

Resiliency Indicator Framework

2020 Addendum



Metro

Addendum: Resiliency Indicator Framework 2020 Update

Metro completed an update to the Resiliency Indicator Framework (the “framework”) in 2020. This addendum summarizes those changes. While the background information provided in the 2015 framework is still valid, users should use the updated indicators presented in Table 5 of this addendum.

Metro pursued the 2020 update for the following reasons:

- > For the 2015 framework, Metro completed a vetting process focused on the technical indicators. A similar process was still needed for the organizational indicators, including completion of a case study.
- > The state of knowledge about climate change resiliency is quickly evolving. The addendum reflects changes in the field and within Los Angeles County.
- > To make the framework easier for users, the large number of indicators was streamlined; moreover, updates were made to names and descriptions of indicators to align the framework with the latest best practices.
- > The 2015 framework looked only at climate change hazards, but agencies like Metro plan for resiliency to climate change in coordination with plans for resiliency to other hazards. Therefore, this update reflects thinking about resiliency in terms of all hazards (natural and human-induced), not just climate hazards.

This addendum is organized as follows:

- > Update Process
- > 2020 Changes to the Resiliency Indicators Framework
- > Revised Indicators
- > Earthquake Case Study

When Metro first undertook the development of this update in 2018, the world was a different place. Amidst the challenges presented by COVID-19, Metro has worked diligently to be responsive to Angelenos’ travel needs at all times, all while not wavering on its commitment to sustainability. Metro must continue to quickly adapt to these types of unexpected conditions; for example, the wildfires of the past few years have demonstrated just how resilient Metro must be against natural hazards. Meanwhile, cybersecurity and terrorist threats continue to be a concern for many organizations, not just Metro.

As threats like COVID-19 and climate change continue to shape the world, understanding resiliency is more important than ever. The framework can help guide internal conversations about how to prepare for threats that will become more frequent or severe in the future, and how to help Metro react quickly and effectively to unforeseen hazards. The 2020 update makes the framework even more relevant than previously imagined as Metro advances towards recovery and a more resilient future.

Update Process

The process to update the framework involved:

- > **Expert review:** Metro identified initial adjustments based on professional judgement.
- > **Stakeholder engagement:** Metro then used internal stakeholder engagement workshops to identify the needs and unique viewpoints of various departments within the agency. Metro also engaged the Sustainability Council, an external stakeholder advisory group, to determine how the framework fits into broader local and regional resilience efforts (see “Stakeholder Engagement” box).
- > **Case study:** A team of internal stakeholders applied the revised organizational indicators to a hypothetical earthquake event to determine whether adjustments to the indicators revealed gaps in critical information to assess. This process also provided insights into areas of resilience across the agency.

These processes led to the final set of revised indicators, weighting system and scoring system.

2020 Changes to the Resiliency Indicators Framework

Major changes to the framework include:

- > Expanding the framework to all hazards
- > Revising and streamlining organizational indicators
- > Removing the safe-to-fail principle from the technical indicators
- > Weighting indicators and principles equally
- > Expressing resiliency scores as a percentage

Expanding the Framework to All Hazards

During the course of the 2020 update, stakeholders pointed out that achieving a resilient system requires being resilient against all hazards, not just the long-term changes in average weather conditions and extreme weather events that are likely to result from climate change. Moreover, they noted it would be inefficient to address climate change resiliency separately from other hazards. It became evident that many actions needed to ensure resiliency against climate change are the same ones needed to ensure resiliency against other hazards.

Table 1 shows the natural and human-induced hazards included in the updated framework. This list reflects consultation between Metro’s Risk, Safety and Asset Management Department, Environmental Compliance and Sustainability Department, the System Security and Law

Stakeholder Engagement

Departments represented at the internal workshop:

- > Customer Relations/Metro Information
- > Emergency Management
- > Environmental Compliance and Sustainability
- > Facilities Engineering and Operations
- > Office of Extraordinary Innovation
- > Rail Maintenance-of-Way Engineering
- > Safety
- > Systems Engineering
- > Transit Operations, Executive Office
- > Transit Project Delivery, Executive Office

Metro Sustainability Council

Resiliency experts:

- > Marissa Aho, former Chief Resiliency Officer, City of Los Angeles
- > Heather Rosenberg, former Director of LA Resilience Initiative, U.S. Green Building Council - Los Angeles Chapter (USGBC-LA)

Enforcement Department and through consultation on hazards covered in the *City of Los Angeles 2018 Local Hazard Mitigation Plan*.¹

Although the switch to an all-hazards viewpoint is a significant change in how the framework may be used at Metro, this change did not require substantial revisions to the indicators themselves. Rather, updates to indicator names and descriptions in the scoring spreadsheet made them more inclusive of non-climate related hazards. Now, no indicators relate specifically to one hazard; rather, all indicators in the framework can apply to any of the hazards listed in Table 1.

Table 1: List of hazards covered by the 2020 update to the Resiliency Indicators Framework

Natural Hazards	Human-induced Hazards
<ul style="list-style-type: none"> > Drought > Earthquake > Extreme heat > Flood > High wind > Landslide > Sea-level rise > Severe storm > Tornado > Tsunami > Wildfire 	<ul style="list-style-type: none"> > Active shooter > Chemical hazard > Cyber-attack and space weather > Dam failure > Hazardous material, transportation and radiological incident > Public health hazard > Special event > Terrorism and weapons of mass destruction, civil unrest > Threat to critical infrastructure

Revising and Streamlining Organizational Indicators

Metro simplified the organizational dimension. The 2015 framework contained four levels in its structure (dimension, principle, category, indicator) with a total of 41 indicators, some of which were similar to each other (see Table 2 for the 2015 structure).

Table 2: 2015 Framework levels

Dimension	Technical	Organizational
Principles	Robustness Redundancy Safe-to-Fail	Change Readiness Networks Leadership and Culture
Categories	None	7 in Change Readiness 2 in Networks 3 in Leadership and Culture
Indicators	20 indicators	41 indicators

The following changes are intended to streamline the framework and make it easier to understand and implement.

¹ City of LA. 2018. *Local Hazard Mitigation Plan*. Available at: https://emergency.lacity.org/sites/g/files/wph496/f/2018_LA_HMP_Final_2018-11-30.pdf

Rebalancing and clarifying principle categories

As shown in Table 3, the organizational dimension contained three principles: Change Readiness, Networks and Leadership and Culture. However, the Change Readiness principle contained more than 70% of the organizational indicators, inflating the significance of that principle. To make the organizational principles more balanced and to offer more granularity on what “Change Readiness” actually means, this principle is now split into three new principles. As a result, the organizational dimension of the framework now has five principles. The “Networks” principle is also now expanded to “Networks and Staffing” as this principle covers both internal and external partnerships.

Table 3: 2015 vs. 2020 principles

2015 Principles	2020 Principles
Change Readiness	Information Management and Communication
	All Hazards Planning, Preparedness and Response
	Financial Preparedness
Networks	Networks and Staffing
Leadership and Culture	Leadership and Culture

Removing categories

To create a more parallel structure between the organizational dimension and the technical dimension, the categories in the organizational dimension were removed.

Revising indicators

To make the indicators more concise, they were consolidated, revised and moved to balance out the principles. Indicator descriptions and scoring metrics were revised for clarity and to include hazards beyond climate change.

As a result, the number of organizational indicators is now 36, reduced from the original 41.

Figure 1 shows a side-by-side comparison of the different elements of the 2015 and 2020 organizational dimension. Meanwhile, Table 4 shows a side-by-side comparison of the 2015 and 2020 frameworks to illustrate the specific changes made to the organizational indicators. The more detailed descriptions of each indicator are included in the Excel scoring tool that accompanies this framework.

Figure 1: 2015 vs. 2020 levels

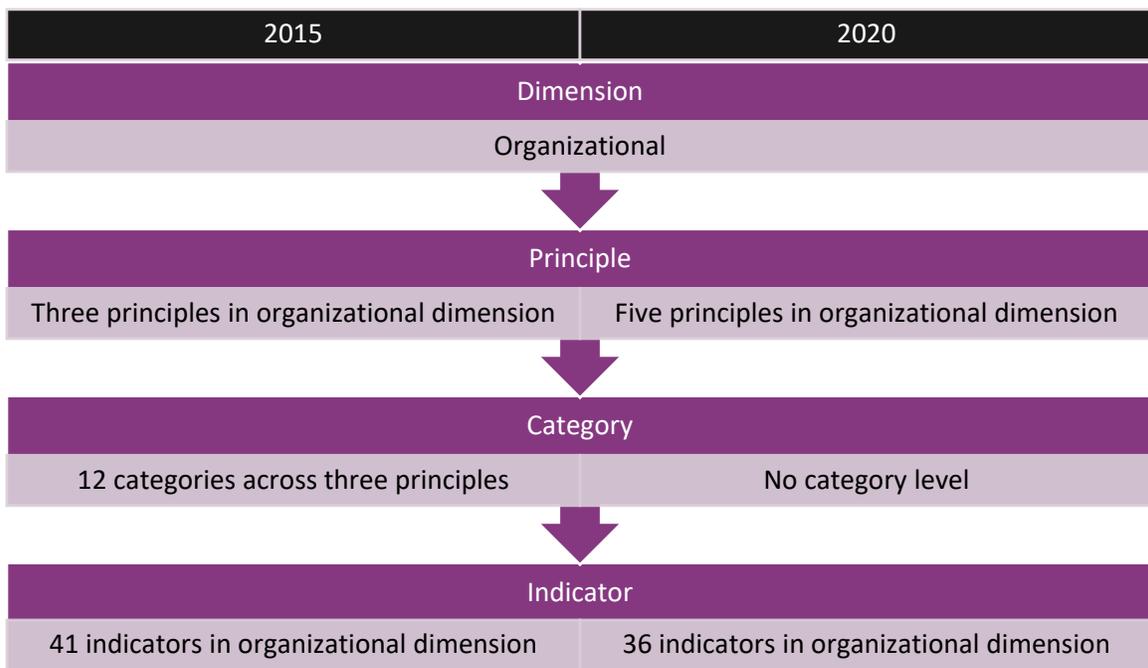


Table 4: Comparison of 2015 and 2020 Framework: Organizational Indicators

2015			2020			
Principle	Category	Indicator	Principle	Indicator		
Change Readiness	Communications and Warning	C-1. Warnings – General Public	Information Management and Communication	I-1. Warnings and Public Awareness		
		C-2. Communication Systems - Staff		I-2. Communication Systems - Staff		
		C-3. External - Public Awareness		I-3. External - Public Awareness		
	Information and Technology	C-4. Sensors		I-4. Sensors		
		C-5. Current Weather Data		I-5. Data - Access to, and Maintenance of, Key Data Sets		
		C-6. Backup		I-6. Information Security and Contingency Planning		
	Insurance	C-7. Coverage	All Hazards Planning, Preparedness and Response	A-1. Risk Assessment and Scenario Planning		
		C-8. Information		A-2. Tracking Incident-Related Injuries		
	Internal Resources	C-9. Roles and Responsibilities – Key People Identified		A-3. Tracking Essential Resources		
		C-10. Roles and Responsibilities – Succession Planning		A-4. Priority Routes/Structures		
		C-11. Internal Coordination – Event Response		A-5. Emergency Management Plans – Existence		
		C-12. Remote Response Ability		A-6. Joint Planning		
		C-13. Staffing Response Roles		A-7. Training/Drills – Offered		
	Planning Strategies	C-14. Sufficient Staffing		A-8. Training/Drills/Tests – Completed		
		C-15. Risk Assessment and Scenario Planning		A-9. Lessons Learned and Thinking Ahead		
		C-16. Emergency Management Plans - Existence		A-10: Critical Energy and Supply Chain Provision		
		Drills and Response Exercises	C-17. Tracking Climate-Related Injuries	Financial Preparedness	F-1. Insurance Coverage	
			C-18. Joint Planning		F-2. Insurance Information	
			C-19. Priority Routes/Structures to Manage First		F-3. Capital Availability	
			C-20. Lessons Learned and Thinking Ahead		F-4. Operational Funding	
	Funding	C-21. Training/Drills - Curriculum	F-5. Contingency Funding			
		C-22. Training/Drills - Offered	F-6. Modelling			
		C-23. Training/Drills - Completed				
		C-24. Training/Drills Practice - Testing and Public Engagement				
	Networks	Breaking Siloes	C-25. Capital Availability			
			C-26. Operational Funding for Resilience Initiatives			
		Effective Partnerships (External)	C-27. Integration with Resilience			
			C-28. Contingency Funding			
			C-29. Modeling			
Leadership and Culture			Leadership	N-1. Internal Relationships	Networks and Staffing	N-1. Internal Relationships
				L-2. Staff Engagement		N-2. Information Sharing - Internal
				L-3. Leveraging Knowledge		N-3. Interagency Compatibility
		Decision Making Authority	L-4. Crisis Decision Making	N-4. Business Continuity/Awareness		
			L-5. Advance Agreements	N-5. External Information Sharing and Cooperation		
		Innovation and Creativity	L-6. Approach to Projects	N-6. Roles and Responsibilities Identified		
				N-7. Remote Response Ability		
			L-1. Resilience is a Clear Priority of Metro Leadership			
		L-2. Roles, Responsibilities and Goals				
		L-3. Staff Engagement and Leveraging Knowledge				
		L-4. Crisis Decision Making				
		L-5. Mid/Long Term Decision Making				
		L-6. Advance Agreements				
		L-7. Approach to Projects				

Removing the Safe-to-Fail Principle From the Technical Indicators

The 2015 framework describes the safe-to-fail approach as allowing for failure in a controlled and planned manner that facilitates rapid recovery, using design components such as modularity. Rather than trying to avoid any failure at all, a safe-to-fail approach was thought to be helpful in identifying where, under extreme circumstances, failures could occur with minimal impact to the system as a whole.

Metro recognized some practical challenges in implementing this principle. Instances where a transit agency had successfully implemented this principle in the United States or internationally could not be identified to guide implementation of this approach. Second, this principle runs counter to how Metro is designed. Although some failures are inevitable over time, engineers and planners do not design the system and its components with the intention of failing under certain circumstances.

Rather, Metro is implementing the underlying premise of safe-to-fail, but in a different way. The Metro system is a series of nodes and links designed so that if one node or link goes down, the system can still operate. Metro has emergency management plans, detour routes and best practices for dealing with situations where a key asset may become unusable. Metro staff continually learns from past experiences and improves practices based on those experiences. Without declaring any single asset safe-to-fail, Metro is already planning for how to handle situations involving failed assets.

Metro decided to remove the safe-to-fail principle from the framework because the Metro system is designed to handle failed assets. Moreover, the framework already supports this change. Within the technical indicators, the Redundancy Category captures whether alternate routes exist if regular routes are disrupted. The organizational indicators include a “Priority Routes/Structures to Manage First” indicator that allows Metro to identify the most critical parts of their system.

Weighting Indicators and Principles Equally

Metro planned to establish a weighting system similar to the one for technical indicators after the 2015 framework release. However, in examining this task, Metro determined that all principles should be weighted equally, as all are essential to be truly resilient. For the same reason, Metro determined that, within each principle, all the indicators should carry equal weight to ensure that a given principle is neither over- nor under-emphasized in the final score simply because that category has a different number of indicators.

To maintain consistency with the organizational indicators, the technical indicators have been restructured with equal weighting across principles and equal weighting of indicators within each principle.

Expressing Resiliency Scores as a Percentage

To make the information more intuitive to key users, dimensions, principles and scores are now expressed as a percentage rather than the previous scale of 1-4. However, at the indicator level, scores of 1-4 are still assigned, which reflects the measurement scales for each indicator.

Revising Indicators

Figure 2 below shows the updated framework structure, while Table 5 lists the updated resiliency indicators:

Figure 2: 2020 Framework levels

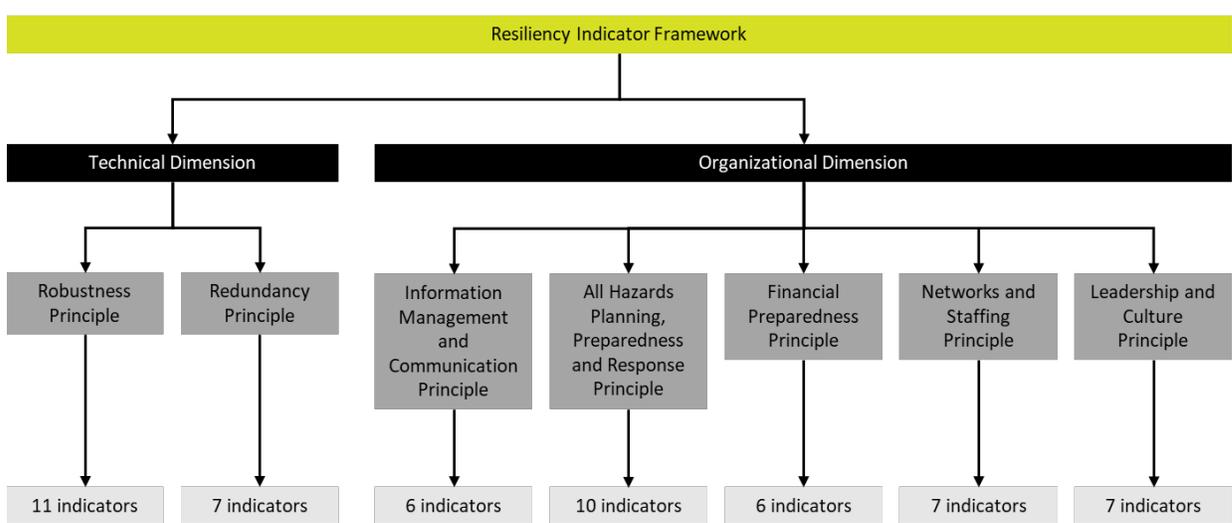


Table 5: Updated Indicators for Metro’s Climate Change Resiliency Framework

Technial	Organizational
Robustness	Information Management and Communication
R-01. Maintenance - Day to Day R-02. Maintenance - Post Incident R-03. Renewal/Upgrade (Long Range Plans) R-04. Design - Compliance with Current Codes R-05. Design - Condition of Asset R-06. Design - Vulnerability Assessment R-07. Design - Resilience Design Criteria R-08. Design - Overheating Standards R-09. Extreme Weather Repair Costs R-10. Supplier Utility Robustness - Awareness R-11. Supplier Utility Robustness - Improvement	I-01. Warnings and Public Awareness I-02. Communication Systems - Staff I-03. External - Public Awareness I-04. Sensors I-05. Data – Access to, and Maintenance of, Key Data Sets I-06. Information Security and Contingency Planning
Redundancy	All Hazards Planning, Preparedness and Response
RE-01. Alternate Route/Mode Availability RE-02. Alternate Route/Mode Capacity RE-03. Spare Capacity RE-04. Back Up Parts and Equipment RE-05. Re-routing and Communication Plans RE-06. Supplier Utility Redundancy - Awareness RE-07. Supplier Utility Redundancy - Improvements	A-01. Risk Assessment and Scenario Planning A-02. Tracking Incident-Related Injuries A-03. Tracking Essential Resources A-04. Priority Routes/Structures A-05. Emergency Management Plans - Existence A-06. Joint Planning A-07. Training/Drills – Offered A-08. Training/Drills/Tests – Completed A-09. Lessons Learned and Thinking Ahead A-10. Critical Energy and Supply Chain Provision
	Financial Preparedness
	F-01. Insurance Coverage F-02. Insurance Information F-03. Capital Availability F-04. Operational Funding F-05. Contingency Funding F-06. Modelling
	Networks and Staffing
	N-01. Internal Relationships N-02. Information Sharing – Internal N-03. Inter-agency Compatibility N-04. Business Continuity/Awareness N-05. External Information Sharing and Cooperation N-06. Roles and Responsibilities Identified N-07. Remote Response Ability
	Leadership and Culture
	L-01. Resilience is a Clear Priority of Metro Leadership L-02. Roles, Responsibilities and Goals L-03. Staff Engagement and Leveraging Knowledge L-04. Crisis Decision Making L-05. Mid/Long Term Decision Making L-06. Advance Agreements L-07. Approach to Projects

Earthquake Case Study

For the 2020 update, Metro conducted this case study using the organizational indicators. Because these indicators span the entire agency and do not revolve around a specific location or asset, Metro used a major hazard event as the basis for the case study to examine how resilient Metro is as an organization.

This case study is based on a theoretical earthquake similar to the 1994 Northridge earthquake occurring in LA today. The Northridge quake was a 6.7 magnitude earthquake that occurred in the San Fernando Valley early in the morning on January 17, 1994. It resulted in 57 fatalities, thousands of injuries, displacements and billions of dollars in structural damage. Metro did not experience any damage to the B (Red) Line rail infrastructure closest to the earthquake. However, Metro faced short-term changes in ridership throughout its bus and rail lines due to road and freeway closures, and it delivered enhanced service along certain corridors.²

Using this event as a basis for a case study was useful as many Metro employees remember the event, and even for those who were not employed at Metro at the time, there is considerable knowledge regarding this event and how Metro was affected.

1994 Northridge Earthquake Damage to a Freeway



Photo credit: Robert A Eplett³

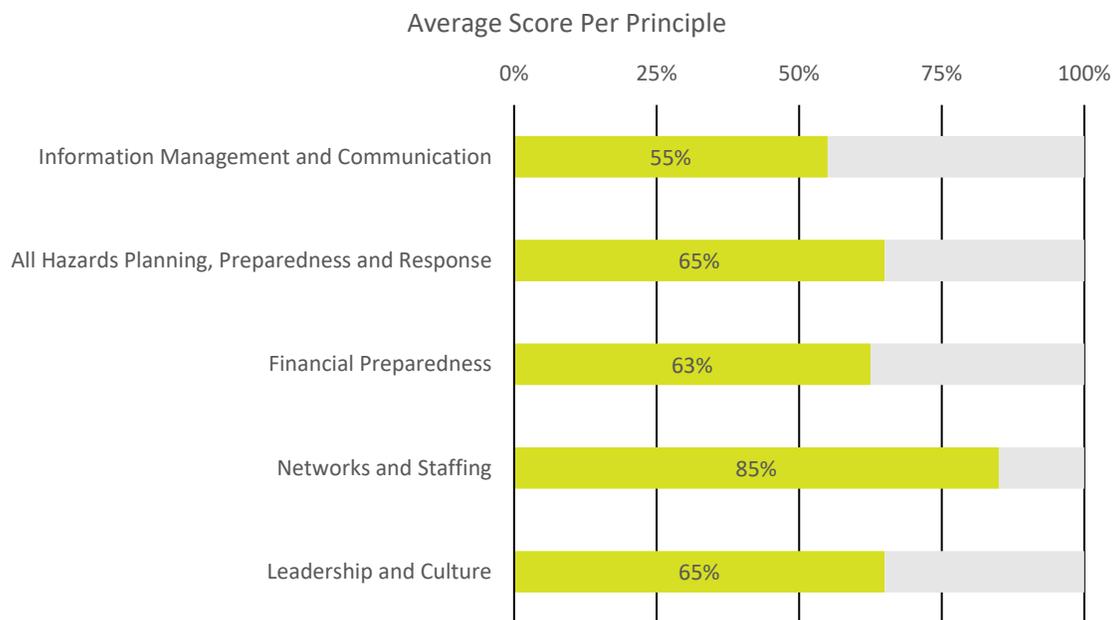
It is likely Los Angeles will experience earthquakes in the future. This case study reflects how much Metro has improved its resiliency since 1994 and to assess how resilient Metro's organizational processes would be to an earthquake of this magnitude if it were to occur now. To conduct the case study, Metro held an internal workshop and asked participants the following questions: *What if the Northridge earthquake were to happen in the near future? Is Metro's current system resilient against this event?*

² Metro. 1994. *Impact of Northridge Earthquake on MTA Service Delivery and System Patronage: 30 Day Progress Report*. Available at: <http://libraryarchives.metro.net/DPGTL/studies/1994-impact-of-northridge-earthquake-on-MTA-service.pdf>

³ Wikimedia Commons. 1994. File:FEMA - 1788 - Photograph by Robert A. Eplett taken on 01-17-1994 in California.jpg. Available at: https://commons.wikimedia.org/wiki/File:FEMA_-_1788_-_Photograph_by_Robert_A._Eplett_taken_on_01-17-1994_in_California.jpg

The primary purpose of the earthquake case study was to test the organizational indicators and their application to non-climate hazards. Participants went through the 36 organizational indicators and gave Metro a score for each, with justification for each score. Scores for each principle were averaged to determine overall scores that reflect how well Metro would fare against another Northridge earthquake, as shown below in Figure 3. Participants determined that in an earthquake situation, Metro is strongest in the category of Networks and Staffing and needs improvement in the category of Information Management and Communication.

Figure 3: Organizational principle scores for Northridge earthquake case study from workshop participants



Workshop participants felt the strengths in Networks and Staffing stem from well-defined roles and protocols and staff who are ready to respond if an emergency occurs. This is the case especially in the Operations Department. Participants recognized the high level of awareness of emergency processes in bus and rail operations, the Emergency Operating Center and processes related to Standard Operating Procedures.

Metro's staff indicated that improvements in communications during such an event would prove extremely helpful, particularly when interfacing with ridership and promoting public awareness. If disruptions occur in Metro service, making sure passengers are well-informed is critical. Participants recognized that Metro's current procedures for doing so could be improved.

Resiliency in a Broader Lens

When the Resiliency Indicators Framework was first developed in 2015, it was an important step toward evaluating and improving Metro's resiliency to climate change.

Since then, the state of knowledge in the field of resiliency has advanced. In particular, Metro recognized that being resilient—across a wide range of hazards, not just climate change—is important, and that increasing resiliency to one hazard often increases resiliency in another. Thinking about resiliency to all hazards—not just climate change—encourages more internal collaboration and integration, making the resilience-building process more efficient. Thus, this

2020 update will allow the framework to be used more broadly at Metro, and provide common ground for discussion about resiliency across departments and about more hazards.

As described in *Moving Beyond Sustainability*, Metro's strategic sustainability plan for the next decade, Metro will integrate and apply this framework into the Environmental Management System (EMS) process. The EMS supports Metro's environmental compliance program through creating a framework that helps ensure compliance with federal, state and local environmental regulations, pollution prevention and sustainability goals.