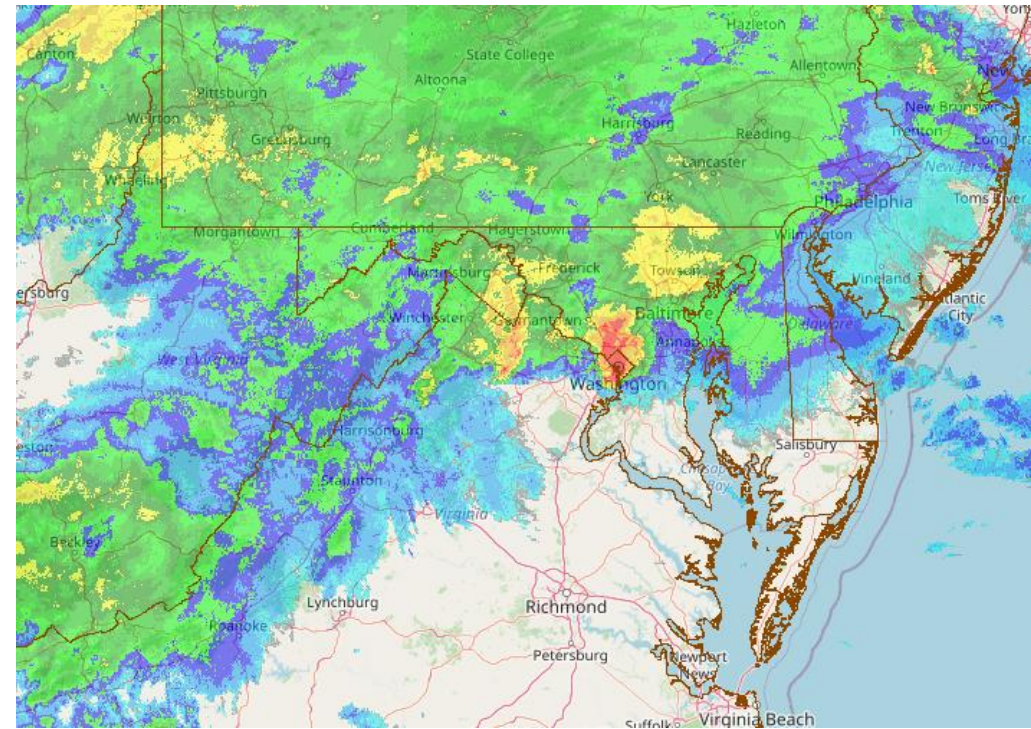




Montgomery County Comprehensive Flood Management Plan

December 2024



Overview of the Comprehensive Flood Management Plan

Goals of the Comprehensive Flood Management Plan

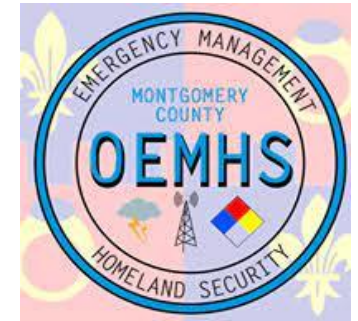
- Understand the County's current and future flood risk and vulnerability through hydrologic and hydraulic (H&H) modeling
- Understand and modify the County's programs, regulations, communications, and other government activities that address, or contribute to, flood risk and vulnerability
- Ensure racial equity and social justice issues are considered during every facet of this effort.

Phase 1 Participants

- Emergency Management & Homeland Security
- Environmental Protection
- Montgomery Parks
- Montgomery Planning
- Permitting Services
- Transportation
- Representatives from the CE's Office



M-NCPPC



Phases of the CFMP

Phase 1

FY23 (Completed)

- Prioritize watersheds for detailed engineering assessments in Phase 2
- Review programs and policies related to understanding and responding to flooding

Phase 2

FY24 – FY26

- Conduct engineering assessments in the priority watersheds identified in Phase 1
- Develop, and begin to implement, program and policy recommendations to address flooding

Phase 3

FY26 & Beyond

- Implementation of prioritized flood mitigation alternatives in the priority watersheds
- Continue to develop and implement program and policy recommendations to address flooding

Results of Phase 1

Watershed Assessment & Prioritization

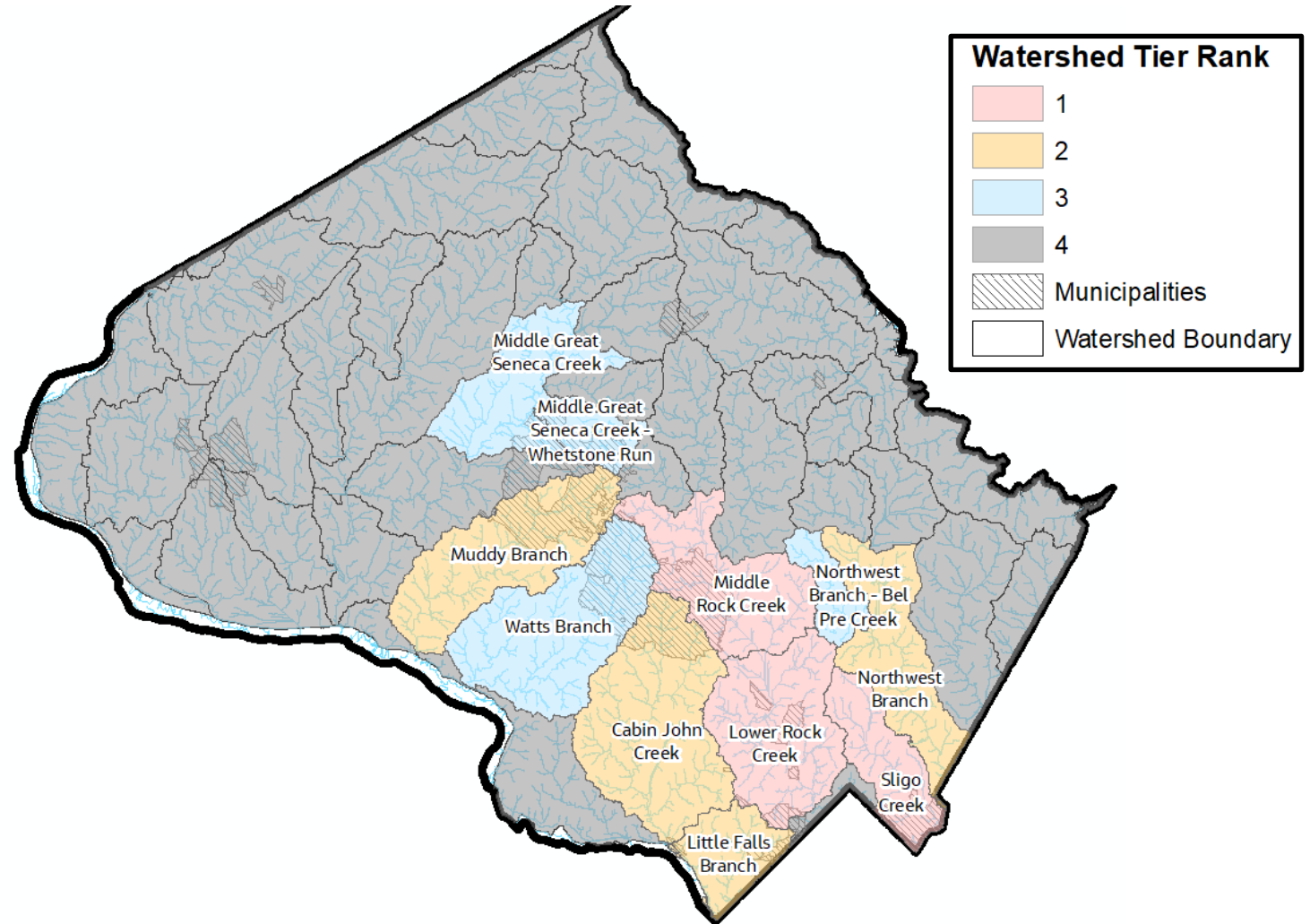
Watershed Prioritization Inputs and Methods

- A variety of data were collected, including previous mapping of flood hazard areas, areas/locations that may be vulnerable to flood impacts, and records of observed impacts
- Six primary attributes were considered to develop an initial prioritization of watersheds for the next phase of detailed modeling to identify flood risk and vulnerability

Attribute	Measure
Non-Residential Buildings	Number of non-residential buildings
Residential Buildings	Number of residential buildings
Socially Vulnerable Areas	Amount of socially vulnerable areas (SVI>0.5)
Impervious Area	Amount of impervious area
Critical Facilities and Infrastructure	Number of critical facilities and infrastructure
Environmentally Sensitive Areas	Amount of wetland area

Watershed Modeling Plan

- 11 watersheds should be modeled by 2027. Sligo in 2024, Rock Creek x 2 in 2025, and the others in 2026.
- Models will show flood risk of 2-year to 500-year storms.
- Models will be created for now, 2050, and 2100.
- These models have updated assumptions about rainfall and development.



Watershed Attributes

Tier	Watershed	Area (Acres)	Estimated Population	Estimated Population in Areas with SVI > 0.5	% of Population in Areas with SVI > 0.5
1	Middle Rock Creek	10,780	77,117	37,756	49.0%
	Lower Rock Creek	12,005	113,565	26,610	23.4%
	Sligo Creek	6,156	68,817	25,792	37.5%
2	Cabin John Creek	16,303	73,477	5,275	7.2%
	Little Falls Branch	4,821	43,454	0	0.0%
	Northwest Branch	9,706	58,495	21,078	36.0%
	Muddy Branch	12,531	57,984	8,526	14.7%
3	Middle Great Seneca Creek	9,028	58,791	21,503	36.6%
	Middle Great Seneca Creek – Whetstone Run	3,049	44,518	41,154	92.4%
	Northwest Branch – Bel Pre Creek	2,866	27,935	15,919	57.0%
	Watts Branch	14,231	45,036	1,560	3.5%
Total		101,476	669,189	205,173	30.7%

Results of Phase 1

Program & Policy Review

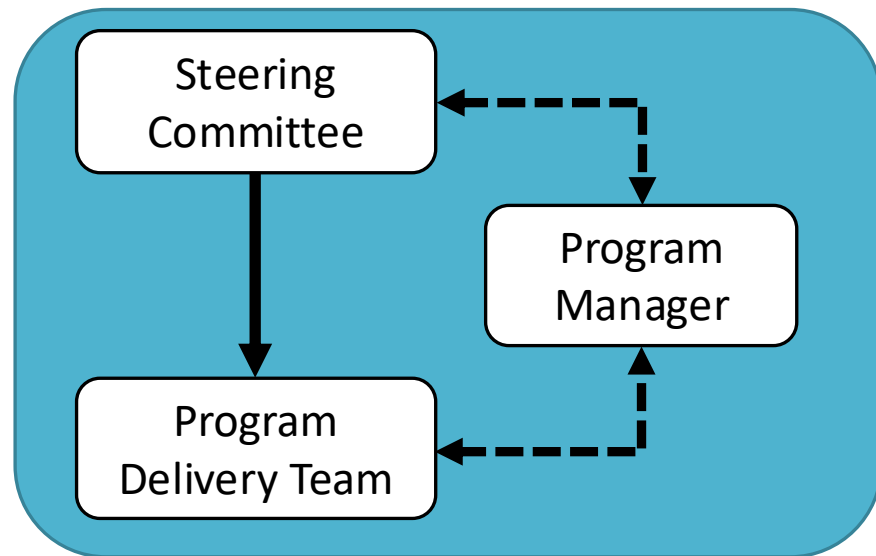
Program and Policy Review Results

- Made key ***observations*** about the current responsibilities, policies, and systems related to flooding and flood management
- Identified 17 ***desired outcomes*** dealing with
- Made ***recommendations*** regarding programmatic structure to deliver the desired outcomes

The 17 Outcomes fall under 7 Themes:

- Governance
- Flood Management Planning
- Flood Hazard and Risk Information
- Flood Mitigation
- Asset Management
- Emergency Management
- Budget and Finance

Programmatic Delivery Structure



Steering Committee

- Director-level participants that guides efforts of Program Delivery Team
- Oversees recommendations to County leadership

Program Delivery Team

- Develops “business plans” to achieve desired outcomes and implementation of plans

Program Manager

- Supports/facilitates Steering Committee & Program Delivery Team

Phase 2

Watershed Studies

Detailed Watershed Studies Overview

- Develop flood inundation mapping for a variety of climate and land use scenarios that reflect both current and future conditions.
- Use the results to assess flood vulnerability and risk under different scenarios.
- Identify adaptation/mitigation alternatives for identified problem areas.
- Provide County staff with accessible information (flood extents, rainfall data, vulnerability and risk results).

Development of Climate and Land Use Scenarios



Today's Focus: Future Climate and Land Use Scenarios



Climate Scenarios

PAST

PRESENT

FUTURE

Climate Scenario Development

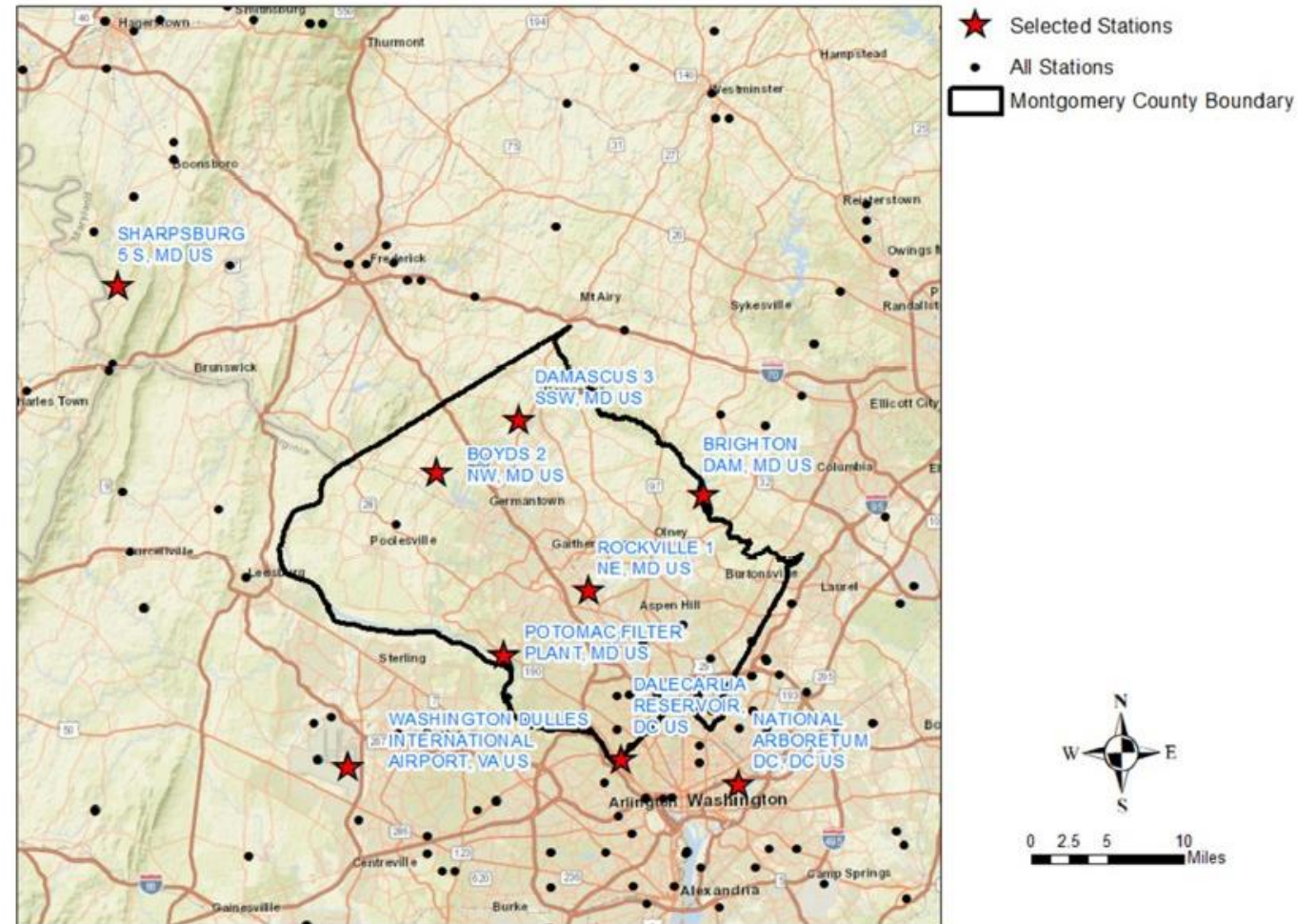
County chose to use two past events as well as **updated design storms for 2022, 2050, and 2100.**

To do so, the county needed updated intensity, duration, and frequency (IDF) curves for most events.

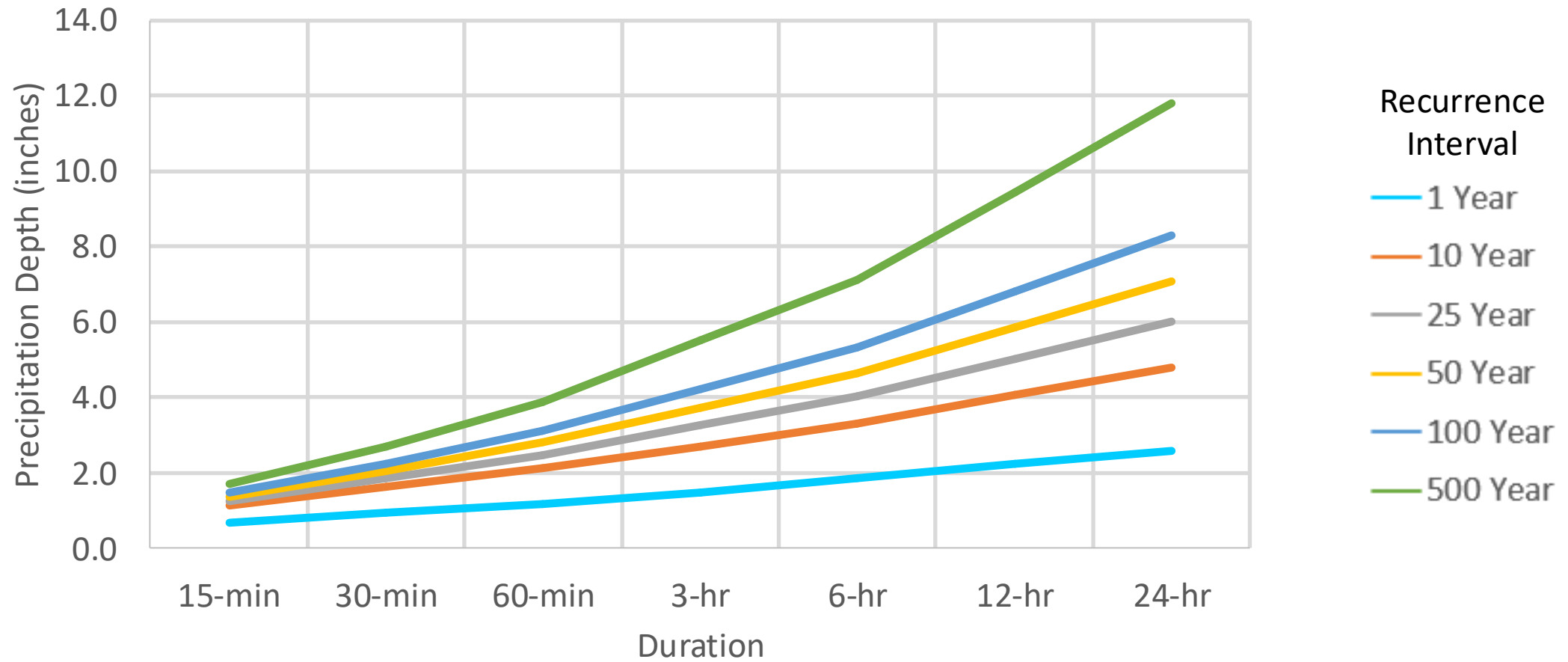
Updating Present Numbers

Data for 2022 IDF Updates:

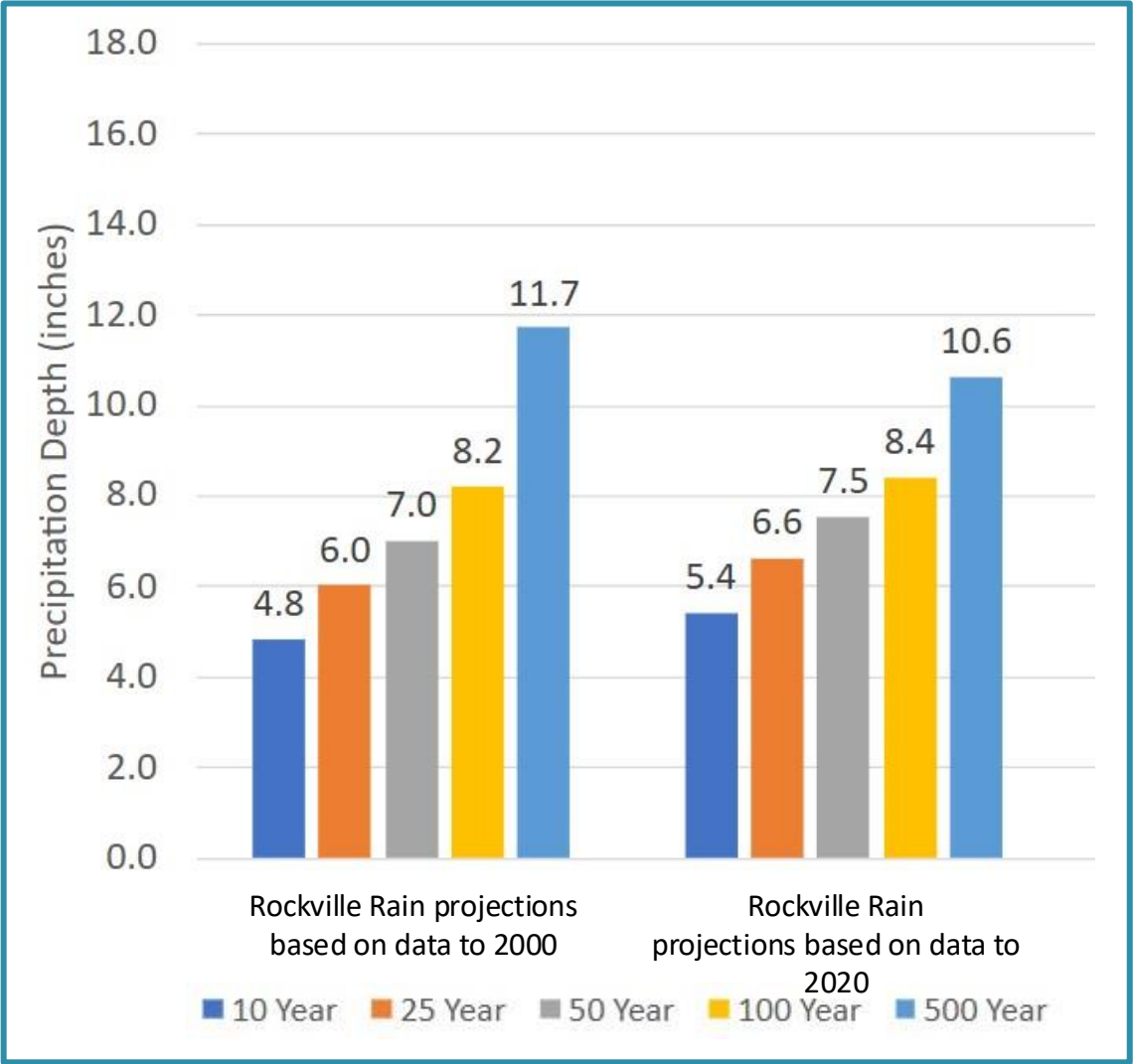
- Station/location-based Atlas 14 IDF curve values for nine selected stations, using both AMS and PDS methodology,
- Geographic Information System (GIS) Grids,
- Annual maxima time series for the seven stations also used to develop Atlas 14 Volume 2, and
- Daily historical precipitation time series, updated through 2022 from the Global Historical Climate Network (GHCN), using NOAA National Centers for Environmental Information Climate Data Online.

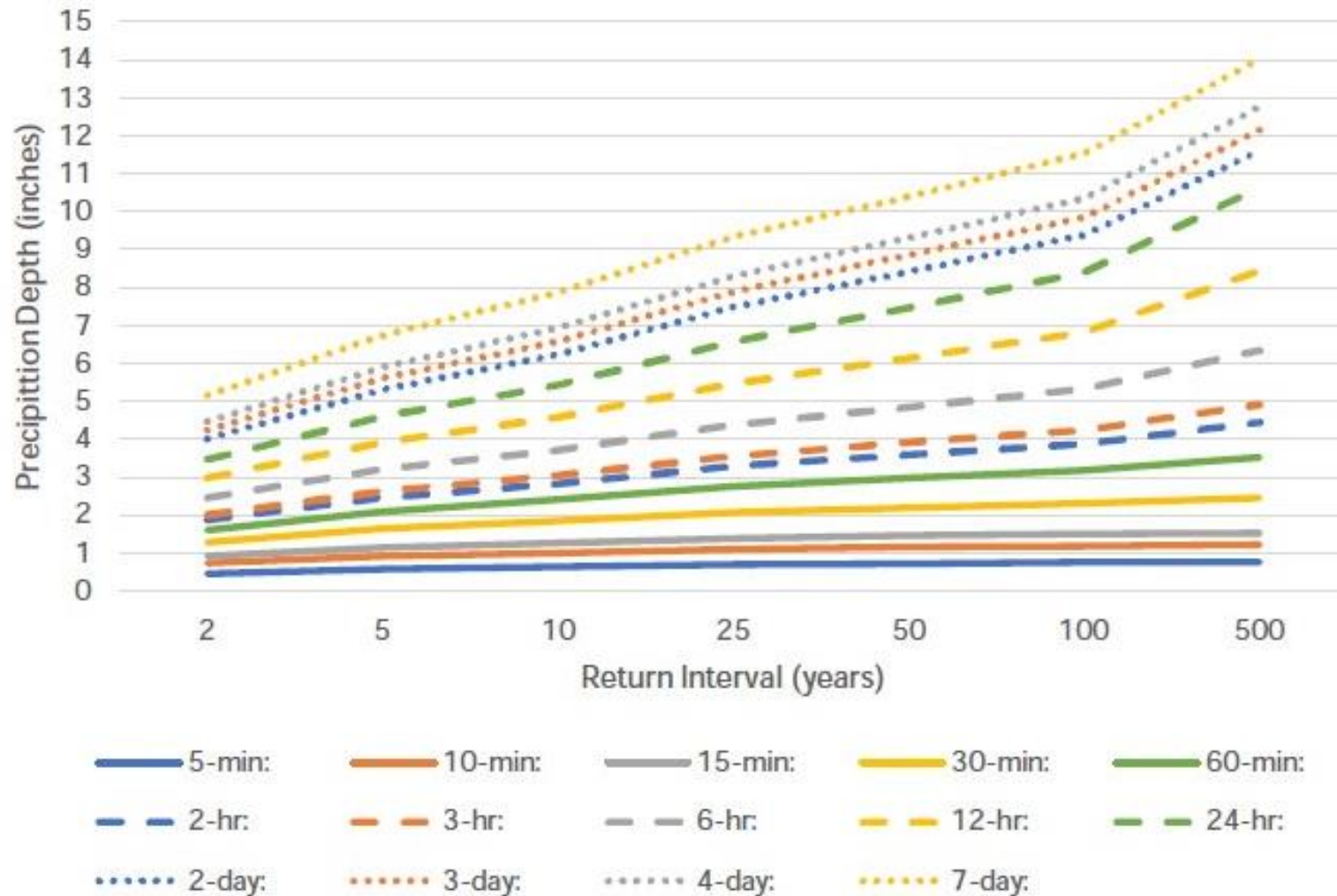


2020 IDF Curves for Rockville, MD



Atlas 14 vs. Updated Precipitation Depths for Rockville





Updated IDF Curve for the County

*at Dalecarlia Reservoir

Notes:

-PDS, converted from AMS

-Based on analysis of 24-hour precipitation data; other durations converted using ratios from NOAA Atlas 14.

Future IDF Curve Development

The County considered two different sources for updating our climate projections, the Mid-Atlantic Regional Integrated Climate Assessments (MARISA) and SimCLIM.

The County ultimately chose SimCLIM as it

- Allowed for projections **further in the future**, 2100 versus 2075,
 - Used **updated climate models**, AR6 versus AR5, and
 - Contains **more climate model scenarios**.

Future Scenario Selections

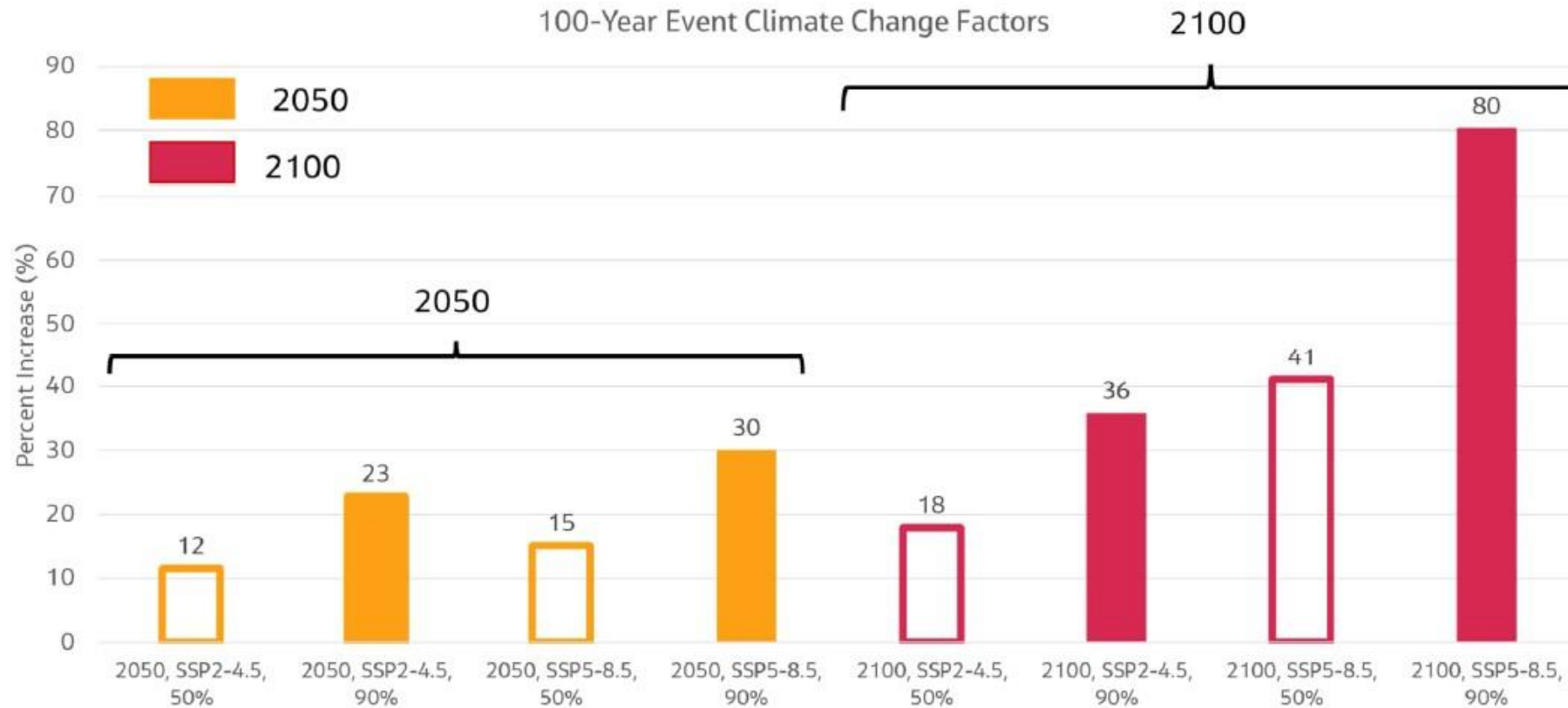
The County selected various options within three parameters:

- Planning Time Horizon: 2050 and 2100
- GHG scenarios: SSP2-4.5 and SSP5-8.5
- General Circulation Model (GCM): 50% non-exceedance and 90% non-exceedance

Shared Socioeconomic Pathway	Description
SSP5-8.5	Fossil Fuel Driven Development
SSP3-7.0	Regional Rivalry
SSP2-4.5	Middle of the Road
SSP2-2.6	Sustainable Development
SSP1-1.9	Ambitious Sustainability

Projected Percent Change for Selected Scenarios

Figure 4-1. Projected Percent Change in 100-Year, 24-Hour Depth



The Resulting Updates: Rockville Precipitation Depths

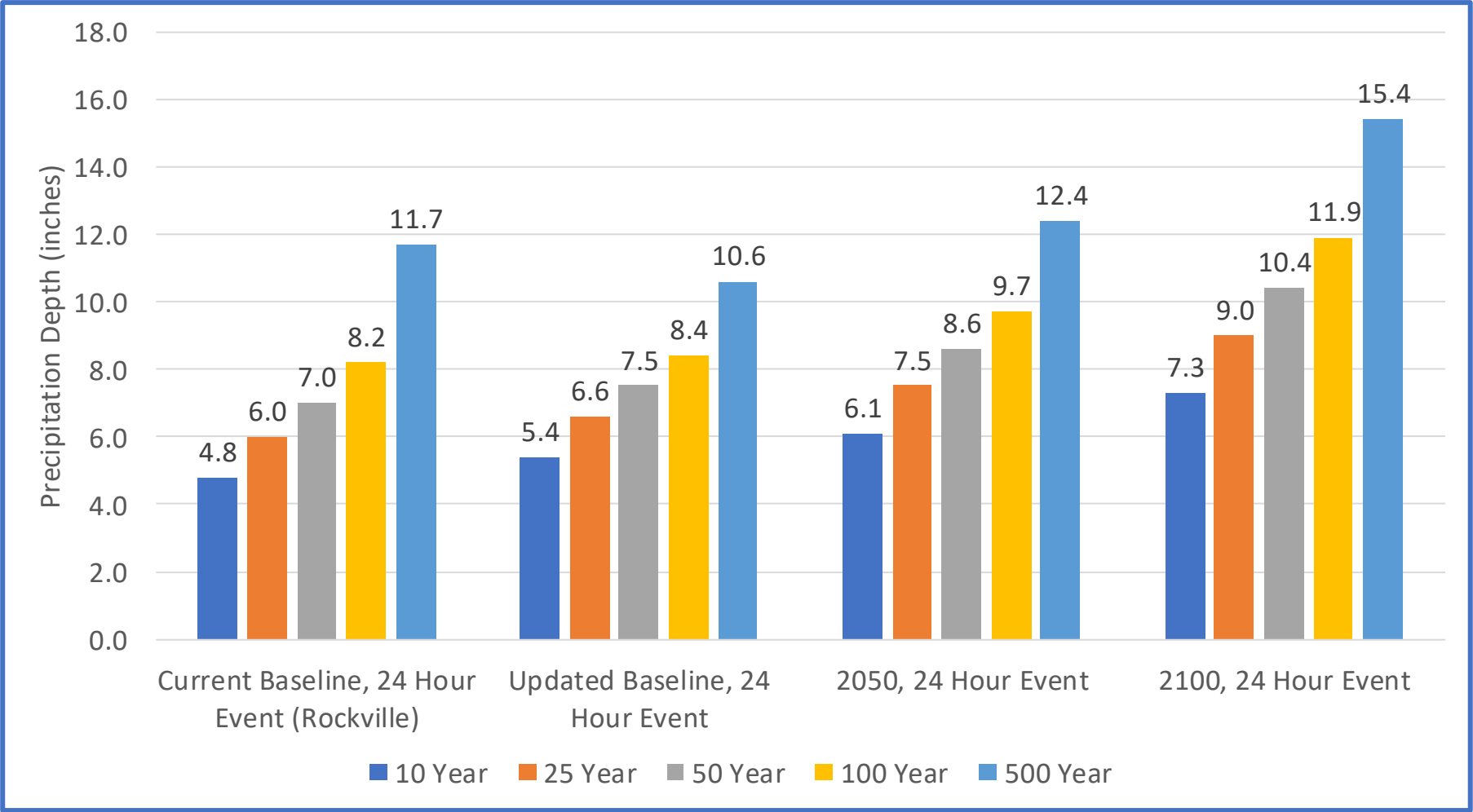


Table ES-1. Historical, Baseline, and Future Climate Scenarios Recommended for Modeling

Event	Return Period	24-hour Depth (inches)	Total Historical Event Depth (inches)
September 10, 2020 at Silver Spring gage	5-Year (at 2- and 3-hour durations) ^a	-	3.6
July 8, 2019 at Ten Mile Creek gage	500-Year (at 15-, 30-, and 60-minute durations) ^a	-	5.0
Updated Baseline IDF Curve	10-Year	5.4	-
Updated Baseline IDF Curve	25-Year	6.6	-
Updated Baseline IDF Curve	50-Year	7.5	-
Updated Baseline IDF Curve	100-Year	8.4	-
Updated Baseline IDF Curve	500-Year	10.6	-
2050, SSP5-8.5, 50th Percentile	10-Year	6.1	-
2050, SSP5-8.5, 50th Percentile	25-Year	7.5	-
2050, SSP5-8.5, 50th Percentile	50-Year	8.6	-
2050, SSP5-8.5, 50th Percentile	100-Year	9.7	-
2050, SSP5-8.5, 50th Percentile	500-Year	12.4	-
2100, SSP5-8.5, 50th Percentile	10-Year	7.3	-
2100, SSP5-8.5, 50th Percentile	25-Year	9.0	-
2100, SSP5-8.5, 50th Percentile	50-Year	10.4	-
2100, SSP5-8.5, 50th Percentile	100-Year	11.9	-
2100, SSP5-8.5, 50th Percentile	500-Year	15.4	-

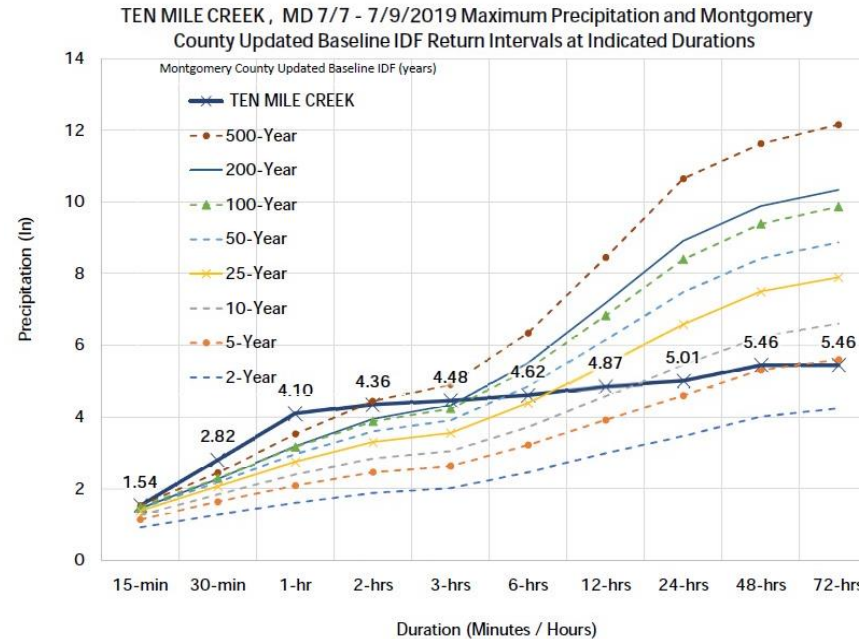
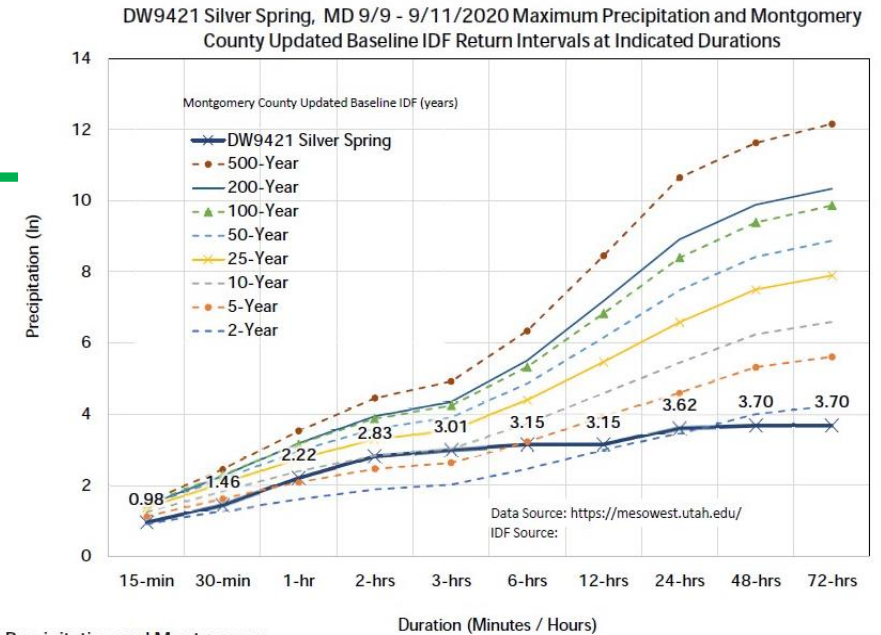
^a Largest return period observed during the event, based on evaluation of multiple durations.

Recommended Climate Scenarios

Selecting Past Events

The County considered four historical rain events for use in its models.

Events on September 10, 2020 and July 8, 2019 were selected as they had the best data availability from rain gauges and public complaints. They also represent events from the southeast and northwest of the county, respectively.



Impervious Area Projections

REASONABLE WORST
CASES

FOCUS GROWTH
AREAS

Impervious Area Projections

As Montgomery County is trying to understand and plan for future flooding risk, it needs to also account for continued development in the County.

Calculating impervious area coverage in the future will allow the county to **quantify more useful runoff** volumes in its H&H models.

Calculating Two Types of Scenarios

Reasonable Worst Case (RWC) Scenario

The maximum observed IA percentage by zone based on observed samples by subdivision or by neighborhood.

The RWC percent IA was used to estimate the long-term scenario for IA and the mid-term was taken based on the difference between current (2019) percent IA and long-term.

Focus Growth Area (FGA) Scenario

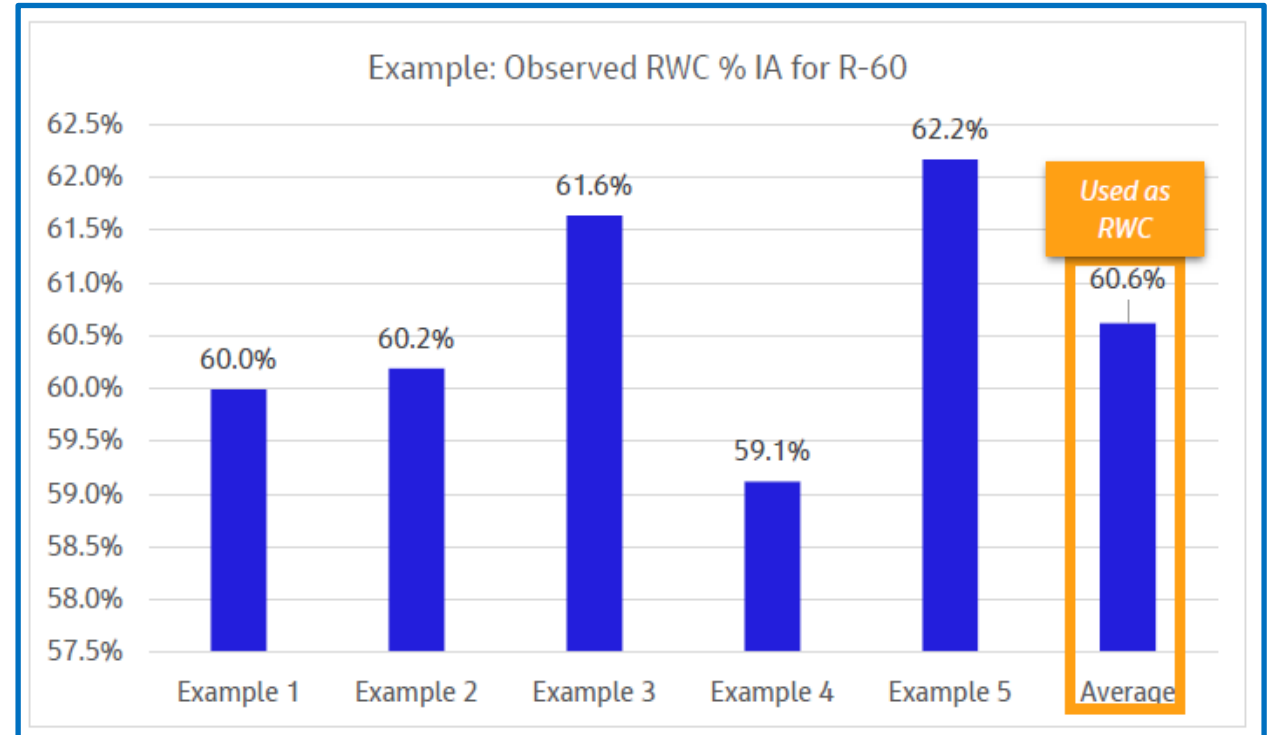
The observed the percentage of IA coverage around transit stations and along transit corridors.

The maximum observed percent IA around transit was used as a cap on the maximum long-term percent IA, with a growth rate from current to future used to estimate mid-term and long-term percent IA.

Calculating Reasonable Worst Case Scenarios

An average of the five samples was used to define the RWC for CR, R-60, R-90, R-200 zones that contribute the most impervious area within the selected watersheds.

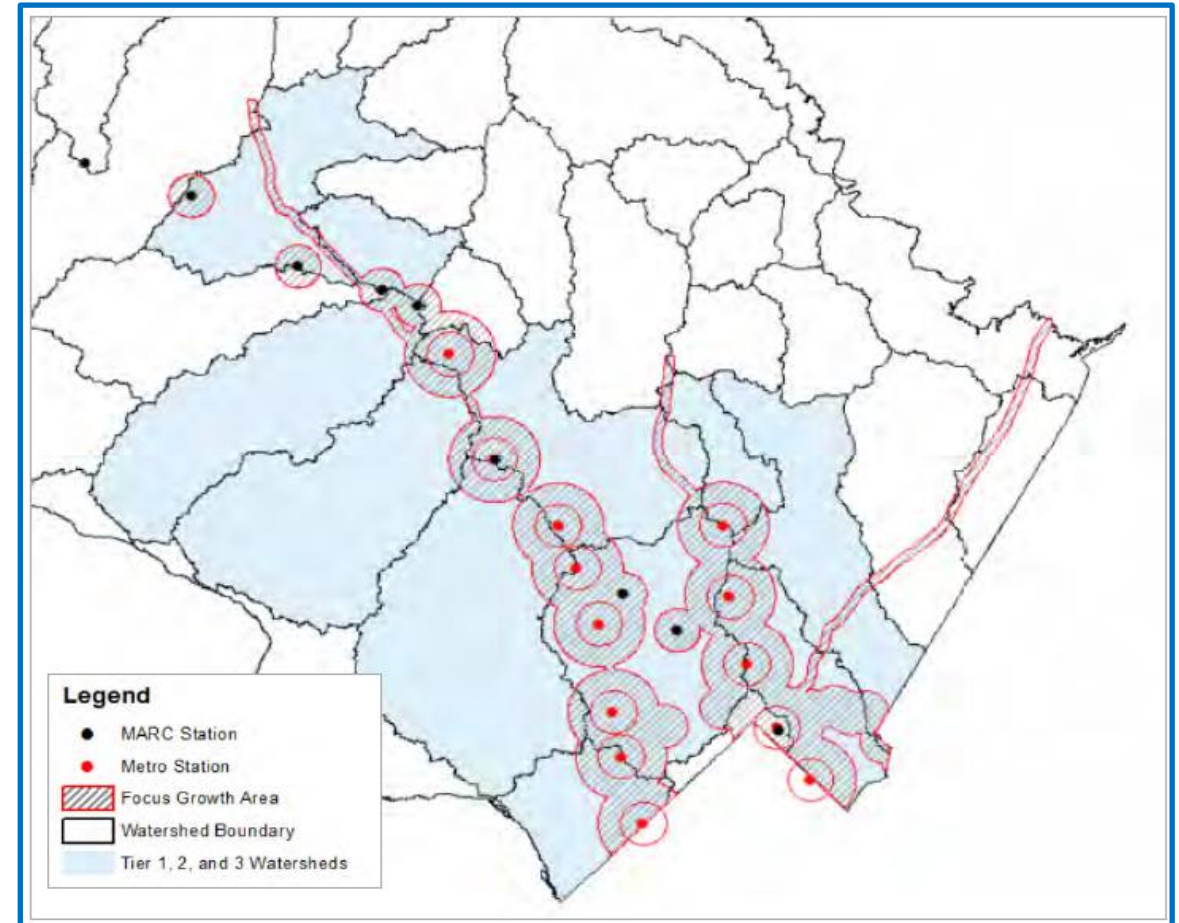
ROW, because it is a zone not tied to parcel-by-parcel boundaries, was calculated differently.



Calculating Focus Growth Area Scenarios

Used in areas around present and future transit corridors

Sub-Area	Extent
Metro Station	Half-mile radius around Metro stations
	One-mile radius around Metro stations
MARC Station	Half-mile radius round MARC stations
Future Purple Line Station	Half-mile radius around future Purple Line stations
Corridor Areas	500-foot buffer around MD 355 (Rockville Pike), MD 97 (Georgia Ave.), and US 29 (Colesville Road) corridors



Current Scenario	Reasonable Worst-Case Scenario	Focus Growth Area Scenario
<p>Scenario developed by summarizing existing impervious area by catchments and zone.</p> <ul style="list-style-type: none"> Based on existing (2019) IA data 	<p>Mid and Long-term IA projections developed by growing existing IA to observed RWC values by zone.</p> <ul style="list-style-type: none"> Current conditions percent IA is grown within each catchment by zone using the RWC percent IA by zone. Preserved areas are kept at current conditions. Areas already exceeding the RWC percent IA are kept at current conditions. 	<p>Mid and Long-term IA projections developed by growing existing IA to observed RWC values by zone and incorporating increased IA growth rates and caps based on maximum observed percent IA plus a percent growth factor.</p> <ul style="list-style-type: none"> Current conditions percent IA is grown within each catchment by zone using the RWC percent IA by zone. Preserved areas are kept at current conditions. Current conditions percent IA within the identified FGA are grown using percent growth rates and capped using the maximum observed FGA percent IA plus a percent growth factor. Areas already exceeding the RWC percent IA are kept at current conditions.

Scenarios Used to Calculate percent IA used in Models

IA Projection Results

The Reasonable Worst Case Scenario results increase total percent IA from **40% (2019) to 50% at the mid-term and 59% at the long-term.** The Focus Growth Area Scenario results increase total percent IA from **40% (2019) to 51% at the mid-term and 64% at the long-term.**

Questions?

helen.waller@montgomerycountymd.gov
<https://www.montgomerycountymd.gov/flooding/>

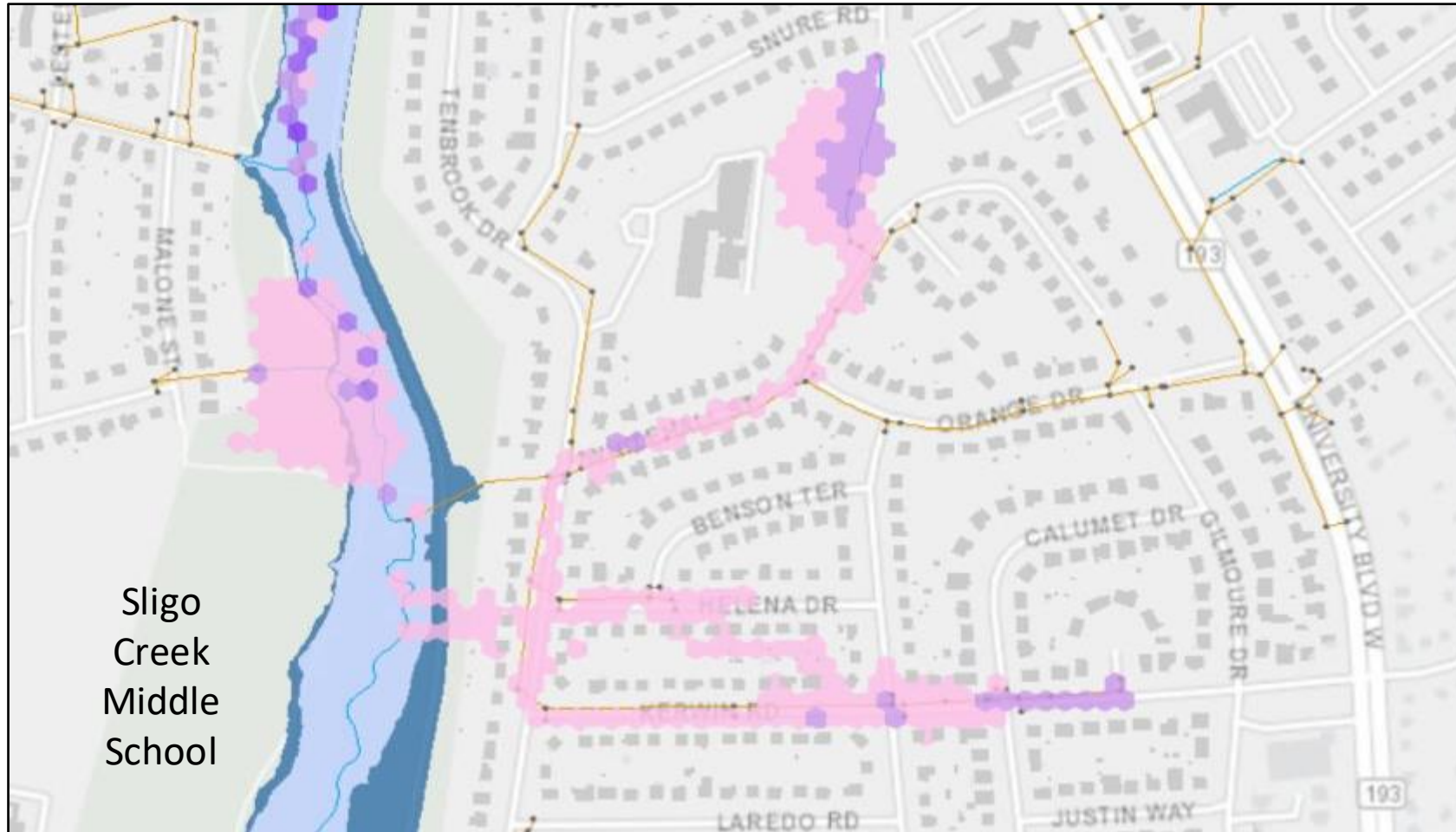
Next Steps

Data Collection and Modeling



- Develop detailed hydrologic and hydraulic models to generate flood inundation and depth information for selected scenarios
- Develop flood viewer tool for internal use
- Develop external/public flood viewer for public use

Data Collection and Modeling



Vulnerability and Risk Assessment



- Use output of flood modeling (flood inundation and flood depth for selected scenarios) and available County data (critical facilities, CDC SVI areas, etc.) to define current and future flood vulnerability
- Use property value information to define current and future risk due to flooding

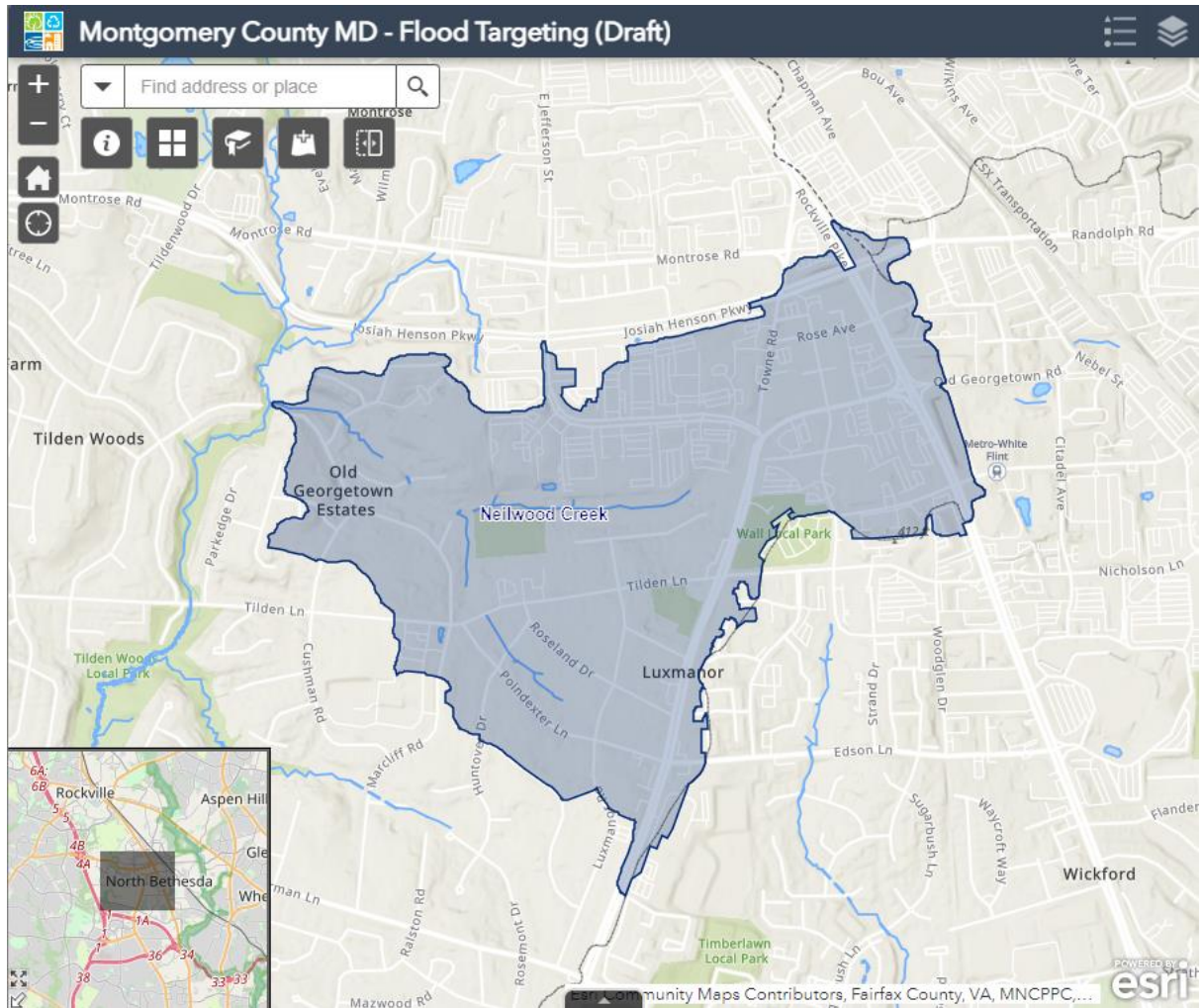
Flood Mitigation Project Alternatives Assessment



- Define and develop preliminary cost estimates for flood mitigation/adaptation projects for identified problem areas
- Complete Benefit Cost Analysis to understand impact of selected alternatives on both flood inundation/depth and risk assessments

Other Activities

Army Corps of Engineers Studies – Luxmanor/Neilwood Creek



EJSCREEN Demographic Index (DI) (80%ile or higher)

No: 20%ile, 23%ile, and 50%ile

Primarily in FEMA Floodplain (Yes/No) Flood Factor Inundation Mapping

Yes

Yes

High Priority Areas with Multifamily Residents

- Single family residential, with multifamily and mixed use retail in the upper drainage area

Complaints / Insurance Claims / Observation

- Luxmanor neighborhood - Identified from flooding complaints where multiple homes received damage, there have also been nearby erosion complaints
- The primary area where flooding has been a concern is in the vicinity of Danville Dr and Ct, an area which is in the FEMA floodplain
- DOT has also been significantly involved in this issue as well as the CE's office and others

DEP Activity

- Old Farm stream restoration project in drainage area

DOT Drainage Assistance Program

- DOT has been involved in response

Lot to Lot Flooding in the CFMP

- The CFMP will help the County understand areas at risk of acute flooding which can cause loss of life and property.
- The tools created to develop the CFMP will not have a level of granularity able to assess lot to lot flooding.
- The CFMP process can help address lot to lot flooding through:
 - Improved planning
 - Updated building codes
 - More communication on flood management options

Community Rating System Membership

Pursuing reduced premiums for the county

- The CRS is a FEMA program that rewards flood risk reductions in communities that participate in the National Flood Insurance Program.
- Five agencies are working together on MoCo's CRS membership application.
- Joining CRS can reduce flood insurance premiums for most renters, homeowners, and businesses by 5% to 10%.

Activity	Max Points
300 Public Information Activities	971
400 Mapping and Regulations	5841
500 Flood Damage Reduction Activities	5042
600 Warning and Response	790
Total	12644

Flood-Related Communications



During a Flood

Learn about flood sensors, flooded roads, and report flooding.

[Learn more](#)

Real Time Information

- Flood Sensors
- Flooded Roads
- Report Flooding



Flood Management

Flood management plan, technical studies, and policy actions.

[Learn more](#)

Flood Management Planning with the full Phase I report

- Technical Studies
- Policy Actions
- *Forthcoming: Capital Projects*



Resident Portal

Learn about flood insurance and how to prepare for a flood.

[Learn more](#)

Resident Portal

- Flood Insurance
- Taking Steps to Prepare
- *Forthcoming: Assistance Programs*

Program and Policy Review – Desired Outcomes

#	Category	Desired 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.

Program and Policy Review – Desired Outcomes

#	Category	Desired Outcome
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.
9		Urban Flood Zones/ Riverine Floodplain are defined/mapped.

Program and Policy Review – Desired Outcomes

#	Category	Desired Outcome
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.

Program and Policy Review – Desired Outcomes

#	Category	Desired Outcome
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.