Les inondations dans le comté peuvent survenir lorsque le ruissellement des pluies dépasse la capacité du système local de drainage des eaux pluviales ou la capacité d'infiltration du sol. C'est ce qu'on appelle l'inondation pluviale, également connue sous le nom d'inondation « urbaine » ou d'inondation dite « de lot en lot ». Les inondations peuvent également être dues au fait que le niveau des cours d'eau ou des rivières dépasse le niveau des berges. Ce type d'inondation est connu sous le nom d'inondation fluviale. L'une quelconque de ces causes peut poser autant une nuisance qu'un danger pour la vie.

Restez informés

Visitez le site Internet du projet pour en savoir plus et rester informé des activités à venir !

www.montgomerycountymd.gov/flooding

DEPARTMENT OF
ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

몽고메리 카운티의 포괄적인 홍수 관리 계획

왜 홍수 관리 계획을 하는가?

몽고메리 카운티는 공공 및 사유 재산에 영향을 미치는 홍수 사건의 증가를 경험하고 있습니다. 이러한 증가의 이유는 다양하지만 개발로 인한 불침투성 표면의 증가와 고강도 강우 현상의 증가가 주요 원인 중 일부입니다. 지속적인 성장과 기후 변화로 인해 두 가지 모두의 영향이 증가할 것으로 예상됩니다.

홍수 관리 계획이란 무엇입니까?

몽고메리 카운티 환경 보호국(DEP)은 포괄적인 홍수 관리 계획을 개발하는 과정중에 있습니다. 홍수 관리 계획은 카운티가 정보를 제공하기 위한 개발과 궁극적으로 이러한 홍수 위험의 증가를 알릴 수 있는 단계를 제시합니다. 이 계획은 앞으로 몇 년 동안 여러 단계에 걸쳐 취약성 평가, 상세한 홍수 관련 연구, 적응 설계와 완화 프로젝트 실행 및 체계적인 응답 등으로 구성될 것입니다.

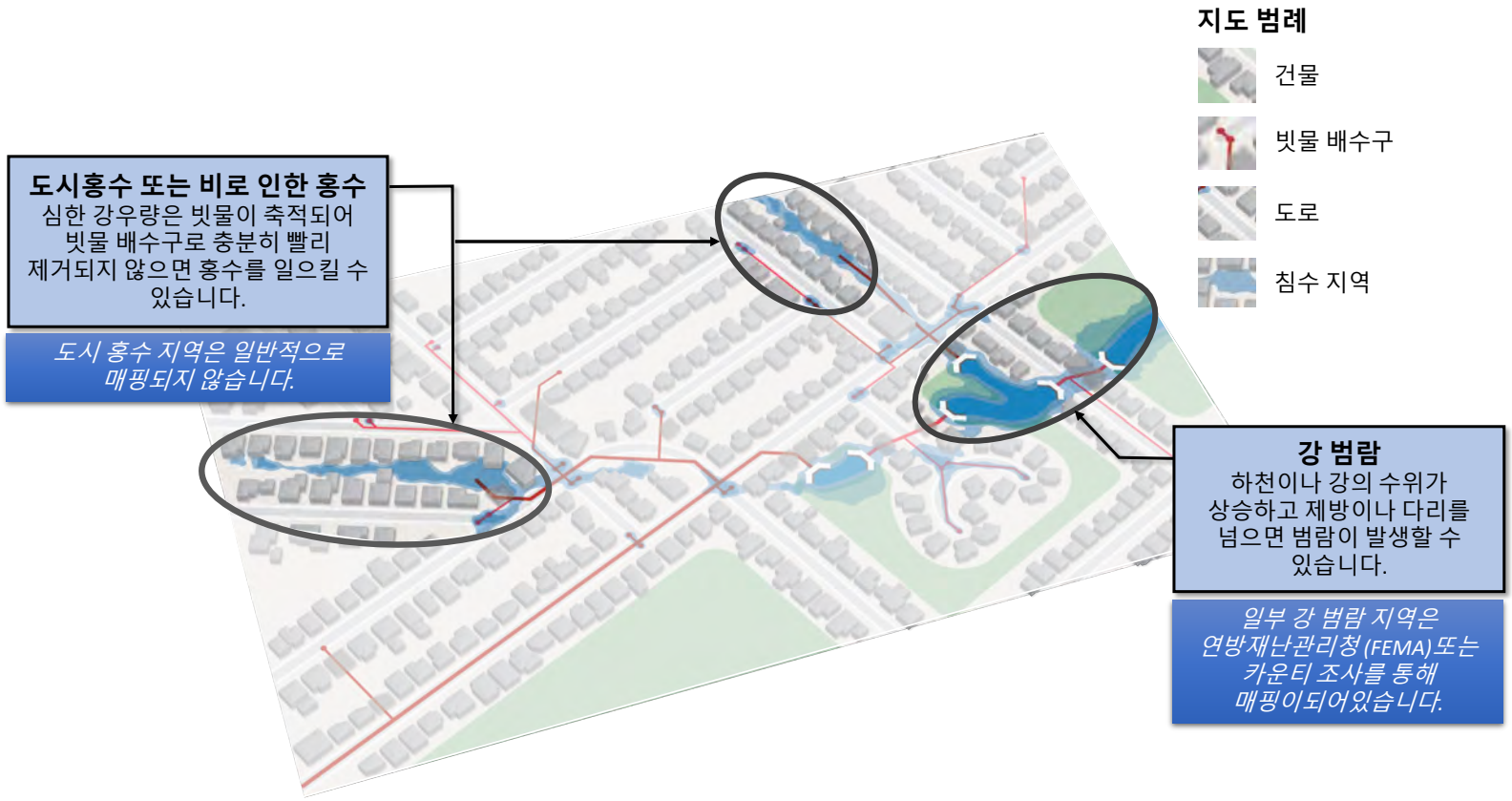
설문 조사에 참여 해주십시오.

이 과정을 시작하기 위해 여러분의 의견을 듣고 싶습니다! 귀하께서 어디서, 언제, 어떻게 홍수로 인한 영향을 받았는지 알고 싶습니다. 카운티 모든 지역의 주민들의 의견을 바탕으로 이 데이터 세트를 구축하는 것은 역사적 홍수가 미치는 영향, 위치, 범위 및 유형을 이해하는 데 중요합니다. 모든 답변은 기밀로 유지됩니다.

QR 코드를 스캔하거나 아래 링크를 사용하여 설문조사를 완료하십시오.

https://bit.ly/MocoFloodSurvey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND



홍수의 원인은 무엇입니까?

카운티의 홍수는 지역 빗물 배수 시스템의 용량을 초과하는 지역 강우 유출 또는 지반의 흡수 속도용량으로 인해 발생할 수 있습니다. 이것은 "도시홍수" 또는 "거리 사이의 범람"으로 알려진 비로 인한 홍수입니다. 홍수는 또한 제방을 초과하는 하천이나 강의 수위로 인해 발생할 수 있습니다. 이러한 유형의 범람을 강 범람이라고 합니다. 이러한 문제로 인해서 생명의 위협을 받거나 일상을 성가시게 하는 등 여러가지 면에서 영향을 받습니다.

최신 정보 유지

웹사이트를 방문하여 프로젝트에 대해 자세히 알아보고 앞으로의 이벤트와 관련된 최신 소식을 받아보세요!

www.montgomerycountymd.gov/flooding

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Plan Integral de Manejo de Inundaciones del Condado de Montgomery

¿Por qué un Plan de Manejo de Inundaciones?

El condado de Montgomery ha experimentado un aumento en los eventos de inundación que causan impactos a la propiedad pública y privada. Si bien las razones de este aumento son variadas, los aumentos a la superficie impermeable debido al desarrollo y los aumentos en los eventos de lluvia de alta intensidad son algunas de las principales razones. Se espera que los impactos de ambos aumenten debido al crecimiento continuo y al cambio climático.

¿Qué es un Plan de Manejo de Inundaciones?

Un plan de manejo de inundaciones establece los pasos por los cuales el Condado de Montgomery puede desarrollar la información para informar y en última instancia, abordar este riesgo creciente. Este plan constará de varias fases de trabajo, que abarcarán los próximos años, evaluaciones de vulnerabilidad, estudios detallados de inundaciones, diseño de adaptación e implementación de proyectos de mitigación y respuestas programáticas.

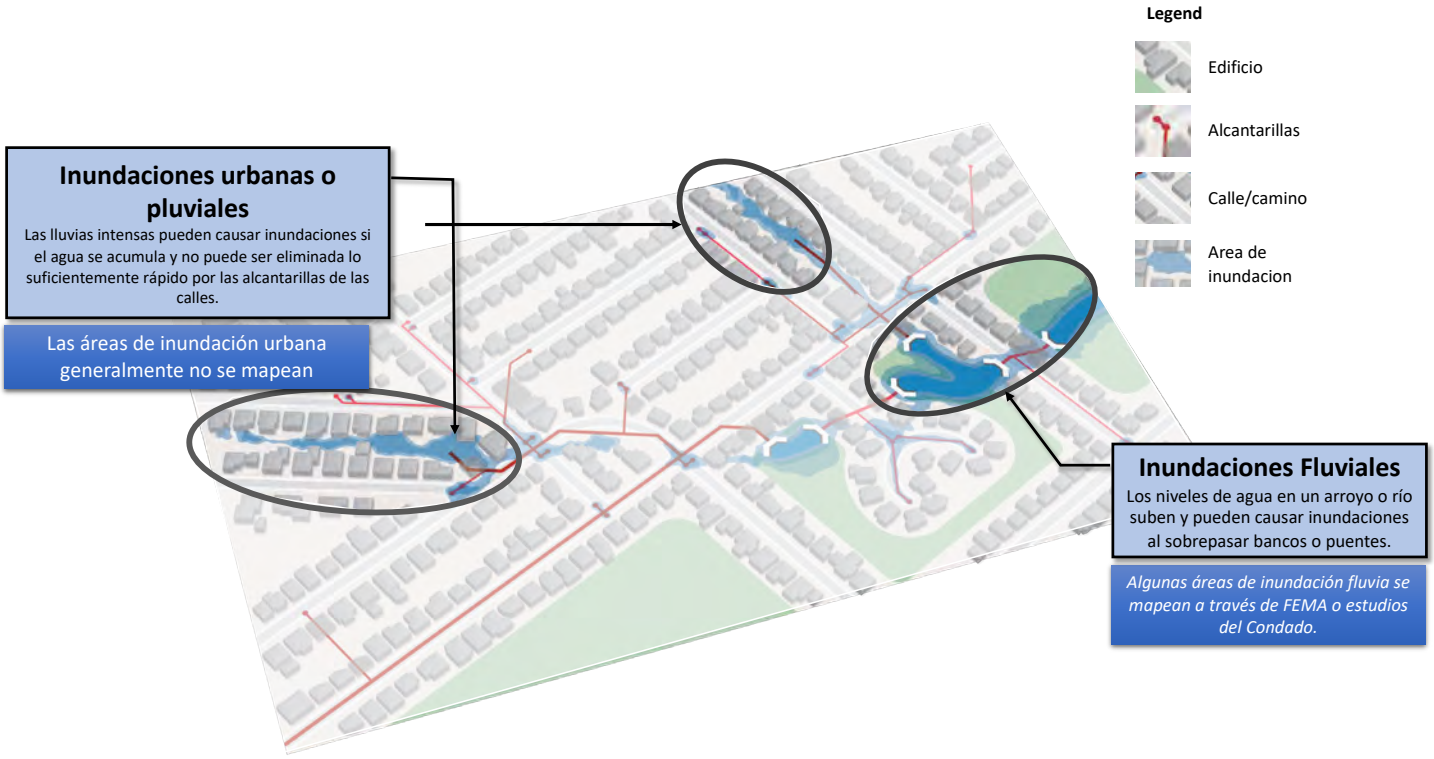
Complete la Encuesta

Para comenzar este proceso, ¡queremos escuchar de usted! Queremos saber dónde, cuándo y cómo puede haber sido afectado por las inundaciones. La construcción de este conjunto de datos, con aportes de residentes de todas partes del Condado, será fundamental para comprender las ubicaciones, la extensión y el tipo de impactos de inundaciones históticas. Todas las respuestas permanecerán confidenciales.

Escanee el código QR o use el siguiente enlace para completar la encuesta.

bit.ly/mocofloodsurvey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND



¿Cuáles son las fuentes de las inundaciones?

Las inundaciones en el Condado de Montgomery pueden ocurrir debido al escurrimiento de lluvia local que excede la capacidad del sistema local de drenaje pluvial o la capacidad de infiltración del suelo. Este tipo de inundación, se llama inundación pluvial, "inundación urbana" o "inundación de lote a lote".

Las inundaciones también pueden ocurrir debido a que los niveles de los arroyos o ríos exceden las orillas. Este tipo de inundación se conoce como inundación fluvial. Los impactos de cualquiera de estas fuentes pueden variar en riesgos.

Mantengase Informado

Visite la página del proyecto para obtener más información sobre el proyecto, los próximos even-tos y otras formas de participar.

www.montgomerycountymd.gov/flooding

DEPARTMENT OF
ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Kế hoạch Quản lý Lũ lụt Toàn diện của Quận Montgomery

Tại sao phải có Kế hoạch Quản lý Lũ lụt?

Quận Montgomery đã và đang ghi nhận các đợt lũ lụt gia tăng, gây ảnh hưởng tới cả tài sản công và tư nhân. Trong các nguyên nhân khác nhau gây nên sự gia tăng này thì sự gia tăng bề mặt không thấm nước do sự phát triển hạ tầng và sự gia tăng các trận mưa cường độ cao là hai trong những lý do hàng đầu. Các tác động của cả hai nguyên nhân này được dự báo sẽ tăng lên do tăng trưởng kinh tế và biến đổi khí hậu vẫn tiếp tục.

Kế hoạch Quản lý Lũ lụt là gì?

Sở Bảo vệ Môi trường Quận Montgomery (DEP) đang trong quá trình phát triển bản Kế hoạch Quản lý Lũ lụt Toàn diện. Kế hoạch quản lý lũ lụt đưa ra các bước mà qua đó Quận có thể phát triển dữ liệu và thông tin để cung cấp cho người dân và cuối cùng là giải quyết mối nguy cơ ngày càng gia tăng này. Kế hoạch này sẽ bao gồm nhiều giai đoạn công việc, kéo dài trong vài năm tới, đánh giá các mối đe dọa, nghiên cứu chi tiết về lũ lụt, thiết kế thích ứng và thực hiện dự án giảm thiểu lũ lụt và các ứng phó theo chương trình.

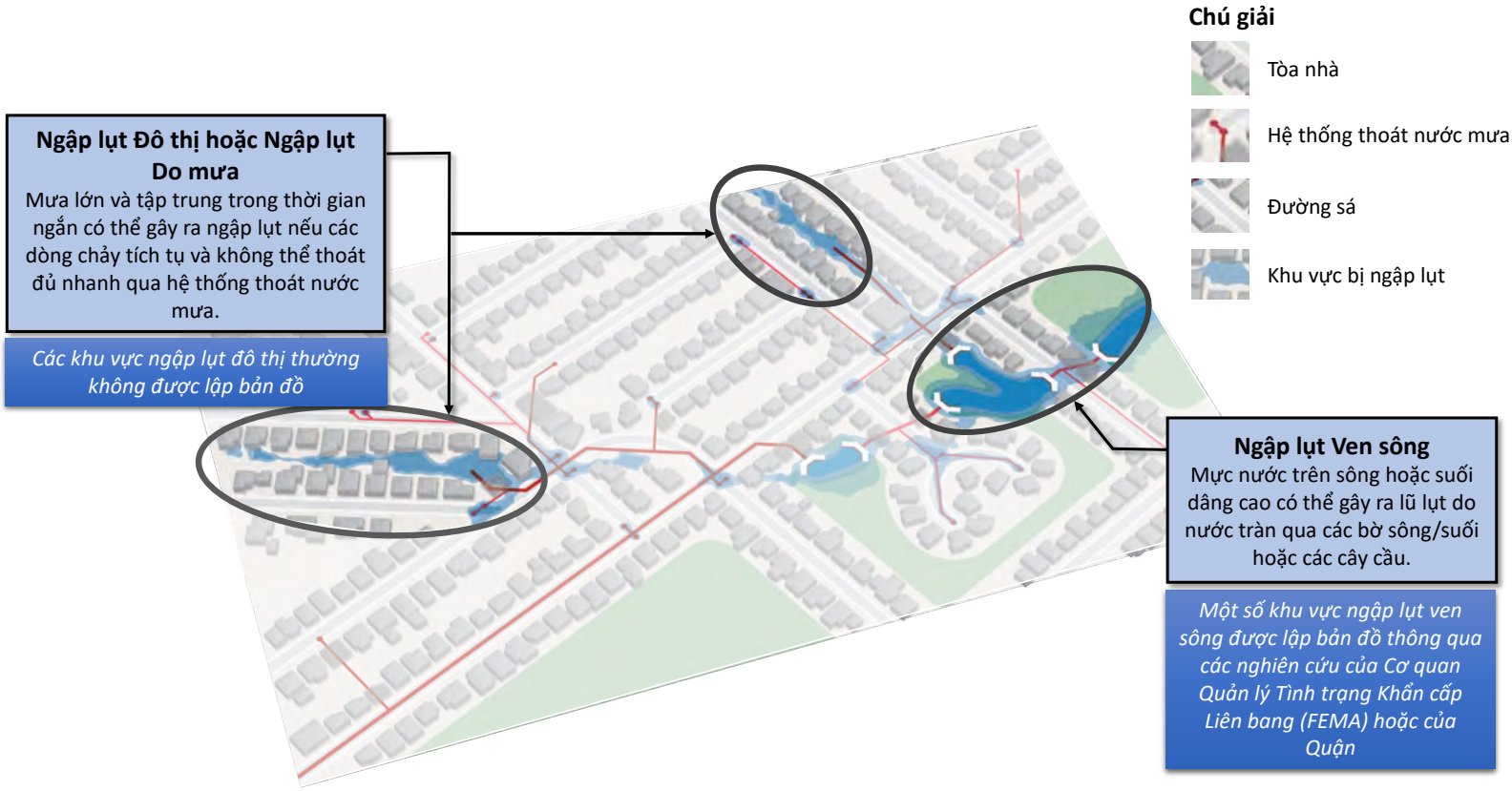
Hãy tham gia khảo sát!

Để bắt đầu quá trình này, chúng tôi muốn lắng nghe ý kiến của quý vị! Chúng tôi muốn tìm hiểu xem quý vị có thể đã bị ảnh hưởng bởi lũ lụt ở đâu, khi nào và như thế nào. Việc xây dựng bộ dữ liệu (data-set) này với thông tin đầu vào từ cư dân ở tất cả các vùng trong Quận sẽ rất quan trọng cho việc tìm hiểu các vị trí, mức độ và loại hình tác động của lũ lụt nghiêm trọng. Tất cả các câu trả lời sẽ được bảo mật.

Quét (scan) mã QR hoặc sử dụng liên kết/đường link bên dưới để hoàn thành khảo sát.

https://bit.ly/MocoFloodSurvey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND



Nguyên nhân gì gây ra Ngập lụt?

Ngập lụt trong Quận có thể xảy ra do lượng mưa quá lớn, vượt quá khả năng của hệ thống thoát nước mưa của địa phương hoặc khả năng thẩm thấu của mặt đất. Đây được gọi là ngập lụt do mưa, còn được gọi là "ngập lụt đô thị" hoặc "ngập lụt nhiều nơi". Ngập lụt cũng có thể xảy ra do mực nước sông hoặc suối vượt cao quá bờ. Loại hình lũ lụt này được gọi là lũ lụt ven sông. Tác động từ một trong hai nguồn này gây ra có thể từ mức phiền toái cho tới nguy hiểm đến tính mạng.

Tiếp tục theo dõi để được cập nhật!

Truy cập (vào xem) trang web để tìm hiểu thêm về dự án và được cập nhật thông tin về các sự kiện sắp tới!

www.montgomerycountymd.gov/flooding

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

የሞንጎመሪ ካውንቲ አጠቃላይ የጎርፍ አስተዳደር እቅድ

የጎርፍ አስተዳደር እቅድ ለምን አስፈለገ?

በሞንትጎመሪ ካውንቲ በሕዝብ እና በግል ንብረት ላይ አደጋ የሚፈጥሩ የጎርፍ መጥለቅለቅ ክስተቶች እየጨመሩ መጥተዋል። ለእነዚህ ክስተቶች መጨመር የተለያዩ ምክንያቶች ቢኖሩም በዋንኛነት የሚጠቀሱት በልማት ምክንያት ፍሳሽ የማያሳልፉ ወለሎች መበራከት እና ከፍተኛ የዝናብ መጠን መጨመር ዋና ዋናዎቹ ናቸው። እነዚህ ተፅእኖዎች ቀጣይነት ባለው የእድገት እና የአየር ንብረት ለውጥ ምክንያት ይጨምራሉ ተብሎ ይጠበቃል።

የጎርፍ አስተዳደር እቅድ ምንድን ነው?

የሞንጎመሪ ካውንቲ የአካባቢ ጥበቃ ዲፓርትመንት (DEP) አጠቃላይ የጎርፍ አስተዳደር ዕቅድ በማዘጋጀት ላይ ነው። የጎርፍ አስተዳደር እቅድ ይህንን እያደረገ ያለውን አደጋ ለማሳወቅ እና በመጨረሻም ካውንቲው ችግሩን ለመፍታት የሚያስችለውን መረጃ የሚያዳብርባቸውን መንገዶች ይዘረዝራል። ይህ እቅድ በሚቀጥሉት ጥቂት አመታት ውስጥ በርካታ የስራ ደረጃዎችን ያካተተ ሲሆን ፤ የተጋላጭነት ምዘናዎችን፣ ዝርዝር ስለጎርፍ ጥናቶችን፣ የመከላከያ ዲዛይኖችን እና የማስተካከያ ፕሮጀክቶችን እና የፕሮግራም ምላሾች ትግበራን ያካትታል።

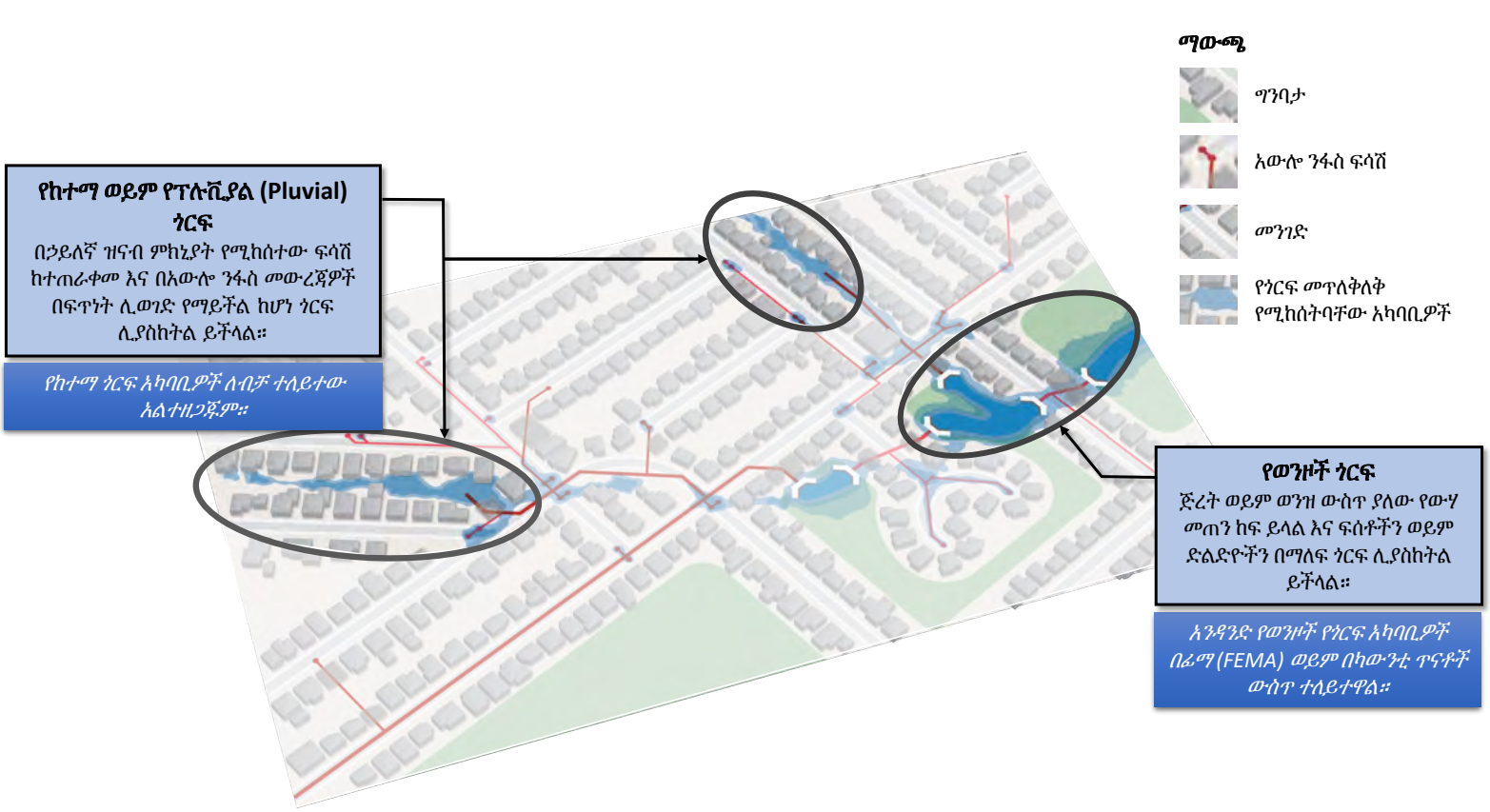
የዳሰሳ ጥናቱን ይሙሉ

ይህንን ሂደት ለመጀመር ፣ ከእርስዎ መስማት እንፈልጋለን! በጎርፍ አደጋ የት ፤ መቼ እና እንዴት ጉዳት እንደደረሱብዎ ለማወቅ እንፈልጋለን። ይህን የመረጃ ስብስብ በሁሉም የካውንቲው ክፍሎች ከሚኖሩ ነዋሪዎች በሚገኝ መረጃ ማደራጀት ፣ የጎርፍ አካባቢዎችን፣ መጠንን እና ሂደትን ለመረዳት ወሳኝ ይሆናል። ሁሉም መልሶች ሚስጥራዊ ሆነው ይቆያሉ።

የዳሰሳ ጥናቱን ለማጠናቀቅ የኪውአር ኮዱን (QR code) ስካን ያድርጉ ወይም ከታች ያለውን ሊንክ ይጠቀሙ።

https://bit.ly/MocoFloodSurvey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND



ለጎርፍ መጥለቅለቅ ምክኒያቶች ምንድናቸው?

በካውንቲው ውስጥ የጎርፍ መጥለቅለቅ ሊከሰት የሚችለው የአካባቢው የዝናብ ፍሳሽ መጠን ከአካባቢው የአውሎ ንፋስ ፍሳሽ ስርዓት አቅም በላይ ሲሆን ወይም ወደ መሬት ውስጥ ሰርጎ መግባት ባለመቻሉ ነው። ይህ ፕሉቪያል (Pluvial) ጎርፍ ይባላል፣ በሌላ መልኩ "የከተማ ጎርፍ" ወይም "ሎት ቱ ሎት / lot to lot) ጎርፍ" በመባል ይታወቃል። የጎርፍ መጥለቅለቅ በጅረቶች ወይም በወንዞች ከመጠን በላይ በመሙላት ምክንያት ሊከሰት ይችላል። የዚህ አይነት ጎርፍ የወንዞች ጎርፍ በመባል ይታወቃል። በእነዚህ በሁለቱም ምክኒያት የሚመጡ አደጋዎች ከሕይወት አስጊ እስከ አስጨናቂ ተጽእኖዎች ሊያደርሱ ይችላሉ።

ወቅታዊ መረጃ ያግኙ

ስለ ፕሮጀክቱ የበለጠ ለማወቅ እና ስለቀጣይ ፕሮግራሞች ወቅታዊ መረጃ ለማግኘት የፕሮጀክቱን ድህረ-ገጽ ይጎብኙ!

www.montgomerycountymd.gov/flooding

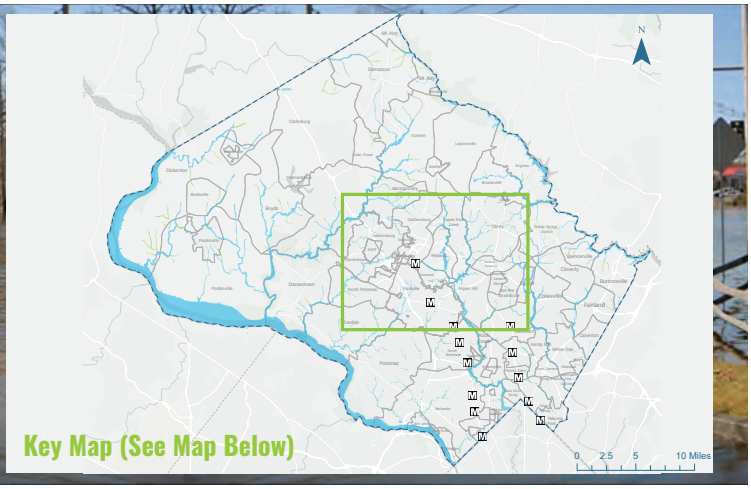
DEPARTMENT OF
ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Montgomery County Comprehensive Flood Management Plan

Montgomery Mid County, MD

Comprehensive Flood Management Plan

The County is working to develop a Comprehensive Flood Management Plan that will aid long-term strategic planning for flood mitigation.



Mid County Pop-up Locations within Areas with Flooding Risk

Riverine Flood Map
100-year Flood
500-year Flood
Metro Stations
Community Boundary
Pop-Ups Locations
0 0.5 1 2 Miles

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Montgomery County Comprehensive Flood Management Plan

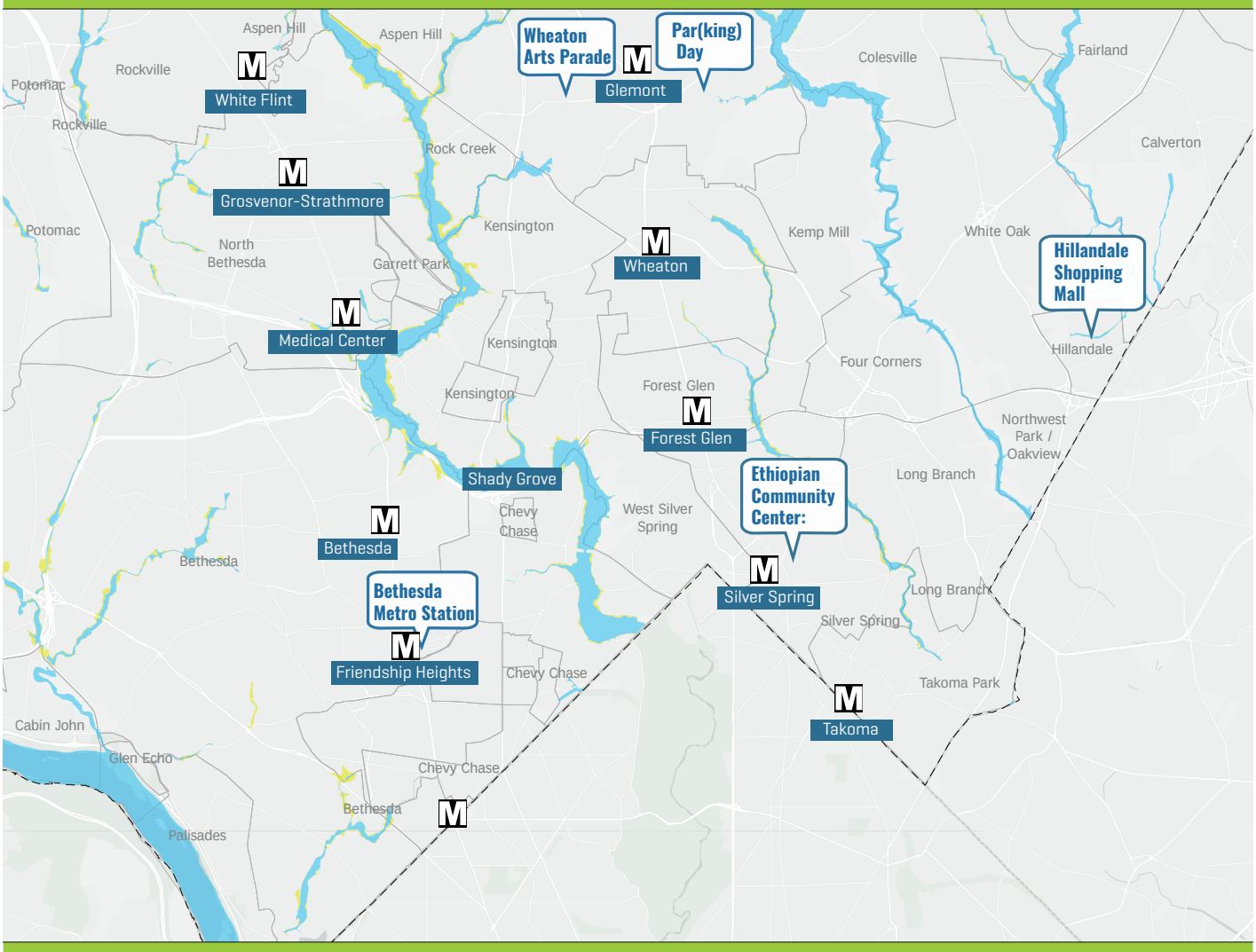
Montgomery South-East County, MD

Comprehensive Flood Management Plan

The County is working to develop a Comprehensive Flood Management Plan that will aid long-term strategic planning for flood mitigation.

South-East County Pop-up Locations within Areas with Flooding Risk

Pop-Ups Locations



Riverine Flood Map
100-year Flood
500-year Flood
Metro Stations
Community Boundary
Pop-Ups Locations

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

Montgomery County Comprehensive Flood Management Plan

Why a Flood Management Plan?

Montgomery County has experienced an increase in flooding events causing impacts to public and private property. While the reasons for this increase are varied, increases to impervious surface due to development and increases in high-intensity rainfall events are some of the top reasons. The impacts of both are expected to increase due to continued growth and climate change.

The Montgomery County Department of Environmental Protection (DEP) is in the process of developing a Comprehensive Flood Management Plan. A flood management plan lays out the steps by which the County can develop the information to inform and ultimately address this growing risk. This plan will consist of several phases of work, panning the next few years, vulnerability assessments, detailed flood studies, adaptation design, and implementation of mitigation project and programmatic responses.

GOT FLOODING?

The County is working to develop a Comprehensive Flood Management Plan that will aid long-term strategic planning for flood mitigation. We want to hear from you to better understand the location and type of flooding impacts residents are experiencing.

STAY INVOLVED!

Visit the project's website to learn more about the project and stay up-to-date on upcoming events!

TAKE THE SURVEY

Take our survey to tell us about your experience with flooding in the County and help inform the Flooding Management Plan!

We want to learn where and how you may have been impacted by flooding. This short questionnaire is expected to take 5 minutes to complete. All answers will remain confidential.

Survey takes 5 Minutes!

DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONTGOMERY COUNTY • MARYLAND

What are the sources of flooding in Montgomery County?

Urban Flooding

Flooding in the county can occur due to local rainfall runoff exceeding the capacity of the local storm drainage system or infiltration capacity of the ground. This is termed pluvial flooding, otherwise known as "urban flooding" or "lot to lot flooding".

Riverine Flooding

Flooding can also occur due to stream or river levels exceeding the banks. This type of flooding is known as riverine flooding. Impacts from either of these sources can range from life hazard to nuisance impacts.

What Are The Sources of Flooding?

Flood Safety Tips

1. 6 inches of moving water will knock you off your feet
2. 1 foot of water will float vehicles.
3. Do not attempt to drive through a flooded road.
4. Turn off your electricity and gas.

Legend

- Building
- Storm drain
- Road
- Area of flooding

Urban or Pluvial Flooding

Intense rainfall can cause flooding if runoff accumulates and cannot be removed quickly enough by storm drains.

Urban flooding areas are typically not mapped

Riverine Flooding

Water levels in a stream or river rise and can cause flooding by overtopping banks or bridges.

Some riverine flooding areas are mapped through FEMA or County studies

English Reset

Montgomery County Comprehensive Flood Management Plan Survey

The Montgomery County Department of Environmental Protection is in the process of developing a flood management plan that will serve as a comprehensive guide for the community to understand types of flooding, risks associated with flooding, and potential mitigation strategies. To begin this process, we want to hear from you! We want to hear your thoughts about flooding and about your experience with it in the county. This short questionnaire is expected to take 5 minutes to complete. All answers will remain confidential.

1. Are you a resident of Montgomery County?

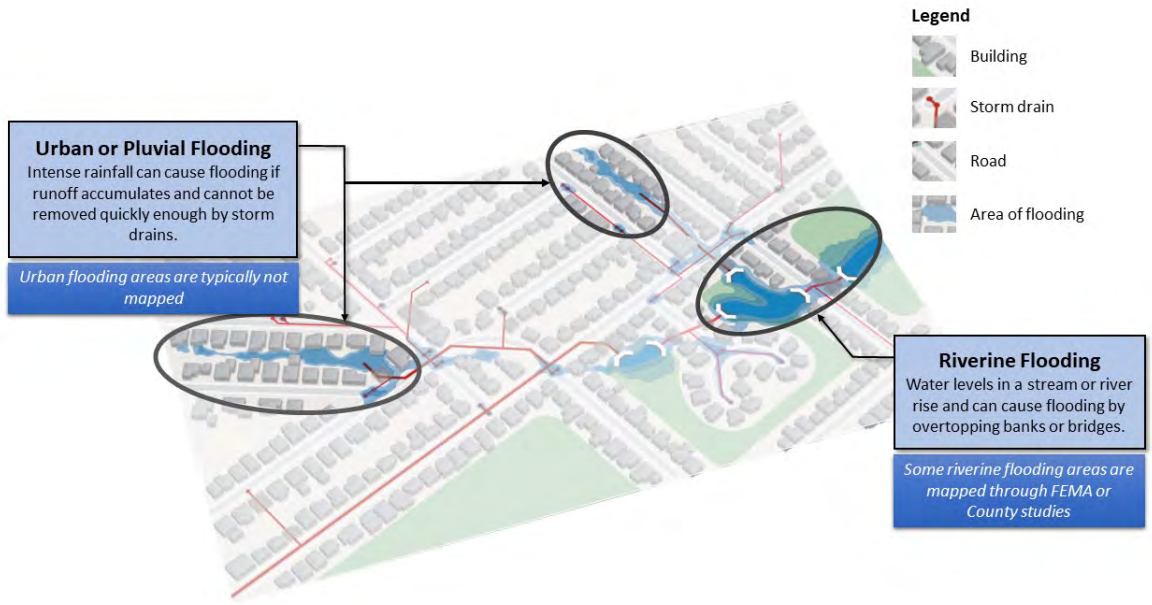
- ○ Yes
- ○ No

2. How much, if at all, do you know about flooding?

1 (Nothing at all)	2	3	4	5	6	7	8	9	10 (I know a lot)
○	○	○	○	○	○	○	○	○	○

Types of Flooding

English Reset



This graphic shows how different types of flooding can occur in an area. The graphic provides definitions for urban and riverine flooding. Keep these definitions in mind as you answer the following questions.

3. Have you experienced or do you currently experience flooding in your neighborhood?

- ○ Yes
- ○ No

4. How often do you observe or get impacted by flooding events?

- ○ Very often
- ○ Often
- ○ Once in a while

English Reset

Never

5. How concerned are you about flooding impacting you in the future?

Not concerned at all

Not concerned

A little concerned

Very Concerned

6. What type of flooding have you been impacted by or observed in your neighborhood?

Riverine flooding: nearby stream or river is overtopping its banks

Urban flooding or local drainage flooding: nearby street drains are overflowing, or water is running from one property onto another before it gets into a street drain or stream

English Reset

☐ Plumbing/sewage backup

☐ Groundwater: water seeping into a basement or seeping out of the ground

☐ Water main break: drinking water pipe has broken

English Reset

☐ Unknown

7. During which time of the year do you experience or see flooding events occurring in your neighborhood?

(1)

8. Please put a pin in locations where you have seen and/or experienced flooding.

Tip: This question will try to use your location. Press to continue.

English Reset

9. If possible, please share any dates of major flooding events that you have experienced.

10. Please indicate the type of impact you have experienced due to this event. For events, you have observed, but not been impacted by, please select "no personal impact"

- [ ] Affected health of someone in your household
- [ ] Damage to structures
- [ ] Caused stress
- [ ] Lost valuables
- [ ] Lost hours of work to clean up
- [ ] Lost items of emotional value
- [ ] Lost the use of part of your property
- [ ] Lost business income
- [ ] Environmental damage/erosion

English Reset

- [ ] No personal impact
- [ ] Other

11. Please provide an estimate of your expenses due to flooding.

Damages to structures (USD)

123

Lost valuables (USD)

123

Other expenses (USD)

123

Lost wages (USD)

123

Lost other income (USD)

123

12. Please provide any further details about flooding impact or specific dates in which you experienced major flooding events.

13. How confident do you feel about finding resources and information

English Reset

- ○ Not confident at all
- ○ Not confident
- ○ Somewhat confident
- ○ Confident
- ○ Very confident

14. Have you used 311 to report flooding events or impacts?

- ○ Yes
- ○ No

Demographic

Lastly, we want to ask you some questions about yourself and your household. We are asking these questions to understand who we are talking to in Montgomery County to make sure we equitably reaching everyone in the county. You can choose to answer or skip these questions. All information will be confidential.

15. City/Town

English Reset

123

17. What's your age group?

- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65+

18. Which gender do you identify with?

- Female
- Male
- Transgender

English Reset

- Prefer Not to respond

19. Which of the following best describes you?

- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Hispanic, Latino/a/x, Spanish Origin
- White

20. What was your household income in 2021 before taxes?

- Under $15,000
- Between $15,000 and $29,999
- Between $30,000 and $49,999
- Between $50,000 and $74,999

English Reset

- [ ] Between $100,000 and $150,000
- [ ] Over $150,000

21. Not counting yourself, how many adults age 18 or older live in your household?

123

22. How many children under the age of 18 live in your household?

123

23. Do you own or rent your home?

- [ ] Rent
- [ ] Own

24. Your house type is…

- [ ] Single family detached home
- [ ] Townhouse
- [ ] Condo/apartment

English Reset

Other

Thank you for taking the survey! There will also be a series of community forums to take place from 6:30-8:30pm on Wednesday, October 12th and Thursday, October 20th. Participants will have the choice to attend either dates as the same presentation will be given by DEP at both events. Click here to sign up.

The community forum will provide information about the Comprehensive Flood Management Plan, updates on the project, and general information about flooding in Montgomery County. Participants will have the opportunity to share information about their experience with flooding events in the County.

Submit

Powered by ArcGIS Survey123

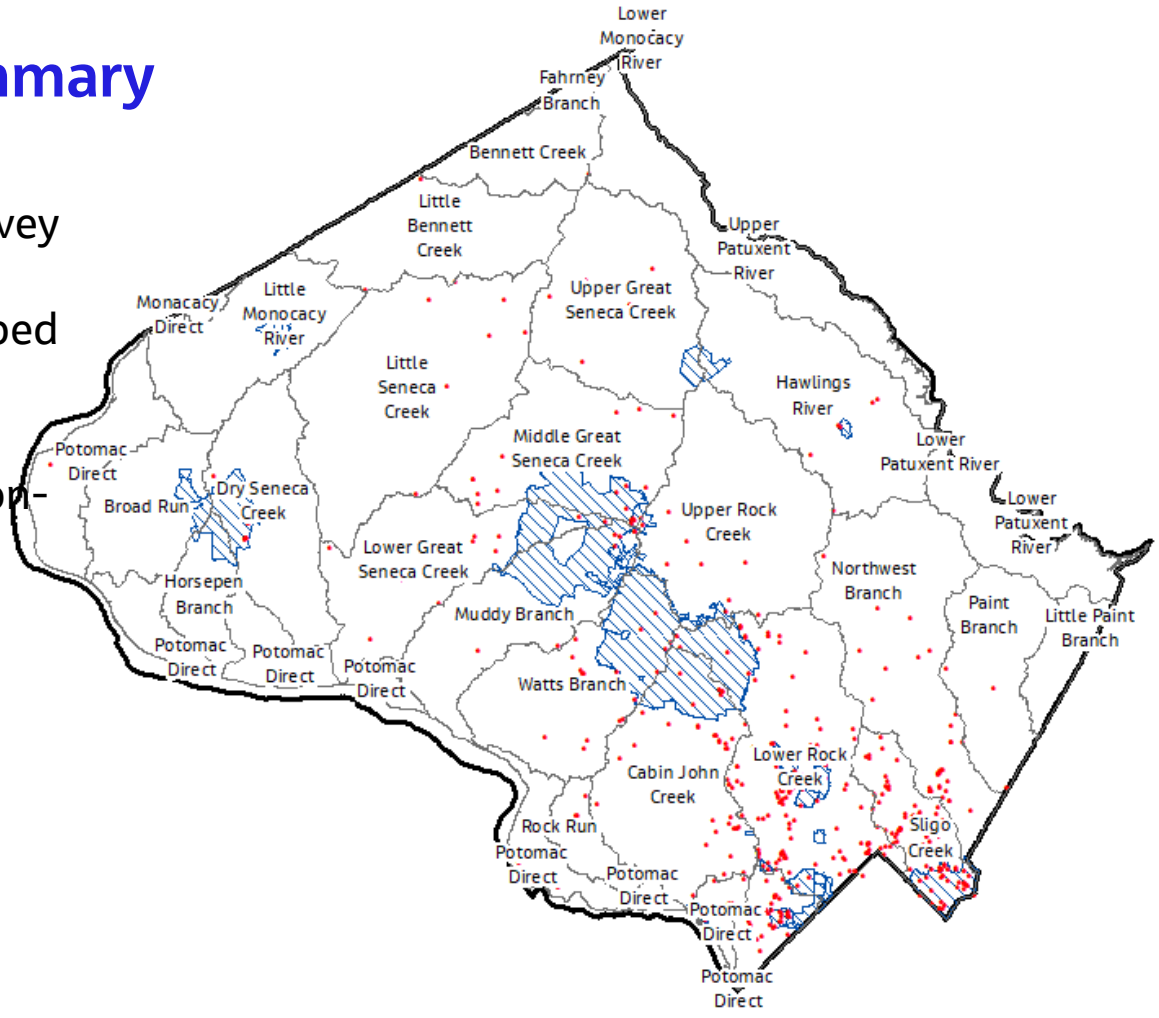
Jacobs Challenging today. Reinventing tomorrow.

Flooding Community Survey – Summary of Initial Results

November 9, 2022

Community survey results summary

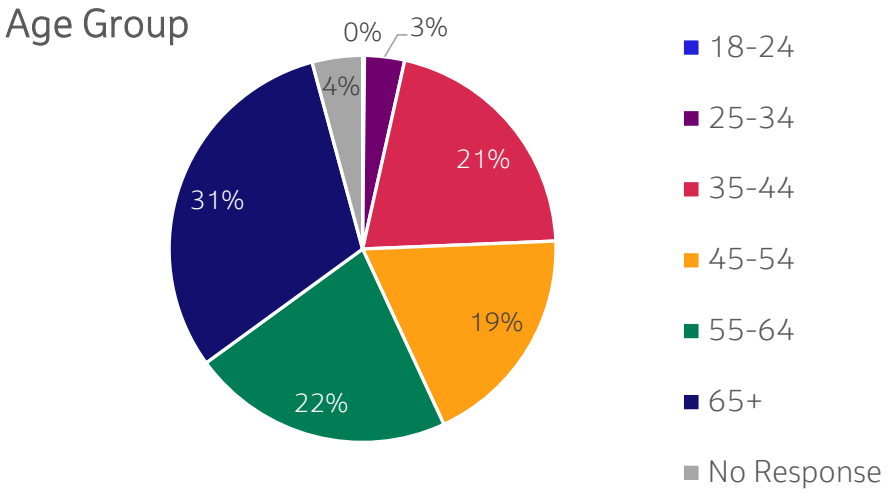
- A total of 571 responses collected from September 20 to November 2, 2022 (survey remains open)
  - 705 reported flooding locations (mapped at right)
- 98% (559 of 571) indicated they were County residents (10 “no response”, 1 “non-resident”)
- Gathering:
  - Flood impact locations
  - Impacts types, flood mechanisms
  - Flood information knowledge and concerns
  - Demographic information

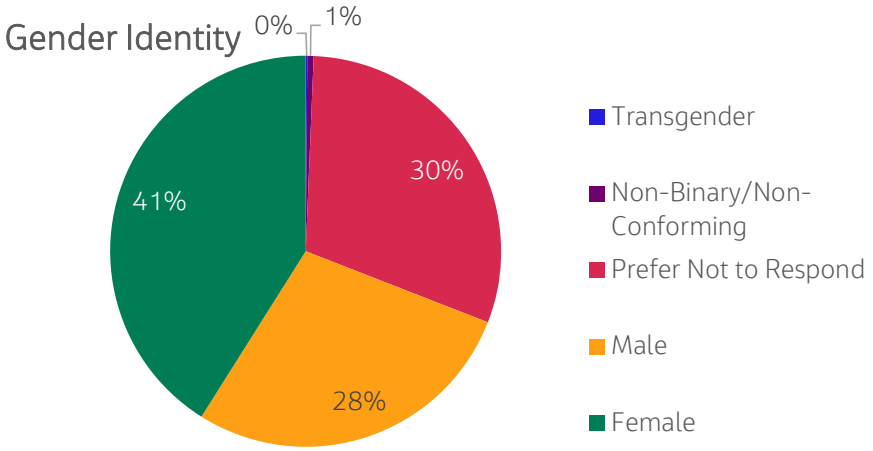


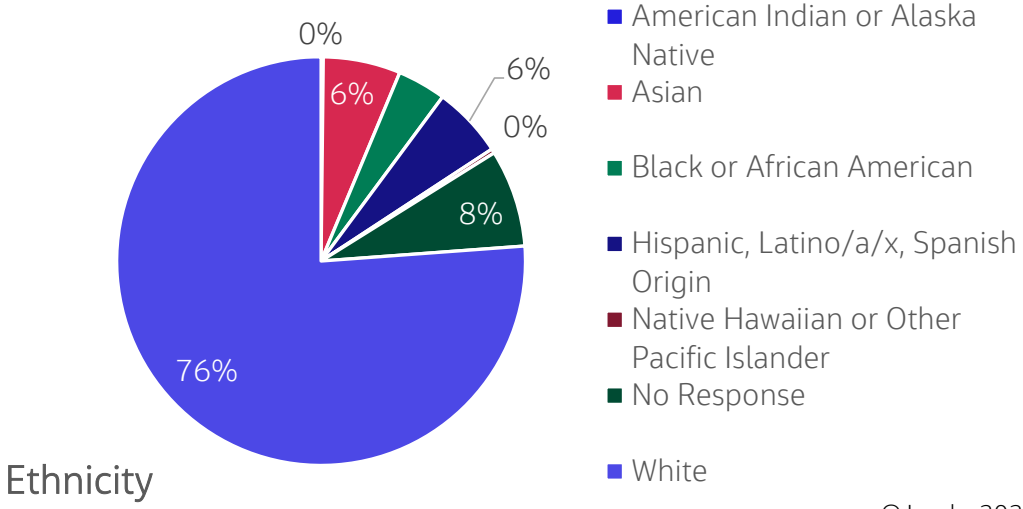
©Jacobs 2022

Who have we reached?

- Greater representation among:
  - Older residents (largest group – 31% are 65+)
    [US Census Bureau 2021 ~17%]
  - Residents identifying as White (76-84%)
    [US Census Bureau 2021 ~59%]





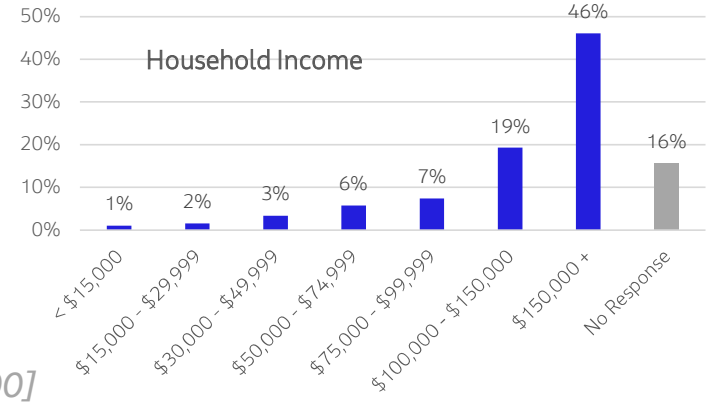


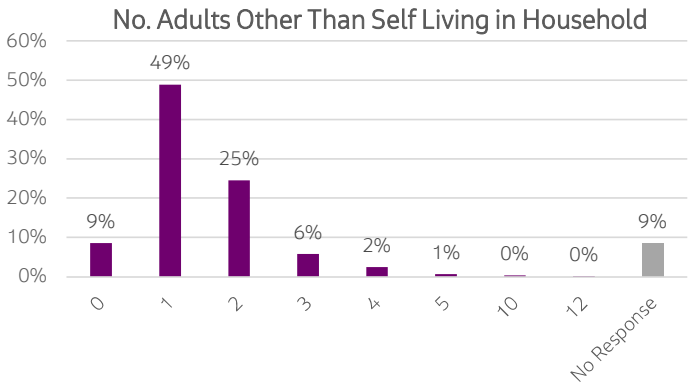
Ethnicity

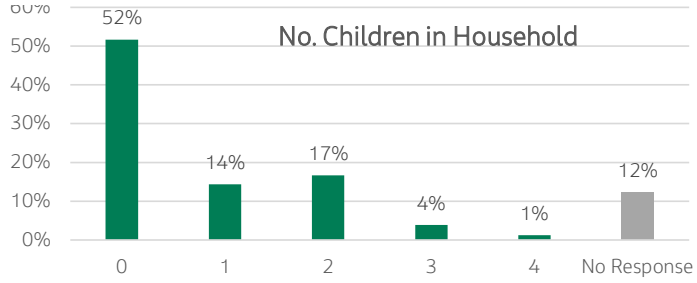
https://www.census.gov/quickfacts/montgomerycountymaryland
©Jacobs 2022

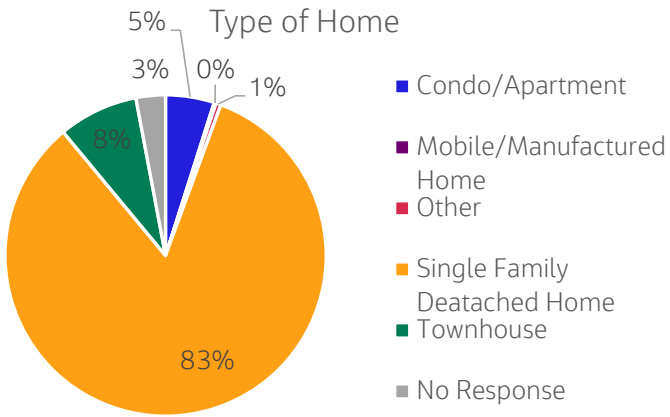
Who have we reached? (continued)

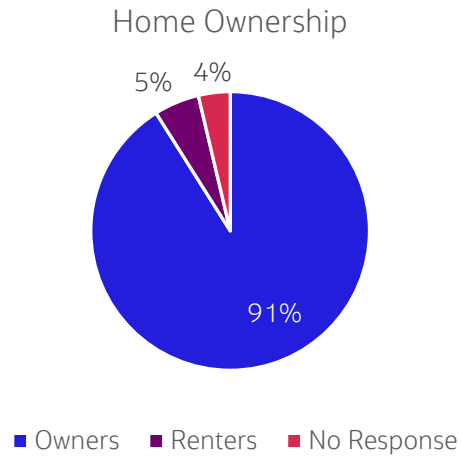
- Generally:
  - Single family home residents
  - Homeowners (91%) *[US Census Bureau 2021 ~66%]*
  - Income $150,000+ (46%) *[US Census Bureau 2021 median = $110,000]*
  - Households with 2-3 adults (84%)
    - 52% with no children
    - 31% with 1-2 children







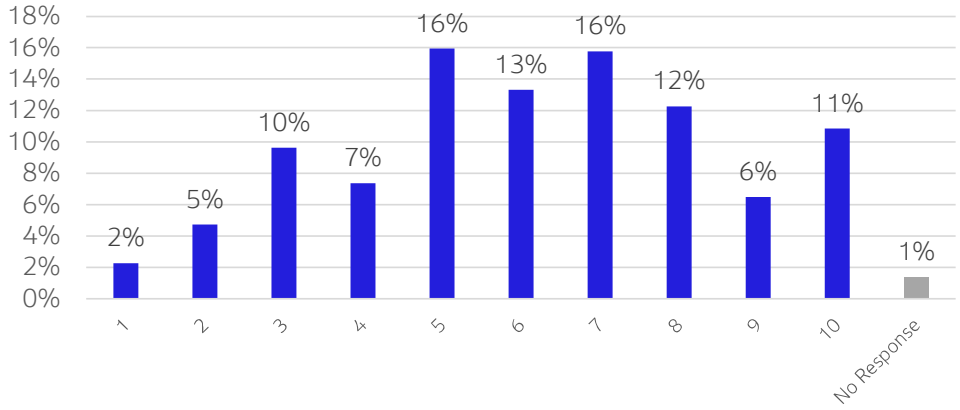




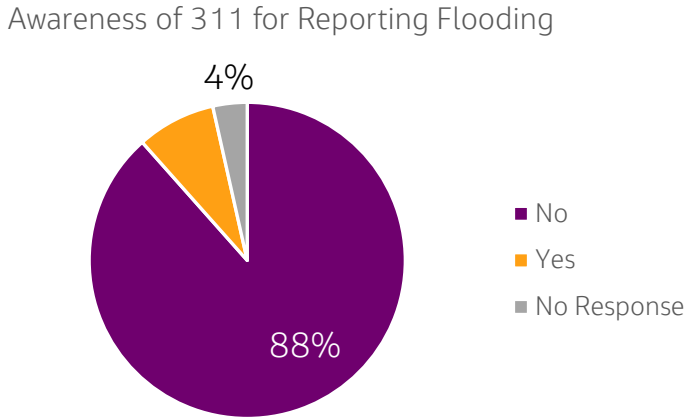
https://www.census.gov/quickfacts/montgomerycountymaryland

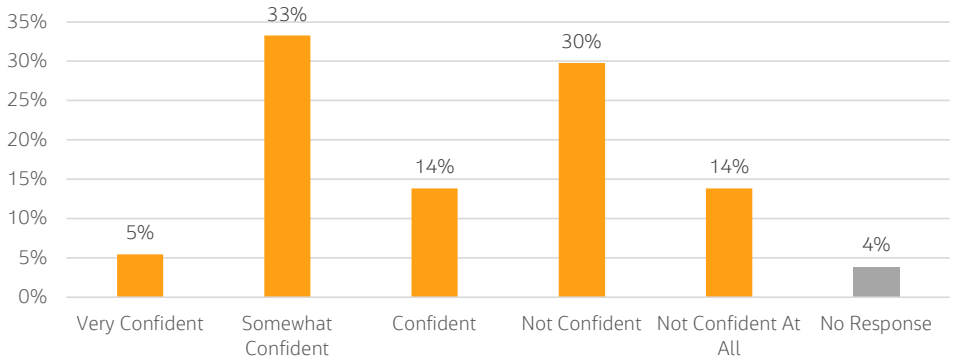
Understanding of the issues and County services

- Respondents are generally knowledgeable about the issue, but not necessarily how to interact with County services
  - Combined 74% rate knowledge 5 or higher
  - Combined 45% indicate they are not confident in finding resources



Self-Rating of Flood Knowledge



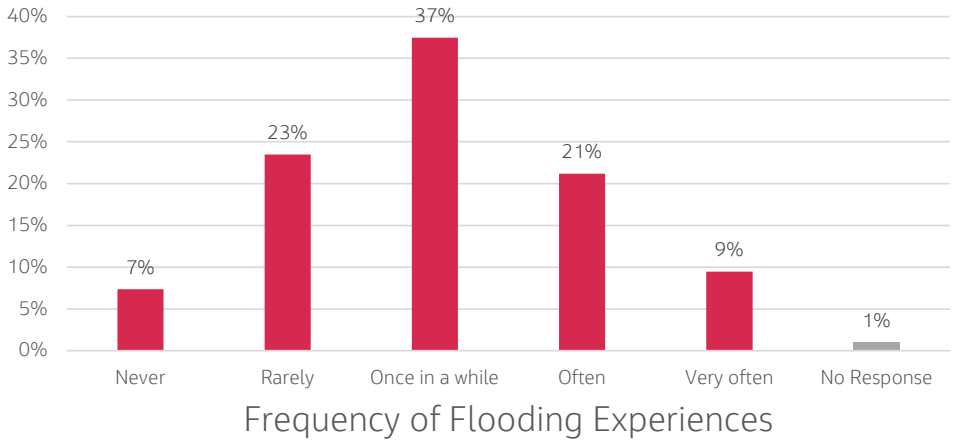


Confidence in Finding Resources for Handling and Preparing for Flooding

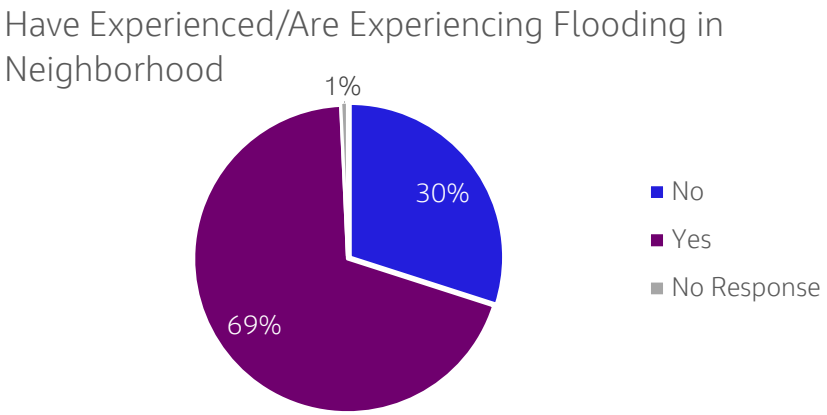
©Jacobs 2022

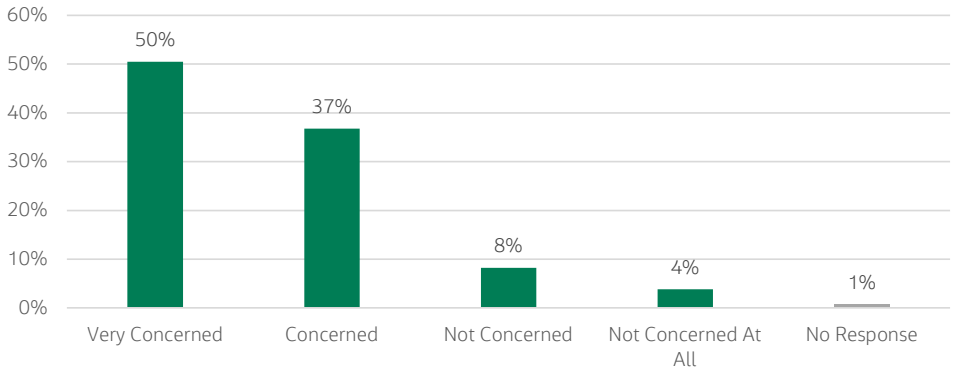
Frequency of flooding impacts

- While most (60%) are rare or occasional impacts, 30% indicated experiences are “often” or “very often”
- Most respondents (87%) are at least somewhat concerned about future impacts



Frequency of Flooding Experiences



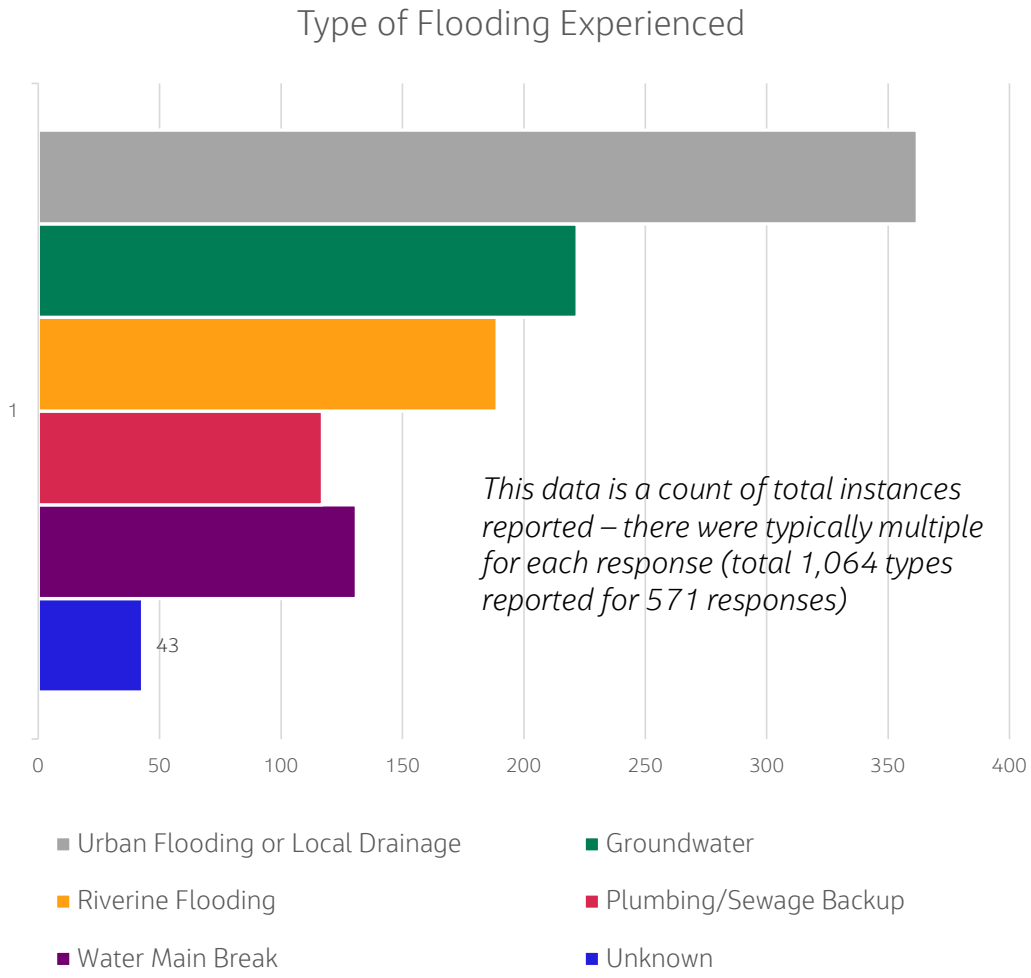


Concern Over Future Flooding Impacts

©Jacobs 2022

Types of flooding

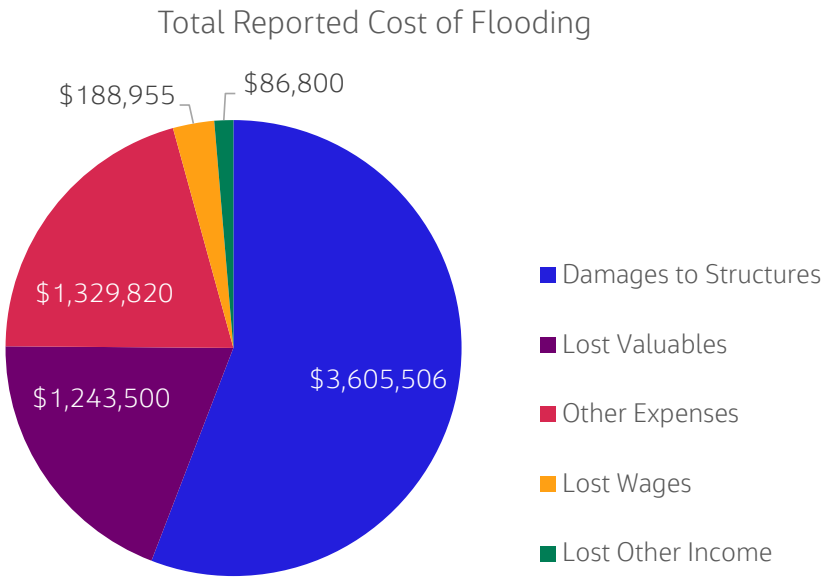
- Respondents typically indicated multiple flooding type - Only 32% reported a single vector
- Based on total responses…
  - A combined 63% of respondents indicated “urban flooding” as a contributing vector
  - A combined 33% of respondents indicated “riverine flooding” as a contributing vector
    - Approximately 9% of reported locations are within mapped FEMA 100- and 500-year floodplain areas (64 of a total 705 location reported)
  - Combined 23% of respondents indicated “plumbing/sewage backup” or “water main break” as a contributing vector

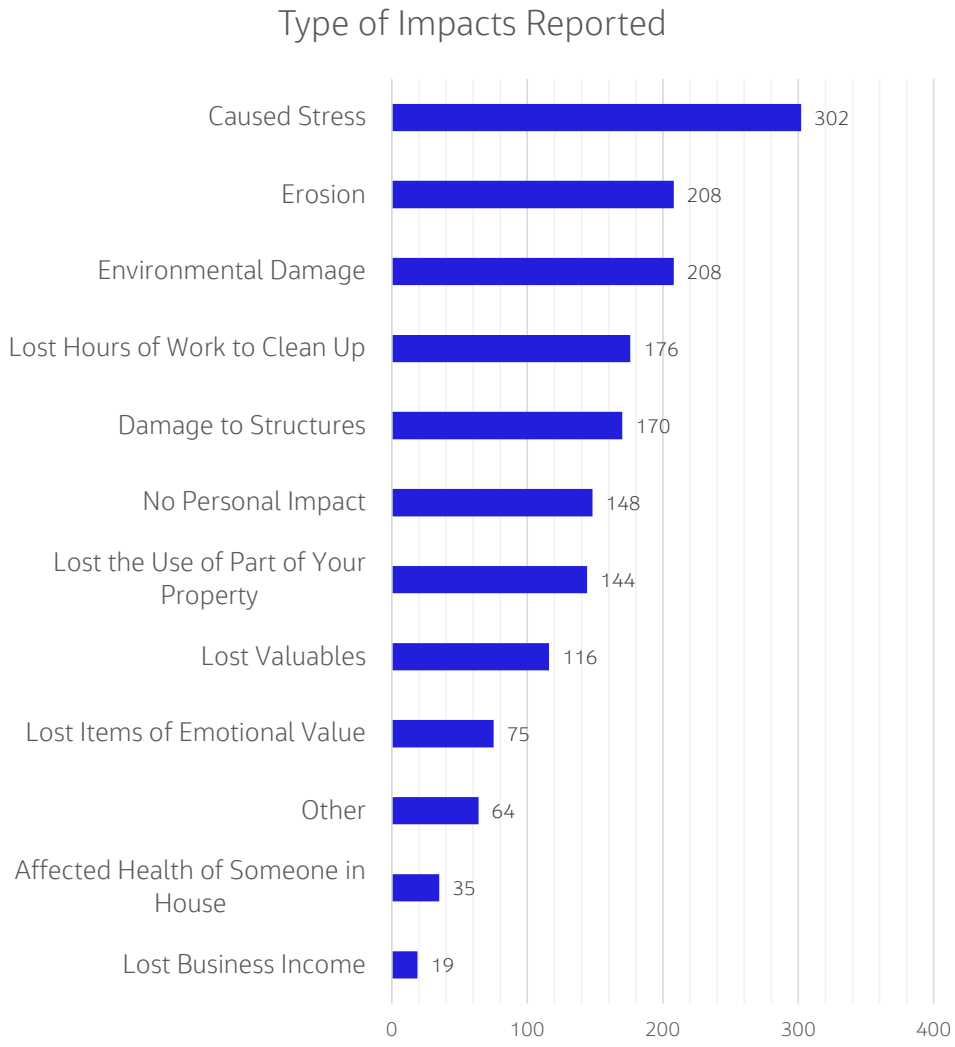


©Jacobs 2022

Types of impacts due to flooding

- Considerable structural damage reported ($3.6M total)
- Impact types vary, most impacts are multi-faceted





©Jacobs 2022

Jacobs

Challenging today.
Reinventing tomorrow.

Comprehensive Flood Management Plan Phase 1

Virtual Community Forum

October 20, 2022

Jacobs

Agenda

- Introductions & Context
- Consultant Presentation
- Q&A
- Breakout Groups **as time and numbers allow**
- Wrap-up
- Adjourn

Introduction & Context

What is the Comprehensive Flood Management Plan? Why do we need it?

- Recurrent problem
- Impacts: nuisance flooding > significant damage > loss of life
- Projected to worsen due to climate change and urban development

Loss of life and severe property impacts, Rockville

Road closure, Sligo Creek Parkway

Severe property impacts, Potomac

Local road and property impacts, Oakmont

Development of a Comprehensive Flood Management Plan will provide the County with solutions to mitigate flood risk…

What is the Comprehensive Flood Management Plan?

The plan will develop solutions to flooding based on an understanding of current and future flood risk

Detailed Study	Mapping of flooded areas for a range of current and future conditions
Vulnerability & Risk Assessment	Understand potential impacts to homes, businesses, vulnerable populations, critical facilities and infrastructure
Alternatives Assessment	Develop solutions to mitigate flood risk

The County's approach to Comprehensive Flood Management

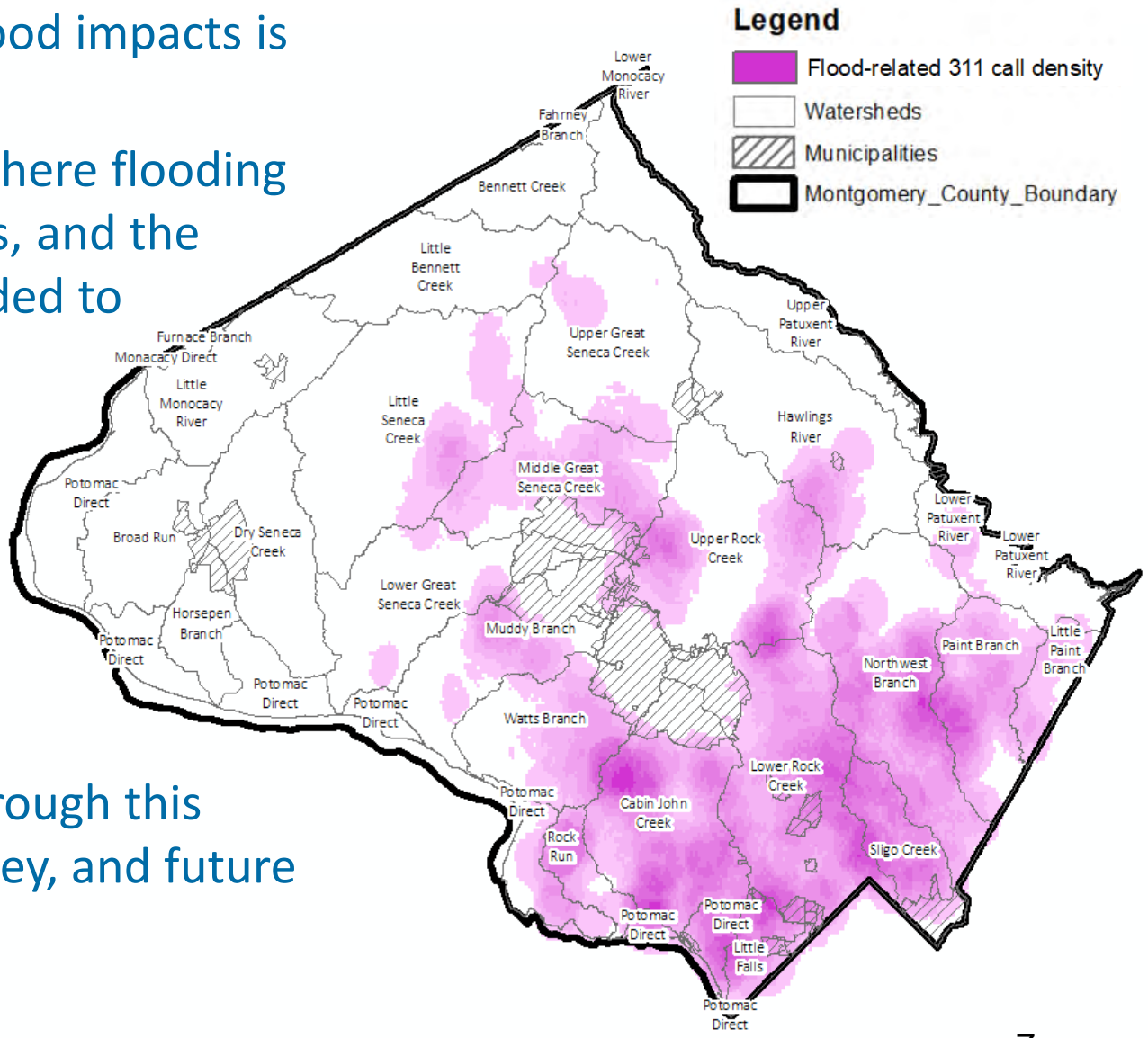
- Phase 1 (9 months): Understand current organizational approach to flooding and identify recommended changes
- Phase 2 (2-3 years): Detailed studies including risk assessment and alternatives analysis
- Phase 3 (varies): Implementation of alternatives

Further community engagement is anticipated at all phases of this process.

Durations dependent on data availability, funding

Why are we here today?

- Information on past flood impacts is limited
- An understanding of where flooding has impacted residents, and the type of impacts is needed to prioritize future work



We seek to learn more through this session, the on-going survey, and future engagement events.

Understanding Stormwater and Flooding

What is Stormwater?

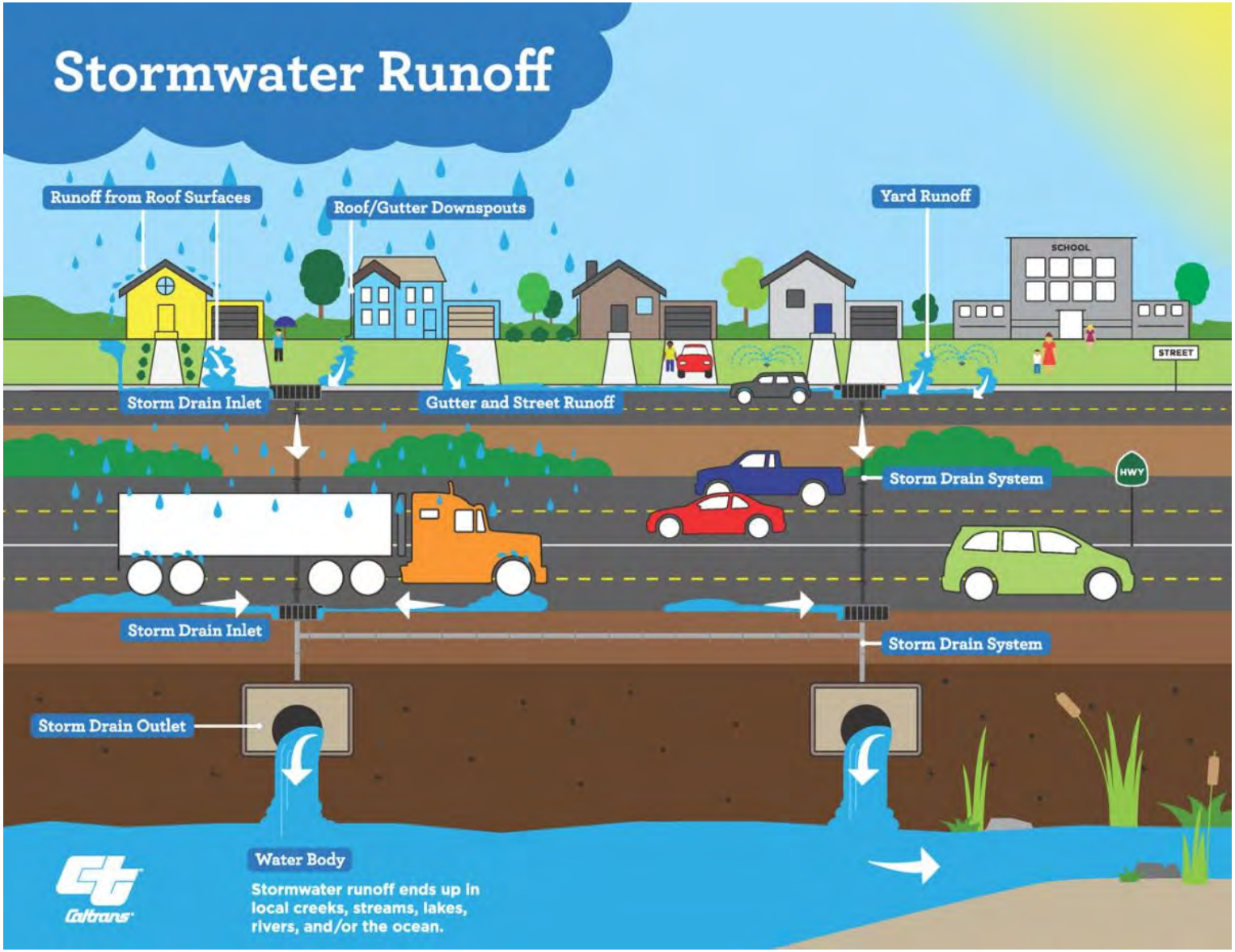


Image Source: California Department of Transportation (CalTrans)

Flooding happens in different ways….

Precipitation – Driven Flooding

Pluvial / Urban

Smaller storms exceed capacity of local drainage

Localized flooding

Riverine

Larger storms overtop stream/river channels

Regional flooding

A high groundwater table (driven by precipitation, riverine and/or coastal influence) can also cause flooding

What is a Floodplain?

A floodplain is an area adjacent to a stream or river that is expected to flood when water levels rise

- FEMA definition: area inundated by 1% annual occurrence storm (100-year storm)
- County definition: area inundated by 100-year storm for any stream channel with a drainage area of 30 acres or more

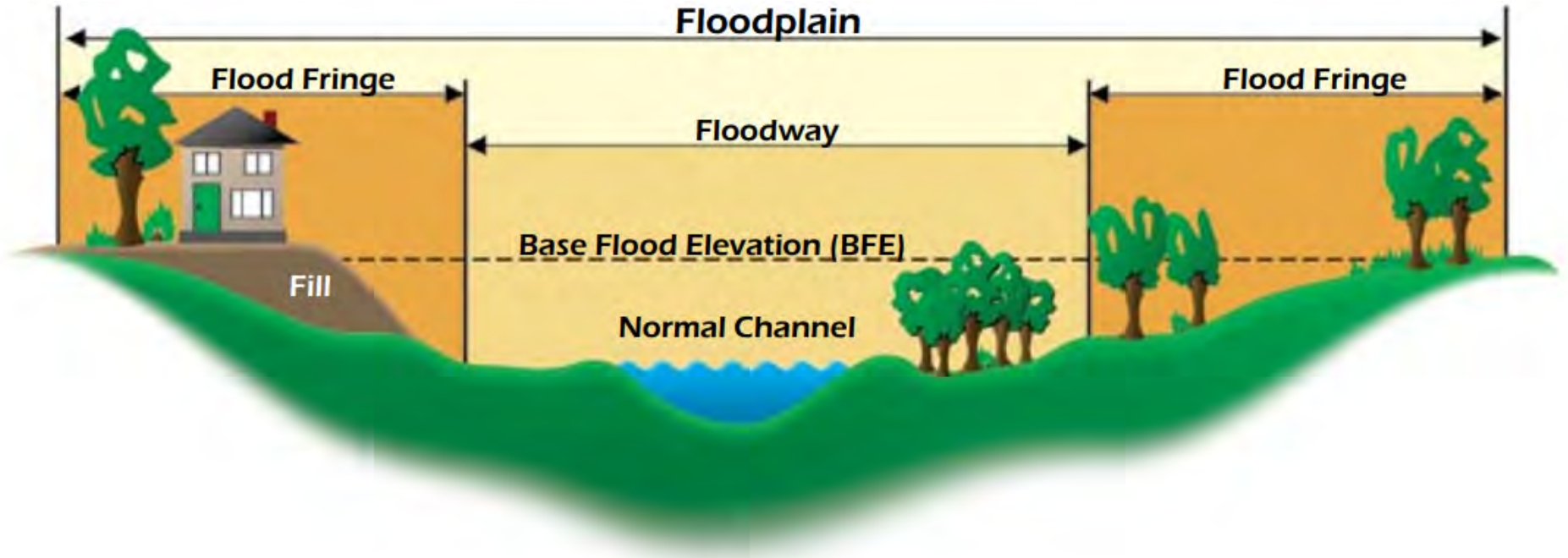
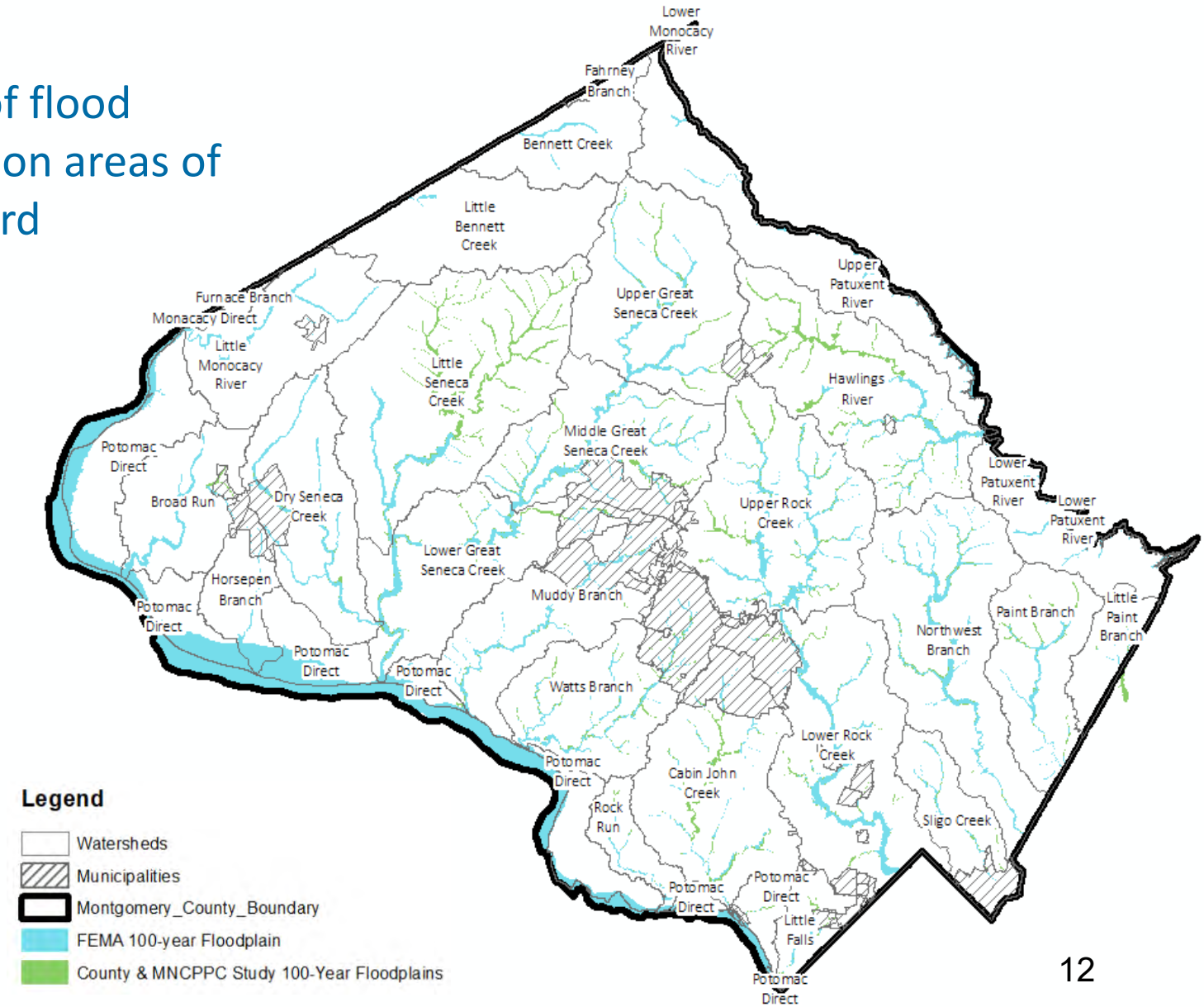


Image Source: Oregon NFIP Guidebook 5th Edition (FEMA Region 10, 2009)

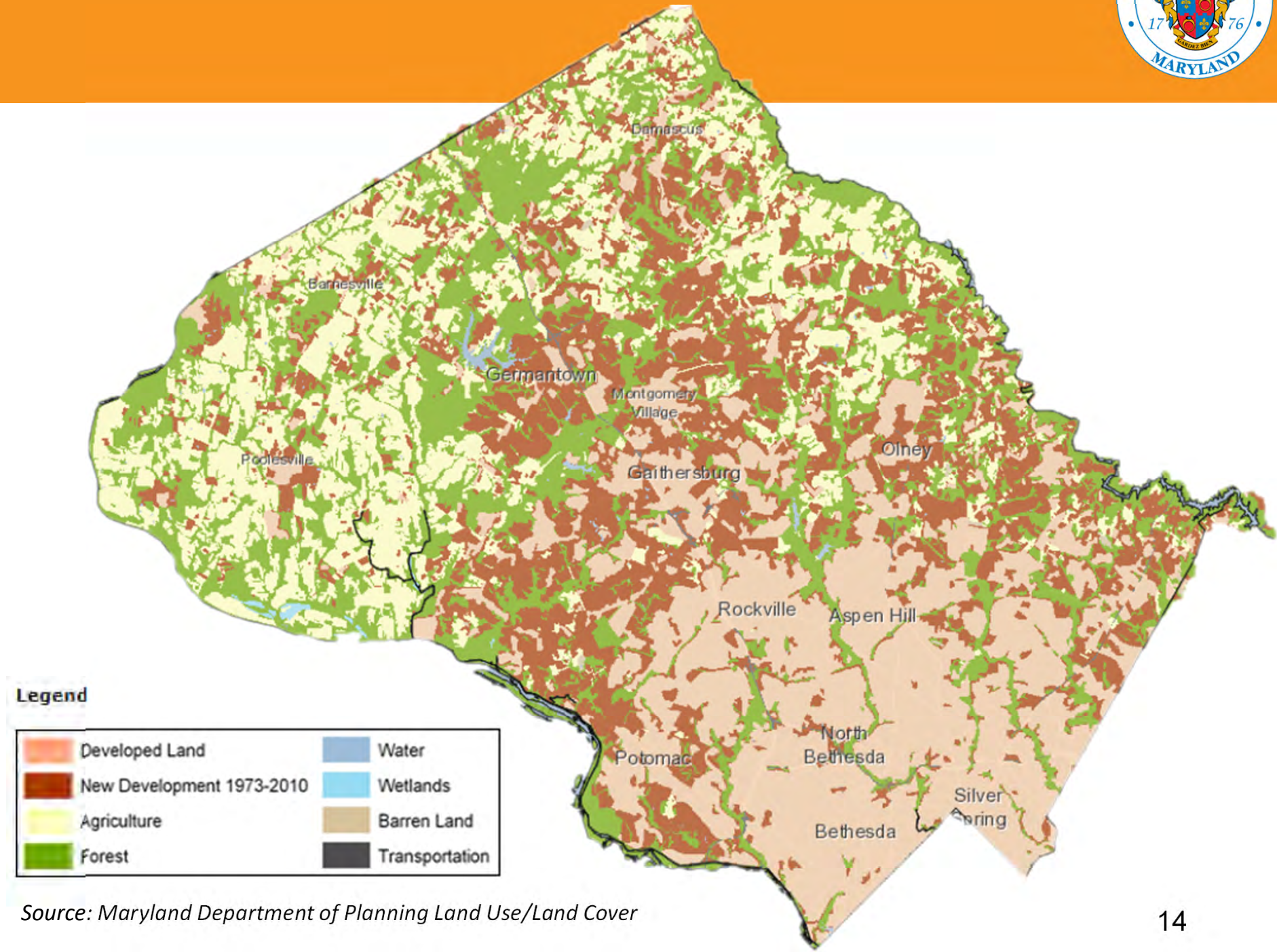
What information does the County currently have on flood risk areas?

Existing mapping of flood hazards is focused on areas of riverine flood hazard



Why is flood risk changing?

Increased Urbanization



Source: Maryland Department of Planning Land Use/Land Cover

Aging Infrastructure

The Washington Post
Democracy Dies in Darkness

TRANSPORTATION

I-270 sinkhole work could last weeks during drainage pipe repairs

By Justin George
June 21, 2022 at 5:45 p.m. EDT

Listen 3 min | Comment 12 | Save | Gift Article | Share

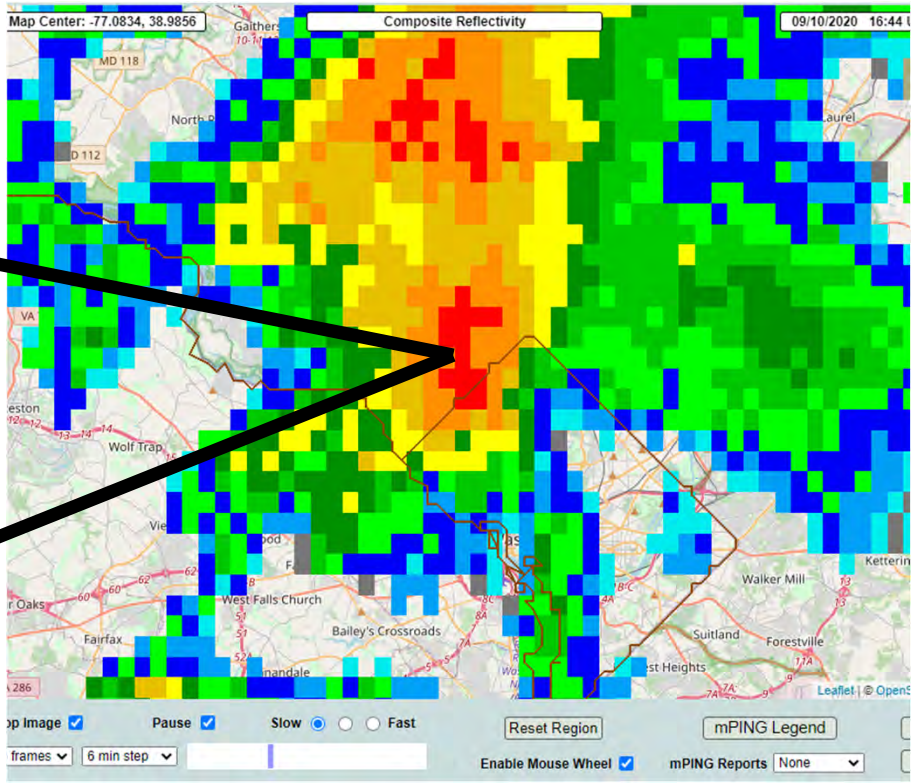
Maryam Shahzad
@maryam_mcm · Follow

The sinkhole on I-270 from the Muddy Branch Road overpass. @mymcmedia

Image sources: MoCo Show, Washington Post

Climate Change

High-intensity events exceeding storm drain inlet capacity result in localized flooding impacts

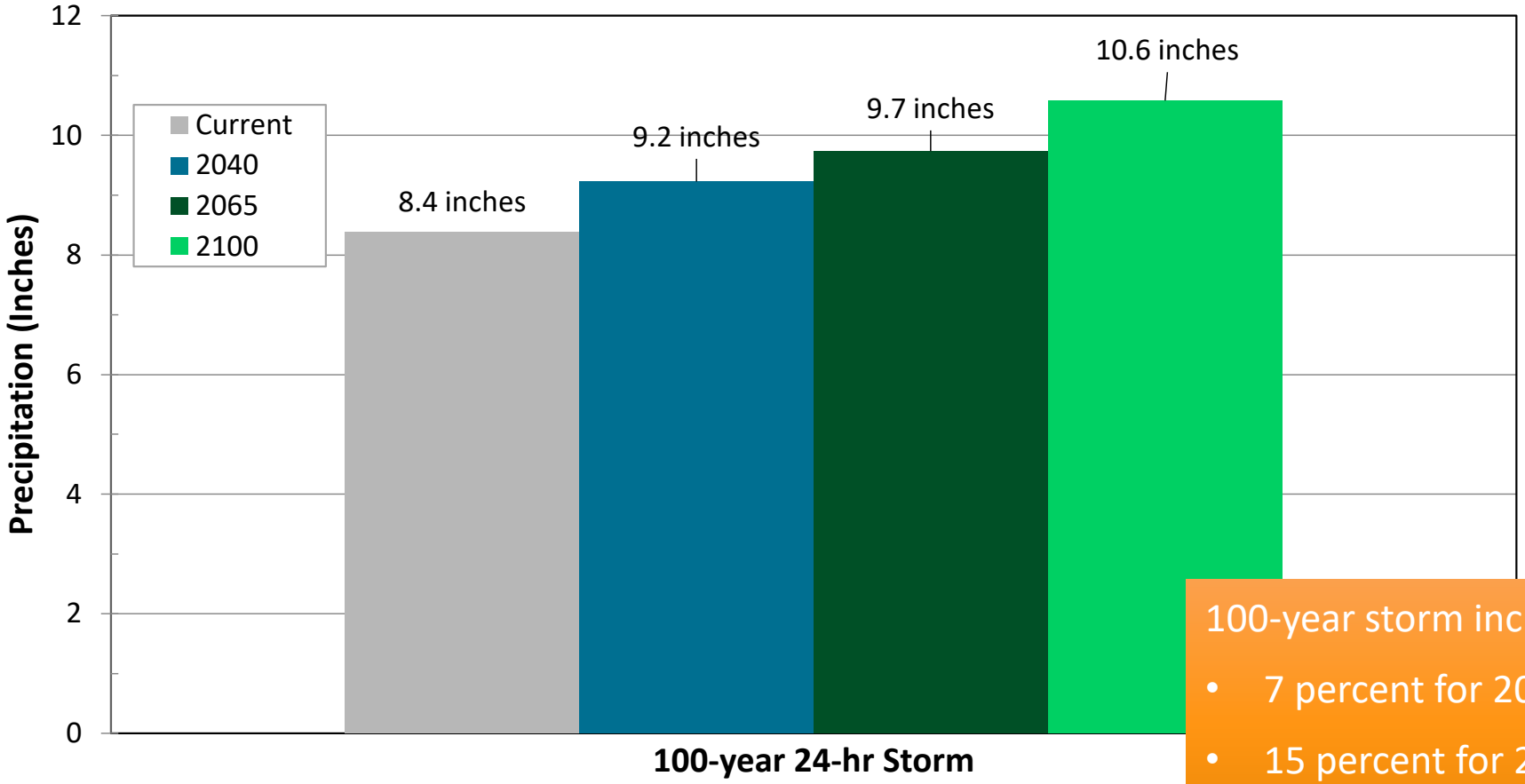


Weather radar showing cumulative 3-hour rainfall for the September 10, 2020 storm cell—a high-intensity short-duration event, with rain intensities as high as 10 inches per hour for 1 to 3 hours in some areas.

Source: NOAA Multi-Radar Multi-Sensor (MRMS) Operational Product Viewer

Climate Change

Rainfall depth (inches) for the 1% annual recurrence (100-year) 24-hr storm



100-year storm increases:

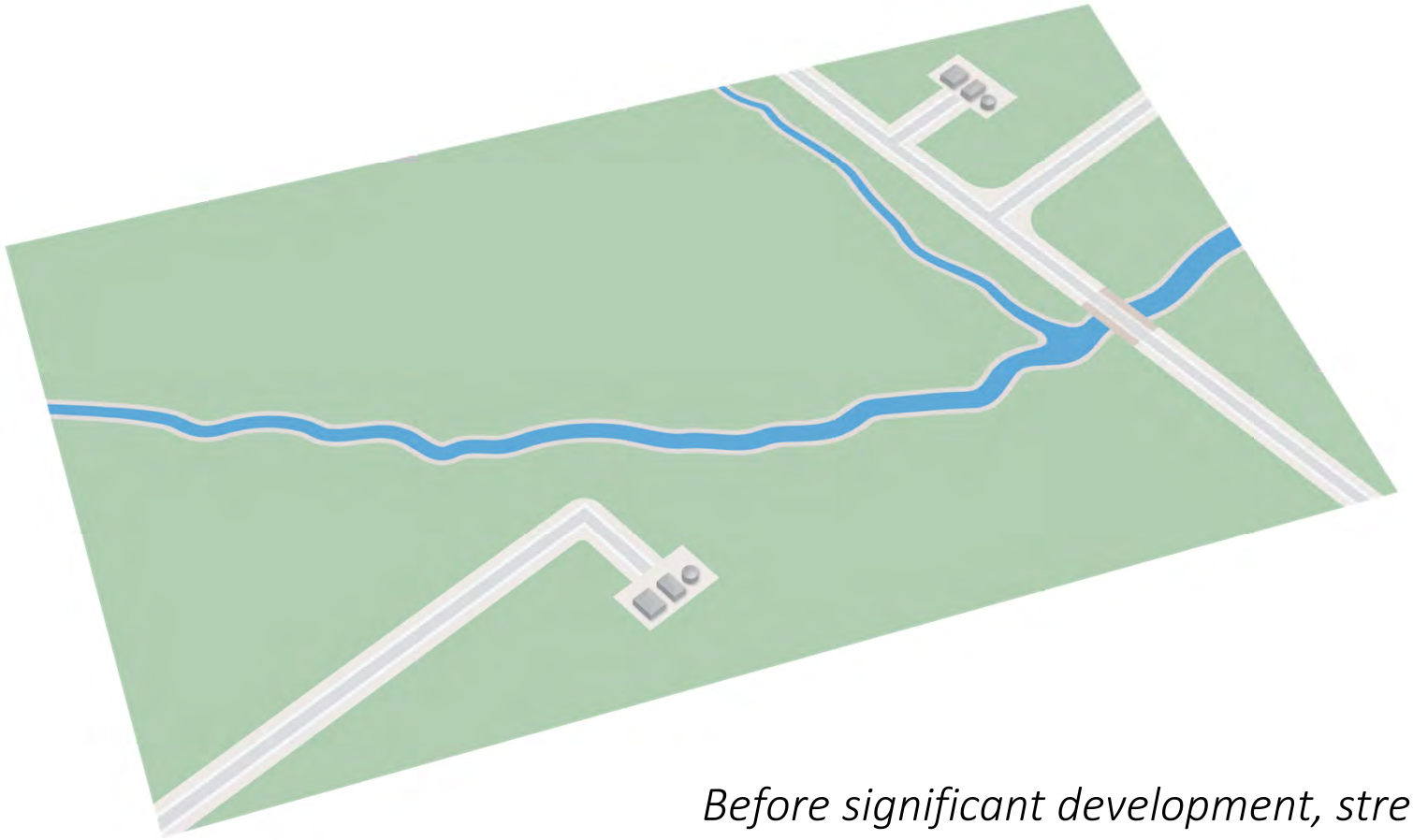
- 7 percent for 2040
- 15 percent for 2065
- 23 percent for 2100

Source: Rainfall projections for WSSC Water (Jacobs, 2019)

How is flood risk in the County expected to change?

How is flood risk in the County expected to change?

Pre-development

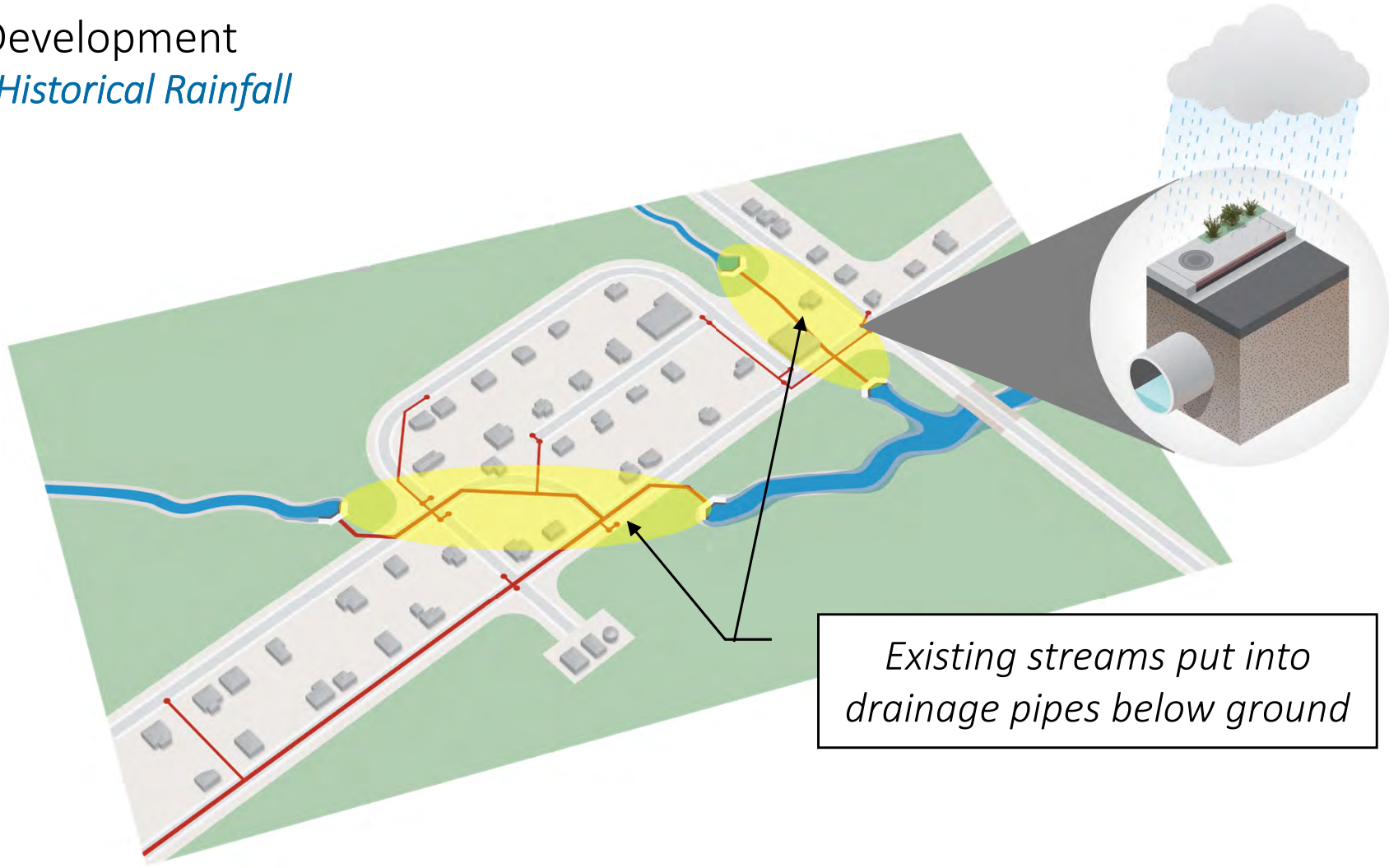


Before significant development, stream channels remain largely intact

How is flood risk in the County expected to change?

Early Development

Typical Historical Rainfall

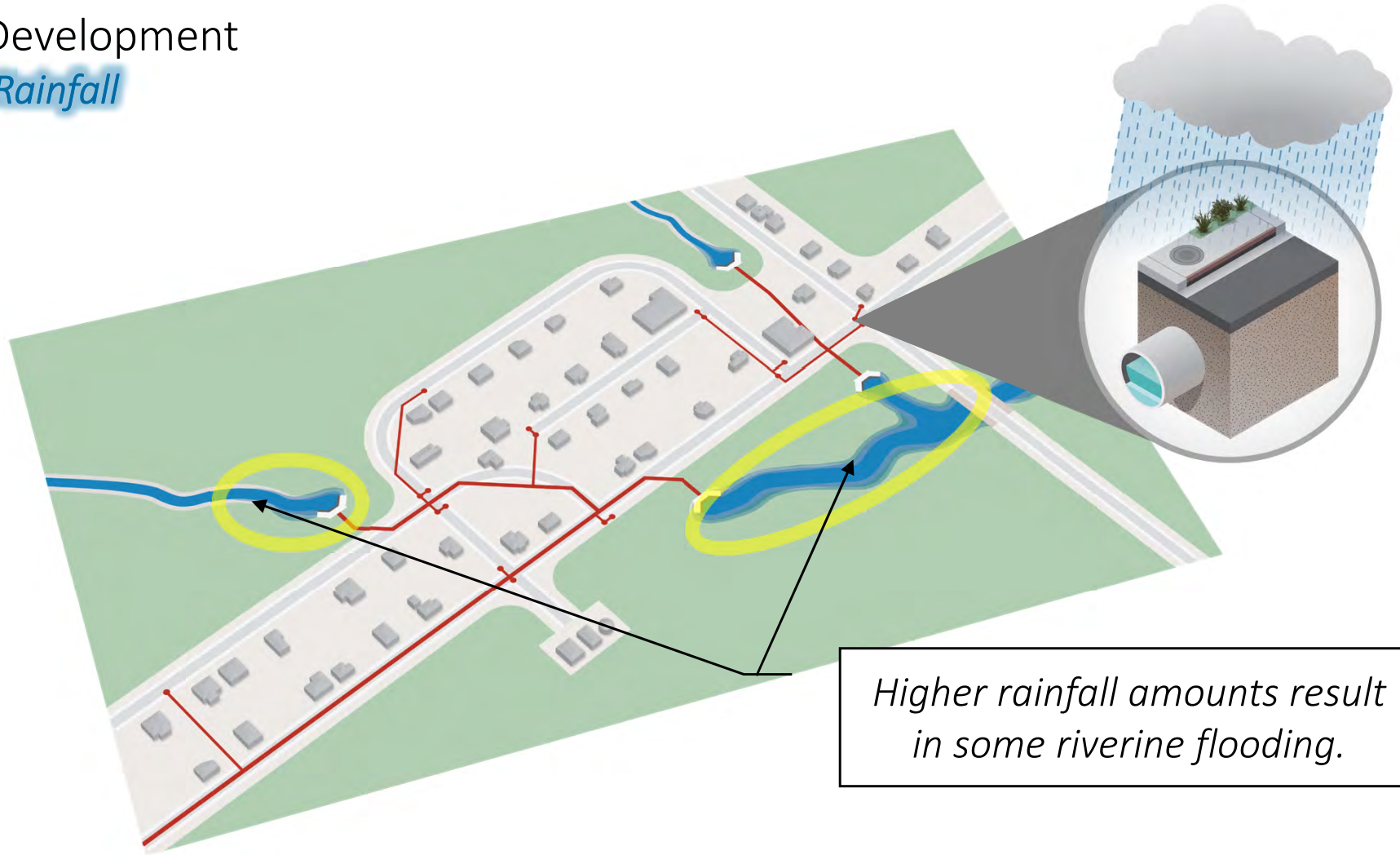


Existing streams put into drainage pipes below ground

How is flood risk in the County expected to change?

Early Development

Heavy Rainfall



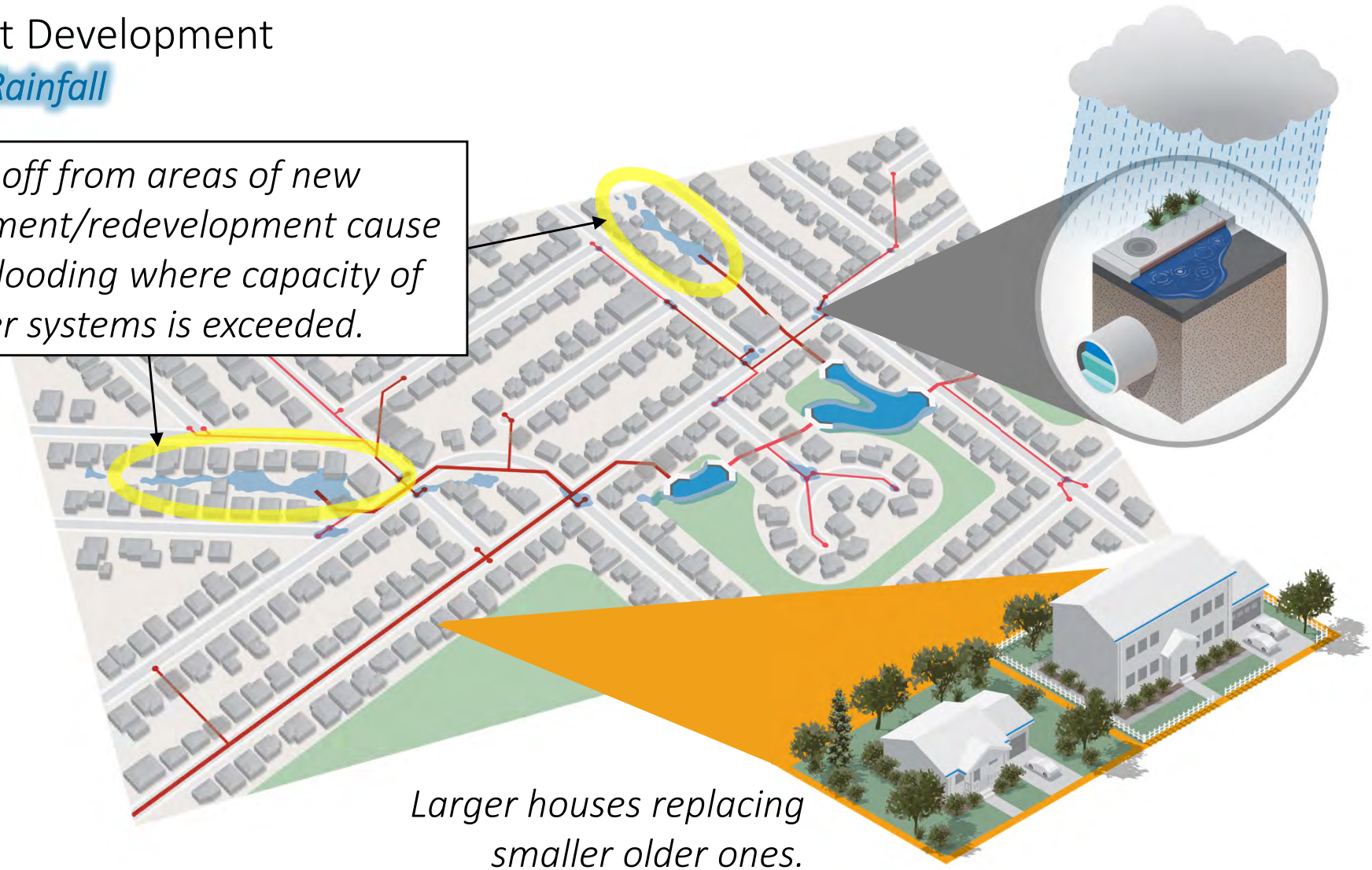
Higher rainfall amounts result in some riverine flooding.

How is flood risk in the County expected to change?

Current Development

Heavy Rainfall

Runoff from areas of new development/redevelopment cause urban flooding where capacity of older systems is exceeded.

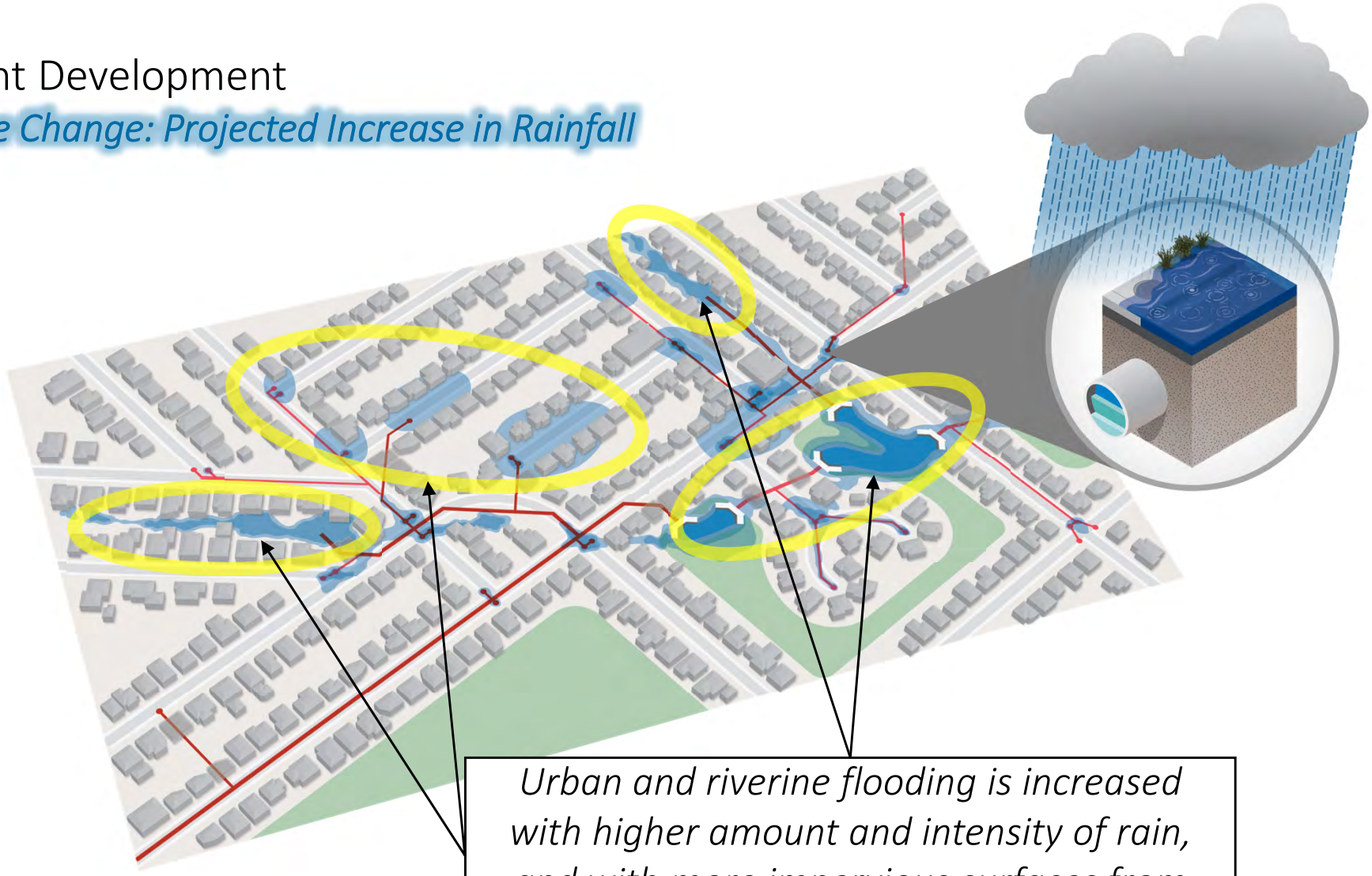


Larger houses replacing smaller older ones.

How is flood risk in the County expected to change?

Current Development

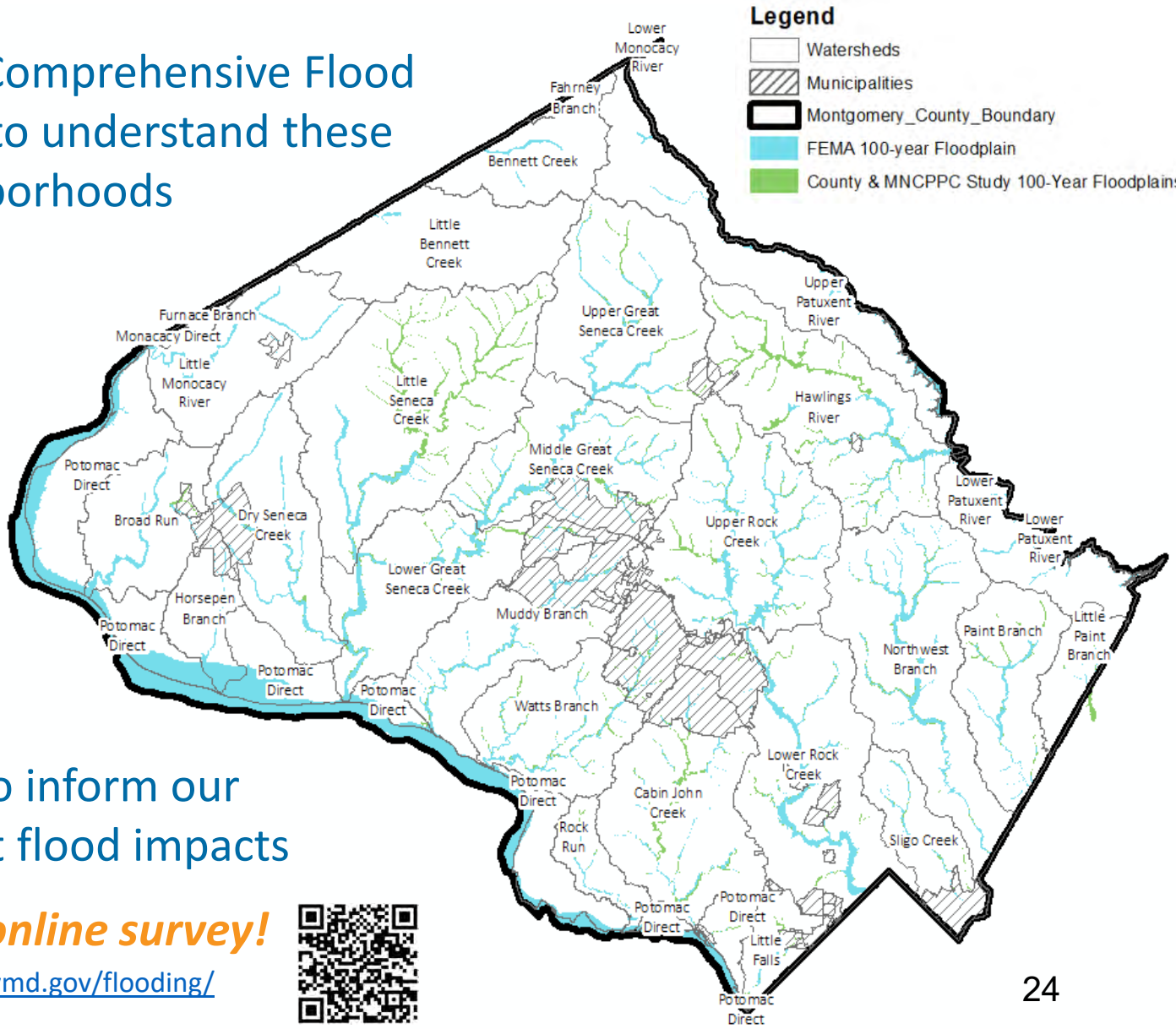
Climate Change: Projected Increase in Rainfall



Urban and riverine flooding is increased with higher amount and intensity of rain, and with more impervious surfaces from new development or redevelopment.

The Comprehensive Flood Management Plan will expand our understanding of flood risk

The objective of the Comprehensive Flood Management Plan is to understand these risks in County neighborhoods and identify solutions



Your help is needed to inform our understanding of past flood impacts

Please complete the online survey!

https://www.montgomerycountymd.gov/flooding/

Summary

Summary

- Flood risk is anticipated to worsen and affect more residents in the future.
- Addressing flood risk is a complex problem that involves a variety of infrastructure issues.
- This is the beginning of the process to address flooding on a County-wide basis.
- Please stay connected via the new DEP flooding website to learn about future engagement opportunities.

The Comprehensive Flood Management Plan will provide the County with a plan to address these issues in a technically sound and equitable manner.

Please complete the online survey and share with others!

https://www.montgomerycountymd.gov/flooding/

Questions?

Breakout Sessions

Breakout Group Questions

1. Do you have any questions on the presentation that you would like to ask?
2. What would be the most useful outcome of this effort from your perspective?
3. Have you been impacted by flooding?
4. Where and when have you been impacted?
5. How would you characterize the impact? (health and safety, economic, nuisance, etc.)

Please complete the online survey and share with others!

https://www.montgomerycountymd.gov/flooding/

Wrap Up & Next Steps

Wrap Up

- Breakout Session Report-out

Next Steps

- **What are the next steps?**
  - County agencies are working toward a list of recommendations for moving forward that will touch on governance, resources, funding, additional studies, etc.
- **How will information gathered today be used?**
  - Virtual forum and survey results will be used to more accurately/fully characterize past flood impacts
  - This understanding will be helpful in prioritizing future work

Closing – Actions!

Please complete the online survey and share with others!

https://survey123.arcgis.com/share/5b44d52148be4fbcb7ec4923d8736547

Response deadline: ~~October 28, 2022~~ (extended to 2023)

Sign up for information and future opportunities to be involved:

https://www.montgomerycountymd.gov/flooding/

Sign up to receive emergency flooding alerts via AlertMontgomery:
https://member.everbridge.net/1332612387832009/login

View available flood risk mapping:
https://mdfloodmaps.net/map/

Thank you!

Stan Edwards

Division Chief

Energy, Climate, & Compliance Division

Stan.Edwards@montgomerycountymd.gov

240-777-7748

Frank Dawson

Division Chief

Watershed Restoration Division

Frank.Dawson@montgomerycountymd.gov

240-777-7732

Appendix F
Other Jurisdiction Review Summary

Multi-Jurisdiction Review of Regulation, Policy, and Programmatic Approaches to Flood Management

Date: November 11, 2022
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56703

Jacobs Engineering Group Inc.
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Contents

Contents 1
1. Purpose 4
2. Approach 5
   2.1 Methods 5
   2.2 Topics of Review 5
3. Jurisdictions 8
   3.1 Anne Arundel County and Anne Arundel and Annapolis Resilience Authority 8
      3.1.1 Overview 8
      3.1.2 Land Use Planning and Permitting 8
      3.1.3 Urban Flood Zone Identification and Mapping 9
      3.1.4 Hazard Mitigation 9
      3.1.5 Equity and Community Engagement 9
      3.1.6 Flood Warning, Emergency Response and Recovery 9
      3.1.7 Funding & Finance 9
   3.2 City of Baltimore 10
      3.2.1 Overview 10
      3.2.2 Land Use Planning and Permitting 10
      3.2.3 Urban Flood Zone Identification and Mapping 11
      3.2.4 Hazard Mitigation 11
      3.2.5 Equity and Community Engagement 11
      3.2.6 Flood Warning, Emergency Response and Recovery 12
      3.2.7 Funding & Finance 12
   3.3 City of Boston 12
      3.3.1 Overview 12
      3.3.2 Land Use Planning and Permitting 12

3.3.3 Urban Flood Zone Identification and Mapping 13
3.3.4 Equity and Community Engagement 13
3.3.5 Funding & Finance 13
3.3.6 Other Policy Topics 13
3.3.7 Mitigation Projects of Note 14
3.4 City of Fort Worth 14
3.4.1 Overview 14
3.4.2 Land Use Planning and Permitting 14
3.4.3 Urban Flood Zone Identification and Mapping 15
3.4.4 Equity and Community Engagement 15
3.4.5 Funding & Finance 15
3.4.6 Other Policy Topics / Building-Related Policies 15
3.4.7 Mitigation Projects of Note 16
3.5 City of Houston 16
3.5.1 Overview 16
3.5.2 Land Use Planning and Permitting 16
3.5.3 Urban Flood Zone Identification and Mapping 16
3.5.4 Hazard Mitigation 16
3.5.5 Equity and Community Engagement 17
3.5.6 Funding & Finance 17
3.5.7 Other Policy 17
3.5.8 Mitigation Projects of Note 17
3.6 City of New York 17
3.6.1 Overview 17
3.6.2 Land Use Planning and Permitting 18
3.6.3 Urban Flood Zone Identification and Mapping 18
3.6.4 Hazard Mitigation 18
3.6.5 Equity and Community Engagement 18
3.6.6 Flood Warning, Emergency Response and Recovery 19
3.6.7 Funding & Finance 19
3.6.8 Other Policy 19
3.6.9 Mitigation Projects of Note 19
3.7 District of Columbia 20
3.7.1 Overview 20
3.7.2 Land Use Planning and Permitting 20
3.7.3 Urban Flood Zone Identification and Mapping 21
3.7.4 Hazard Mitigation 21
3.7.5 Equity and Community Engagement 21
3.7.6 Funding & Finance 22

3.7.7 Other Policy 22
3.7.8 Mitigation Projects of Note 22
3.8 Chicago – Metropolitan Water Reclamation District of Greater Chicago 23
3.8.1 Overview 23
3.8.2 Land Use Planning and Permitting 23
3.8.3 Urban Flood Zone Identification and Mapping 23
3.8.4 Equity and Community Engagement 24
3.8.5 Funding & Finance 24
3.9 Mile High Flood District – Denver 24
3.9.1 Overview 24
3.9.2 Land Use Planning and Permitting 25
3.9.3 Urban Flood Zone Identification and Mapping 25
3.9.4 Equity and Community Engagement 25
3.9.5 Flood Warning Emergency Response and Recovery 25
3.9.6 Financing 26
3.10 Charlotte-Mecklenburg, North Carolina 26
3.10.1 Overview 26
3.10.2 Land Use Planning and Permitting 26
3.10.3 Urban Flood Zone Identification and Mapping 27
3.10.4 Hazard Mitigation 28
3.10.5 Equity and Community Engagement 28
3.10.6 Flood Warning Emergency Response and Recovery 28
3.10.7 Financing 28
3.10.8 Other policy 28
3.11 Pittsburgh Water and Sewer Authority 29
3.11.1 Overview 29
3.11.2 Land Use Planning and Permitting 29
3.11.3 Urban Flood Zone Identification and Mapping 31
3.11.4 Equity and Community Engagement 31
3.11.5 Flood Warning, Emergency Response and Recovery 31
3.11.6 Funding & Finance 31
4. Summary Remarks 32
4.1 Summary 32
Appendix A – Sample Interview Questionnaire 33
Sample Interview Questionnaire 33

1. Purpose

This is an interim technical memorandum (TM) generated for Task 4.2 Organizational Review of Task order #3 and #4 of Montgomery County Department of Environmental Protection's (DEP's) Comprehensive Flood Management Plan (CMFP) (Contract #1127041). This TM will be incorporated by reference into the final Task 4.2 report. The purpose of this technical memorandum (TM) is to document the review of policy and programmatic approaches to flood management in several jurisdictions. The results of this review will be used in subsequent organizational review work for Montgomery County.

2. Approach

2.1 Methods

Two primary methods were used to understand the ways other jurisdictions have addressed flood management in their localities: a desktop study and an informal interview with representatives from select jurisdictions. Interviews were conducted virtually using a prepared questionnaire (See Appendix).

Jurisdiction/City Name	State	Desktop Review	Interview
Anne Arundel County	MD		X
Charlotte-Mecklenburg Stormwater	NC		X
City of Baltimore	MD		X
City of Boston	MA	X	
Metropolitan Water Reclamation District of Greater Chicago (MWRD)	IL		X
City of Denver & Mile High Flood District	CO		X
District of Columbia (DOEE / DDOT)	DC		X
City of Fort Worth (Stormwater Management Division)	TX		X
City of Houston/Harris County Flood Control District	TX	X	
New York City	NY	X	
Pittsburgh Water and Sewer Authority	PA		X

2.2 Topics of Review

Table 2-1 Policy Topics Reviewed

Policy Topic	Elements Relevant to Urban Flooding	Key Considerations
O&M-Public	Maintain pipes, channels, green infrastructure; Keep catch basins/inlets clear of debris	• Which elements currently require public maintenance as part of O&M programs, and should any be added? (i.e., size threshold for open channels and ownership considerations vs. right-of-way ROW); • When infrastructure is slated for an upgrade, is urban flood mitigation encouraged (or required) in partnership with other activities (i.e., build a new school-can we over mitigate detention or green infrastructure)?
O&M-Private	Green infrastructure, downspouts, maintenance agreements. Temporary floodproofing until more permanent mitigation is installed, Technical assistance and funding	• New development or retroactive? Include private homeowners? Requirement maintenance schedule? • What steps can private homeowners take (i.e., backflow valves, floodgates, sandbag readiness) to protect until more permanent measures can be installed? Are technical assistance or funding available?

Policy Topic	Elements Relevant to Urban Flooding	Key Considerations
Urban Flood Zones/ Floodplain definition	Designated risk areas, i.e.: Local (Non-FEMA) floodplains; Historic creek beds; Storm sewer areas with low capacity; FirstStreet flood layers (i.e., Redfin)	• Does the community have designated risk areas? Are these advisory or regulatory? Property and/or Roads? • Do localized standards require an *urban* floodplain development permit? • How has the community addressed potential impact to real estate property values; Disclaimer on data, i.e., Boston viewer, not for detailed analysis, etc.
Redevelopment Quantity Standards; Differential Runoff Requirements; Land use planning	Private infill & redevelopment. Differential Runoff; Compensatory floodplain or detention storage; Mitigation Requirements; climate escalation; Storm sewer design standards; Use building codes to eliminate increases in runoff from newly constructed properties	• Thresholds-i.e., require if contributing urban drainage area is greater than 1 Ac; • Timeframe; include climate escalated precipitation; • Defined level of service and climate integration; • Integrate flood with MS4/water quality requirements/policy
Freeboard	NFIP Floodway Compliance; Exceed NFIP or State DOT Criteria	• Pure freeboard (i.e., 2' over the 100-year) or include climate escalation parameters? • What type of development or infrastructure have a freeboard requirement?
New Development Setback/Fringe Requirements	Locational restrictions (i.e., mapped urban flood zones, coastal hazard/SLR zones, or contributing drainage area); Similar elements to Redevelopment	• Thresholds-i.e., require if contributing urban drainage area is greater than 1 Ac; timeframe; process; • Does the community follow “No Adverse Impact” approach/principles
Grading/Drainage Provisions	Require no adverse flood impact or improve the situation when a certain level of redevelopment is met; Require city-funded projects to consider if neighborhood-scale nuisance/urban flooding can be improved in project ROW; climate escalation	• Thresholds-i.e., require if contributing urban drainage area is greater than 1 Ac; timeframe; Requiring a simple evaluation of potential may open up opportunities for grants/loans (partnerships/opportunities); Include climate escalated standards and level of service? Consider incorporating "Design for exceedance" principles (UK-CIRIA)
Gutters & Downspouts; Overflow Pipes	Direct away from structures; into receiving sewers; into green infrastructure	Require for all new and redevelopment or just at a threshold point?
Site-Level Building Standards	Elevation of first floor; Basements (allowed?); Enclosures with flood vents; Elevated mechanical/ electrical/plumbing	What thresholds/standards must mitigation measures meet? (i.e., standard elevation difference, climate standard, freeboard, FEMA vs. urban flood map elevations, different standards for CSO vs. MS4 areas); see also Freeboard item-often executed as a building standard
Hazard Mitigation	Restoring natural floodplains; NGO partnerships for floodproofing; BMPs for urban drainage; Design for Exceedance (CIRIA); Managed Retreat (buyouts); Policies that ensure fair processes and compensation for mitigation and managed retreat. "Worst First" type prioritization for	Policy can enable or set requirements for what to do in redevelopment and/or buyouts as related to mitigation. Managed retreat/buyouts-local programs-encourage/require acquired property to be used for mitigation measures/community amenities? Staged mitigation-what can we fix now and what is the long-term plan (CIRIA)? Ensure that stormwater & mitigation infrastructure is equitably and adequately funded; should State Revolving Funds be used for flood mitigation as well as other infrastructure and that coded in policy? Prioritize repetitive loss properties-and if so, define as FEMA zones

Policy Topic	Elements Relevant to Urban Flooding	Key Considerations
	capital improvement spending in mitigation	(insured only) or all properties (how to define without data)?
Diversity & Inclusion/Equity	Fully incorporate equity into resilience planning process & policy; integrate social data into policy evaluation; overlay social vulnerability mapping layer data to inform urban flood policy; Pairing of social and technical information; Stormwater Management Advisory Committee; Community Benefits Assessment requirement; Remove any legal barriers to rate structures that enable billing/assistance options so that mitigation costs do not disproportionately impact disadvantaged	Use policy to enable and/or require neighborhood-level reduction strategies and target BMPs on individual lots; evaluate policies to see if they can be changed to make a difference in urban/nuisance flooding at the small scale; engage community groups when determining design issues and policies (threshold for requiring engagement?); maximize sewer system improvements by considering climate resilience, flooding, and equity goals together (threshold to consider/require in policy?); require equity reports for mitigation and infrastructure measures
Vacant Lots/Land Acquisition	Repurpose for urban flood mitigation	• Are vacant lot programs integrated with local land reclamation efforts? • Is a green infrastructure analysis required before sending tax properties to auction? • Are properties in floodplain put in a conservation set-aside?

3. Jurisdictions

3.1 Anne Arundel County and Anne Arundel and Annapolis Resilience Authority

3.1.1 Overview

Anne Arundel County is a coastal Maryland county located to the northeast of Montgomery County. The County was selected for research due to the newly established Anne Arundel County / City of Annapolis Resilience Authority (Throw Environmental) as well as a number of vulnerability assessments undertaken by the Anne Arundel County (AACo) Department of Public Works Water Resource Division.

Key highlights

- Stormwater Strike Force to look at downstream stability.
- Newly established Resilience Authority.
- Lot-to-lot flooding: AACo offers technical assistance but considers lot-to-lot a private property issue to sort out through legal means.
- AACo has restoration Grant Program through Chesapeake Bay Trust, which is water quality focused but, thinking creatively, also an opportunity to blend conveyance (water quantity) into water quality practice and take advantage of program as cost share. AACo has worked with several churches with ongoing flood problems and have been able to help them. Program is not targeted at homeowners but can be used at private properties.
- Any infill lots that remain have environmental challenges: a big portion act as de facto stormwater management for conveyance or stormwater quality. When lots get developed, it creates problems for residents in the lot and surrounding neighborhoods. Office of Planning and Zoning, for first time in history, denied development of a lot because incumbered by nature. The purchaser of the lot thought they could “work the county system”. AACo has endeavored to acquire lots and take them off tax roll/development docket so there is no need to be at odds with developers.

3.1.2 Land Use Planning and Permitting

- AACo created a Stormwater Strike Force, the “eyes on the ground” for review staff, inspectors and project level and senior engineers looking at downstream stability. The County has an outfall adequacy requirement; if there is an instability with an existing outfall, the developer may be required to design, permit and construct an outfall stabilization for their project in addition to stormwater regulatory requirements. The Stormwater Strike Force is able to spot potential issues during the plan review approval process, be a liaison with County staff and provide technical assistance during construction. There’s an opportunity to get plan reviewers invested in real world context of the plan and ask, “Are there problems we should be aware of? Let’s put our heads together to mitigate.”
- AACo has less redevelopment and more greenfield development than Montgomery County. In discussions about requiring developer to purchase floodplain easement on downstream property or to move existing infrastructure on downstream property in order to move forward with a project; it gets expensive. Depending on political winds, may not be feasible. At a minimum, County can require over-management in terms of quantity. County wants to be careful not to disincentivize redevelopment, but if redevelopment is so heavy, County considers upping ante.
- Big fan of carrot-based approach. As an example: the County has funds to entice redevelopers to go above and beyond or creates a trading program like DC has.

- Resilience Authority (RA) – newly established. Resilience *financing* authority. RA is not a planning agency but works in partnership with Planning and Public Works in the County and City. They will be part of the plan's implementation; RA tasked with making County's processes efficient and identifying sources of revenue, how to pay for CIP on ground. Project portfolio will be based off the planning from County and City. RA works in green bank issue of financing.
- Historically, AACo had been looking at 24-hr window but now are seeing more intense, shorter duration storms causing a lot of problems; 3 inches in an hour is worse than 5 inches in a day. They do not have good engineering solutions yet nor good data at hourly intervals. RA is necessary to help with thinking more proactively.

3.1.3 Urban Flood Zone Identification and Mapping

- AACo delineates riverine floodplain to an extent.

3.1.4 Hazard Mitigation

- Floodplain Acquisition program example: $423K spent for a house with repetitive floodplain-driven flooding that was developed 15 years ago. Expensive but engineering solution to make more viable would have been more expensive. Primary metric is, "Is there revenue to support it?" There is opportunity in existing communities where parcels are flooding, where an authority could step in and purchase, and if used as flood mitigation, parcel adds value to community that could be leveraged to pay for costs. Fee simple purchase with not a lot of political sensitivity. Problem to avoid is "condemning properties" and then turning them into flood mitigation means.

3.1.5 Equity and Community Engagement

- AACo has applied for FEMA grant for assessment of Shady Side area, south of Annapolis, which is fairly flood prone. If successful, part of grant will be dedicated to outreach.

3.1.6 Flood Warning, Emergency Response and Recovery

- Monitor high hazard facility, regulated by MDE.
- Their sense of road flooding is based on experience. Highways group is working with consultant to put out 20-30 stage gauging stations at road crossings to trigger response, given a flood elevation. A couple gauges are tied to controlled gates that come down to prevent drivers from entering into flood waters. They also have remote sensing tools and emergency alerts. Goal is to marry stage gauging with near term precipitation data so they are prepared, ready and responding 3 hours, rather than 15 minutes, before a road overtops. County Highways department funds most of the effort.

3.1.7 Funding & Finance

- Transportation flooding revenue is limited (no tolling system). Fee systems in place for water quality. Trying to work with state to make it more competitive in federal transportation money. RA looks at onsite and offsite funding. Onsite: County assets and developing revenues. Offsite opportunity: assets that can be leveraged and redirected to flooding exercises. Stormwater Utility is well-funded. RA in conversation to leverage revenues from water quality with water quantity program.

3.2 City of Baltimore

3.2.1 Overview

Baltimore was one of the primary cities chosen for this screening study due to its recurrent urban flooding issues, proposed/implemented policy updates to address this, and equity considerations.

Key highlights

- Baltimore is a Class 5 CRS community, but the NAS report notes the community doesn't think they have done much. In partnership with the University of Maryland (UMD), they have mapped common flood areas based on statistical analysis including urban areas and heavy storm events.
- Found in Article 7, Floodplain Management, Baltimore regulates according to the geographic extent of the 0.2% or 500-year floodplain. Baltimore is the only county in Maryland that does this.
- For operations and maintenance, the Department of Public Works protects, enhances and restores waterways. The city implements a Stormwater Fee (calculated by amount of impervious surface on a property) and Guidelines/incentives for private property owners to install green infrastructure or stormwater management methods.

3.2.2 Land Use Planning and Permitting

- Lot-to-lot flooding: Planning does annual publicity to let owners know that they are in the FEMA floodplain. Planning connects with Department of Public Works (DPW) for stormwater management and sediment and erosion control. DPW sends inspectors to identify source. There are instances where owners are responsible, for example: fixing grading of private property.
- DPW requires either redevelopment or new development to manage and retain the volume of a 10-year storm. See Article 7, Natural Resources Code, Division II Stormwater Management.
- Redevelopment is detailed in the City Code (Article 7, Section 23-7).
- Planning wants and needs to understand where flood hazards outside of FEMA floodplain are; map would be needed as first step to try to understand cause of flooding and could mean a CIP. Next step would be to regulate construction in those areas in the same way it's regulated in FEMA floodplain, which would require legislative staff as they anticipate pushback from developers. Next step after mapping: watershed masterplans to identify flooding hotspots and suggest CIP. For Class 4 upgrade, City needs watershed masterplans.
- 2 ft. elevation for mechanical equipment if new system installed. If non-tidal, 2 ft. over BFE. If in tidal system, elevation of the 0.2% annual flood.
- For New Development Setback/Fringe requirements – "A minimum 25-foot flood protection setback must be maintained from the edge of the banks of any watercourse delineated on the floodplain map or FIRM as having a floodplain" (Article 7, Section 3-16). Also, vegetation should be planted along watercourse banks to reduce erosion.
- For Grading/Drainage Provisions in Baltimore, a grading permit is required:
    - If the proposed work disturbs over 5,000 square feet of surface area or over 100 cubic yards of earth.
    - For any grading activities in any watercourse, floodplain, wetland area, buffers (stream and within 100 feet of tidal water), habitat protection areas or forest buffer areas, including forest conservation areas.

- For gutters in the city, Baltimore Code states that Building drains are to be no less than 4".
- The Site-level building standards follow the City Floodplain Code.
- When a building is designated as historic, it does not have to meet full force of floodplain code. They do require still some level of floodproofing. Baltimore's Commission for Historical and Architectural Preservation (CHAP) works closely with Floodplain Office to determine appropriate level of floodproofing and oversees flood mitigation project reviews and criteria for Baltimore's historic areas and properties.
- Flood Infrastructure Working Group formed by Mayor meets monthly and includes Planning, DPW, DOT, Rec and Parks, and Department of General Services (above ground infrastructure maintenance) to come up with joint solutions.

3.2.3 Urban Flood Zone Identification and Mapping

- Initial efforts underway to delineate commonly flooded areas; have data but not centralized.
    - Planning is required by FEMA to collect data on whatever flooding that happens within FEMA's floodplain; DPW has data of flooding due to burst pipes, pluvial flooding, areas with poor stormwater systems; DOT has another set of data of when they deploy crews due to flooding; OEM deploys crews for rescues; 311 data for basement and street flooding.
    - Recognize the need to consolidate data; the models do not reflect reality. Details of stormwater pipe systems unknown. DPW is undertaking an H&H model to identify locations and capacity of pipes, looking at 3 watersheds with pilot projects, which will expand to citywide to 2025. They will include projected rainfall events when conducting study.
- The urban Flood Zones/ FEMA Floodplain are defined in Baltimore in the CoDe Map.
- Planning, Designing, Operating, and Maintaining Local Infrastructure in a Changing Climate
    - "Senate Bill 457 (2020) authorizes local governments to establish a Resilience Authority to fund large-scale infrastructure projects aimed at addressing the impacts from climate change" (page 39).
    - "Baltimore County's codes currently exceed the National Flood Insurance Program requirements and further mitigate vulnerability to flooding" (page 42).

3.2.4 Hazard Mitigation

- Regarding hazard mitigation, the Disaster Preparedness and Planning Project (DP3), which the city adopted in 2018, fulfills the FEMA requirements to update the city's formal plans. For stream restoration the city implements stream restoration and stabilization projects.
- Baltimore also has done a few property acquisitions of flood prone properties in Towson.

3.2.5 Equity and Community Engagement

- The Baltimore Urban Waters Partnership held workshops in 2020 with participants of experts and stakeholders to produce the Baltimore Urban Waters Flood Science and Policy Action Report to address urban flooding.
- Baltimore also conducts flooding equity assessments according to their Nuisance Flood Plan 2020 (see page 68).
- Regional flood-focused partnerships with Maryland Silver Jackets.

- No designated person in the Office or City for public outreach. Staff members will pass out resources through tabling and post information on social media. There is also a tool MyCoast Maryland application that is available for users to identify nuisance flooding.

3.2.6 Flood Warning, Emergency Response and Recovery

- Emergency Management Alert System: BMore Alert

3.2.7 Funding & Finance

- Currently Baltimore receives funding for several flood mitigation projects from the Maryland Comprehensive Flood Management Grant Program.
- MDE is funding H&H study for Frederick Avenue, DNR Grants Gateway: 6 different outcomes from NOAA to address flooding.
- City wants to provide, for free, elevation certificates for residents (costs an average $1000) to have better understanding of compliance when doing home improvement.
- Dept Housing and Community Development has Weatherization Program, funded by HUD.

3.3 City of Boston

3.3.1 Overview

Boston was chosen as a key city to screen due to its recurrent urban flooding issues, proposed/implemented policy updates to address this, and equity considerations as well.

Key highlights

- The Resiliency Policy "requires that all projects consider present and future climate conditions in assessing project environmental impacts, including carbon emissions, extreme precipitation, extreme heat, and sea level rise. Projects must identify building strategies that eliminate, reduce, and mitigate adverse impacts including those due to changing climate conditions."
- Boston Redevelopment Authority Article 80: Development Review and Approval.
- Boston has an Online hazard mapper with urban hazards, including heat and flooding maps. The mapper overlays these with social equity mapping.

3.3.2 Land Use Planning and Permitting

- City of Boston requires all construction and re-construction projects to retain stormwater on site. Projects <100,000 sq. ft. must infiltrate the volume of runoff equal to one inch of rainfall times the total impervious area prior to discharge; Projects >100,000 sq. ft. must infiltrate volume of runoff equal to 1.25 inches of rainfall times the total impervious area on site. These requirements are documented in the Massachusetts Stormwater Handbook. [see also Smart Utilities Policy]
- See Article 25 for Flood Hazard Districts. Building codes are referenced to the Massachusetts State Building Code.
- Article 25A provides specific requirements for the Coastal Flood Resilience Overlay District (CFROD). Article 25A requires a minimum sea level rise assumption of at least 2 feet [25A-6(1)(a)]. The Boston Planning and Development Agency has also published Coastal Flood Resilience Design Guidelines for redevelopment and new construction projects.
- The Boston Environment Department provides recommendations for improving flood resiliency to individual homeowners as part of the Climate Ready Boston Program. The Boston Planning Department has also published potential strategies on increasing flood resiliency for building

retrofits. The State of Massachusetts Department of Housing and Community Development publishes guidelines for gutters and downspouts. Section 10.17 of Unified State Plumbing Code sets out requirements for storm drain design. See also DHCD CHARM Rapid RVA Design Guidelines.

- Climate Resilient Design Standards and Guidelines for Protection of Public Rights-of-Way

3.3.3 Urban Flood Zone Identification and Mapping

- The City of Boston has an online map viewer application that displays Social Vulnerability data, stormwater and coastal flooding, temperature data from the heat resiliency study, and Urban Heat Island Intensity analysis presented in the 2021 Natural Hazard Mitigation Plan Update.

3.3.4 Equity and Community Engagement

- Green infrastructure integrated in Boston Public Schools science curriculum.
- StormSmart Coasts Program. A catalogue of publications on coastal zone management developed by the Massachusetts Office of Coastal Zone Management.
- The City of Boston has developed the Greenovate Leaders Program through which Bostonians can be trained to lead climate equity discussions in their communities. The program hosts roundtables and workshops for socially vulnerable groups to address equity concerns and improve resiliency in disadvantaged areas.

3.3.5 Funding & Finance

- Boston is one of 78 municipalities participating in the Massachusetts Coastal Resilience Grant Program, which provides financial and technical support for resilience and adaptation. Grants are available for planning, outreach, assessment, design and construction activities.
- Boston has a Climate Resiliency Fund established to "help finance the berms, seawalls, and natural systems restoration that will help protect real estate in the vulnerable Seaport district". Developers pay into the fund to offset state, local, federal expenditures on flood infrastructure.

3.3.6 Other Policy Topics

- Boston Water and Sewer Commission (BWSC) manages the majority of municipal storm drains. In 2013, BWSC established Memorandums of Understanding (MOUs) under Consent Decree which requires it to:
    - Perform annual wet and dry weather field screening of its storm drain outfalls, CSO outfalls and storm rain manholes that discharge to (interconnect with) other MS4 drain systems
    - Establish priorities and schedules for investigating sub-catchment areas that demonstrate contamination
    - Implement a sub-catchment investigation program based on the priorities and schedules established
    - Correct or repair illicit discharges within deadlines established in the Consent Decree
    - Coordinate efforts with other city agencies, state agencies, and surrounding cities to implement green infrastructure solutions
- These policies are summarized in the most recent BWSC Annual Stormwater Management Report (BWSC, 2022).

3.3.7 Mitigation Projects of Note

- Climate Ready Boston helps Boston plan for the impacts of climate change and build a resilient future.
- Multiple projects including Climate Ready Dorchester, Climate Ready South Boston

3.4 City of Fort Worth

3.4.1 Overview

Fort Worth was selected as a key city to be screened because of its modeled/mapped local flood risks that are tied to policy. The City of Fort Worth Interim Assistant Director of Transportation and Public Works Department and City Floodplain Manager were interviewed as part of the research.

Key highlights

- Fort Worth is equipped with an integrated stormwater management community program (iSWM) to assist their counties in meeting their state stormwater permits during construction and post-construction.
- The city of Fort Worth developed a local floodplain management policy designed to amend the city's existing Floodplain Provisions Ordinance, Subdivision Ordinance, Stormwater Criteria Manual, Comprehensive Plan, and other applicable city codes to establish a consistent method for reducing flood damage that occurs in areas outside of current city regulatory floodplains, specifically urban flood hazard areas.
- The City produced the Informal Report: Update on Non-FEMA Flood Risk Initiative (August 2022) proposing to amend the Comprehensive Plan to include both FEMA and City flood risk mapping areas.
- The City of Fort Worth produced the Cumulative Impacts of Development on Flood Risk (October 2022) report to the mayor and City Council, providing an analysis of potential options for City Code revisions related to impervious surface.
- Stakeholder group was involved at beginning (for non-FEMA flood risk areas), volunteered after awareness of flood risk not being mapped or communicated well. More support garnered after realizing unintended consequences. Surveys reflected locals were in-favor of getting maps updated at the end of the day. City promotes transparency to help property owners in decision-making.

3.4.2 Land Use Planning and Permitting

- The City of Fort Worth Public Works manages the majority of stormwater projects.
- Fort Worth reviews development if the area is greater than 1 acre. They require developers to fill out a certificate of compliance, floodproof and consider flow paths and adverse impacts. The engineer is held responsible. City does not provide detailed review.
- Regulations are focused on building protections and are based off the 100-year storm event. City has adopted 2 ft. of freeboard standard, local areas included.
- The City adopted a Grading Ordinance in June 2012 which include requirements of an integrated Stormwater Management Plan grading permit for land alterations in excess of 1 acre, and lot grading patterns for single family and building permit applicants.
- 2 Case studies on cumulative impervious areas conducted:
    - Increases in impervious cover
    - Loss of flood/valley storage within natural creeks that have been encroached

- Goal of case studies is to verify standards are accurate; found areas already exceed amount of impervious cover anticipated. City does not regulate impervious cover in backyards. About to kick-start stakeholder engagement. Interestingly, basins with detention ponds performed well for low-frequency (100-, 500- year) storm events. But 1-, 2-, 5-, and 10-year storm flows were increasing significantly. City does not look at smaller storms typically.
- Case studies provide evidence necessary to help planners change standards.
- On valley storage side, a typical development process is as follows: There is a natural stream through a pasture with a wide floodplain with X amount of storage, and in typical FEMA fashion, will allow encroachment up to a certain point to create channelized stream – this leads to a more efficient channel with increased velocity (development engineers improve conveyance) but can sometimes increase velocity and flows downstream. The Study found this to be occurring.
- Through the case study areas, Fort Worth can adjust standards and reflect reality (impervious cover will increase runoff or the City can limit impervious cover or offset mitigation measures, the latter which is currently not allowed). Standards will be rolled out to whole city. Not intending to look basin-by-basin.
- Regarding infill, Council members want development moratorium. They and politicians create policy.

3.4.3 Urban Flood Zone Identification and Mapping

- Fort Worth is in the process of updating their City-wide map (which is currently low-level in detail) to include pipe sizes, have a more specific drainage basin to better map flood risk, and help regulate where there is a high degree of data. Planning to take updated map to Council to update floodplain ordinance and Stormwater Management Criteria regulations.

3.4.4 Equity and Community Engagement

- Development-focused stakeholder group (the real estate council) for non-FEMA areas were very involved early on. They got on board once they realized how extensive the problem was. Community wants flood information reflected on maps. There was a lot of concern when this was kicked off due to the potential impacts on property values. However, it was concluded that there is no downside of having more information at the end of the day. City wants to be transparent to help owners with their decision-making.

3.4.5 Funding & Finance

- The City of Fort Worth received funding of $403 million from the US Army Corps of Engineers for the Trinity River Vision/Central City flood control project.
- The City also collects a stormwater utility fee.

3.4.6 Other Policy Topics / Building-Related Policies

- Article VIII specific requirements for floodplain provisions.
- The Texas minimum Construction Standards (page 32) requires all gutters and downspouts to be installed or replaced on all rehabilitations, along with minimum requirements for slope, distance from foundation, screens, and other guidelines.
- The City has also done voluntary acquisitions of properties in the most flood prone Arlington Heights neighborhoods.

3.4.7 Mitigation Projects of Note

- The Native Grass Program helps the city of Fort Worth to reduce flooding risks by planting native grasses and flowers around reconstructed drainage channels which reduce erosion.

3.5 City of Houston

3.5.1 Overview

Houston was chosen as a key city to screen because of its recurrent urban flooding issues, proposed/implemented policy updates to address this, equity considerations, flood easements to restrict development in known flooding areas, urban flood mapping, as well as increased building requirements.

Houston was also noted to have a mapping tool that has regulatory and "ponding" layers. The City has also tied funding to equity through policy, climate accounted for with increased freeboard but not with climate science, and coastal barrier projects in planning stages in response to sea level rise.

3.5.2 Land Use Planning and Permitting

- The Code of Ordinances Chapter 19 provides regulations and standards in Houston for special flood hazard areas.
- Chapter 9 of the Infrastructure Design Manual: Stormwater Design Requirements (and supplemental revision to storm detention requirements) of the City of Houston include: drainage criteria, storm sewer design, and max ponding elevation. The City also has incentives for Green stormwater infrastructure including an expedited permitting pilot program and tax abatement program.
- Chapter 19 of the Houston Code of Ordinances lays out the definitions and regulations of the city for floodplains.
- The Houston/Harris County freeboard updates state that all new construction in floodplains is to be built up 2 feet above the water level of a 500-year storm.
- The city of Houston also added measures of fringe/setback requirements after Hurricane Harvey.
- See The Houston Construction Code for minimum standards for the construction, alteration, maintenance, repair, and demolition of buildings and other structures. The city also published a more visionary document of the Houston Incentives for Green development which could potentially lead to further regulation in the near future.
- The City's ordinances and building codes also guide and regulate construction in the floodplain in order to align with NFIP standards. This includes limited development in 1% and 0.2% annual flood chance floodplains, requirements for buildings to be 2' above 500-year elevation, and flood studies required for developments adjacent to a creek.

3.5.3 Urban Flood Zone Identification and Mapping

- The City of Houston has an interactive ArcGIS Pro web map - GeoLink Floodplain – that displays urban floodplains or FEMA floodplains.

3.5.4 Hazard Mitigation

- In terms of flood risk property acquisition, the City has a Harris County Flood Control District Property Acquisition Program, Harris County Home Buyout Program, and Harvey Buyout Program (multifamily buildings).

3.5.5 Equity and Community Engagement

- Harris County MAAPNext is an interactive tool with resources and educational information for community members to understand their flood risks.
- The Harris County Flood Control District has held over 150 Bond Program Community Engagement Meetings which total 12,000+ Registered Attendees and 8,000+ Bond program comments received.
- Houston has initiatives to redirect flood mitigation projects/funds to historically high SVI and lower income communities. They have Citizens Advisory Committees which provide guidance on flood mitigation projects/resource distribution as well as Harris County Flood Control District's Community Flood Resilience Task Force which influences policy with an equity focus.

3.5.6 Funding & Finance

- The city of Fort Worth/Harris County is actively receiving bond funding with a total received amount of $2.5 Billion and $578 Million in bond funding authorized.
- Harris County has also received $1.35 Billion in Partnership Funding.
- The unprecedented Houston/Harris County "worst first" formula (8 criteria) was set in policy for $2.5M flooding bond "Harris Thrives". This policy included community-based oversight committee for DEI in implementation. The Flood Control District has also developed written guidelines adopted by Commissioners Court on August 27, 2019, to assist with the prioritization of the 2018 bond projects that have not started.

3.5.7 Other Policy

- Stormwater Operations Branch of Public works manages storm sewer systems, roadside & off-road ditches, detention basins and stormwater pump stations. They also implement green infrastructure projects.

3.5.8 Mitigation Projects of Note

- Houston invests in incentives for nature based infrastructure to mitigate against water pollution and flooding effects in the future.
- The County projects interactive map gives an overview of capital and maintenance projects the City is undertaking to reduce flooding risks.

3.6 City of New York

3.6.1 Overview

New York City was selected due to their planned pilot Cloudburst and Bluebelt Programs as well as their Harbor Protection Program.

- Cloudburst program – a pilot program to address flood impacts of intense rainfall events.
- Bluebelt program – "Ecologically rich and cost-effective drainage systems that naturally handle the precipitation runoff from […] streets and sidewalks by preserving natural drainage corridors […]"
- Harbor Protectors Program – a program to enlist residents as volunteers to maintain green infrastructure and improve functionality of the piped stormwater system.

3.6.2 Land Use Planning and Permitting

- NYCDEP developed a Unified Stormwater Rule, which changes requirements related to how stormwater is managed on new and redevelopment properties across NYC. The rule requires updated stormwater quantity and flow rates for site and house connection proposals and a retention-first approach for projects that need MS4 Construction Permits.
- NYCDEP has developed the Guidelines for the Design and Construction of Stormwater Management Systems to "provide guidance to New York City's development community and licensed professionals for the planning, design and construction of onsite source controls that comply with DEP's stormwater performance standard".
- New York City requires one foot of freeboard for commercial and multi-family buildings, and two feet for single- and two-family buildings in Zone A Special Flood Hazard Areas (SFHAs). [New York City Administrative Code, Title 28, Chapter 7, Appendix G, Section BC G501]. Chapter 4 of the New York Zoning Resolution lists setback requirements for flood zones. Chapter 11 of the New York City plumbing code sets standards for grading and storm drainage design, including sizing of gutters and downspouts (sized for 100-year rainfall rate of 3 inches per hour). The code also requires backflow preventers in special flood hazard areas.
- As part of the New York City Climate Mobilization Act passed in 2019, New York City Council passed Local Laws 92 and 97, which require new and substantially renovated or enlarged rooftops to incorporate sustainable (green) roofing on all available roof space. The City anticipates that these laws will help buildings manage up to 1 million additional gallons of stormwater per year and help manage water quality and urban flooding. The City provides financial incentives through a grant program for residents to install green infrastructure (green roofs in particular) on their private property.
- NYC Planning Department: Coastal Climate Resilience - Designing for Flood Risk
- NYC Planning Department: Retrofitting buildings for flood risk

3.6.3 Urban Flood Zone Identification and Mapping

- NYC has published its Stormwater Resiliency Plan to address climate change resiliency. See page 10 for city-wide map of two scenarios: moderate stormwater, rain-driven flooding under future conditions and extreme stormwater, rain-driven flooding under future conditions.
- The NYC Flood Hazard Mapper tool shows the flood hazard areas shown on the FEMA FIRM.

3.6.4 Hazard Mitigation

- Emergency preparedness for New Yorkers
- NYC seeks to get residents involved in resiliency and environmental stewardship through its Harbor Protectors program. The program enlists residents to clean and stencil catch basins and care for rain gardens. A 311 program encourages residents to report sewer grates that are blocked with leafy debris.
- New York City has adopted an Interim Flood Protection Measures Program, which is used to protect critical infrastructure from hurricane flooding. Measures to preserve natural drainage flow paths that improve drainage during major storm events are and are included in the Bluebelt program.

3.6.5 Equity and Community Engagement

Engagement programs by New York City include:

- The Special Initiative for Rebuilding and Resiliency (SIRR) conducted ongoing briefings with community leaders/key stakeholders.
- NYCDEP: Comprehensive Waterfront Plan - Climate Resiliency and Adaptation. The plan includes measures to promote social equity and access to water recreation.

3.6.6 Flood Warning, Emergency Response and Recovery

- New York City participates in the New York State Governor's Office of Storm Recovery (GOSR) - Buyout & Acquisition Programs, which were designed to purchase properties damaged by Superstorm Sandy, Hurricane Irene or Tropical Storm Lee.

3.6.7 Funding & Finance

- New York City participates in the New York Governor's Storm Recovery effort, which seeks to fund resiliency and recovery projects. The State provides a portal that includes a dashboard of funding by County that lists initiatives and summarizes expenditure. New York City Funding and grant programs listed in the portal include the HUD Rebuild by Design grant and Community Development Block Grant Disaster Recovery (CDBG-DR) funding program. A specific project listed under the program is the Living Breakwaters program, which is enhancing the shoreline protection of Staten Island.

3.6.8 Other Policy

- New York City Department of Environmental Protection (NYCDEP) has developed design guidelines, standards and specifications for green infrastructure built in city streets and sidewalks, right-of-way (ROW), and green infrastructure built within the property line of a City-owned site such as parklands and schools (public on-site). The City has a mapping tool that identifies the location of all green infrastructure projects in New York, and provides details on those projects.

3.6.9 Mitigation Projects of Note

- High level storm sewers (HLSS) are designed specifically for stormwater and help reduce street flooding, improve the health of surrounding waterbodies, ensure the reliability of the drinking water delivery system, and make neighborhood roadways safer for all users. In 2018 DEP completed the first phase of installing high level storm sewers along 3rd Avenue in the Gowanus neighborhood, with Phase II anticipated to be completed by 2021. This $53M project, which will increase capacity in the neighborhood's drainage system, is helping to reduce roadway flooding and the amount of pollution that may be discharged into the Gowanus Canal during heavy rainstorms.
- Living Breakwaters Project - nearshore breakwaters that promote risk reduction, ecological enhancement, and foster social resilience
- Living with the Bay - project seeks to promote flood defenses, ecological restoration, access and urban quality, and social resiliency along the Mill River and around the South Shore's bays in Nassau County, Long Island
- Lower Manhattan Coastal Resiliency - making lower Manhattan flood resilient

3.7 District of Columbia

3.7.1 Overview

DC was selected as a key city to be screened because of its recurrent urban flooding issues, proposed/implemented policy updates to address this, flood zone overlay considerations, and equity considerations. The District Department of Energy and Environment (DOEE) is responsible for managing the floodplain, administering outreach, and coordinating the Flood Task Force. The District Department of Transportation (DDOT) is responsible for stormwater design in the public right of way.

Key highlights

- DOEE's Proposed Floodplain Regulation Updates
- In the of process of developing a heat map that will flag a permit going through erosion and sediment control review that it is in an area prone to flooding (1% annual chance flooding).
- Flood Task Force

3.7.2 Land Use Planning and Permitting

- Regarding lot-to-lot flooding, the City responds to complaints through inspection-enforcement. If water goes into the street and into a neighbor's property, DDOT gets involved. There's a matrix of cause/effect and which agency is responsible. DC is working on a flowchart. Some issues are the resident's responsibility.
- The Building Code Appendix G (page 449) lays out the building standards which include the minimum elevation of 2 feet above base flood elevation for 500 year floodplains.
- The District Department of the Environment amended its code of Flood Hazard Rules in 2006 to include a freeboard safety factor of 1.5 feet above base flood elevation. It also defines three zones of Special Flood Hazard Areas (SFHA), the area within a floodplain subject to a 1-percent or greater chance of flooding in any year and designates that building permits or special regulations be required for proposals in the Special Flood Hazard Areas. In 2021, the DOEE's Proposed Floodplain Regulation Updates proposed changes to the Flood Hazard Rule, that all new and substantially improved buildings must be elevated or floodproofed to the higher value of either the Base Flood Elevation + 2 feet or the High Flood Elevation.
- The 2020 Stormwater Management Guidebook provide guidance and minimum requirements to comply with the District's stormwater management regulations including the use of best management practices (BMPs). According to the Guidebook, sites must have detention to accommodate for the post-project peak discharge rate for the 2-year, 24-hour storm event (except for areas with exceptions), the 15-year, 24-hour storm event, and the extreme flood requirement - detention to accommodate the 100-year storm. Requirements for grading/drainage provisions, gutter, and downspouts are also outlined in the guidebook.
- Long-term goals include interior flood management with neighborhood residential plans that identify flood problems and incorporate use of blue-green infrastructure as well as setting aside funding and applying for FEMA grants.
- Medium-term goals: Till infrastructure is in place, provide help from an insurance angle (FloodSmart Homes) where DC pays for the home assessment and a contractor will make the necessary improvements for free. Money available from local budget, FY23 is $2.3M. DC will also make sandbags available and offer rebates for fixes homeowners make.

3.7.3 Urban Flood Zone Identification and Mapping

- In the of process of developing a heat map that will flag a permit going through erosion and sediment control review that it is in an area prone to flooding (1% annual chance flooding). Nothing is enforced; the map is intended to be advisory, reliable and as legitimate as FEMA flood maps but for interior (urban) flooding.
- The District has developed several tools accessible to the public including an interactive floodmap with FEMA floodplains, forecasted risk, socioeconomic values, as well as a Flood Inundation Mapping Tool for the Potomac and Anacostia Rivers.

3.7.4 Hazard Mitigation

- The means of improving flood management are at a more tactical level (in contrast to centralized authority). Small procedural changes have a big impact. For example, while working through TetraTech report, National Capital Planning Commission made small changes to monthly meeting invites to address federal communications issue (one of the core organizational recommendations). Currently, DOEE houses most of the programmatic responses.
- The Flood Task Force is a shared responsibility between DC Water and DOEE. DC Water has a consultant facilitator to assist. There are weekly DC Water/DOEE/Consultant meetings to prepare for monthly task force meetings. Consultant prepares and revises presentations. DOEE does much of the inter-agency coordination.
    - The task force was formed to elevate request for separate agencies to implement actions – allowing the agencies to point to the task force to justify budget request. In practice, this is still very difficult to make progress on.
    - The task force has 30 different action plans that are 3-5 pages each, which will be aggregated into an annual report that will include budget information. The task force doesn't make budget recommendations itself; the individual agencies are responsible for placing the budget items into their annual budget requests. May be problematic because agencies may elect to not incorporate the action plan items (for example, not request additional inspection staff). The reporting/accountability is at the mayoral level. They are considering doing a website rather than a written report to add some public accountability; this is a limitation – having a more defined process of incorporating recommendations into budgets, whether agency or chair budgets, would assist in keeping momentum/progress.
- To mitigate hazards, the District is also engaged in wetland restoration work and conservation projects.

3.7.5 Equity and Community Engagement

- The DC Silver Jackets is an inter-agency team of federal, DC and regional agencies and academia that facilitates collaborative solutions to State Flood Risk Priorities.
- DC also has taken initiative to address equity, including the Far Northeast Ward 7 Equity Advisory Group (EAG) that engaged citizens and communities in discussion on climate change.
- The District has developed the Watts Branch Flood Risk Management Plan to work to protect the Watts Branch area, which is in a designated FEMA Special Flood Hazard Area from flooding risks.
- Flooding in the District E-Learning Series is a resource made available for public access to raise awareness of flooding risks.
- There are concerns surrounding gentrification and optics around buy-outs. Casey Trees, a non-profit, will buy property and convert it to open preservation land. They're able to purchase the house and

allow the resident to remain till they no longer want to. This helps mitigate the concern but not entirely.

- DOEE is moving away from "swoop in" type engagement in areas with an equity-focus. Wards 7 and 8 house much of the District's floodplain and are also areas of high SVI. DOEE has established a relationship with a local community center as an initial step in improving engagement. The community center provides a monthly 1.5 hour programming slot that DOEE fills with flood education. They are working on composing a 3-module education series (Flood 101, Flood Insurance, DC's FloodSmart homes program) that will be continually offered at the center.
- They have also identified specific federal grants that they hope to use to increase community center programming/outreach. The grants can be provided with some metric to measure success of engagement (number of engagements) to use the existing community center connections to get information out.
- Outreach outlets include radio station, Washington Informer (Black-owned newspaper), retirement centers and "hang outs" for those without internet access

3.7.6 Funding & Finance

- DC secured a FEMA Building Resilient Infrastructure and Communities (BRIC) grant for $20 million to support resilience efforts
- DC applies for funding from the Flood Mitigation Assistance Program
- NFIP is not the best program for interior flooding; it does not cover backflow valve flooding and to be defined as "flooding" requires crossing two or more properties.
- Riversmart Rewards is a Stormwater fee discount program developed by the District to give discounts on water treatment bills if residents, property owners, or businesses install green infrastructure.

3.7.7 Other Policy

- The Department of Energy and Environment (DOEE) has worked with the District of Columbia to explore the potential applications of Blue-green infrastructure (BGI) and cloudburst management strategies and conduct workshops with district agencies and stakeholders.

3.7.8 Mitigation Projects of Note

- Rock Creek Green Infrastructure Project B, the second project of DC Water's Clean Water Green Infrastructure projects, will be completed by 2024 and include the construction of permeable pavement and bioretention sites in the Rock Creek sewershed to reduce flood risks.
- To protect the Blue Plains Advanced Treatment Plant, DC water is constructing a Blue Plains Floodwall to mitigate against a 500-year flood event.

3.8 Chicago – Metropolitan Water Reclamation District of Greater Chicago

3.8.1 Overview

Greater Chicago was selected to be screened as it resembles Montgomery County in its scale and suburban landscape around a big municipality (Chicago). The Metropolitan Water Reclamation District of Greater Chicago manages wastewater treatment and stormwater for residents and businesses in Chicago and 128 suburban communities throughout Cook County.

3.8.2 Land Use Planning and Permitting

- Adopted watershed management ordinance for suburban, regional ordinance. Anything over 0.5 acres has requirements to fall under ordinance. City of Chicago has their own that mirrors MWRD's ordinance. MWRD does not get involved in single-family home requirements but looks more at multi-family development or redevelopment (City of Chicago is the same).
- City of Chicago, in general, is structurally a very different organization. Their permit review section is a bit smaller; they have 50% of land area, but enforcement is shared among the departments. Department of Water Management leads their Stormwater management permitting, but they also enlist people from Building department to do inspections and some of the permitting. Their high SVI areas may have similar issues, like more violations, but is by Ward: they are all served by the same department but there may be differences in what the wards prioritize.
- Have freeboard with detention; pond detention requirements in Technical Guidance Manual. Zero release required in developments in floodplain.
- Full-time staff of 25 people in permit review and about 20 in enforcement section. They inspect every permit and look into violations and notices; sometimes have hearings to try to get people back in compliance.
- Communities are co-permittees; communities are aware that they have a role.

3.8.3 Urban Flood Zone Identification and Mapping

- City of Chicago has modeled entire sewer system, all sizes of service lines. Good model data in City; City knows where stress points are and look at many factors, such as other infrastructure projects and how they can work on sewer when doing a roadway project. MWRD has a tunnel system for CSO relief to City Sewers and other combined sewer communities, which have been modeled.
- MWRD is careful about mapping; it can be seen as negative. Rely on local datasets to identify what the area's "flood susceptibility" is and not necessarily an urban flood zone. It's hard to pinpoint specific locations but there are indicators they've used and have access to.
- Flood Susceptibility Index: metro planning organization gives indicator of where areas might be more susceptible.
- Riverine (FEMA data) but also Urban flooding index: gives an indication where communities may be more likely to see urban flooding based on factors in the index. It is currently being updated.
- MWRD is also doing master planning to look at the subwatershed level, where there are known flooding problems based on local communities. Looking at flooding locations in high SVI communities; there has been a lot of turnover in those communities and thus, less historical knowledge and data readily available.

- Have done studies using many GIS tools to see where there is a lack of stormwater storage (an indicator of risk) and where they have information about the system, i.e., a model, which is used to help pinpoint risk and solutions. Volumetrics approach to stormwater management, overland flow routing, other GIS data/tools; metrics to help focus attention in the future on where volume is needed/lacking.

3.8.4 Equity and Community Engagement

- More high SVI communities have more violations; it's a challenge to make sure people seek out a permit and that their property is properly maintained after permit is issued and construction is completed.

3.8.5 Funding & Finance

- Have a capital program for urban flooding problems and floodplain. About half of communities outside Chicago also have combined sewers and programs to help fund green infrastructure and more traditional flood control/stormwater projects. In high SVI areas, MWRD tries to encourage those with permit violations to get them fixed, but also carrot/stick approach: address violations but if not, they might not be able to partner on flood control funding. On the flip side, trying to promote those communities to take advantage of what is available poses a challenge because MWRD doesn't want to reward those in violation. Looking for projects that are for the greater good.

- $50-75 million/yr capital improvements; have some long-term programs, including Department of Water Management and school system-space to grow. Schoolyards convert to green infrastructure (GI), playgrounds, etc., to help flooding in neighborhoods. Partner with other larger agencies, like Forest Preserve District, where MWRD adds on volume or GI that agencies are already providing.

- 3 programs with open calls for projects from any community, township, agency in jurisdiction that want to take on a stormwater project, which can be GI, traditional stormwater, pipes and storage, buyout program. Usually budget about $5 million/per project but can vary. Much of budget is set aside to help communities move projects forward with construction money. Have helped high SVI communities with design and construction. Can also partner with USACE. For some communities, money for construction isn't sufficient. Cook County is mirroring their program, working to get MWRD to fund directly. Exciting opportunity; don't want to just be provider of services but want to help communities build capacity.

- Call for projects: application period is 2-3 months, do outreach on the application process, and have a very basic pre-application process so MWRD can help them with the full application, if it is promising.

3.9 Mile High Flood District – Denver

3.9.1 Overview

Mile High Flood District (MHFD) was selected due to their work integrating local flood maps with FEMA mapping and updating policy based on mapping. The Planning and Floodplain Management Director for MHFD was interviewed as part of the research.

Key highlights

- MHFD has in-depth technical criteria for stormwater management, which all the local governments have voluntarily adopted.

- Currently, their approach is to build in freeboard factor of safety, discourage new pipe systems and try to keep open channel design; design with flexibility and freeboard resilience, rather than taking the approach of modeling with future projections.

- MHFD has a number of rainfall and streamflow gauges throughout the district that help communicate in real-time the risk to local governments.

3.9.2 Land Use Planning and Permitting

- MHFD does not do land use planning nor get involved in areas less than 130 acres unless local government requests it of them. 130 figure is the amount where development with a minor storm drain and surface conveyance through streets would not be enough and thus would require a major drainpipe. Their role is to help influence but not set zoning or land use regulations, working with local government to make sure zoning makes sense with underlying drainage system.
- If local flood risk on map becomes part of a regulatory requirement, it would be a considerable challenge from a revisions-standpoint; updating through FEMA's process would be a lot of work and slow things down.
- The details of a storm sewer network, onsite detention ponds, gutters, inlets, etc., would make a significant difference to what homeowner would see in terms of actual flooding. Models that FEMA put together are calibrated to major drainage; may not fully reflect the impacts homeowner will see. Prefers keeping in local government hands rather than making flood risk map regulatory.
- MHFD has in-depth technical criteria for stormwater management, which all the local governments have adopted and use even though not required to do so.

3.9.3 Urban Flood Zone Identification and Mapping

- Have begun working on 2D rain on mesh modeling (HEC-RAS 2D, latest version) for the District. Colorado Water Conservation Board (CWCB) provides 2D mapping. MHFD hires consultants to take CWCB's data/map to a level of detail appropriate for the urban area. For Denver, 2D mapping results with GIS mapping interface; potential inundation areas or urban flooding areas not on FEMA maps. Apply 1 ft of freeboard.
- Confluence is online platform. Plan is to take it and combine with FEMA regulatory data to develop understanding of risk to prioritize projects.
- MHFD has a specific agreement with FEMA for their FEMA regulated mapping that allows them to consider future land use and projected zoning. Rainfall is trickier without NOAA Atlas15. Their approach is to build in freeboard factor of safety, discourage new pipe systems and try to keep open channel design; design with flexibility + freeboard resilience, rather than taking the approach of modeling with future projections. After obtaining better projections, can take a combined approach. Map what is best available/known today regarding what may happen in the future, i.e., what is zoned today plus any development and planning tools that are currently available from local government will be incorporated.

3.9.4 Equity and Community Engagement

- Local governments take the lead in engaging their communities because they know them best.
- The city/county of Denver set aside $200K for a masterplan study, $400K (double the study budget) for outreach/engagement. Robust engagement targeting socially vulnerable communities.

3.9.5 Flood Warning Emergency Response and Recovery

- Works with Office of Emergency Management of local governments; their role is in prediction side, working with NWS. MHFD has a number of rainfall and streamflow gauges throughout the district that help communicate in real-time the risk to local government. Local government are the ones to make calls for evacuation.

- Biggest role is to try to make necessary improvements to be as prepared as possible for flood events.
- Recovery efforts after flooding include partnering with local government for repair to major drainage ways (ex: rebuild a culvert that blew out, fix erosion).

3.9.6 Financing

- Available as a technical resource. If there's a new capital project over 130 acres, MHFD funds 50% and look for local government to provide 50% match. Maintenance can be funded 100% but has to be requested by local government.
- To spend maintenance dollars in future, MHFD must review developer led projects for approval. Local governments must have easement/right-of-way and MHFD will maintain it in future.

3.10 Charlotte-Mecklenburg, North Carolina

3.10.1 Overview

In 2000, Charlotte-Mecklenburg became the first community in the nation to show both current and future floodplains on its official maps. Charlotte-Mecklenburg Stormwater Services (CMSWS) is comprised of Mecklenburg County Stormwater and City of Charlotte Stormwater. City of Charlotte Stormwater was interviewed to understand urban flood mitigation approaches.

Key highlights

- Charlotte's Unified Development Ordinance (UDO) as described on their website, "will simplify, consolidate and update the regulations that guide development into a single document. In addition, the draft UDO will align these standards with the vision of the Charlotte Future 2040 Comprehensive Plan and other adopted City policies. This effort will also make development standards easier to understand through the increased use of common language and graphics."
- Summary of changes to Stormwater Ordinance
- They are a CRS Class 3 with good flood protection measures. They don't prohibit building in floodplain but require building responsibly and mitigating the risk – they are very active in removing existing problems in the floodplain with the acknowledgment that their landscape is different from others – they have steep valleys and the floodplain is confined.
- The FEMA Floodplain shows where flooding is likely to occur now. Their Community Floodplain shows where flooding is likely to occur in the future, based on expected development upstream.
- 3D Interactive Floodzone Mapping

3.10.2 Land Use Planning and Permitting

- City of Charlotte and Mecklenburg County splits responsibilities. They have inter-local agreement; for Charlotte City, "turf" is everything that drains less than 1 sq mile, and for County, everything that drains more than 1 sq mile. County is mostly responsible for their floodplain mapping and ordinances; they draft them and go through Daryl Hammock (City of Charlotte, Stormwater Management) for approval to City Council.
- Both City and County collaborate in outreach/communications. They incorporate flood awareness campaigns together. County is seeking to satisfy requirements for FEMA process and CRS, and the City is trying to reach those experiencing flooding in basements/crawl space.

- Substantial improvement rule: if adding onto a house in FEMA floodplain and enhancing to over 50% of the value, there are standards to be met. See Drainage Article. Building code department is not involved in prevent flooding problems. County is focused on Community Floodplain, going above and beyond, and adding flood depth. Development and Building Industry collaborate in terms of ordinance requirements.

- Drainage Article will be in effect in June 2023. Cursory reviews are forthcoming; for instance, checking to see if a new bathroom is near a ditch or over a pipe. However, 70%-80% of these reviews will be "pass throughs". Number of staff required will be about 6-7: Supervisor + plan review engineers. They will likely charge a $50-$100 fee for short 15-minute reviews. No calculation reviews but will make sure what is being built is not in harm's way or damaging city infrastructure in right-of-way or causing flooding problem for someone else.

- CMSWS standards: If building a house with the drainage area threshold of 100 cubic ft per sec for 100-yr storm, a study / analysis is required before siting home and must elevate home to "100 +1" elevation. Mostly crawl spaces and basements have to be above 100 + 1. Longstanding standard for 30-40 years.

- Lot-to-lot issues: Charlotte is experiencing a lot of growth, infill development and redevelopment. Spending 3 years to work on Charlotte's Unified Development Ordinance, drawing the line between developer and homeowner responsibility. See Drainage Article; CMSWS staff will review smaller infill sites, smaller addition to homes, etc. but are not taking responsibility for lot-to-lot drainage. Instead, they seek to prevent nuisance problems from happening. When citizens experience lot-to-lot issues, they call 311 and CMSWS inspects and determines whether they can provide services. There is no direct campaign towards lot-to-lot issues. Information on their website specifies what they will provide.

- Due to the degree of infill development, small site development is dominating, so CMSWS has lowered the threshold to require stormwater control measures from 20k sq. ft. down to 5k sq. ft. New impervious surface of 5k sq. ft. or more will require control measures, such as an infiltration basin or a raingarden for a single-family home.

3.10.3 Urban Flood Zone Identification and Mapping

- Stormwater Utility Department created because of urban pluvial flooding. Spent 20-30 years to address witnessed/known flooding locations (didn't need to do modeling for this). Invested 1B USD since 1993 for capacity improvements. Now, focus is on inspection and modeling of drainage systems and asset management - not sure how extensive modeling will be or if it'll be used for land development requirements because developers are required to conduct a study when building on site.

- 3D Floodzone Map Tool: No pluvial mapping done upstream of FEMA floodplain and 1 square mile point but discussions underway with County.

- 311 database in existence since 1993. Inspector / drainage investigator would go out for each call to determine the nature of problem and whether it qualifies for public service. More thorough data collection now on first site visit from homeowner and observer. Very good database.

- Modeling used existing zoning records, considering what is likely the maximum intensity based on that zoning category. Stormwater control measures were installed intensely since 2008. An internal source of debate is on how to map them; the attenuation in the system is not included in the model.

- Flood zone maps are available for City and Planning Dept to review. County has been active over last 20 years, buying out flooded properties and converting to greenways and trails, and CMSWS has funneled money to same projects to build stormwater control measures and stream restoration projects to reclaim beneficial uses. Have not used floodplain modeling to rezone property or prohibit how it is used.

3.10.4 Hazard Mitigation

- If major systemic problem, CMSWS logs, categorizes and prioritizes it in system. No other cost to citizen other than their monthly stormwater fees. If it does not qualify for public program, CMSWS does not have cost-share program to offer.

3.10.5 Equity and Community Engagement

- Looking at a map of past 1000s of projects in last 30 years, no evidence of economic disparities in service delivery.
- Website has been useful, TV media broadcast and commercials – pay for 15-30 seconds of ad time and run on local TV stations. Big money, but number of people who see the ad is really high. Very good value. Partner with neighboring cities to pull resources together. Using social media more and more, Twitter and Facebook weekly. If it's a regional message, for NPDES permits, localities will help buy ad/air time collectively with a universal message and that will meet regulatory requirement for permits.

3.10.6 Flood Warning Emergency Response and Recovery

- Staff has a dense network of 74 automated rain gauges that provide live, real-time data available for anyone to see online. Helps with erosion control violations and in understanding whether the CMSWS could have expected the system to fail in that kind of event.
- Flood Information Notification System (FINS). County works closely with Charlotte Fire Dept. When rain gauges hit certain levels, it sends message to Fire and Staff and lets them know where it's raining hard.
- Failing small old earth dams originally from 75 years ago. Staff met with Emergency Management. State regulates dams (safety/inspection) but City's/County's local emergency responders would be called into action if there are dam failures. Dam owner is responsible for repairs. The State sets the pace and interest level in updating dam emergency plans. Owner must keep an updated EAP. CMSWS maintains and owns some dams; they try to be leaders in City.

3.10.7 Financing

- As federal initiatives come down, CMSWS has been active on grants. Submitted ARPA funding, $6M through Biden administration. Focus is on having adequate stormwater utility rates, paying close attention to bond ratings and keeping elected officials aware of what CMSWS is doing.
- 70% of their revenue is funded through fees. CMSWS leverages some revenue from debt funding. They are a fee-funded program and do not get any general or tax funds; it's all stormwater utility fees.

3.10.8 Other policy

- See RetroFIT on how the CMSWS prioritizes/assists with existing buildings that are prone to flood damage in the FEMA floodplain. CMSWS is willing to accept some level of street and house flooding that they previously would not tolerate. More focused on making sure the infrastructure won't fall apart.
- Strategic Plan. Comprehensive big picture planning with a focus on aging infrastructure. Prioritizing keeping what they have functioning and worrying about tier 2 flooding problems later on. They do less private property work, more asset management and preventative maintenance work. Their

program grows, 200+ staff members; no construction crew members, just professional staff. Rally workforce around mission and move in same direction.

- Report on metrics. A work to be completed. Trying to tie staff's workplan to the strategic plan. Getting burdensome. They have 5 core metrics that they report to Strategy and Budget, Finance, and City Management Office every year: 2 metrics related to surface water quality improvement, retrofitting impervious and stream restoration, and number of miles of pipe rehabilitated in a year. Trying to measure infrastructure provision, which is the main metric they push up to Citywide organization.
- Pond Retrofitting Program. 15+ years ago, CMSWS recognized old farm ponds were having subdivisions built around them and were failing. They also had NPDES permit requirement to capture and treat impervious surfaces. Homeowners wanted dams to look nice, and CMSWS needed BMPs and stormwater control measures in areas that did not have them. Started Pond Retrofitting Program, where the public invests in retrofitting BMPs. CMSWS will put multi-stage outlet control structures on them, permit them to function at much higher level to meet NPDES permit goals and give residents a place to row boat and fish. Public gives them the protective easement they need. Good partnership. Raleigh recently jumped on board. Still private BMPs but CMSWS has permanent storm drainage easement on property; public can't alter it or remove it but can enjoy it and CMSWS maintains it.

3.11 Pittsburgh Water and Sewer Authority

3.11.1 Overview

Pittsburgh Water and Sewer Authority (PWSA) was selected because it is undergoing a policy update to incorporate climate change. Pittsburgh is different in that PWSA is an authority of City of Pittsburgh, a quasi-governmental agency; technically a nonprofit that operates City's sewer and water systems, with board members appointed by the Mayor. They manage the drinking water system from Allegheny River to the tap and sewer conveyance system; however, they do not manage treatment.

Key highlights

- PWSA worked closely with the City in drafting up a stormwater agreement, acknowledging that it'll be cost prohibitive if they don't find a way to change land use regulations to increase the level of participation from private development.
- PWSA considered stormwater management a land use issue and that there was the need to change land use codes. PWSA doesn't control land use or planning codes. They work with Planning all the time but needed some kind of agreement to hold them to.
- RAND and Carnegie Mellon provided studies on climate change effects and projection models for the local region, which added a layer of justification for PWSA's work; they recommend incorporating local researchers/universities, if possible.
- Watershed analysis was done as CSO study, where water quality was a benefit from the water quantity analysis.

3.11.2 Land Use Planning and Permitting

- Until about 10 years ago, there wasn't any stormwater agency, just a combined sewer system; some of the newer portions (20-25%) are separated due to changes in Code (1970s Clean Water Act) and NPDES permitting. However, Code is lacking in control measures.
- The City sets code for land use, building construction. PWSA manages the stormwater itself. It was an unwritten agreement in past that City would manage water on surface and once it penetrated to

storm drain or inlet, it came under the purview of Water and Sewer Authority. Surface plane was delineation, but it left gray areas: back-up of flooding, overflowing banks of streams. Took time to sort out. Last decade, they had seen an increase in rainfall amounts (IDF is off the charts). Systems weren't designed for heavy downpours/cloudburst events. Asked: "What is LoS as a sewer system?" "What should City be doing to get water to system?" City would have a paving plan but it would not include stormwater acknowledgment. It came to a head where everybody had to come to the table to figure out a solution; there is not enough space in right of way to build enough stormwater management systems for everyone to offload their water to.

- In terms of quantifying runoff, it was gut-feeling, anecdotal evidence from years of experience. There was too much water coming in from private properties.
- County 167 Stormwater ordinance required the City to change laws to implement code to meet minimum; thresholds were low. Water Authority was footing the bill and able to get land grants from local foundations for initial study on how code can change stormwater impact. It's cost-effective to change code to put burden back on private development. PWSA paid for legal updates to change City's code correctly. They consider themselves the subject matter experts and wrote up and presented to City Council on why changes were necessary.
- County Conservation District (CCD) approves stormwater plans over an acre. Erosion and Sedimentation enforcement is in their wheelhouse.
- Multiple meetings with City Departments and agencies, CCD, and State DEP held to ensure they were heard and that their recommendations would be taken into consideration. Shared pinch points with the Code as it exists currently. Then PWSA reached out to stakeholders, engineers, developers, land owners, and asked what their pinch points were with existing Code. It gave PWSA a reality check on how much work it was going to require. The meetings provided a lot of transparency for stakeholder group, who don't like surprises. It helped to have them at table from beginning. The buy-in was there, less push back when changes were launched. PWSA did a lot to streamline the process. Carrot-stick approach: If developers go above and beyond, they could get density credits. Outreach was paramount to their success.
- Trying to get neighboring counties/municipalities to change their codes as well. 167 municipalities with different codes.
- Code changes are really targeting development/redevelopment over a certain threshold. For those properties not going through large development projects, establishing LoS is still an ongoing conversation; it changes for every street, neighborhood, block. System was not built comprehensively. Trying to change narrative on how people talk about LoS and trying to understand what PWSA can feasibly provide. Still designing to the 10-year storm, no one has been willing to commit to higher level yet.
- Lot-to-lot issues. Code writes those as private property matter. However, also in Code, no property can redirect runoff that detrimentally impacts neighboring property. PWSA has its own credit program with stormwater fee. They offer guidance on how to manage property better to limit stormwater fee. PWSA handles lot-to-lot issue once it gets out to the street and have reached out to neighborhood to let them know they can disconnect downspouts. Code Enforcement gives violation when appropriate.
- PWSA has some oversight by PA Public Utility Commission (PUC), a statewide organization, consumer-advocacy group that oversees private company utilities.
- 3 Rivers Wet Weather, nonprofit of 20+ years. Established/funded by Allegheny County Sanitary Authority (regional treatment facility). Information sharing, strategic planning, comprehensive strategies. 12 out of 83 municipalities participate. Cordial but in the end, municipalities are still going to operate according to their preference.

3.11.3 Urban Flood Zone Identification and Mapping

- Act 167 Countywide Model Ordinance, mandated from the State. Certain watersheds were selected for having impaired waterways and would have to have restricted release rates in place. Watershed analysis was done as CSO study, where water quality was a benefit from the water quantity analysis (latter was the focus; volume-centric). After obtaining detailed model, they identified 20 or so watersheds to further analyze, focusing on problem areas, and modeling at granular level, some to every single inlet.

- Looked at infill, land use projections, etc. PWSA were fortunate that RAND and Carnegie Mellon were already performing studies on climate change effects and projection models for the local region. Serendipitous that they were downscaling large climate models to city/local level. PWSA could use rainfall data/projections and expected land use change, population shifts, and economic parameters. It added a layer of justification for what they were going to do and would require, to answer, "What can we manage to the year 2100?" PWSA recommends incorporating local researchers/universities, if possible.

3.11.4 Equity and Community Engagement

- Engage.pittsburghpa.gov. With the Code update project, one of the key things in RFP was to implement public engagement to address equity issues as well as high-dollar developers who will likely complain to Mayor's office. Wanted to make sure their writing of the Code wouldn't be overly burdensome on small developers and property owners in high SVI communities. Address certain comment periods before getting codified. On stakeholder working group, they had neighborhood organizations and advocacy groups for high SVI neighborhoods to stimulate economic development. Stipulations were written into Code that certain areas had limitations due to economic variables. AKRF consultants were very helpful.

3.11.5 Flood Warning, Emergency Response and Recovery

- Look at LiDAR rainfall data to see where heavy spots were, how it correlates with what they saw in system. Long-term, looking closely at real-time controls within sewer system and using rain gauge data to see how runoff/flood progresses. Use data to prevent more flooding downstream.

3.11.6 Funding & Finance

- PWSA has stormwater fee based on impervious area. Relatively low initially but allows them a foot in the door, familiarizing residents with paying a fee. They'll be able to use that as more of an incentive to limit runoff. The plan is to gradually increase the rate over several rate cycles till it becomes more cost effective to manage the water well than pay the fee.

4. Summary Remarks

4.1 Summary

The selected jurisdictions had different approaches to flood management, bespoke to their regulatory and hydrographic environments. Some had the advantage of resources (such as nearby academics) and organizational structures already in place to make strides toward policy changes needed to improve their stormwater and flood management. Noteworthy elements and/or common threads include the advisory, rather than regulatory, purpose of urban, pluvial maps, the carrot-based approach to reward those going above and beyond in stormwater management, the hiring of legal professionals to assist in writing new ordinances for consideration by governing authorities, partnering with established community groups to communicate flood-related information in high SVI areas, the importance of stakeholder engagement and soliciting feedback prior to implementing changes in code, and the creativity of securing project funding for water quality improvements by taking a water quantity approach. The information provided from these desktop studies and interviews will inform the organizational review of Montgomery County Flood Management.

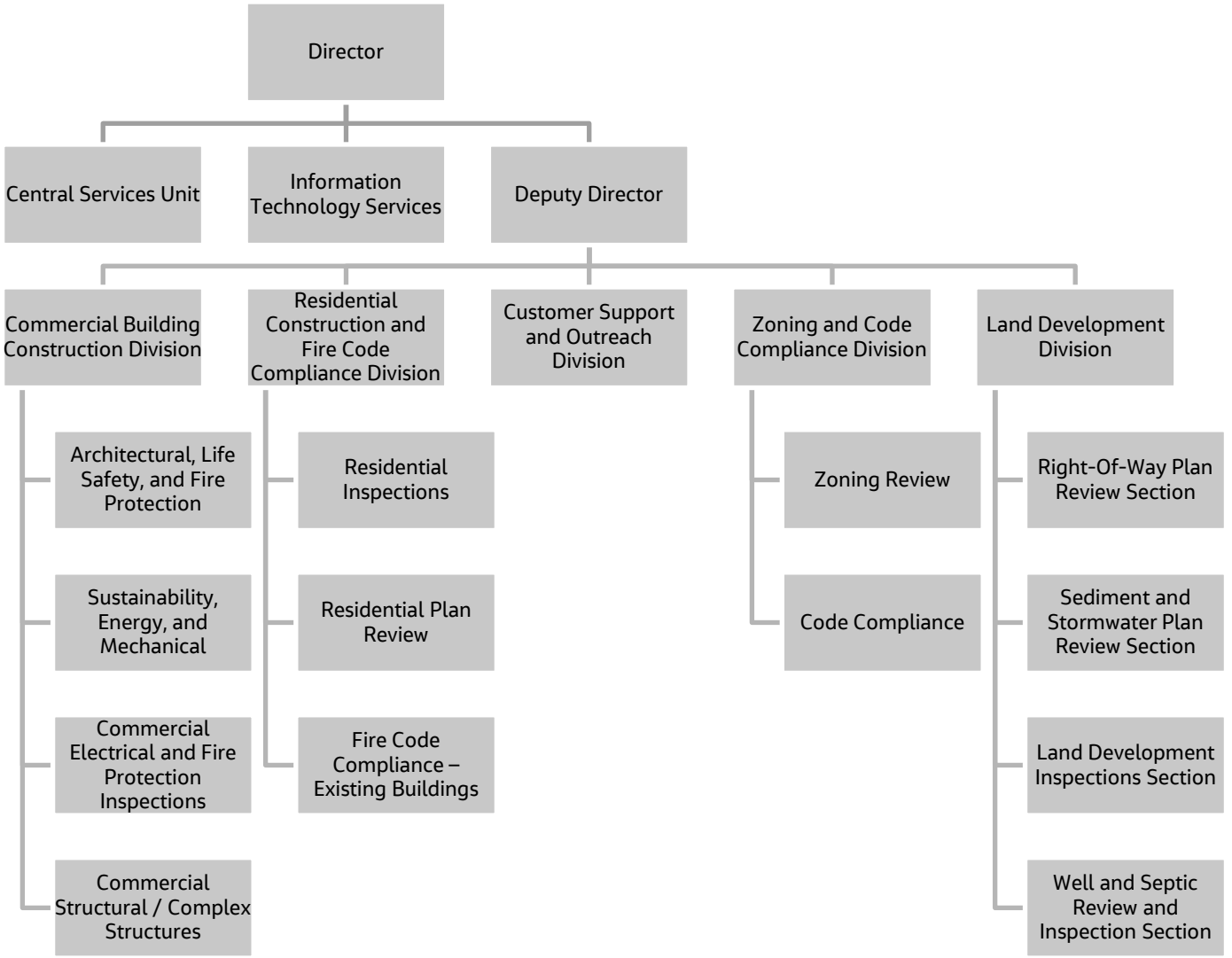
Appendix A – Sample Interview Questionnaire

Sample Interview Questionnaire

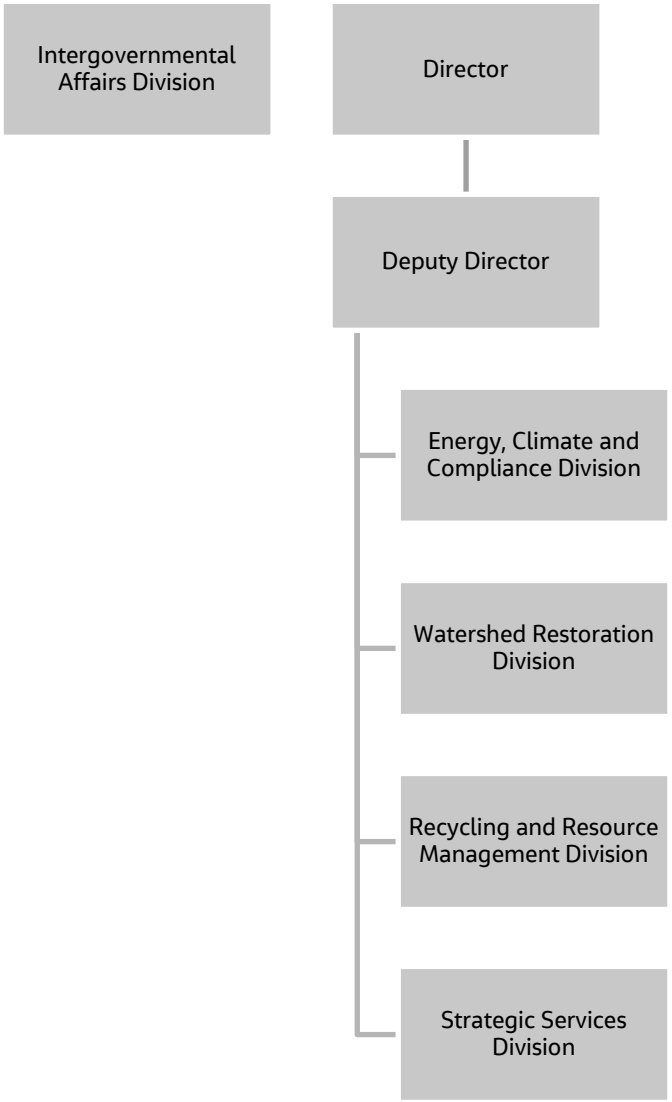
1. Land Use Planning and Permitting
    a. How would you briefly characterize the organizational structure around urban flooding for your community?
    b. What stormwater management and building code requirements do you include for redevelopment projects to minimize urban flood risk? New development projects?
    c. How does your community address lot-to-lot flooding issues?
    d. How have your building standards have been adjusted for development in urban flood zones/areas with known urban flooding issues?
2. Urban Flood Zone Identification and Mapping
    a. Has your community mapped urban flooding areas outside of the FEMA zones, and if so, how did you develop them?
    b. Does your urban flooding analysis approach include climate change effects?
3. Hazard Mitigation
    a. What kind of programs does your community have to help homeowners mitigate flood risk?
4. Equity and Community Engagement
    a. How does your community approach social equity when it comes to urban flooding?
    b. What is the most successful outreach method employed by your community? What methods have been unsuccessful?
5. Flood Warning Emergency Response and Recovery
    a. Has your community identified areas that are likely to flood or areas that flood repeatedly during large storm events?
6. Financing
    a. What are your current actions and/or relating to funding for urban flood planning mitigation related activities?

Appendix G
Core Agency Organizational Charts

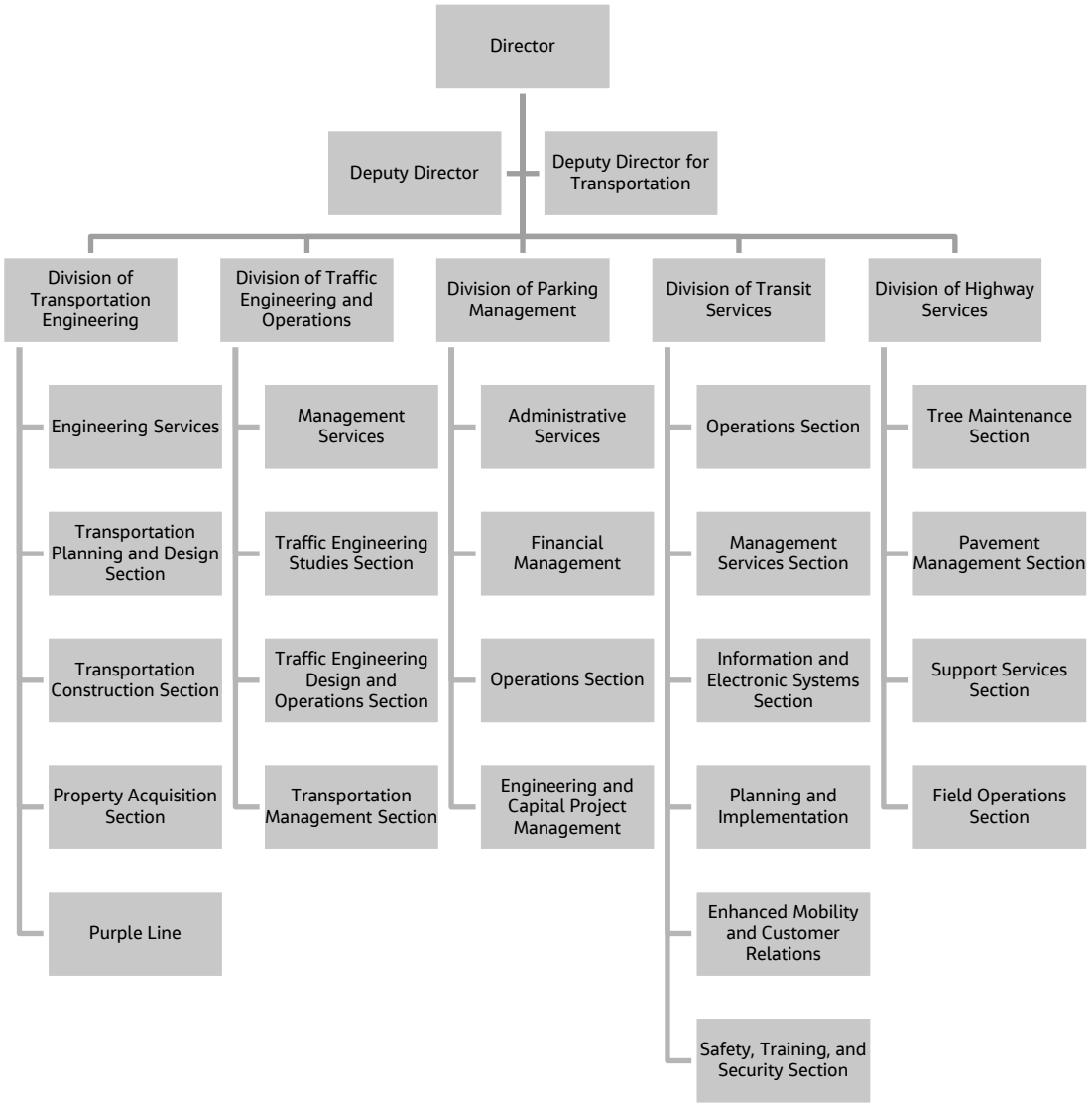
Department of Permitting Services (DPS) Organizational Chart



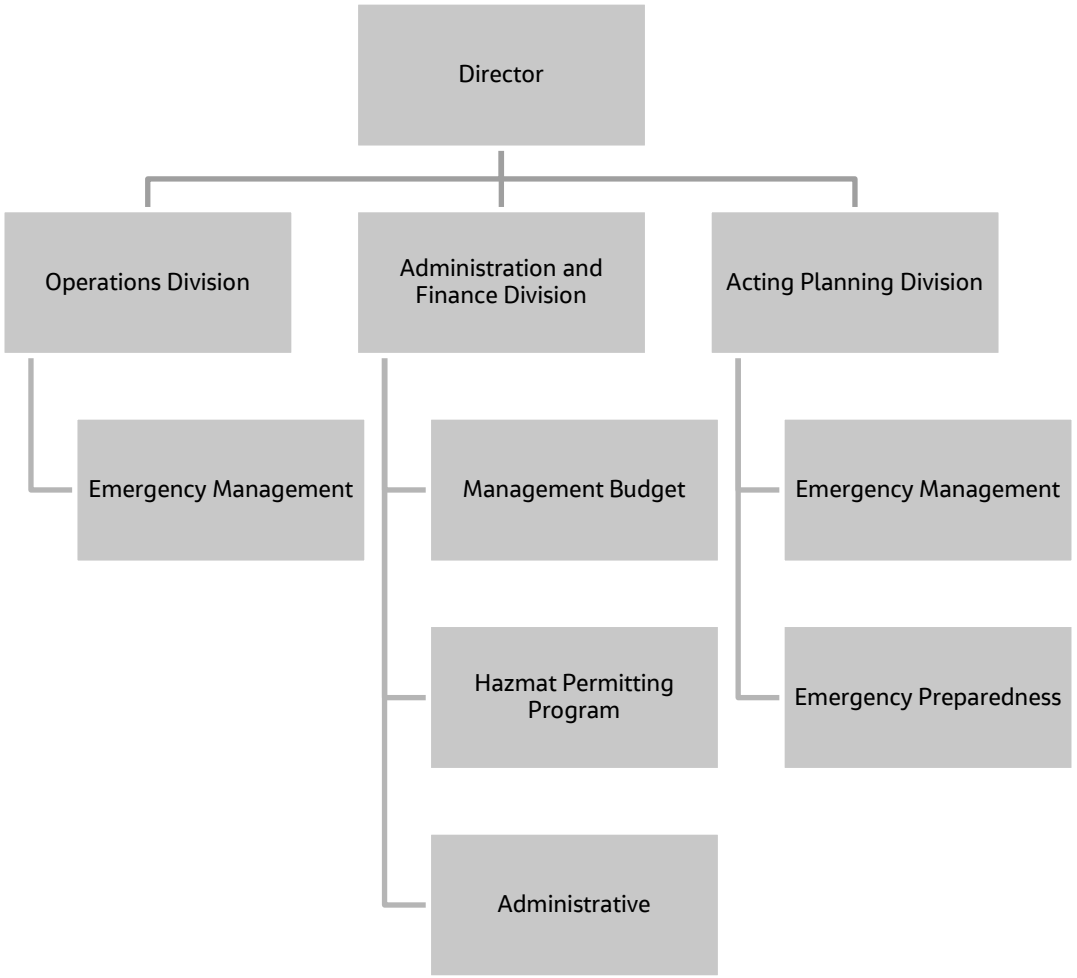
Department of Environmental Protection (DEP) Organizational Chart



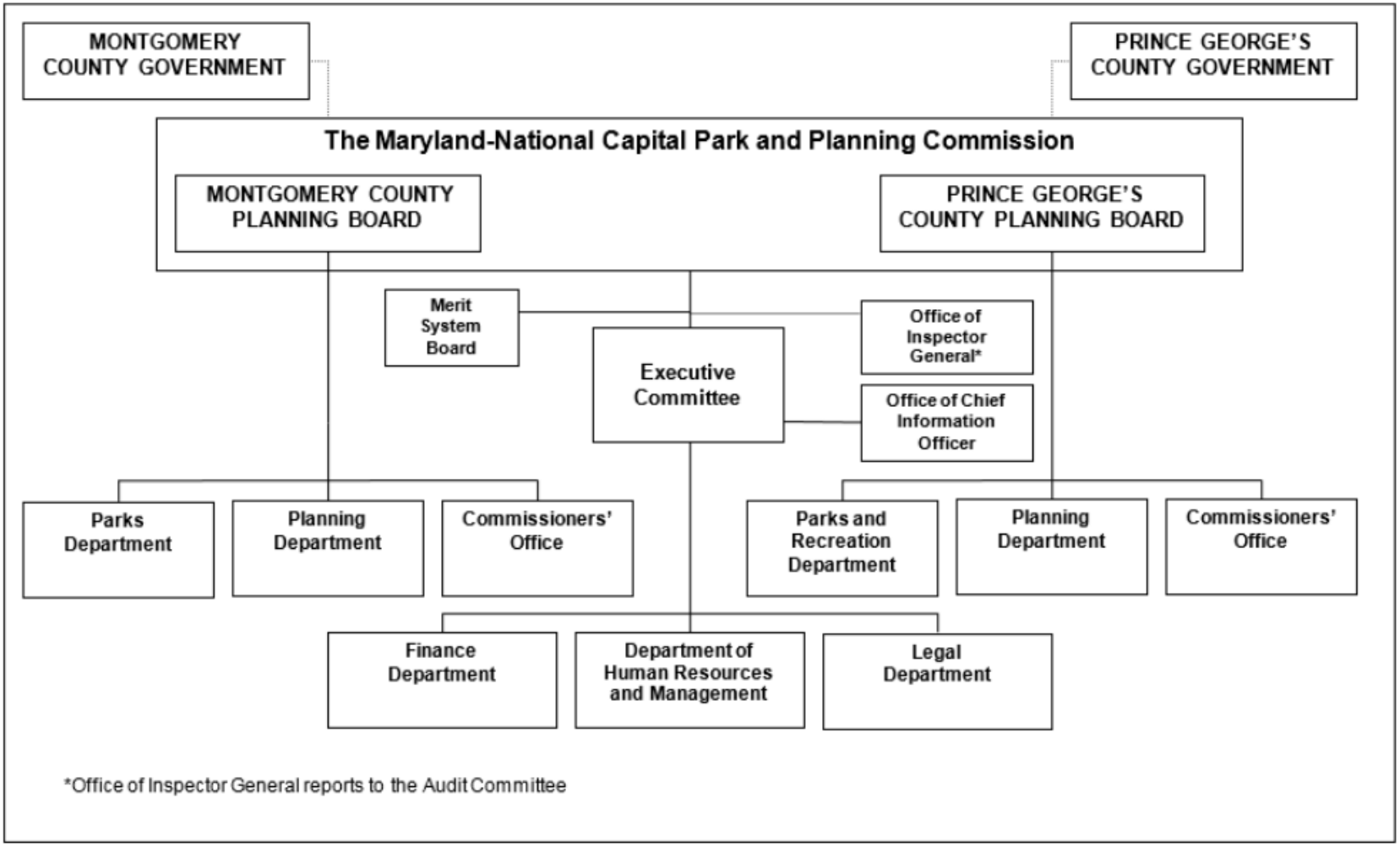
Department of Transportation (DOT) Organizational Chart



Office of Emergency Management and Homeland Security (OEMHS) Organizational Chart



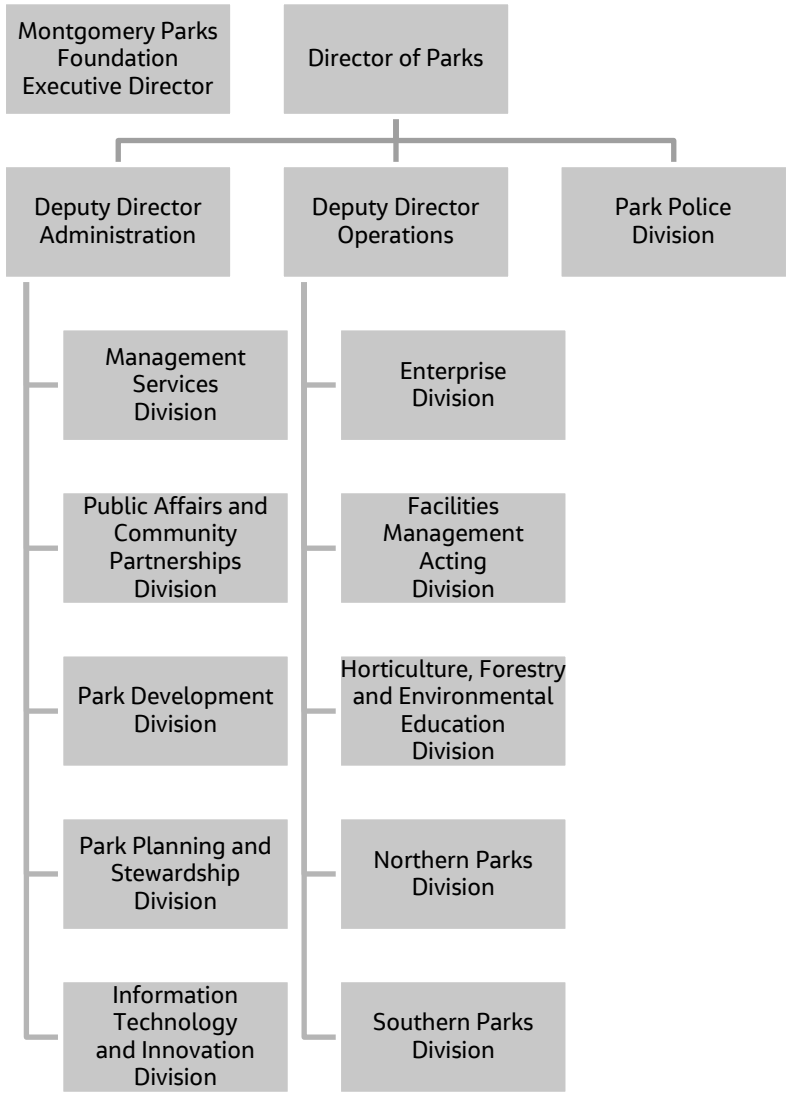
M-NCPPC Overall Organizational Chart



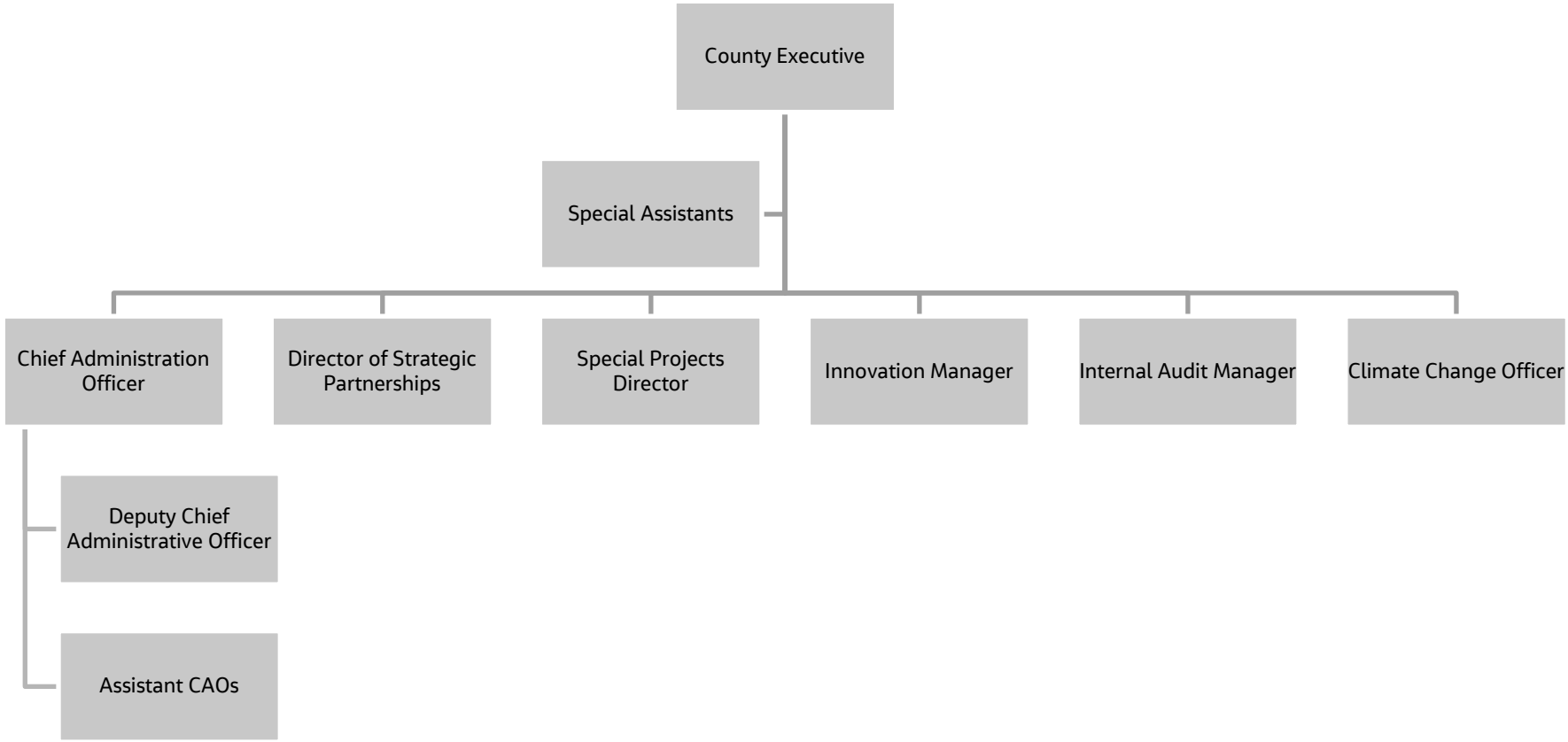
Source: M-NCPPC Proposed Annual Budget for Fiscal Year 2022

M-NCPPC Planning Division Organizational Chart

M-NCPPC Parks Division Organizational Chart



Office of the County Executive (OCE) Organizational Chart



ATTACHMENT 2
HISTORIC FLOOD CONDITIONS AND DATA GAPS TECHNICAL MEMORANDUM

Characterization of Historic Flood Conditions and Review of Data Gaps

Date: May 5, 2023
Project name: Comprehensive Flood Management Plan Phase 1
Project no: E4X56703 and E4X56704
Client: Montgomery County Department of Environmental Protection

Jacobs
1010 Wayne Avenue
Suite 1150
Silver Spring, MD 20910
United States
T +1.301.495.8840
www.jacobs.com

Contents

Contents **1**
1. Purpose **3**
2. Background and Introduction **3**
2.1 Watersheds 3
2.2 Data collection detail 4
3. Existing Conditions and Past Flood Impacts **5**
3.1 Watershed characteristics 5
3.2 Flood Hazard Summary by Watershed 13
3.3 Summary of Past Flood Impacts 17
3.3.1 Observed Flood Impacts Data 17
3.3.2 Observed Flood Impacts By Watershed 18
3.4 Discussion 27
4. Flood Exposure Ranking of Watersheds **27**
4.1 Overview of Methods 27
4.2 Flood Exposure Measures 28
4.3 Overall Flood Exposure Scoring 33
4.4 Sensitivity Analysis and Recommended Watershed Ranking 36
4.4.1 Tiered Ranking by Flood Hazard Source 39
4.4.2 Recommended Tiered Ranking 41
5. Review of Data Available for Flood Modeling **50**
5.1 Review Methods 50
5.2 Results 51
5.2.1 Countywide Summary 51
5.2.2 Watershed Summaries 52
5.2.3 Local Municipalities 69
5.3 Discussion 69
5.3.1 County Stormwater Infrastructure Data Management 69

5.3.2 Discussion of Engineering Data Gaps 69
6. Conclusions and Recommendations 71
7. References 71
Attachment 1. Data Requested and Received 1
Attachment 2. Background on Preliminary Flood Zone Model Development 1
Attachment 3. Watershed Exposure Attribute Data 1
Attachment 4. Normalized Scores for Watershed Exposure Attributes 1
Attachment 5: Watershed Flood Exposure Scores for FEMA and Flood Modeller Scenarios 1
Attachment 6: Model Requirements 1

1. Purpose

This technical memorandum (TM) is intended to summarize work conducted under Task 3 of the Comprehensive Flood Management Plan Phase 1 (CFMP P1) Task Order #3 work (Contract #1127041), which includes:

- Summarizing, at a watershed level, historic flood conditions in terms of type of flooding and populations impacted (**Section 3**).
- Presenting the watershed prioritization methodology and initial results (**Section 4**).
- Reviewing available stormwater infrastructure data to identify and quantify gaps in existing data (**Section 5**).

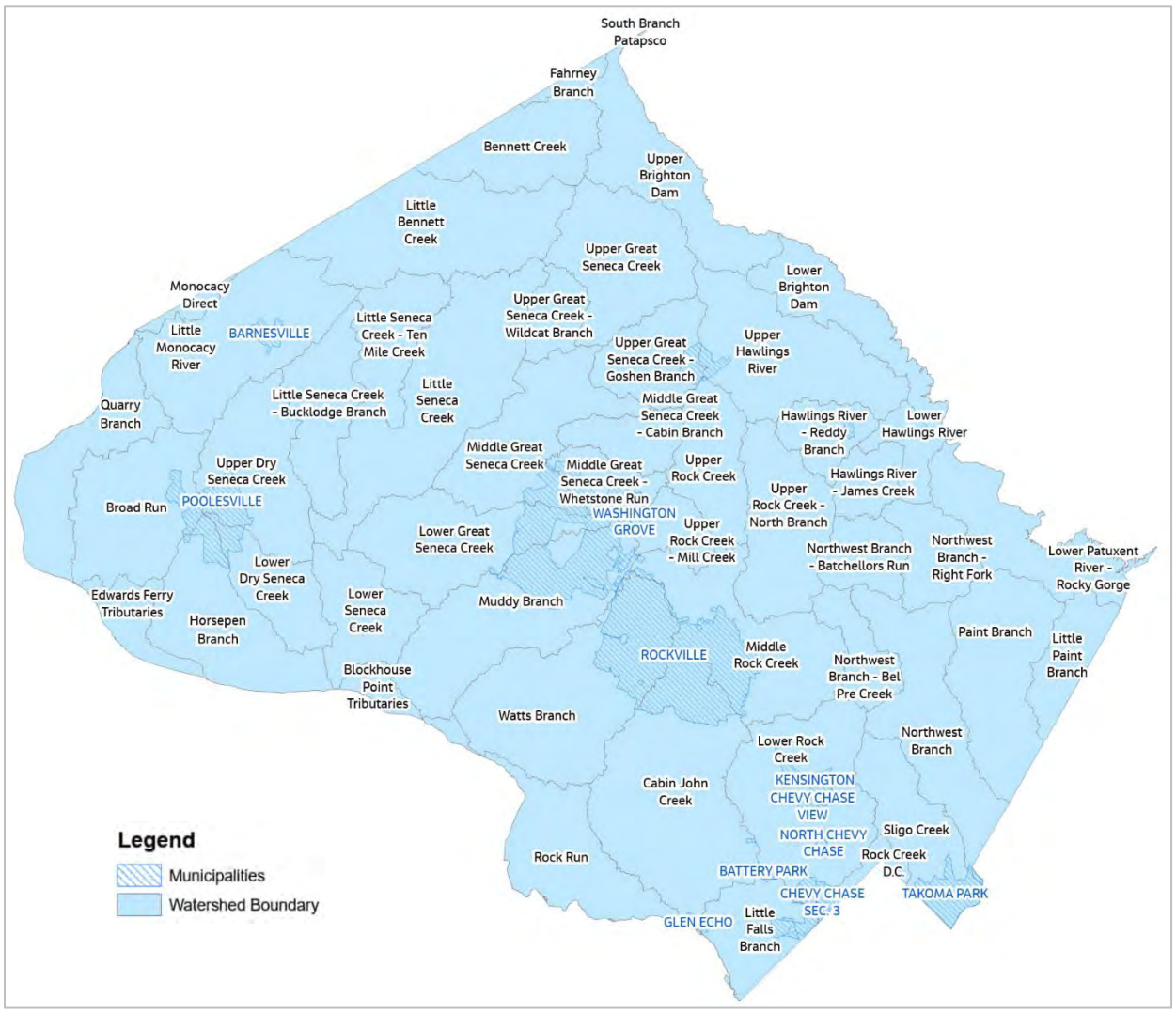
Revisions to this draft TM will be incorporated in the Comprehensive Flood Management Strategy Final Report (Task Order #4, Task 5).

2. Background and Introduction

2.1 Watersheds

Watershed delineations used to summarize historic flood conditions and engineering data gaps were obtained from the Montgomery County (County or MC) Department of Environmental Protection (MCDEP). The watersheds are USGS 12-digit watersheds, with some MCDEP improvements to watershed boundaries based on review of LiDAR contour data. **Figure 2-1** shows each of 49 watersheds in Montgomery County.

Figure 2-1. Watersheds of Montgomery County



2.2 Data Collection Detail

Data were collected from County agencies and Montgomery-National Capital Park and Planning Commission (M-NCPPC) in Spring and Summer of 2022. A listing of data requested and provided by County agencies and M-NCPPC (Parks and Planning Divisions) is included in **Attachment 1**.

Several data sets were collected to assist in characterizing past flood conditions in the County (**Figure 2-2**). Data are generally organized according to whether they inform an understanding of flood hazards (mapping of flood hazard areas), flood receptors (areas or locations that may be vulnerable to flood impacts) or observed impacts (flood event or flood impact information from County records). These data come from several sources within the County, from public sources, and from existing Jacobs work. While none of these data sets offer a clear and comprehensive picture of flood hazards or past flood impacts, together – and along with a knowledge of their limitations – they have been used to generate a watershed-level summary.

A more detailed discussion of specific data items is included in the following sections.

Figure 2-2. Summary of Data Used to Characterize Existing Conditions and Observed Flooding Impacts

Flood Hazards	Receptors	Observed Impacts
• FEMA and County Floodplains • Jacobs simplified physics model (ADI Flood Modeller) 100-year 2065 preliminary flood zone for WSSC Water	• Critical Facilities • Areas of Social Vulnerability • Non-residential Buildings • Residential Buildings • Impervious Area • Environmentally Sensitive Areas	• DOT DAR program project/solution calls • DEP erosion calls • Flooding related 311 calls • 911 flood response calls • Frequently flooded roads (DOT and MCFRS) • Survey results

ADI = Alternating Direction Implicit [solver]

MCDOT DAR = Department of Transportation Drainage Assistance Request

FEMA = Federal Emergency Management Agency

MCFRS = Montgomery County Fire and Rescue

WSSC Water = Washington Suburban Sanitary Commission

3. Existing Conditions and Past Flood Impacts

3.1 Watershed Characteristics

County land use ranges from largely agriculture and forest in the northwest to largely urban in the south. Impervious cover has increased as urbanization extends northward, and density increases in suburban areas in the south. Maryland Department of Planning land use and land cover information is illustrated on **Figure 3-1**.

The County has developed an impervious area dataset that is used to administer the Water Quality Protection Charge program. The data were developed using aerial imagery and provide an accurate understanding of the extent of impervious area within each watershed. A summary of watershed area and impervious area totals is included on **Figure 3-2** and in **Table 3-1**. The County is currently home to approximately 1.05 million residents (2020 U.S. Census), with population density being highest in the south of the County. Populations totals, estimated using the 2010 national census, are also included in Table 3-1.

According to the United States Agency for Toxic Substances and Disease Registry (ATSDR), which is part of the Centers for Disease Control and Prevention (CDC), "social vulnerability refers to the potential negative effects on communities caused by external stresses on human health" (ATSDR 2021). In the context of this task, the external stress is flooding. Social Vulnerability Index (SVI) values were developed by the CDC/ATSDR by Census Block and is based on data from the 2010 U.S. Census (**Figure 3-3**). The CDC/ASTDR SVI aggregates an index from a combination of 15 social factors such as poverty, lack of access to transportation, overcrowded housing, and lack of medical facilities. This task considers social vulnerability, given that natural hazards and specifically flood can have adverse impacts that amplify for socially vulnerable populations. It is estimated that approximately 30 percent of the County population is included in SVI areas greater than 0.5. The data are visualized on Figure 3-3 and summarized at a watershed level on **Figure 3-4** and in **Table 3-2**.

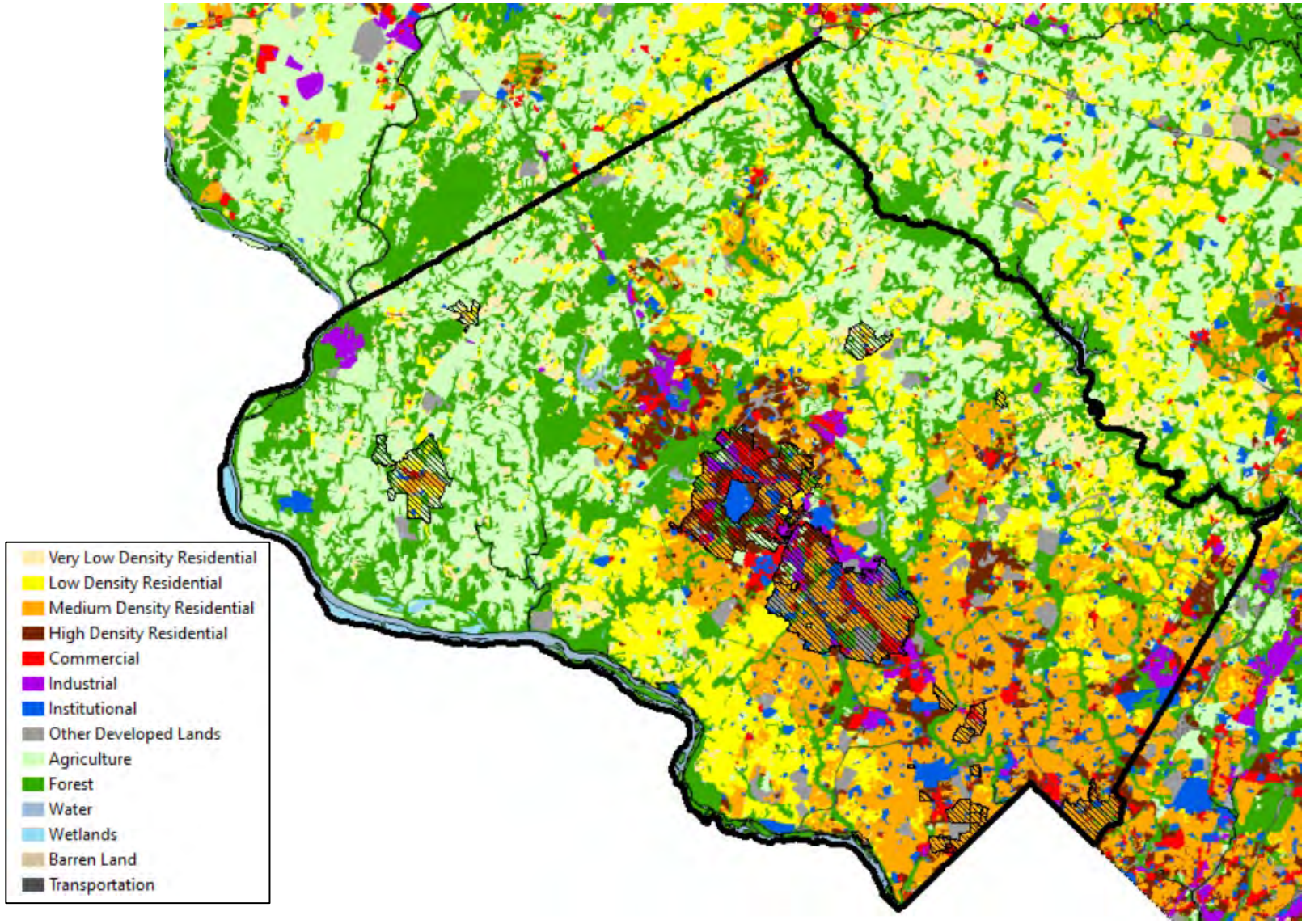


Figure 3-1 Land Use and Land Cover for Montgomery County (MDP, 2010)

Figure 3-2 Watershed Area and Impervious Area – in order of highest amount of Impervious Area (acres)

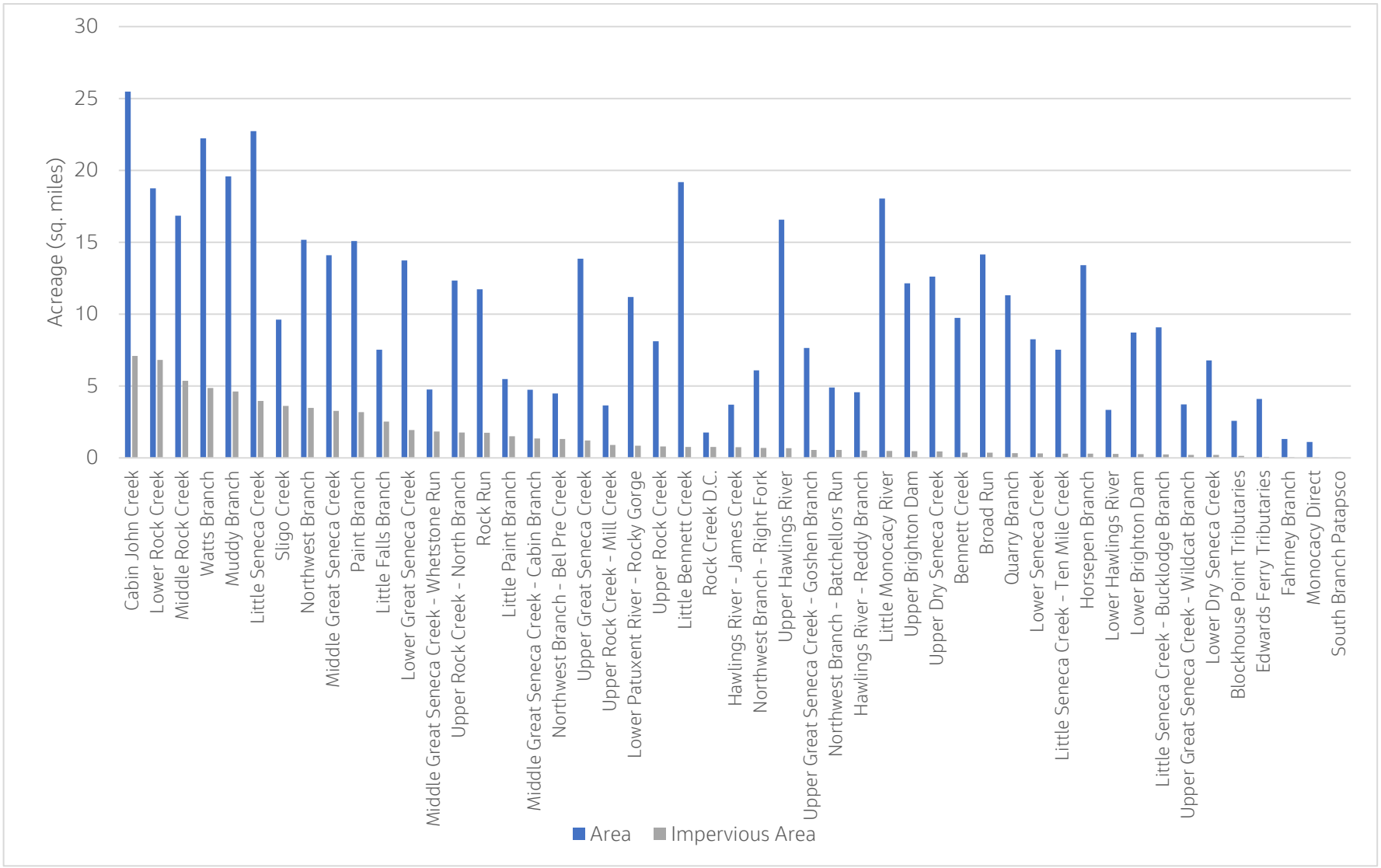


Table 3-1. Watershed Area (acres), Impervious Area (acres), and Estimated Population (2010)

Watershed	Area	Impervious Area	% Impervious	Estimated Population
Bennett Creek	6,235	237	3.80%	1,500
Blockhouse Point Tributaries	1,647	86	5.23%	2,802
Broad Run	9,057	234	2.59%	1,042
Cabin John Creek	16,303	4,535	27.82%	73,477
Edwards Ferry Tributaries	2,622	43	1.62%	1,042
Fahrney Branch	843	39	4.64%	300
Hawlings River - James Creek	2,369	482	20.33%	9,057
Hawlings River - Reddy Branch	2,920	318	10.91%	7,138
Horsepen Branch	8,585	184	2.14%	1,042
Little Bennett Creek	12,274	487	3.97%	3,000
Little Falls Branch	4,821	1,619	33.59%	43,454
Little Monocacy River	11,543	310	2.68%	1,100
Little Paint Branch	3,513	962	27.38%	30,562
Little Seneca Creek	14,550	2,533	17.41%	44,286
Little Seneca Creek - Bucklodge Branch	5,813	161	2.77%	1,100
Little Seneca Creek - Ten Mile Creek	4,814	187	3.89%	3,126
Lower Brighton Dam	5,575	162	2.90%	2,566
Lower Dry Seneca Creek	4,339	130	2.99%	1,042
Lower Great Seneca Creek	8,791	1,240	14.11%	19,539
Lower Hawlings River	2,140	174	8.14%	2,680
Lower Patuxent River - Rocky Gorge	7,160	546	7.63%	7,880
Lower Rock Creek	12,005	4,360	36.32%	113,565
Lower Seneca Creek	5,281	196	3.71%	4,000
Middle Great Seneca Creek	9,028	2,095	23.20%	58,791
Middle Great Seneca Creek - Cabin Branch	3,034	863	28.46%	17,088
Middle Great Seneca Creek - Whetstone Run	3,049	1,178	38.64%	44,518
Middle Rock Creek	10,780	3,428	31.80%	77,117
Monocacy Direct	714	26	3.68%	99
Muddy Branch	12,531	2,956	23.59%	57,984
Northwest Branch	9,706	2,223	22.91%	58,495
Northwest Branch - Batchellors Run	3,134	349	11.15%	3,023
Northwest Branch - Bel Pre Creek	2,866	846	29.52%	27,935
Northwest Branch - Right Fork	3,892	446	11.45%	7,253
Paint Branch	9,649	2,035	21.09%	37,577
Quarry Branch	7,240	207	2.86%	1,042

Watershed	Area	Impervious Area	% Impervious	Estimated Population
Rock Creek D.C.	1,125	482	42.87%	16,670
Rock Run	7,504	1,123	14.96%	10,932
Sligo Creek	6,156	2,318	37.65%	68,817
South Branch Patapsco	12	3	23.32%	24
Upper Brighton Dam	7,774	297	3.82%	3,984
Upper Dry Seneca Creek	8,067	288	3.57%	1,042
Upper Great Seneca Creek	8,864	774	8.73%	11,387
Upper Great Seneca Creek - Goshen Branch	4,897	356	7.27%	4,321
Upper Great Seneca Creek - Wildcat Branch	2,384	131	5.50%	6,312
Upper Hawlings River	10,605	433	4.08%	2,566
Upper Rock Creek	5,190	515	9.92%	5,042
Upper Rock Creek - Mill Creek	2,339	571	24.44%	12,800
Upper Rock Creek - North Branch	7,895	1,131	14.33%	16,622
Watts Branch	14,231	3,106	21.83%	45,036

Figure 3-3. CDC Social Vulnerability Index areas within Montgomery County

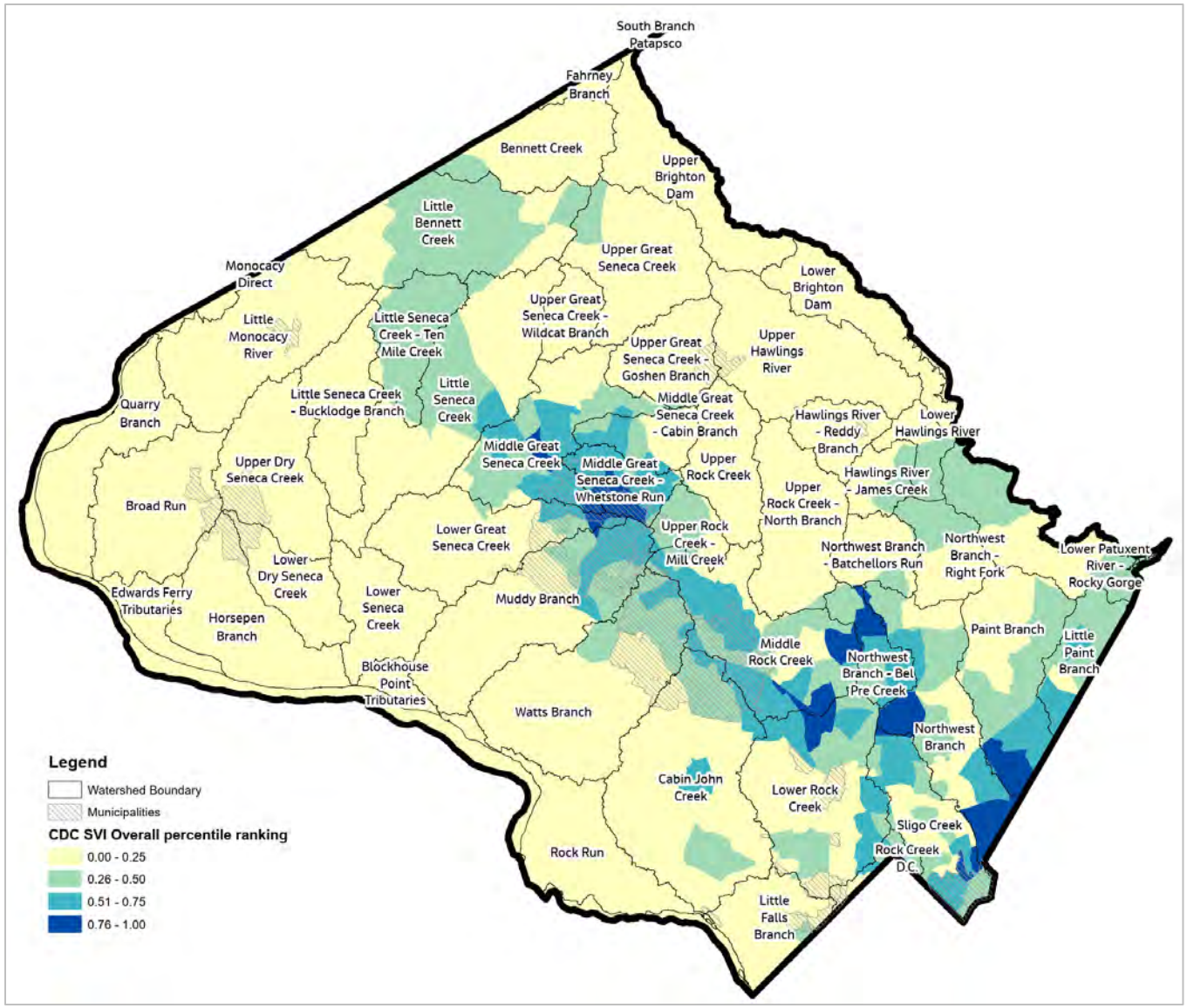


Figure 3-4 Estimated Watershed Population and Amount of Watershed (% of total) and Estimated Amount of Population (% of total) Designated as Socially Vulnerable Area (CDC SVI > 0.5)

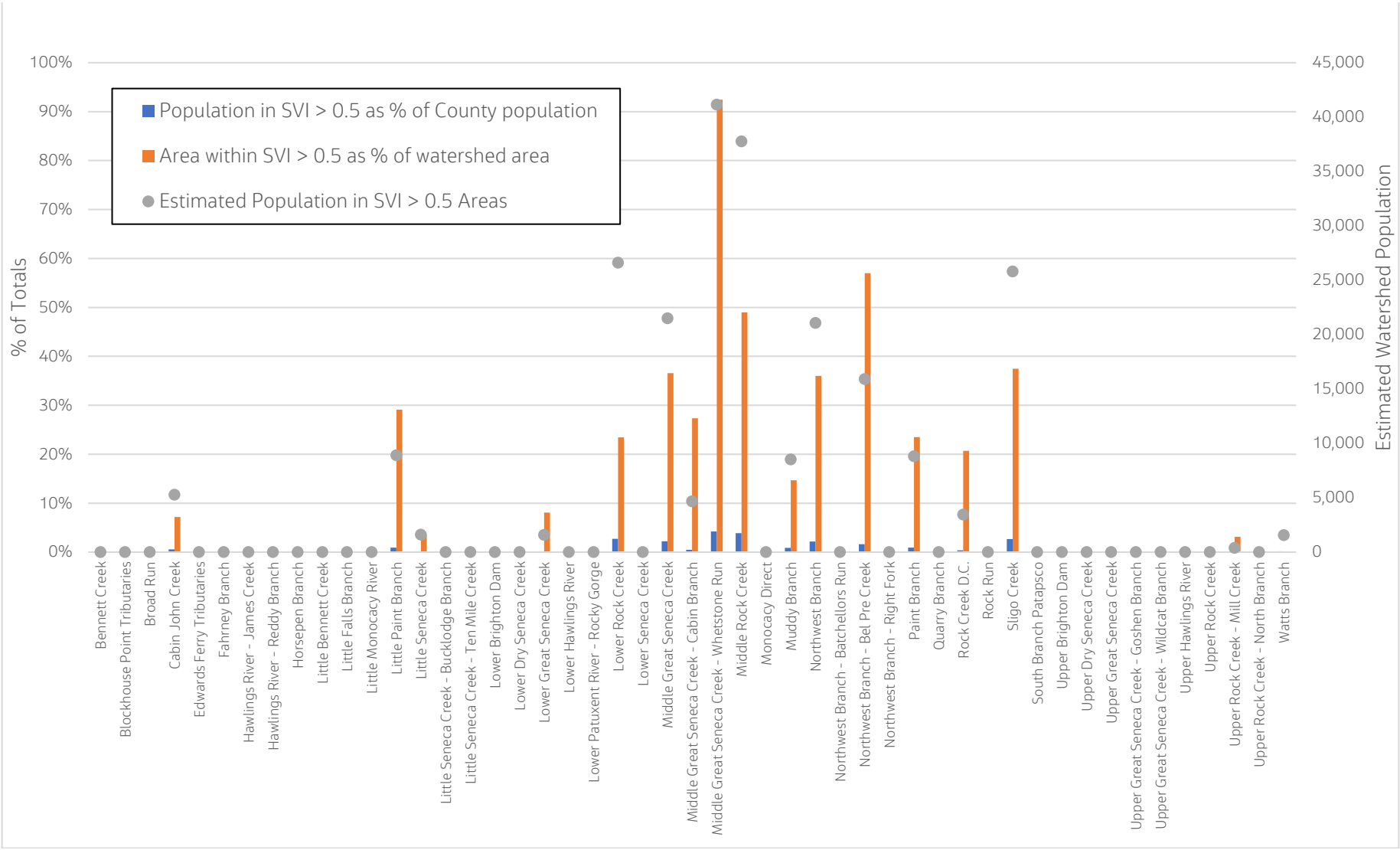


Table 3-2. Amount of Watershed and Estimated Population within SVI>0.5 Areas

Watershed	Watershed Area within Areas of SVI > 0.5 (acres)	Percent of Total Watershed Area	Estimated Population in SVI > 0.5 Areas	Percent of Total County Population
Bennett Creek	0	0%	0	0%
Blockhouse Point Tributaries	0	0%	0	0%
Broad Run	0	0%	0	0%
Cabin John Creek	1,170	7%	5,275	1%
Edwards Ferry Tributaries	0	0%	0	0%
Fahrney Branch	0	0%	0	0%
Hawlings River - James Creek	0	0%	0	0%
Hawlings River - Reddy Branch	0	0%	0	0%
Horsepen Branch	0	0%	0	0%
Little Bennett Creek	0	0%	0	0%
Little Falls Branch	0	0%	0	0%
Little Monocacy River	0	0%	0	0%
Little Paint Branch	1,023	29%	8,901	1%
Little Seneca Creek	531	4%	1,616	0%
Little Seneca Creek - Bucklodge Branch	0	0%	0	0%
Little Seneca Creek - Ten Mile Creek	0	0%	0	0%
Lower Brighton Dam	0	0%	0	0%
Lower Dry Seneca Creek	0	0%	0	0%
Lower Great Seneca Creek	708	8%	1,573	0%
Lower Hawlings River	0	0%	0	0%
Lower Patuxent River - Rocky Gorge	0	0%	0	0%
Lower Rock Creek	2,813	23%	26,610	3%
Lower Seneca Creek	0	0%	0	0%
Middle Great Seneca Creek	3,302	37%	21,503	2%
Middle Great Seneca Creek - Cabin Branch	830	27%	4,675	0%
Middle Great Seneca Creek - Whetstone Run	2,818	92%	41,154	4%
Middle Rock Creek	5,278	49%	37,756	4%
Monocacy Direct	0	0%	0	0%
Muddy Branch	1,843	15%	8,526	1%
Northwest Branch	3,498	36%	21,078	2%
Northwest Branch - Batchellors Run	4	0%	4	0%
Northwest Branch - Bel Pre Creek	1,633	57%	15,919	2%
Northwest Branch - Right Fork	0	0%	0	0%
Paint Branch	2,265	23%	8,821	1%
Quarry Branch	0	0%	0	0%
Rock Creek D.C.	233	21%	3,452	0%

Watershed	Watershed Area within Areas of SVI > 0.5 (acres)	Percent of Total Watershed Area	Estimated Population in SVI > 0.5 Areas	Percent of Total County Population
Rock Run	0	0%	0	0%
Sligo Creek	2,307	37%	25,792	3%
South Branch Patapsco	0	0%	0	0%
Upper Brighton Dam	0	0%	0	0%
Upper Dry Seneca Creek	0	0%	0	0%
Upper Great Seneca Creek	0	0%	0	0%
Upper Great Seneca Creek - Goshen Branch	0	0%	0	0%
Upper Great Seneca Creek - Wildcat Branch	0	0%	0	0%
Upper Hawlings River	0	0%	0	0%
Upper Rock Creek	0	0%	0	0%
Upper Rock Creek - Mill Creek	73	3%	397	0%
Upper Rock Creek - North Branch	0	0%	0	0%
Watts Branch	493	3%	1,560	0%

3.2 Flood Hazard Summary by Watershed

Several data sets were collected and reviewed to understand current flood hazard (**Table 3-3**). The first FEMA National Flood Insurance Program flood hazard boundary map for Montgomery County was published in July 1975. Periodic updates to the County's flood hazard mapping and Flood Insurance Study have occurred since that time. The most recent effective mapping is from September 29, 2006; however, an ongoing update by FEMA, coordinated with Montgomery County Department of Permitting Services (DPS), is nearly complete, with preliminary mapping anticipated in Spring 2023. A copy of draft National Flood Hazard Layer (NFHL) updates (including both 100- and 500-year flood extents) was obtained via DPS for use in this study.

Table 3-3. Flood Hazard Information

#	Data Layer	Owner	Description
1	National Flood Hazard Layer (NFHL)	FEMA	Draft riverine study 100-year and 500-year floodplain
2	County detailed river studies	DPS	Riverine study 100-year floodplain
3	M-NCPPC detailed river studies	M-NCPPC/DPS	Riverine study 100-year floodplain
4	WSSC Water 100-year 2065 preliminary flood zone	WSSC Water/Jacobs	Preliminary riverine/pluvial 100-year 2065 (future conditions) flood zone

Other available detailed riverine study mapping was obtained from DPS – including consultant detailed studies completed for the County for Floodplain District Permits and historic studies completed by M-NCPPC Planning. Each of these flood extent layers is for the 100-year event. While the County defines the Floodplain District as including any stream with a drainage area of 30 acres or more, only about 30 percent of these streams (mileage basis) are presently mapped.

Finally, a preliminary riverine/pluvial 100-year 2065 flood zone was obtained from previous Jacobs work with WSSC Water. A simplified physics model (Jacobs Flood Modeller) was used to route projected 100-year 2065 rainfall totals through the WSSC Water services areas (generally urban and suburban

regions of Montgomery and Prince George's Counties). The model extent includes southern and mid-County watershed but does not cover more rural watersheds that do not have water and sewer service. The model was constructed using National Hydrography Dataset stream lines and County light detection and ranging (LiDAR) but does not include hydraulic structures (such as bridges and culverts). Therefore, it represents a screening-level future conditions assessment of both riverine and pluvial flood hazards. Further information on the development of this preliminary flood zone is included in **Attachment 2**.

The model extent can be observed in **Figure 3-5**. A summary of flood extent areas by watershed is illustrated in **Figure 3-6**. As shown in both figures, the preliminary Flood Modeller flood extent does not include Bennet Creek, Broad Run, Edwards Ferry Tributaries, Fahrney Branch, Horsepen Branch, Little Bennet Creek, Little Monocacy River, Little Seneca Creek - Bucklodge Branch, Lower Brighton Dam, Lower Dry Seneca Creek, Lower Hawlings River, Lower Patuxent River - Rocky Gorge, Lower Seneca Creek, Monocacy Direct, Quarry Branch, South Branch Patapsco, Upper Brighton Dam, Upper Dry Seneca Creek, Upper Hawlings River, and Little Seneca Creek - Ten Mile Creek.

Figure 3-5. Extent of Draft FEMA 100- and 500-year Floodplains, County and M-NCPPC 100-year Floodplains, and Flood Modeller Combined Riverine/Pluvial 100-year 2065 Flood Zone Extent

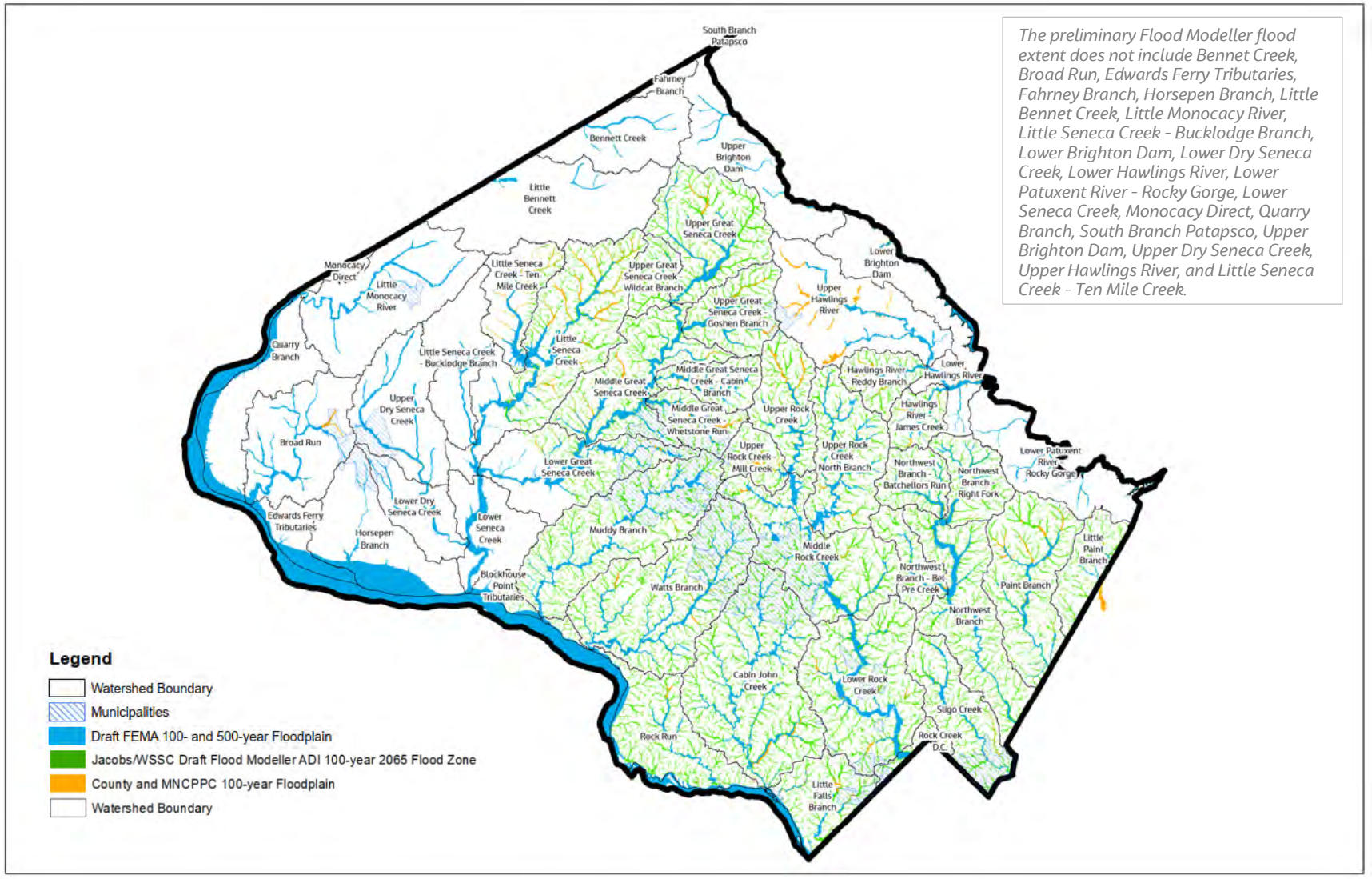
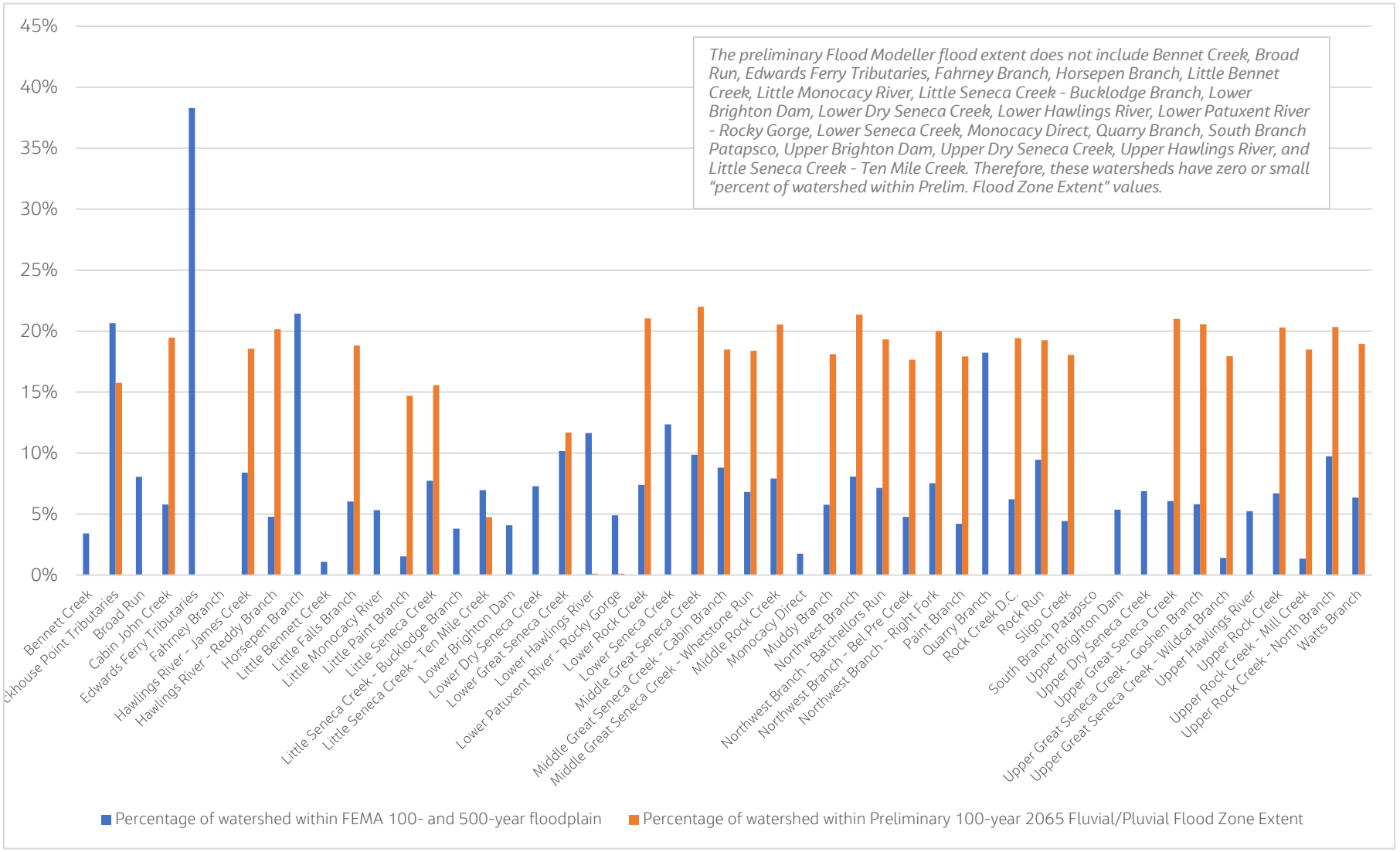


Figure 3-6. Percent of Watershed within: (1) Flood Modeller Combined Riverine/Pluvial 100-year 2065 Flood Zone Extent and (2) FEMA 100- and 500-year Floodplain Extent



3.3 Summary of Past Flood Impacts

3.3.1 Observed Flood Impacts Data

Data on historic impacts of flooding are limited. Therefore, available County service calls and frequently flooded area logs, obtained via various agencies was compiled to help illustrate where County services have been directed for different flooding responses (**Table 3-4**). The following sections provide some detail on the data layers, including a discussion of limitations.

It is understood that each of these sources of information has limitations, particularly with respect to illustrating impacts in areas with socially vulnerable populations. Socially vulnerable populations, such as those having low-income or populations with language barriers, may find it challenging to access County services or may not know of various services and programs. At the time of this analysis, an online survey has been launched and advertised in seven languages with the intent of providing a more complete picture of flood impacts to County residents and businesses.

Table 3-4. Data Used to Characterize Historic Flood Impacts

#	Data layer	Owner	Description
1	311 calls related to flooding	MC311	311 calls associated with flooding were provided for the period of January 19, 2010 to June 6, 2022. A total of 8,812 calls were included.
2	911 calls related to flooding	MCPD 911 Dispatch Center	911 calls associated with flooding responses. Calls were provided for the period of December 4, 2020 through June 2, 2022. A total of 22 calls were included.
3	Frequently flooded roads	MCDOT via County flooding website	MCMCDOT listing of frequently flooded roads published on the County flooding website (https://www.montgomerycountymd.gov/flooding/roads/)
4	DAR program calls	MCDOT	MCDOT DAR program call log. Calls were provided for the period of May 1, 1973 through August 18, 2022. A total of 3,435 calls were included.
5	Frequently flooded roads	MCFRS	MCFRS listing of frequently flooded roads (provided June 20, 2022).
6	Drainage calls	MCDEP	Data set including drainage, erosion, and flooding complaints and inquiries reviewed by MCDEP. The data include an indication of severity as well as type of impact. Calls were provided for the period of April 3, 2007 to July 7, 2022. A total of 543 calls were listed, including some without associated dates.
7	Community survey results	MCDEP	This data includes flooding locations from October 2022 community survey. The survey remains open as of the writing of this memo. Results summarized here were from a survey export completed February 1, 2023. A total of 616 survey responses and 550 flooding locations were included.

MC311 = Montgomery County 311, MCPD = Montgomery County Police Department

3.3.1.1 MC311 Calls

MC311 receives and maintains records of calls and online messages received by the County 311 system. A spreadsheet file of 311 calls for the period of January 19, 2020 through June 6, 2022, was provided for all calls related to flooding or drainage. It is understood the categorization of MC311 calls is subject to some inaccuracy. Calls are received by MC311 operators who refer to Knowledge Base Articles (KBAs) produced by individual County departments to categorize and assign service tickets. The category identified by the MC311 operator may be inaccurate due to the limited time that operators have to diagnose an issue, as the characterization of the issue by the caller, and the overlapping and, at times,

conflicting nature of the KBAs. Therefore, the 311 call category or "solution" type (for example, "clogged storm drain" or "road flooding" or "private land flooding") was not used as a means of analyzing the calls. Rather, the data were used to understand general location and density of calls as a measure of resident-County interaction on a broad range of flood issues. As noted in the introductory section of this TM, it is reiterated that these data may not equally reflect the issues experienced by persons that face challenges accessing County services, such as socially vulnerable populations. Furthermore, the total number of calls may not reflect older calls, for which residents have given up on receiving help and so have not continued calling, or which have not recurred in this time-frame.

3.3.1.2 Department of Transportation Drainage Assistance Request Data

The MCDOT Drainage Assistance Request (DAR) program, administered through the MCDOT's Division of Transportation Engineering (DTE), receives and addresses requests for assistance to correct drainage problems because of public right-of-way runoff, DTE maintains a log of request from as far back as 1973. Entries include information such as addresses and notes related to the complaint. More recent records include the date the request was received and an indication of whether the request was dropped, moved to a project, or assigned for maintenance action, or referred to another agency in the County. Since there are a number of DAR requests that do not move forward, the data were filtered to include only those requests that resulted in a MCDOT action (MCDOT capital project, DAR project, or Highway Services Division maintenance action) or referral (if another County department was noted as receiving the request).

3.3.1.3 Montgomery County Department of Environmental Protection Drainage Call Data

The MCDEP Drainage Call database logs a variety of complaints and inquiries that the MCDEP Planning Group received between 2007 and 2022. The calls include an indication of severity as well as information on the type of issue (such as flooding and erosion). It is possible that drainage calls to MCDEP and the DAR program requests are overlapping with MC311 data. The MCDEP calls and DAR program data are viewed as potentially more reliable than MC311 data because they represent a specific agency follow-up or a targeted request for assistance from a resident or business (that is, direct call to the department providing service).

3.3.1.4 Community Survey Flooding Locations

A community survey was launched as part of the CFMP P1. The survey included a number of questions related to resident knowledge of flooding, type and magnitude of impact, and requested they provide locations of observed flooding. A total of 616 responses and 550 flooding locations were obtained from the period of September 20, 2022 through February 1, 2023.

3.3.2 Observed Flood Impacts By Watershed

The observed flood impacts data previously noted was georeferenced and totaled for each watershed. A watershed summary of the various calls (MCDOT DAR calls resulting in project and referrals, MCDEP drainage calls, 911 flooding-related calls, and MC311 drainage and flooding calls) is provided in **Table 3-5**. A summary of frequently flooded road locations by watershed is included in **Table 3-6**.

When totals calls are compared across the County, the highest percentage of calls was observed in Cabin John Creek (14 percent), Lower Rock Creek (13 percent), Northwest Branch (8 percent) and Sligo Creek (7 percent) watersheds. While useful to observe the location of calls, as previously noted, it is anticipated that calls may not equally represent impacts for socially vulnerable populations. If calls within SVI greater than 0.5 areas are compared to the total number of calls within a watershed, the watersheds with the highest percentage of calls from these areas are Middle Great Seneca Creek – Whetstone Run (81 percent), Northwest Branch – Bel Pre Creek (69 percent), Middle Great Seneca Creek – Cabin Branch (50 percent), Little Paint Branch (44 percent), Middle Rock Creek (38 percent), Sligo Creek and Middle Great Seneca Creek (both 34 percent), and Northwest Branch (25 percent). A summary of this information for all

watersheds is shown in **Table 3-7**. The geographic locations of calls and road flood hazards is shown on **Figure 3-7**.

Recognizing the limitations of County 311 calls discussed previously, the locations of flooding calls were used to provide a rough assessment of whether the calls fell within close proximity to a river or stream (within 100 feet of a streamline, potentially riverine in nature) or not (greater than 100 feet from a streamline, potentially pluvial in nature). The total calls associated with either potentially riverine or potentially pluvial flooding are presented on **Figure 3-8**.

Table 3-5. MCDOT DAR Program, MCDEP Calls, 911 Flood Calls, and MC311 Drainage Calls By Watershed

Watershed	MC311 Flooding Related Calls	MCPD 911 Flood Calls	MCDEP Drainage and Flood Calls	MCDOT DAR Projects and Referrals[a]	Community Survey Flooding Locations	Total Calls
Bennett Creek	26	0	2	1	0	29
Blockhouse Point Tributaries	1	0	0	0	0	1
Broad Run	9	0	0	0	0	9
Cabin John Creek	1,194	7	93	171	39	1,504
Edwards Ferry Tributaries	0	0	0	0	0	0
Fahrney Branch	1	0	0	0	0	1
Hawlings River - James Creek	53	0	2	3	1	59
Hawlings River - Reddy Branch	121	0	5	8	3	137
Horsepen Branch	1	0	0	0	0	1
Little Bennett Creek	60	0	2	2	2	66
Little Falls Branch	453	1	30	40	50	574
Little Monocacy River	14	0	1	0	0	15
Little Paint Branch	155	0	4	5	0	164
Little Seneca Creek	264	0	4	4	6	278
Little Seneca Creek - Bucklodge Branch	24	0	0	0	0	24
Little Seneca Creek - Ten Mile Creek	6	2	0	0	1	9
Lower Brighton Dam	15	0	0	1	0	16
Lower Dry Seneca Creek	2	0	0	0	4	6
Lower Great Seneca Creek	76	0	3	2	8	89
Lower Hawlings River	8	0	0	1	0	9
Lower Patuxent River - Rocky Gorge	83	1	3	7	0	94
Lower Rock Creek	1,023	3	82	115	120	1,343
Lower Seneca Creek	39	0	0	3	2	44
Middle Great Seneca Creek	252	1	2	6	9	270

Watershed	MC311 Flooding Related Calls	MCPD 911 Flood Calls	MCDEP Drainage and Flood Calls	MCDOT DAR Projects and Referrals[a]	Community Survey Flooding Locations	Total Calls
Middle Great Seneca Creek - Cabin Branch	114	0	6	2	3	125
Middle Great Seneca Creek - Whetstone Run	134	0	2	9	10	155
Middle Rock Creek	366	2	29	19	25	441
Monocacy Direct	0	0	0	0	0	0
Muddy Branch	315	0	16	16	10	357
Northwest Branch	700	2	59	58	30	849
Northwest Branch - Batchellors Run	61	0	7	7	1	76
Northwest Branch - Bel Pre Creek	232	0	13	3	3	251
Northwest Branch - Right Fork	52	0	4	4	0	60
Paint Branch	543	0	32	28	5	608
Quarry Branch	0	0	1	0	1	2
Rock Creek D.C.	132	0	5	7	20	164
Rock Run	381	0	36	59	10	486
Sligo Creek	521	1	17	57	146	742
South Branch Patapsco	0	0	0	0	0	0
Upper Brighton Dam	21	0	1	0	1	23
Upper Dry Seneca Creek	9	0	0	0	3	12
Upper Great Seneca Creek	104	0	1	4	5	114
Upper Great Seneca Creek - Goshen Branch	68	0	5	3	0	76
Upper Great Seneca Creek - Wildcat Branch	25	0	0	1	1	27
Upper Hawlings River	51	1	2	3	2	59
Upper Rock Creek	46	0	4	5	2	57
Upper Rock Creek - Mill Creek	182	0	12	10	4	208
Upper Rock Creek - North Branch	331	0	24	25	2	382
Watts Branch	373	0	31	29	18	451
Total	8,641	21	540	718	547	10,467

a MCDOT DAR program requests have been filtered to only include those resulting in projects (DAR project, Capital improvement project, or maintenance action) or referrals to other agencies/entities.

Table 3-6. Observed Road Flood Hazard Locations By Watershed

Watershed	MCDOT List of Frequently Flooded Roads	MCFRS List of Road Flood Hazards	Total Road Hazards
Bennett Creek	0	0	0
Blockhouse Point Tributaries	0	1	1
Broad Run	1	3	4
Cabin John Creek	8	3	11
Edwards Ferry Tributaries	0	0	0
Fahrney Branch	0	0	0
Hawlings River - James Creek	0	0	0
Hawlings River - Reddy Branch	1	3	4
Horsepen Branch	1	0	1
Little Bennett Creek	1	2	3
Little Falls Branch	2	2	4
Little Monocacy River	0	0	0
Little Paint Branch	0	0	0
Little Seneca Creek	0	6	6
Little Seneca Creek - Bucklodge Branch	0	2	2
Little Seneca Creek - Ten Mile Creek	1	2	3
Lower Brighton Dam	1	0	1
Lower Dry Seneca Creek	0	0	0
Lower Great Seneca Creek	1	2	3
Lower Hawlings River	0	2	2
Lower Patuxent River - Rocky Gorge	0	1	1
Lower Rock Creek	10	5	15
Lower Seneca Creek	2	2	4
Middle Great Seneca Creek	3	7	10
Middle Great Seneca Creek - Cabin Branch	0	1	1
Middle Great Seneca Creek - Whetstone Run	0	1	1
Middle Rock Creek	3	3	6
Monocacy Direct	0	0	0
Muddy Branch	3	0	3
Northwest Branch	0	1	1
Northwest Branch - Batchellors Run	0	3	3
Northwest Branch - Bel Pre Creek	0	0	0
Northwest Branch - Right Fork	0	0	0

Watershed	MCDOT List of Frequently Flooded Roads	MCFRS List of Road Flood Hazards	Total Road Hazards
Paint Branch	0	0	0
Quarry Branch	0	2	2
Rock Creek D.C.	0	0	0
Rock Run	2	0	2
Sligo Creek	0	16	16
South Branch Patapsco	0	0	0
Upper Brighton Dam	1	2	3
Upper Dry Seneca Creek	0	0	0
Upper Great Seneca Creek	1	0	1
Upper Great Seneca Creek - Goshen Branch	0	2	2
Upper Great Seneca Creek - Wildcat Branch	1	0	1
Upper Hawlings River	2	4	6
Upper Rock Creek	0	4	4
Upper Rock Creek - Mill Creek	0	1	1
Upper Rock Creek - North Branch	1	1	2
Watts Branch	0	1	1
Total	46	85	131

Table 3-7. Percent of Flooding and Drainage Calls Within Areas of SVI > 0.5

Watershed	Watershed Area (Acres)	Percent Impervious	Percent Calls within Areas of SVI>0.5
Bennett Creek	6,235	4%	0%
Blockhouse Point Tributaries	1,647	5%	0%
Broad Run	9,057	3%	0%
Cabin John Creek	16,303	28%	3%
Edwards Ferry Tributaries	2,622	2%	NA
Fahrney Branch	843	5%	0%
Hawlings River - James Creek	2,369	20%	0%
Hawlings River - Reddy Branch	2,920	11%	0%
Horsepen Branch	8,585	2%	0%
Little Bennett Creek	12,274	4%	0%
Little Falls Branch	4,821	34%	0%
Little Monocacy River	11,543	3%	0%
Little Paint Branch	3,513	27%	44%
Little Seneca Creek	14,550	17%	8%
Little Seneca Creek - Bucklodge Branch	5,813	3%	0%
Little Seneca Creek - Ten Mile Creek	4,814	4%	0%
Lower Brighton Dam	5,575	3%	0%
Lower Dry Seneca Creek	4,339	3%	0%
Lower Great Seneca Creek	8,791	14%	8%
Lower Hawlings River	2,140	8%	0%
Lower Patuxent River - Rocky Gorge	7,160	8%	0%
Lower Rock Creek	12,005	36%	21%
Lower Seneca Creek	5,281	4%	0%
Middle Great Seneca Creek	9,028	23%	34%
Middle Great Seneca Creek - Cabin Branch	3,034	28%	50%
Middle Great Seneca Creek - Whetstone Run	3,049	39%	81%
Middle Rock Creek	10,780	32%	38%
Monocacy Direct	714	4%	NA
Muddy Branch	12,531	24%	10%
Northwest Branch	9,706	23%	25%
Northwest Branch - Batchellors Run	3,134	11%	0%
Northwest Branch - Bel Pre Creek	2,866	30%	69%
Northwest Branch - Right Fork	3,892	11%	0%
Paint Branch	9,649	21%	9%

Watershed	Watershed Area (Acres)	Percent Impervious	Percent Calls within Areas of SVI>0.5
Quarry Branch	7,240	3%	0%
Rock Creek D.C.	1,125	43%	15%
Rock Run	7,504	15%	0%
Sligo Creek	6,156	38%	34%
South Branch Patapsco	12	23%	NA
Upper Brighton Dam	7,774	4%	0%
Upper Dry Seneca Creek	8,067	4%	0%
Upper Great Seneca Creek	8,864	9%	0%
Upper Great Seneca Creek - Goshen Branch	4,897	7%	0%
Upper Great Seneca Creek - Wildcat Branch	2,384	5%	0%
Upper Hawlings River	10,605	4%	0%
Upper Rock Creek	5,190	10%	0%
Upper Rock Creek - Mill Creek	2,339	24%	4%
Upper Rock Creek - North Branch	7,895	14%	0%
Watts Branch	14,231	22%	0%

Figure 3-7. Flooding Related Calls and Road Hazard Locations

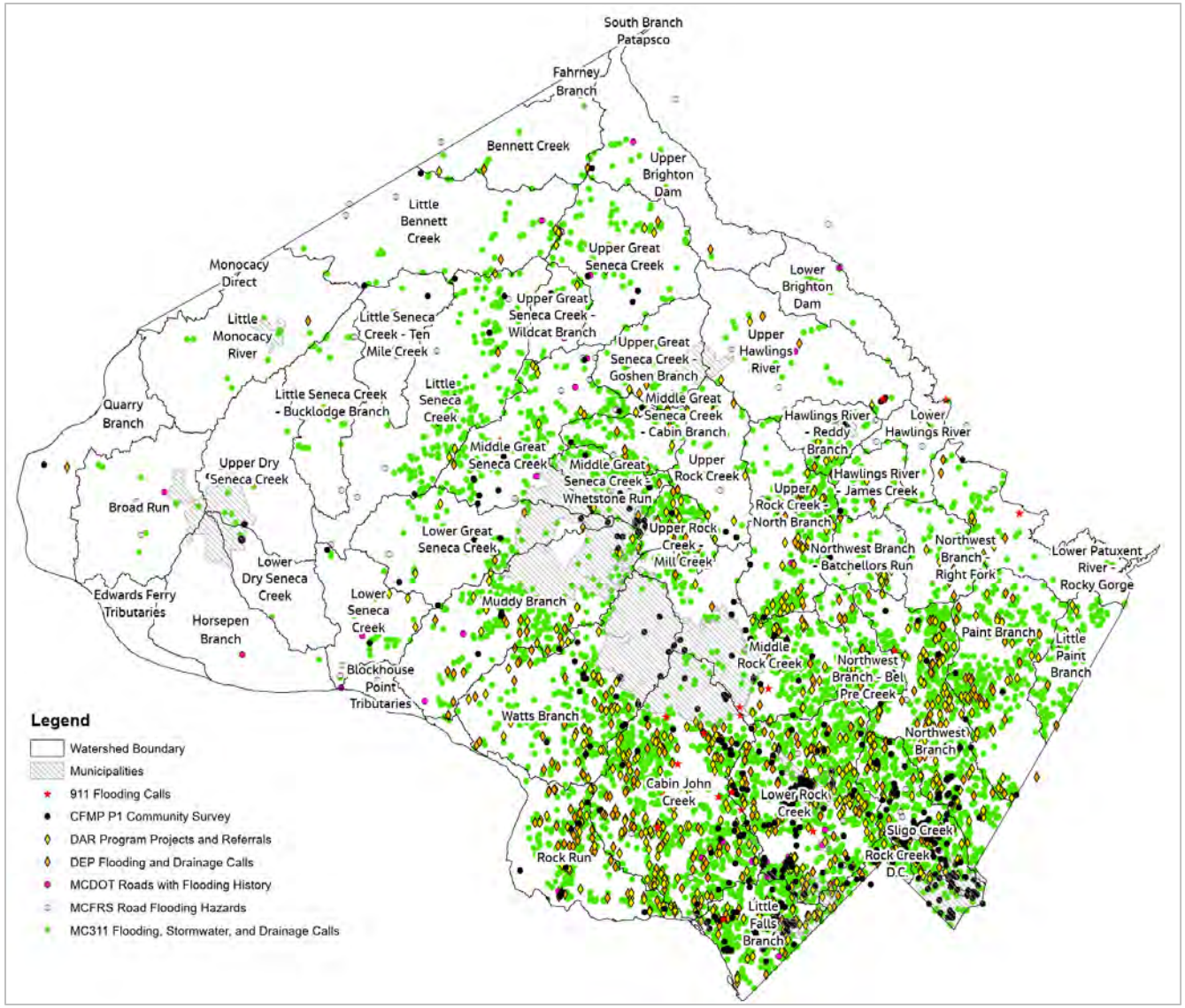
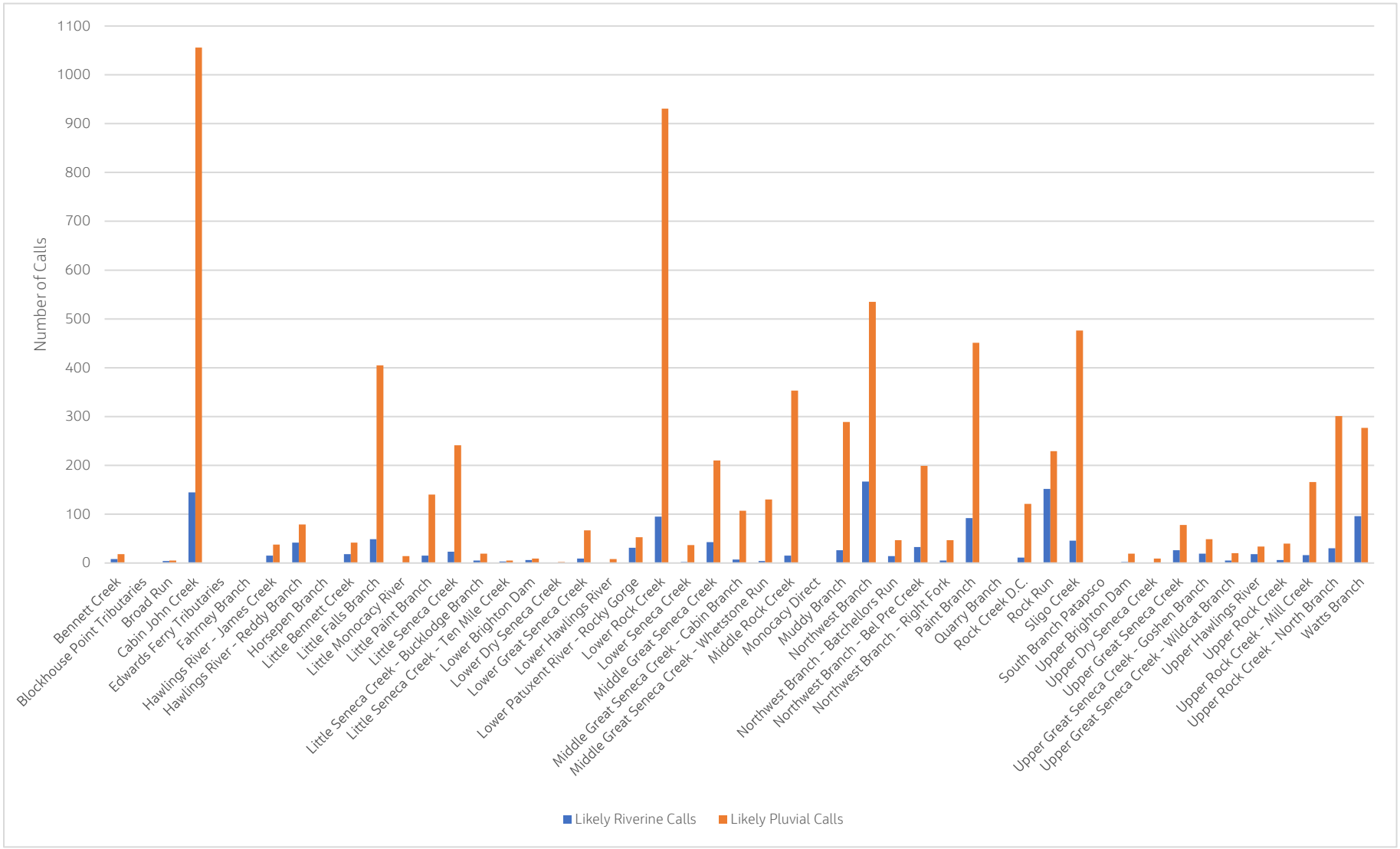


Figure 3-8. Potential Flood Mechanism Estimate by Proximity to Stream Channels (within 100-feet of a Stream = Potentially Riverine, Greater Than 100-feet from a Stream = Potentially Pluvial)



3.4 Discussion

As previously noted, it is known that there are limitations with existing data both in quality (providing an accurate picture of location and type of impact) and in completeness (in terms of including impacts from all residents). However, this data can be reviewed to better understand past impacts.

Areas of higher social vulnerability (CDC SVI greater than 0.5) are found in mid- and down-county watersheds Those watersheds with more than 10 percent SVI > 0.5 area include: Little Paint Branch, Lower Rock Creek, Middle Great Seneca Creek, Middle Great Seneca Creek – Cabin Branch, Middle Great Seneca Creek – Whetstone Run, Middle Rock Creek, Muddy Branch, Northwest Branch, Northwest Branch – Bel Pre Creek, Paint Branch, Rock Creek, and Sligo Creek. The percentage of calls believed to originate from higher SVI areas varies but some are significant (for example, 81 percent of total calls (311, 911, DEP, DOT DAR) in Middle Great Seneca Creek – Whetstone Run Watershed are from SVI areas greater than 0.5, 69 percent for Northwest Branch – Bel Pre, 50 percent for Middle Great Seneca Creek – Cabin Branch, 44 percent for Little Paint Branch, 38 percent from Middle Rock Creek, 34 percent from Sligo Creek, and 34 percent from Middle Great Seneca Creek).

While 311 and other service calls represent the bulk of the information, 911 calls may be considered a measure of severity of flooding, particularly flash flooding-type events. The watersheds with the highest 911 calls are Cabin John Creek (7 calls), Lower Rock Creek (3 calls), and Little Seneca Creek – Ten Mile Creek, Middle Rock Creek, and Northwest Branch (2 calls). Of a total of 22 911 calls, 6 calls were related to water rescues, the remainder were due to vehicles stuck in floodwaters. Water rescue events were noted in Middle Rock Creek, Little Falls Branch, Sligo Creek, Northwest Branch, and both Lower Brighton Dam and Lower Patuxent River – Rocky Gorge.

Understanding that more detailed watershed studies will provide the necessary inputs for more focused and comprehensive flood management, a multicriteria approach was used to develop an initial prioritization of watersheds for detailed study.

4. Flood Exposure Ranking of Watersheds

An initial ranking of watersheds based on flood exposure was developed to aid in planning for completion of detailed hydrologic and one-dimensional (1-D) and 2-dimensional (2-D) hydraulic watershed studies and risk assessments. The results of this assessment are intended to provide an understanding of potential flood exposure using available information. Detailed vulnerability assessments are anticipated to be performed as part of Phase 2 watershed risk assessment. This information will be provided to the CFMP P1 Core Team for review. The results are expected to be further informed by Core Team agency observations.

4.1 Overview of Methods

The methodology described below was used to develop an initial prioritized list of watersheds for further analysis based on flood exposure. Flood exposure, rather than observed flooding, forms the basis for an initial ranking because a prioritization based on observed flooding information may skew the results towards those watersheds where residents are more knowledgeable about and familiar with methods for reporting to, and requesting services from, the County.

The flood-exposure based approach includes the following steps:

- Identify attributes and criteria that describe flood exposure of the watersheds.
- Measure these attributes using two sources of flood hazard areas information (FEMA 100- and 500-year floodplains (riverine exposure) and Flood Modeller 100-year 2065 flood zone (combined riverine/pluvial exposure).

- Normalize scores for individual attributes using a 5-point scale and apply overall exposure scoring and weighting using a multi-attribute rating technique (MART, also referred to Multi-Objective Decision Analysis [MODA]) to each flood hazard scenario.
- Conduct a sensitivity analysis for each flood hazard scenario to understand impact of various weighting scenarios.
- Combine the sensitivity analysis results for both flood hazard sources (FEMA and Flood Modeller) to produce a list of prioritized watersheds.

The following subsections provide more detail on each step of this process.

4.2 Flood Exposure Measures

The watershed flood exposure analysis was used to develop an initial watershed ranking in order to prioritize the next phase of work based on measures of flood exposure of non-residential buildings, residential buildings, socially vulnerable areas, total impervious areas, number of critical facilities and infrastructure, environmentally sensitive areas. A summary of scoring measures is included in **Table 4-1.** Additional discussion of each of these criteria is included in the following subsections.

As described in Section 3, the extent of FEMA-studied riverine floodplain information is good throughout the County. The Jacobs and WSSC Water Flood Modeller analysis provides combined riverine and pluvial flood zone mapping in most, but not all, areas. To make use of both sources of information, the following two flood exposure scenarios were calculated:

1. Flood exposure based on draft FEMA (September 2022) 100-year and 500-year floodplain extent
2. Flood exposure based on draft Jacobs and WSSC Flood Modeller 100-year 2065 flood extents

Measures for each of these criteria were calculated for both the FEMA (100-year and 500-year floodplain extent via draft FEMA NFHL) and available Flood Modeller 100-year 2065 flood zone area. Measured values for each criterion for both flood hazard scenarios are included in **Attachment 3**.

Table 4-1. Summary of multi-criterial rating method input measures

Criterion	Measure of Criterion within Mapped Flood Hazard Areas[a]
Non-Residential Buildings	Number of non-residential buildings (categorized as non-residential from property land use designations)
Residential Buildings	Number of residential buildings (categorized as residential from property land use designations)
Socially Vulnerable Areas	Socially vulnerable areas (CDC SVI greater than 0.5)
Total Impervious Area	Total impervious area (i.e. total flooded impervious area for each modeling output)
Critical Facilities and Infrastructure	Number of critical facilities and infrastructure
Environmentally Sensitive Areas	USFWS National Wetlands Inventory area

[a] The noted measurements were made for both the FEMA 100- and 500-year floodplain extent (riverine exposure) and the available Flood Modeller 100-year 2065 flood zone extent (combined riverine/pluvial exposure).

4.2.1.1 Non-Residential Buildings

Non-residential buildings were identified from the County building footprint geospatial layer using the associated property land use categorization. Non-residential building impacts were identified to provide a measure of economic exposure. Buildings on properties indicated as commercial, mixed-use commercial and residential, and industrial were overlaid with flood hazard areas to quantify potential exposure.

4.2.1.2 Residential Buildings

Residential buildings were identified from the County building footprint geospatial layer using the associated property land use categorization. Buildings on properties indicated as residential (apartments, residential, residential/commercial, residential condominiums, or town house) were overlaid with flood hazard areas to quantify potential exposure.

4.2.1.3 Socially Vulnerable Areas

The CDC SVI was the basis for defining flood exposure of socially vulnerable areas (see Figure 3-3). The SVI are generated by census tract. This initial watershed prioritization focused on all areas with combined SVI values greater than 0.5 as a measure of Medium to High Social Vulnerability. The measurement of the criterion was computed as the amount of SVI greater than 0.5 area within the scenario flood extent (either FEMA 100- and 500-year floodplain or Jacobs and WSSC 100-year 2065 flood zone extent). There are some watersheds that did not have any SVI greater than 0.5 areas within the flood zone.

4.2.1.4 Total Impervious Area

Total impervious area was measured as the total flooded impervious area within the watershed (**Figure 4-1**). Depending on the flood hazard scenario, this was either calculated as the total impervious area within the draft FEMA 100- and 500-year floodplains or the total impervious area within the Flood Modeller 100-year 2065 preliminary flood zone. This criteria was included to provide an assessment of flood exposure of access areas (roads, parking) rather than purely structural exposure.

4.2.1.5 Critical Facilities and Infrastructure

Exposure of critical facilities to flood hazards was another key factor in this analysis. The primary source of information for the spatial location of critical facilities was the property point geographic information system (GIS) data obtained from MCDEP. The County Office of Emergency Management and Homeland Security (OEMHS) is currently developing a geospatial layer of critical facilities and infrastructure; however, the dataset was not available at the time of this analysis. Types of facilities indicated by OEMHS to be included in their dataset were filtered from the County property point data (**Figure 4-3**). Exposure score for critical facilities was calculated as the number impacted per watershed. In some watersheds, there are no critical facilities within flood extents which means no critical facilities are exposed.

4.2.1.6 Environmentally Sensitive Areas

Exposure of environmentally sensitive areas to flooding was measuring using the United States Geological Survey (USGS) National Wetland Inventory (NWI) extent (**Figure 4-2**). Wetlands are areas that serve as natural flood buffer areas. While wetlands can be adversely impacted by flooding if subjected to erosive velocities, they can also benefit from periodic flooding. For this reason, the exposure of these areas was tabulated by generally de-emphasized within the weighting scenarios (Section 4.3). Exposure of these sensitive areas was calculated using the total NWI area within a scenario flood extent. There are some watersheds that did not have any NWI area within the flood zone.

Figure 4-1. County FEMA 100-year and 500-year floodplain and Jacobs/WSSC Flood Modeller 100-year 2065 Flood Extent

Note:

The preliminary Flood Modeller flood extent does not include Bennet Creek, Broad Run, Edwards Ferry Tributaries, Fahrney Branch, Horsepen Branch, Little Bennet Creek, Little Monocacy River, Little Seneca Creek - Buckldge Branch, Lower Brighton Dam, Lower Dry Seneca Creek, Lower Hawlings River, Lower Patuxent River - Rocky Gorge, Lower Seneca Creek, Monocacy Direct, Quarry Branch, South Branch Patapsco, Upper Brighton Dam, Upper Dry Seneca Creek, Upper Hawlings River, and Little Seneca Creek - Ten Mile Creek.

Figure 4-2. Extent of National Wetlands Inventory within Montgomery County

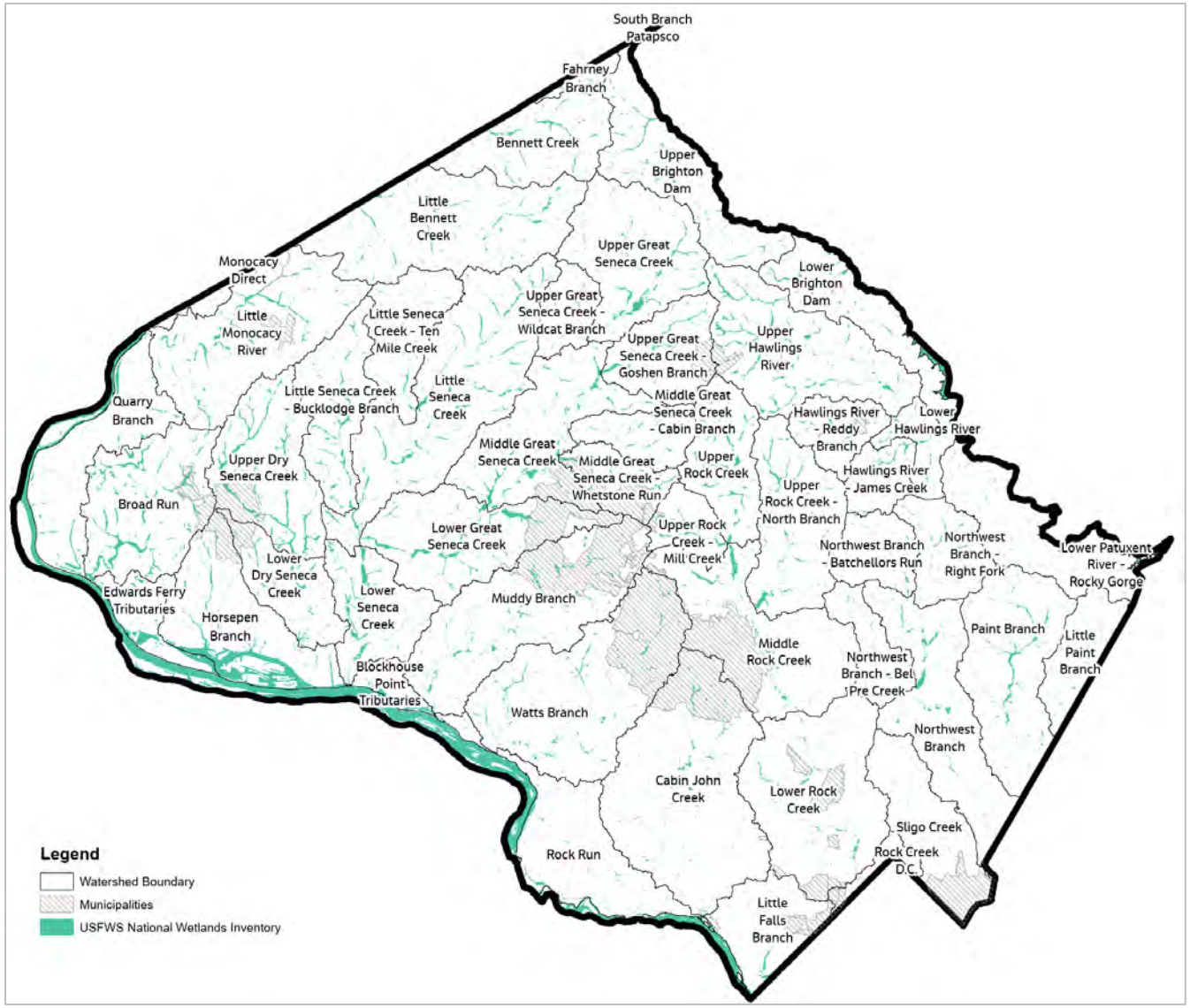
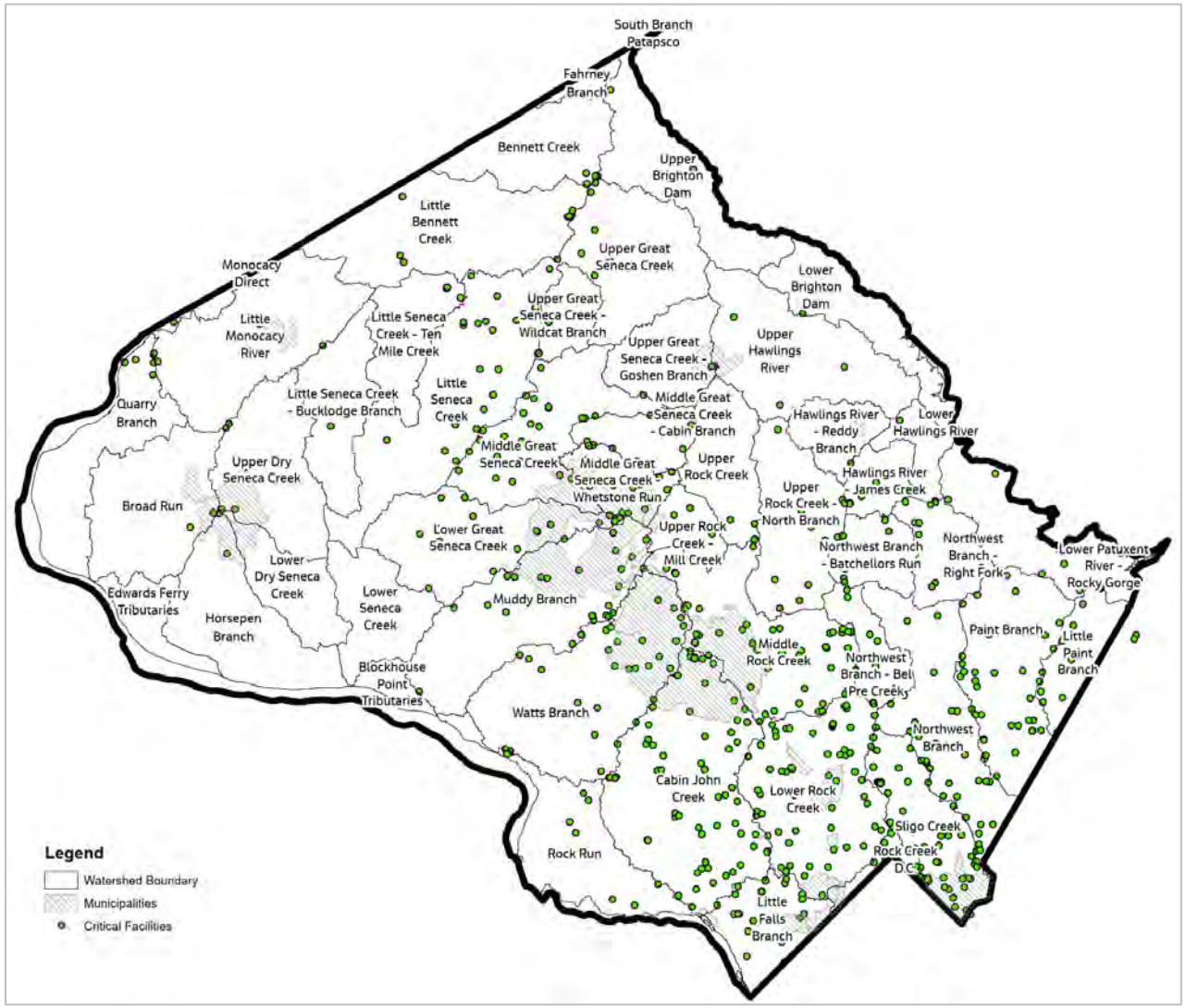


Figure 4-3. County Critical Facilities and Infrastructure



4.3 Overall Flood Exposure Scoring

A Multi-Objective Decision Analysis (MODA), was used for the aggregating exposure scores. An overall score for flood exposure was computed by combining criteria and criteria weighting factors using the following formula:

$$\begin{aligned} &Overall\ Flood\ Exposure\ Score \\ &= (Non-Residential\ Buildings\ Score\ \times Non-Residential\ Buildings\ Weight) \\ &+ (Total\ Impervious\ Score\ \times Total\ Impervious\ Weight) \\ &+ (Enviromental\ Score\ \times Environmental\ Weight) \\ &+ (Residential\ Buildings\ Score\ \times Residential\ Buildings\ Weight) \\ &+ (Social\ Vulnerability\ Score\ \times Social\ Vulnerability\ Weight) \\ &+ (Critical\ Facility\ Score\ \times Critical\ Facility\ Weight) \end{aligned}$$

While the weighting factors can be assigned an equal value, the methodology allows for changing the weight factors to give more importance to one criterion over another to reflect local policy choices. In the following section, a weight factor sensitivity analysis is described to achieve a more comprehensive representation of the watershed prioritization.

A characteristic of MODA is that all outputs for each criterion are normalized to a common scale. In this analysis, the total impervious areas, social vulnerability areas, and environmental areas are in acres whereas critical facilities, number of non-residential and residential buildings exposure are based on number of facilities or buildings impacted per watershed. Normalization to a common scale adds the following benefits:

- Removes units for each variable and allows for a simple addition of a final score based on the six criteria.
- It introduces an intuitive scale, common to all six criteria. This also allows for easier comparison of the relative ranking of watersheds across different criteria.

A 5-point normalization (low score = 0, high score = 5) was applied in the following manner to measurements for each criterion:

$$Normalized\ Watershed\ Flood\ Exposure\ Score = \frac{5}{Maximum\ Watershed\ Score} * Watershed\ Score$$

Using the Social Vulnerability (SV) attribute as an example, this formula yields the following normalized exposure scores for the social vulnerability criteria for Sligo Creek Watershed:

For the FEMA extent:

$$Normalized\ Watershed\ SV\ Score\ (FEMA) = \frac{5}{419\ acres} * 85\ acres = 1.01$$

For the Flood Modeller extent:

$$Normalized\ Watershed\ SV\ Score\ (FM) = \frac{5}{1{,}085\ acres} * 417\ acres\ = 1.92$$

Normalized scores for each criterion for both flood hazard scenarios (FEMA and Flood Modeller) for all watersheds are provided in **Attachment 4**.

The overall exposure scores calculated for an even weighting between commercial, social, critical facilities and environmental criteria scores are presented in **Figure 4-4** and **Figure 4-5**, for FEMA and Flood Modeller modelled flood extents, respectively. These figures use a stack bar that allows for a quick view of the contribution from each criterion to the final overall score. An equal weight theme is assigned to non-residential buildings, social vulnerability, total impervious area, residential buildings, critical facilities, and environmental risk at 17 percent each.

Figure 4-4. Example Result - Overall Flood Exposure Score for FEMA 100- and 500-year Flood Extent and Even Weighting Scenario

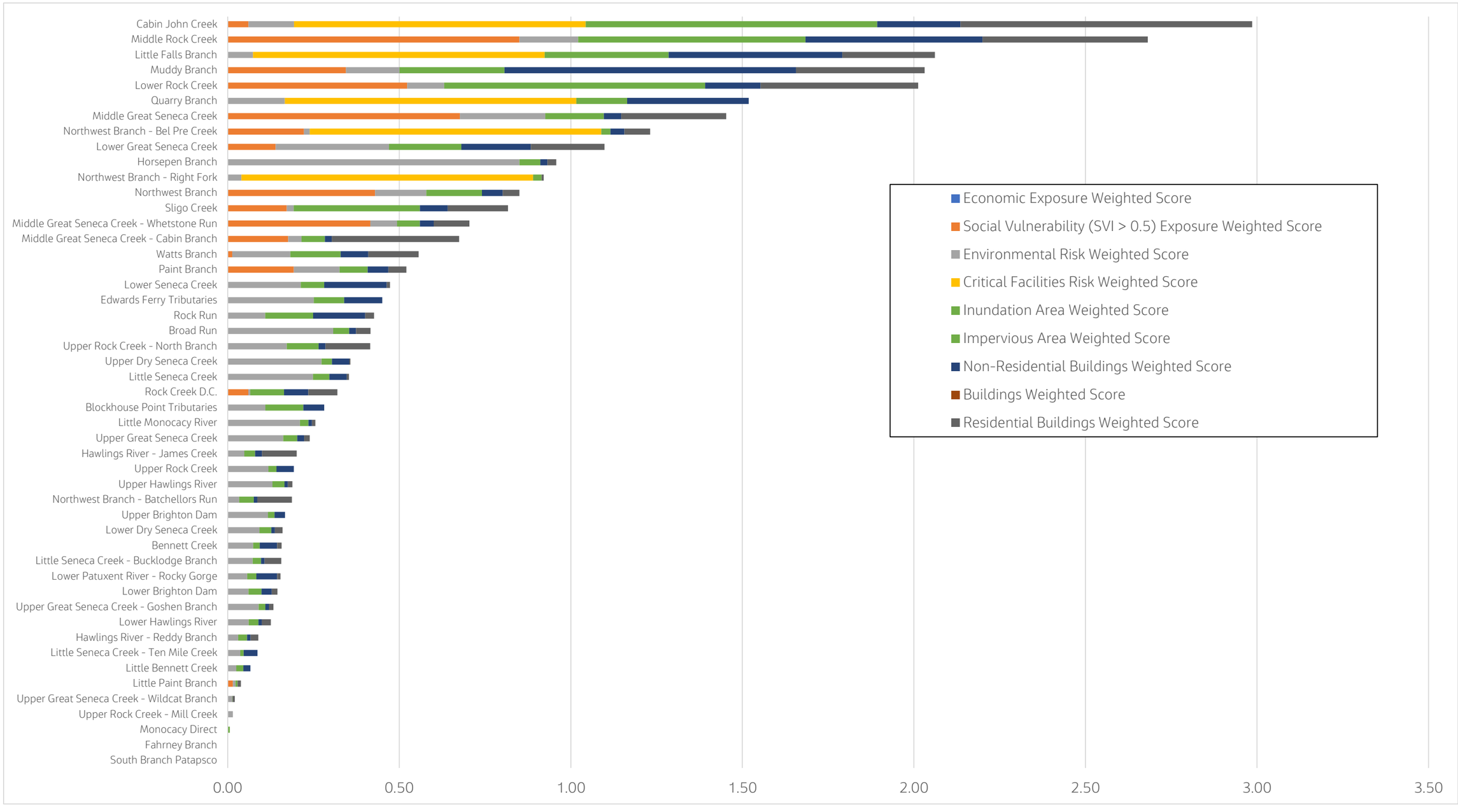
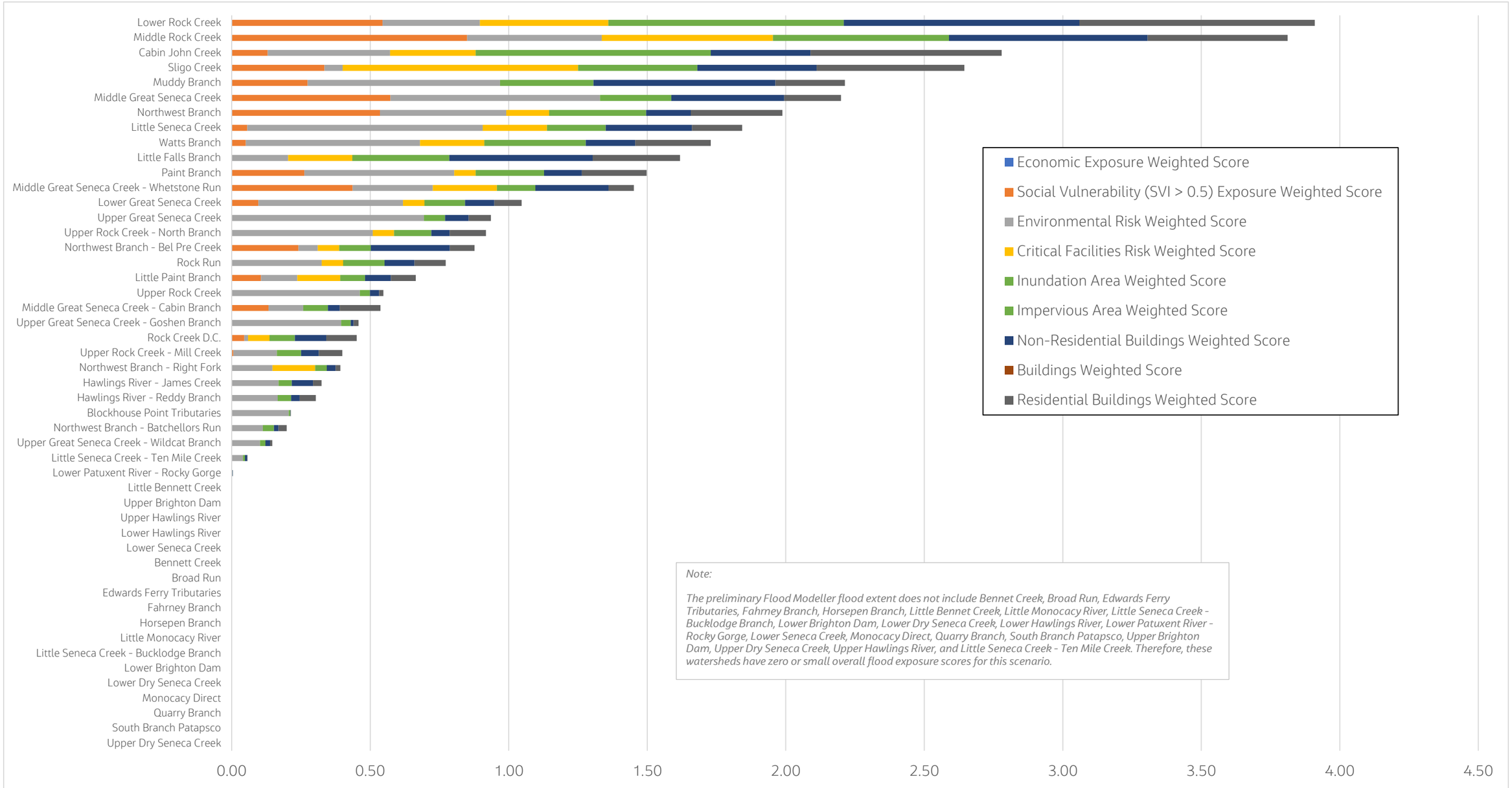


Figure 4-5 Example Results – Overall Flood Exposure Scores for Flood Modeller 100-year 2065 Flood Extent and Even Weighting Scenario



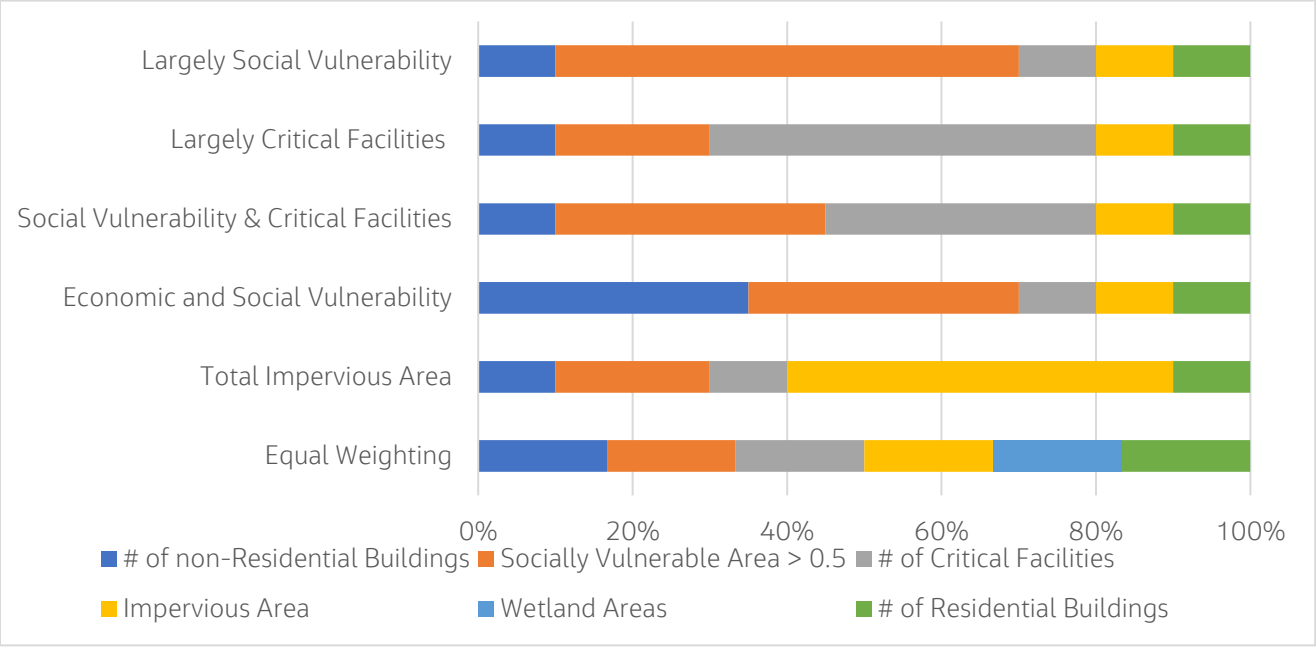
4.4 Sensitivity Analysis and Recommended Watershed Ranking

A sensitivity analysis was carried out to understand how sensitive overall scoring was to specific criteria. The steps of the analysis were:

- Generate weighting scenarios
- Calculated Overall Flood Exposure Scores for each weighting scenario for each flood hazard source (FEMA and Flood Modeller)
- Calculated Total Flood Exposure Score (sum of Overall Flood Exposure Scores for each weighting scenario) for each watershed
- Develop tiered ranking based on Total Flood Exposure Score for each flood hazard source
- Generate a combined tiered ranking based on the Maximum Total Flood Exposure Score for either flood hazard source to create one list for watershed prioritization

The first step in the sensitivity analysis methodology included creating various themes based on weight of importance of the varying exposure criteria. Themes created in this initial step are presented in **Figure 4-6**. The environmental criterion was not assigned a high importance in the majority of the scenarios because NWI areas are natural flood buffer areas and generally not sensitive to flooding.

Figure 4-6. Sensitivity Analysis Weighting Scenarios



Exposure scores were calculated for each weighting scenario for both sets of flood hazard extent measurements (FEMA and Flood Modeller). Watershed exposure scores for each weighting scenario for both flood hazard extents are provided in **Attachment 5**. The top ten watersheds for each weighting scenario are listed in **Table 4-2** and **Table 4-3** (FEMA and Flood Modeller results, respectively).

Table 4-2. Watershed Ranking List from FEMA Flood Hazard Layer Sensitivity Analysis (Top Ten by Total Exposure Score)

Ranking	Equal Weighting	Total Impervious Area	Economic & Social Vulnerability	Social Vulnerability & Critical Facilities	Largely Critical Facilities	Largely Social Vulnerability
1	Cabin John Creek	Cabin John Creek	Middle Rock Creek	Cabin John Creek	Cabin John Creek	Middle Rock Creek
2	Middle Rock Creek	Middle Rock Creek	Muddy Branch	Middle Rock Creek	Little Falls Branch	Middle Great Seneca Creek
3	Little Falls Branch	Lower Rock Creek	Lower Rock Creek	Little Falls Branch	Northwest Branch - Bel Pre Creek	Lower Rock Creek
4	Muddy Branch	Muddy Branch	Cabin John Creek	Northwest Branch - Bel Pre Creek	Quarry Branch	Muddy Branch
5	Lower Rock Creek	Little Falls Branch	Little Falls Branch	Quarry Branch	Northwest Branch - Right Fork	Cabin John Creek
6	Quarry Branch	Middle Great Seneca Creek	Middle Great Seneca Creek	Lower Rock Creek	Middle Rock Creek	Northwest Branch
7	Middle Great Seneca Creek	Sligo Creek	Quarry Branch	Northwest Branch - Right Fork	Lower Rock Creek	Middle Great Seneca Creek - Whetstone Run
8	Northwest Branch - Bel Pre Creek	Quarry Branch	Northwest Branch	Middle Great Seneca Creek	Muddy Branch	Northwest Branch - Bel Pre Creek
9	Lower Great Seneca Creek	Northwest Branch	Northwest Branch - Bel Pre Creek	Muddy Branch	Middle Great Seneca Creek	Little Falls Branch
10	Horsepen Branch	Lower Great Seneca Creek	Middle Great Seneca Creek - Whetstone Run	Northwest Branch	Northwest Branch	Sligo Creek

Table 4-3. Watershed Ranking List from Flood Modeller Flood Hazard Layer Sensitivity Analysis (Top Ten by Total Exposure Score)

Ranking	Equal Weighting	Total Impervious Area	Economic & Social Vulnerability	Social Vulnerability & Critical Facilities	Largely Critical Facilities	Largely Social Vulnerability
1	Lower Rock Creek	Lower Rock Creek	Middle Rock Creek	Middle Rock Creek	Middle Rock Creek	Middle Rock Creek
2	Middle Rock Creek	Middle Rock Creek	Lower Rock Creek	Lower Rock Creek	Sligo Creek	Lower Rock Creek
3	Cabin John Creek	Cabin John Creek	Sligo Creek	Sligo Creek	Lower Rock Creek	Middle Great Seneca Creek
4	Sligo Creek	Sligo Creek	Middle Great Seneca Creek	Cabin John Creek	Cabin John Creek	Sligo Creek
5	Muddy Branch	Northwest Branch	Muddy Branch	Northwest Branch	Northwest Branch	Northwest Branch
6	Middle Great Seneca Creek	Muddy Branch	Cabin John Creek	Middle Great Seneca Creek	Middle Great Seneca Creek - Whetstone Run	Middle Great Seneca Creek - Whetstone Run
7	Northwest Branch	Middle Great Seneca Creek	Northwest Branch	Middle Great Seneca Creek - Whetstone Run	Little Falls Branch	Cabin John Creek
8	Little Seneca Creek	Little Falls Branch	Middle Great Seneca Creek - Whetstone Run	Muddy Branch	Watts Branch	Muddy Branch
9	Watts Branch	Watts Branch	Little Falls Branch	Little Falls Branch	Middle Great Seneca Creek	Paint Branch
10	Little Falls Branch	Paint Branch	Northwest Branch - Bel Pre Creek	Watts Branch	Little Seneca Creek	Northwest Branch - Bel Pre Creek

4.4.1 Tiered Ranking by Flood Hazard Source

The overall exposure scores (Attachment 5) for each weighting scenario were then used to generate a tiered ranking based on the sum of the overall exposure scores for each flood hazard source (FEMA and Flood Modeller). Tiers were defined to identify a specified number of watersheds based on the sum of the flood exposure score for each flood hazard source:

- Tier 1: Watersheds in the top 3 based on the sum of overall exposure score
- Tier 2: Watersheds in the next top 4 based on the sum of overall exposure score
- Tier 3: Watersheds in the next top 5 based on the sum of overall exposure score
- Tier 4: All remaining watersheds

The following watershed tier lists (**Table 4-4** for FEMA and Flood Modeller extents) were established for Tiers 1, 2 and 3. A full listing of watersheds with associated total flood exposure scores by flood hazard source, maximum, and average values is provided in **Table 4-5**. Three of the watersheds (Fahrney Branch, South Branch Patapsco River, and Monocacy Direct) have flood exposure scores of zero or near zero. These watersheds are very small (between 0.00 and 0.27% of total County watershed acreage).

Table 4-4. Tiers 1, 2, and 3 Watershed Ranking using FEMA and Flood Modeller Flood Hazard Sources

Tier	FEMA (Riverine Exposure)		Flood Modeller (Combined Riverine/Pluvial Flood Exposure)	
	Watershed	Sum of Flood Exposure Score[a]	Watershed	Sum of Flood Exposure Score[a]
1	Middle Rock Creek	18.39	Middle Rock Creek	26.31
	Cabin John Creek	17.41	Lower Rock Creek	24.59
	Lower Rock Creek	13.33	Sligo Creek	19.96
2	Little Falls Branch	12.75	Cabin John Creek	15.18
	Muddy Branch	11.95	Northwest Branch	12.38
	Middle Great Seneca Creek	10.25	Middle Great Seneca Creek	11.69
	Northwest Branch - Bel Pre Creek	9.74	Muddy Branch	10.38
3	Quarry Branch	9.61	Middle Great Seneca Creek - Whetstone Run	10.23
	Northwest Branch - Right Fork	6.82	Little Falls Branch	8.93
	Northwest Branch	6.41	Watts Branch	8.01
	Middle Great Seneca Creek - Whetstone Run	5.70	Little Seneca Creek	7.68
	Sligo Creek	5.36	Paint Branch	7.47

Note:

a. Sum of Flood Exposure Score is the sum of the overall flood exposure score for each weighting scenario (1 through 6) for the noted flooding source (FEMA or Flood Modeller). Weighting scenario overall flood exposure scores are included in Attachment 5.

Table 4-5. Sum of Flood Exposure Scores for Flood Modeller and FEMA Flood Hazard Sources

Watershed	Sum of Flood Modeller Flood Exposure Scores[a]	Sum of FEMA Flood Exposure Scores	Maximum of Flood Exposure Score[b]	Average of Flood Exposure Score[a,b]
Bennett Creek	NA	0.52	0.52	0.52
Blockhouse Point Tributaries	0.25	1.13	1.13	0.69
Broad Run	NA	0.88	0.88	0.88
Cabin John Creek	14.28	17.41	17.41	15.85
Edwards Ferry Tributaries	NA	1.41	1.41	1.41
Fahrney Branch	NA	0.00	0.00	0.00
Hawlings River - James Creek	1.01	0.75	1.01	0.88
Hawlings River - Reddy Branch	0.87	0.34	0.87	0.60
Horsepen Branch	NA	1.45	1.45	1.45
Little Bennett Creek	NA	0.26	0.26	0.26
Little Falls Branch	8.25	12.75	12.75	10.50
Little Monocacy River	NA	0.46	0.46	0.46
Little Paint Branch	3.92	0.25	3.92	2.08
Little Seneca Creek	7.00	0.85	7.00	3.93
Little Seneca Creek - Bucklodge Branch	NA	0.47	0.47	0.47
Little Seneca Creek - Ten Mile Creek	0.13	0.32	0.32	0.23
Lower Brighton Dam	NA	0.53	0.53	0.53
Lower Dry Seneca Creek	NA	0.45	0.45	0.45
Lower Great Seneca Creek	4.07	5.13	5.13	4.60
Lower Hawlings River	NA	0.40	0.40	0.40
Lower Patuxent River - Rocky Gorge	NA	0.59	0.59	0.59
Lower Rock Creek	23.24	13.33	23.24	18.29
Lower Seneca Creek	NA	1.67	1.67	1.67
Middle Great Seneca Creek	11.69	10.25	11.69	10.97
Middle Great Seneca Creek - Cabin Branch	2.96	3.98	3.98	3.47
Middle Great Seneca Creek - Whetstone Run	9.55	5.70	9.55	7.63
Middle Rock Creek	24.51	18.39	24.51	21.45
Monocacy Direct	NA	0.04	0.04	0.04
Muddy Branch	10.38	11.95	11.95	11.16
Northwest Branch	11.93	6.41	11.93	9.17
Northwest Branch - Batchellors Run	0.58	0.76	0.76	0.67
Northwest Branch - Bel Pre Creek	5.93	9.74	9.74	7.84
Northwest Branch - Right Fork	1.85	6.82	6.82	4.34
Paint Branch	7.24	3.31	7.24	5.27
Quarry Branch	NA	9.61	9.61	9.61
Rock Creek D.C.	2.74	2.00	2.74	2.37
Rock Run	2.90	1.91	2.90	2.40

Watershed	Sum of Flood Modeller Flood Exposure Scores[a]	Sum of FEMA Flood Exposure Scores	Maximum of Flood Exposure Score[b]	Average of Flood Exposure Score[a,b]
Sligo Creek	17.49	5.36	17.49	11.43
South Branch Patapsco	NA	0.00	0.00	0.00
Upper Brighton Dam	NA	0.40	0.40	0.40
Upper Dry Seneca Creek	NA	0.75	0.75	0.75
Upper Great Seneca Creek	1.95	0.59	1.95	1.27
Upper Great Seneca Creek - Goshen Branch	0.74	0.32	0.74	0.53
Upper Great Seneca Creek - Wildcat Branch	0.35	0.05	0.35	0.20
Upper Hawlings River	NA	0.46	0.46	0.46
Upper Rock Creek	0.93	0.54	0.93	0.73
Upper Rock Creek - Mill Creek	1.45	0.02	1.45	0.73
Upper Rock Creek - North Branch	2.83	1.38	2.83	2.10
Watts Branch	7.33	2.25	7.33	4.79

Note:

a. NA = Not applicable. The preliminary Flood Modeller flood extent does not include Bennet Creek, Broad Run, Edwards Ferry Tributaries, Fahrney Branch, Horsepen Branch, Little Bennet Creek, Little Monocacy River, Little Seneca Creek - Bucklodge Branch, Lower Brighton Dam, Lower Dry Seneca Creek, Lower Hawlings River, Lower Patuxent River - Rocky Gorge, Lower Seneca Creek, Monocacy Direct, Quarry Branch, South Branch Patapsco, Upper Brighton Dam, Upper Dry Seneca Creek, Upper Hawlings River, and Little Seneca Creek - Ten Mile Creek. Therefore, these watersheds have "NA" or very small Total Flood Exposure Scores for "Flood Modeller Flood Extent". b. Maximum and Average of Flood Exposure Score is calculated based on the values shown in the second and third column of this table, Sum of Flood Exposure Scores for the Flood Modeller and FEMA flood hazard extent scenarios.

4.4.2 Recommended Tiered Ranking

Tier designations for each flood hazard data set were combined to generate a single recommended prioritization list for completing detailed watershed studies. The maximum of either flood exposure score sum (FEMA or Flood Modeller) was observed to identify a tier designation. The combined list is presented in **Table 4-6**. A full listing of weighting scenario ranking, by tier, is included in **Table 4-7**. Weighting scenario total exposure scores, by tier, are included in **Table 4-8**.

The results presented here were discussed with County staff. A recommendation was made to reconsider the third-tier ranking of Quarry Branch. For this small, rural watershed, scoring was overshadowed by the location of a critical facility – the Dickerson Power Plant. While the plant has been decommissioned, the raw water intake on the Potomac River is still in use by the co-located County resource recovery facility. Since the intent of the flood exposure ranking was to identify watersheds that will benefit from watershed-scale (vs. facility-scale) detailed hydraulic modeling and vulnerability assessments, location of a single facility exposure is not consistent with recommending the watershed be prioritized for detailed risk assessments. While understanding vulnerability of this structure is important, it would be more efficiently accomplished through study specific to the facility property. A comparison of tiers with observed flooding data is included in the following section.

Table 4-6. Recommended Combined List of Watersheds By Ranking Tier

Tier	Watershed	Maximum of Flood Exposure Score[a]	Tier	Watershed	Maximum of Flood Exposure Score[a]
1	Middle Rock Creek	26.31	4	Edwards Ferry Tributaries	1.41
	Lower Rock Creek	24.59		Blockhouse Point Tributaries	1.13
	Sligo Creek	19.96		Hawlings River - James Creek	1.01
2	Cabin John Creek	17.41		Upper Rock Creek	0.93
	Little Falls Branch	12.75		Broad Run	0.88
	Northwest Branch	12.38		Hawlings River - Reddy Branch	0.87
	Muddy Branch	11.95		Northwest Branch - Batchellors Run	0.76
3	Middle Great Seneca Creek	11.69		Upper Dry Seneca Creek	0.75
	Middle Great Seneca Creek - Whetstone Run	10.23		Upper Great Seneca Creek - Goshen Branch	0.74
	Northwest Branch - Bel Pre Creek	9.74		Lower Patuxent River - Rocky Gorge	0.59
	Quarry Branch*	9.61		Lower Brighton Dam	0.53
	Watts Branch	8.01		Bennett Creek	0.52
4	Little Seneca Creek	7.68		Little Seneca Creek - Bucklodge Branch	0.47
	Paint Branch	7.47		Little Monocacy River	0.46
	Northwest Branch - Right Fork	6.82		Upper Hawlings River	0.46
	Lower Great Seneca Creek	5.13		Lower Dry Seneca Creek	0.45
	Little Paint Branch	4.37		Upper Brighton Dam	0.40
	Middle Great Seneca Creek - Cabin Branch	3.98		Lower Hawlings River	0.40
	Rock Run	3.12		Upper Great Seneca Creek - Wildcat Branch	0.35
	Upper Rock Creek - North Branch	3.06		Little Seneca Creek - Ten Mile Creek	0.32
	Rock Creek D.C.	2.96		Little Bennett Creek	0.26
	Upper Great Seneca Creek	1.95		Monocacy Direct	0.04
	Lower Seneca Creek	1.67		Fahrney Branch	0.00
	Upper Rock Creek - Mill Creek	1.45		South Branch Patapsco	0.00
	Horsepen Branch	1.45			

Note:

a. Maximum of Flood Exposure Score is the maximum of the sum of flood exposure

* This watershed is not recommended for detailed modeling as the high score is due to the location of a single critical facility. Watershed-scale detailed hydraulic modeling is not appropriate for determining flood vulnerabilities at a single facility. See Section 4.4.2 text for further discussion.

Table 4-7. Watershed Ranking for Each Weighting Scenario and Flood Hazard Layer (FEMA and Flood Modeller) by Tier

Tier	Watershed	Equal Weighting		Total Inundation Area		Economic & Social Vulnerability		Social Vulnerability & Critical Facilities		Largely Critical Facilities		Largely Social Vulnerability	
		FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA
1	Middle Rock Creek	2	2	2	2	1	1	1	2	1	6	1	1
	Lower Rock Creek	1	5	1	3	2	3	2	6	3	7	2	3
	Sligo Creek	4	13	4	7	3	12	3	12	2	12	4	10
2	Cabin John Creek	3	1	3	1	6	4	4	1	4	1	7	5
	Little Falls Branch	10	3	8	5	9	5	9	3	7	2	11	9
	Muddy Branch	5	4	6	4	5	2	8	9	11	8	8	4
	Northwest Branch	7	12	5	9	7	8	5	10	5	10	5	6
3	Middle Great Seneca Creek	6	7	7	6	4	6	6	8	9	9	3	2
	Northwest Branch - Bel Pre Creek	16	8	13	11	10	9	13	4	13	3	10	8
	Quarry Branch	NA	6	NA	8	NA	7	NA	5	NA	4	NA	13
	Middle Great Seneca Creek - Whetstone Run	12	14	11	12	8	10	7	11	6	11	6	7
	Watts Branch	9	16	9	14	13	19	10	17	8	16	12	17
4	Paint Branch	11	17	10	16	11	14	11	15	12	15	9	14
	Little Seneca Creek	8	24	12	25	12	24	12	27	10	27	13	28
	Northwest Branch - Right Fork	24	11	22	15	23	15	19	7	16	5	21	15
	Lower Great Seneca Creek	13	9	14	10	15	11	15	13	15	13	16	12
	Middle Great Seneca Creek - Cabin Branch	20	15	18	13	16	13	16	14	20	14	14	11
	Little Paint Branch	18	44	16	44	14	43	14	35	14	41	15	27
	Rock Run	17	20	15	17	18	17	18	18	18	18	18	18
	Upper Rock Creek - North Branch	15	22	17	19	19	22	20	20	19	20	19	20
	Rock Creek D.C.	22	25	19	18	17	18	17	16	17	17	17	16
	Upper Great Seneca Creek	14	28	21	28	20	34	22	33	22	33	22	34
	Lower Seneca Creek	NA	18	NA	22	NA	16	NA	19	NA	19	NA	19
	Upper Rock Creek - Mill Creek	23	46	20	47	21	47	21	47	21	47	20	47
	Horsepen Branch	NA	10	NA	23	NA	32	NA	26	NA	26	NA	26
	Edwards Ferry Tributaries	NA	19	NA	21	NA	20	NA	21	NA	21	NA	21
	Blockhouse Point Tributaries	27	26	30	20	30	21	30	22	30	22	30	22
	Hawlings River - James Creek	25	29	23	27	22	27	23	24	23	24	23	24
	Upper Rock Creek	19	30	26	36	25	28	26	34	26	34	26	35
	Broad Run	NA	21	NA	26	NA	31	NA	25	NA	25	NA	25
	Hawlings River - Reddy Branch	26	41	24	37	24	40	24	38	24	37	24	38
	Northwest Branch - Batchellors Run	28	32	25	24	26	29	25	23	25	23	25	23
	Upper Dry Seneca Creek	NA	23	NA	30	NA	25	NA	29	NA	29	NA	30
	Upper Great Seneca Creek - Goshen Branch	21	39	27	42	27	44	27	43	27	43	27	43
	Lower Patuxent River - Rocky Gorge	NA	37	NA	32	NA	23	NA	28	NA	28	NA	29
	Lower Brighton Dam	NA	38	NA	29	NA	30	NA	30	NA	30	NA	31
	Bennett Creek	NA	35	NA	38	NA	26	NA	32	NA	32	NA	33
	Little Seneca Creek - Bucklodge Branch	NA	36	NA	34	NA	36	NA	31	NA	31	NA	32
	Little Monocacy River	NA	27	NA	39	NA	42	NA	42	NA	42	NA	42
	Upper Hawlings River	NA	31	NA	33	NA	41	NA	39	NA	38	NA	39
	Lower Dry Seneca Creek	NA	34	NA	31	NA	37	NA	36	NA	35	NA	36
	Upper Brighton Dam	NA	33	NA	40	NA	35	NA	41	NA	40	NA	41
	Lower Hawlings River	NA	40	NA	35	NA	39	NA	37	NA	36	NA	37

Tier	Watershed	Equal Weighting		Total Inundation Area		Economic & Social Vulnerability		Social Vulnerability & Critical Facilities		Largely Critical Facilities		Largely Social Vulnerability	
		FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA
	Upper Great Seneca Creek - Wildcat Branch	29	45	28	46	28	45	28	45	28	45	28	45
	Little Seneca Creek - Ten Mile Creek	30	42	29	43	29	33	29	40	29	39	29	40
	Little Bennett Creek	NA	43	NA	41	NA	38	NA	44	NA	44	NA	44
	Monocacy Direct	NA	47	NA	45	NA	46	NA	46	NA	46	NA	46
	Fahrney Branch	NA	48	NA	47	NA	47	NA	47	NA	47	NA	47
	South Branch Patapsco	NA	48	NA	47	NA	47	NA	47	NA	47	NA	47

Note: * This watershed is not recommended for detailed modeling as the high score is due to the location of a single critical facility. Watershed-scale detailed hydraulic modeling is not appropriate for determining flood vulnerabilities at a single facility. See Section 4.4.2 text for further discussion.

Table 4-8. Watershed Flood Exposure Score for Each Weighting Scenario and Flood Hazard Layer (FEMA and Flood Modeller) by Tier

Tier	Watershed	Equal Weighting		Total Inundation Area		Economic & Social Vulnerability		Social Vulnerability & Critical Facilities		Largely Critical Facilities		Largely Social Vulnerability	
		FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA
1	Middle Rock Creek	3.81	2.68	3.95	3.54	4.26	3.49	4.12	2.73	3.91	1.98	4.46	3.98
	Lower Rock Creek	3.91	2.01	4.41	3.22	4.14	2.13	3.58	1.89	3.50	1.43	3.69	2.66
	Sligo Creek	2.64	0.82	2.73	1.44	2.64	0.84	3.26	0.72	3.71	0.57	2.50	0.98
2	Cabin John Creek	2.78	2.99	3.45	3.71	2.10	2.13	2.02	3.02	2.18	3.71	1.76	1.86
	Little Falls Branch	1.62	2.06	1.66	2.02	1.59	1.91	1.17	2.42	1.38	3.17	0.83	1.17
	Muddy Branch	2.21	2.03	1.85	2.02	2.26	2.86	1.30	1.61	1.06	1.31	1.70	2.12
	Northwest Branch	1.99	0.85	2.04	1.05	1.93	1.13	1.92	1.04	1.58	0.66	2.48	1.68
3	Middle Great Seneca Creek	2.20	1.45	1.79	1.51	2.29	1.78	1.69	1.70	1.19	1.11	2.53	2.70
	Northwest Branch - Bel Pre Creek	0.88	1.23	0.88	0.91	1.25	1.10	0.94	2.29	0.80	2.85	1.18	1.37
	Quarry Branch	NA	1.52	NA	1.14	NA	1.32	NA	2.05	NA	2.80	NA	0.80
	Middle Great Seneca Creek - Whetstone Run	1.45	0.70	1.27	0.77	1.71	1.04	1.67	0.98	1.49	0.61	1.97	1.59
	Watts Branch	1.73	0.56	1.54	0.58	0.98	0.37	1.06	0.25	1.22	0.24	0.80	0.27
4	Paint Branch	1.50	0.52	1.30	0.53	1.15	0.60	1.06	0.51	0.90	0.34	1.33	0.80
	Little Seneca Creek	1.84	0.35	1.12	0.17	1.12	0.14	1.01	0.06	1.16	0.06	0.75	0.06
	Northwest Branch - Right Fork	0.39	0.92	0.24	0.58	0.19	0.52	0.37	1.77	0.51	2.52	0.14	0.52
	Lower Great Seneca Creek	1.05	1.10	0.71	1.03	0.61	0.95	0.56	0.66	0.55	0.53	0.59	0.86
	Middle Great Seneca Creek - Cabin Branch	0.54	0.67	0.53	0.64	0.50	0.66	0.44	0.63	0.32	0.48	0.63	0.89
	Little Paint Branch	0.66	0.04	0.59	0.04	0.61	0.04	0.70	0.04	0.74	0.03	0.62	0.06
	Rock Run	0.77	0.43	0.62	0.52	0.42	0.41	0.38	0.19	0.45	0.19	0.26	0.19
	Upper Rock Creek - North Branch	0.92	0.42	0.56	0.36	0.34	0.17	0.35	0.14	0.42	0.14	0.24	0.14
	Rock Creek D.C.	0.45	0.32	0.50	0.45	0.49	0.38	0.44	0.27	0.47	0.22	0.39	0.36
	Upper Great Seneca Creek	0.94	0.24	0.32	0.14	0.27	0.08	0.14	0.05	0.14	0.05	0.14	0.05
	Lower Seneca Creek	NA	0.47	NA	0.31	NA	0.42	NA	0.15	NA	0.15	NA	0.15
	Upper Rock Creek - Mill Creek	0.40	0.02	0.35	0.00	0.25	0.00	0.15	0.00	0.15	0.00	0.16	0.00
	Horsepen Branch	NA	0.96	NA	0.21	NA	0.09	NA	0.06	NA	0.06	NA	0.06
	Edwards Ferry Tributaries	NA	0.45	NA	0.33	NA	0.28	NA	0.12	NA	0.12	NA	0.12
	Blockhouse Point Tributaries	0.21	0.28	0.02	0.36	0.01	0.19	0.00	0.10	0.00	0.10	0.00	0.10
	Hawlings River - James Creek	0.32	0.20	0.20	0.16	0.20	0.12	0.09	0.09	0.09	0.09	0.09	0.09
	Upper Rock Creek	0.55	0.19	0.14	0.10	0.10	0.12	0.05	0.04	0.05	0.04	0.05	0.04
	Broad Run	NA	0.42	NA	0.17	NA	0.09	NA	0.06	NA	0.06	NA	0.06
	Hawlings River - Reddy Branch	0.30	0.09	0.20	0.10	0.13	0.05	0.08	0.03	0.08	0.03	0.08	0.03
	Northwest Branch - Batchellors Run	0.20	0.19	0.15	0.19	0.08	0.11	0.05	0.09	0.05	0.09	0.05	0.09
	Upper Dry Seneca Creek	NA	0.36	NA	0.12	NA	0.12	NA	0.05	NA	0.05	NA	0.05
	Upper Great Seneca Creek - Goshen Branch	0.46	0.13	0.12	0.07	0.05	0.04	0.04	0.03	0.04	0.03	0.04	0.03
	Lower Patuxent River - Rocky Gorge	NA	0.15	NA	0.12	NA	0.15	NA	0.06	NA	0.06	NA	0.06
	Lower Brighton Dam	NA	0.14	NA	0.14	NA	0.09	NA	0.05	NA	0.05	NA	0.05
	Bennett Creek	NA	0.16	NA	0.09	NA	0.12	NA	0.05	NA	0.05	NA	0.05
	Little Seneca Creek - Bucklodge Branch	NA	0.16	NA	0.11	NA	0.06	NA	0.05	NA	0.05	NA	0.05
	Little Monocacy River	NA	0.26	NA	0.09	NA	0.04	NA	0.03	NA	0.03	NA	0.03
	Upper Hawlings River	NA	0.19	NA	0.12	NA	0.05	NA	0.03	NA	0.03	NA	0.03
	Lower Dry Seneca Creek	NA	0.16	NA	0.12	NA	0.05	NA	0.04	NA	0.04	NA	0.04
	Upper Brighton Dam	NA	0.17	NA	0.08	NA	0.07	NA	0.03	NA	0.03	NA	0.03
	Lower Hawlings River	NA	0.13	NA	0.11	NA	0.05	NA	0.04	NA	0.04	NA	0.04

Tier	Watershed	Equal Weighting		Total Inundation Area		Economic & Social Vulnerability		Social Vulnerability & Critical Facilities		Largely Critical Facilities		Largely Social Vulnerability	
		FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA	FM	FEMA
	Upper Great Seneca Creek - Wildcat Branch	0.15	0.02	0.07	0.01	0.05	0.00	0.03	0.00	0.03	0.00	0.03	0.00
	Little Seneca Creek - Ten Mile Creek	0.06	0.09	0.03	0.05	0.02	0.09	0.01	0.03	0.01	0.03	0.01	0.03
	Little Bennett Creek	NA	0.07	NA	0.07	NA	0.05	NA	0.02	NA	0.02	NA	0.02
	Monocacy Direct	NA	0.01	NA	0.02	NA	0.00	NA	0.00	NA	0.00	NA	0.00
	Fahrney Branch	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00
	South Branch Patapsco	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00

Note:

* This watershed is not recommended for detailed modeling as the high score is due to the location of a single critical facility. Watershed-scale detailed hydraulic modeling is not appropriate for determining flood vulnerabilities at a single facility. See Section 4.4.2 text for further discussion.

4.4.2.1 Comparison with Observed Flooding Data

Watershed tiers were compared based on total observed flooding locations (911, MC311, MCDOT DAR calls, DEP drainage calls) within the watershed and within SVI > 0.5 areas of the watershed. Approximately 66 percent of all calls and 88 percent of calls within SVI > 0.5 areas are represented in the first two tiers (**Figure 4-7**). A listing of the percentage of total calls within each watershed, and total calls within SVI > 0.5 areas is included in **Table 4-9**.

When calls within SVI > 0.5 areas are compared, there are a few watersheds that appear to have a relatively high number of calls compared to watersheds in their tier/cohort: namely Sligo Creek (Tier 2) and Little Paint Branch (Tier 3). These watersheds may be considered for promotion based on density and percentage of total calls within SVI > 0.5 areas.

Figure 4-7. Percentage of Watershed Flooding and Drainage Calls by Tier and Percentage of Watershed Flooding and Drainage Calls from Areas with Social Vulnerability Index (SVI) > 0.5 by Tier

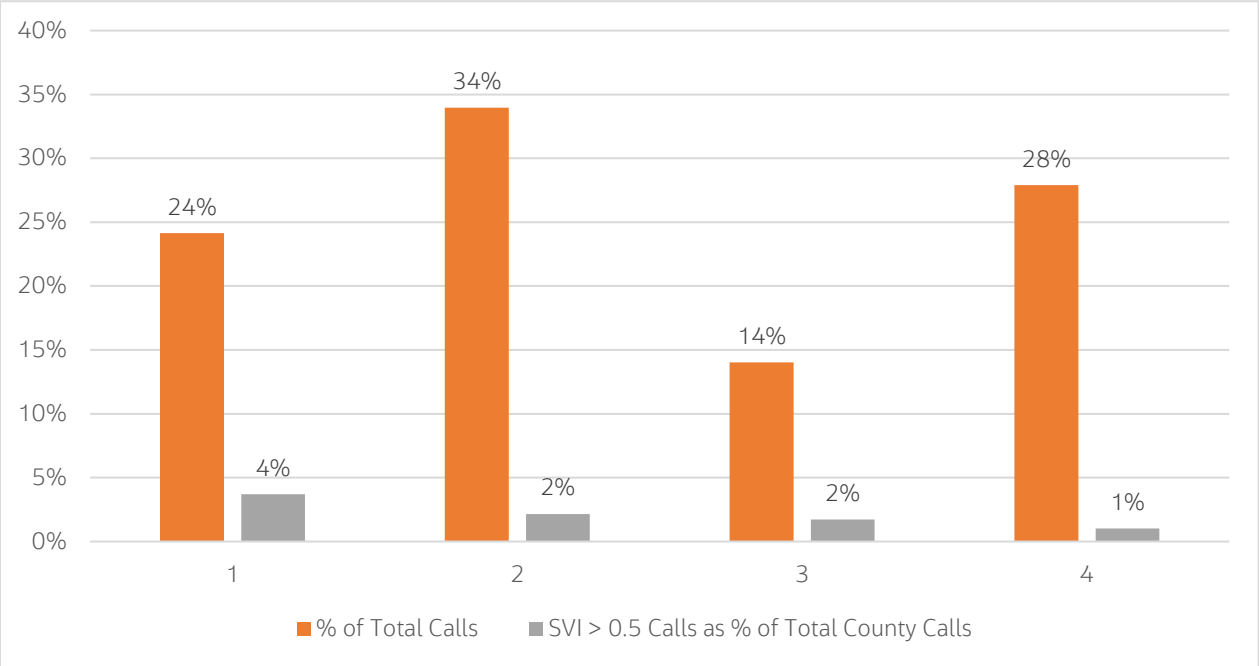


Table 4-9. Comparison of Ranking Tiers with Observed Flood Data

Tier	Watershed	Percent Impervious	SVI > 0.5 population as a % of total County population	% of Total Calls	SVI > 0.5 Calls as % of Total County Calls
1	Middle Rock Creek	32%	49%	4%	21%
	Lower Rock Creek	36%	23%	13%	11%
	Sligo Creek	38%	37%	7%	20%
2	Cabin John Creek	28%	7%	14%	3%
	Little Falls Branch	34%	0%	5%	0%
	Muddy Branch	24%	15%	3%	6%
	Northwest Branch	23%	36%	8%	15%
3	Middle Great Seneca Creek	23%	37%	3%	13%
	Northwest Branch - Bel Pre Creek	30%	57%	2%	35%
	Quarry Branch	3%	0%	0%	0%
	Middle Great Seneca Creek - Whetstone Run	39%	92%	1%	38%
	Watts Branch	22%	3%	4%	0%
4	Paint Branch	21%	23%	6%	5%
	Little Seneca Creek	17%	4%	3%	4%
	Northwest Branch - Right Fork	11%	0%	1%	0%
	Lower Great Seneca Creek	14%	8%	1%	6%
	Middle Great Seneca Creek - Cabin Branch	28%	27%	1%	25%
	Little Paint Branch	27%	29%	2%	24%
	Rock Run	15%	0%	5%	0%
	Upper Rock Creek - North Branch	14%	0%	4%	0%
	Rock Creek D.C.	43%	21%	2%	10%
	Upper Great Seneca Creek	9%	0%	1%	0%
	Lower Seneca Creek	4%	0%	0%	0%
	Upper Rock Creek - Mill Creek	24%	3%	2%	1%
	Horsepen Branch	2%	0%	0%	0%
	Edwards Ferry Tributaries	2%	0%	0%	0%
	Blockhouse Point Tributaries	5%	0%	0%	0%
	Hawlings River - James Creek	20%	0%	1%	0%
	Upper Rock Creek	10%	0%	1%	0%
	Broad Run	3%	0%	0%	0%
	Hawlings River - Reddy Branch	11%	0%	1%	0%
	Northwest Branch - Batchellors Run	11%	0%	1%	0%
	Upper Dry Seneca Creek	4%	0%	0%	0%
	Upper Great Seneca Creek - Goshen Branch	7%	0%	1%	0%
	Lower Patuxent River - Rocky Gorge	8%	0%	1%	0%
	Lower Brighton Dam	3%	0%	0%	0%

Tier	Watershed	Percent Impervious	SVI > 0.5 population as a % of total County population	% of Total Calls	SVI > 0.5 Calls as % of Total County Calls
	Bennett Creek	4%	0%	0%	0%
	Little Seneca Creek - Bucklodge Branch	3%	0%	0%	0%
	Little Monocacy River	3%	0%	0%	0%
	Upper Hawlings River	4%	0%	1%	0%
	Lower Dry Seneca Creek	3%	0%	0%	0%
	Upper Brighton Dam	4%	0%	0%	0%
	Lower Hawlings River	8%	0%	0%	0%
	Upper Great Seneca Creek - Wildcat Branch	5%	0%	0%	0%
	Little Seneca Creek - Ten Mile Creek	4%	0%	0%	0%
	Little Bennett Creek	4%	0%	1%	0%
	Monocacy Direct	4%	0%	0%	0%
	Fahrney Branch	5%	0%	0%	0%
	South Branch Patapsco	23%	0%	0%	0%

SVI = Social Vulnerability Index

Note:

* This watershed is not recommended for detailed modeling as the high score is due to the location of a single critical facility. Watershed-scale detailed hydraulic modeling is not appropriate for determining flood vulnerabilities at a single facility. See Section 4.4.2 text for further discussion.

5. Review of Data Available for Flood Modeling

5.1 Review Methods

The available data received was reviewed to confirm which data needs are available to feed hydrologic and hydraulic modeling for detailed flood risk assessments in the next phase of the Flood Management Plan. Based on the objective of understanding areas of flood inundation and flood risk for a range of storm events it is anticipated that a 2-D hydraulic model will be required. This model would include 1-D model elements to represent the linear stormwater assets (storm sewers, culverts, and streams) integrated with 2-D analysis of flooding across the ground surface. A full listing of anticipated data requirements and potential sources are provided in **Attachment 6**.

A full listing of storm drain, channel, and stream channel information collected is listed in **Table 5-1.** It is noted that there may be existing infrastructure not contained in the GIS layers reviewed to date. The gap analysis documented here does not quantify how many structures and miles of conveyance systems are not captured at all in the GIS layers reviewed to date; however, informal reviews of the data and discussions with County GIS staff suggests that the linear features and structure locations are mostly complete.

Table 5-1. Stormwater infrastructure asset data

Layer Name	Owner	Via	Asset Type Included (Typical)
SD_County_Manholes	MCDOT	MCDEP	Manholes
SD_County_Inlets	MCDOT	MCDEP	Inlets
SD_County_Culv_Exit	MCDOT	MCDEP	Culvert
SD_County_Culv_Entrance	MCDOT	MCDEP	Culvert
SD_County_Pipes	MCDOT	MCDEP	Storm Drain Pipes
SD_County_Culverts	MCDOT	MCDEP	Culvert
SD_County_Channels	MCDOT	MCDEP	Open Channels
Streams	MCDOT	MCDEP	Streams
S_WTR_LN	FEMA	MCDEP	FEMA-studies stream centerlines
SD_Gaitherburg_Headwalls	City of Gaithersburg	MCDEP	Culverts
SD_Gaitherburg_Inlets	City of Gaithersburg	MCDEP	Inlets
SD_Gaitherburg_Manholes	City of Gaithersburg	MCDEP	Manholes
SD_Gaitherburg_Outlets	City of Gaithersburg	MCDEP	Outlets
SD_Gaitherburg_SWFAC	City of Gaithersburg	MCDEP	SWM Facilities
SD_Gaitherburg_Pipes	City of Gaithersburg	MCDEP	Storm Drain Pipes
SD_Kensington_Structures	Town of Kensington	MCDEP	Manholes, Inlets
SD_Kensington_Channels	Town of Kensington	MCDEP	Open Channels
SD_Kensington_Pipes	Town of Kensington	MCDEP	Storm Drain Pipes
SD_Poolesville_Structures	Town of Poolesville	MCDEP	Manholes, Inlets
SD_Poolesville_Pipes	Town of Poolesville	MCDEP	Storm Drain Pipes
SD_Rockville_Nodes	City of Rockville	MCDEP	Manholes, Inlets
SD_Rockville_Lines	City of Rockville	MCDEP	Storm Drain Pipes, Open Channel
SD_TakomaPark_Structures	City of Takoma Park	MCDEP	Manholes, Inlets

Layer Name	Owner	Via	Asset Type Included (Typical)
SD_TakomaPark_Pipes	City of Takoma Park	MCDEP	Storm Drain Pipes
MCDEP_SWFAC_Points	MCDEP	MCDEP	SWM Facilities

5.2 Results

5.2.1 Countywide Summary

The following set of tables summarizes the overall watershed characteristics, storm sewer system characteristics, and completeness of the data sets relative to the data needs listed in Attachment 6. These results will assist in prioritizing the first set of watersheds to be included in the next phase of work, and data collection that may be required before initiating any modeling. Because of the large quantity of data, a countywide data gap summary has been listed for each available stormwater item analyzed in this study:

- Stormwater Pipes
  - Total Length of Stormwater Pipes: **6,433,732 feet**
  - Total Number of Pipe Segments: **72,552**
  - Total Number of Diameter data gaps: **8,674 (12 percent of pipes)**
  - Total Number of Slope data gaps: **26,557 (37 percent of pipes)**
  - Total Number of upstream (US) Invert data gaps: **54,897 (76 percent of pipes)**
  - Total Number of downstream (DS) Invert data gaps: **55,062 (76 percent of pipes)**
- Stormwater Inlets
  - Total Number of Inlets: **43,775**
  - Total Number of Top of Grate elevation data gaps: **19,464 (44 percent of inlets)**
  - Total Number of Invert elevation data gaps: **14,144 (32 percent inlets)**
  - Total Number of Inlet Type data gaps: **16,028 (37 percent of inlets)**
- Stormwater Manholes
  - Total Number of Stormwater Manholes: **19,404**
  - Total Number of Rim elevation data gaps: **12,018 (62 percent of manholes)**
  - Total Number of Invert elevation data gaps: **8,411 (43 percent of manholes)**
  - Total Number of Manhole Type data gaps: **14,773 (76 percent of manholes)**
- Stormwater Culverts
  - Total Length of Stormwater Culverts: **219,605 feet**
  - Total Number of Stormwater Culverts: **3,017**
  - Total Number of Diameter data gaps: **654 (22 percent of culverts)**
  - Total Number of Slope data gaps: **2,424 (80 percent of culverts)**
  - Total Number of US Invert data gaps: **1,574 (52 percent of culverts)**
  - Total Number of DS Invert data gaps: **1,563 (52 percent of culverts)**
- Stormwater Channels[1]
  - Total Number of Channels: **11,706**
  - Total Length of Channels: **678,929 feet**
  - Total Number of Slope data gaps: **8,273 (71 percent of channels)**

[1] Stormwater Channels in GIS were shown to be made up of roadside open channel ditches and swales.

  - Total Number of upstream (US) Invert data gaps: **11,411 (97 percent of channels)**
  - Total Number of downstream (DS) Invert data gaps: **11,425 (98 percent of channels)**
  - Total Number of Channel Type data gaps: **8,962 (77 percent of channels)**

- Streams[2]
  - Total Length of Streams: **14,183,068 feet**
  - Total Length of Streams within FEMA SFHA Zones: **2,484,148 feet**
  - Total Length of Streams outside of FEMA SFHA Zones: **11,698,920 feet**
  -

5.2.2 Watershed Summaries

This section is dedicated to a watershed level summary of data gaps. A summary of relative lengths of storm drain pipe within various diameter ranges is included on **Figure 5-1**. A summary of some selected data gaps (upstream pipe inverts, inlet inverts, manhole inverts), which are generally the most time-consuming to address, is included on **Figure 5-2**. A summary of watershed storm drain infrastructure is provided in **Table 5-2** and **Table 3-5.** Tables containing tallies of data gaps within stormwater pipes, inlets, and manhole structures data sets are included in **Table 5-4** (storm drain pipes), **Table 5-5** (storm drain pipes 36 inches or greater), **Table 5-6** (storm drain inlets), **Table 5-7** (manhole structures), and **Table 5-8** (culverts). It is noted that the following watersheds have little to no stormwater infrastructure documented in the GIS: Fahrney Branch, Quarry Branch, Little Seneca-Creek-Ten Mile Creek, Monocacy Direct, Edwards Ferry Tributaries, Upper Brighton Dam, and South Branch Patapsco River.

[2] Streams layer was processed to improve its accuracy by eliminating double counted bank lines and other structure alignment polylines already quantified in the other stormwater layers within GIS. For FEMA SFHA Zone lengths, a separate stream centerline for FEMA studied streams was utilized. See Section 5.3.2 for further discussion.

Figure 5-1. Length of Storm Drain Pipe within Each Watershed by Pipe Size Category

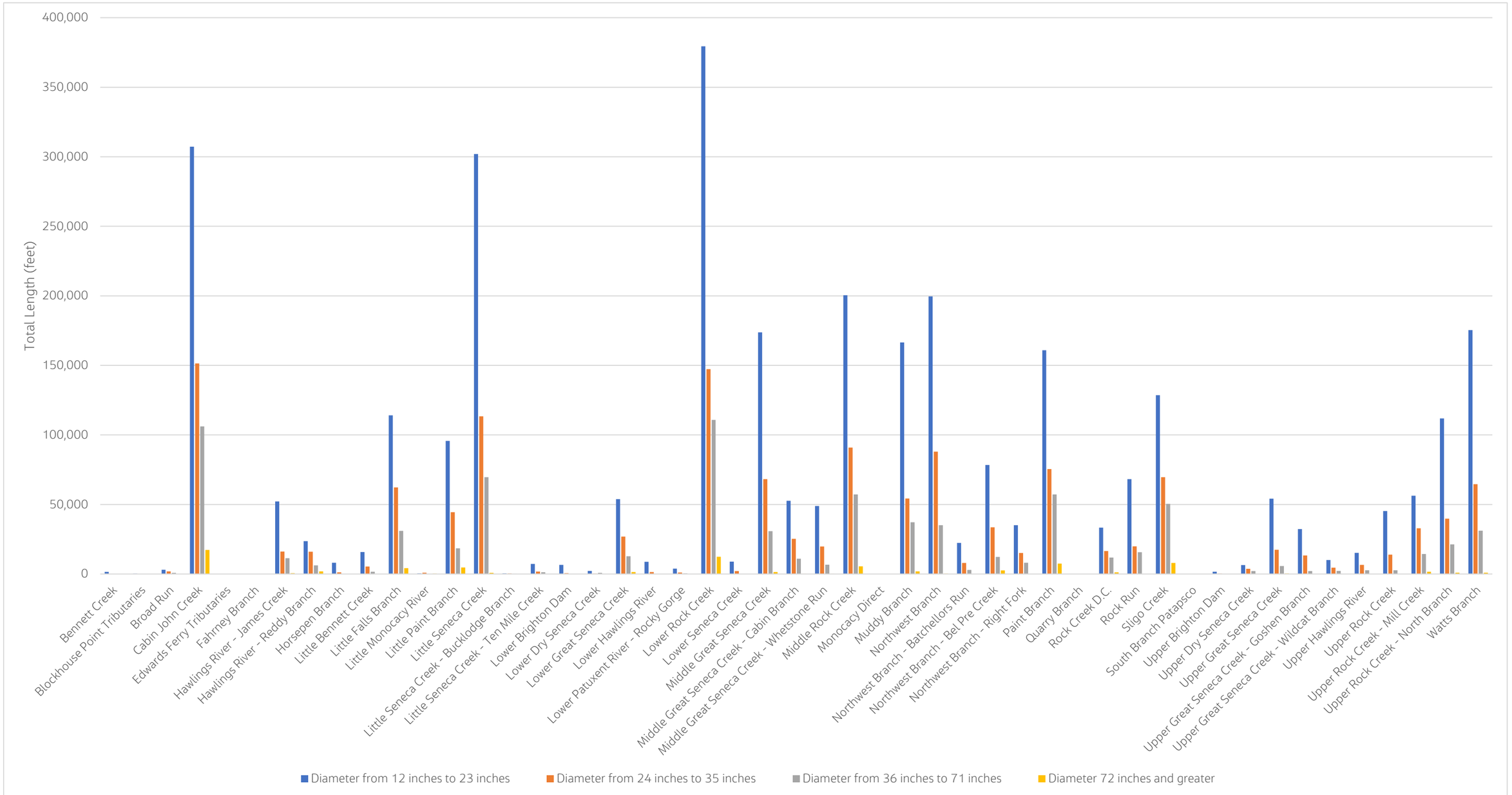


Figure 5-2. Summary of Selected Data Gaps by Watershed

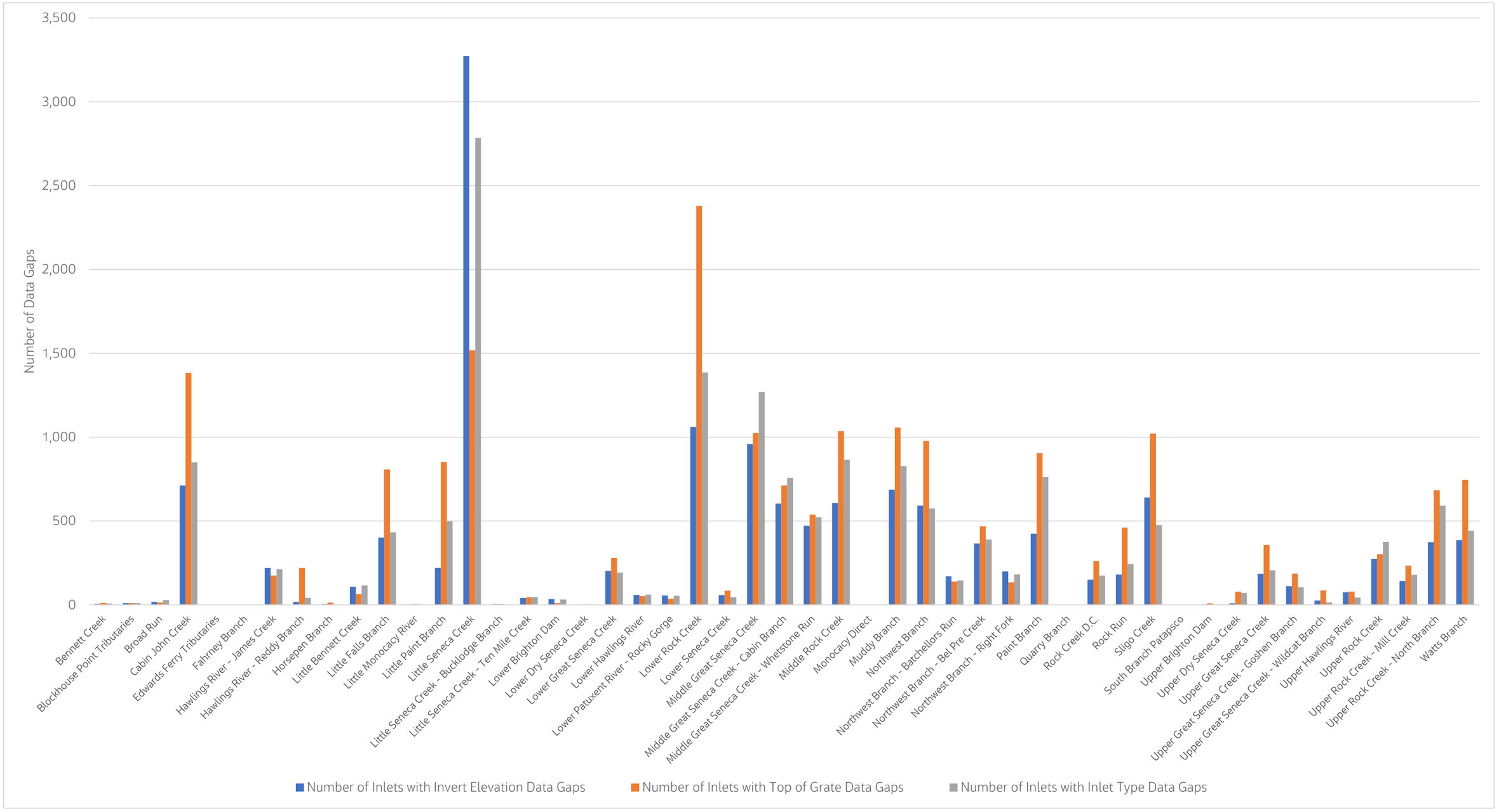


Table 5-2. Montgomery County Watershed Stormwater Item Characteristics

Watershed	Total Length of Stormwater Pipes (feet)	Total Length of Stormwater Culverts (feet)	Total Length of Streams within FEMA Zones[a] (feet)	Total Length of Streams (feet)	Total Number of Outfalls[b]
Bennett Creek	2,102	1,604	42,099	331,209	41
Blockhouse Point Tributaries	1,207	255	11,365	118,304	5
Broad Run	6,078	1,785	107,542	435,534	51
Cabin John Creek	628,437	23,469	131,620	405,375	922
Edwards Ferry Tributaries	0	439	0	144,599	8
Fahrney Branch	41	342	3,656	25,647	3
Hawlings River - James Creek	93,094	2,647	38,205	105,301	175
Hawlings River - Reddy Branch	48,454	963	24,220	99,104	232
Horsepen Branch	9,331	3,845	36,915	640,045	104
Little Bennett Creek	23,188	4,017	23,700	705,580	139
Little Falls Branch	246,495	11,875	28,703	107,978	332
Little Monocacy River	1,817	2,635	101,052	660,176	33
Little Paint Branch	182,173	2,310	17,852	124,561	229
Little Seneca Creek	557,065	11,618	62,456	507,738	591
Little Seneca Creek - Bucklodge Branch	1,111	2,155	37,479	294,192	50
Little Seneca Creek - Ten Mile Creek	12,626	1,481	0	204,944	89
Lower Brighton Dam	6,664	418	46,275	261,492	23
Lower Dry Seneca Creek	3,370	962	42,685	290,190	26
Lower Great Seneca Creek	100,948	3,289	93,880	348,296	252
Lower Hawlings River	15,260	641	36,465	111,479	60
Lower Patuxent River - Rocky Gorge	8,906	2,246	56,780	407,018	51
Lower Rock Creek	712,231	12,778	90,867	217,790	742
Lower Seneca Creek	12,873	1,154	31,878	229,312	67
Middle Great Seneca Creek	381,865	6,608	129,623	323,010	459
Middle Great Seneca Creek - Cabin Branch	161,601	3,793	49,172	102,490	202
Middle Great Seneca Creek - Whetstone Run	141,893	3,094	34,372	74,786	145
Middle Rock Creek	406,460	7,591	67,431	226,348	349
Monocacy Direct	0	210	0	32,539	1
Muddy Branch	319,540	13,966	105,203	430,215	613
Northwest Branch	376,599	11,329	61,715	329,507	673
Northwest Branch - Batchellors Run	39,163	4,657	52,549	119,880	147
Northwest Branch - Bel Pre Creek	143,286	4,709	14,761	76,857	210
Northwest Branch - Right Fork	63,989	3,193	56,894	161,859	273
Paint Branch	348,738	9,843	77,353	329,612	562
Quarry Branch	0	2,015	0	355,051	35
Rock Creek D.C.	69,523	264	9,600	16,285	46
Rock Run	126,145	11,173	36,192	352,688	503
Sligo Creek	276,532	2,938	41,874	95,080	340
South Branch Patapsco	0	0	0	0	0
Upper Brighton Dam	1,982	1,629	100,163	415,782	71
Upper Dry Seneca Creek	12,762	1,960	87,463	489,120	41
Upper Great Seneca Creek	94,831	4,167	65,791	390,286	358
Upper Great Seneca Creek - Goshen Branch	51,165	1,485	46,667	215,055	175

Watershed	Total Length of Stormwater Pipes (feet)	Total Length of Stormwater Culverts (feet)	Total Length of Streams within FEMA Zones[a] (feet)	Total Length of Streams (feet)	Total Number of Outfalls[b]
Upper Great Seneca Creek - Wildcat Branch	17,407	1,647	10,617	80,435	96
Upper Hawlings River	25,897	1,615	30,961	431,830	156
Upper Rock Creek	85,499	2,444	60,441	208,064	253
Upper Rock Creek - Mill Creek	110,671	5,253	0	68,093	397
Upper Rock Creek - North Branch	219,007	9,038	107,300	280,679	673
Watts Branch	285,705	12,056	172,309	476,893	601
Grand Total	**6,433,732**	**219,605**	**2,484,148**	**12,858,310**	**11,604**

[a] FEMA ZONE X: AREA OF MINIMAL FLOOD HAZARD was omitted because no FEMA modeling is completed in these areas.

[b] GIS Data for Culvert Exits was used for identifying outfalls. There was no provided data strictly for structures defined as outfalls.

Table 5-3. Stormwater Pipe Diameter Total Lengths Countywide Summary

Watershed	Diameter between 12 inches and 24 inches (feet)	Diameter between 24 inches and 36 inches (feet)	Diameter between 36 inches and 72 inches (feet)	Diameter greater than 72 inches (feet)
Bennett Creek	1,559	109	0	0
Blockhouse Point Tributaries	208	0	0	0
Broad Run	3,075	1,924	874	0
Cabin John Creek	307,203	151,443	106,180	17,283
Edwards Ferry Tributaries	0	0	0	0
Fahrney Branch	0	0	0	0
Hawlings River - James Creek	52,137	16,196	11,398	540
Hawlings River - Reddy Branch	23,649	16,054	6,201	1,831
Horsepen Branch	8,088	1,188	56	0
Little Bennett Creek	15,776	5,351	1,597	0
Little Falls Branch	114,118	62,249	31,004	4,207
Little Monocacy River	527	903	0	293
Little Paint Branch	95,691	44,484	18,451	4,745
Little Seneca Creek	302,032	113,335	69,657	852
Little Seneca Creek - Bucklodge Branch	459	380	148	0
Little Seneca Creek - Ten Mile Creek	7,307	1,809	1,267	0
Lower Brighton Dam	6,513	656	84	0
Lower Dry Seneca Creek	2,209	239	870	0
Lower Great Seneca Creek	53,848	26,904	12,812	1,418
Lower Hawlings River	8,761	1,395	0	0
Lower Patuxent River - Rocky Gorge	3,891	1,097	498	0
Lower Rock Creek	379,488	147,359	110,831	12,420
Lower Seneca Creek	8,850	2,067	110	0
Middle Great Seneca Creek	173,772	68,167	30,732	1,365
Middle Great Seneca Creek - Cabin Branch	52,705	25,314	11,041	176
Middle Great Seneca Creek - Whetstone Run	48,873	19,752	6,677	169
Middle Rock Creek	200,379	90,866	57,263	5,520
Monocacy Direct	0	0	0	0
Muddy Branch	166,500	54,246	37,253	1,870
Northwest Branch	199,656	88,035	35,092	291
Northwest Branch - Batchellors Run	22,383	7,918	2,910	0
Northwest Branch - Bel Pre Creek	78,398	33,561	12,312	2,529
Northwest Branch - Right Fork	35,057	15,152	8,095	97
Paint Branch	160,844	75,489	57,199	7,496
Quarry Branch	0	0	0	0
Rock Creek D.C.	33,409	16,534	11,848	1,184

Rock Run	68,226	19,943	15,741	66
Sligo Creek	128,563	69,653	50,447	7,996
South Branch Patapsco	0	0	0	0
Upper Brighton Dam	1,692	218	60	0
Upper Dry Seneca Creek	6,416	3,810	2,109	0
Upper Great Seneca Creek	54,134	17,395	5,753	341
Upper Great Seneca Creek - Goshen Branch	32,305	13,321	2,062	0
Upper Great Seneca Creek - Wildcat Branch	10,102	4,546	2,192	0
Upper Hawlings River	15,231	6,622	2,675	0
Upper Rock Creek	45,345	13,987	2,747	0
Upper Rock Creek - Mill Creek	56,264	32,939	14,360	1,630
Upper Rock Creek - North Branch	111,852	39,811	21,319	923
Watts Branch	175,376	64,562	31,158	938
Grand Total	**3,272,871**	**1,376,980**	**793,083**	**76,179**

Table 5-4 Summary of Stormwater Pipes and Data Gaps

Watershed	Total Number of Pipe Segments	Number of Pipe Segments with Diameter Data Gaps	% of Pipe Segments with Diameter Gaps	Number of Pipe Segments with Slope Data Gaps	% of Pipe Segments with Pipe Slope Data Gaps	Number of Pipe Segments with Upstream Invert Data Gaps	% of Pipe Segments with Upstream Invert Gaps	Number of Pipe Segments with Downstream Invert Data Gaps	% of Pipe Segments with Downstream Invert Gaps
Bennett Creek	23	5	22%	12	52%	21	91%	21	91%
Blockhouse Point Tributaries	14	10	71%	12	86%	14	100%	14	100%
Broad Run	69	0	0%	18	26%	46	67%	46	67%
Cabin John Creek	6994	480	7%	2272	32%	5,299	76%	5,327	76%
Edwards Ferry Tributaries	0	0	0%	0	0%	0	0%	0	0%
Fahrney Branch	1	1	100%	1	100%	1	100%	1	100%
Hawlings River - James Creek	1073	116	11%	216	20%	860	80%	866	81%
Hawlings River - Reddy Branch	446	3	1%	45	10%	422	95%	422	95%
Horsepen Branch	78	0	0%	24	31%	70	90%	70	90%
Little Bennett Creek	275	8	3%	34	12%	90	33%	89	32%
Little Falls Branch	2879	395	14%	2253	78%	1,395	48%	1,526	53%
Little Monocacy River	21	3	14%	6	29%	20	95%	20	95%
Little Paint Branch	1997	176	9%	687	34%	1,478	74%	1,489	75%
Little Seneca Creek	6738	704	10%	1386	21%	2,688	40%	2,685	40%
Little Seneca Creek - Bucklodge Branch	21	0	0%	3	14%	15	71%	16	76%
Little Seneca Creek - Ten Mile Creek	209	9	4%	74	35%	165	79%	165	79%
Lower Brighton Dam	65	3	5%	5	8%	12	18%	12	18%
Lower Dry Seneca Creek	29	0	0%	2	7%	29	100%	29	100%
Lower Great Seneca Creek	1072	31	3%	283	26%	841	78%	840	78%
Lower Hawlings River	159	44	28%	67	42%	108	68%	109	69%
Lower Patuxent River - Rocky Gorge	99	27	27%	45	45%	32	32%	32	32%
Lower Rock Creek	8783	574	7%	3655	42%	7,421	84%	7,446	85%
Lower Seneca Creek	146	16	11%	27	18%	83	57%	83	57%
Middle Great Seneca Creek	4133	921	22%	1439	35%	3,736	90%	3,736	90%
Middle Great Seneca Creek - Cabin Branch	1782	737	41%	936	53%	1,633	92%	1,631	92%
Middle Great Seneca Creek - Whetstone Run	1447	611	42%	874	60%	1,362	94%	1,361	94%
Middle Rock Creek	4524	540	12%	1265	28%	3,915	87%	3,897	86%
Monocacy Direct	0	0	0%	0	0%	0	0%	0	0%
Muddy Branch	3817	751	20%	1696	44%	3,166	83%	3,157	83%
Northwest Branch	4007	424	11%	1634	41%	3,281	82%	3,282	82%
Northwest Branch - Batchellors Run	424	58	14%	138	33%	226	53%	217	51%
Northwest Branch - Bel Pre Creek	1673	152	9%	601	36%	1,199	72%	1,190	71%
Northwest Branch - Right Fork	685	23	3%	101	15%	461	67%	459	67%
Paint Branch	3660	446	12%	1524	42%	3,051	83%	3,027	83%

Watershed	Total Number of Pipe Segments	Number of Pipe Segments with Diameter Data Gaps	% of Pipe Segments with Diameter Gaps	Number of Pipe Segments with Slope Data Gaps	% of Pipe Segments with Pipe Slope Data Gaps	Number of Pipe Segments with Upstream Invert Data Gaps	% of Pipe Segments with Upstream Invert Gaps	Number of Pipe Segments with Downstream Invert Data Gaps	% of Pipe Segments with Downstream Invert Gaps
Quarry Branch	0	0	0%	0	0%	0	0%	0	0%
Rock Creek D.C.	965	71	7%	440	46%	779	81%	786	81%
Rock Run	1341	232	17%	639	48%	1,031	77%	1,046	78%
Sligo Creek	3458	200	6%	1605	46%	2,739	79%	2,740	79%
South Branch Patapsco	0	0	0%	0	0%	0	0%	0	0%
Upper Brighton Dam	29	0	0%	6	21%	21	72%	21	72%
Upper Dry Seneca Creek	125	1	1%	92	74%	105	84%	104	83%
Upper Great Seneca Creek	983	180	18%	325	33%	749	76%	752	77%
Upper Great Seneca Creek - Goshen Branch	505	27	5%	74	15%	368	73%	369	73%
Upper Great Seneca Creek - Wildcat Branch	167	4	2%	47	28%	165	99%	166	99%
Upper Hawlings River	224	12	5%	16	7%	95	42%	95	42%
Upper Rock Creek	920	198	22%	337	37%	577	63%	579	63%
Upper Rock Creek - Mill Creek	1164	27	2%	285	24%	888	76%	886	76%
Upper Rock Creek - North Branch	2292	365	16%	581	25%	1,743	76%	1,746	76%
Watts Branch	3036	89	3%	775	26%	2,497	82%	2,507	83%
Grand Total	**72,552**	**8,674**	**12%**	**26,557**	**37%**	**54,897**	**76%**	**55,062**	**76%**

Table 5-5. Summary of Stormwater Pipes and Data Gaps for Diameters Greater than 36 inches

Watershed	Number of Pipes	Number of Pipes with Slope Gaps	% of Pipes with Slope Data Gaps	Number of Pipes with US Invert Gaps	% of Pipes with US Invert Data Gaps	Number of Pipes with DS Invert Gaps	% of Pipes with DS Invert Data Gaps
Bennett Creek	18	7	39%	16	89%	16	89%
Blockhouse Point Tributaries	4	2	50%	4	100%	4	100%
Broad Run	69	18	26%	46	67%	46	67%
Cabin John Creek	6,511	1,789	27%	4,820	74%	4,850	74%
Edwards Ferry Tributaries	0	0	0%	0	0%	0	0%
Fahrney Branch	0	0	0%	0	0%	0	0%
Hawlings River - James Creek	957	100	10%	744	78%	750	78%
Hawlings River - Reddy Branch	443	42	9%	419	95%	419	95%
Horsepen Branch	78	24	31%	70	90%	70	90%
Little Bennett Creek	266	25	9%	81	30%	80	30%
Little Falls Branch	2,484	1,858	75%	1,001	40%	1,133	46%
Little Monocacy River	18	3	17%	17	94%	17	94%
Little Paint Branch	1,820	511	28%	1,305	72%	1,316	72%
Little Seneca Creek	6,030	678	11%	1,980	33%	1,978	33%
Little Seneca Creek - Bucklodge Branch	21	3	14%	15	71%	16	76%
Little Seneca Creek - Ten Mile Creek	200	65	33%	156	78%	156	78%
Lower Brighton Dam	62	2	3%	9	15%	9	15%
Lower Dry Seneca Creek	29	2	7%	29	100%	29	100%
Lower Great Seneca Creek	1,041	252	24%	810	78%	809	78%
Lower Hawlings River	115	23	20%	64	56%	65	57%
Lower Patuxent River - Rocky Gorge	72	19	26%	6	8%	6	8%
Lower Rock Creek	8,208	3,080	38%	6,850	83%	6,874	84%
Lower Seneca Creek	130	11	8%	67	52%	67	52%
Middle Great Seneca Creek	3,212	518	16%	2,815	88%	2,815	88%
Middle Great Seneca Creek - Cabin Branch	1,045	199	19%	896	86%	894	86%
Middle Great Seneca Creek - Whetstone Run	836	263	31%	752	90%	751	90%
Middle Rock Creek	3,984	725	18%	3,375	85%	3,357	84%
Monocacy Direct	0	0	0%	0	0%	0	0%
Muddy Branch	3,066	945	31%	2,415	79%	2,406	78%
Northwest Branch	3,583	1,212	34%	2,858	80%	2,859	80%
Northwest Branch - Batchellors Run	366	81	22%	169	46%	160	44%
Northwest Branch - Bel Pre Creek	1,521	449	30%	1,047	69%	1,038	68%
Northwest Branch - Right Fork	662	78	12%	438	66%	436	66%
Paint Branch	3,214	1,078	34%	2,606	81%	2,583	80%
Quarry Branch	0	0	0%	0	0%	0	0%
Rock Creek D.C.	894	369	41%	708	79%	715	80%

Watershed	Number of Pipes	Number of Pipes with Slope Gaps	% of Pipes with Slope Data Gaps	Number of Pipes with US Invert Gaps	% of Pipes with US Invert Data Gaps	Number of Pipes with DS Invert Gaps	% of Pipes with DS Invert Data Gaps
Rock Run	1,109	408	37%	799	72%	816	74%
Sligo Creek	3,258	1,406	43%	2,539	78%	2,542	78%
South Branch Patapsco	0	0	0%	0	0%	0	0%
Upper Brighton Dam	29	6	21%	21	72%	21	72%
Upper Dry Seneca Creek	124	91	73%	104	84%	103	83%
Upper Great Seneca Creek	803	145	18%	569	71%	572	71%
Upper Great Seneca Creek - Goshen Branch	478	47	10%	341	71%	342	72%
Upper Great Seneca Creek - Wildcat Branch	163	43	26%	161	99%	162	99%
Upper Hawlings River	212	4	2%	83	39%	83	39%
Upper Rock Creek	721	138	19%	378	52%	380	53%
Upper Rock Creek - Mill Creek	1,137	258	23%	861	76%	859	76%
Upper Rock Creek - North Branch	1,927	216	11%	1,378	72%	1,381	72%
Watts Branch	2,946	686	23%	2,407	82%	2,417	82%
Grand Total	**63,866**	**17,879**	**28%**	**46,229**	**72%**	**46,402**	**73%**

Table 5-6. Summary of Stormwater Inlets and Data Gaps

Watershed	Total Number of Inlets	Number of Top of Grate Data Gaps	% of Inlets with Top of Grate Data Gaps	Number of Inlets with Invert Elevation Data Gaps	% of Inlets with Invert Elevation Data Gaps	Number of Inlets with Inlet Type Data Gaps	% of Inlets with Inlet Type Data Gaps
Bennett Creek	21	11	52%	6	29%	8	38%
Blockhouse Point Tributaries	14	10	71%	10	71%	10	71%
Broad Run	49	14	29%	18	37%	28	57%
Cabin John Creek	3,996	1,383	35%	712	18%	850	21%
Edwards Ferry Tributaries	0	0	0%	0	0%	0	0%
Fahrney Branch	0	0	0%	0	0%	0	0%
Hawlings River - James Creek	624	175	28%	219	35%	213	34%
Hawlings River - Reddy Branch	315	220	70%	18	6%	42	13%
Horsepen Branch	36	13	36%	4	11%	0	0%
Little Bennett Creek	173	64	37%	108	62%	115	66%
Little Falls Branch	1,716	808	47%	401	23%	433	25%
Little Monocacy River	14	4	29%	2	14%	2	14%
Little Paint Branch	1,167	852	73%	220	19%	499	43%
Little Seneca Creek	4,233	1,518	36%	3,274	77%	2,785	66%
Little Seneca Creek - Bucklodge Branch	9	5	56%	4	44%	0	0%
Little Seneca Creek - Ten Mile Creek	93	45	48%	41	44%	46	49%
Lower Brighton Dam	39	10	26%	34	87%	32	82%
Lower Dry Seneca Creek	8	2	25%	1	13%	2	25%
Lower Great Seneca Creek	606	280	46%	202	33%	193	32%
Lower Hawlings River	99	52	53%	59	60%	61	62%
Lower Patuxent River - Rocky Gorge	70	37	53%	56	80%	54	77%
Lower Rock Creek	5,260	2,380	45%	1,061	20%	1,386	26%
Lower Seneca Creek	109	85	78%	58	53%	45	41%
Middle Great Seneca Creek	2,408	1,025	43%	959	40%	1,269	53%
Middle Great Seneca Creek - Cabin Branch	1,179	712	60%	604	51%	757	64%
Middle Great Seneca Creek - Whetstone Run	1,019	538	53%	472	46%	523	51%
Middle Rock Creek	2,855	1,036	36%	608	21%	866	30%
Monocacy Direct	0	0	0%	0	0%	0	0%
Muddy Branch	2,097	1,057	50%	686	33%	828	39%
Northwest Branch	2,447	977	40%	591	24%	575	23%
Northwest Branch - Batchellors Run	294	139	47%	171	58%	145	49%
Northwest Branch - Bel Pre Creek	980	468	48%	366	37%	390	40%
Northwest Branch - Right Fork	432	134	31%	199	46%	182	42%
Paint Branch	2,117	905	43%	424	20%	764	36%
Quarry Branch	1	1	100%	1	100%	1	100%
Rock Creek D.C.	511	261	51%	151	30%	175	34%

Watershed	Total Number of Inlets	Number of Top of Grate Data Gaps	% of Inlets with Top of Grate Data Gaps	Number of Inlets with Invert Elevation Data Gaps	% of Inlets with Invert Elevation Data Gaps	Number of Inlets with Inlet Type Data Gaps	% of Inlets with Inlet Type Data Gaps
Rock Run	840	460	55%	181	22%	243	29%
Sligo Creek	2,181	1,022	47%	640	29%	476	22%
South Branch Patapsco	0	0	0%	0	0%	0	0%
Upper Brighton Dam	18	9	50%	2	11%	2	11%
Upper Dry Seneca Creek	86	79	92%	9	10%	71	83%
Upper Great Seneca Creek	609	357	59%	185	30%	206	34%
Upper Great Seneca Creek - Goshen Branch	316	186	59%	111	35%	105	33%
Upper Great Seneca Creek - Wildcat Branch	99	87	88%	26	26%	15	15%
Upper Hawlings River	135	79	59%	75	56%	44	33%
Upper Rock Creek	545	302	55%	274	50%	375	69%
Upper Rock Creek - Mill Creek	734	234	32%	142	19%	179	24%
Upper Rock Creek - North Branch	1,422	683	48%	373	26%	591	42%
Watts Branch	1,799	745	41%	386	21%	442	25%
Grand Total	**43,775**	**19,464**	**44%**	**14,144**	**32%**	**16,028**	**37%**

Table 5-7. Summary of Stormwater Manholes and Data Gaps

Watershed	Total Number of Manholes	Number of Rim Elevation Data Gaps	% of Manholes with Rim Elevation Data Gaps	Number of Invert Elevation Data Gaps	% of Manholes with Invert Elevation Data Gaps
Bennett Creek	5	5	100%	0	0%
Blockhouse Point Tributaries	1	1	100%	1	100%
Broad Run	14	8	57%	10	71%
Cabin John Creek	1,793	1181	66%	500	28%
Edwards Ferry Tributaries	0	0	0%	0	0%
Fahrney Branch	0	0	0%	0	0%
Hawlings River - James Creek	308	222	72%	113	37%
Hawlings River - Reddy Branch	65	59	91%	9	14%
Horsepen Branch	39	36	92%	26	67%
Little Bennett Creek	101	16	16%	94	93%
Little Falls Branch	763	527	69%	277	36%
Little Monocacy River	7	7	100%	0	0%
Little Paint Branch	555	390	70%	199	36%
Little Seneca Creek	2,492	858	34%	2016	81%
Little Seneca Creek - Bucklodge Branch	4	4	100%	0	0%
Little Seneca Creek - Ten Mile Creek	57	44	77%	29	51%
Lower Brighton Dam	24	1	4%	23	96%
Lower Dry Seneca Creek	5	5	100%	0	0%
Lower Great Seneca Creek	333	185	56%	167	50%
Lower Hawlings River	44	26	59%	27	61%
Lower Patuxent River - Rocky Gorge	23	1	4%	21	91%
Lower Rock Creek	2,065	1297	63%	652	32%
Lower Seneca Creek	31	15	48%	17	55%
Middle Great Seneca Creek	1,162	980	84%	440	38%
Middle Great Seneca Creek - Cabin Branch	404	315	78%	163	40%
Middle Great Seneca Creek - Whetstone Run	317	243	77%	145	46%
Middle Rock Creek	970	701	72%	367	38%
Monocacy Direct	0	0	0%	0	0%
Muddy Branch	1,064	652	61%	484	45%
Northwest Branch	990	617	62%	309	31%
Northwest Branch - Batchellors Run	95	26	27%	73	77%
Northwest Branch - Bel Pre Creek	531	274	52%	292	55%
Northwest Branch - Right Fork	128	68	53%	65	51%
Paint Branch	890	569	64%	361	41%
Quarry Branch	0	0	0%	0	0%
Rock Creek D.C.	327	201	61%	109	33%

Watershed	Total Number of Manholes	Number of Rim Elevation Data Gaps	% of Manholes with Rim Elevation Data Gaps	Number of Invert Elevation Data Gaps	% of Manholes with Invert Elevation Data Gaps
Rock Run	342	277	81%	96	28%
Sligo Creek	847	442	52%	285	34%
South Branch Patapsco	0	0	0%	0	0%
Upper Brighton Dam	4	4	100%	0	0%
Upper Dry Seneca Creek	23	18	78%	18	78%
Upper Great Seneca Creek	268	207	77%	81	30%
Upper Great Seneca Creek - Goshen Branch	156	102	65%	63	40%
Upper Great Seneca Creek - Wildcat Branch	45	36	80%	11	24%
Upper Hawlings River	72	21	29%	54	75%
Upper Rock Creek	244	116	48%	170	70%
Upper Rock Creek - Mill Creek	295	188	64%	74	25%
Upper Rock Creek - North Branch	628	436	69%	304	48%
Watts Branch	873	637	73%	266	30%
Grand Total	**19,404**	**12,018**	**62%**	**8,411**	**43%**

Table 5-8. Summary of Stormwater Culverts and Data Gaps

Watershed	Number of Stormwater Culverts	Total Length of Culverts (feet)	Number of Culverts with Diameter Gaps	% of Culverts with Diameter Data Gaps	Number of Slope Data Gaps	% of Culverts with Slope Data Gaps	Number of US Invert Data Gaps	% of Culverts with US INV Data Gaps	Number of DS Invert Data Gaps	% of Culverts with DS Invert Data Gaps
Bennett Creek	43	1,604	1	2%	43	100%	18	42%	17	40%
Blockhouse Point Tributaries	2	255	0	0%	1	50%	2	100%	2	100%
Broad Run	52	1,785	3	6%	50	96%	9	17%	9	17%
Cabin John Creek	281	23,469	62	22%	163	58%	144	51%	143	51%
Edwards Ferry Tributaries	14	439	1	7%	14	100%	6	43%	6	43%
Fahrney Branch	4	342	1	25%	3	75%	3	75%	3	75%
Hawlings River - James Creek	25	2,647	9	36%	18	72%	15	60%	15	60%
Hawlings River - Reddy Branch	20	963	5	25%	20	100%	10	50%	10	50%
Horsepen Branch	94	3,845	7	7%	94	100%	27	29%	27	29%
Little Bennett Creek	106	4,017	12	11%	98	92%	45	42%	46	43%
Little Falls Branch	111	11,875	36	32%	88	79%	75	68%	75	68%
Little Monocacy River	60	2,635	16	27%	60	100%	24	40%	24	40%
Little Paint Branch	29	2,310	15	52%	19	66%	23	79%	23	79%
Little Seneca Creek	111	11,618	22	20%	66	59%	45	41%	44	40%
Little Seneca Creek - Bucklodge Branch	65	2,155	7	11%	65	100%	32	49%	33	51%
Little Seneca Creek - Ten Mile Creek	35	1,481	8	23%	34	97%	20	57%	20	57%
Lower Brighton Dam	7	418	5	71%	7	100%	6	86%	6	86%
Lower Dry Seneca Creek	29	962	3	10%	29	100%	12	41%	12	41%
Lower Great Seneca Creek	36	3,289	5	14%	21	58%	27	75%	27	75%
Lower Hawlings River	14	641	5	36%	12	86%	7	50%	7	50%
Lower Patuxent River - Rocky Gorge	35	2,246	17	49%	34	97%	29	83%	29	83%
Lower Rock Creek	149	12,778	36	24%	114	77%	106	71%	105	70%
Lower Seneca Creek	25	1,154	5	20%	22	88%	13	52%	13	52%
Middle Great Seneca Creek	73	6,608	6	8%	54	74%	38	52%	37	51%
Middle Great Seneca Creek - Cabin Branch	36	3,793	9	25%	18	50%	15	42%	15	42%
Middle Great Seneca Creek - Whetstone Run	21	3,094	8	38%	14	67%	13	62%	13	62%
Middle Rock Creek	52	7,591	22	42%	42	81%	40	77%	38	73%
Monocacy Direct	4	210	1	25%	4	100%	1	25%	2	50%
Muddy Branch	145	13,966	39	27%	107	74%	97	67%	97	67%
Northwest Branch	148	11,329	34	23%	100	68%	84	57%	81	55%
Northwest Branch - Batchellors Run	63	4,657	22	35%	46	73%	34	54%	34	54%
Northwest Branch - Bel Pre Creek	44	4,709	7	16%	22	50%	32	73%	30	68%
Northwest Branch - Right Fork	38	3,193	16	42%	25	66%	27	71%	26	68%

Watershed	Number of Stormwater Culverts	Total Length of Culverts (feet)	Number of Culverts with Diameter Gaps	% of Culverts with Diameter Data Gaps	Number of Slope Data Gaps	% of Culverts with Slope Data Gaps	Number of US Invert Data Gaps	% of Culverts with US INV Data Gaps	Number of DS Invert Data Gaps	% of Culverts with DS Invert Data Gaps
Paint Branch	166	9,843	37	22%	102	61%	93	56%	96	58%
Quarry Branch	49	2,015	7	14%	49	100%	15	31%	14	29%
Rock Creek D.C.	5	264	1	20%	5	100%	2	40%	2	40%
Rock Run	136	11,173	45	33%	135	99%	69	51%	66	49%
Sligo Creek	44	2,938	15	34%	41	93%	33	75%	32	73%
South Branch Patapsco	0	0	0	0%	0	0%	0	0%	0	0%
Upper Brighton Dam	37	1,629	2	5%	34	92%	5	14%	6	16%
Upper Dry Seneca Creek	37	1,960	9	24%	34	92%	18	49%	18	49%
Upper Great Seneca Creek	77	4,167	6	8%	59	77%	21	27%	22	29%
Upper Great Seneca Creek - Goshen Branch	25	1,485	2	8%	24	96%	10	40%	10	40%
Upper Great Seneca Creek - Wildcat Branch	41	1,647	2	5%	38	93%	25	61%	25	61%
Upper Hawlings River	39	1,615	4	10%	39	100%	24	62%	24	62%
Upper Rock Creek	36	2,444	6	17%	24	67%	13	36%	13	36%
Upper Rock Creek - Mill Creek	47	5,253	7	15%	19	40%	27	57%	26	55%
Upper Rock Creek - North Branch	133	9,038	37	28%	86	65%	65	49%	65	49%
Watts Branch	174	12,056	29	17%	124	71%	75	43%	75	43%
Grand Total	**3,017**	**219,605**	**654**	**22%**	**2,320**	**77%**	**1,574**	**52%**	**1,563**	**52%**

5.2.3 Local Municipalities

Stormwater data were collected from Kensington, Poolesville, Takoma Park, Rockville and Gaithersburg. Data were not provided for other jurisdictions, most of which is contained within the Countywide data sets. Discussions with County staff revealed that the Rockville and Gaithersburg municipalities are in the process of completing their own localized stormwater studies. Because of this, these two municipalities were not analyzed. The data provided by other municipalities included pipe location, identification (ID), and diameter, but no other pipe dimensions were included. In addition, stormwater structures data provided by municipalities contained structure types, IDs, and locations but no rim or invert elevation data were provided. The total length of pipe and number of stormwater structures in each municipalities data set are summarized in the **Table 5-9**.

Table 5-9. Quantities from provided Local Municipality stormwater data

Municipality	Total Length of Pipe (feet)	Total Number of Stormwater Structures
Kensington	31,522	411
Poolesville	86,402	741
Takoma Park	86,752	1,124

5.3 Discussion

5.3.1 County Stormwater Infrastructure Data Management

Storm drain component data are generally owned by MCDOT DTE Survey Division. Discussions with survey staff indicate that funding is dedicated to addressing gaps in the data. Historically, the storm culvert dataset was prioritized, and all gaps have been addressed. Further completion of data gaps in the storm drain layer is prioritized geographically using a MCDOT survey grid layer. Discussions with survey staff indicate that the survey crews are working through this grid, generally from south to north. This is because of the density and age (density of gaps) of infrastructure in the southern areas of the County. MCDOT survey staff are currently working to address gaps in asset databases.

MCDOT survey manages the data through use of several layers. One set of layers is actively updated by field crews. Another set of layers is updated with DPS and MCDEP information on permitted facilities. The MCDOT field crew data layers are "pushed" into the "Master" layers on a regular basis. The permitted facilities layers are moved into the "master" layers once they are constructed. MCDOT survey maintains a dashboard that is updated in real-time based on the content of the "Master" layers.

Stormwater management facility (Best Management Practice [BMP]) data are managed by MCDEP GIS.

5.3.2 Discussion of Engineering Data Gaps

Based on review of the data available, there are significant data gaps that will need to be addressed through the survey, digitizing of as-built plans, or the assumptions made. An enumeration of several observed gaps and potential solutions are included in **Table 5-10**.

It is noted that there may be existing infrastructure not contained in the GIS layers reviewed to date. While it is understood that some layers are of good quality (culverts, for example), the storm drain pipes and manholes may not capture all in-ground assets; therefore, the gaps associated with those elements are not addressed in this document.

Table 5-10. Observed 2-D Modeling Data Gaps and Potential Solutions

Issue or Concern	Potential Solution
No indication of upstream or downstream structure IDs on pipes or culverts.	This could be automated based on digitizing direction, however digitizing direction does not consistently follow flow direction. Manual assessment may be required.
Current GIS stormwater pipe data does not provide any indication if more than one barrel is present for a given stormwater pipe.	Unless additional information is provided, this gap may need to be solved by assuming all are single barrel, with some targeted surveying.
Current GIS stormwater pipes data does not provide information on pipe shape.	Can assume all are circular if equal height and width, or rectangular if dimensions are not equal.
Culvert Exits GIS layer is the only known data set of outfalls, and many pipes have no exit structure defined. Are there any flap gates?	Culvert exits can be used; however, data gaps are present. Surveying will address this issue.
Limited structural data for stormwater control structures within the County.	It is assumed the asbuilt review and field verification of structural conditions for control structures may be needed.
Local municipality data is of varying quality and completeness.	In prioritized watersheds, local municipality data can be collected and reviewed.
There is no known stream cross section data outside of FEMA study areas.	Stream cross sections may need to be collected via survey or estimated based on DEM data.
There is no stream layer suitable for 1-D modeling purposes outside of FEMA study areas.	Available stream alignment layers frequently, but inconsistently, contains multiple features (bank lines) for streams. If 1-D modeling is needed, a stream line may need to be developed using automated GIS processes and manual checking.
There is a high percentage of data gaps for stormwater structure invert elevations and top of structure elevations across most watersheds (43% of manholes and 32% of inlets missing data Countywide).	Digitizing of design plans or field survey will be needed to address invert data gaps. Top of Structure elevations could be populated from DEM. Surveying rims and top of grates and respective inverts at manholes and inlets would also solve data gaps in stormwater pipes.
There is a high percentage of data gaps for stormwater pipe upstream and downstream inverts across most watersheds (76% of pipes and 52% of culverts missing data Countywide).	Pipe inverts can be assumed to match the connected structure where data are available for the structure. Pipe inverts are generally recorded in the manhole database. Automated joining of these databases can population a good portion of inverts but there still remain significant gaps.

DEM = Digital elevation model

The following discussion items have been highlighted for further investigation before the completion of Task 6 of CFMP Phase 1, which includes providing an outline, timeline, and estimate for watershed detailed studies:

- Identify which watersheds that stormwater surveying priorities should be focused on, and within them which stormwater items are highest priority.
- Stay updated on any further local watershed studies that are predicted to start within the analysis phase of this project.
- If necessary, for stormwater items that are not able to be surveyed or that are chosen not to be surveyed, understand what sort of assumptions are reasonable and feasible to make to fill gaps.
- Discuss cost drivers for survey (such as, access and complexity of gaps, proximity of gaps to one another, confirm if smaller nonsignificant stormwater systems need to be surveyed, and determine any known cost-drivers for stream modeling).
- Understand how existing survey planning (utility location survey and existing MCDOT survey gap completion) may intersect with needs for detailed study.

6. Conclusions and Recommendations

Following the completion of this TM, the results of the watershed prioritization will be reviewed by County staff. It is expected that an understanding of the timeline needed to address both the quantified and less defined data gaps, as well as observations from County staff, may be integrated into a final prioritization that will be used to plan Phase 2 activities. Based on the outcome of watershed prioritization review, data gaps quantified in this TM will be used to develop a work plan (timeline, budget, and task breakdown) for priority watersheds.

7. References

Maryland Department of Planning (MDP). Land Cover and Land Use Data 2010. https://planning.maryland.gov/Pages/OurWork/landuse.aspx

U.S. Agency for Toxic Substances and Disease Registry (ATSDR). 2021. https://www.atsdr.cdc.gov/placeandhealth/svi/index.html

U.S. Census. 2010. https://www.census.gov/geographies/reference-maps/2010/geo/2010-census-block-maps.html

U.S. Census. 2020. https://www.census.gov/geographies/mapping-files/2010/geo/tiger-data.html

Attachment 1
Data Requested and Received

Attachment 1. Data Requested and Received

Table A1. Data Received and Collected

#	Item	Notes from Data Request	Date Received	Provided By	Department	Received
1	High resolution aerial photos	Jacobs received updated imagery from MCDEP in 2019	2019	MC	MCDEP	No
2	Digital elevation model (if MC has data more recent than 2018 M-NCPPC LiDAR)	Raster/grid format elevation model from processed LiDAR data (if MC has data more recent than 2018 M-NCPPC LiDAR). Jacobs received 2-foot contours from MCDEP in 2017	2017	MC	MCDEP	No
3	Processed LiDAR Data	Processed LiDAR point data (if MC has data more recent than 2018 M-NCPPC LiDAR)		NA Accessed		No
4	311 calls	Relating to flooding from storm events		MC	MC311	Yes
4a	311 calls - other jurisdictions				Not available	No
5	911 calls	Relating to flooding from storm events	2022	MC	MCPD	Yes
6	County storm drains / culverts	Including inverts and elevations, and physical condition, if available. Jacobs received County storm drain structure data via MCDEP in 2017 and some data via MC MCDOT in 2020.	2022	MC	MCDEP	Yes
7	SHA storm drains / culverts	Including inverts and elevations, and physical condition, if available. Jacobs received some SHA storm drain structures via MC MCDOT in 2020.	2022	MC/SHA	MCDOT	Yes
8	Incorporated jurisdiction's storm drains / culverts	City of Rockville, City of Gaithersburg, Town of Poolesville, etc. Including inverts and elevations, and physical condition, if available	2022	MC/Other	MCDEP	Partial
9	County stormwater BMP locations	Jacobs currently has BMP location from 2017 to2022	2022	MC	MCDEP	Yes
10	Land use		2022	MC	MCDEP	No
11	Zoning		2022	MC	MCDEP	No
12	Impervious Area		2022	MC	MCDEP	Yes
13	Critical Infrastructure	Specify type or provide examples of what MC considers "critical infrastructure"	NA	MC		No
14	SVI or social needs layers	County-generated SVI, social needs, or other georeferenced demographic information	2022	MC	MCDEP	Yes
15	Buildings	Including year built and ownership, if available	2022	MC	MCDEP	Yes
16	Parcels / Property boundaries	Including year platted and ownership, if available. Jacobs received parcel boundaries from MCDEP in 2017.	2017	MC	MCDEP	Yes
17	Available detailed flooding analyses completed by the County or other stakeholders	Any available flood studies conducted by MCDEP or other County agencies or stakeholders including GIS results geodatabase, if available: An Assessment of Maryland's Vulnerability to Flood Damage	2022	MD	MCDEP	Yes
18	Storm drainage condition assessment information	If not already included in Items 6, 7 and 8		MC		No
19	Environmental resources	Data delineating environmental resources of concern for the County (wetlands, stream buffers, etc.)		MC		No
20	Stormwater drainage design manuals (MC, M-NCPPC, SHA, local jurisdictions)		2022	MC		NA Accessed
21	Roadway Centerlines	Jacobs received street centerlines from MCDEP in 2017.	2017	MC	MCDEP	Yes
22	River, Lake, and Streams		2022	MC	MCDEP	Yes
23	Community / neighborhood boundaries		2022	MC	MCDEP	Yes
24	Commercial district boundaries			MC		No
25	Climate projections	County-derived climate change precipitation projections, if available. Jacobs does have climate projections for rainfall and temperature in the County from prior work.		MC	Not available	No
26	Update on pending FEMA studies	Information (extent, timeline, etc.) on pending FEMA studies (FIS updates or requested LOMRs)	2022	MC	DPS	Yes
27	Additional layers recommended for review by MCDEP	If there is information outside of these items that MCDEP uses for flood management (tracking events or responses, etc.) please include with a brief narrative		MC	MCDEP	NA
28	MCDEP SWM RFP - County Provided Projects		2021	MC	MCDEP	Yes
29	MCDEP SWM RFP - MogoCo_GIS Data RFP1124469.gdb		2021	MC	MCDEP	Yes

#	Item	Notes from Data Request	Date Received	Provided By	Department	Received
30	MCDEP SWM RFP - Suitability and Equity GIS		2021	MC	MCDEP	Yes
31	MCDEP SWM RFP -Watershed Assessments		2021	MC	MCDEP	Yes
32	DPS Design Manuals - Maryland Stormwater Design Manual.url		2022	MC	DPS	Yes
33	DPS Design Manuals - SWM Volume 1 and 2		2022	MC	DPS	Yes
34	DPS Design Manuals - Drainage Design Criteria		2022	MC	DPS	Yes
35	DPS MC Floodplain Policies		2022	MC	DPS	Yes
36	DPS Policy and Regulations - Montgomery County - Ch 19 ESC and SWM		2022	MC	DPS	Yes
37	DPS DFIRM Update Outreach		2022	MC	DPS	Yes
38	USGS NHD	From Jacobs Data Collection: NHDPLUS H_0206_0207_0208 HU4 and WBD_02_HU2	2022	USGS		Yes
39	FEMA NFHL	From Jacobs Data Collection, FEMA Flood Map Service Center	2022	FEMA		Yes
40	FEMA Flood Insurance Study	From Jacobs Data Collection, 2006 Effective FEMA FIS, FEMA Flood Map Service Center	2022	FEMA		Yes
41	Streams and wetlands	From Jacobs Data Collection; MD online data (data.imap.maryland.gov)	2022	MD		Yes
42	Watershed boundaries	From Jacobs Data Collection; MCDEP/Jacobs: Base GIS data, delineated DA for BMPs	2022	MC/Jacobs	MCDEP	Yes
43	National hydrography dataset		2022	USGS		
44	FEMA LOMR	From Jacobs Data Collection: Pending LOMR	2022	FEMA		Yes
45	FEMA Flood Risk Products	From Jacobs Data Collection: Flood Risk Maps (1), Flood Risk Reports (1), Flood Risk Database (3)	2022	FEMA		Yes
46	Gaithersburg Environmental Standards		2022	Gaithersburg	Department of Public Works	Yes
47	MCFRS: Street Flooding All Battalions	MC: MCFRS. Street Flooding Target Hazards	2022	MC	MCFRS	Yes
48	MCDOT Frequent Flood History	From MC: MCDOT	2022	MC	MCDOT	Yes
49	Sensor Locations	From MC: MCDOT	2022			Yes
50	M-NCPPC Parks GIS files	Shape files: bridges, farm ponds, SWM facilities	2022	MC	M-NCPPC Parks	Yes
51	MontgomeryCounty_MD_FRR_Presentation	Draft FEMA data from MCDEP	2022	MC	MCDEP	Yes
52	MCDEP Erosion Complaints	MCDEP Erosion Complaints from MCDEP	2022	MC	MCDEP	Yes
53	DAR Database	DAR received from MCDOT	2022	MC	MCDOT	Yes
54	MCDEP_GIS_Data_Aug2022	Received from MCDEP. Saved in 20220804_DEP_Facilities & Flood mapping.	2022	MC	MCDEP	Yes

BMP = Best management practice
DAR = Drainage Assistance Request
MCDOT = Department of Transportation
DPS = Department of Permitting Services
FEMA = Federal Emergency Management Agency
FIS = Flood Insurance Study
GIS = geographic information system
LiDAR = light detection and ranging
LOMR = letter of map revision
M-NCPPC = Montgomery-National Capital Park and Planning Commission
MC = Montgomery County
MCDEP = Montgomery County Department of Environmental Protection
MCFRS = Montgomery County Fire and Rescue
MD = Maryland
NA = Not applicable
NFHL = National Flood Hazard Layer
NHD = National Hydrography Dataset
RFP = Request for Proposal
SHA = State Highway Administration
SVI = social vulnerability index
SWM = Stormwater Management
USGS = United States Geological Survey

Attachment 2
Background on Preliminary Flood Zone Model Development

Attachment 2. Background on Preliminary Flood Zone Model Development

Attachment 3
Watershed Exposure Attribute Data

Attachment 3. Watershed Exposure Attribute Data

Watershed	FEMA 100- and 500-year Flood Extent Scenario						Flood Modeller ADI Preliminary 100-year 2065 Flood Extent Scenario					
	Impervious Area (acres)	Number of non-Residential Buildings	Number of Residential Buildings	Socially Vulnerable Area > 0.5 (acres)	Number of Critical Facilities	Wetland Area (acres)	Impervious Area (acres)	Number of non-Residential Buildings	Number of Residential Buildings	Socially Vulnerable Area > 0.5 (acres)	Number of Critical Facilities	Wetland Area (acres)
Bennett Creek	1.98	5.00	4.00	0.00	0.00	89.54	0.03	0.00	0.00	0.00	0.00	0.00
Blockhouse Point Tributaries	11.36	6.00	0.00	0.00	0.00	133.00	4.81	1.00	5.00	0.00	0.00	102.12
Broad Run	4.77	2.00	13.00	0.00	0.00	372.23	0.00	0.00	0.00	0.00	0.00	0.00
Cabin John Creek	87.42	24.00	261.00	29.93	1.00	160.24	725.30	304.00	3322.00	161.91	4.00	219.04
Edwards Ferry Tributaries	9.10	11.00	0.00	0.00	0.00	303.61	0.00	0.00	0.00	0.00	0.00	0.00
Fahrney Branch	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hawlings River - James Creek	3.24	2.00	31.00	0.00	0.00	58.54	40.80	65.00	146.00	0.00	0.00	83.90
Hawlings River - Reddy Branch	2.65	1.00	7.00	0.00	0.00	37.01	41.42	26.00	282.00	0.00	0.00	82.34
Horsepen Branch	6.31	2.00	8.00	0.00	0.00	1029.05	0.00	0.00	0.00	0.00	0.00	0.00
Little Bennett Creek	2.12	2.00	0.00	0.00	0.00	30.39	0.42	0.00	4.00	0.00	0.00	0.00
Little Falls Branch	37.19	50.00	83.00	0.00	1.00	89.13	299.01	437.00	1520.00	0.00	3.00	101.05
Little Monocacy River	2.58	1.00	3.00	0.00	0.00	254.71	0.00	0.00	0.00	0.00	0.00	0.00
Little Paint Branch	0.64	0.00	3.00	7.39	0.00	8.89	76.90	79.00	432.00	131.40	2.00	65.16
Little Seneca Creek	4.94	5.00	2.00	0.00	0.00	300.66	181.33	263.00	872.00	69.94	3.00	421.85
Little Seneca Creek - Bucklodge Branch	2.52	1.00	15.00	0.00	0.00	88.02	0.00	0.00	0.00	0.00	0.00	0.00
Little Seneca Creek - Ten Mile Creek	1.02	4.00	0.00	0.00	0.00	44.13	6.02	7.00	4.00	0.00	0.00	20.34
Lower Brighton Dam	3.87	3.00	5.00	0.00	0.00	73.37	0.00	0.00	0.00	0.00	0.00	0.00
Lower Dry Seneca Creek	3.56	1.00	7.00	0.00	0.00	112.00	0.00	0.00	0.00	0.00	0.00	0.00
Lower Great Seneca Creek	21.66	20.00	66.00	68.77	0.00	400.47	125.50	89.00	475.00	119.91	1.00	259.00
Lower Hawlings River	2.95	1.00	8.00	0.00	0.00	73.57	0.20	0.00	0.00	0.00	0.00	0.29
Lower Patuxent River - Rocky Gorge	2.73	6.00	3.00	0.00	0.00	68.76	2.18	1.00	2.00	0.00	0.00	0.00
Lower Rock Creek	78.21	16.00	141.00	257.70	0.00	130.79	726.23	718.00	4093.00	677.74	6.00	174.38
Lower Seneca Creek	7.05	18.00	3.00	0.00	0.00	257.49	0.09	0.00	1.00	0.00	0.00	0.00
Middle Great Seneca Creek	17.54	5.00	94.00	333.42	0.00	301.80	220.03	344.00	988.00	713.12	0.00	375.42
Middle Great Seneca Creek - Cabin Branch	6.97	2.00	114.00	86.78	0.00	47.54	76.01	36.00	709.00	165.76	0.00	62.04
Middle Great Seneca Creek - Whetstone Run	6.84	4.00	32.00	204.97	0.00	93.80	118.19	223.00	442.00	543.27	3.00	143.56
Middle Rock Creek	68.17	51.00	148.00	418.87	0.00	207.15	542.47	606.00	2434.00	1057.81	8.00	241.09
Monocacy Direct	0.60	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00
Muddy Branch	31.44	84.00	115.00	169.83	0.00	189.09	288.10	555.00	1208.00	341.37	0.00	344.57
Northwest Branch	16.68	6.00	15.00	211.56	0.00	180.85	299.51	136.00	1593.00	666.32	2.00	226.16
Northwest Branch - Batchellors Run	4.40	1.00	31.00	0.00	0.00	40.18	34.71	14.00	141.00	0.47	0.00	55.41

Watershed	FEMA 100- and 500-year Flood Extent Scenario						Flood Modeller ADI Preliminary 100-year 2065 Flood Extent Scenario					
	Impervious Area (acres)	Number of non-Residential Buildings	Number of Residential Buildings	Socially Vulnerable Area > 0.5 (acres)	Number of Critical Facilities	Wetland Area (acres)	Impervious Area (acres)	Number of non-Residential Buildings	Number of Residential Buildings	Socially Vulnerable Area > 0.5 (acres)	Number of Critical Facilities	Wetland Area (acres)
Northwest Branch - Bel Pre Creek	2.75	4.00	23.00	109.53	1.00	20.23	97.00	241.00	430.00	300.03	1.00	34.68
Northwest Branch - Right Fork	2.54	0.00	2.00	0.00	1.00	48.42	35.72	27.00	81.00	0.00	2.00	72.92
Paint Branch	8.45	6.00	16.00	95.03	0.00	160.69	210.93	115.00	1127.00	326.59	1.00	268.52
Quarry Branch	15.21	35.00	0.00	0.00	1.00	201.28	0.00	0.00	0.00	0.00	0.00	0.00
Rock Creek D.C.	10.13	7.00	26.00	29.57	0.00	6.84	78.07	96.00	529.00	56.34	1.00	6.95
Rock Run	14.37	15.00	8.00	0.00	0.00	132.02	128.10	91.00	543.00	0.00	1.00	161.17
Sligo Creek	37.85	8.00	54.00	84.88	0.00	24.15	367.57	364.00	2566.00	416.60	11.00	32.61
South Branch Patapsco	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Upper Brighton Dam	2.00	3.00	0.00	0.00	0.00	141.90	0.09	1.00	0.00	0.00	0.00	0.00
Upper Dry Seneca Creek	3.13	5.00	1.00	0.00	0.00	330.79	0.00	0.00	0.00	0.00	0.00	0.00
Upper Great Seneca Creek	4.16	2.00	5.00	0.00	0.00	196.03	65.25	72.00	386.00	0.00	0.00	344.32
Upper Great Seneca Creek - Goshen Branch	2.04	1.00	4.00	0.00	0.00	109.03	29.39	9.00	86.00	0.00	0.00	196.10
Upper Great Seneca Creek - Wildcat Branch	0.13	0.00	2.00	0.00	0.00	15.82	16.41	14.00	41.00	0.00	0.00	50.80
Upper Hawlings River	3.59	1.00	4.00	0.00	0.00	157.92	0.50	0.00	3.00	0.00	0.00	0.03
Upper Rock Creek	2.38	5.00	0.00	0.00	0.00	143.78	31.02	28.00	74.00	0.00	0.00	229.54
Upper Rock Creek - Mill Creek	0.00	0.00	0.00	0.00	0.00	18.16	74.67	54.00	409.00	7.46	0.00	77.90
Upper Rock Creek - North Branch	9.53	2.00	40.00	0.00	0.00	208.57	114.69	56.00	633.00	0.00	1.00	252.54
Watts Branch	15.07	8.00	45.00	6.48	0.00	204.79	312.75	151.00	1312.00	63.40	3.00	312.20

Attachment 4
Normalized Scores for Watershed Exposure Attributes

Attachment 4. Normalized Criteria Scores for Watershed Exposure Attributes

Watershed	FEMA Flood Extent Scenario						Flood Modeller Flood Extent Scenario					
	Number of Non-Residential Buildings within Flood Zone	Social Vuln. (acres SVI > 0.5) within Flood Zone	Number of Critical Facilities within Flood Zone	Total Impervious Area (acres)	Number of Residential Buildings within Flood Zone	Wetland areas (acres) within Flood Zone	Number of Non-Residential Buildings within Flood Zone	Social Vuln. (acres SVI > 0.5) within Flood Zone	Number of Critical Facilities within Flood Zone	Total Impervious Area (acres)	Number of Residential Buildings within Flood Zone	Wetland areas (acres) within Flood Zone
Bennett Creek	0.30	0.00	0.00	0.11	0.08	0.44	NA	NA	NA	NA	NA	NA
Blockhouse Point Tributaries	0.36	0.00	0.00	0.65	0.00	0.65	0.01	0.00	0.00	0.03	0.01	1.21
Broad Run	0.12	0.00	0.00	0.27	0.25	1.81	NA	NA	NA	NA	NA	NA
Cabin John Creek	1.43	0.36	5.00	5.00	5.00	0.78	2.12	0.77	1.82	4.99	4.06	2.60
Edwards Ferry Tributaries	0.65	0.00	0.00	0.52	0.00	1.48	NA	NA	NA	NA	NA	NA
Fahrney Branch	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	NA	NA
Hawlings River - James Creek	0.12	0.00	0.00	0.19	0.59	0.28	0.45	0.00	0.00	0.28	0.18	0.99
Hawlings River - Reddy Branch	0.06	0.00	0.00	0.15	0.13	0.18	0.18	0.00	0.00	0.29	0.34	0.98
Horsepen Branch	0.12	0.00	0.00	0.36	0.15	5.00	NA	NA	NA	NA	NA	NA
Little Bennett Creek	0.12	0.00	0.00	0.12	0.00	0.15	NA	NA	NA	NA	NA	NA
Little Falls Branch	2.98	0.00	5.00	2.13	1.59	0.43	3.04	0.00	1.36	2.06	1.86	1.20
Little Monocacy River	0.06	0.00	0.00	0.15	0.06	1.24	NA	NA	NA	NA	NA	NA
Little Paint Branch	0.00	0.09	0.00	0.04	0.06	0.04	0.55	0.62	0.91	0.53	0.53	0.77
Little Seneca Creek	0.30	0.00	0.00	0.28	0.04	1.46	1.83	0.33	1.36	1.25	1.07	5.00
Little Seneca Creek - Bucklodge Branch	0.06	0.00	0.00	0.14	0.29	0.43	NA	NA	NA	NA	NA	NA
Little Seneca Creek - Ten Mile Creek	0.24	0.00	0.00	0.06	0.00	0.21	0.05	0.00	0.00	0.04	0.00	0.24
Lower Brighton Dam	0.18	0.00	0.00	0.22	0.10	0.36	NA	NA	NA	NA	NA	NA
Lower Dry Seneca Creek	0.06	0.00	0.00	0.20	0.13	0.54	NA	NA	NA	NA	NA	NA
Lower Great Seneca Creek	1.19	0.82	0.00	1.24	1.26	1.95	0.62	0.57	0.45	0.86	0.58	3.07
Lower Hawlings River	0.06	0.00	0.00	0.17	0.15	0.36	NA	NA	NA	NA	NA	NA
Lower Patuxent River - Rocky Gorge	0.36	0.00	0.00	0.16	0.06	0.33	NA	NA	NA	NA	NA	NA
Lower Rock Creek	0.95	3.08	0.00	4.47	2.70	0.64	5.00	3.20	2.73	5.00	5.00	2.07
Lower Seneca Creek	1.07	0.00	0.00	0.40	0.06	1.25	NA	NA	NA	NA	NA	NA
Middle Great Seneca Creek	0.30	3.98	0.00	1.00	1.80	1.47	2.40	3.37	0.00	1.51	1.21	4.45
Middle Great Seneca Creek - Cabin Branch	0.12	1.04	0.00	0.40	2.18	0.23	0.25	0.78	0.00	0.52	0.87	0.74
Middle Great Seneca Creek - Whetstone Run	0.24	2.45	0.00	0.39	0.61	0.46	1.55	2.57	1.36	0.81	0.54	1.70
Middle Rock Creek	3.04	5.00	0.00	3.90	2.84	1.01	4.22	5.00	3.64	3.73	2.97	2.86
Monocacy Direct	0.00	0.00	0.00	0.03	0.00	0.00	NA	NA	NA	NA	NA	NA

Watershed	FEMA Flood Extent Scenario						Flood Modeller Flood Extent Scenario					
	Number of Non-Residential Buildings within Flood Zone	Social Vuln. (acres SVI > 0.5) within Flood Zone	Number of Critical Facilities within Flood Zone	Total Impervious Area (acres)	Number of Residential Buildings within Flood Zone	Wetland areas (acres) within Flood Zone	Number of Non-Residential Buildings within Flood Zone	Social Vuln. (acres SVI > 0.5) within Flood Zone	Number of Critical Facilities within Flood Zone	Total Impervious Area (acres)	Number of Residential Buildings within Flood Zone	Wetland areas (acres) within Flood Zone
Muddy Branch	5.00	2.03	0.00	1.80	2.20	0.92	3.86	1.61	0.00	1.98	1.48	4.08
Northwest Branch	0.36	2.53	0.00	0.95	0.29	0.88	0.95	3.15	0.91	2.06	1.95	2.68
Northwest Branch - Batchellors Run	0.06	0.00	0.00	0.25	0.59	0.20	0.10	0.00	0.00	0.24	0.17	0.66
Northwest Branch - Bel Pre Creek	0.24	1.31	5.00	0.16	0.44	0.10	1.68	1.42	0.45	0.67	0.53	0.41
Northwest Branch - Right Fork	0.00	0.00	5.00	0.15	0.04	0.24	0.19	0.00	0.91	0.25	0.10	0.86
Paint Branch	0.36	1.13	0.00	0.48	0.31	0.78	0.80	1.54	0.45	1.45	1.38	3.18
Quarry Branch	2.08	0.00	5.00	0.87	0.00	0.98	NA	NA	NA	NA	NA	NA
Rock Creek D.C.	0.42	0.35	0.00	0.58	0.50	0.03	0.67	0.27	0.45	0.54	0.65	0.08
Rock Run	0.89	0.00	0.00	0.82	0.15	0.64	0.63	0.00	0.45	0.88	0.66	1.91
Sligo Creek	0.48	1.01	0.00	2.16	1.03	0.12	2.53	1.97	5.00	2.53	3.13	0.39
South Branch Patapsco	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA	NA	NA	NA	NA
Upper Brighton Dam	0.18	0.00	0.00	0.11	0.00	0.69	NA	NA	NA	NA	NA	NA
Upper Dry Seneca Creek	0.30	0.00	0.00	0.18	0.02	1.61	NA	NA	NA	NA	NA	NA
Upper Great Seneca Creek	0.12	0.00	0.00	0.24	0.10	0.95	0.50	0.00	0.00	0.45	0.47	4.08
Upper Great Seneca Creek - Goshen Branch	0.06	0.00	0.00	0.12	0.08	0.53	0.06	0.00	0.00	0.20	0.11	2.32
Upper Great Seneca Creek - Wildcat Branch	0.00	0.00	0.00	0.01	0.04	0.08	0.10	0.00	0.00	0.11	0.05	0.60
Upper Hawlings River	0.06	0.00	0.00	0.21	0.08	0.77	NA	NA	NA	NA	NA	NA
Upper Rock Creek	0.30	0.00	0.00	0.14	0.00	0.70	0.19	0.00	0.00	0.21	0.09	2.72
Upper Rock Creek - Mill Creek	0.00	0.00	0.00	0.00	0.00	0.09	0.38	0.04	0.00	0.51	0.50	0.92
Upper Rock Creek - North Branch	0.12	0.00	0.00	0.55	0.77	1.01	0.39	0.00	0.45	0.79	0.77	2.99
Watts Branch	0.48	0.08	0.00	0.86	0.86	1.00	1.05	0.30	1.36	2.15	1.60	3.70

Attachment 5
Watershed Flood Exposure Scores for FEMA and Flood Modeller Scenarios

Attachment 5: Watershed Flood Exposure Scores for FEMA and Flood Modeller Scenarios

Sensitivity Scenario	Weighted Score											
	Equal Weighting		Total Impervious Area		Economic & Social Vulnerability		Social Vulnerability & Critical Facilities		Largely Critical Facilities		Largely Social Vulnerability	
Basins	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller
Bennett Creek	0.16	NA	0.09	NA	0.12	NA	0.05	NA	0.05	NA	0.05	NA
Blockhouse Point Tributaries	0.28	0.21	0.36	0.02	0.19	0.01	0.10	0.00	0.10	0.00	0.10	0.00
Broad Run	0.42	NA	0.17	NA	0.09	NA	0.06	NA	0.06	NA	0.06	NA
Cabin John Creek	2.99	2.78	3.71	3.45	2.13	2.10	3.02	2.02	3.71	2.18	1.86	1.76
Edwards Ferry Tributaries	0.45	NA	0.33	NA	0.28	NA	0.12	NA	0.12	NA	0.12	NA
Fahrney Branch	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA
Hawlings River - James Creek	0.20	0.32	0.16	0.20	0.12	0.20	0.09	0.09	0.09	0.09	0.09	0.09
Hawlings River - Reddy Branch	0.09	0.30	0.10	0.20	0.05	0.13	0.03	0.08	0.03	0.08	0.03	0.08
Horsepen Branch	0.96	NA	0.21	NA	0.09	NA	0.06	NA	0.06	NA	0.06	NA
Little Bennett Creek	0.07	NA	0.07	NA	0.05	NA	0.02	NA	0.02	NA	0.02	NA
Little Falls Branch	2.06	1.62	2.02	1.66	1.91	1.59	2.42	1.17	3.17	1.38	1.17	0.83
Little Monocacy River	0.26	NA	0.09	NA	0.04	NA	0.03	NA	0.03	NA	0.03	NA
Little Paint Branch	0.04	0.66	0.04	0.59	0.04	0.61	0.04	0.70	0.03	0.74	0.06	0.62
Little Seneca Creek	0.35	1.84	0.17	1.12	0.14	1.12	0.06	1.01	0.06	1.16	0.06	0.75
Little Seneca Creek - Bucklodge Branch	0.16	NA	0.11	NA	0.06	NA	0.05	NA	0.05	NA	0.05	NA
Little Seneca Creek - Ten Mile Creek	0.09	0.06	0.05	0.03	0.09	0.02	0.03	0.01	0.03	0.01	0.03	0.01
Lower Brighton Dam	0.14	NA	0.14	NA	0.09	NA	0.05	NA	0.05	NA	0.05	NA
Lower Dry Seneca Creek	0.16	NA	0.12	NA	0.05	NA	0.04	NA	0.04	NA	0.04	NA
Lower Great Seneca Creek	1.10	1.05	1.03	0.71	0.95	0.61	0.66	0.56	0.53	0.55	0.86	0.59
Lower Hawlings River	0.13	NA	0.11	NA	0.05	NA	0.04	NA	0.04	NA	0.04	NA
Lower Patuxent River - Rocky Gorge	0.15	NA	0.12	NA	0.15	NA	0.06	NA	0.06	NA	0.06	NA
Lower Rock Creek	2.01	3.91	3.22	4.41	2.13	4.14	1.89	3.58	1.43	3.50	2.66	3.69
Lower Seneca Creek	0.47	NA	0.31	NA	0.42	NA	0.15	NA	0.15	NA	0.15	NA
Middle Great Seneca Creek	1.45	2.20	1.51	1.79	1.78	2.29	1.70	1.69	1.11	1.19	2.70	2.53
Middle Great Seneca Creek - Cabin Branch	0.67	0.54	0.64	0.53	0.66	0.50	0.63	0.44	0.48	0.32	0.89	0.63
Middle Great Seneca Creek - Whetstone Run	0.70	1.45	0.77	1.27	1.04	1.71	0.98	1.67	0.61	1.49	1.59	1.97
Middle Rock Creek	2.68	3.81	3.54	3.95	3.49	4.26	2.73	4.12	1.98	3.91	3.98	4.46
Monocacy Direct	0.01	NA	0.02	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA
Muddy Branch	2.03	2.21	2.02	1.85	2.86	2.26	1.61	1.30	1.31	1.06	2.12	1.70
Northwest Branch	0.85	1.99	1.05	2.04	1.13	1.93	1.04	1.92	0.66	1.58	1.68	2.48
Northwest Branch - Batchellors Run	0.19	0.20	0.19	0.15	0.11	0.08	0.09	0.05	0.09	0.05	0.09	0.05
Northwest Branch - Bel Pre Creek	1.23	0.88	0.91	0.88	1.10	1.25	2.29	0.94	2.85	0.80	1.37	1.18

Sensitivity Scenario	Weighted Score											
	Equal Weighting		Total Impervious Area		Economic & Social Vulnerability		Social Vulnerability & Critical Facilities		Largely Critical Facilities		Largely Social Vulnerability	
Basins	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller	FEMA	Flood Modeller
Northwest Branch - Right Fork	0.92	0.39	0.58	0.24	0.52	0.19	1.77	0.37	2.52	0.51	0.52	0.14
Paint Branch	0.52	1.50	0.53	1.30	0.60	1.15	0.51	1.06	0.34	0.90	0.80	1.33
Quarry Branch	1.52	NA	1.14	NA	1.32	NA	2.05	NA	2.80	NA	0.80	NA
Rock Creek D.C.	0.32	0.45	0.45	0.50	0.38	0.49	0.27	0.44	0.22	0.47	0.36	0.39
Rock Run	0.43	0.77	0.52	0.62	0.41	0.42	0.19	0.38	0.19	0.45	0.19	0.26
Sligo Creek	0.82	2.64	1.44	2.73	0.84	2.64	0.72	3.26	0.57	3.71	0.98	2.50
South Branch Patapsco	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA	0.00	NA
Upper Brighton Dam	0.17	NA	0.08	NA	0.07	NA	0.03	NA	0.03	NA	0.03	NA
Upper Dry Seneca Creek	0.36	NA	0.12	NA	0.12	NA	0.05	NA	0.05	NA	0.05	NA
Upper Great Seneca Creek	0.24	0.94	0.14	0.32	0.08	0.27	0.05	0.14	0.05	0.14	0.05	0.14
Upper Great Seneca Creek - Goshen Branch	0.13	0.46	0.07	0.12	0.04	0.05	0.03	0.04	0.03	0.04	0.03	0.04
Upper Great Seneca Creek - Wildcat Branch	0.02	0.15	0.01	0.07	0.00	0.05	0.00	0.03	0.00	0.03	0.00	0.03
Upper Hawlings River	0.19	NA	0.12	NA	0.05	NA	0.03	NA	0.03	NA	0.03	NA
Upper Rock Creek	0.19	0.55	0.10	0.14	0.12	0.10	0.04	0.05	0.04	0.05	0.04	0.05
Upper Rock Creek - Mill Creek	0.02	0.40	0.00	0.35	0.00	0.25	0.00	0.15	0.00	0.15	0.00	0.16
Upper Rock Creek - North Branch	0.42	0.92	0.36	0.56	0.17	0.34	0.14	0.35	0.14	0.42	0.14	0.24
Watts Branch	0.56	1.73	0.58	1.54	0.37	0.98	0.25	1.06	0.24	1.22	0.27	0.80

Attachment 6
Model Requirements

Attachment 6: Model Requirements

Table 0-1 Data Required as Inputs to the Hydrologic and Hydraulic Models, and Anticipated Data Sources or Assumptions to be Used to Meet Those Requirements

Modeling Item	Field	Source	Comments
Stormwater Manhole	X-Coordinate, Y-Coordinate	MCDEP, SD_County_Manhholes.shp	Available
	Invert Elevation (feet)	MCDEP, SD_County_Manhholes.shp	Available with Data Gaps
	Rim Elevation (feet)	MCDEP, SD_County_Manhholes.shp	Available with Data Gaps
	Initial Depth (feet)		Assume zero
	Surcharge Depth (feet)		Assume to be rim elevation unless other information is available
	Diameter (feet)		Assume standard MH diameter unless storage manholes
	Ponded Area (ft^2)		Can be processed from DEM or an assumption made. Only required in 1-D models.
Stormwater Inlet	X-Coordinate, Y-Coordinate	MCDEP, SD_County_Inlets.shp	Available
	Inlet Type	MCDEP, SD_County_Inlets.shp	Data Gaps are present in data from MCDEP
	Invert Elevation (feet)	MCDEP, SD_County_Inlets.shp	Data Gaps are present in data from MCDEP
	Top of Grate Elevation (feet)	MCDEP, SD_County_Inlets.shp	Data Gaps are present in data from MCDEP; Need to verify that for curb inlets that Top of Grate elevation is equal to bottom of curb elevation
	Inlet Opening Dimensions (ft^2)		Not available. Assumptions can be made from standard types
	Initial Depth (feet)		Assume zero
	Surcharge Depth (feet)		Assume to be TG Elevation unless stated otherwise
	Ponded Area (ft^2)		Can be processed from DEM or an assumption to be made. Only required in 1-D models.
Stormwater Pipe	Upstream/Downstream Structure IDs		Not Available. Can process from GIS if digitizing direction is accurate, however it does not appear to be consistent. This will require data processing.
	Length (feet)	MCDEP, SD_County_Pipes.shp	Available
	Material Type	MCDEP, SD_County_Pipes.shp	Available
	Roughness (n)	Unknown	Coefficient number can be calculated based on material type
	Upstream Invert Elevation(feet)	MCDEP, SD_County_Pipes.shp	Available with Data Gaps
	Downstream Invert Elevation (feet)	MCDEP, SD_County_Pipes.shp	Available with Data Gaps
	Slope (feet/feet)	MCDEP, SD_County_Pipes.shp	Available with Data Gaps
	Entry Loss Coefficient	Unknown	Assumptions will be made during modeling
	Exit Loss Coefficient	Unknown	Assumptions will be made during modeling
	Cross-Section Type / Shape	Unknown	Not provided but could assume all are circular if Width and Height are the same. And assume all others are box culverts (Concrete) or Elliptical
	Geom1 (feet) / Width (feet)	MCDEP, SD_County_Pipes.shp	Available with Data Gaps
	Geom2 (feet) / Height (feet)	MCDEP, SD_County_Pipes.shp	Available with Data Gaps
	Number of Barrels	Unknown	Assume all pipes in GIS are single pipes unless other data is available
Subcatchments	Area (acres), Width	Unknown	Individual subcatchment drainage areas will be configured in the analysis phase
	Width (feet)	Unknown	Width calculation is derived from time of concentration, width = flow path length
	Slope (%)	Unknown	Could be calculated via the relevant DEM during modeling phase. May be time consuming
	Impervious (%)	MC, Impervious GIS layer	Available with detailed accuracy (Dated 2020)
	Manning's N (Impervious)	Unknown	Assumptions will be made during modeling
	Manning's N (Pervious)	Unknown	Assumptions will be made during modeling
	Depth of Storage (Impervious)	Unknown	Assumptions will be made during modeling
	Depth of Storage (Pervious)	Unknown	Assumptions will be made during modeling
	% of Impervious Area with Zero Depression Storage	Unknown	Assumptions will be made during modeling
	Soil Information	Unknown	USGS Web Soil Survey can be used if County-specific data is not available
	Curve Number	Unknown	Will be computed with automated GIS software
Outfalls (No specific layer in GIS)	X-Coordinate, Y-Coordinate	MCDEP, SD_County_Culv_Exit.shp	Incomplete – Not all pipe systems have a culvert Exit.
	Flap Gate	Unknown	Do outfalls within MC have flap gates? Outfalls not a specific layer in GIS data provided
	Invert Elevation (feet)	MCDEP, SD_County_Culv_Exit.shp	Outfalls not a specific layer in GIS data provided, Data Gaps present
	Rim Elevation (feet)	Unknown	Outfalls not a specific layer in GIS data provided
Control Structures/Weirs (No data provided)	Height (feet)	Unknown	
	Length (feet)	Unknown	
	Side Slope (feet/feet)	Unknown	
	Upstream Invert Offset (feet)	Unknown	
	Discharge (cfs)	Unknown	
	End Coefficient (cfs)	Unknown	
Open Channels	Stream Centerlines	MCDEP, MCDEP_GIS_Data_May2022.gdb	Available
	Bridges	Unknown	Could be added manually in the analysis phase depending on modeling needs
	Cross Sections	Unknown	May be available from FEMA. Could use DEM to cut cross-sections for larger channels. Otherwise need to survey
2-D Surface Flood Modeling	DEM Elevation	Unknown	2 feet contours from 2020 are available. Surface DEM for watershed specific models will be needed
	Land Cover	MCDEP, MCDEP_GIS_Data_May2022.gdb	Properties Land Use shapefile in GIS
	Soil Information		USGS Web Soil Survey as a backup option
	Stream Gauges	Unknown	MCDEP instream flow monitoring in SPAs and USGS
	Bridges	Unknown	Could be added manually in the analysis phase depending on modeling needs
	Roadway Centerlines	MCDEP, MCDEP_GIS_Data_May2022.gdb	
	Stormwater Facilities	M-NPCC Parks, SWFAC.shp	Storage Curve, Outlet Sizing/Details, Stage Discharge Curves needed

Modeling Item	Field	Source	Comments
General	Rainfall		Utilize Standard Distribution Methods for Chosen Design Storm Events. Jacobs has climate projections for rainfall in the County from previous work.

1-D = one dimensional
2-D = two dimensional
cfs = cubic feet per second
DEM = Digital elevation model
FEMA = Federal Emergency Management Agency
ft^2 = square feet
GIS = geographic information system
ID = identification
MC = Montgomery County
MCDEP = Montgomery County Department of Environmental Protection
MH = Manhole
TG = Top of grade
USGS = United States Geological Survey