DRAFT

Summary of Stakeholder Concerns, Current Management and Future Needs for Addressing Climate Change Impacts on Stormwater Management

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For: Chesapeake Bay Program Workgroups

1 SUMMARY

Preliminary analysis from the Chesapeake Bay Program estimates a 3.1% increase in rainfall volume across the Chesapeake Bay Watershed by 2025 (Linker et al. 2019). Further, it is expected that more of that rainfall will be concentrated in a series of high intensity events that can pose a risk to stormwater infrastructure and best management practices (NOAA 2018). Meanwhile, tidal communities are also experiencing increased occurrence of "blue sky flooding" that can inundate low lying areas, posing a public health risk and decreasing capacity in stormwater conveyance systems.

These changing hydrologic conditions, especially when coupled with ongoing development, pose a risk to stormwater infrastructure and public safety. BMPs and stormwater conveyance systems designed to capture, treat and safely move water through the urban environment may be undersized or ill-equipped to handle runoff from increasingly larger storm events, leading to failure or loss in performance.

To help address this challenge, the Chesapeake Stormwater Network (CSN) is seeking to clearly define the needs of local stormwater managers and identify the specific initiatives that will allow them to address their restoration and public safety functions under future climate conditions.

In November 2019, CSN developed and distributed two surveys to engage key stormwater stakeholders and better understand what they perceive as the biggest climate-change related risks to their communities. The surveys help clarify current management approaches to improving resiliency of stormwater infrastructure to climate change and the informational and resource needs of local communities. The key takeaways from the survey are summarized below:

- **Overall, the biggest concern among respondents is damage to public and private infrastructure --- particularly roads, bridges and culverts -- caused by large storm events.** The combination of increased risk to public safety, and increased costs of non-routine maintenance make this a pressing concern. However, tidal communities are equally concerned with the impacts of "blue sky flooding". Decreased capacity within their conveyance network due to frequent tidal inundation leads to similar concerns about damage to roadways and impacts on public safety.
- **Very few communities are prepared for the increased costs associated with climate change, and fewer have begun implementing practices to improve climate resiliency.** Most communities are cobbling together a mix of capital improvement funds, grants, and loans to pay for upgrades to infrastructure and are relying on state or federal disaster aid to cover repair costs incurred during high intensity storm events. Even with these funds, the majority consider themselves to be "not prepared" because funds are being re-directed to meet other pressing maintenance and retrofit needs.
- **Respondents are not comfortable with the current quality and utility of engineering design criteria on future rainfall intensity provided by state and/or federal authorities**. Respondents are open to almost any new tool, including updated or projected intensity-duration-frequency (IDF) curves. However, anything new must be incorporated in the state and federal guidance – a major concern due to anticipated pushback from developers and the amount of time it takes for changes to be made. In general, respondents preferred new tools that are more "straight out of the box" - design specifications that cover new sizing, conveyance and materials, or planning

tools that describe how to better integrate BMPs, floodplain management and stormwater conveyance.

- **Responses were generally consistent, across differing community sizes (Phase 1 vs Phase 2 MS4s) and geographies.** Cost and resource constraints were more of a focus in the headwater states and smaller communities. Smaller communities were also more likely to look for new tools that focused on easing maintenance burdens or providing planning guidance, while larger communities were more likely to look for new retrofit options.

These findings will provide guidance as CSN continues to work with experts from the public sector, private sector and academia to develop a synthesis of current research and management practices to improve resilience of stormwater management practices. A series of memos, released over the coming year, will outline:

- A state-by-state assessment of current engineering standards,
- A summary of current research projecting future climate conditions and developing local intensity-duration-frequency (IDF) curves,
- An assessment of BMP vulnerability and future management options.

The culmination of the year-long effort will be the development of a long-term work plan to establish a Chesapeake Bay climate watershed response. The goal of the plan is to deliver engineering tools and management solutions to communities so they can help protect their current and future watershed restoration investments from climate change risk.

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This memo summarizes the findings from each section of the surveys. Complete results from both surveys can be found in Appendix B.

2 METHOD

To increase the response rate while also targeting important stakeholder groups, two survey instruments were developed. The first was a detailed survey, consisting of 29 questions separated into three sections: concerns, current management and future needs. The survey was distributed via email to 90 key stakeholders who either expressed interest in participating during initial briefing presentations to the Urban Stormwater Workgroup (USWG) and Climate Resiliency Workgroup (CRWG), or who CSN identified as critical stormwater voices around the watershed. A breakdown of the demographics for this first survey group is in Appendix A.

The second survey was a pared-down version of the first survey. Only 19 questions, the second survey was distributed more broadly, using CSN's 11,000-member network of stormwater professionals, as well as distribution lists for the CRWG and USWG.

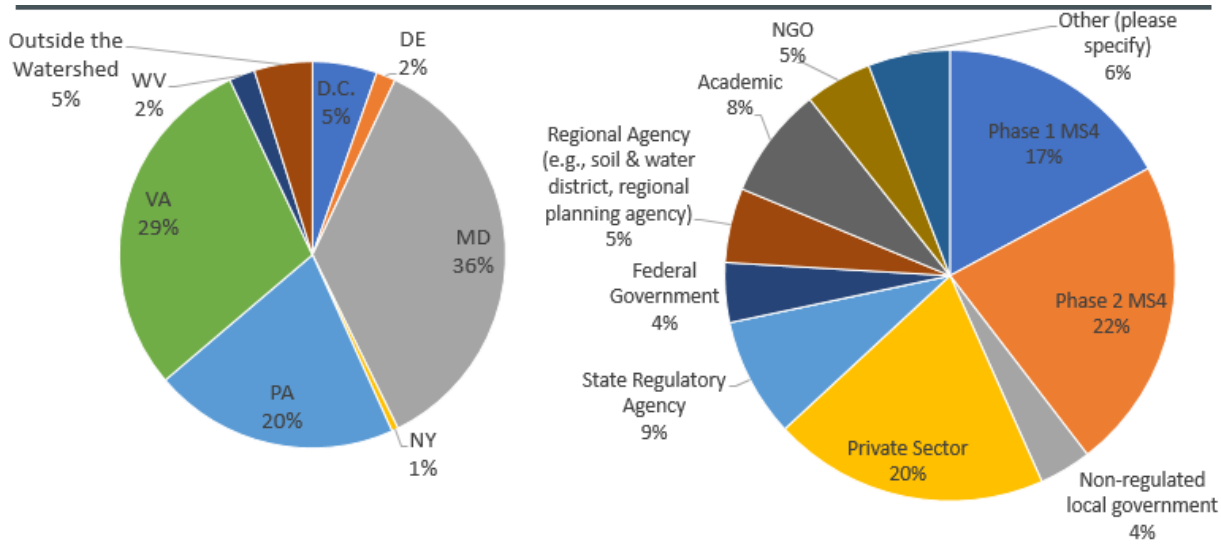
In addition to the two survey instruments, CSN held a number of informal conversations with stormwater professionals and floodplain managers around the watershed to obtain additional information and seek clarification on survey responses.

The surveys were developed and distributed in November 2019. A steering committee, consisting of five local stormwater managers reviewed the questions and provided feedback. The survey was left open for three weeks.

3 RESPONSE

In total, the two surveys generated 188 responses, including 57 of the 90 stakeholders who were directly contacted. The responses represented every state in the Chesapeake Bay Watershed, as well as every major sector. A breakdown of response demographics is available in Figure 1 and a complete summary of the survey results are provided in Appendix B.

Figure 1. Summary of Climate Survey Response Demographics by Geography and Sector.



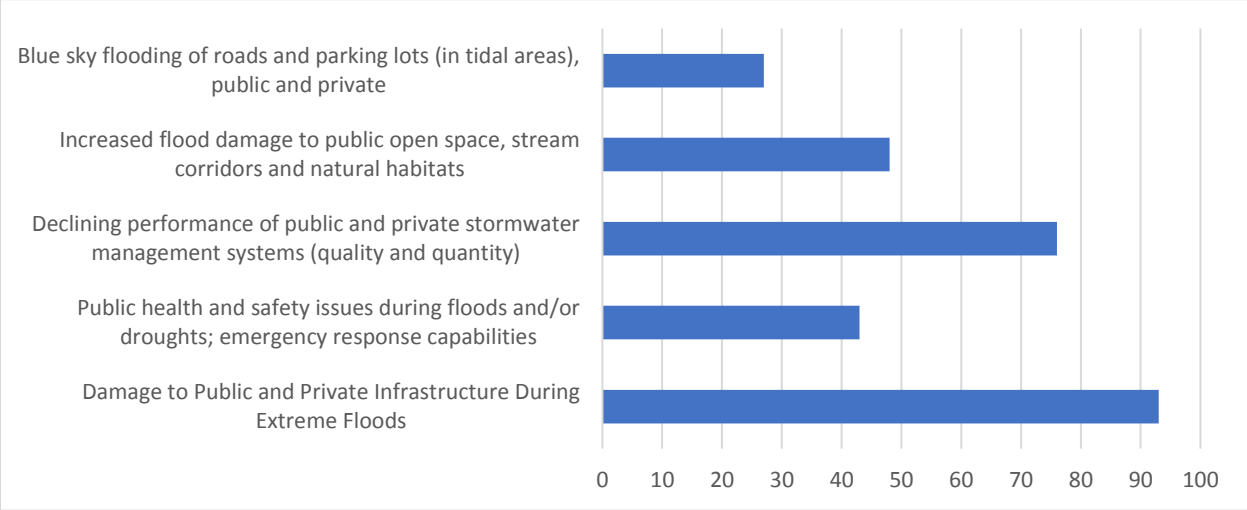
4 Overview of Risks and Concerns

The greatest concerns among respondents can be generally boiled down to two primary themes:

1. Concerns about damage to infrastructure and its impacts on public safety,
2. How to pay for the necessary maintenance and upgrades needed to both reduce flood risks and meet water quality goals.

Across all respondents, the most common climate change-related concern, cited by approximately 60% of respondents, was damage to public and private infrastructure during extreme floods. Looking at their conveyance systems specifically, respondents were most concerned about the loss of hydraulic capacity in conveyance systems leading to road flooding during smaller storm events. They also describe roads, streets and storm drains to be the infrastructure most vulnerable to climate change.

Figure 2. Top 5 most commonly cited climate risks that are of greatest concern in the respondent's community (n=162). Respondents could select up to 3.



Taken together, these responses reinforce that the protection of transportation infrastructure will be the primary focus of future efforts to improve stormwater management and climate resiliency. Stormwater conveyance practices, legacy stormwater ponds, large retrofits and other "on-line" practices that are responsible for the capture and safe conveyance of large storm events through the urban environment will be the first targets for maintenance and upgrades because they will bear the brunt increased runoff and have the most direct impact on public health and safety.

However, failure of smaller, more distributed green infrastructure practices also remain a concern, largely because of cost. Increased costs of maintenance, both routine and non-routine, were cited as the biggest concerns about the effect of increased rainfall intensity on publicly or privately-owned stormwater practices. While Phase I communities are better prepared to handle increased routine maintenance costs, they are not necessarily prepared to undertake major retrofits to their BMP

plumbing to help prevent future damage. Phase II and non-regulated communities are more likely to focus on keeping their existing practices working than undertaking expensive retrofits. Thus, they are more concerned about funding repairs to damaged infrastructure and staff time to provide routine maintenance.

Respondents also frequently cited concerns about achieving both pollutant removal and flood control functions with BMPs. Traditional flood-control practices, like stormwater detention ponds, provide little pollutant removal function but are seen as a necessary component of quantity control. Smaller, distributed green infrastructure can improve water quality and provide limited, localized quantity control, but are more vulnerable to failure during large events. Respondents generally agreed that a mix of quantity and quality control is needed, but that comes with a higher price tag, both for installation and long-term maintenance. This concern was more pronounced in the headwater states.

Finally, there was strong agreement across demographics that a major expansion of the local FEMA flood hazard maps is needed. Between expected increases in rainfall frequency and intensity, sea level rise and increased development, the current maps are largely outdated. Respondents are looking to see locally led updates (with federal funding support), but also acknowledge that it may be difficult to keep up with the changes, especially if local legislation does not provide better guidance for developers.

5 CURRENT MANAGEMENT TAKEAWAYS

Descriptions of current management can be broken into funding, planning and design. Overall, few communities are prepared to respond to climate change impacts, but fewer have funding set aside to plan for resiliency. Most respondents are cobbling together a combination of capital improvement budgets, loans and grants, or are dependent upon state or federal disaster relief to respond to damages caused by climate change. Some respondents who said their community does have funding for "resiliency planning" generally see that funding redirected to address other priorities or have it earmarked for emergency management.

That said, about half of respondents said they are mitigating climate change risk in one way or another. Less than 10% are comfortable with the current engineering design criteria provided by the state or federal agencies and are currently evaluating other options. Only one or two examples were cited as having already made changes to their design criteria or local ordinances. In the meantime, most communities have asset management systems, some of which can be queried for specific indicators of climate risk.

Some Phase I communities are starting to look at adjusting their BMP sizing criteria, or are planning to distribute their BMPs to address high risk areas. However, this is still the minority of communities. The vast majority are dependent upon changes being made to the state stormwater design manuals before they will adjust the design and sizing of their stormwater management practices. The concern is that deviations from state design manuals will expose them to legal risk or result in additional costs that cannot be justified if it isn't a state requirement. However, communities that are concerned about their current design criteria also worry about the lag time associated with updating those manuals, which

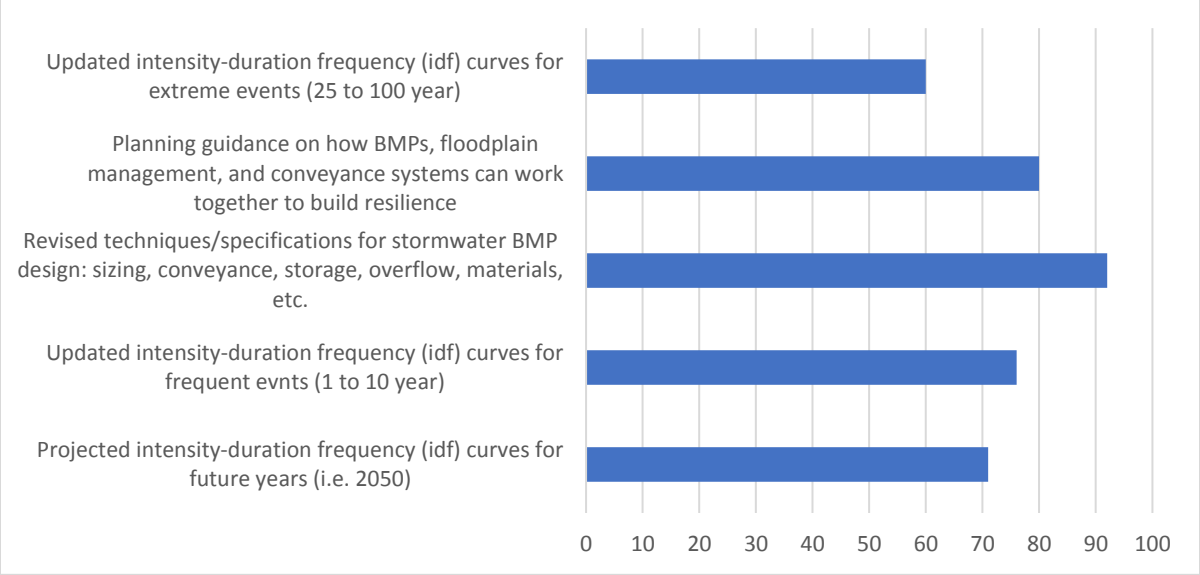
often takes several years. Phase II communities generally have no resiliency plans nor have the capacity to begin work on those plans.

When looking at planning horizons, it is helpful to look at a range of timeframes. Most stormwater BMPs are expected to last 10-25 years with proper maintenance, while transportation infrastructure are expected to last much longer. Being able to understand the expected changes in local hydrology for both near and long-term design objectives is important to many designers.

6 Moving Forward

Respondents were open to almost any new tool that could help them improve the resiliency of their stormwater management systems. Generally, they preferred more "full-package" tools, such as revised BMP design specifications that include updated sizing criteria for conveyance, storage, and overflow as well as material guidance. They also were interested in planning guidance for how BMPs, floodplain management and conveyance systems can work together to improve resiliency.

Figure 3. Top 5 tools rated as "useful" or "very useful" for communities with a need for better design specifications (n=124).



Updated and projected IDF curves were also welcomed, but respondents indicated that they would need to be incorporated into the state design manuals in order to be implemented. Respondents were also somewhat split on how new IDF curves should be developed, depending on their demographics. State agencies preferred projected IDF curves more than the local governments, who were more concerned with the uncertainty associated with projections and showed a slight preference for updated historic IDF curves. Phase I communities were also much more interested in new IDF curves than the Phase II and non-regulated communities who would rather see planning guidance and adjust their maintenance routines.

It is also important to understand the barriers to improving resiliency. The most commonly referenced barrier, mentioned several times already, is lack of funding. There are concerns about increased costs associated with large retrofits to existing stormwater management practices, the need to implement more stormwater management to address increased rainfall, and the increased costs of routine maintenance. The other major barriers are more related to politics – resistance from developers to increased sizing criteria, and lag times associated with implementing new design guidance or regulations.

Over the coming year, CSN will synthesize the existing research on future climate projections, with a focus on efforts to develop local projections that can inform future stormwater design. CSN will also investigate the vulnerabilities of existing stormwater BMPs and summarize the anticipated impacts on pollutant removal performance. Ultimately, the goal is to understand the strategies that can help local communities make cost-effective adjustments to their design criteria, runoff modeling procedures and maintenance regimes to improve the resilience of the next generation of stormwater practices.

7 REFERENCES CITED

Linker, L., G. Shenk, G. Bhatt, R. Tian. 2019. Phase 6 Climate Change Model Initial Findings: Hot, Wet, and Crowded. Presentation to the Chesapeake Bay Program Modeling Workgroup. December 5, 2019. Annapolis, MD. https://www.chesapeakebay.net/channel_files/40161/cc_model_findings_12-5-19_final.pdf

NOAA Mid-Atlantic RISA Team. 2018. Chesapeake Bay Climate Impacts Summary and Outlook for 2018. https://www.midatlanticrisa.org/climate-summaries/2018/11.html. Accessed June 21, 2019.

APPENDIX A. SURVEY OUTREACH

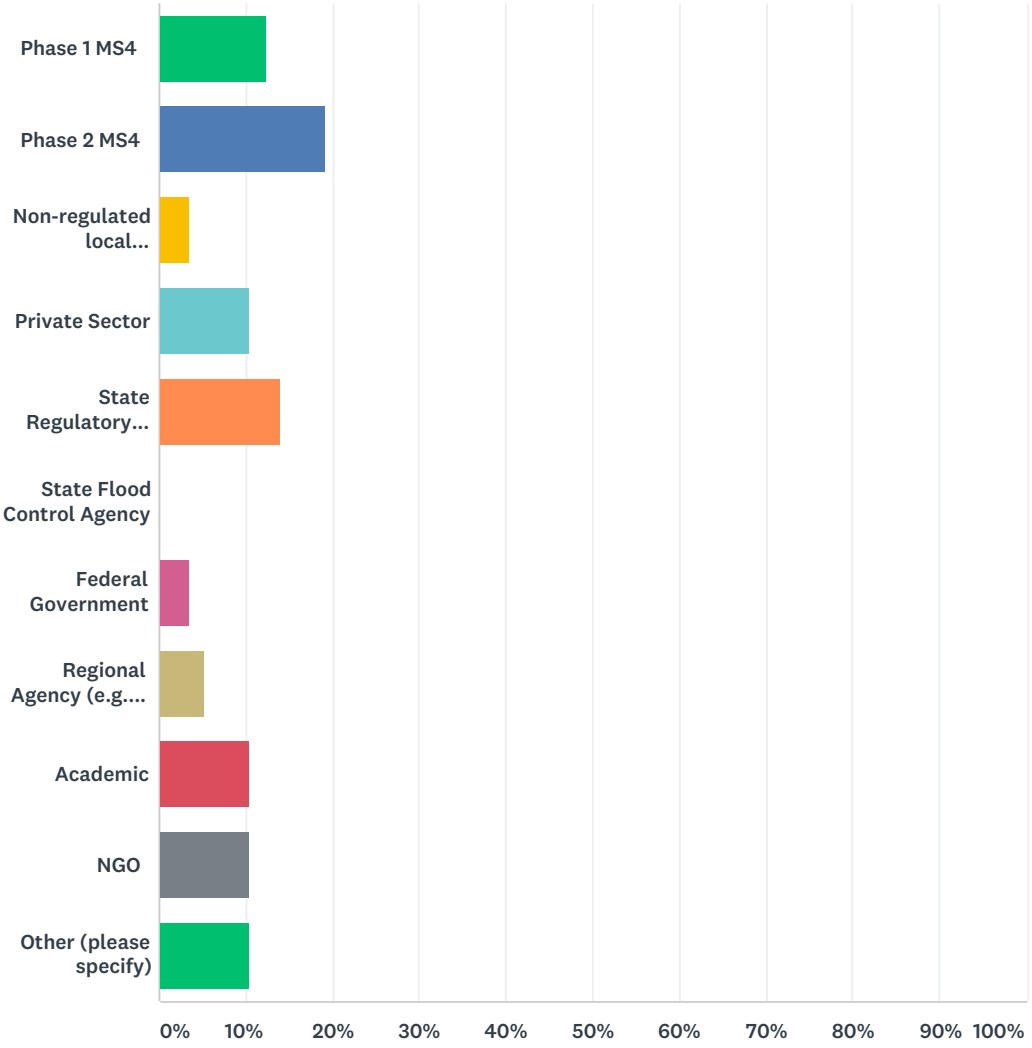
Sector	Represented
Bay Program Workgroups	• Urban Stormwater WG • Land Use WG • Climate Resiliency WG • Modeling WG
Federal Government	• EPA • NOAA • DOD
State Stormwater Agencies	• DE DNREC • DelDOT • DOEE • DDOT • MDE • MD DNR • MDOT SHA • NYS DEC • NY DOT • PA DEP • PA Turnpike Commission • VA DEQ • VDOT • WV DEP
Local Governments	• Anne Arundel County (MD) • Baltimore County (MD) • Carroll County (MD) • Frederick County (MD) • Montgomery County (MD) • Talbot County (MD) • City of Baltimore (MD) • City of Rockville (MD) • Hampton Roads PDC (VA) • Northern Virginia Regional Commission (VA) • Rappahannock Rapidan PDC (VA) • Fairfax County (VA) • City of Alexandria (VA) • City of Charlottesville (VA) • City of Hopewell (VA) • City of Mannassas (VA) • City of Norfolk (VA) • City of Virginia Beach (VA) • WV Region 9 Planning Commission (WV) • New Castle County (DE) • Otsego County Conservation Association (NY)

	• City of Lancaster (PA) • York County (PA) • Lancaster County Conservation District (PA) • Lebanon County Conservation District (PA) • Blair County Conservation District (PA)
Researchers	• University of Maryland • Cornell University • Old Dominion University • Tetra Tech • Penn State University • Virginia Institute for Marine Science • Villanova University
Others	• Center for Progressive Reform • Environmental Action Center • Bayland Consulting • KCI • RAND (VA MARISA) • Potomac Conservancy • AKRF • Blue Water Baltimore • Chesapeake Bay Trust • Arcadis • Hirschman Water and Environment • Hazen and Sawyer

APPENDIX B. COMPLETE SURVEY RESULTS

Q1 Which best describes the sector you work in?

Answered: 57 Skipped: 0



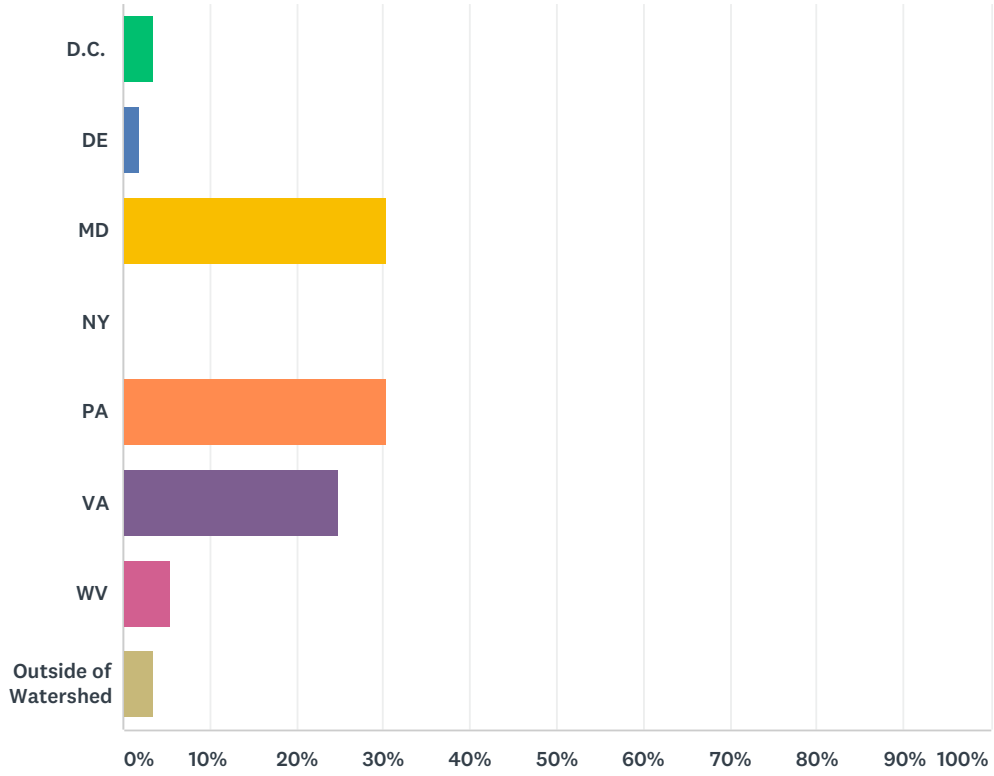
ANSWER CHOICES	RESPONSES	
Phase 1 MS4	12.28%	7
Phase 2 MS4	19.30%	11
Non-regulated local government	3.51%	2
Private Sector	10.53%	6
State Regulatory Agency	14.04%	8
State Flood Control Agency	0.00%	0
Federal Government	3.51%	2
Regional Agency (e.g., soil & water district, regional planning agency)	5.26%	3
Academic	10.53%	6
NGO	10.53%	6

Other (please specify)	10.53%	6
TOTAL		57

#	OTHER (PLEASE SPECIFY)	DATE
1	Represent a grant funder	12/4/2019 11:23 PM
2	state - non regulatory agency	12/3/2019 3:44 PM
3	Conservation District	11/21/2019 2:59 PM
4	regional technical service provider throughout the MidAtlantic	11/15/2019 12:40 AM
5	University Extension Educator	11/14/2019 4:55 PM
6	Town	11/13/2019 7:20 PM

Q2 What state do you primarily work in?

Answered: 56 Skipped: 1

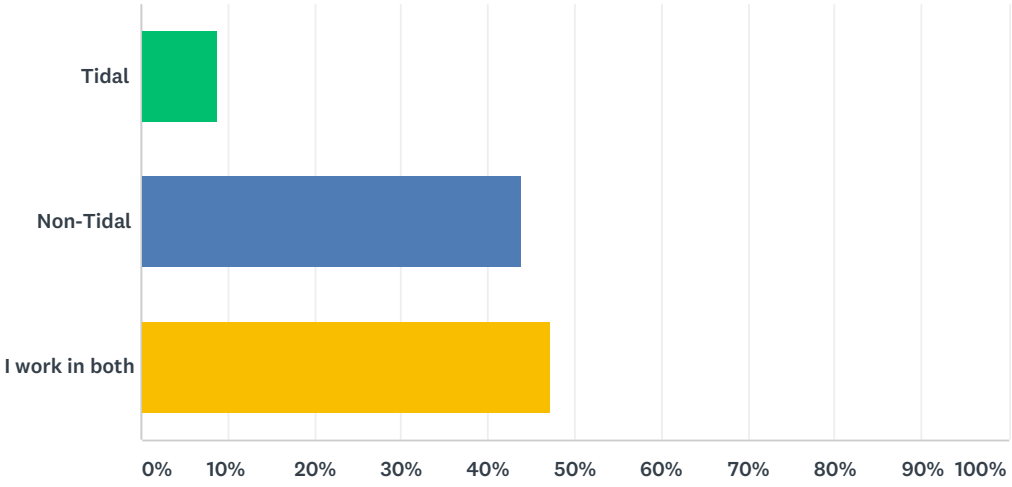


ANSWER CHOICES	RESPONSES	
D.C.	3.57%	2
DE	1.79%	1
MD	30.36%	17
NY	0.00%	0
PA	30.36%	17
VA	25.00%	14

WV	5.36%	3
Outside of Watershed	3.57%	2
TOTAL		56

Q3 My community is:

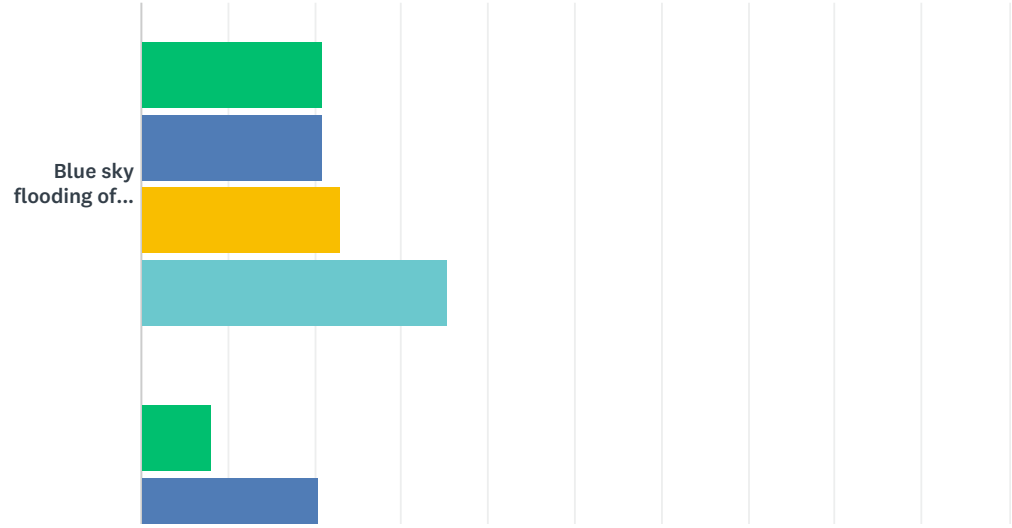
Answered: 57 Skipped: 0

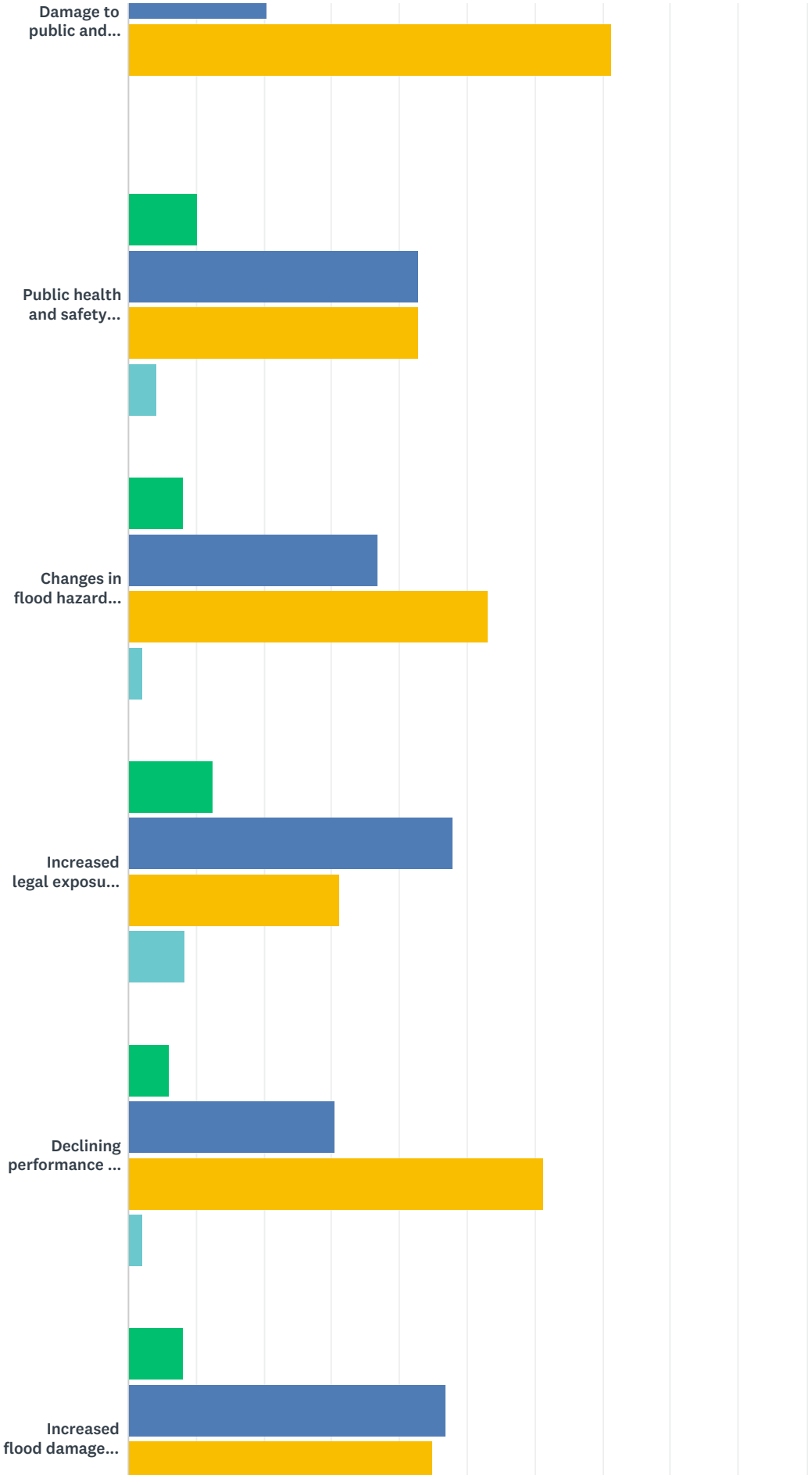


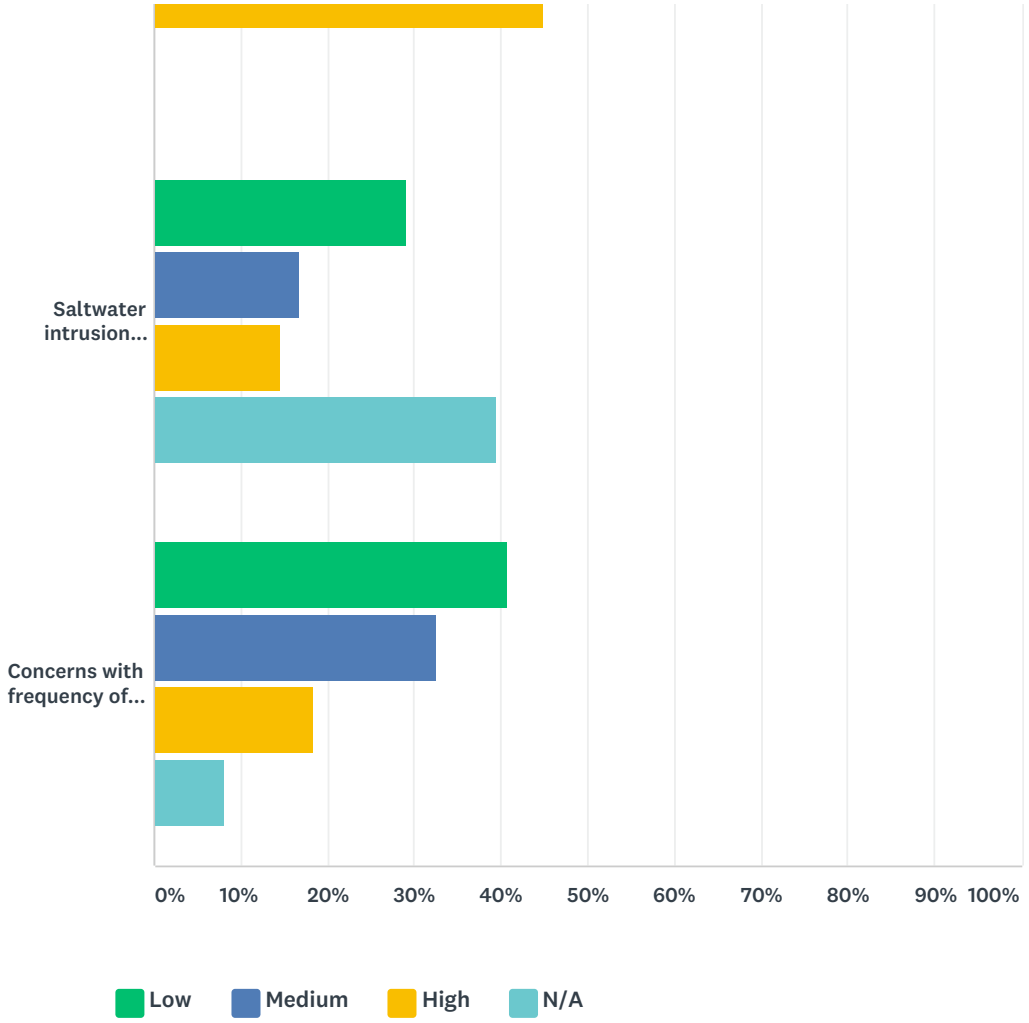
ANSWER CHOICES	RESPONSES	
Tidal	8.77%	5
Non-Tidal	43.86%	25
I work in both	47.37%	27
TOTAL		57

Q4 How would you rate the following climate-change related risks to your community? (High/Moderate/Low)

Answered: 49 Skipped: 8



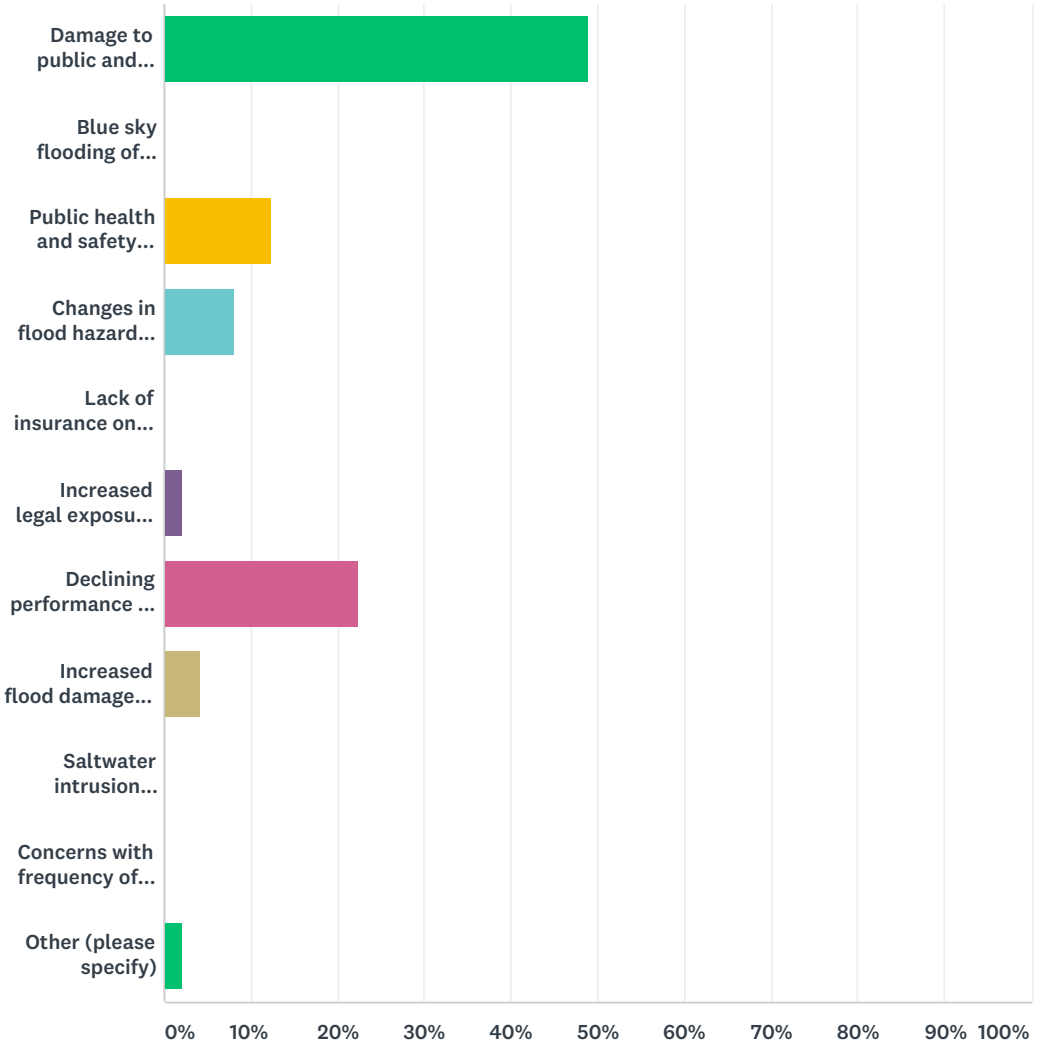

Damage to public and...
Public health and safety...
Changes in flood hazard...
Increased legal exposu...
Declining performance ...
Increased flood damage...



	LOW	MEDIUM	HIGH	N/A	TOTAL	WEIGHTED AVERAGE
Blue sky flooding of roads and parking lots (in tidal areas), public and private	20.83% 10	20.83% 10	22.92% 11	35.42% 17	48	2.03
Damage to public and private infrastructure during extreme floods	8.16% 4	20.41% 10	71.43% 35	0.00% 0	49	2.63
Public health and safety issues during floods and/or droughts; emergency response capabilities	10.20% 5	42.86% 21	42.86% 21	4.08% 2	49	2.34
Changes in flood hazard boundaries along floodplains and waterfront areas	8.16% 4	36.73% 18	53.06% 26	2.04% 1	49	2.46
Increased legal exposure for flooding or erosion on private property	12.50% 6	47.92% 23	31.25% 15	8.33% 4	48	2.20
Declining performance of public and private stormwater management systems (quality and quantity)	6.12% 3	30.61% 15	61.22% 30	2.04% 1	49	2.56
Increased flood damage to public open space, stream corridors and natural habitats	8.16% 4	46.94% 23	44.90% 22	0.00% 0	49	2.37
Saltwater intrusion impacting drinking water sources	29.17% 14	16.67% 8	14.58% 7	39.58% 19	48	1.76
Concerns with frequency of drought conditions (e.g., water supply, survival of trees, wells going dry, wildfires)	40.82% 20	32.65% 16	18.37% 9	8.16% 4	49	1.76

Q5 Of these climate-change related risks, what would you consider the greatest concern in your community?

Answered: 49 Skipped: 8



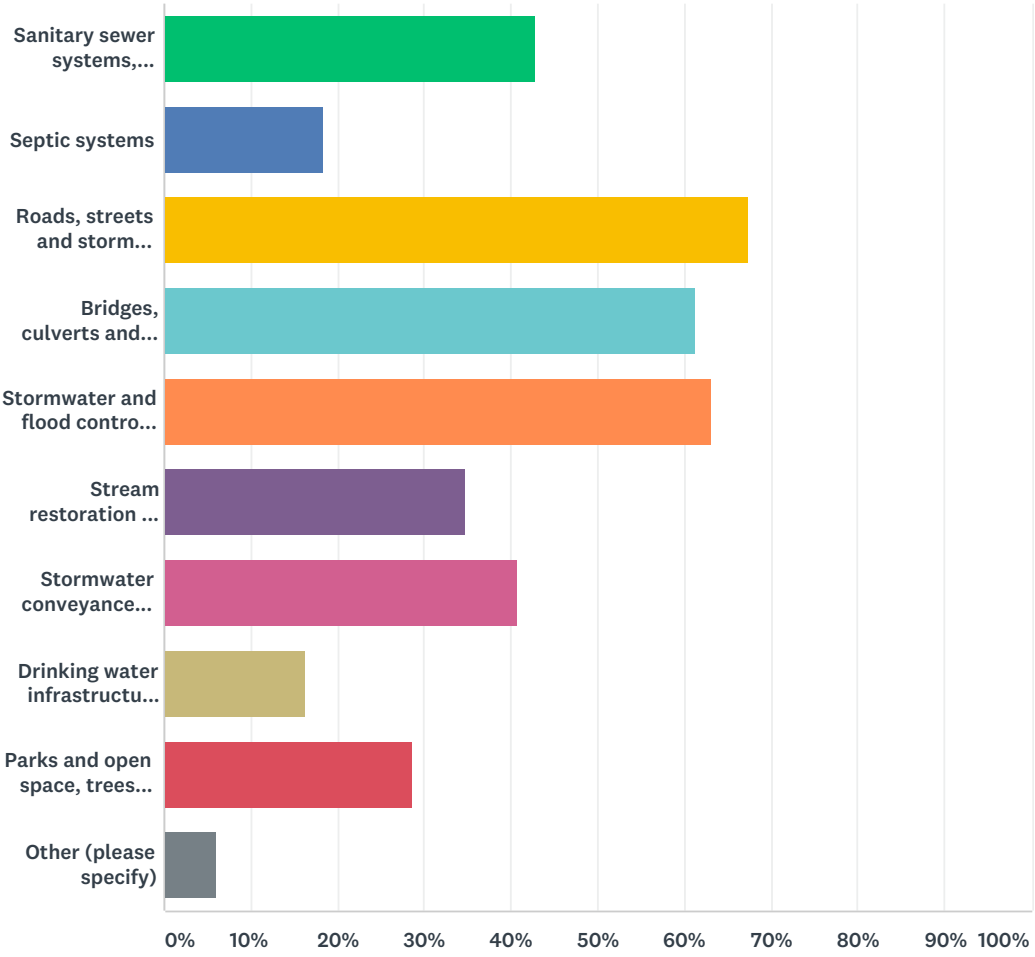
ANSWER CHOICES	RESPONSES	
Damage to public and private infrastructure during extreme floods	48.98%	24
Blue sky flooding of roads and parking lots (in tidal areas), public or private	0.00%	0
Public health and safety issues during floods and/or droughts; emergency response capabilities	12.24%	6
Changes in flood hazard boundaries along floodplains and waterfront areas (i.e. outdated FEMA maps?)	8.16%	4
Lack of insurance on private property	0.00%	0
Increased legal exposure for flooding or erosion on private property	2.04%	1
Declining performance of public and private stormwater management systems (quality and quantity)	22.45%	11
Increased flood damage to public open space, stream corridors and natural habitats	4.08%	2
Saltwater intrusion impacting drinking water sources	0.00%	0

Concerns with frequency of drought conditions (e.g., water supply, survival of trees, wells going dry, wildfires)	0.00%	0
Other (please specify)	2.04%	1
TOTAL		49

#	OTHER (PLEASE SPECIFY)	DATE
1	The economic and political challenges of reestablishing a workable interface between historic towns and flood-prone rivers and streams.	11/25/2019 1:38 PM

Q6 What elements of your public or private infrastructure do you feel are most vulnerable to climate change? (check all that apply)

Answered: 49 Skipped: 8



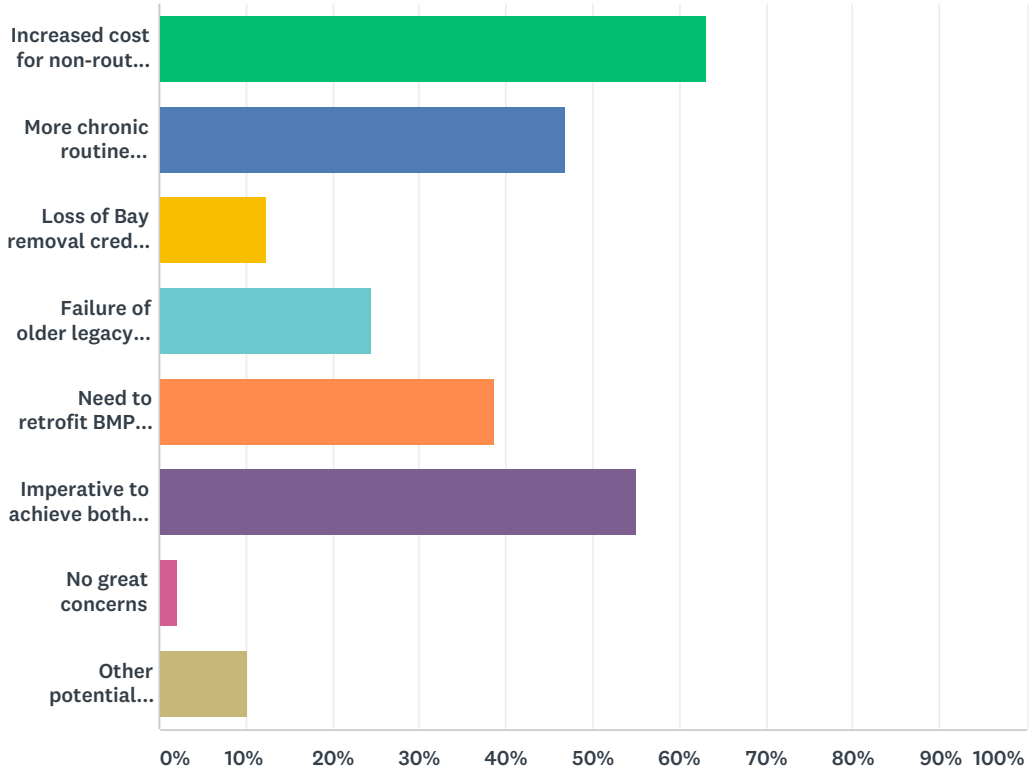
ANSWER CHOICES	RESPONSES	
Sanitary sewer systems, wastewater treatment	42.86%	21
Septic systems	18.37%	9
Roads, streets and storm drains	67.35%	33
Bridges, culverts and crossings	61.22%	30
Stormwater and flood control practices	63.27%	31

Stream restoration and other habitat projects built for the Bay TMDL	34.69%	17
Stormwater conveyance systems (swales and open channels)	40.82%	20
Drinking water infrastructure, water storage and distribution network	16.33%	8
Parks and open space, trees, urban forests, trails systems (especially waterfront or stream corridor)	28.57%	14
Other (please specify)	6.12%	3
Total Respondents: 49		

#	OTHER (PLEASE SPECIFY)	DATE
1	Existing Dams (not necessarily swm-related)	12/10/2019 7:37 PM
2	Historic neighborhoods and downtowns (Buildings)	11/25/2019 1:38 PM
3	Manure storage systems on farms, streambank fencing and crossings	11/14/2019 2:34 PM

Q7 What are your greatest concerns about the effect of increased rainfall intensity on publicly or privately-owned stormwater practices in your community? (Choose up to 3)

Answered: 49 Skipped: 8



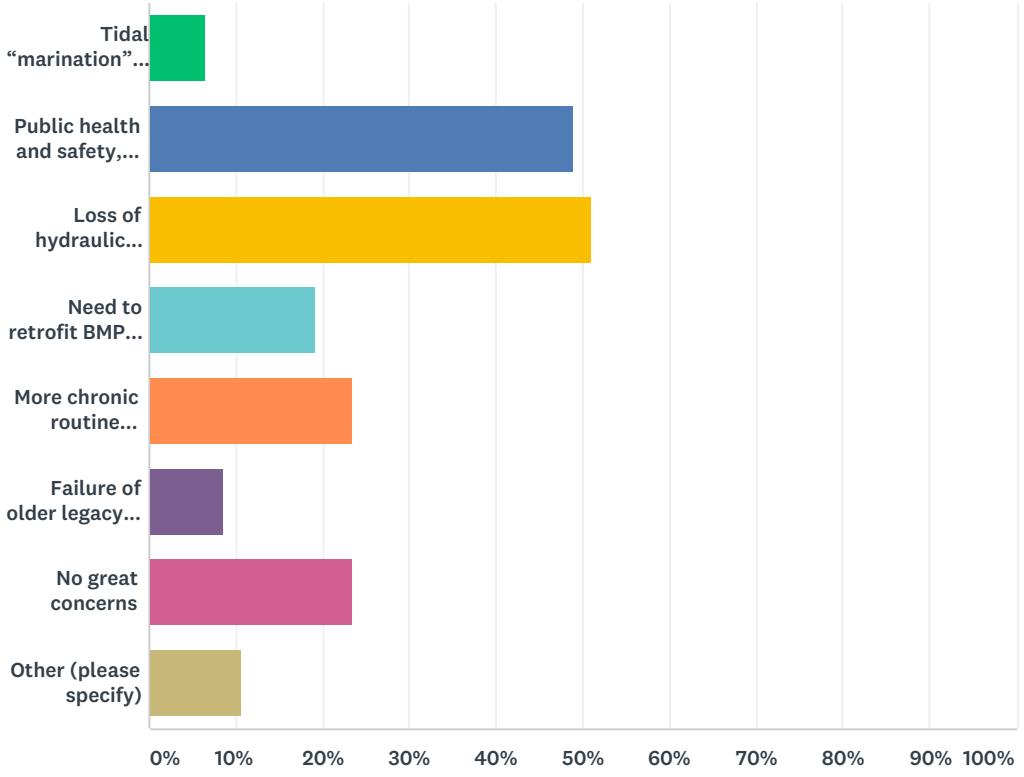
ANSWER CHOICES	RESPONSES	
Increased cost for non-routine maintenance to fix storm damages	63.27%	31
More chronic routine maintenance problems at BMPs	46.94%	23
Loss of Bay removal credits due to BMP failure	12.24%	6

Failure of older legacy detention and retention ponds	24.49%	12
Need to retrofit BMP “plumbing” to accommodate bigger storms	38.78%	19
Imperative to achieve both pollutant removal and flood control with BMPs	55.10%	27
No great concerns	2.04%	1
Other potential problems with stormwater practices (please specify)	10.20%	5
Total Respondents: 49		

#	OTHER POTENTIAL PROBLEMS WITH STORMWATER PRACTICES (PLEASE SPECIFY)	DATE
1	Establishing effective design guidance for new facilities	12/10/2019 7:37 PM
2	embankment failures	12/4/2019 5:36 PM
3	Uncertainty- we don’t know what we don’t know and that is really bad for all our past, current, and future stormwater controls. So I am worried about practices working (quantity/quality) and missed opportunities to improve now.	11/22/2019 12:23 AM
4	Doesn't account for the impacts due to abandoned mines, underground mine pool complexes and sediment loads from AMD or abandoned culm banks located along the major tributaries and the Susquehanna River that flow to the Bay.	11/18/2019 8:47 PM
5	Can I say all?	11/13/2019 6:43 PM

Q8 What are your greatest concerns about the effect of tidal or backwater flooding on the stormwater infrastructure in your community (as applicable to your community)? (Choose up to 3)

Answered: 47 Skipped: 10

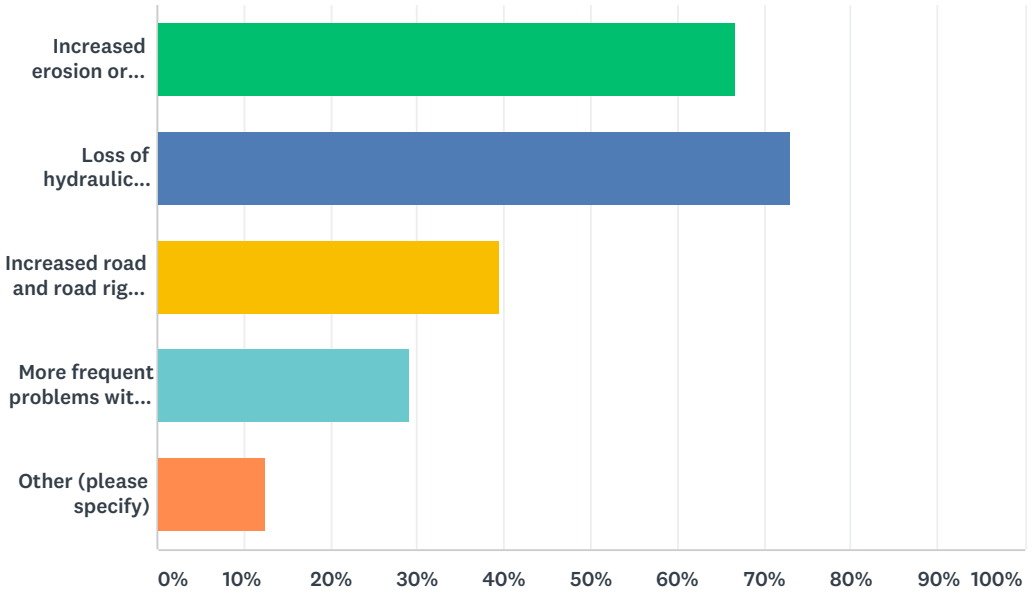


ANSWER CHOICES	RESPONSES	
Tidal “marination” (higher tides reaching nutrient sources on land) will produce new loads that offset loads removed by BMPs	6.38%	3
Public health and safety, flooded streets and buildings	48.94%	23
Loss of hydraulic capacity in stormwater conveyance systems	51.06%	24
Need to retrofit BMP plumbing to accommodate higher tides	19.15%	9
More chronic routine maintenance problems at BMPs	23.40%	11
Failure of older legacy detention and retention ponds	8.51%	4
No great concerns	23.40%	11
Other (please specify)	10.64%	5
Total Respondents: 47		

#	OTHER (PLEASE SPECIFY)	DATE
1	System not tidal, but undersizing of infrastructure to accommodate observed rain events under current weather conditions, and projected climate conditions are a concern. Already seeing rainwater-backwater from full storwmater drainage system during high volume episodic rain events	12/4/2019 5:40 PM
2	N/A	11/18/2019 7:37 PM
3	N/A	11/13/2019 8:21 PM
4	na non tidal	11/13/2019 7:17 PM
5	N/A	11/13/2019 6:46 PM

Q9 What are the most pressing concerns you have about how your current and future stormwater conveyance can handle the runoff produced by increased rainfall frequency and intensity? (Choose up to 3)

Answered: 48 Skipped: 9



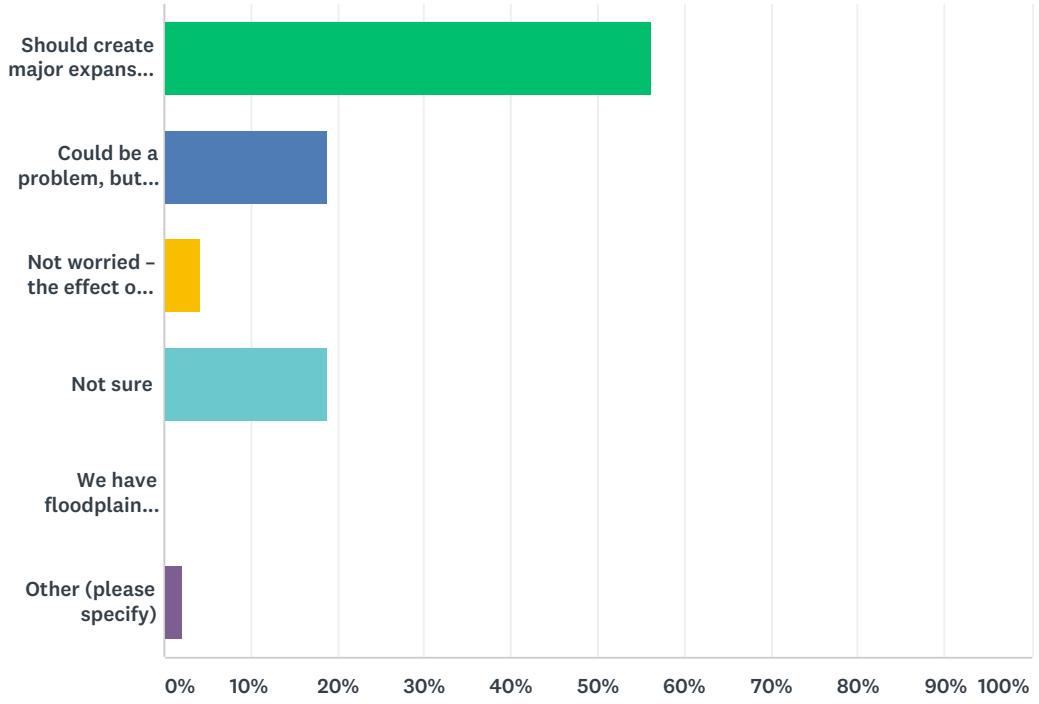
ANSWER CHOICES	RESPONSES

Increased erosion or standing water in open channels/swales	66.67%	32
Loss of hydraulic capacity/street flooding during minor storm events (e.g., 1 – 10 yr)	72.92%	35
Increased road and road right of way maintenance costs	39.58%	19
More frequent problems with pollutant deposition on curbs, inlets and storm drains	29.17%	14
Other (please specify)	12.50%	6
Total Respondents: 48		

#	OTHER (PLEASE SPECIFY)	DATE
1	look at this as a system, cant break this out with current knowledge	12/5/2019 8:54 PM
2	Failure of these systems to handle larger storms, thus causing damage/flooding to personal properties and homes and homeowners without a means to pay/repair damages.	12/4/2019 8:12 PM
3	More frequent localized property flooding and personal property losses/impacts related to episodic high water events resulting from loss of hydraulic capacity	12/4/2019 5:40 PM
4	redesign/rebuild of previously installed practices to adapt to new discharges	12/4/2019 5:36 PM
5	Missed opportunity to do more now to handle future climate change impacts to stormwater BMPs	11/22/2019 12:23 AM
6	droughts on vegetation	11/13/2019 6:47 PM

Q10 What are your main concerns about how climate will impact current and future floodplain boundaries in your community? Check all that apply:

Answered: 48 Skipped: 9



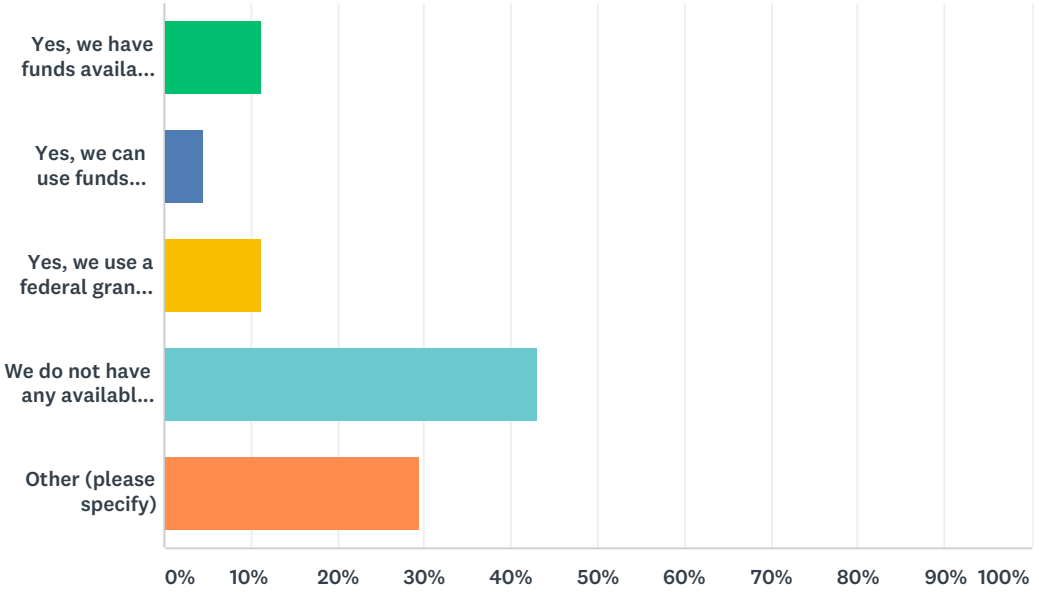
ANSWER CHOICES	RESPONSES	
Should create major expansion in local FEMA flood hazard maps as there is too much emphasis on out-dated FEMA flood-hazard maps	56.25%	27

Could be a problem, but we do not expect that these hazard maps will be updated in the foreseeable future	18.75%	9
Not worried – the effect of future upstream development or increased impervious cover should overwhelm the climate impact on the future dimensions of the ultimate floodplain	4.17%	2
Not sure	18.75%	9
We have floodplain boundary maps?	0.00%	0
Other (please specify)	2.08%	1
TOTAL		48

#	OTHER (PLEASE SPECIFY)	DATE
1	In Maryland, there are current discussions and projects underway to select the future scenario that will be our standard when mapping floodplain boundaries at the state (ie not federal - FEMA) level. I think the greater concern is how we communicate and create change based on these shifting boundaries.	12/3/2019 3:59 PM

Q11 Do you have funding available for climate resiliency planning?

Answered: 44 Skipped: 13



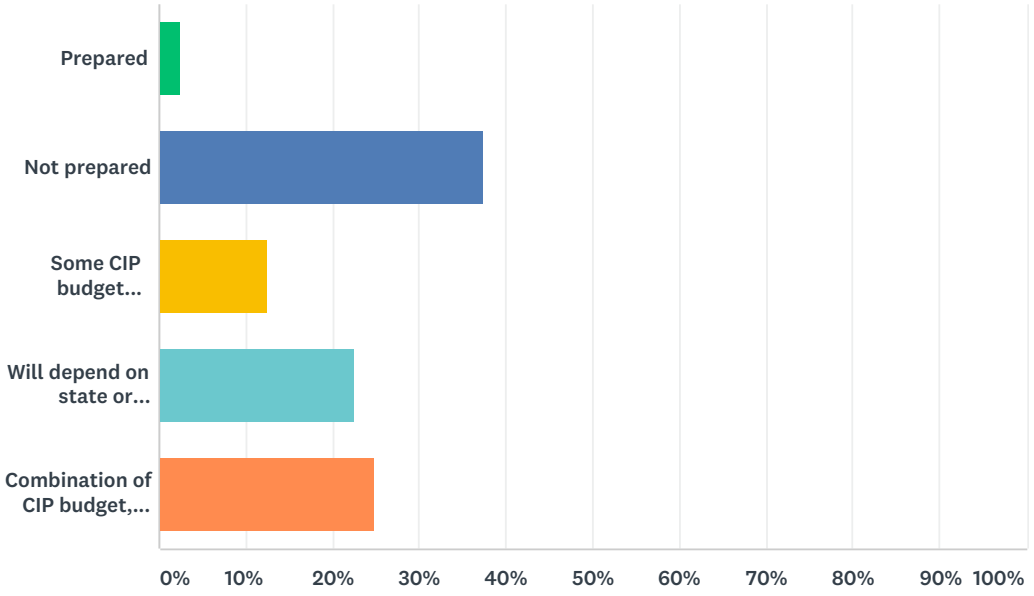
ANSWER CHOICES	RESPONSES	
Yes, we have funds available in the capital improvement budget but need to augment with grant or loans	11.36%	5
Yes, we can use funds collected through our stormwater fees	4.55%	2
Yes, we use a federal grant or other funding source for this purpose	11.36%	5
We do not have any available funding for climate resiliency planning	43.18%	19
Other (please specify)	29.55%	13
TOTAL		44

#	OTHER (PLEASE SPECIFY)	DATE
1	Not Applicable	12/10/2019 7:52 PM

2	Academic	12/5/2019 8:56 PM
3	The Critical Area Commission works with local jurisdictions to implement their local Critical Area Programs. Funding for climate resiliency varies among the local jurisdictions; however, my view is that local political, social, and cultural realities are the most critical issues to address regarding climate resiliency.	12/5/2019 3:43 PM
4	question not applicable to me.	12/4/2019 11:37 PM
5	Not a municipal respondent	12/4/2019 7:25 PM
6	Capital is available for new construction, but would not be available for improvement projects on existing assets unless it was incorporated into a MS4 retrofit project.	12/4/2019 6:35 PM
7	We funded a study to evaluate the potential impacts of sea level rise and develop a list of strategies. Additional funding will be needed to implement suggested strategies and/or perform subsequent studies.	11/25/2019 4:02 PM
8	We are an award-making organization and are focused on climate but in a different way than most orgs	11/22/2019 12:27 AM
9	N/A	11/20/2019 1:39 PM
10	Localities have a combination of funds for planning.	11/13/2019 8:44 PM
11	I'm with a state agency; unsure if this is being considered in an office different from mine.	11/13/2019 6:51 PM
12	university	11/13/2019 6:50 PM
13	We have funding for people power in this topic area	11/13/2019 6:45 PM

Q12 How prepared are you for the future costs/impacts of climate change to your public infrastructure?

Answered: 40 Skipped: 17

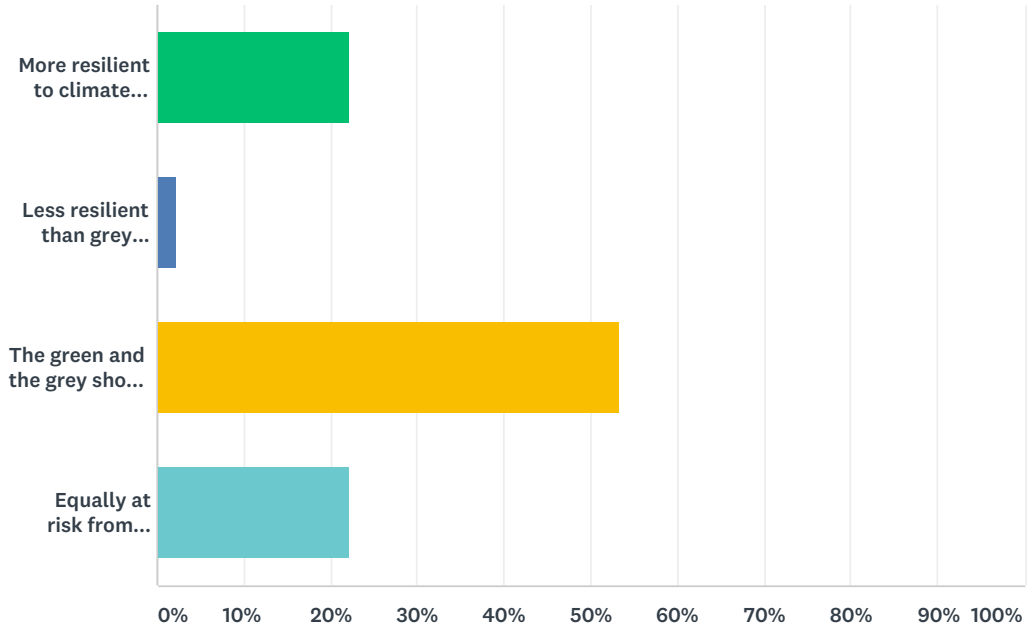


ANSWER CHOICES	RESPONSES	
Prepared	2.50%	1
Not prepared	37.50%	15
Some CIP budget available	12.50%	5

Will depend on state or federal emergency disaster relief	22.50%	9
Combination of CIP budget, fees, grants, and loans	25.00%	10
TOTAL		40

Q13 Do you feel the “green infrastructure” practices recently built in your community are:

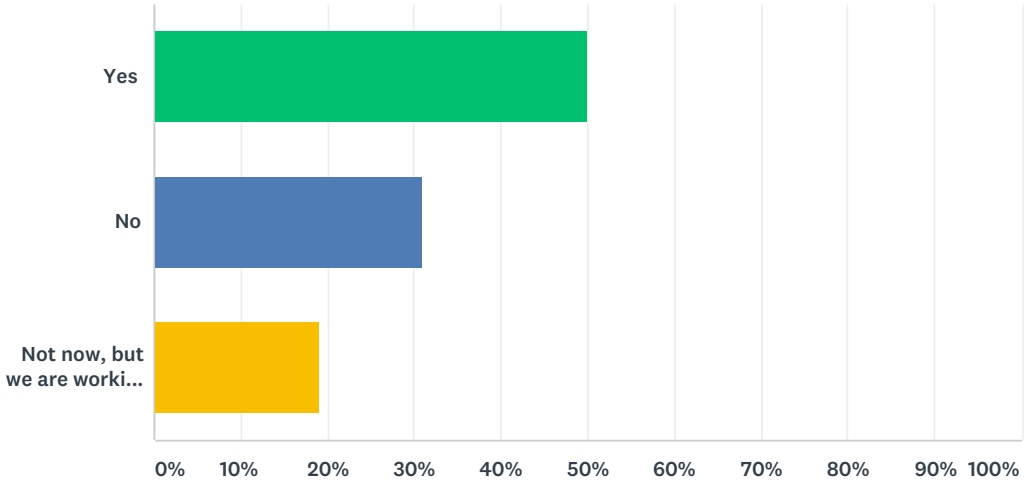
Answered: 45 Skipped: 12



ANSWER CHOICES	RESPONSES	
More resilient to climate change than grey infrastructure?	22.22%	10
Less resilient than grey infrastructure?	2.22%	1
The green and the grey should work together to build resiliency.	53.33%	24
Equally at risk from future climate change?	22.22%	10
TOTAL		45

Q14 Do you have an asset management system, database, or GIS layers that you use to regularly inspect and maintain key stormwater and stream infrastructure?

Answered: 42 Skipped: 15



ANSWER CHOICES	RESPONSES	
Yes	50.00%	21
No	30.95%	13
Not now, but we are working on it	19.05%	8
TOTAL		42

Q15 If you do have an asset management system, database, or GIS layers, can this system map, track or otherwise identify the most vulnerable infrastructure assets in the community at risk from climate change? Please describe in the box below:

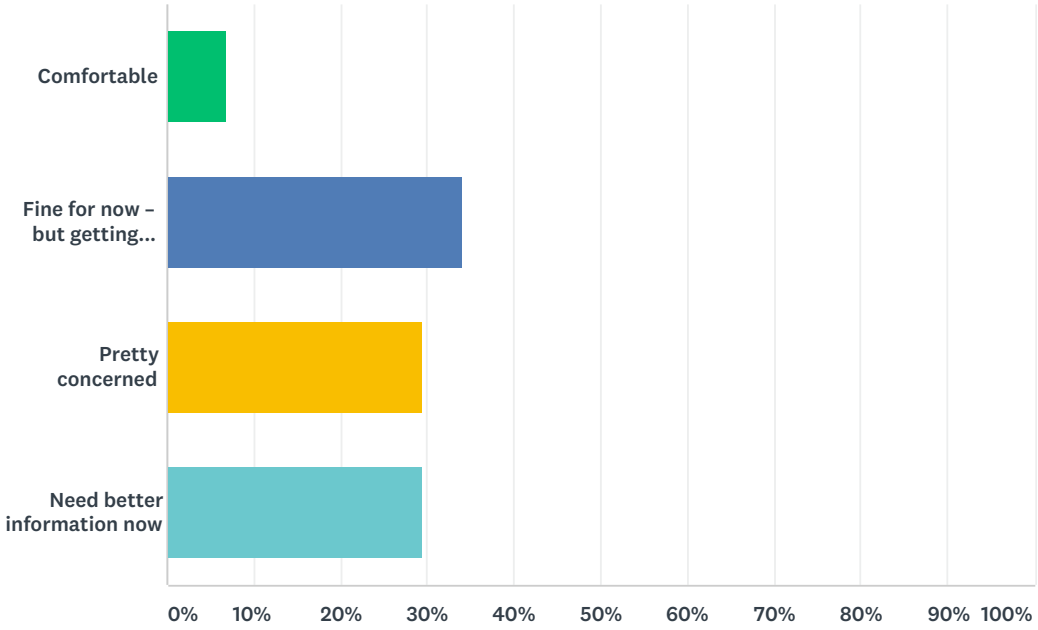
Answered: 34 Skipped: 23

#	RESPONSES	DATE
1	I would think that we are capable of doing this but am not sure it has been or (is being) done	12/12/2019 3:38 AM
2	Only in a primitive manner. Systems were developed prior without specific climate change features	12/10/2019 7:52 PM
3	Research topic we are working on	12/5/2019 8:56 PM
4	NA. I can't speak for my community	12/4/2019 11:37 PM
5	Not a municipal respondent	12/4/2019 7:25 PM
6	Yes. With additional filtering, querying, and analysis vulnerable assets could be identified through looking at contributing drainage area, legacy storm data, salt usage, outfall location, stream impairment, etc. all within the database.	12/4/2019 6:35 PM
7	Not completely sure, but believe we could compare to vulnerability layers	12/4/2019 5:44 PM
8	It is anticipated that the current study efforts may be able to produce such a dataset.	11/25/2019 4:02 PM
9	NA	11/22/2019 12:27 AM
10	N/A	11/21/2019 9:55 PM
11	Conveyance systems	11/21/2019 3:09 PM
12	N/A	11/21/2019 3:06 PM
13	No	11/20/2019 9:12 PM

14	N/A	11/20/2019 1:39 PM
15	NA	11/19/2019 3:46 AM
16	not without accurate flood maps scaled to future. Design are already out of date by the time the project is complete.	11/18/2019 10:34 PM
17	No, it locates additional sources of water to the tributaries and sediment loads that are unaccounted for.	11/18/2019 8:53 PM
18	No	11/18/2019 7:51 PM
19	Yes we have ArcGIS	11/18/2019 7:09 PM
20	Very basic and beginning of GIS data	11/18/2019 3:37 PM
21	No. Vulnerable infrastructure is not yet defined.	11/15/2019 2:07 PM
22	We are working on it and can program this into the future capabilities of the program	11/15/2019 1:26 PM
23	N/A	11/14/2019 8:45 PM
24	No -- we are not using our asset management system to rank the risks to the various infrastructure assets	11/14/2019 8:06 PM
25	no	11/14/2019 2:06 PM
26	No, field observations are lacking.	11/14/2019 3:46 AM
27	N/A	11/13/2019 8:52 PM
28	No, probably not.	11/13/2019 8:43 PM
29	not really	11/13/2019 8:27 PM
30	Capacity of existing infrastructure to convey stormwater runoff safely downstream	11/13/2019 8:25 PM
31	Although data is available, queries have not been developed based on climate change or resiliency criteria.	11/13/2019 7:25 PM
32	Yes, it does. We have conducted interior flooding and analysis with DDOT and DC Water.	11/13/2019 7:13 PM
33	n/a	11/13/2019 6:51 PM
34	Analysis using GIS and H&H models are used to assess impacts	11/13/2019 6:42 PM

Q16 How comfortable are you with the quality and utility of engineering design criteria on future rainfall intensity provided to you by state and/or federal authorities in your community?

Answered: 44 Skipped: 13



ANSWER CHOICES	RESPONSES	
Comfortable	6.82%	3
Fine for now – but getting concerned	34.09%	15
Pretty concerned	29.55%	13
Need better information now	29.55%	13
TOTAL		44

Q17 What design storm(s) do you use for open channel and storm drain conveyance? (please describe in the box below)

Answered: 34 Skipped: 23

#	RESPONSES	DATE
1	10 year 24 hour storm	12/12/2019 3:38 AM
2	1 year storm for erosive velocities, 10 year storm for overtopping, and 100 year if warranted (very rare)	12/10/2019 7:52 PM
3	NA	12/5/2019 8:56 PM
4	not a municipal respondent	12/4/2019 7:25 PM
5	2-year	12/4/2019 6:35 PM
6	1 inch per the Maryland Stormwater Design Manual	12/3/2019 4:05 PM
7	Follow VSMP regulations and the VDOT Drainage Manual	11/25/2019 4:02 PM
8	Our awardees use whatever the state and federal requirements are which are outdated so we need to update the base data for designs ASAP	11/22/2019 12:27 AM
9	2-inch storm	11/21/2019 9:55 PM
10	2 yr	11/21/2019 3:09 PM
11	1-2 year	11/21/2019 3:06 PM

12	2-10	11/20/2019 9:12 PM
13	10-year storm based on NOAA Atlas 14 for Virginia.	11/20/2019 1:39 PM
14	Unkown	11/19/2019 3:46 AM
15	all the standard FHWA design requirements, watershed requirements, Atlas 14	11/18/2019 10:34 PM
16	We hire subcontractors to do the design work. We partner with other organizations, like the WVSA that will end up ultimately doing the design and construction projects to lead to improved BMPs.	11/18/2019 8:53 PM
17	10-15 yr storm events	11/18/2019 7:51 PM
18	25 Year design storm	11/18/2019 7:09 PM
19	10	11/18/2019 3:37 PM
20	N/A	11/15/2019 2:07 PM
21	2yr and 10yr	11/15/2019 1:26 PM
22	N/A	11/14/2019 8:45 PM
23	100 year storm	11/14/2019 8:06 PM
24	2 and 10 year storms	11/14/2019 2:06 PM
25	1 to 10 year	11/14/2019 3:46 AM
26	10 + FREEBOARD + TIDAL EVENT ELEVATIONS	11/13/2019 8:52 PM
27	10 year storm	11/13/2019 8:43 PM
28	10-year	11/13/2019 8:27 PM
29	25 year	11/13/2019 8:25 PM
30	100 year old underground decaying viaduct systems	11/13/2019 7:36 PM
31	Typically 10-YR storm event.	11/13/2019 7:25 PM
32	15 year	11/13/2019 7:13 PM
33	I don't know.	11/13/2019 6:51 PM
34	standard... i want to use continuous simulation	11/13/2019 6:50 PM

Q18 What design storm(s) do you use to meet on-site requirements for downstream flood control? (please describe in the box below)

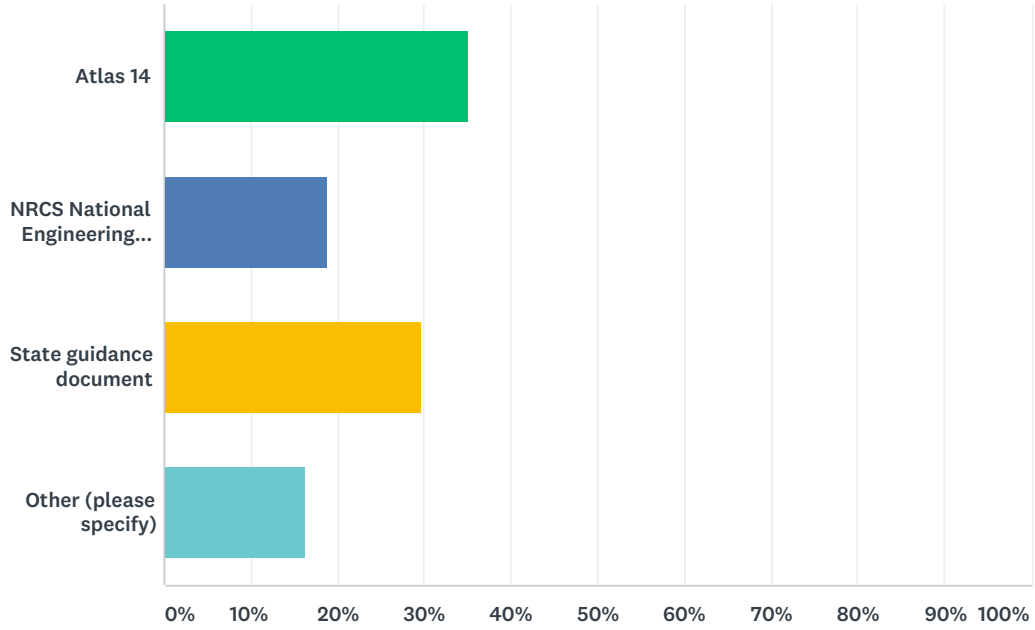
Answered: 31 Skipped: 26

#	RESPONSES	DATE
1	100 year 24 hour storm	12/12/2019 3:38 AM
2	1-year, 10-year 24 hour storms; 2 year 24 hour on Eastern Shore, 100 year 24 hr for certain flood control structures and interjurisdictional watersheds	12/10/2019 7:52 PM
3	NA	12/5/2019 8:56 PM
4	not a municipal respondent	12/4/2019 7:25 PM
5	Performance based data/ criteria on actual rainfall events. More analysis of the data is required.	12/4/2019 6:35 PM
6	1 inch per the Maryland Stormwater Design Manual	12/3/2019 4:05 PM
7	Follow VSMP regulations and the VDOT Drainage Manual	11/25/2019 4:02 PM
8	2-inch	11/21/2019 9:55 PM
9	2 yr	11/21/2019 3:09 PM

10	1-2 year	11/21/2019 3:06 PM
11	Not sure	11/20/2019 9:12 PM
12	100-year flood event	11/20/2019 1:39 PM
13	depends on asset. Interstates might be 50yr, state roads 25 year down to a 2 yr type storm (that no longer fits any SDS curve for intensity, duration, nor frequency)	11/18/2019 10:34 PM
14	We hire subcontractors.	11/18/2019 8:53 PM
15	10-15 yr storm events	11/18/2019 7:51 PM
16	10 Year Storm with a 5 minute duration.	11/18/2019 7:09 PM
17	1 or 2	11/18/2019 3:37 PM
18	N/A	11/15/2019 2:07 PM
19	meet current VRRM standards	11/15/2019 1:26 PM
20	pre-development hydrology	11/14/2019 8:45 PM
21	100 year storm	11/14/2019 8:06 PM
22	10 and 100 year	11/14/2019 2:06 PM
23	10 year	11/14/2019 3:46 AM
24	IN ACCORDANCE WITH VA RULES.	11/13/2019 8:52 PM
25	10 year storm	11/13/2019 8:43 PM
26	10 post development controlled to the 2 year pre develop discharge rates when we do not get fee in lieu	11/13/2019 8:27 PM
27	None	11/13/2019 7:36 PM
28	Typically 100-YR storm event.	11/13/2019 7:25 PM
29	15 year	11/13/2019 7:13 PM
30	I don't know.	11/13/2019 6:51 PM
31	2-100	11/13/2019 6:50 PM

Q19 Where do you currently obtain IDF curves?

Answered: 37 Skipped: 20

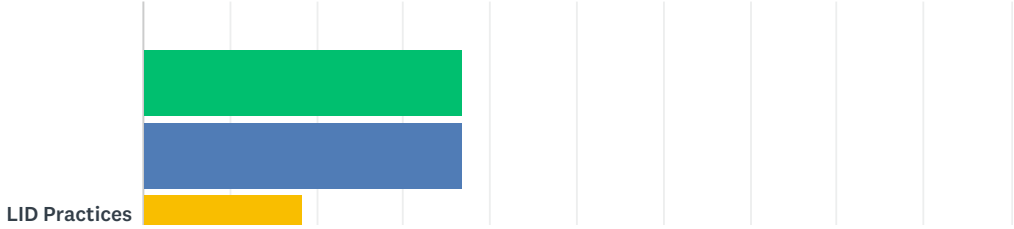


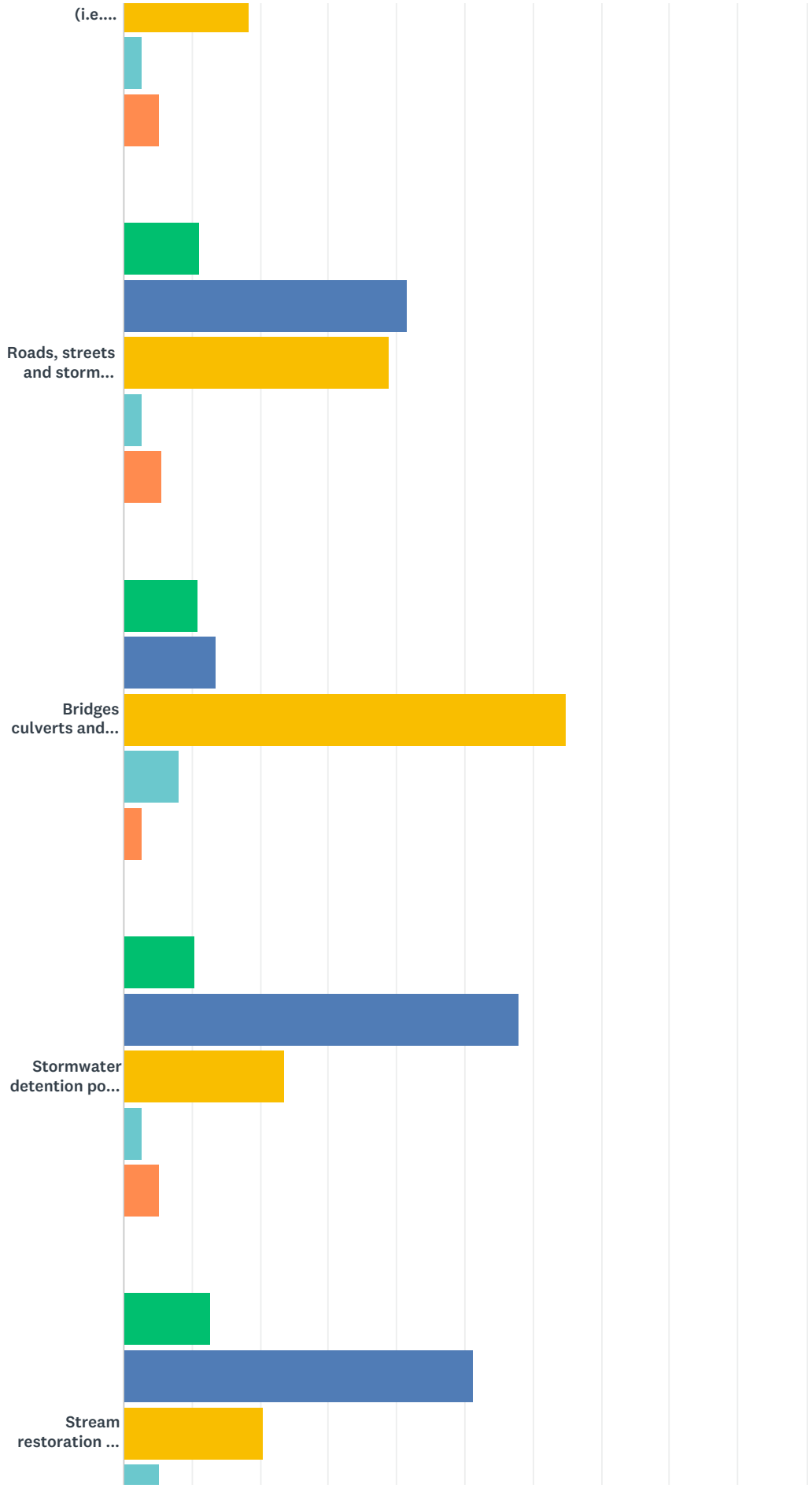
ANSWER CHOICES	RESPONSES	
Atlas 14	35.14%	13
NRCS National Engineering Handbook	18.92%	7
State guidance document	29.73%	11
Other (please specify)	16.22%	6
TOTAL		37

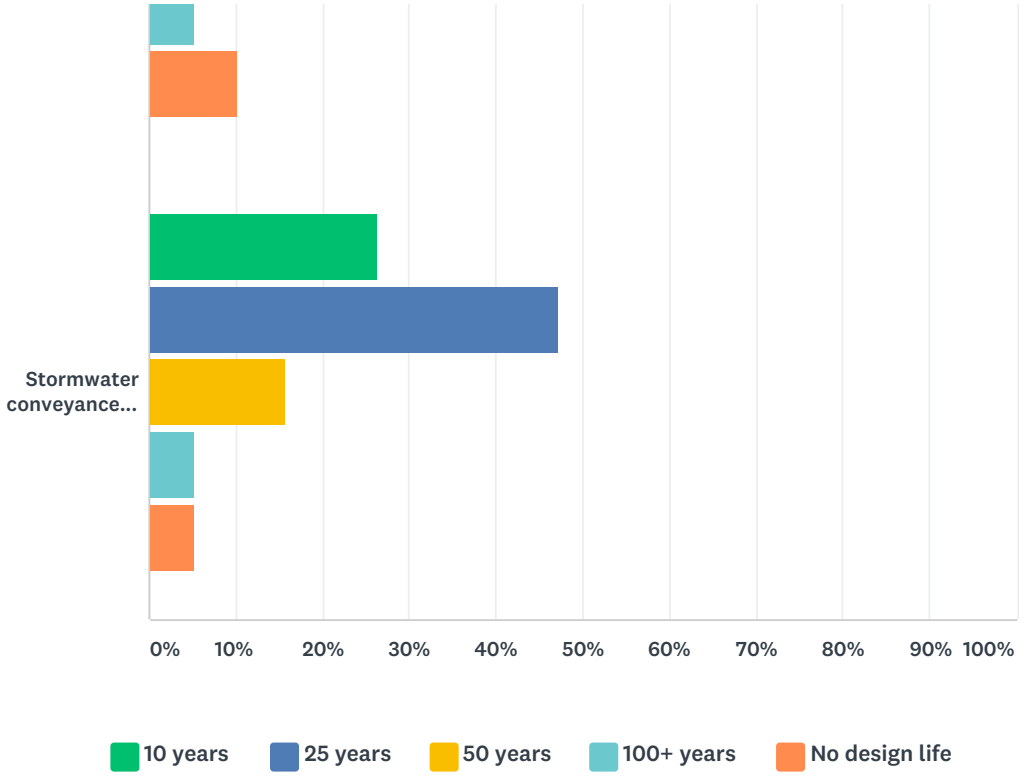
#	OTHER (PLEASE SPECIFY)	DATE
1	Atlas 14 if possible, NRCS NEH (TR-60, HMR 52) for large storms and dam safety, and State guidance	12/10/2019 7:52 PM
2	not a municipal respondent	12/4/2019 7:25 PM
3	Unknown	11/19/2019 3:46 AM
4	I don't know -- not an engineer	11/14/2019 8:06 PM
5	we use historic standards based on NRCS - we think. They are the same standards used regionally we believe. We will wait for the state to update before we would change our design criteria.	11/13/2019 8:27 PM
6	I don't have to do this.	11/13/2019 6:51 PM

Q20 What do you consider as the design life for the following stormwater assets?

Answered: 39 Skipped: 18



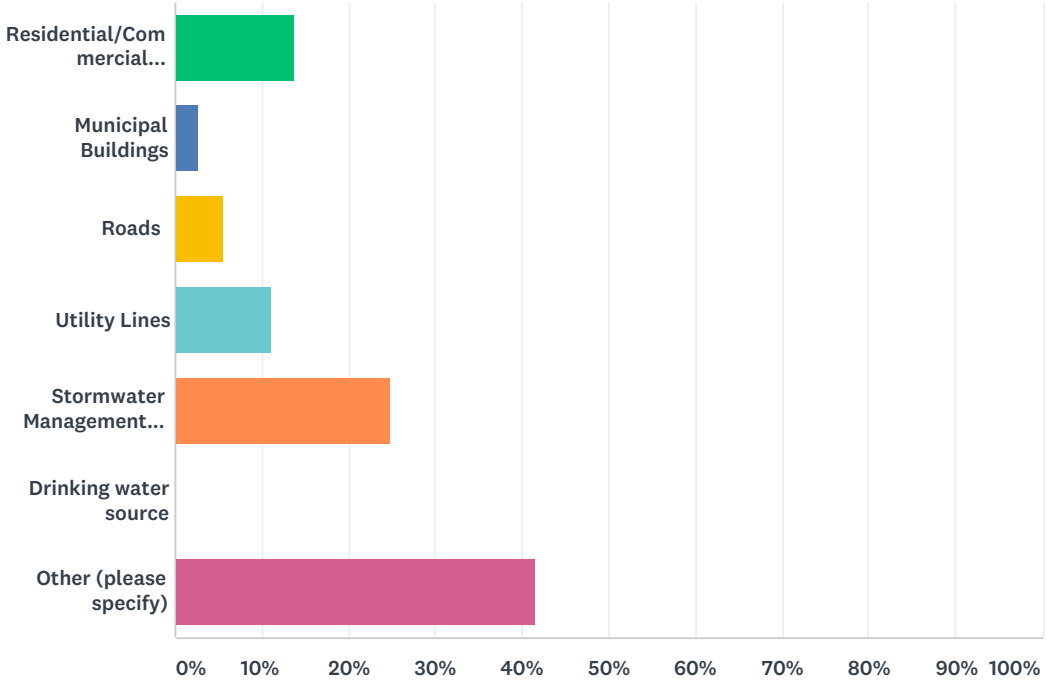

(i.e....
Roads, streets and storm...
Bridges culverts and...
Stormwater detention po...
Stream restoration ...



	10 YEARS	25 YEARS	50 YEARS	100+ YEARS	NO DESIGN LIFE	TOTAL
LID Practices (i.e. bioretention)	36.84% 14	36.84% 14	18.42% 7	2.63% 1	5.26% 2	38
Roads, streets and storm drains	11.11% 4	41.67% 15	38.89% 14	2.78% 1	5.56% 2	36
Bridges culverts and crossings	10.81% 4	13.51% 5	64.86% 24	8.11% 3	2.70% 1	37
Stormwater detention ponds and flood control practices	10.53% 4	57.89% 22	23.68% 9	2.63% 1	5.26% 2	38
Stream restoration and other habitat projects built for the Bay TMDL	12.82% 5	51.28% 20	20.51% 8	5.13% 2	10.26% 4	39
Stormwater conveyance systems (swales and open channels)	26.32% 10	47.37% 18	15.79% 6	5.26% 2	5.26% 2	38

Q21 Which, if any, of the following does your community currently allow within the 100-year floodplain?

Answered: 36 Skipped: 21



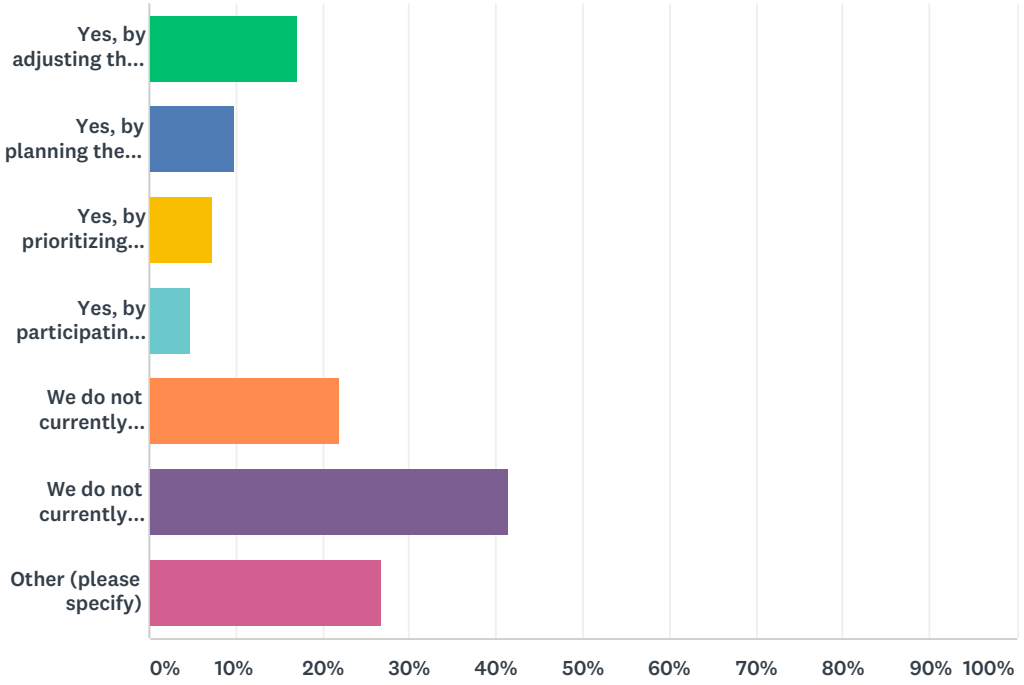
ANSWER CHOICES	RESPONSES	
Residential/Commercial Buildings	13.89%	5
Municipal Buildings	2.78%	1
Roads	5.56%	2
Utility Lines	11.11%	4
Stormwater Management Facilities or BMPs	25.00%	9
Drinking water source	0.00%	0
Other (please specify)	41.67%	15
TOTAL		36

#	OTHER (PLEASE SPECIFY)	DATE
1	Regulated by other entities. All are discouraged.	12/10/2019 7:52 PM
2	NA	12/5/2019 8:56 PM
3	The local jurisdictions/Counties manage their floodplains individually.	12/5/2019 3:43 PM
4	all of the above - very poor local controls and floodplain protection	12/4/2019 11:37 PM
5	not sure	12/4/2019 8:14 PM
6	not sure	11/21/2019 3:06 PM
7	Unkwown	11/19/2019 3:46 AM
8	Not sure	11/18/2019 10:34 PM
9	Within any designated Floodway District (FW), Flood-Fringe District (FF) or General Floodplain Conservation District (FA), the lowest floor, including basement, of any new or substantially improved residential structure shall be at least 1 1/2 feet above the one-hundred-year-flood elevation.	11/18/2019 7:09 PM
10	N/A	11/15/2019 2:07 PM
11	multiple items but can only check one.	11/15/2019 1:26 PM

12	utilities, SWM facilities, road crossings, recreational features (playgrounds, fields, etc.)	11/13/2019 8:27 PM
13	I don't know.	11/13/2019 6:51 PM
14	not my area	11/13/2019 6:50 PM
15	all of the above	11/13/2019 6:42 PM

Q22 Do you currently manage your stormwater assets to mitigate risk from future climate change? (Check all that apply)

Answered: 41 Skipped: 16



ANSWER CHOICES	RESPONSES	
Yes, by adjusting the sizing of our stormwater infrastructure to account for increased storm intensity.	17.07%	7
Yes, by planning the location and distribution of stormwater BMPs to protect critical infrastructure and address high flood risk areas	9.76%	4
Yes, by prioritizing maintenance and capital improvement projects based on their risk of failure due to changing climate	7.32%	3
Yes, by participating in the Community Rating System for floodplain management	4.88%	2
We do not currently account for climate change in our stormwater management but have plans to	21.95%	9
We do not currently account for climate change in our stormwater management and do not have a plan for how to do that	41.46%	17
Other (please specify)	26.83%	11
Total Respondents: 41		

#	OTHER (PLEASE SPECIFY)	DATE
1	We are investigating how best to move forward with updated design criteria	12/10/2019 7:52 PM
2	Research Topic	12/5/2019 8:56 PM

3	I am not aware of any local jurisdiction that is currently including climate change factors (increased frequency, intensity, and duration of precipitation and increased riverine and coastal flooding) when designing SWM BMPs. The issue has been discussed in various meetings/conferences but taking the next step of actually requiring more stringent design criteria has not occurred since this will obviously result in higher costs.	12/5/2019 3:43 PM
4	As far as I can tell, there is no real management aimed at mitigating risk from future climate change.	12/4/2019 11:37 PM
5	Not sure	12/4/2019 8:14 PM
6	not a municipal respondent	12/4/2019 7:25 PM
7	wider floodplains and better access for flood flows for stream restoration	12/4/2019 5:44 PM
8	While we have no existing plans, the ongoing study will likely develop a plan for the future.	11/25/2019 4:02 PM
9	We ask our applicants to consider future sustainability in their projects and tell reviewers how they will do this. We have a climate change statement on our website driving our work and approved by our Board of Directors.	11/22/2019 12:27 AM
10	BY ADJUSTING TAILWATER CONDITIONS TO FACTOR IN SLR	11/13/2019 8:52 PM
11	all of the above selections are on a case-by-case basis, not standard practice yet	11/13/2019 6:42 PM

Q23 Has your community developed or considered developing local stormwater ordinances that are designed to help better manage climate risk? If so, please tell us about it in the box below:

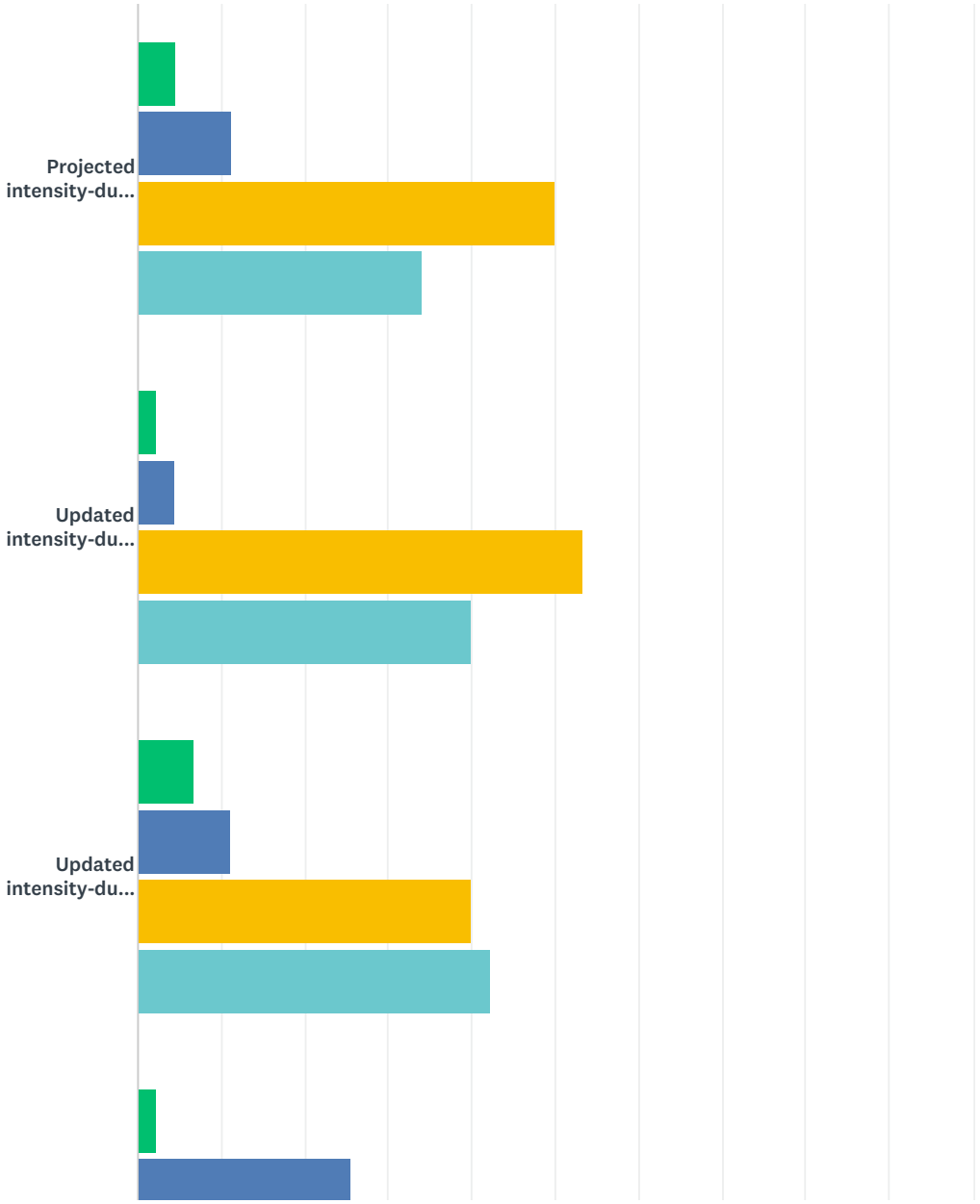
Answered: 23 Skipped: 34

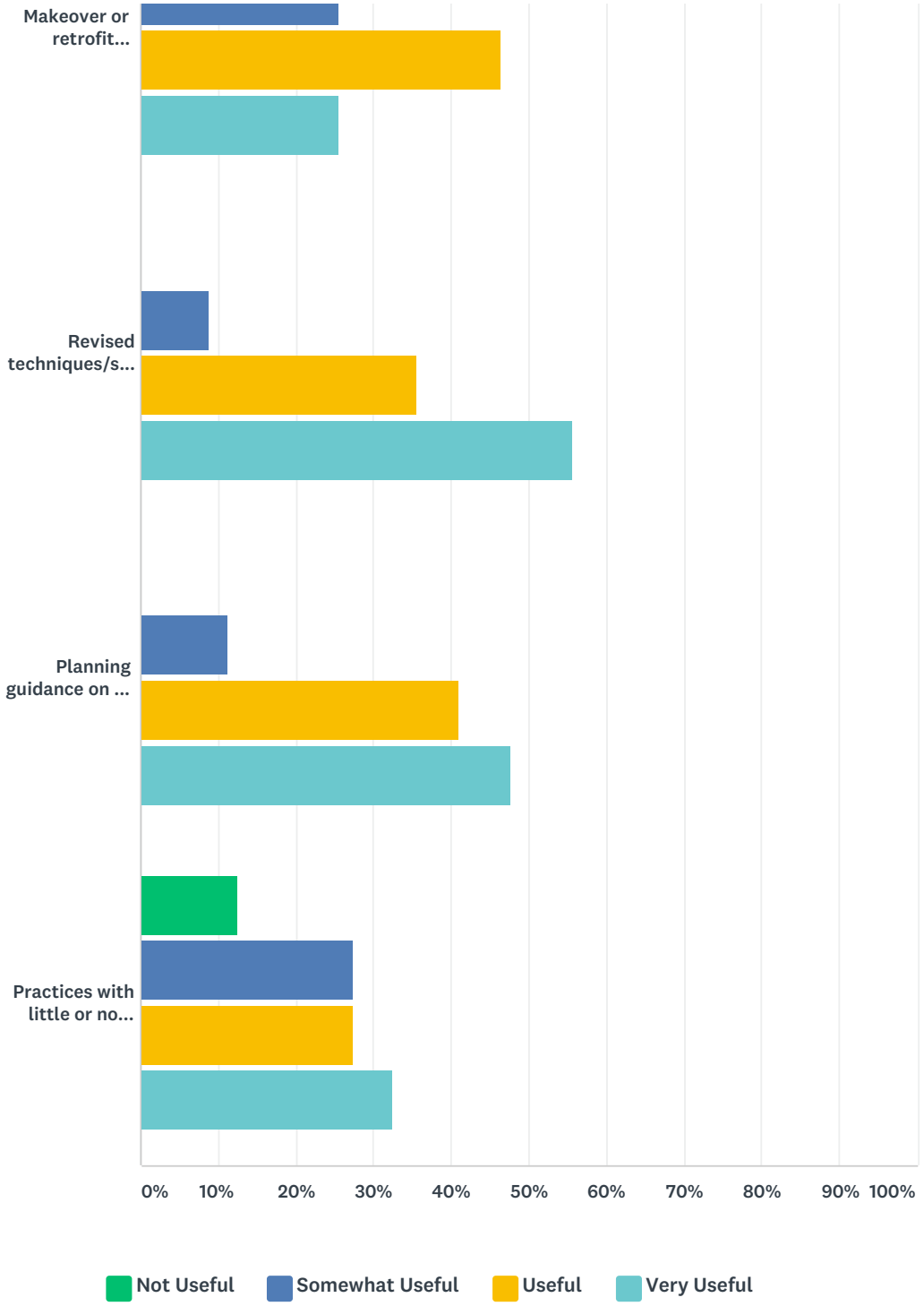
#	RESPONSES	DATE
1	We are in the initial stages of updating regulations and design criteria. This is a multiyear process	12/10/2019 7:52 PM
2	Staff in our office have had numerous discussions regarding stormwater requirements and how the various initiatives we are involved with (Critical Area pollutant reduction requirements for development/redevelopment projects in the IDA, WIPS, reviewing waterfront redevelopment projects, crediting scenarios for various SWM BMPs, MDE stormwater requirements (ESD to the MEP), etc.) could work together to achieve the greatest benefit for the least cost.	12/5/2019 3:43 PM
3	not as far as I know.	12/4/2019 11:37 PM
4	not a municipal respondent	12/4/2019 7:25 PM
5	N/A	11/25/2019 4:02 PM
6	Not in our field. Hoping MDE will begin work on it.	11/21/2019 9:55 PM
7	some have	11/21/2019 3:06 PM
8	N/A	11/20/2019 1:39 PM
9	politics still in the way	11/18/2019 10:34 PM
10	We're a non-profit organization that works with local governments and municipalities. We don't develop local stormwater ordinances.	11/18/2019 8:53 PM
11	N/A to organization	11/18/2019 7:51 PM
12	I work as a consultant for several Bay jurisdictions and have not seen this from any of them yet.	11/15/2019 2:07 PM
13	no	11/15/2019 1:26 PM
14	Yes. Account for pre-development hydrology based on recent historical met data.	11/14/2019 8:45 PM
15	No we have a local stormwater ordinance, but it is not specifically designed to manage climate risk	11/14/2019 8:06 PM
16	No	11/14/2019 3:46 AM

17	NO	11/13/2019 8:52 PM
18	We have considered it, but have not done so yet.	11/13/2019 8:43 PM
19	no	11/13/2019 8:27 PM
20	No	11/13/2019 8:25 PM
21	no	11/13/2019 6:51 PM
22	na	11/13/2019 6:50 PM
23	Developed Green Infrastructure Plan, Resilience Plan, Climate Action Plan, Long-Range Plan and others, but so far just used for general guidance	11/13/2019 6:42 PM

Q24 Of the following information, please indicate what how useful the following tools would be to you if you have a need for better stormwater design specs:

Answered: 45 Skipped: 12





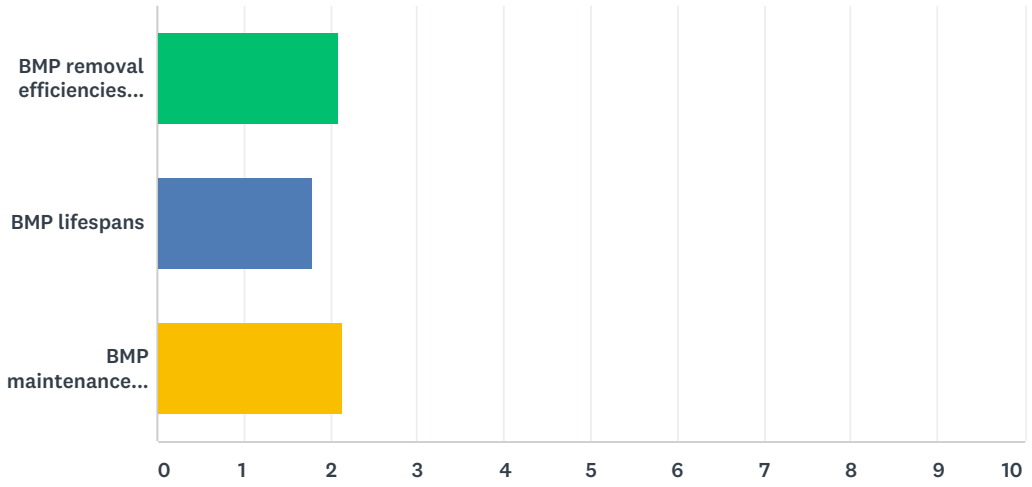
	NOT USEFUL	SOMEWHAT USEFUL	USEFUL	VERY USEFUL	TOTAL	WEIGHTED AVERAGE
Projected intensity-duration frequency (idf) curves for future years (i.e. 2050)	4.55% 2	11.36% 5	50.00% 22	34.09% 15	44	3.14
Updated intensity-duration frequency (idf) curves for frequent events (1 to 10)	2.22% 1	4.44% 2	53.33% 24	40.00% 18	45	3.31
Updated intensity-duration frequency (idf) curves for extreme events (25 to 100)	6.67% 3	11.11% 5	40.00% 18	42.22% 19	45	3.18
Makeover or retrofit practices to restore function in climate damaged practices	2.33% 1	25.58% 11	46.51% 20	25.58% 11	43	2.95

Revised techniques/specifications for stormwater BMP design: sizing, conveyance, storage, overflow, materials, etc.	0.00% 0	8.89% 4	35.56% 16	55.56% 25	45	3.47
Planning guidance on how BMPs, floodplain management, and conveyance systems can work together to build resilience.	0.00% 0	11.36% 5	40.91% 18	47.73% 21	44	3.36
Practices with little or no restrictions in terms of depth to water table	12.50% 5	27.50% 11	27.50% 11	32.50% 13	40	2.80

#	OTHER (PLEASE SPECIFY)	DATE
1	Need to move away from design storms to continuous simulation that is CC informed	12/5/2019 8:59 PM
2	Conveyance is definitely an issue in coastal areas. SWM BMPs can hypothetically be designed and maintained perfectly; however, if there is no conveyance, the area is going to flood regardless. Sea level rise, storm surge, land subsidence, and continued development/redevelopment directly adjacent to the water are all contributing to issues with conveying stormwater off the site in areas where the difference in MHW and site elevation is small to begin with.	12/5/2019 4:05 PM
3	Re: Planning guidance, I think this is already available but not sure relevant guidance or insight is reflected in policy or regulations or practice. Re: depth to water table, is this a trick question/clarification needed - at minimum, BMP designs should consider current data on water table elevation	12/5/2019 12:32 AM
4	I do not approve of lifting restrictions to the water table. Too risky.	11/21/2019 3:11 PM
5	how to link and integrate assets for treatment train systems with redundancy in limited ROW	11/18/2019 10:39 PM

Q25 Please rank the following research needs under increased storm frequency and intensity conditions:

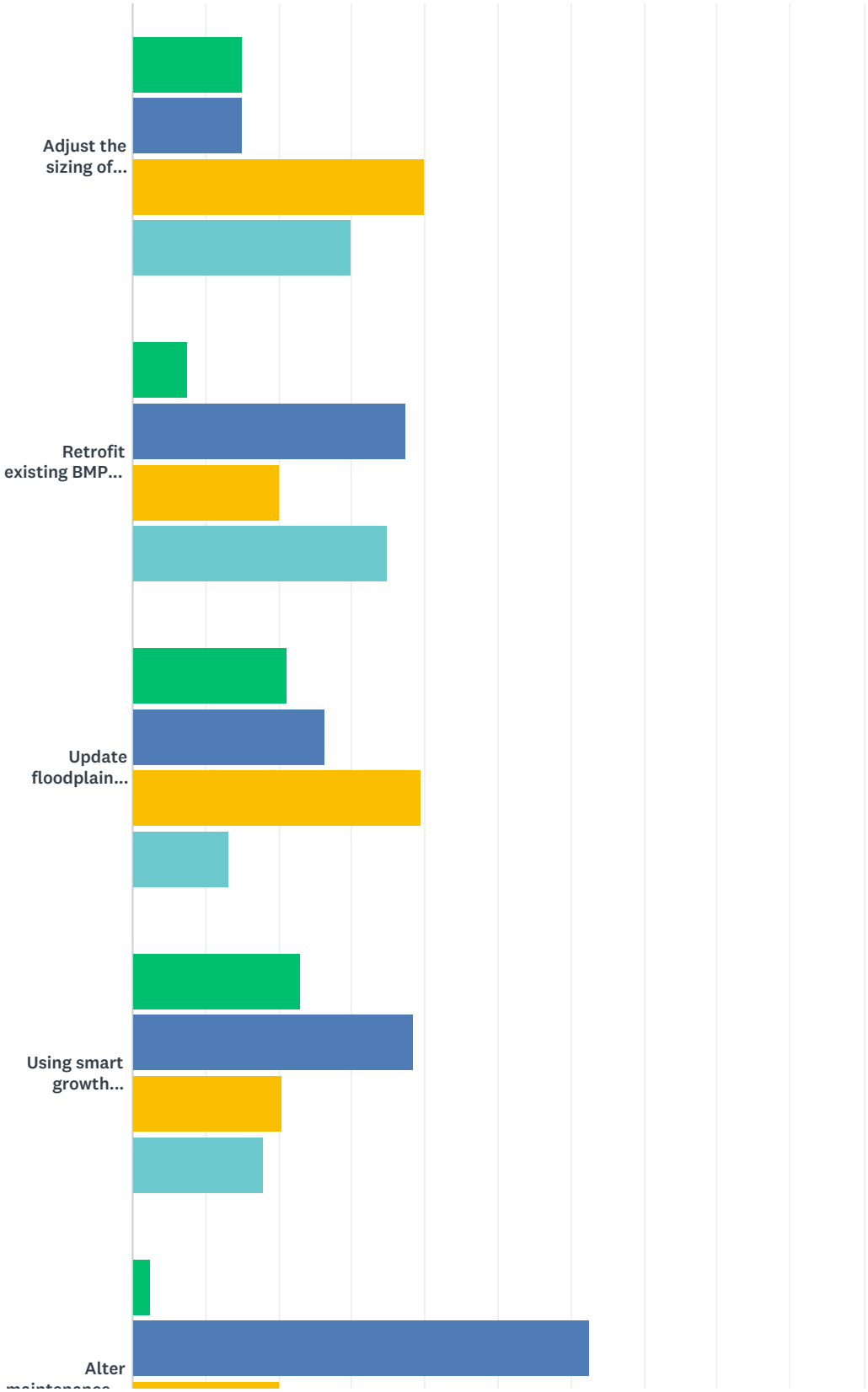
Answered: 45 Skipped: 12

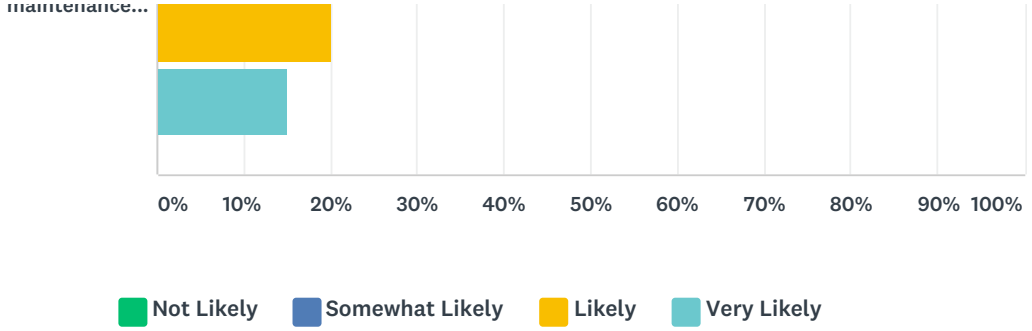


	1	2	3	TOTAL	SCORE
BMP removal efficiencies for various pollutants (nutrients, bacteria, others),	38.64% 17	31.82% 14	29.55% 13	44	2.09
BMP lifespans	28.89% 13	22.22% 10	48.89% 22	45	1.80
BMP maintenance frequency and expectations,	33.33% 15	46.67% 21	20.00% 9	45	2.13

Q26 How likely are you to consider the following potential strategies for reducing risk to stormwater infrastructure?

Answered: 40 Skipped: 17





	NOT LIKELY	SOMEWHAT LIKELY	LIKELY	VERY LIKELY	TOTAL	WEIGHTED AVERAGE
Adjust the sizing of future stormwater assets	15.00% 6	15.00% 6	40.00% 16	30.00% 12	40	2.85
Retrofit existing BMPs with design elements that protect them from higher intensity storms (i.e. overflows and spillways, smart BMPs)	7.50% 3	37.50% 15	20.00% 8	35.00% 14	40	2.83
Update floodplain management and mapping using the Community Rating System or other tools	21.05% 8	26.32% 10	39.47% 15	13.16% 5	38	2.45
Using smart growth principles and land use policy to mitigate future risk	23.08% 9	38.46% 15	20.51% 8	17.95% 7	39	2.33
Alter maintenance practices to provide more frequent inspections of at-risk assets.	2.50% 1	62.50% 25	20.00% 8	15.00% 6	40	2.48

#	OTHER (PLEASE SPECIFY)	DATE
1	I am not directly involved in these types of decisions; however, they all appear necessary strategies to incorporate into SWM infrastructure planning and design.	12/5/2019 4:05 PM

Q27 What do you see as the greatest barrier to incorporating climate resilience into stormwater management?

Answered: 43 Skipped: 14

#	RESPONSES	DATE
1	Water quality requirements	12/12/2019 3:46 AM
2	Uncertainty concerning design criteria and future expectations	12/10/2019 7:57 PM
3	Dependence on static design	12/5/2019 8:59 PM
4	The greatest barrier is the lack of public understanding and support among citizens and the lack of political will among elected officials to explain/communicate the current and likely future climate conditions we will experience and to make the necessary but difficult and unpopular policy decisions required to plan for these conditions.	12/5/2019 4:05 PM
5	In my community, from my observation, township is challenged at managing current development/redevelopment and developer practices, and ensuring public and private BMPs are properly designed, installed and maintained. Additionally, development and redevelopment occurs in floodplains, wetlands, sinkhole-prone areas making BMP design/performance even more challenged. A lack of understanding among policy-makers and enforcement officials and poor enforcement of current rules due to a lack of resources/capacity.	12/5/2019 12:32 AM
6	Lack of knowledge on how to adjust BMPs to accommodate sea level rise and changes in precipitation. How to deal with uncertainty in climate projections.	12/4/2019 10:52 PM
7	Funding for BMP retrofits and maintenance, particularly in non-MS4 localities.	12/4/2019 8:16 PM

8	Consensus on what needs to be done	12/4/2019 7:28 PM
9	Lack of education and guidance.	12/4/2019 6:39 PM
10	real estate/cost	12/4/2019 5:59 PM
11	research to know what to design to that is translated into policy and regulation	12/3/2019 4:09 PM
12	1.) Funding 2.) Issues due to inter-connectivity of storm sewer networks among jurisdictions 3.) lack of unified statewide approach	11/25/2019 4:09 PM
13	Bad land use decisions made by local governments.	11/25/2019 1:53 PM
14	Science to guide us and the training/communication to tell us what the science is and how we can use it	11/22/2019 12:30 AM
15	Creating policies that effectively encourage and assist in moving those living in the floodplain to higher elevations.	11/21/2019 9:57 PM
16	policy	11/21/2019 3:11 PM
17	funding	11/21/2019 3:08 PM
18	Funding	11/20/2019 9:14 PM
19	Lack of funds to upgrade/update existing and future SWM systems.	11/20/2019 2:01 PM
20	Funding	11/19/2019 3:48 AM
21	Funding	11/18/2019 10:39 PM
22	Funding and not having to impose fees on underserved population centers that can't afford to pay for the infrastructure improvements who are either in poverty or on fixed incomes.	11/18/2019 8:59 PM
23	Updated NRCS design standards.	11/18/2019 8:04 PM
24	The uncertainty of data and not enough data to plan for the future	11/18/2019 7:13 PM
25	Funding. There is typically insufficient funding for maintaining what we have now at both the state and local level.	11/15/2019 2:11 PM
26	sound and robust engineering and design guidance	11/14/2019 8:49 PM
27	Convincing elected officials and the general public that investment in more resilient facilities is important	11/14/2019 8:19 PM
28	Lack of consensus on rainfall projections and funding challenges	11/14/2019 5:12 PM
29	Do engineers think to do this when they are hired to do design? Funding to implement.	11/14/2019 2:42 PM
30	lack of precise forecast on future rainfall intensity	11/14/2019 2:08 PM
31	No IDF curves that consider climate change. Next-generation IDF curves will be important but are lacking.	11/14/2019 3:54 AM
32	THE UNWILLINGNESS OF ADAPTATION ADVOCATES TO PROMOTE SMALLER TIME INCREMENT PLANNING....WE NEED TO LOOK AT SHORTER TIME FRAMES THAN 100 YEARS	11/13/2019 8:57 PM
33	Developing the appropriate standards and specifications. For our City that will need to be carried out/endorsed at the state level. Our current management would not endorse standards. etc. not state required.	11/13/2019 8:49 PM
34	The basin size needed for practices.	11/13/2019 8:46 PM
35	DEQ and the regulatory structure	11/13/2019 8:44 PM
36	Justifying increased costs	11/13/2019 8:29 PM
37	Funding	11/13/2019 7:41 PM
38	Resistance by regulated community through lobbying legislature.	11/13/2019 7:32 PM
39	Lack of regulations	11/13/2019 7:15 PM
40	Use of design storms instead of continuous simulation	11/13/2019 6:54 PM
41	It seems like it will require more space/real estate.	11/13/2019 6:54 PM

42	cost and political will	11/13/2019 6:48 PM
43	budget and developer opposition to increased requirements	11/13/2019 6:44 PM

Q28 What other comments or suggestions do you have to help us better understand the current engineering and management responses to climate change in the Chesapeake Bay Watershed?

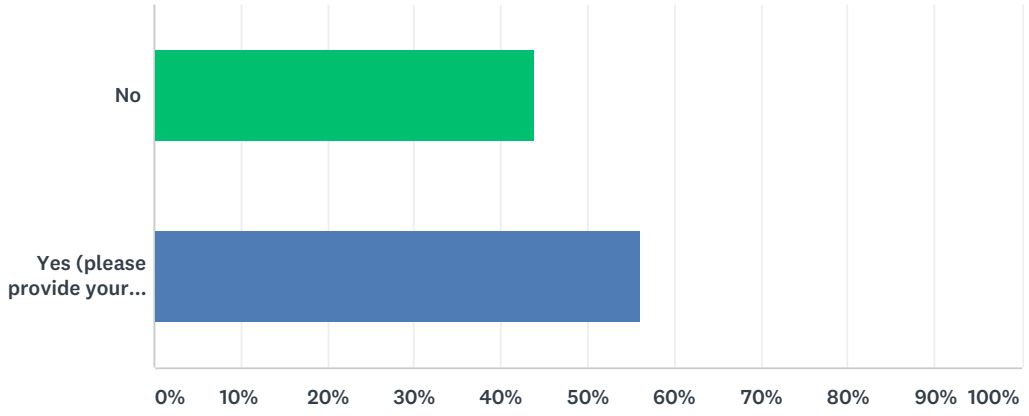
Answered: 25 Skipped: 32

#	RESPONSES	DATE
1	I suggest finding people embedded within their communities to bridge the gap between the decision-makers/engineers/elected officials/managers/regulators/etc. and "regular citizens" whose day to day responsibilities and duties do not include keeping abreast of the complex, scientific, data-driven world of climate change including the difficult decisions and policy changes that need to be made to prepare as well as we can as a society/country. Without public support for the difficult decisions and policy changes that lie ahead, it will be close to impossible to prepare for what, in all likelihood, we will experience in terms of increased flooding and climate-related disasters in the future.	12/5/2019 4:05 PM
2	SE PA municipalities for the most part, from my experience, are challenged to simply implement and enforce current BMP designs using specs from existing (and old) BMP Manual (currently being updated!). Honestly, I'm not sure. I've lived so long in PA with such poor implementation practices that I can hardly imagine forward-thinking policies having any effect, except in rare instances and perhaps in a few of PA's forward-thinking townships unlike my own. It's hard to imagine my municipality adjusting engineering/management practices relative to climate change, which is based on a strong pattern of past poor performance in this regard which can be attributed to a lack of capacity and will to fund. Further climate-related changes will likely only be considered or implemented if severe issues (including severe property damage and public harm) and malfunctions come to light or penalties imposed for non-compliance. In my non-tidal region/township, I'd say BMP performance is more impacted by storm intensity and duration issues (associated w climate change) as well as inadequacy of BMP siting, installation, maintenance. And yet, understandably, climate/storm-intensity-related guidance reflected in BMP design, performance and maintenance standards could likely improve outcomes, address issues, and create BMPs with greater value/resiliency/life span. I hope this is clear and helpful. I'd be happy to query a few muni's directly if survey responses lacking ~ maybe my township isn't as representative as I think.	12/5/2019 12:32 AM
3	Would like to see more resiliency information for non-coastal localities.	12/4/2019 8:16 PM
4	You cannot leave out the need to plan for, finance and maintain these BMP responses	12/4/2019 7:28 PM
5	Thank you for your efforts, this needs more attention within the water resources world. For stream restoration I suggest we analyze the performance of various design approaches to gage performance through the new norm(s).	12/4/2019 5:59 PM
6	political will is going to be crucial to accomplish changes needed to make our systems more resilient	12/3/2019 4:09 PM
7	None	11/25/2019 4:09 PM
8	N/A	11/21/2019 9:57 PM
9	it is slow to disseminate to the engineering community	11/21/2019 3:11 PM
10	none	11/21/2019 3:08 PM
11	N/A	11/20/2019 9:14 PM
12	Regional/watershed GIS based Map-To-Map (projected precipitation map to flood map) with active upgrade capabilities.	11/20/2019 2:01 PM
13	This is not the only area with a climate crisis. Results that scale or are adaptable to other USA regions are ideal	11/18/2019 10:39 PM

14	The responses aren't taking into consideration the impacts caused by abandoned mine lands nor are they accounting for the credits that should be included for the reduction in sediment loads from reclamation and AMD remediation projects in the Bay watershed that are removing iron, aluminum, manganese, trace metals, coal, culm, silt, and legacy sediments from the waterways that are causing flooding and pollution problems in addition to ag impacts, etc. AMD is sediment and it should be counted as such.	11/18/2019 8:59 PM
15	Research is very useful but until it gets incorporated into ordinances and design criteria our hands are tied as designers. We have to do what the regulations require.	11/15/2019 2:11 PM
16	N/A	11/14/2019 8:49 PM
17	It's a tough case to make in rural areas that we should increase spending on stormwater infrastructure, particularly existing infrastructure, to make it more resilient to climate change.	11/14/2019 8:19 PM
18	In South Central PA, climate change is rarely discussed but flooding during large storm systems is a problem and a concern. Typical Green Infrastructure BMPs don't address the level of flooding that causes damage.	11/14/2019 2:42 PM
19	Fund research to develop next/generation ISF curves and revisit the designs of existing BMPs	11/14/2019 3:54 AM
20	NONE	11/13/2019 8:57 PM
21	MDE's lack of real crediting for significant volumetric control is a disincentive to pursuing more of that work.	11/13/2019 8:46 PM
22	Our municipalities are not interested in addressing climate change concerns at this time	11/13/2019 8:29 PM
23	Available funding oportunities	11/13/2019 7:41 PM
24	None at this time pending review of survey results.	11/13/2019 7:32 PM
25	none	11/13/2019 6:54 PM

Q29 Are you willing to be contacted by CSN for follow-up discussion?

Answered: 41 Skipped: 16

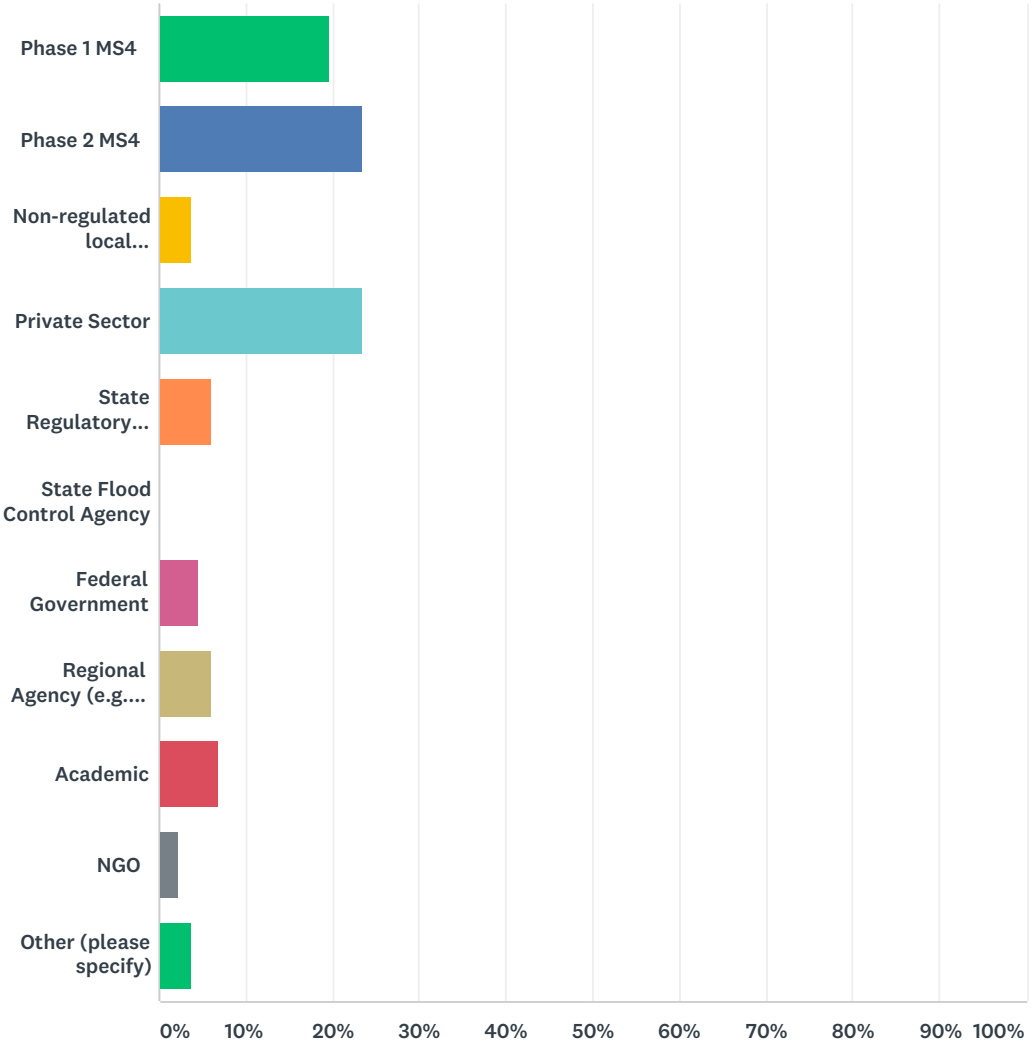


ANSWER CHOICES	RESPONSES	
No	43.90%	18
Yes (please provide your email in the box below)	56.10%	23
TOTAL		41

#	YES (PLEASE PROVIDE YOUR EMAIL IN THE BOX BELOW)	DATE
1		12/10/2019 7:57 PM
2		12/5/2019 8:59 PM

Q1 Which best describes the sector you work in?

Answered: 132 Skipped: 0



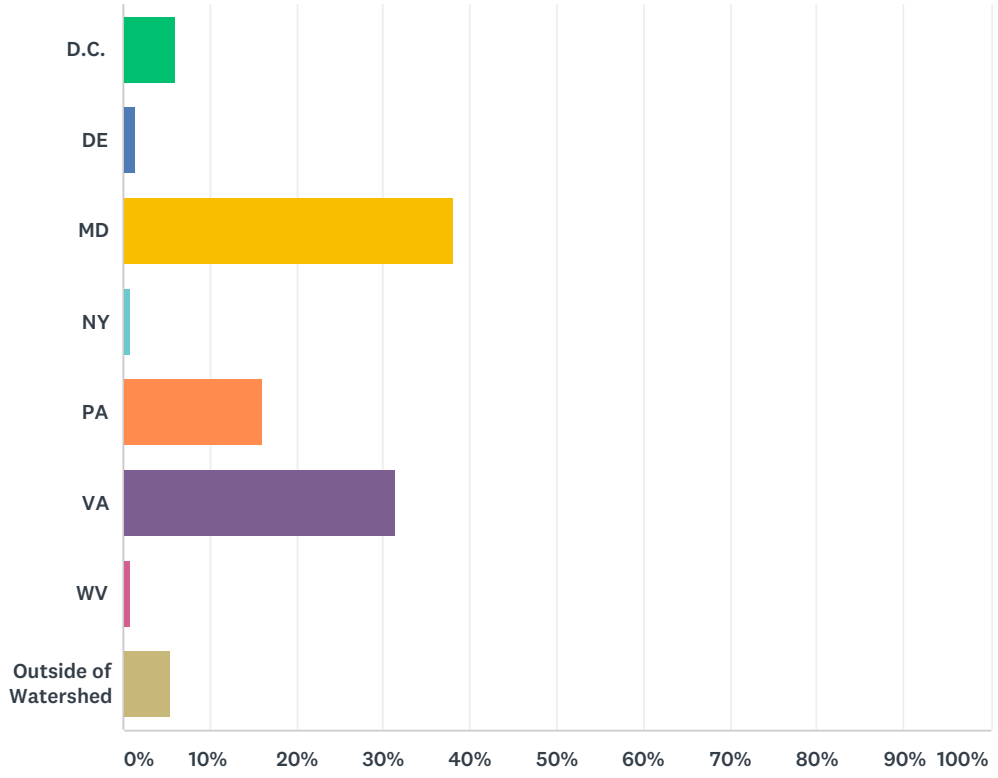
ANSWER CHOICES	RESPONSES	
Phase 1 MS4	19.70%	26
Phase 2 MS4	23.48%	31
Non-regulated local government	3.79%	5
Private Sector	23.48%	31
State Regulatory Agency	6.06%	8
State Flood Control Agency	0.00%	0
Federal Government	4.55%	6
Regional Agency (e.g., soil & water district, regional planning agency)	6.06%	8
Academic	6.82%	9
NGO	2.27%	3

Other (please specify)	3.79%	5
TOTAL		132

#	OTHER (PLEASE SPECIFY)	DATE
1	MS4 waiver local government	12/10/2019 2:54 PM
2	municipal authority	12/10/2019 1:11 PM
3	City PW	12/10/2019 12:39 PM
4	state department of natural resources	11/20/2019 3:44 PM
5	General Contractor	11/14/2019 8:57 PM

Q2 What state do you primarily work in?

Answered: 131 Skipped: 1

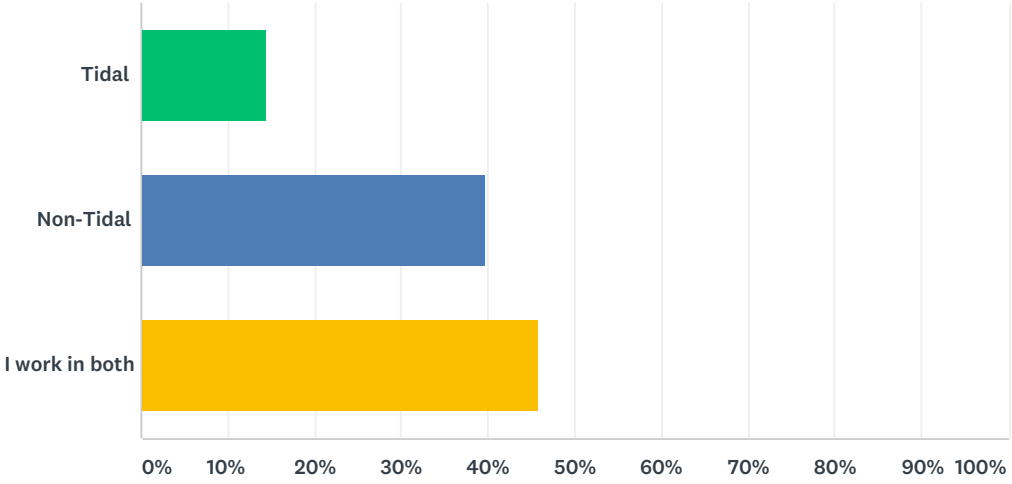


ANSWER CHOICES	RESPONSES	
D.C.	6.11%	8
DE	1.53%	2
MD	38.17%	50
NY	0.76%	1
PA	16.03%	21
VA	31.30%	41
WV	0.76%	1

Outside of Watershed	5.34%	7
TOTAL		131

Q3 My community is:

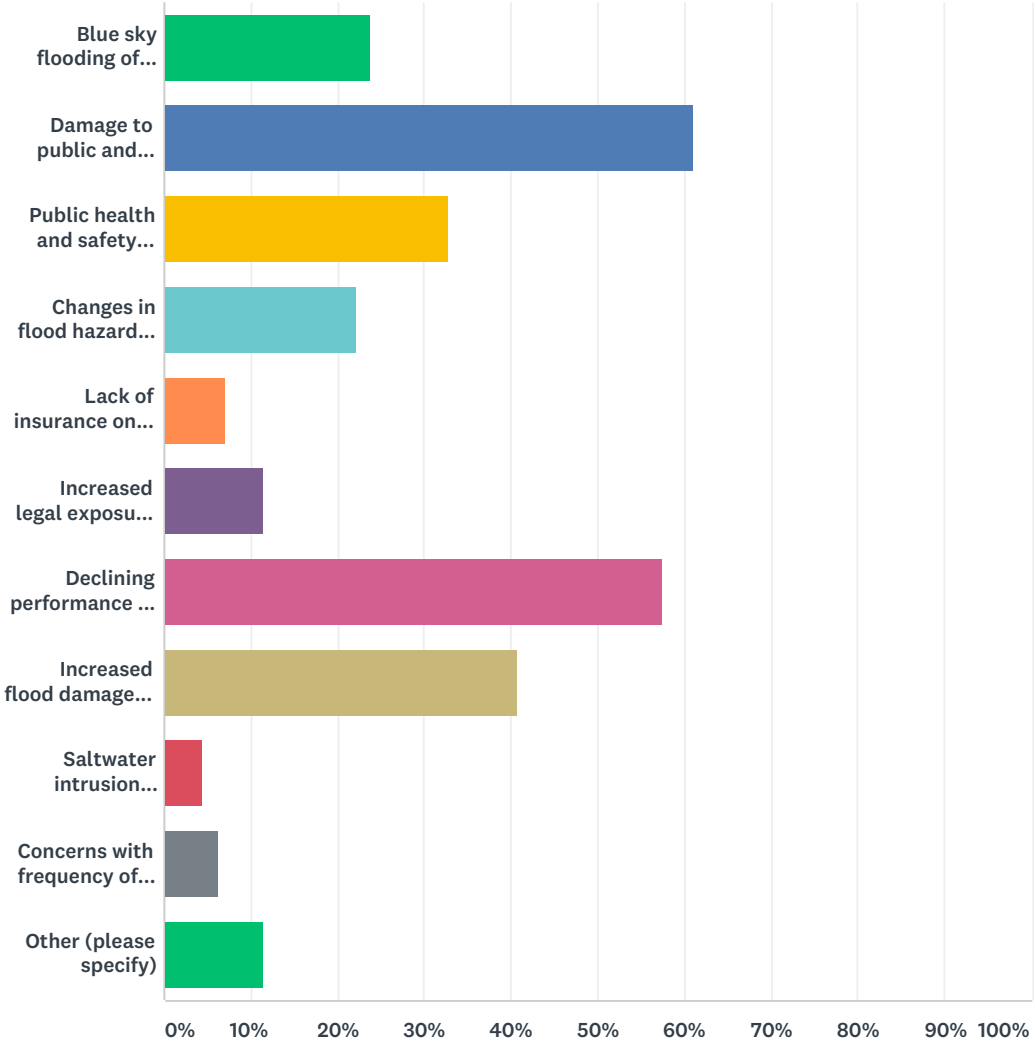
Answered: 131 Skipped: 1



ANSWER CHOICES	RESPONSES	
Tidal	14.50%	19
Non-Tidal	39.69%	52
I work in both	45.80%	60
TOTAL		131

Q4 Of these climate-change related risks, what would you consider the greatest concern in your community (Select up to 3)?

Answered: 113 Skipped: 19



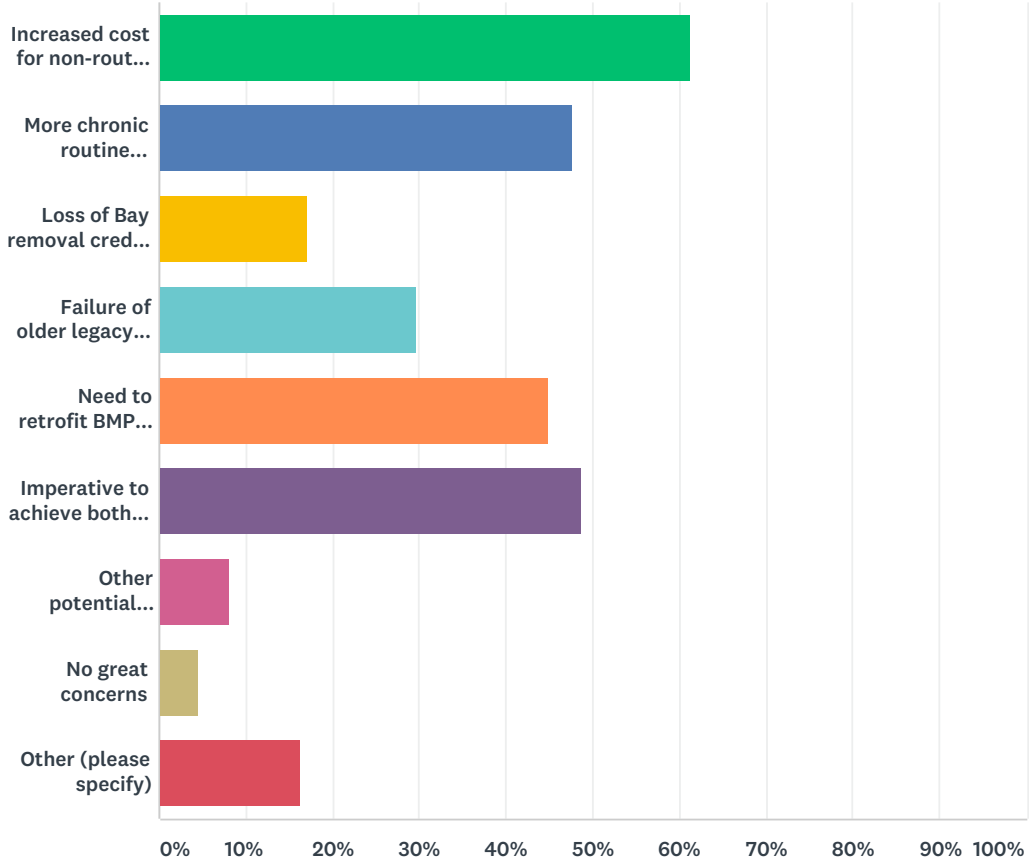
ANSWER CHOICES	RESPONSES	
Blue sky flooding of roads and parking lots (in tidal areas), public and private	23.89%	27
Damage to public and private infrastructure during extreme floods	61.06%	69
Public health and safety issues during floods and/or droughts; emergency response capabilities	32.74%	37
Changes in flood hazard boundaries along floodplains and waterfront areas (i.e. outdated FEMA maps?)	22.12%	25
Lack of insurance on private property	7.08%	8
Increased legal exposure for flooding or erosion on private property	11.50%	13
Declining performance of public and private stormwater management systems (quality and quantity)	57.52%	65
Increased flood damage to public open space, stream corridors and natural habitats	40.71%	46
Saltwater intrusion impacting drinking water sources	4.42%	5
Concerns with frequency of drought conditions (e.g., water supply, survival of trees, wells going dry, wildfires)	6.19%	7
Other (please specify)	11.50%	13
Total Respondents: 113		

#	OTHER (PLEASE SPECIFY)	DATE

1	Indiscrete spending on mitigation or adaption projects. Proper risk management analysis for such projects is critical and should focusing on population impacts (morbidity and mortality) and not property.	12/10/2019 8:56 PM
2	inadequate stormwater systems due to them being based on the 100 year storm rule and in the past 2 years the rain received has exceded that amount.	12/10/2019 3:00 PM
3	increased severity and frequency of rain induced flooding due to higher tides (sea level rise) - outfalls increasingly underwater and unable to drain	12/10/2019 2:56 PM
4	elected officials & senior management not taking this impending threat seriously enough.	12/10/2019 1:44 PM
5	carbon sequestration	12/10/2019 1:08 PM
6	A lack of buy-in from administrators and budget managers to address regulatory requirements. Unwillingness to properly budget for stormwater infrastructure costs.	12/10/2019 1:06 PM
7	Frank education to the public	12/10/2019 12:44 PM
8	We are not prepared, under blue skies today, to adequately address the extended displacement times likely to be experience by vulnerable populations stemming from severe storm events, such as a catastrophic storm.	11/19/2019 4:52 PM
9	Government Intrusion and overregulation	11/14/2019 8:59 PM
10	Financial penalties for not meeting NPDES MS4 requirements.	11/14/2019 8:39 PM
11	Loss of species - for the Pacific Northwest that would be changes in the macroinvertebrate populations and potential loss of salmon including those on the Endangered Species List	11/14/2019 8:28 PM
12	inadequate design storm models	11/14/2019 1:52 PM
13	The use of climate change factors as a scare tactic to drive public policy	11/14/2019 1:25 PM

Q5 What are your greatest concerns about the effect of increased rainfall intensity on publicly or privately-owned stormwater practices in your community (Choose up to 3)?

Answered: 111 Skipped: 21



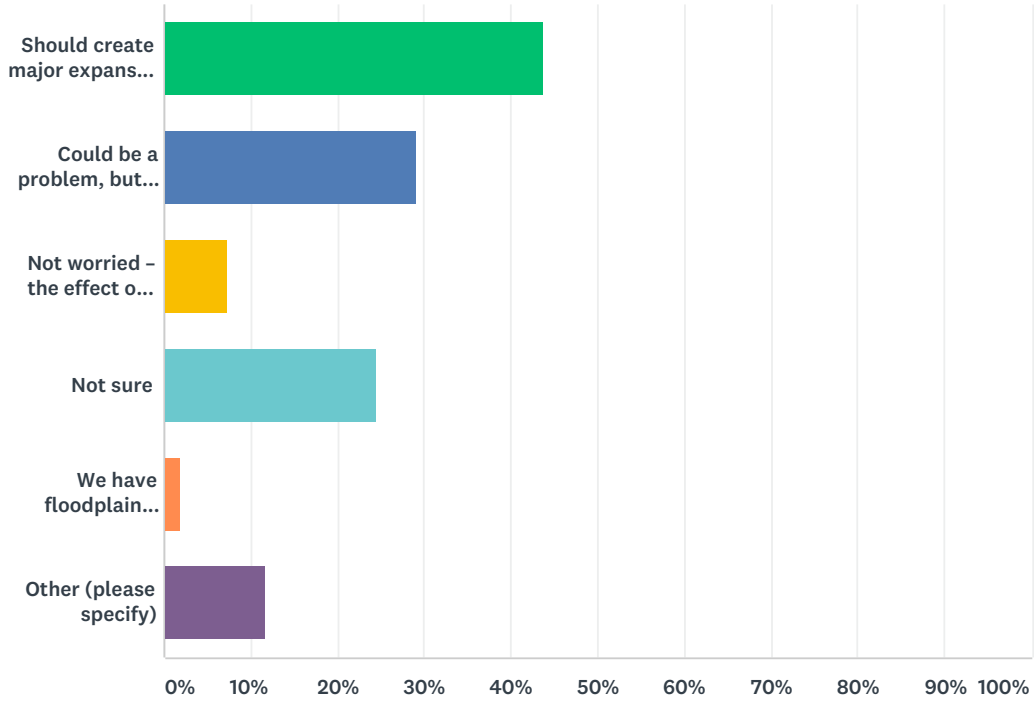
ANSWER CHOICES	RESPONSES	
Increased cost for non-routine maintenance to fix storm damages	61.26%	68
More chronic routine maintenance problems at BMPs	47.75%	53
Loss of Bay removal credits due to BMP failure	17.12%	19
Failure of older legacy detention and retention ponds	29.73%	33
Need to retrofit BMP “plumbing” to accommodate bigger storms	45.05%	50
Imperative to achieve both pollutant removal and flood control with BMPs	48.65%	54
Other potential problems with stormwater practices (please describe in the box below)	8.11%	9
No great concerns	4.50%	5
Other (please specify)	16.22%	18
Total Respondents: 111		

#	OTHER (PLEASE SPECIFY)	DATE
1	Upstream developments creating increasing flooding erosion and pollutants downstream	12/11/2019 4:47 PM
2	Increased rainfall intensity means changes to the 0.2 & 1%-chance storm rainfall. Developing rainfall intensity flood maps that accurately map floodplains and flood zones of these potential storms.	12/10/2019 8:56 PM
3	We are more concerned about the stormwater infrastructure such as pipes and ditches and street flooding during these extreme flood events more than BMP failure.	12/10/2019 8:13 PM

4	Lack of subsurface aeration in wet ponds to reduce organic muck at the bottom thus increasing the capacity of the stormwater facility. Keep the facility ready to contain the higher rainfall amounts in the future. Something simple and independent like PondHawk.	12/10/2019 6:49 PM
5	failure of stormwater infrastructure to accomodate increased rainfall intensity given design standards of accomodating 10 yr storms leading to increased and more widespread flooding, damages, and systemic risks.	12/10/2019 2:56 PM
6	applicability and long-term feasibility of Micro-practice BMPs	12/10/2019 2:40 PM
7	That there is no mention of combining restored stream channels with climate resiliency features: ecological restoration, which addresses both the Bay and community resiliency to climate stress, e.g.healthier waterways, replenished aquifers/drinking water, carbon sequestration, cooling air and water temps, flood management, absorbs flood tides.	12/10/2019 1:08 PM
8	Increasingly urbanized spaces that do not accommodate these new rainfall totals	12/10/2019 1:06 PM
9	Water carried invasive plant species, loss of ecosystem health	12/10/2019 12:22 PM
10	What size storm we should design facilities to	11/19/2019 5:31 PM
11	current retention ponds are not well maintained just several years after being installed; a sizable portion of legacy retention basins (say, 10+ years ago) are clearly not well maintained. There is an assumed "effectiveness" of these retention devices that is not in sync with the reality on the ground as many of us see it.	11/19/2019 4:52 PM
12	Not able to achieve water quality goals.	11/18/2019 7:16 PM
13	Designing appropriately for these increased rainfall intensity events	11/15/2019 5:59 PM
14	increased stormwater/groundwater intrusion into houses	11/15/2019 12:53 PM
15	As designed BMPs not functioning to in-field realities. BMPs effectiveness reduction due to poor O&M by un-knowledgeable/ recalcitrant property owners resulting in cumulative, negative impacts.	11/14/2019 8:39 PM
16	We have large areas of the county that have no stormwater controls. Our current retrofitting needs for nonconforming sites is estimated in the billions. We are going to have to ensure that these are appropriately sized and function in any climate change scenario.	11/14/2019 8:28 PM
17	drainage systems, starting with inlets sized only for 4"/hr, aren't designed to handle the increased intensity and longer periods of high intensity, so flooding ensues before water even reaches BMPs.	11/14/2019 1:52 PM
18	Lack of comprehensive planning for inter-agency projects.	11/14/2019 1:24 PM

Q6 What are your main concerns about how climate will impact current and future floodplain boundaries in your community? Check all that apply:

Answered: 110 Skipped: 22



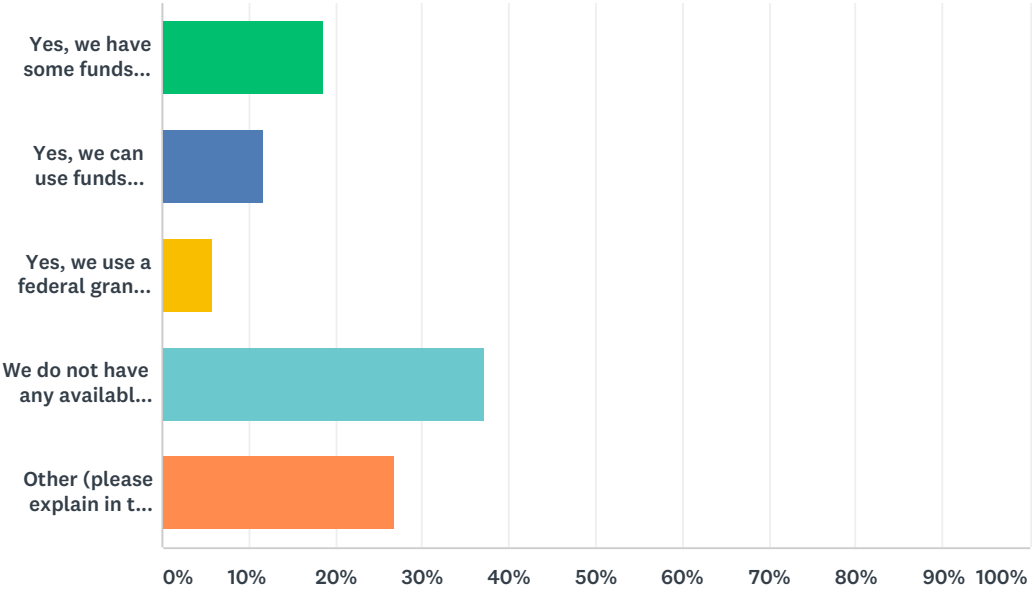
ANSWER CHOICES	RESPONSES	
Should create major expansion in local FEMA flood hazard maps as there is too much emphasis on out-dated FEMA flood-hazard maps	43.64%	48
Could be a problem, but we do not expect that these hazard maps will be updated in the foreseeable future	29.09%	32
Not worried – the effect of future upstream development or increased impervious cover should overwhelm the climate impact on the future dimensions of the ultimate floodplain	7.27%	8
Not sure	24.55%	27
We have floodplain boundary maps?	1.82%	2
Other (please specify)	11.82%	13
Total Respondents: 110		

#	OTHER (PLEASE SPECIFY)	DATE
1	Better data helps inform planners but we need stronger leglislation to both mandate , guide, or prevent upstream developments and increased folding	12/11/2019 4:47 PM
2	Any major extension of flood hazards should be directed locally through block grants from FEMA and not by FEMA directly. A decentralization of flood mapping and flood planning should the direction of the agency.	12/10/2019 8:56 PM
3	Floodplain boundaries? The mapping of boundaries in a changing environment will be extremely challenging to maintain with any sense of accuracy.	12/10/2019 6:49 PM
4	We recently uses drones to map floodplain boundaries within new development in areas not mapped by FEMA and see that floodplains used by the developers are not accurate and development is encroaching too close.	12/10/2019 6:01 PM
5	Changing designs to accommodate larger flooding events and the increased costs of infrastructure projects to accommodate the events; dealing with existing newer development that complies with contemporary standards but may not comply with (potential) updated standards. What will the increased cost of insurance be and will it be affordable and feasible for financed projects?	12/10/2019 4:43 PM
6	We currently don't have Federally defined Flood Plains located in our municipality.	12/10/2019 3:36 PM

7	The horizontal and vertical set-backs in the zoning code should help mitigate some of the initial floodplain boundary changes from climate change -- at least in the near future. I'm concerned that past floodplain studies for the non-FEMA areas didn't always require the studies to be based on ultimate development.	12/10/2019 1:39 PM
8	This will undoubtedly affect FEMA maps, but they are static, and these dynamic storms are changing the way we predict and manage floods at smaller scale, using more advanced predictive tools.	11/19/2019 5:31 PM
9	We know from sampling households about the frequency of flooding in front of their homes and on their streets where neigh the AE are not reporting flooding. In essence, we have "ground-truthed" the maps and there is inconsistency.	11/19/2019 4:52 PM
10	The narrative and historical focus of the "100-year storm" with changes to frequency, magnitude and duration of locally severe storm events.	11/19/2019 4:12 PM
11	stop assuming that boundary will increase. It is just as likely to decrease	11/15/2019 1:41 PM
12	In non tidal areas sea level rise combined with increased levels of rain of one inch have an unknown effect on those FEMA flood plain maps areas	11/14/2019 2:57 PM
13	combination of concerns: increased development coupled with climate impacts should result in expanded flood limits. we're seeing incentive programs for rebuilding flood impacted developments rather than incentives to move development out of flood zones.	11/14/2019 1:52 PM

Q7 Do you have funding available for climate resiliency planning?

Answered: 86 Skipped: 46

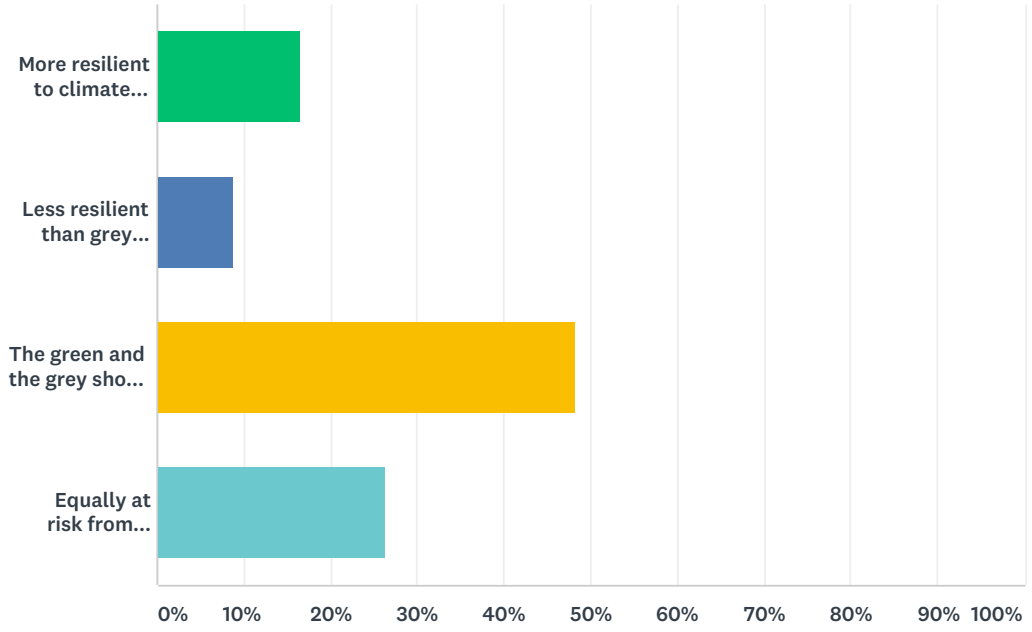


ANSWER CHOICES	RESPONSES	
Yes, we have some funds available in the capital improvement budget but need to augment with grants or loans	18.60%	16
Yes, we can use funds collected through our stormwater fees	11.63%	10
Yes, we use a federal grant or other funding source for this purpose	5.81%	5
We do not have any available funding for climate resiliency planning	37.21%	32
Other (please explain in the box below)	26.74%	23
TOTAL		86

#	OTHER (PLEASE EXPLAIN IN THE BOX BELOW)	DATE
1	Federal funds are available when the aggregate damage associated with an event exceeds the $1 M threshold and an emergency is declared. Otherwise lack of available funding for the required restoration and more frequent maintenance as a result of increased localized extreme events, let alone infrastructure improvements is challenged.	12/11/2019 2:34 PM
2	Not sure; recently employed.	12/11/2019 1:40 PM
3	Private Sector empoyee, do not know exact funding mechanism of clients	12/10/2019 6:17 PM
4	Current funding not available.	12/10/2019 3:38 PM
5	yes, we have funds available through our stormwater utility; however, we have $500MM of existing stormwater needs without even addressing resiliency issues.	12/10/2019 3:06 PM
6	do not know	12/10/2019 2:46 PM
7	We may be able to use funds collected through our stormwater fees.	12/10/2019 1:42 PM
8	DNR has grant funding for 1) modelling/adaptation planning, and 2) BMP design	12/10/2019 1:39 PM
9	Have not considered it	12/10/2019 1:15 PM
10	I suspect we will react to issues as they arise, and not a moment sooner.	12/10/2019 1:14 PM
11	i dunno	12/10/2019 12:45 PM
12	We need to raise water/septic fees to cover infrastructure upgrades to protect from bigger storms	12/10/2019 12:30 PM
13	Regional agency, so not able to respond as a local government. If so, it would be grant funding.	11/21/2019 7:58 PM
14	Unsure	11/19/2019 10:41 PM
15	We are doing a Hazard Mitigation Plan update and plan to roll in flooding.	11/19/2019 5:38 PM
16	yes, but we are an academic institution that partners with several localities.	11/19/2019 4:54 PM
17	It can be included in our current capital improvement budget on a per project basis as needed, but there is nothing designated in the budget solely for this purpose. Including this analysis in the design of each capital project will result in piece-meal approach, reduced funding available for other projects and reduced crediting.	11/19/2019 4:28 PM
18	Not applicable	11/15/2019 11:33 PM
19	Private consultant	11/14/2019 8:55 PM
20	n/a	11/14/2019 2:50 PM
21	n/a	11/14/2019 2:41 PM
22	in private practice, but not seeing leadership in resiliency outside of the Hampton Roads/VA Beach areas.	11/14/2019 1:59 PM
23	Funding has been related to emergency management plans but not a comprehensive resiliency plan with a dedicated budget.	11/14/2019 1:31 PM

Q8 Do you feel the “green infrastructure” practices recently built in your community are:

Answered: 91 Skipped: 41



ANSWER CHOICES	RESPONSES	
More resilient to climate change than grey infrastructure?	16.48%	15
Less resilient than grey infrastructure?	8.79%	8
The green and the grey should work together to build resiliency.	48.35%	44
Equally at risk from future climate change?	26.37%	24
TOTAL		91

Q9 If have an asset management system, database, or GIS layers, that you use to inspect and maintain key stormwater infrastructure, can this system map, track or otherwise identify the most vulnerable infrastructure assets in the community at risk from climate change? Please describe in the box below:

Answered: 58 Skipped: 74

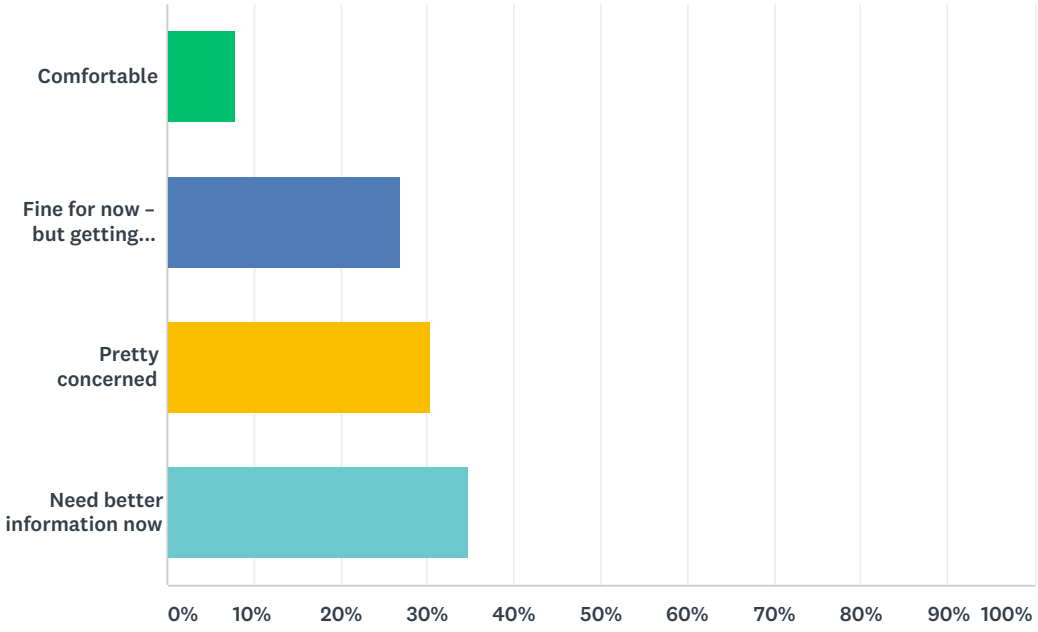
#	RESPONSES	DATE
1	Not sure what the City of Takoma Park is using	12/11/2019 4:50 PM
2	Currently not established to do so, but should track-predict the at risk infrastructure assets!	12/11/2019 2:34 PM
3	yes	12/11/2019 1:40 PM
4	No	12/10/2019 10:47 PM
5	We have a GIS system, I don't know if flooding and stormwater infrastructure are integrated.	12/10/2019 8:56 PM
6	Not currently but with the inclusion of floodplain, sea level rise, etc. data it could easily be used to determine which assets are susceptible to those hazards.	12/10/2019 8:15 PM
7	Do not have an asset management system.	12/10/2019 6:54 PM
8	Current;y does not track	12/10/2019 6:42 PM

9	The data can be used to put together a high level analysis	12/10/2019 6:17 PM
10	no	12/10/2019 6:14 PM
11	We have a pretty good web app that we use for inspection and maintenance, but not aware of how to use it to track or identify most vulnerable infrastructure assets.	12/10/2019 6:11 PM
12	No	12/10/2019 6:05 PM
13	Our township does have a database and GIS layers to use, track and identify the most vulnerable infrastructure assets.	12/10/2019 4:49 PM
14	CEDAR	12/10/2019 3:54 PM
15	no	12/10/2019 3:38 PM
16	NA	12/10/2019 3:11 PM
17	not currently	12/10/2019 3:06 PM
18	We do have access to sea level rise inundation scenarios from SHA for coastal areas, but nothing related to extreme precipitation events in non-tidal areas.	12/10/2019 2:48 PM
19	not to my knowledge	12/10/2019 2:46 PM
20	It probably could but doesn't currently.	12/10/2019 2:41 PM
21	yes. we have MD dams and drainage areas mapped, flood evacuation plans drafted, and a full inventory of all BMPs.	12/10/2019 2:29 PM
22	It could, but we have not designed it to do this at this point.	12/10/2019 1:56 PM
23	NO	12/10/2019 1:42 PM
24	GIS layers in final development stage and should be ready in a month or two. Asset management system in early design phase.	12/10/2019 1:42 PM
25	NO	12/10/2019 1:40 PM
26	Certainly could but still in the very early stages of considering doing this, lack of resources and guidance on process/protocols for evaluating vulnerability.	12/10/2019 1:22 PM
27	Most localities do but not all are up to date.	12/10/2019 1:20 PM
28	yes	12/10/2019 1:15 PM
29	We have a GIS database that identifies our stormwater BMPs. We are developing a more robust system that includes inspection and tracking. This is a top priority for my work.	12/10/2019 1:14 PM
30	Our Asset Mgt Team handles this. I will forward this survey to that Team Leader.	12/10/2019 12:52 PM
31	Not as currently configured	12/10/2019 12:46 PM
32	What is #8 talking about green & grey? #9 I dunno	12/10/2019 12:45 PM
33	We have recently provided grants to state agencies (through our Strategic Opportunity Fund for Adaptation program) to do this exact work for state-based buildings and infrastructure.	11/21/2019 2:17 PM
34	no	11/20/2019 4:48 PM
35	Depend on access to State Maps for information	11/19/2019 6:46 PM
36	We do have this mapping, as it is required for our Phase I permit. The assets can definitely be used with hydraulic and hydrologic models to determine areas susceptible to floods. We are running analyses like this already.	11/19/2019 5:38 PM
37	We have an asset management system and it can map and track vulnerable infrastructure, but it is not currently used this way.	11/19/2019 4:53 PM
38	No. We do have tracking systems but they do not incorporate climate vulnerability.	11/18/2019 7:26 PM
39	DOEE uses Quickbase, stormwater managment database system but does not track risk from climate change.	11/18/2019 5:48 PM
40	Currently working on a system (just starting) to do just that.	11/18/2019 2:59 PM
41	Yes	11/18/2019 1:18 PM

42	?	11/16/2019 3:44 AM
43	Do not have	11/15/2019 11:33 PM
44	Not sure.	11/15/2019 6:02 PM
45	N/A	11/15/2019 2:53 PM
46	no	11/15/2019 2:04 PM
47	I am uncertain if the asset management system has this capability.	11/15/2019 12:57 PM
48	I dont know	11/14/2019 9:01 PM
49	It has capability, but needs to be set-up/programmed	11/14/2019 8:55 PM
50	No, not without us first integrating the asset management tracking data into another GIS-based system, and working from there.	11/14/2019 8:50 PM
51	We do have an asset management system combined with GIS layers for our inspection and maintenance programs. We are currently working with the University of Washington to develop predictive rainfall models based on various climate change scenarios. We hope to use this to identify "at risk" parts of our MS4	11/14/2019 8:33 PM
52	No, current systems are unable to identify the most vulnerable assets but we are working with USACE to identify those.	11/14/2019 3:13 PM
53	no	11/14/2019 3:05 PM
54	The data base and GIS systems of critical infrastructures is in place but it requires updated lidar elevation data to accurately assess the effects of sea level rise and increased flooding in no tidal areas of the county	11/14/2019 3:04 PM
55	n/a	11/14/2019 2:50 PM
56	no	11/14/2019 2:41 PM
57	Yes, with the addition of other data sources such an analysis is possible. However, there are still things we need, like updated IDF curves and associated updates to stormwater management requirements that we need to accurately assess risks from climate change. Most of our risk data is based on past conditions and is not useful in assessing current and future risks with the rate of change in weather patterns.	11/14/2019 2:17 PM
58	n/a	11/14/2019 1:59 PM

Q10 How comfortable are you with the quality and utility of engineering design criteria on future rainfall intensity provided to you by state and/or federal authorities in your community?

Answered: 89 Skipped: 43



ANSWER CHOICES	RESPONSES	
Comfortable	7.87%	7
Fine for now – but getting concerned	26.97%	24
Pretty concerned	30.34%	27
Need better information now	34.83%	31
TOTAL		89

Q11 What design storm(s) do you use for open channel and storm drain conveyance? (please describe in the box below)

Answered: 64 Skipped: 68

#	RESPONSES	DATE
1	Not sure	12/11/2019 4:50 PM
2	The latest greatest extreme event and back calculate shear stress values based on the largest most recent particle size moved by this storm-flood event.	12/11/2019 2:34 PM
3	1, 10, and 100-yr storms	12/11/2019 1:40 PM
4	10Y/24H	12/11/2019 1:51 AM
5	10-year for storm drain conveyance, ideally 100-year (don't make things worse) for open channel	12/10/2019 10:47 PM
6	I believe the 4%-chance storm	12/10/2019 8:56 PM
7	10 year storms	12/10/2019 8:15 PM
8	10 year	12/10/2019 8:11 PM
9	The experience of the installing contractor is the gauge used to determine the installation of stormwater facility upgrades.	12/10/2019 6:54 PM
10	Don't know	12/10/2019 6:42 PM
11	Main client is DDOT - uses 15-years storm	12/10/2019 6:17 PM

12	generally, 10yr. larger storms for certain situations, facility types, cross lines etc.	12/10/2019 6:14 PM
13	Local road - 10 year Collector road - 25 year Arterial road - 50 year, all cross culverts 100 year	12/10/2019 6:11 PM
14	5 to 10 year	12/10/2019 6:05 PM
15	100 year frequency (grass waterways, underground piping)	12/10/2019 4:49 PM
16	100 year storms.	12/10/2019 3:38 PM
17	open channel 25 to 100 year storm drains 10 year	12/10/2019 3:38 PM
18	standard is 10-yr for capacity will TW that varies depending on client (locality) requirements	12/10/2019 3:11 PM
19	In general, channel capacity is evaluated for the peak flow rate from the 10-year 24-hour storm for all channel types and channel (lining) stability is evaluated for manmade channels for the peak flow rate from the 2-year 24-hour storm. Channel protection for natural channels is met with compliance with the energy balance equation at the discharge point and does not require downstream analysis unless more stringent requirements are established by VSMP authorities.	12/10/2019 3:06 PM
20	1 inch?	12/10/2019 2:48 PM
21	10 & 100	12/10/2019 2:46 PM
22	10 year and 20 year	12/10/2019 2:41 PM
23	1	12/10/2019 2:29 PM
24	We adhere to MC DPS standards.	12/10/2019 1:56 PM
25	10-year	12/10/2019 1:42 PM
26	2yr erosive velocity, 10 yr capacity, 100 year structural integrity of detention facilities	12/10/2019 1:40 PM
27	10-year storm	12/10/2019 1:25 PM
28	1"	12/10/2019 1:22 PM
29	Depends but generally 10-year	12/10/2019 1:20 PM
30	25-year storm	12/10/2019 1:04 PM
31	2-, 10- and 100-year design storms are used.	12/10/2019 12:52 PM
32	2 and 10 year	12/10/2019 12:46 PM
33	2-year & 10 year	12/10/2019 12:45 PM
34	n/a	12/10/2019 12:24 PM
35	Not sure, I don't work in the stormwater section of my agency (I work in the Climate section)	11/21/2019 2:17 PM
36	10 yr storm	11/20/2019 4:48 PM
37	10 and 100 year	11/19/2019 6:46 PM
38	MD regulates this	11/19/2019 5:38 PM
39	Criteria is situational. Most private drainage is designed for the 10-year storm. Public drainage is typically designed for the 25 year storm or greater depending on the classification of the ROW.	11/19/2019 4:53 PM
40	N/A.	11/18/2019 7:26 PM
41	15 year conveyance, 2-yr stream protection	11/18/2019 5:48 PM
42	10 yr, 24 hr storm	11/18/2019 2:59 PM
43	10Yr	11/18/2019 1:18 PM
44	?	11/16/2019 3:44 AM
45	Not applicable	11/15/2019 11:33 PM
46	I don't know	11/15/2019 2:53 PM
47	10-year	11/15/2019 2:04 PM
48	10 year	11/15/2019 1:44 PM

49	open channel 1% annual chance storm storm drain 10% annual chance storm (unless direct to a SWM facility than 1% annual chance storm)	11/15/2019 12:57 PM
50	?	11/14/2019 9:01 PM
51	10-year peak discharge; use 5-min Rainfall Intensity; where it can be applied	11/14/2019 8:55 PM
52	Activities requiring Stormwater Management Plans, or under SALDO, must generally be sized to convey the 25 yr, 24 hour SCS Type II storm or IDF curve Rational Method storm.	11/14/2019 8:50 PM
53	We use HSPF or WWHM modeling to size our facilities and do downstream analyses for new developments	11/14/2019 8:33 PM
54	Varies, but is typically the 10-year or 25-year design storm.	11/14/2019 5:09 PM
55	5,10,25, 50, 100 year	11/14/2019 4:44 PM
56	2 year, 24-hour	11/14/2019 3:48 PM
57	10 yr	11/14/2019 3:36 PM
58	100 year storms	11/14/2019 3:26 PM
59	2-year or 10-year depending on location.	11/14/2019 3:13 PM
60	Don’t know	11/14/2019 3:04 PM
61	n/a	11/14/2019 2:50 PM
62	n/a but I feel that ten year should not be the norm	11/14/2019 2:41 PM
63	10-year rational for design capacity; inlets sized to intercept 4 "/hr storm (per VDOT)	11/14/2019 1:59 PM
64	2-year, 24-hr and 10-year, 24-hour	11/14/2019 1:52 PM

Q12 What design storm(s) do you use to meet on-site requirements for downstream flood control? (please describe in the box below)

Answered: 62 Skipped: 70

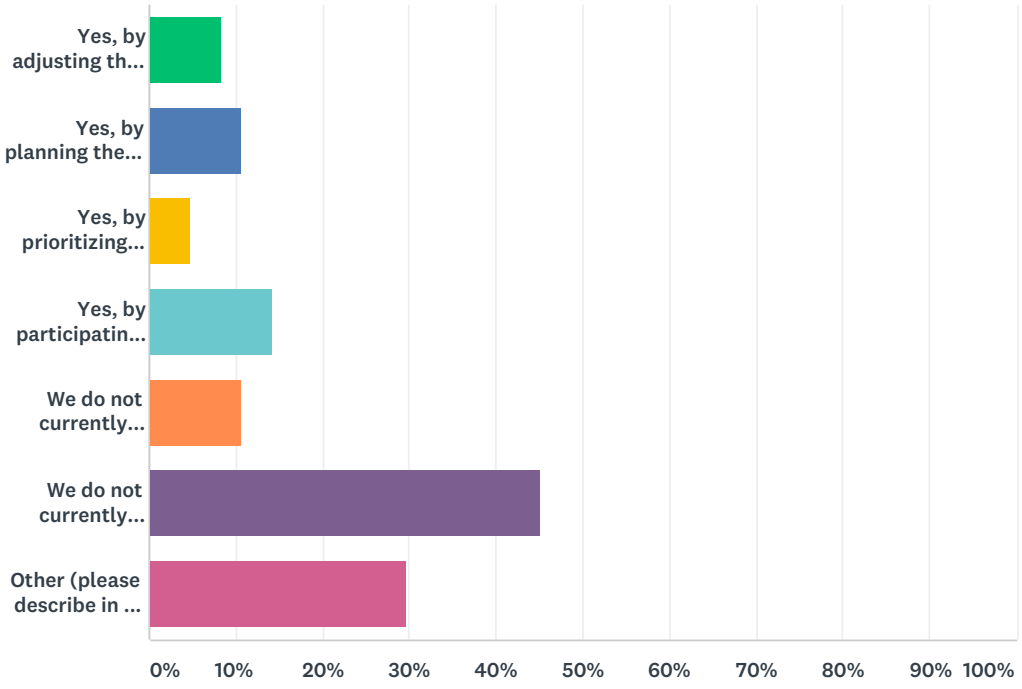
#	RESPONSES	DATE
1	2” storms	12/11/2019 4:50 PM
2	Depends on where the work is being performed- which state and where each state is in the process of updating their IDF curves for current extreme rainfall amounts.	12/11/2019 2:34 PM
3	1, 10, and 100-yr storms	12/11/2019 1:40 PM
4	1-inch, 24hr storm for on-site	12/10/2019 10:47 PM
5	unsure	12/10/2019 8:56 PM
6	10 year storms	12/10/2019 8:15 PM
7	100 year	12/10/2019 8:11 PM
8	The experience of the installing contractor is the gauge used to determine the installation of stormwater facility upgrades.	12/10/2019 6:54 PM
9	Don't know	12/10/2019 6:42 PM
10	15-year	12/10/2019 6:17 PM
11	no flood control requirements	12/10/2019 6:14 PM
12	10 year	12/10/2019 6:11 PM
13	5 to 10 year	12/10/2019 6:05 PM
14	100 year	12/10/2019 4:49 PM
15	20 year storms	12/10/2019 3:38 PM

16	100 year for future master plan	12/10/2019 3:38 PM
17	VSMP Part IIB	12/10/2019 3:11 PM
18	Channel protection for natural channels is met with compliance with the energy balance equation at the discharge point and does not require downstream analysis unless more stringent requirements are established by VSMP authorities. Flood protection for natural channels requires a downstream analysis to ensure capacity requirements are met for the 10-year 24 hour storm from the discharge point to the limits of analysis.	12/10/2019 3:06 PM
19	1 inch?	12/10/2019 2:48 PM
20	10	12/10/2019 2:46 PM
21	5 and 10 year	12/10/2019 2:41 PM
22	10	12/10/2019 2:29 PM
23	We adhere to MC DPS standards.	12/10/2019 1:56 PM
24	100-year	12/10/2019 1:42 PM
25	1yr, 10 yr	12/10/2019 1:40 PM
26	Virginia stormwater regs. Also 100-year	12/10/2019 1:25 PM
27	1"	12/10/2019 1:22 PM
28	Depends on the drainage area, 10-year and 100-year	12/10/2019 1:20 PM
29	100-year storm	12/10/2019 1:04 PM
30	2-, 10- and 100-year design storms are used.	12/10/2019 12:52 PM
31	10 and 100 year	12/10/2019 12:46 PM
32	10 year	12/10/2019 12:45 PM
33	n/a	12/10/2019 12:24 PM
34	Not sure, I don't work in the stormwater section of my agency (I work in the Climate section)	11/21/2019 2:17 PM
35	2 yr storm through 100 yr storm	11/20/2019 4:48 PM
36	2 year and 10 year	11/19/2019 6:46 PM
37	MD regulates this	11/19/2019 5:38 PM
38	Downstream flood control is only required when historic flooding is known. On a case by case basis flood control will be designed to target the specific threat. 2 year control is used to address stream bank erosion. 10 year control to address nuisance flooding issues and 100 year control to address hazard flooding.	11/19/2019 4:53 PM
39	Pre-development: Two (2) year storm Pre-project: 15 year storm. New development must meet the above protocols.	11/18/2019 7:26 PM
40	see previous	11/18/2019 5:48 PM
41	25 yr, Type II distribution for BMPs	11/18/2019 2:59 PM
42	10yr	11/18/2019 1:18 PM
43	?	11/16/2019 3:44 AM
44	Not applicable	11/15/2019 11:33 PM
45	NA	11/15/2019 2:53 PM
46	10- and 100-year	11/15/2019 2:04 PM
47	2, 10, 100 year	11/15/2019 1:44 PM
48	1% annual chance	11/15/2019 12:57 PM
49	Biofilters	11/14/2019 9:01 PM
50	100-year (typically); seeing where 500-year may come into consideration	11/14/2019 8:55 PM
51	100 year runoff event, based on 24 hour SCS Type II storm or IDF Curve Rational Method storm.	11/14/2019 8:50 PM

52	see q 11	11/14/2019 8:33 PM
53	5,10,25, 50, 100 year	11/14/2019 4:44 PM
54	10 year, 24-hour	11/14/2019 3:48 PM
55	25yr	11/14/2019 3:36 PM
56	we plan for 100 year storms but they happen all the time though. adding stress and too much water to undersized basins and traps	11/14/2019 3:26 PM
57	100-year on-site control required for most areas	11/14/2019 3:13 PM
58	Don’t know	11/14/2019 3:04 PM
59	n/a	11/14/2019 2:50 PM
60	n/a but feel t should be closer to 100 year now	11/14/2019 2:41 PM
61	10-year, 24-hr NRCS design storm	11/14/2019 1:59 PM
62	2-year, 24-hr and 10-year, 24-hour	11/14/2019 1:52 PM

Q13 Do you currently manage your stormwater assets to mitigate risk from future climate change? (Check all that apply)

Answered: 84 Skipped: 48



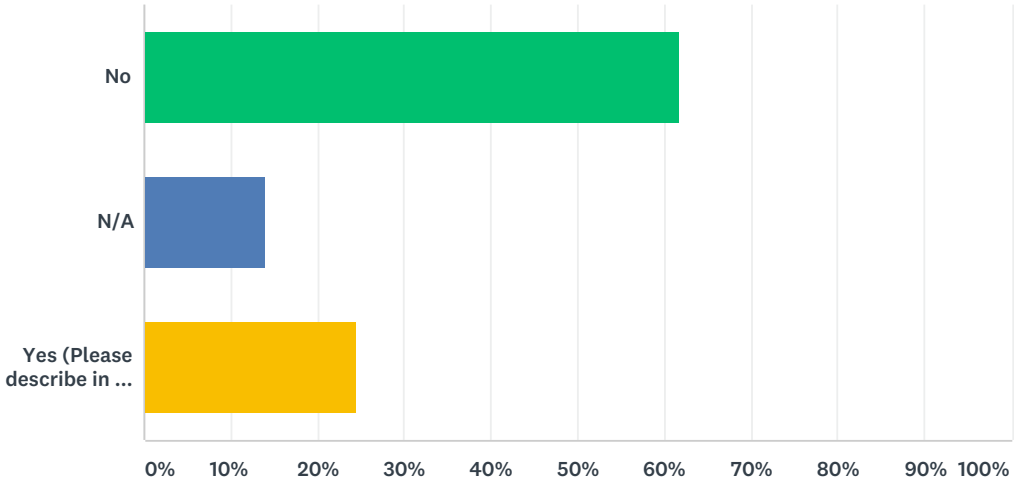
ANSWER CHOICES	RESPONSES	
Yes, by adjusting the sizing of our stormwater infrastructure to account for increased storm intensity.	8.33%	7
Yes, by planning the location and distribution of stormwater BMPs to protect critical infrastructure and address high flood risk areas	10.71%	9
Yes, by prioritizing maintenance and capital improvement projects based on their risk of failure due to changing climate	4.76%	4
Yes, by participating in the Community Rating System for floodplain management	14.29%	12
We do not currently account for climate change in our stormwater management but have plans to	10.71%	9

We do not currently account for climate change in our stormwater management and do not have a plan for how to do that	45.24%	38
Other (please describe in the box below)	29.76%	25
Total Respondents: 84		

#	OTHER (PLEASE DESCRIBE IN THE BOX BELOW)	DATE
1	Not sure	12/11/2019 4:50 PM
2	Answered Yes, as these are the responses that should be performed, but are not necessarily practiced presently. Some municipalities are in progress of adjusting their programs and others not.	12/11/2019 2:34 PM
3	Not sure	12/11/2019 1:40 PM
4	IDF curves are more conservative and take into account more intense rainfall that is expected	12/10/2019 10:47 PM
5	unsure	12/10/2019 8:56 PM
6	I don't know current practices	12/10/2019 6:42 PM
7	resiliency planning is in the works but not determined yet	12/10/2019 6:14 PM
8	We don't manage SW assets but do administer Ag BMP programming. I'm not familiar with any changes being considered for the BMP standards to address future climate change.	12/10/2019 4:38 PM
9	Difficult enough to design to current conditions in many areas w/out adding to tailwater or increasing storm intensity	12/10/2019 3:11 PM
10	not involved in this aspect	12/10/2019 1:25 PM
11	A couple localities in the Hampton Roads region are in the process of updating design standards to incorporate increased precipitation as well as increased tailwater values.	12/10/2019 1:20 PM
12	Our infrastructure is designed within another department. I manage our existing systems with an eye toward performance, looking for deficiencies and opportunities to improve our systems.	12/10/2019 1:14 PM
13	n/a	12/10/2019 12:24 PM
14	Not applicable as a regional planning entity.	11/21/2019 7:58 PM
15	Not sure, I don't work in the stormwater section of my agency (I work in the Climate section)	11/21/2019 2:17 PM
16	We would like to do a better job of this by understanding how changing intensities, frequencies and durations of storms will change demand on stormwater assets.	11/19/2019 5:38 PM
17	N/A	11/19/2019 4:42 PM
18	Our focus is more to handle future growth rather than climate change.	11/18/2019 2:59 PM
19	Above pay scale	11/15/2019 11:33 PM
20	We cannot predict what the climate will be like in 20 years. It's a hoax.	11/14/2019 9:01 PM
21	We do not currently account for climate change in our stormwater management.	11/14/2019 8:50 PM
22	n/a	11/14/2019 2:50 PM
23	n/a	11/14/2019 2:41 PM
24	private practice tend to meet minimum requirements of locality without adding factors for climate change unless client's goals require/allow. We can council that it makes sense to do so for owners with long term maintenance, but many chose not to invest beyond minimum required for permits.	11/14/2019 1:59 PM
25	Future design criteria will require higher tailwater considerations and higher rainfall predictions.	11/14/2019 1:52 PM

Q14 Has your community (or are you aware of another community) who has developed or considered developing local stormwater ordinances that are designed to help better manage climate risk?

Answered: 86 Skipped: 46



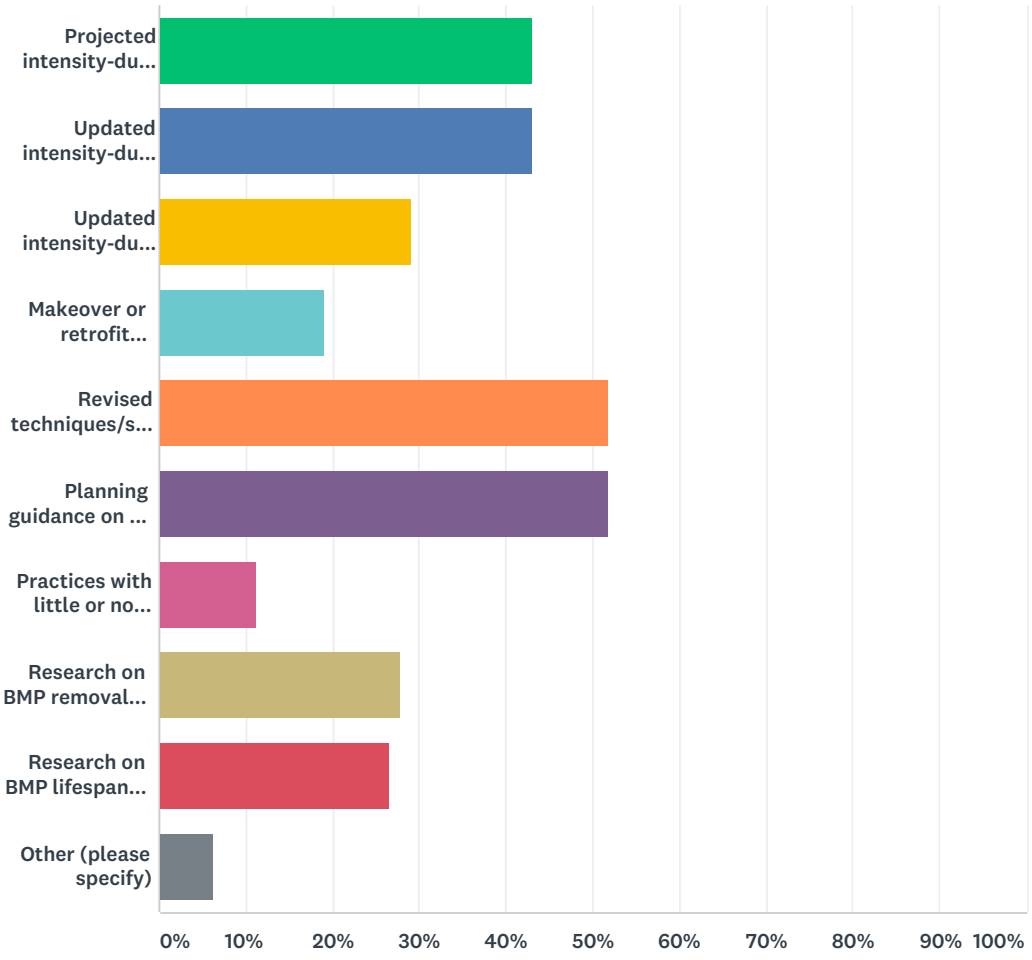
ANSWER CHOICES	RESPONSES	
No	61.63%	53
N/A	13.95%	12
Yes (Please describe in the box below)	24.42%	21
TOTAL		86

#	YES (PLEASE DESCRIBE IN THE BOX BELOW)	DATE
1	Va Beach	12/12/2019 3:10 PM
2	Community led task force about to present findings to city council.	12/11/2019 1:51 AM
3	I believe we are working on it.	12/10/2019 6:42 PM
4	Sea level rise	12/10/2019 3:54 PM
5	City of Virginia Beach	12/10/2019 3:06 PM
6	major cities such as Boston, NYC, etc.	12/10/2019 2:46 PM
7	City of Virginia Beach has been working on this for a few years but it has not been incorporated into ordinance yet	12/10/2019 1:20 PM
8	Va. Beach	12/10/2019 1:04 PM
9	Georgetown is being proactive in embracing conservation landscaping.	12/10/2019 12:52 PM
10	the sky is falling	12/10/2019 12:45 PM
11	I hope so? But again, I'm not sure, as I don't work in the stormwater section of my agency (I work in the Climate section)	11/21/2019 2:17 PM
12	We have talked about it relating to ensuring that individual houses are not built below groundwater lines, wondering if MD is planning to change design criteria that would require ordinance updates.	11/19/2019 5:38 PM
13	The District will begin this process in FY20	11/18/2019 5:48 PM
14	We have a county hazard mitigation plan to help define & manage risk. We are in the process of exploring steep slope & floodplain regulations. We are working with Army Corps to update floodplain maps & provide real time simulation of storm events to aid emergency personnel & eventually the general public.	11/18/2019 2:59 PM
15	Above my paygrade	11/15/2019 11:33 PM
16	Coastal communities beginning to	11/14/2019 8:55 PM
17	yes through ms4 requirements	11/14/2019 6:49 PM

18	WSSC is working on considering how to account for this in their design standards.	11/14/2019 5:09 PM
19	I believe Howard County, Maryland has been working on this in connection with the Ellicott City flooding. My city would be interested in incorporating climate risk management into our ordinance but we lack resources to accomplish this.	11/14/2019 3:13 PM
20	Stormwater ordinances have been adopted in several areas where I have resided.	11/14/2019 2:41 PM
21	Draft design specifications and standards are in the process of being approved.	11/14/2019 1:52 PM

Q15 Of the following information, please indicate what would be most useful to you if you have a need for better stormwater design specs (please select up to 3):

Answered: 79 Skipped: 53



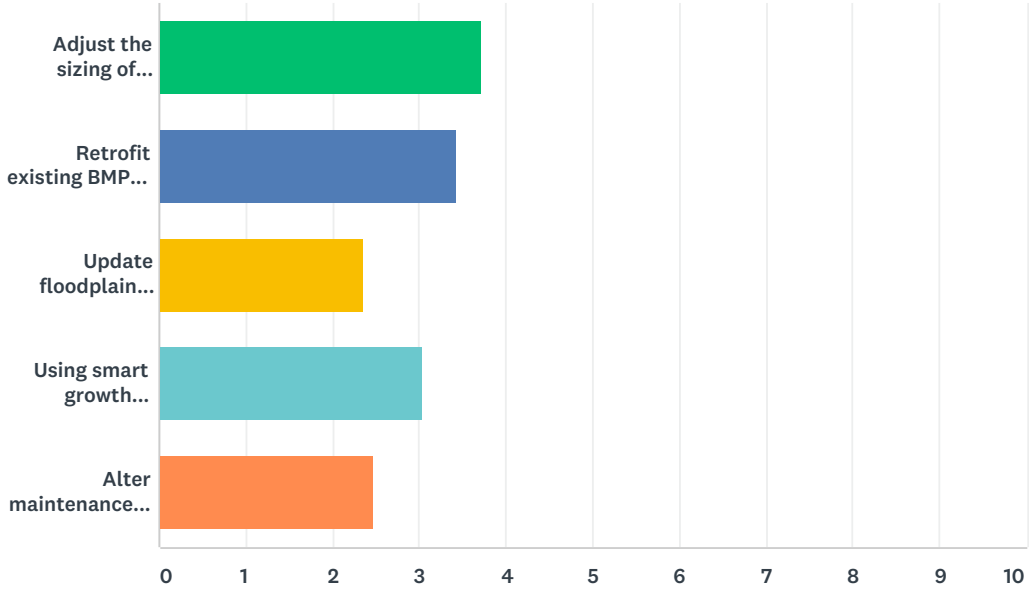
ANSWER CHOICES	RESPONSES	
Projected intensity-duration frequency (idf) curves for future years (i.e. 2050)	43.04%	34
Updated intensity-duration frequency (idf) curves for frequent events (1 to 10)	43.04%	34
Updated intensity-duration frequency (idf) curves for extreme events (25 to 100)	29.11%	23
Makeover or retrofit practices to restore function in climate damaged practices	18.99%	15
Revised techniques/specifications for stormwater BMP design: sizing, conveyance, storage, overflow, materials, etc.	51.90%	41

Planning guidance on how BMPs, floodplain management, and conveyance systems can work together to build resilience.	51.90%	41
Practices with little or no restrictions in terms of depth to water table	11.39%	9
Research on BMP removal efficiencies for various pollutants under increasing storm frequency and intensity conditions	27.85%	22
Research on BMP lifespans under increased storm frequency and intensity conditions	26.58%	21
Other (please specify)	6.33%	5
Total Respondents: 79		

#	OTHER (PLEASE SPECIFY)	DATE
1	Not sure	12/11/2019 4:55 PM
2	All of these	11/19/2019 5:40 PM
3	We need to begin a concerted effort to link 'adaptation' and 'mitigation' strategies together. We cannot plan adaptation if we don't have a better handle on what is being done to mitigate GHG emissions and reduce our uncertainty as to what conditions we are building for. This connection has to be part of any conversation on stormwater management going forward. Municipalities and citizens need to understand the idea of acceleration in climate change and understand mitigation must be addressed to improve how we do adaptation.	11/19/2019 5:01 PM
4	SWM practices with no or reduced restriction on drainage areas. This is the greatest current need in MD. Allowance of large scale practices.	11/15/2019 1:52 PM
5	Honestly, all of the above are serious and pressing needs.	11/14/2019 2:21 PM

Q16 What potential strategies for reducing risk to stormwater infrastructure would you be most likely to consider (please rank them).

Answered: 76 Skipped: 56



	1	2	3	4	5	TOTAL	SCORE
Adjust the sizing of future stormwater assets	37.84% 28	25.68% 19	14.86% 11	13.51% 10	8.11% 6	74	3.72

Retrofit existing BMPs with design elements that protect them from higher intensity storms (i.e. overflows and spillways, smart BMPs)	22.37% 17	27.63% 21	30.26% 23	10.53% 8	9.21% 7	76	3.43
Update floodplain management and mapping using the Community Rating System or other tools	10.81% 8	8.11% 6	20.27% 15	28.38% 21	32.43% 24	74	2.36
Using smart growth principles and land use policy to mitigate future risk	22.97% 17	16.22% 12	17.57% 13	27.03% 20	16.22% 12	74	3.03
Alter maintenance practices to provide more frequent inspections of at-risk assets.	6.76% 5	21.62% 16	16.22% 12	21.62% 16	33.78% 25	74	2.46

Q17 What do you see as the greatest barrier to incorporating climate resilience into stormwater management?

Answered: 75 Skipped: 57

#	RESPONSES	DATE
1	Politiciand	12/11/2019 4:55 PM
2	Availability of adequate funding including replacement of existing aging and functionally obsolete gray infrastructure components with outdated useful life design capacities.	12/11/2019 2:42 PM
3	The unknown rainfall amounts and anticipating future design storms.	12/11/2019 1:43 PM
4	Politicians without term limits. More concerned about re-election than solving key SW problems.	12/11/2019 1:55 AM
5	Lack of political and public will to pay for it	12/10/2019 10:52 PM
6	A lack of understanding of how the two are interconnected	12/10/2019 9:02 PM
7	Political apathy/disinterest/obstruction, lack of funding	12/10/2019 8:17 PM
8	Lag time for regulatory updates to get adopted and take effect. Resistance from Development community	12/10/2019 8:14 PM
9	Budget	12/10/2019 7:00 PM
10	idk	12/10/2019 6:46 PM
11	economics of taking more property for stormwater management out of potential lands for development	12/10/2019 6:19 PM
12	Development community thinking it will cost them more now.	12/10/2019 6:13 PM
13	Lack of data e.g. rainfall frequency curve	12/10/2019 6:12 PM
14	Increased cost of development and cost of upgrading existing BMP's	12/10/2019 4:58 PM
15	Acceptance of climate change and impacts. Our work is heavily motivated by compliance efforts for CBPA WIP3.	12/10/2019 4:42 PM
16	cost	12/10/2019 3:56 PM
17	Over use of unsustainable small rain gardens and swales	12/10/2019 3:44 PM
18	Cost	12/10/2019 3:41 PM
19	Lack of education and training.	12/10/2019 3:23 PM
20	Increased costs & increased regulations	12/10/2019 3:20 PM
21	$$$	12/10/2019 3:13 PM
22	money	12/10/2019 3:10 PM
23	funding	12/10/2019 2:52 PM
24	Cost and available research	12/10/2019 2:45 PM

25	the powers-that-be.	12/10/2019 2:30 PM
26	Planning and funding	12/10/2019 1:45 PM
27	Cost of designing for the what if.	12/10/2019 1:45 PM
28	Having to change regulations to incorporate future 10-year storm's rainfall intensity	12/10/2019 1:43 PM
29	Understanding of cost vs. benefit if increasing size or using different design storm. Practical guidance for sizing and design.	12/10/2019 1:29 PM
30	Additional cost with "minimal immediate visible benefits" to average property owners. Benefits may not be visible until certain storm events occur, so some may feel the additional cost may not be warranted without other co-benefits being highlighted, promoted and accepted by the general public.	12/10/2019 1:27 PM
31	the public	12/10/2019 1:24 PM
32	The institutional will to do so.	12/10/2019 1:20 PM
33	Need data that is specific enough to our area that I can present the issue to Board of Commissioners.	12/10/2019 1:14 PM
34	public perception	12/10/2019 1:06 PM
35	None - simply design them for more volume.	12/10/2019 1:05 PM
36	People's attitudes and lack of real education.	12/10/2019 12:57 PM
37	Money	12/10/2019 12:50 PM
38	fanatics	12/10/2019 12:48 PM
39	Citizens still don’t seem to care, accept responsibility, and not willing to pay for.	12/10/2019 12:34 PM
40	Financing and uncertainty.	11/21/2019 8:05 PM
41	Cost of retrofitting existing impervious surface areas	11/21/2019 2:55 PM
42	Political will to get statutes and regulations passed; people don't like change	11/21/2019 2:24 PM
43	public acceptability of the additional expense associated with upsizing infrastructure	11/20/2019 4:50 PM
44	private ownership built to outdated standards	11/19/2019 6:50 PM
45	Costs	11/19/2019 5:40 PM
46	Making future climate risk assessments for projects mandatory and specific budgeting for capital improvements. We have learned that updated climate-adjusted IDF curves are more useful than our current projections for adjusting engineering standards	11/19/2019 5:26 PM
47	lack of predictability. regulators and designers seem to thrive with hard and unwavering numbers.	11/19/2019 5:08 PM
48	Conveying to all users the idea of accelerated risk and how holistic and regional adaptation strategies must be to be effective. Piecemeal approaches will just continue a long trend of bad management decisions leading to poorly conceived construction of BMPs.	11/19/2019 5:01 PM
49	Meeting a positive benefit cost ratio that permits funding allocations to support the integration of climate resilience under current frameworks.	11/18/2019 7:33 PM
50	politics & Home Builder's Association lack of understanding & resistance based on mis-information (told it will cost more).	11/18/2019 3:03 PM
51	Increase O&M	11/18/2019 1:20 PM
52	Historical development that put streams in pipes and built over top without providing overland relief.	11/16/2019 11:26 AM
53	Complexity of existing regulatory programs	11/16/2019 3:49 AM
54	Lack of maintenance of existing systems	11/15/2019 11:34 PM
55	Lack of solid data to update regs/design specs (re: future conditions)	11/15/2019 6:06 PM
56	Funding?	11/15/2019 2:56 PM

57	resistance from regulators to change. they have barely gotten used to the 2009 update to the maryland manual	11/15/2019 2:09 PM
58	The current MDE manual; written by politicians, not engineers.	11/15/2019 1:52 PM
59	retrofitting legacy SWM facilities for climate change	11/15/2019 12:59 PM
60	Everyone has to buy-in; mandatory policy	11/14/2019 8:58 PM
61	Community perceptions related to the politics of climate change. Funding.	11/14/2019 8:55 PM
62	Funding	11/14/2019 8:38 PM
63	funding and public pushback due to increased taxes to cover costs of implementation and maintenance	11/14/2019 6:52 PM
64	Cost	11/14/2019 4:49 PM
65	Coordination and acceptance within the development community.	11/14/2019 3:50 PM
66	Cost	11/14/2019 3:39 PM
67	People who "don't believe" in climate change. Developers who have to spend more on increasing the size of their SWM and making less money on a planned subdivision or commercial property. developers also have the money to fight new regulations to keep the things the way they are now.	11/14/2019 3:32 PM
68	Funding and space availability	11/14/2019 3:17 PM
69	Staffing limitations	11/14/2019 3:09 PM
70	uncertainty	11/14/2019 2:53 PM
71	ignorance	11/14/2019 2:43 PM
72	The fact that developers are going to make it extremely difficult to implement stormwater regulations that are stricter than current state regulations. Also, that climate resilience is going to depend greatly on limiting development, overall.	11/14/2019 2:21 PM
73	politics	11/14/2019 2:04 PM
74	Cost and private developer resistance to the idea. Private developers have voiced negative opinions about designing for more frequent and intense storms. The public voiced the opinion that flooding was one of the greatest concerns.	11/14/2019 1:56 PM
75	Forecasting, prioritization and funding.	11/14/2019 1:45 PM

Q18 What other comments or suggestions do you have to help us better understand the current engineering and management responses to climate change in the Chesapeake Bay Watershed?

Answered: 52 Skipped: 80

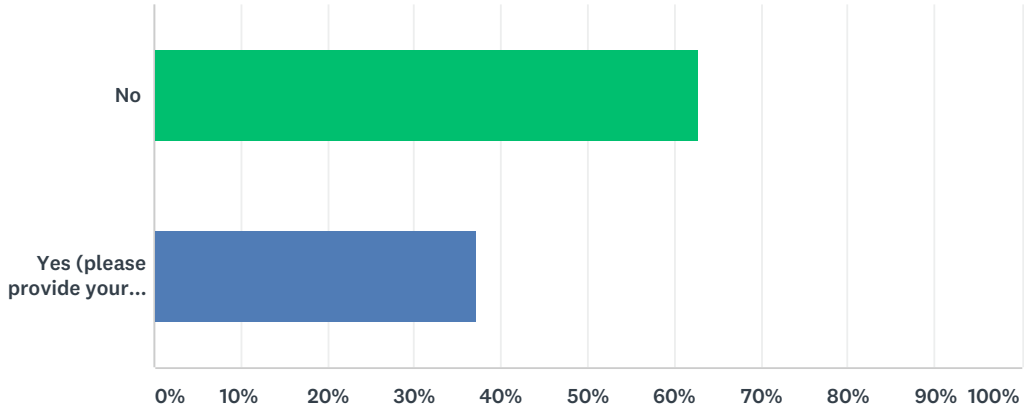
#	RESPONSES	DATE
1	Peer review of all government work by the best experts in each municipal, county and state juridictions	12/11/2019 4:55 PM
2	Continue to get the word out and educate the designers, maintainers and decision makers.	12/11/2019 2:42 PM
3	none	12/11/2019 1:43 PM
4	Much stronger emphasi$ on protecting large trees for long term benefits.	12/11/2019 1:55 AM

5	There is little political will to actually affect change. We've known for a long time that we need to change our development policies, but that means developers might be unhappy, so we can't do that. We've also known for a long time that we need to change our land use and zoning, but residents (generally wealthy and white) do not want any changes. They got in early and they want to prevent any changes. There is also a lack of political will here. Also, unreasonable demands from environmental groups to do something immediately and for very cheap. We need time and money, and in many cases aren't really sure what to do to appease these groups. One group even said to us that there was nothing we could do to appease them, they just wanted to see the City suffer. Hard to affect real change when 50% of staff tine us taken up with these useless fights.	12/10/2019 10:52 PM
6	Too much reliance on engineered solutions. Further research into soft, non-structural measures to control flooding and stormwater.	12/10/2019 9:02 PM
7	None	12/10/2019 8:17 PM
8	Provide funded engineering to communities with a goal to develop a ten year plan to incrementally increase the resiliency of the existing stormwater facilities.	12/10/2019 7:00 PM
9	idk	12/10/2019 6:46 PM
10	'	12/10/2019 6:19 PM
11	Currently we are not taking climate change into consideration in our designs. More data and guidelines are needed from authorities	12/10/2019 6:12 PM
12	While considering designs to accommodate climate change, affordable alternatives and funding sources must also be considered in order to efficiently and afforably implement the changes to existing BMP's.	12/10/2019 4:58 PM
13	Budget will play the biggest role in any approach we use	12/10/2019 3:56 PM
14	Last 25 years has created an unsustainable stormwater management system. Depends on small BMPs which are too many, not inspected regularly and never maintained.	12/10/2019 3:44 PM
15	Need Federal funding.	12/10/2019 3:41 PM
16	Land use policy is important to maintain and enhance regional green infrastructure & the natural hydrology system.	12/10/2019 3:20 PM
17	NA	12/10/2019 3:13 PM
18	none at this time	12/10/2019 2:52 PM
19	Current engineering has a hard enough time meeting regulatory requirements. More stringent requirements will face opposition.	12/10/2019 1:45 PM
20	na	12/10/2019 1:43 PM
21	N/A	12/10/2019 1:27 PM
22	Improvements for compliance with Construction General Permit are in direct conflict with improvements to reduce flooding.	12/10/2019 1:24 PM
23	This is a new piece of the stormwater big picture that I haven't looked into too much. I've only been at this job for a few months, but no one has mentioned climate change resiliency at all.	12/10/2019 1:14 PM
24	education	12/10/2019 1:06 PM
25	Consider sending this survey to those in government that can enact some change in policy.	12/10/2019 12:57 PM
26	None	12/10/2019 12:50 PM
27	ice age	12/10/2019 12:48 PM
28	How quickly will we be able to employ new knowledge for development/redevelopment, given the expected slow pace of issuing new design standards.	11/21/2019 8:05 PM
29	Glad you are thinking about climate change with respect to stormwater management!	11/21/2019 2:55 PM
30	My answer to Q16 above is based off of what I believe is most likely to occur in Delaware, not what the state Climate office would advocate. "Using smart growth principles and land use policy to mitigate future risk" would be our #1 choice if the state was able to dictate land use practices (that decision-making falls to the individual counties and municipalities). Also, I answered a number of questions above with "I don't know." This is because our stormwater and Climate offices don't often interact much. Perhaps we should!	11/21/2019 2:24 PM

31	fund updates to IDF curves now, like was just done in the Houston TX area	11/20/2019 4:50 PM
32	micro practices need to be coupled with better quantity control	11/19/2019 6:50 PM
33	We have a very robust retrofitting program that is underway, and capitalizing on that ASAP would be important.	11/19/2019 5:40 PM
34	I would like to see continuous modeling incorporated into stormwater design practices to "test" designs against historic and theoretic storm events rather than discrete and limited design storms.	11/19/2019 5:08 PM
35	See above	11/19/2019 5:01 PM
36	N/A.	11/18/2019 7:33 PM
37	More support is needed from governing bodies. Local political climate is very pro-development & needs to be better educated/informed on the science aspect.	11/18/2019 3:03 PM
38	N/A	11/18/2019 1:20 PM
39	None	11/16/2019 3:49 AM
40	Definitely agree that it needs to be a grey/green partnership approach!	11/15/2019 6:06 PM
41	None	11/15/2019 2:56 PM
42	we should revisit the "water quality" storm. How frequent is the 1-inch event? Still 90% of storms?	11/15/2019 2:09 PM
43	Base all design on past history and floods of record. Do not rely on future predictions. They have always proven wrong before; this is unlikely to change.	11/15/2019 1:52 PM
44	CSN (or MDE) should have a designated website for Climate Change Resiliency; practical measures that should be part of design guidelines/requirements	11/14/2019 8:58 PM
45	Long term functionality and maintenance of green infrastructure and the value of them in the face of storm events being of higher intensity and longer durations.	11/14/2019 8:38 PM
46	I'm a sediment control inspector for Baltimore county government. The idea of climate change hasn't entered the mindset of the culture of climate change. Most people in my department believe climate change to be a joke. I try to explain to them it's not but am met with resistance. the current state of our society is to believe your facts and not their facts. It's hard to change old ideas.	11/14/2019 3:32 PM
47	Predicative modeling tools that consider rainfall under different event scenarios coupled with accurate elavation data an sea level rise models	11/14/2019 3:09 PM
48	n/a	11/14/2019 2:53 PM
49	keep up the good work	11/14/2019 2:43 PM
50	It needs to happen much faster. The delay means more BMPs are going into the ground that are undersized or ineffective today, and will only become more so over the next several years.	11/14/2019 2:21 PM
51	developers will always argue price as a barrier, which is not wrong but should not solely drive policy decisions.	11/14/2019 2:04 PM
52	Engineering and management are separate systems with discreet responses to question 17.	11/14/2019 1:45 PM

Q19 Are you willing to be contacted by CSN for follow-up discussion?

Answered: 78 Skipped: 54



ANSWER CHOICES	RESPONSES
No	
Yes (please provide your email in the box below)	