

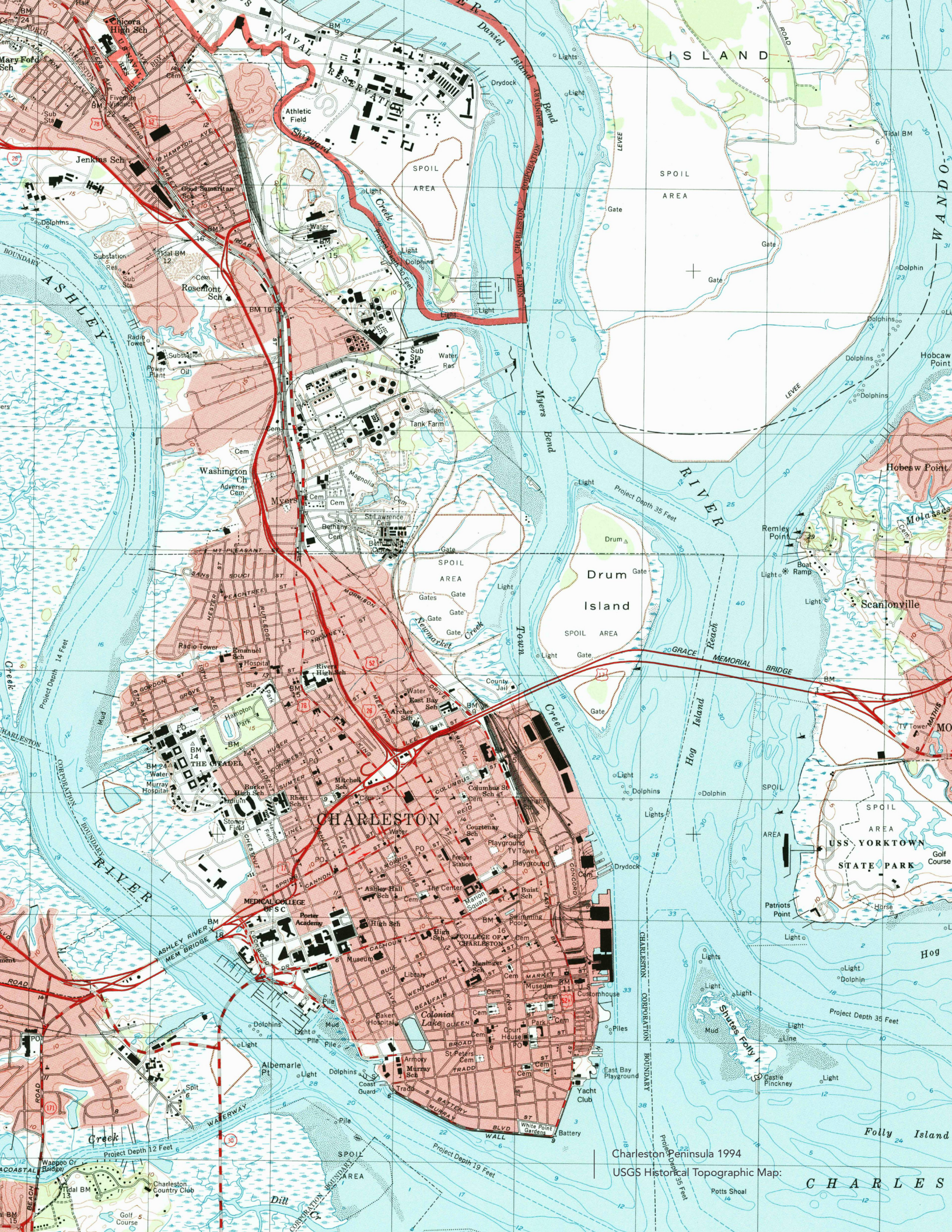
Charleston Medical District

Interim Resilience Guidance

March 2021



CHARLESTON MEDICAL DISTRICT



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Esri Topo Explorer. (2020, September 02).
Retrieved from <https://livingatlas.arcgis.com/topoexplorer/index.html>

Cover Image

Charleston Peninsula terrain elevation derived from 1M Elevation Products: USGS TNM Download. (2020, April 29). Retrieved from <https://viewer.nationalmap.gov/basic>

Building Footprints from City of Charleston GIS Features with CAP modifications: (2020, July 15). Retrieved from <https://data-charleston-sc.opendata.arcgis.com>



Ralph H. Johnson
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Preface

The Charleston Medical District struggles with nuisance flooding interrupting the ability for patients, staff and students to access and provide health services. Coupled with other water risks, too much heat as well as regional earthquake exposure and infrastructure fragility, the District needs to address its challenges while remaining fiscally conservative and making every dollar invested count toward risk reduction. As part of an ongoing effort to address these risks, **the Charleston Medical District Advisory Group (AG) worked in late 2019 and across 2020 to identify key issues and planned investments and to capture expert guidance on ways to improve the overall resilience of the district. The purpose of this report is to summarize that guidance.**

Year in Review

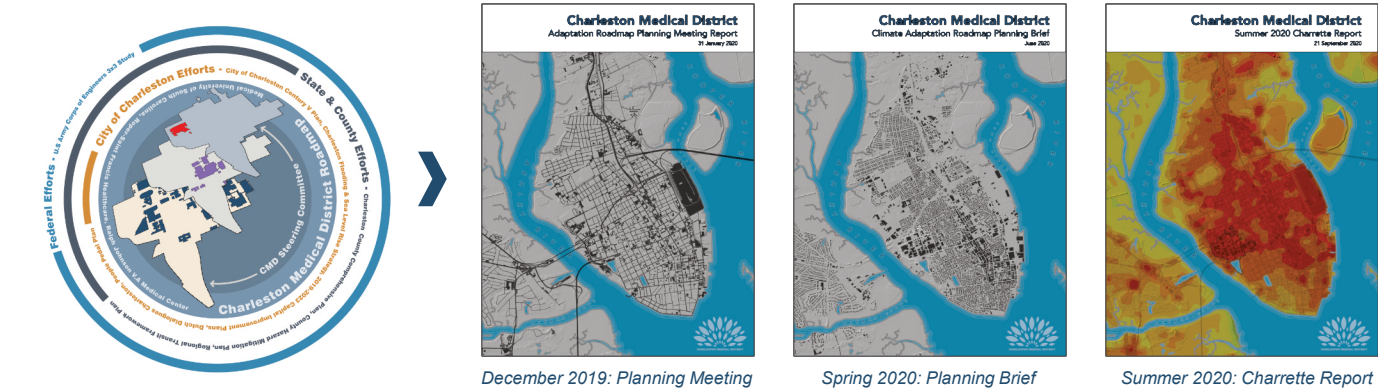
Formed in 2015 via a **Memorandum of Understanding**, the Charleston Medical District (CMD) made the formal commitment to advance collaborations between the Medical University of South Carolina, Roper St. Francis Healthcare and Ralph H. Johnson VA Medical Center in concert with the City of Charleston. Initial efforts focused on the development of a Medical District Greenway Vision and a comprehensive Transportation Study. Subsequently, the CMD invested personnel and resources, via the Charleston Medical District Advisory Group (CMDAG), in the

development of the overall approach to, and conduct of, the Dutch Dialogues® in 2018/2019. Following those efforts, the CMDAG extended its work to build an integrated approach to district planning in concert with city planning and various other initiatives such as the Low Country Rapid Transit program. As part of that approach, the CMDAG hosted a Planning Meeting in December 2019 to identify the various investments nearby and within the District and the recommended considerations from local technical experts. Results of that meeting include nearly eighty issues as summarized in the **Charleston Medical District Planning Meeting Summary**. Following this work, the CMDAG prepared the **Charleston Medical District Planning Brief** which addresses issues raised in terms of planned investments and coalesces known policies, programs, projects or resources that impact near, mid and long-term planning for the District. Developed in the Spring of 2020 and updated in the Fall of 2020, the Planning Brief provides a rapid introduction to orient those working in the District and to build inclusionary planning into the various ongoing investments within and near the District. The CMDAG next facilitated a series of virtual charrettes in the summer of 2020 focused on hazard identification and the intersection of those hazards with known transportation issues across the District as related to the ability to

access health services. Drawing on the expertise of over 60 technical experts, these charrettes provided the foundation for development of an overall climate adaptation strategy, identifying near-term, mid-term and long-term opportunities to reduce flooding, improve transportation and address other hazards as raised by the City of Charleston Vulnerability Assessment. For a summary of those activities, see the **Charleston Medical District Summer 2020 Charrette Report** (September 2020).

These efforts built on one another, establishing a basis of understanding and then leaning into actions that will ultimately improve the resilience of the Medical District and the coordination of planned investments to draw down risks. Each resource is available online at www.charlestonmedicaldistrict.com.

Synthesizing the guidance collected to date is the purpose of this report. Herein are interim recommendations for CMD investments for greater resilience integration while developing formal masterplans for each institution. In considering interim guidance, the planned investments for CMD should answer three key questions: What are the climate projections? What are the CMD vulnerabilities and cascading consequences stemming from those projections? How do planned CMD investments address risks?



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Steps to Resilience

Steps to Resilience represent interim actions that CMD should take while a more holistic resilience strategy is developed for the overall peninsula. These are starting points, not conclusions, and should aim to situate within the larger city/county/state resilience context once available. Ideally CMD becomes a part of the co-production of those interrelated strategies.

UNDERSTAND CMD VULNERABILITIES



Review and integrate the National Climate Assessment, the State of South Carolina, Charleston County and City of Charleston hazard and vulnerability assessments with a CMD-specific vulnerability assessment of buildings and systems

What are the known risks and vulnerabilities?

CONFIRM CAPITAL INVESTMENTS



Given these vulnerabilities, and the CMD commitment to the Charleston peninsula, confirm the (federal, state, county and city) capital and procedural commitments to the necessary sustained operations of services at CMD

What are others building and how do those investments help CMD?

PLAN A RESILIENT HEALTH DISTRICT



With agreed commitments, develop a holistic Resilient Health District plan with coordinated efforts across the three institutions and area partners for near, mid and long-term investments

How do institutional investments interrelate?

ASSURE RESILIENT INVESTMENTS



Assure that existing assets and future investments in the CMD recognize and address vulnerabilities stemming from the recorded hazards and articulate how to mitigate risks and adapt to future scenarios

To what extent do these investments reduce CMD risks?

SET PERFORMANCE CRITERIA



For specific projects, identify intended service life, performance criteria, coping or adaptive capacities, and correlated policies, plans and project areas for risk reduction

For CMD projects, what should expected performance be?

ITERATE AND ADVANCE A RESILIENT PROCESS



Adopt an iterative process to further integrate emergent opportunities and new science into the ongoing resilience-building process while capturing and monitoring CMD impacts on an annual basis

How might the district situation evolve over time?

1. CMD Vulnerabilities

Climate Change and Other Hazards

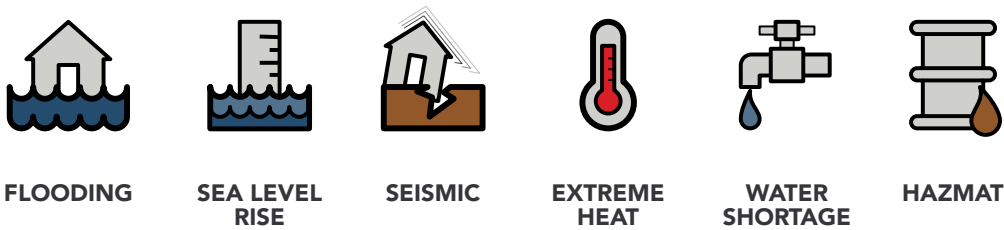
The fourth National Climate Assessment (NCA) describes climate change in the southeast United States in terms of sea level rise, extreme downpours, and increasing exposure to dangerously high temperatures, higher humidity and new diseases. The report notes that average daily minimum temperatures are increasing three times faster than average daily maximum temperatures and the number of extreme rainfall events is also increasing.

The NCA references increasing vulnerabilities with greater summer heat waves, increased drought, increased risk of vector borne diseases, decreased air quality and resulting impacts to transportation systems, quality of life, tourism and business continuity. Saline intrusion and species migration away from and to local ecosystems impact tourism and industries that rely on those ecosystems.

Complementary to the NCA is the State of South Carolina Hazard Mitigation Plan (2018) prepared by the South Carolina Emergency Management Division (SCEMD), which identifies key areas of hazard exposure and state approach to risk reduction. The charge to the SCEMD is to identify natural and human-caused hazards that potentially impact the jurisdiction, assessing the risk and vulnerability of people, property, the environment and jurisdictional operations.

The Charleston County regional Hazard Mitigation Plan (2019) an approved local hazard mitigation plan, rests on the SCEMD work. In turn the City of Charleston Vulnerability Assessment (2020) further localizes city vulnerabilities. This nested scale of hazard identification and risk profiles is central to CMD resilience.

While the NCA presents a broad overview of regional climate impacts, to understand Charleston’s specific vulnerabilities and the likelihood of climate and human-made hazards impacting the City, in 2018, the city commissioned a Vulnerability Assessment to assess hazards, risks and probabilities. The results of this assessment, released in 2020, recognize six primary areas of concern:



| Figure 1.1 - City of Charleston Vulnerabilities (Sourced from Fernleaf Interactive) |

Note that these are but a subset of the broader risk assessment conducted by SCMED and Charleston County. Given resource limitations, the most critical hazards were explored in terms of their likelihood to negatively impact: (1) Property and Public Services, (2) Roads and Mobility, (3) Economy and (4) People and Socioeconomics.

To this end, **the CMD should work with the City of Charleston to specifically review the data related to the district as captured in the vulnerability assessment. This entails an introduction to the AccelAdapt tool (which is the basis for the City Vulnerability Assessment) and the review of each hazard, and of compounded hazards, that will likely effect the district.** With this detail in hand, the CMD would then be positioned to better assess its district vulnerabilities against its planned investments.

2. Capital Commitments

Across Charleston, each of the noted hazards have significant potential to negatively impact the City. In concert with the broader evaluation prepared by Charleston County and SCEMD, a conservative approach addresses, at least initially, all hazards. Given the results of the city’s specific study, more focus on those identified hazards is most relevant. When applied to the Charleston Medical District, the combination of hazards and impact areas warrant careful consideration in terms of planned investments. Central to any investment should be this question:

How does a planned investment address vulnerabilities over its service life?

If the institution undertaking the investment cannot answer this basic question, then the chance that the investment may not be able to withstand expected vulnerabilities increases, as does the likelihood of loss or limited use of the investment. The risk of not asking this question is too great given the costs and criticality of medical district investments. To that end, it is important that the CMD institutions closely coordinate with the federal, state, county, and city to better understand the degree to which the peninsula will be protected and the measures to be taken to reduce ongoing and increasingly problematic environmental risk exposure to health services delivery.

Types of questions include:

- How will the US Army Corps of Engineers (USACE) planned storm surge barrier be adaptable to long-term sea level rise? What tipping point determines permanent closure of storm surge barriers and when is this likely to occur given current sea level rise scenarios?
- With rising seas, how will the storm surge barrier be converted to perimeter protection from expected sea levels and when might it no longer be possible to sustain such protection?
- With increased urban heat, how do existing energy providers, whose systems are already threatened by stormwater flooding and sea level rise, intend to manage increased energy demand?
- With access routes consistently threatened by extreme rain events, and with many potentially compromised further due to sea level rise, how will access to the CMD be maintained?
- Given the costs of these many challenges, is there any expectation that Charleston may not hold the line beyond the end of the century or beyond certain climate tipping points?

The existing CMD represents a multibillion dollar critical care campus. Billions more are pipelined for the next decade. With this type of investment, it is absolutely critical that CMD leadership evaluate answers to these difficult questions and make informed decisions about the shared commitment to remain on the peninsula.

REFERENCES:
National Climate Assessment Southeast Region Chapter <https://nca2018.globalchange.gov/chapter/19/>
South Carolina Emergency Management Division Hazard Mitigation Plan: <https://scemd.org/em-professionals/plans/hazard-mitigation-plan/>
City of Charleston Vulnerability Assessment: <https://www.charleston-sc.gov/1975/All-Hazards-Vulnerability-Risk-Assessment>

3. Resilient Health District

A Resilient Health District Plan prioritizes health service access and continuity by addressing risks in all investments. This in turn requires that each planned investment consider vulnerabilities and provide a plan for reconciling the investment with those vulnerabilities so that risks and impacts are understood, mitigation and adaptive capacity are integrated, and contingency plans are in place.

The basic principle is to assure that any capital planning in process and any capital projects awaiting funding undergo a rigorous evaluation of their readiness for the identified vulnerabilities. Anything less than this type of evaluation introduces risk to the value of the investment.

Given limited budgets and funding constraints, every dollar invested should further the institutional mission for resilient health service provision so this approach to measure twice, cut once, makes the most sense now. The United States government provided a regional assessment in the National Climate Assessment, the State of South Carolina provided its Hazard Mitigation Plan, and the City of Charleston provided a local assessment of likely climate and interrelated risks. The next obvious step is for the institutions comprising the CMD to review these materials in the context of planned investments and to ascertain the embodied risks and the level of comfort with those risks for the respective institutions, or their intended approaches to mitigate or adapt to those risks.

Capital planning is the nominal entryway for this evaluation. More broadly however, programs and policies as related to capital risk should also be considered. For example, the MUSC policy for no net tree canopy loss reinforces the ecological value of the arboretum for stormwater uptake, management of species migration and extreme heat mitigation for the CMD. Identifying alignments such as these, or inconsistencies such as material palettes that hold heat in lieu of dissipating heat, are complementary to the evaluation of capital projects.

Importantly, for each institution, existing programs, policies and plans that might be better leveraged to draw down risks need to be identified, assessed and interconnected. No institution has to start at zero, but all institutions should assume a careful evaluation is required. The information is simply too new and the process too emergent to assume that vulnerabilities are already integrated.

To move toward a resilient health district, this type of integrative evaluation and alignment exercise is critical. Institutions may find that new funding is not required but that existing funding might be better leveraged once the vulnerabilities and interconnections are better understood. To grasp the extent of the potential impact, the next page highlights some of the planned investments that could work toward risk reduction if leveraged appropriately.

Medical District Resilience Vision

Improve Health Service Access

Address Service Life of District

Manage Response to Expected Storm Levels

Improve Cloudburst Response

Improve Response to High Tide Floods

Improve Storm Surge Protection and Preparedness

Address Sea Level Rise

Reduce Urban Heat Impact

Manage Drought

Assess Hazardous Materials and Infrastructure Failure Readiness

Integrate Planning Efforts (including Transportation)

Establish a Coordinated Response to Risks

Develop an Evaluation and Monitoring System for Investments

| Figure 1.2- Charleston Medical District Resilience Vision (Source: Summer 2020 Charrette Report) |

4. Resilient Investment

Planned Investments

In 2020, the CMDAG collected feedback from Federal, State, County, City and Private sector organizations to better understand the range of planned investments that relate to CMD, whether geographically or operationally. **With over \$2 billion of planned CMD investments within the next decade** and far more with related investments of Federal, State, County, City and private sector actors outside of the CMD, the capital landscape that this work represents rests on several key tenets:

- The scale and costs must meet their expected full operational service life to achieve intended value.
- Investments vary widely in terms of their identified approaches to all hazards integration.
- Resilience criteria, multi-benefit approaches and performance requirements warrant further articulation.
- Near-term coping strategies and long-term adaptive strategies need reconciliation

While these may present as challenges, they represent opportunities for constructive change and better investments. Examples of the types of investments planned within the next decade include:

Federal	State	County	City	Private
USACE Storm Surge Barrier	MUSC Phase 3 Hospital	Courtenay / Calhoun and Lockwood / Bee Street Improvements	Low Country Rapid Transit Plan	Roper St. Francis Healthcare Master Plan
VA Bed Tower and Parking Expansion	MUSC Master Plan	Charleston County Comprehensive Plan + Chapter 3.11 Resilience Element	Ehrhardt Shaft / Septima-Clark Tunnel	West Edge Master Plan
	MUSC Elevated Walkway	Charleston County Hazard Mitigation Plan	City Comprehensive Plan Update	
	Citadel Master Plan	Charleston County Resilience Element	Ashley River Bike / Pedestrian Bridge Plan	

| Figure 1.3- Planning and Capital Projects within and near to the CMD (Sourced from Charleston Medical District Planning Brief) |

These planned investments rest on existing programs and policies such as the City Stormwater Guidelines, the City Sea Level Rise Strategy, the Board of Architectural Review, the Dutch Dialogues®, the work of The Nature Conservancy on wetland management, as well as building codes, National Flood Insurance Program and FEMA requirements, national and state DoT planning, and many other convening factors. **What’s missing is the necessary synthesis between good guidance and planned investments in relation to the identified vulnerabilities from the City assessment.** This is not a unique situation as many locales are at the beginning phases of understanding their exposures and prioritizing how to manage them, but it is a timely situation. Before +\$2 billion of CMD investments move into design and bidding, it is imperative that risk and value reconciliation occurs.

REFERENCES:
Charleston Medical District Planning Brief (2020)

Charleston County Resilience Element: <https://www.charlestoncounty.org/departments/zoning-planning/files/comp/Part%203%203.11%20Resilience%20Element.pdf?v=589>

2020 Charrette Resilience Guidance

While the CMD does not have control over the projects outside its properties, the CMD has numerous ongoing projects **with POTENTIAL to increase resilience and improve long-term adaptive capacity**. Currently, however, most projects are not required to broadly consider resilience as a core criterion. Based on results from the Summer 2020 Charrettes, the CMDAG recommended the adoption of initial resilience guidance to assure that proposed and ongoing investments improve the overall resilience of the district and to reduce the likelihood of maladaptation in investments. The summer exercises focused on four key areas: (1) All Hazards, (2) Water, (3) Transportation and (4) Collaboration. Key takeaways suggest that the CMD:



Address an All Hazards Approach

1. Anchor all district investments to the City of Charleston vulnerability assessment. Include an All Hazards Review of investments with a clear plan of action or operational strategy to reduce risk exposure or to manage to acceptable risk.
2. Where possible, leverage and expand existing programs and policies to integrate hazards reduction.
3. Consider extreme heat and material albedo / type / selection to reduce urban heat island impacts. Adopt a district-wide ‘No Net Loss’ protocol for tree canopy.
4. Consider potential impacts on adjacent CMD parcels. Isolate unintended consequences for other CMD entities



Establish Water Storage Targets

1. Identify each project’s overall contribution to Charleston’s Water Plan. Identify extent to which planned projects improve CMD access.
2. Anchor to City **Stormwater Guidelines** (hold water where it falls, use nature based and grey solutions, etc.)



Integrate Transportation Impacts

1. Identify overall contribution to CMD Transportation Plan
2. Design with alternative uses in mind to allow for more cost-effective transformation
3. Leverage shared assets where possible to provide more effective use of funds



Increase Collaboration

1. Require resilience performance in all scopes as part of the base contract. Develop boiler plate language for consistency across institutions.
2. Develop evaluation and monitoring approaches to understand efficacies of investments and establish continuous improvement processes

REFERENCES:
Charleston Medical District Summer 2020 Charrette Report

5. Performance Criteria

Defining Performance

With charrette guidance in mind, the CMD expanded its criteria to include:

- Assign Service Life** - Define the planned use horizon for the investment and assess existing and expected vulnerabilities through scenario planning to assure that the planned use horizon and adaptive capacity align.
- Define Project Performance** - Specify expected performance of the investment in terms of given vulnerabilities, monitoring and evaluation criteria and multibenefit values. Define the criticality of project functions and assess the ability for the planned investment to meet expected performance.
- Identify Coping and Adaptive Strategies** - Identify near-term coping strategies to leverage while long-term adaptive strategies are implemented.
- Correlate Policies, Plan and Projects** – Correlate these criteria with existing programs, policies and projects at the institutional and/or jurisdictional level to increase alignment of investments and performance intent.

Assign Service Life

Service Life is the estimate of the number of years that an investment is likely to remain in service for its intended use and cost-effective revenue generation. Different investments necessarily have varying service life estimates. In chart below, Service Life Categories, initial assumptions of service life as compared to climate scenario time periods introduce this variable.

For each planned CMD investment, the assumed service life is a foundational criterion for resilience building. If CMD has not established an assumed service life, how might it be possible to establish performance criteria given the expected changes in climate and other vulnerabilities over time?

Figure 1.4 offers an initial framework. Investments fall into four categories related to expected service life and the related climate time period for comparison. This guidance asks the investor to consider the likely time period that the investment is intended to serve and correlates this to the climate time period that the investment should consider. For example, for a new hospital in Charleston, the climate time period of 2070-2099 is most suitable. This then requires the investor to understand expected climate changes during that service life time period and to invest accordingly.

Service Life Categories		
Time Period	Category	Examples of building, infrastructure, landscape and components grouped by useful life
2020-2039	Temporary or Rapidly Replaced	interim and deployable flood protection pavements/pavers/ROW finishings plaza/street furniture temporary buildings and storage facilities green infrastructure technologies such as telecommunications, solar panels, batteries
2040-2069	Facility Improvements and components on a regular replacement cycle	electrical, HVAC and mechanical components substantial building retrofits concrete paving infrastructure mechanical components such as pumps, lifts outdoor recreation facilities site energy system stormwater management systems
2070-2099	Long-lived buildings and infrastructure	most buildings plazas retaining walls, culverts onsite energy generation systems
2100+	Assets that cannot be replaced easily	Major infrastructure such as bridges, wastewater systems, tunnels monumental buildings road construction subgrade sewer infrastructure such as catch basins and outfalls

| Figure 1.4 Service Life Categories (Sourced from City of New York Climate Resiliency Design Guidelines) |

REFERENCES:
City of New York Climate Resiliency Design Guidelines: https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v4-0.pdf

Performance Criteria

Define Project Performance Criteria

After defining expected service life of an investment, CMD institutions should identify project performance criteria in terms of expected vulnerabilities and project criticality, inclusive of monitoring and evaluation criteria and a concentrated effort toward multibenefit risk reduction.

Project Vulnerability Assessment

Vulnerability stems from the City of Charleston Vulnerability Assessment coupled with Charleston County and State of South Carolina Hazard Mitigation Plans. These in turn reference the National Climate Assessment. Given local vulnerabilities, CMD institutions should articulate the degree to which planned investments recognize those vulnerabilities and how those investments are intended to perform against those vulnerabilities. First, acknowledge the risk and second, describe what’s been/being done to reduce the risk.Third, quantify and qualify the level of acceptable risk and the budgetary readiness to manage the impacts of those acceptable risks.

Key Steps: District-Level Vulnerability Assessment, Project Specific Risk Interpretation

Project Criticality Definition

Approaches to project performance will vary depending on project criticality. Criticality analysis ranks the impact of system or asset failure on a range of variables such as patient safety, service availability, personnel security, revenue generation, or role in redundancy. For CMD institutions, existing and planned investments should be evaluated with project criticality and vulnerability intertwined. While all institutions have established protocols in many of the vulnerability issues, new information provided by the vulnerability assessment suggests real value in updating assessments. Project criticality rests on vulnerability risk tolerance within each institution and may vary across buildings and infrastructure as well as within buildings.

Key Steps: Portfolio Criticality Definition, Intended Performance/Recovery Timeframes

Monitoring and Evaluation

Monitoring and evaluation links vulnerabilities and project performance criteria with quantifiable metrics and evolving science. For example, if a planned project is intended to function for 50-60 years, CMD institutions should integrate the projected sea level rise during that service life and the criticality of sustained function in project performance criteria. It is equally important however to continue to monitor those projections. This is particularly relevant given currently available climate science, the rapidly improving field of climate scenario development, and the rapidly warming planet.

Key Steps: Project Service Life Monitoring and Evaluation Approach

Multibenefit Risk Reduction

To gain the greatest value for the CMD, performance criteria should articulate shared benefits wherein individual or collected actions and strategies contribute to risk reduction across multiple vulnerabilities. For example, singular solutions for flood risk reduction that fail to address urban heat island miss a key vulnerability. Established design strategies from other cities around the world demonstrate how to effectively integrate the two in a multibenefit risk reduction strategy.

Key Steps: Multibenefit Opportunity Evaluation

Identify Coping and Adaptive Strategies

Articulated Risks, Performance Targets and Delayed Actions

Projects may be unable to address all vulnerabilities given budget or other procedural constraints such as codes or existing policies that conflict with what is clearly emerging knowledge about the impacts of climate change and the integration of vulnerability assessments in planning and design. Yet these projects may be approved to proceed. This is not unique to Charleston, but instead an evolving situation as scientists and investors grapple with rapidly emerging data and unreconciled incentives to invest. The important step for CMD is to articulate the risks and expected performance and to identify what can be done and what must wait.

Near, Mid and Long Term Actions

While there are many resources for the CMD to reference, such as the work on the State, County and City hazard mitigation and vulnerability assessments, these are necessary, but insufficient for full guidance for investments. These instead provide a baseline for investors to evaluate risk. As a result, it is important for the CMD to carefully consider vulnerabilities in the context of what may be done in the near term to reduce risks and what could be done in the mid and longer term to further drawn down risks within the same project. Over the service life of any asset, this tripartite approach asks (1) What do we do now? (2) What do we do next? And finally, (3) What must we eventually do?

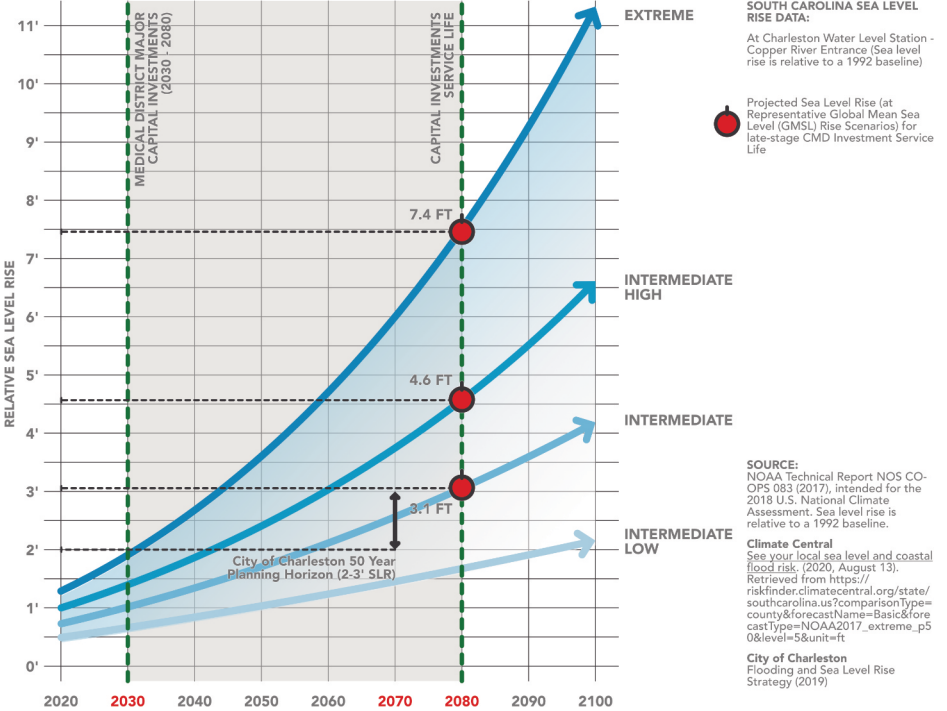


Figure 1.5 Service Life and Sea Level Rise (Source: Climate Adaptation Partners)

Sea Level Rise Example

Using the vulnerability of sea level rise for Charleston, as an example, the CMD should reference the City of Charleston Sea Level Rise Strategy which stands on NOAA data and reference the National Climate Assessment for longer-term perspectives. As CMD institutions plan for new buildings and infrastructure and as the USACE plans for a storm surge barrier, sea level within the service life of those assets changes significantly. Thus near term, CMD institutions must make a decision whether to continue to invest in the district. If yes, then the institutions must determine project service life expectations as compared to the expected change in sea level and its impact on the ability for the CMD to function. If an asset is intended to function for 50 years, what is the expected sea level rise during that time period and how are the various governmental entities planning to address the situation? Near term commitment to continued district investment rests on a shared commitment (from Federal, State, County and City) for perimeter protection and infrastructure for the peninsula over the next century. The investments that the CMD makes to stay on the peninsula will only realize their value if the overall peninsula is protected, which in turn means that the storm surge barrier will need to be permanently closed at some point and likely that it will also need to be raised. Roads to the peninsula and systems serving the peninsula must integrate accordingly. How then is this near-term action? With over \$2 billion of planned investments within the next decade and with projects in design now, it is critical for the CMD to hold its design teams and its governmental collaborators accountable to the issue. Otherwise, these near term investments may have a foreshortened service life, never truly realizing their return for the institutions.

Performance Criteria

Correlate Policies, Plans and Projects

CMD institutions began the process of integrating an all hazards approach to investments in their 2020 climate adaptation workshops. Drawing from the 2020 Charleston Vulnerability Assessment as a first step, each institution polled its engineering and masterplanning teams to understand the degree to which the six key vulnerabilities (as identified in the Vulnerability Assessment) were addressed through either exposure mitigation, practice adaptation or other means.

	Flooding (Rainfall, Tidal, Storm Surge) SLR		Seismic
Exposure Mitigation	Add cisterns at new construction	Reduce GHG	Follow seismic code for new buildings
	Move existing ground floor critical services / Eliminate new ground floor critical services		Retrofit existing buildings
	Increase emergency response budget		
	Continue check valve program		
	Improve Ehrhardt water management		
	Explore Greenway water storage		
	Maintain catch basins, street cleaning		
	Develop USACE stormsurge barrier		
	Upgrade generators, underground fuel tanks, emergency power hook ups, UPS backups, portable fuel storage, propane tanks		
	Elevate new structures and utilities, improve hurricane resistance of roofs/walls/glazing		
	No net tree loss policy		
	Continue to explore Calhoun West drainage system		
	Choose salt tolerant planting, permeable pavement, minimize ground cover in flood areas	Evaluate full cost of ownership over service life	Review earthquake evacuation plans in concert with flooding and extreme heat risks
	Continue telemedicine	Continue to explore road raising in concert with USACE Storm Surge Barrier	
Practice Adaptation	Continue and increase work from home options		
	Evaluate elevated walkways, utilities, and connections		
	Expand offsite services		
	Provide deployable flood gates		
	Encourage CARTA ridership		
	Install Flood Walls, Sump Pumps, Stormwater Drain Vaults, Emergency Generators and Vacuums.		
	Provide high water vehicles		
Other Means	Evaluate energy exposure	Explore retreat option	
	Continue hurricane preparedness programs		
	Evaluate centralized parking / walkway connectivity		

Figure 1.6a: Hazard-correlated Polices, Plans and Projects

Exposure Mitigation refers to the means used to reduce likely risks by reducing exposure, such as moving critical functions to higher floors so that flood waters do not interrupt services.

Practice Adaptation refers to tactics that enable the institutions to function in spite of exposures, such as operating at alternative sites.

Other Means include coping strategies to temporarily manage problems, such as the availability of high water vehicles to move patients during flooding. Results of these discussions appear below.

	Extreme Heat/Cold	Water Shortage	Haz Material	Comments
Exposure Mitigation	Increase district tree canopy via tree planting program	Leverage Hurricane Preparedness program for water management	Continue hazardous material management programs	
	No net tree loss policy	Reduce reliance on irrigation systems	Reduce use of hazardous chemicals	
	Improve material selection to reduce heat gain (road surfaces as well as walls and roofs) and increase	Broaden gray water reuse and consider blackwater processing		
	Introduce more layered planting such as at MUSC Psych Building			
	Increase shade infrastructure			
	Design with cooling breezes /air movement as a criterion			
	Snow removal vehicle/salt storage / snow shovels			
Practice Adaptation	Alter work hours for outdoor workers			
	Monitor patient exposure and appointment timing			
	Educate patients and staff on heat risks and coping options			
Other Means	Evaluate energy exposure	Evaluate water tanker/ potable supply contracts and processes across institutions		Investigate performance contracting
	Engage CISA research to better understand exposures			Explore combined heat and power plant
	Consider how shared backup systems might offer cost saves.			

Figure 1.6b: Hazard-correlated Polices, Plans and Projects

6. Resilient Process

Monitoring and Evaluation

Global exposure to the climate crisis means that masterplans require ongoing update and iteration as climate science and parallel mitigation and adaptive strategies continue to evolve. For the CMD, this means that the overall process of developing a resilient health district plan must include an approach to iteration and advancement that aligns with the availability of better information and the correlation of various outside investors.

Every year / Impacts Analysis

The CMD should systematize the operational and financial impacts of climate-related events. Annual emergency response costs, operations costs and lost revenue tabulations should be consistently summarized for each institution. Without a common and continuously updated baseline understanding of institutional costs for ongoing climate or other emergency response events, it is difficult to quantify the cost:benefit ratio of any proposed investments. Moreover, for the City of Charleston to advocate on behalf of the Charleston Medical District, it is critical to have a common understanding of how institutional costs and City/County emergency response costs increase the respective need for improvements for risk reduction. Having conducted a review in 2020, it is important that the CMD codify the metrics used and the processes undertaken in order to encourage replicability for annual reporting as well as to raise and integrate impact tracking in business as usual operations.

Every 4-5 years / Risk Updates

The CMD should align its own risk updates to the timing of national climate science assessments and state and local hazard updates. The National Climate Assessment (NCA) updates nominally every four years. As a national consensus-based review, it is important that the CMD monitor the NCA and understand how its updates may introduce changes to CMD approaches for investments. Moreover, it is important for the CMD to reconcile the NCA updates with State and Local planning.

The State of South Carolina Hazard Mitigation Plan updates every 5 years at a minimum per FEMA requirements. In turn, the County updates follow state updates.

Institutional Master Plans update approximately every 5 years, depending on need. Given that each institution is currently in process with masterplan updates, this is an opportune time to build in resilience evaluation to near, mid and long-term climate and other hazards. Without a resilience risk review, there is no mandate to direct masterplanning efforts to risk reduction.

Every 10 years / Planning Integration

The City Comprehensive Plan updates every 10 years, a fair period given city growth planning, but an extraordinarily long period in the timespan of climate science. However it is important for the CMD to participate in these updates by providing the City with District planning initiatives and related investments. As the City’s Comprehensive Plan is currently being updated, this again is an opportune time to correlate Federal, State, County, City and CMD investments in order to leverage such planning and to reduce risks.

The Challenge of Water

The importance of monitoring and evaluation is illustrated in the Challenge of Water. While the City of Charleston seeks funding for major water infrastructure projects and envisions near and mid-term investments through the USACE Storm Surge Barrier, the geographies explored in the Dutch Dialogues®, an updated Comprehensive Plan and more extensive Stormwater Guidelines, its water challenges continue to escalate. 2020 saw the most “major” tidal floods (over 8’) and the second highest total number of tidal floods (68) in a year after the record of 89 set in in 2019.

Global ice melt and extreme heat days broke records in 2020, and with their respective feedback cycle alone, expected sea level rise must consider NOAA’s extreme scenarios by 2100. Results from comparative analysis of previous climate scenarios to actual events underscore that such scenarios are not out of the realm of possibility. Just a few short years ago, that was not the case. Moreover, with extreme global warming, Gulfstream shifts may bring greater flooding potential to the southeast region while places like Greenland may actually see sea level recede.

With these Gulfstream changes, precipitation patterns will continue to increase in volatility. Heavier rainfalls on Charleston’s increasingly impervious surfaces will bring more inland flooding even while multi-million dollar investments in grey and green infrastructure will draw down some risks. The Challenge with Water is that the curve extends indefinitely while the projects scoped are finite.

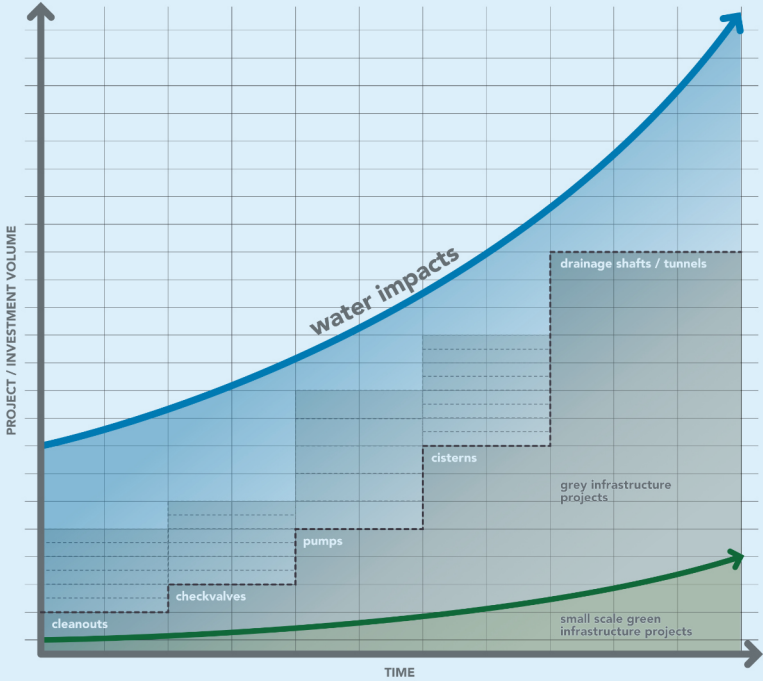


Figure 1.6 The Challenge of Water (Source: Climate Adaptation Partners)

This is not to say that the investments are not helpful. They are. However, it is necessary to question how the service life of the investments that the CMD intends to make, and those already made, correlate to the ability of these parallel adaptation strategies to keep pace. What is the rate of continuous flood exposure, its costs and its impacts to health services?

Compound risks (floodwaters, sea level rise, storm surge AND extreme heat, drought, wildfire and any number of human-induced hazards) are poorly understood, globally. Yet, billions per locale and trillions globally continue to address individual risks, not compounded ones. Moreover, most fail to address the intended service life of the very investments that they’re intended to protect.

How might the CMD change that trajectory, and if not solve the problem, at a minimum codify what is unsolved and how institutional monitoring will manage those risks?

Resilience stands on three core actions: (1) Understand the risks, (2) Evaluate the vulnerabilities, (3) Decide what to do. The Challenge of Water is that risk understanding is evolving, worsening, and compounding in new ways. Vulnerabilities resulting from those compounded risks are infrequently reconciled. Investments in turn address one or a few of the risks, but rarely all. Yet in partially addressing risks, a false sense of assurance calms the context. That should not be the case. Until the unreconciled risks surface, resilience-building remains fraught with de minimis examples that miss the crux of the Challenge.

