Vulnerability Assessments

A Discussion Paper about Community Resilience *June 2015*

Brief: Vulnerability Assessments are a specific consideration of community assets and whether or not they are likely to be impacted during anticipated or potential threats. This can include infrastructure - such as roads and bridges, water and sanitary sewer facilities and distribution systems, or critical structures such as hospitals, police and fire stations, and schools. By assessing and analyzing potential impacts, when they may occur, and the importance of the infrastructure under review, the community can determine strategies to address any specific concerns, as well as to prioritize those that are most important.

Problem

Whether it is because a community already experiences regular flooding events or any other impacts, or if it is preparing for new or increased impacts anticipated due to a changing climate, local governments and tribes care about infrastructure and providing for the safety of our community members, maintaining public and private property, staying connected to other communities in the region, and provision of public services before, during, and as soon as possible after storms or disasters.

Introduction

By considering existing infrastructure and the anticipated impacts a community will face, a vulnerability assessment can help identify weaknesses, areas of strength, options to address any concerns, and prioritize any needed improvements.

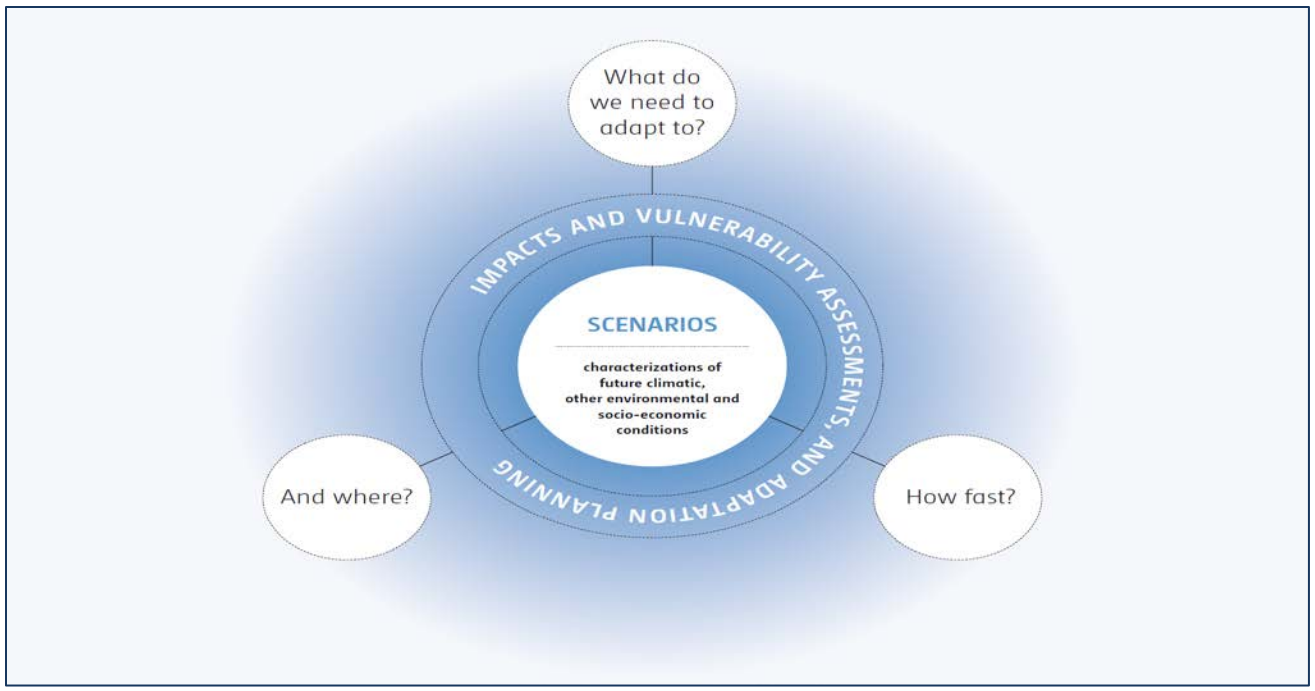
Vulnerability Assessments can look at a specific type of infrastructure or consider risks from certain types of impacts. For example, flooding may be the biggest concern for some cities or counties. They may focus their analysis to consider impacts from flooding on publicly owned infrastructure, public buildings, and transportation networks.

Other communities may want to assess all vulnerabilities in light of anticipated impacts from climate change, based on one or all of the scenarios considered in the University of Washington Climate Impacts Group reports for Washington State and the greater Pacific Northwest.

Still other communities may conduct specific studies or analyses to determine more detailed information regarding the impacts they are likely to experience.

The concept is fairly simple – anticipate which impacts are likely to occur and to what extent, where the impacts will happen, and what infrastructure and public services are likely to be impacted.

Source: WSDOT



Scenarios as essential inputs to impacts and vulnerability assessments and adaptation planning
Source: UN Framework Convention on Climate Change: Assessing Climate Change Impacts and Vulnerability: Making Informed Adaptation Decisions

Assessment Steps

Chapters 8 and 9 in Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments address the steps in conducting a vulnerability and risk assessment. The major steps include:

- Review and Supplement Important Climate Information
- Conduct Your Climate Sensitivity Analysis
- Evaluate the Adaptive Capacity Associated with Systems in Your Planning Areas
- Assess Your Climate Change Risks
- Establish Your List of Priority Planning Areas

The information gleaned from the assessment can be used to determine needs and prioritize investments to increase resiliency, identify areas where it is prudent to direct new growth, and areas that should be avoided or designated as open space or natural areas.

Source: WSDOT. A new box culvert replaced a small culvert on SR 542.

Infrastructure Investments

Over time, communities will analyze impacts to existing and planned infrastructure. And as modifications or new investments are made, consideration of impacts and life span of the investments will be considered, to make the best use of limited funds.

The Center for Sustainable Infrastructure, at The Evergreen State College, released a report "*Infrastructure Crisis, Sustainable Solutions: Rethinking Our Infrastructure Investment Strategies*" in 2014. The report provides an in-depth discussion of infrastructure and changes to consider in order to make these costly, long term investments more affordable, resilient, and sustainable. It includes several examples, many from the Pacific Northwest.

Examples

The **City of Olympia** has looked at the impacts of Sea Level Rise, high tide, and storm surges and how they may impact critical infrastructure near the shoreline.

Flood protection and shoreline enhancement through habitat design
Source: City of Olympia Engineered Response to Sea Level Rise

One of their findings has been that Sea Level Rise threatens to flow into stormwater outfalls and overwhelm the infrastructure. As a result, saltwater could flow up and out of the storm drains and cause flooding in parts of downtown.

The City addresses Sea Level Rise in its comprehensive and shoreline plans. Additionally, staff is working to develop specific plans to reduce the number of outfalls and to add backflow prevention devices at the outfalls.

The Federal Emergency Management Agency (FEMA) has been working with **Grays Harbor County** to assess the potential impacts of flooding and other disasters. The report, "*Risk Report (DRAFT) For Grays Harbor County including the Cities of Aberdeen, Cosmopolis, Hoquiam, Ocean Shores, Westport, Montesano, McCleary, Elma, and Oakville*" released October 2014, considers multiple potential events (e.g. flooding, tsunamis, earthquakes) and scenarios for impact on key infrastructure (hospitals, police stations, etc.). The report includes mitigation measures for each city based on their vulnerabilities.

In 2008 **King County** assessed the vulnerability of its major wastewater facilities from flooding as a result of sea level rise. They considered flooding impacts of approximately 40 facilities that are adjacent to tidally influenced water bodies. They found that more than 30 of these facilities are at risk of flooding from sea level rise. Recommendations included the need for more detailed analysis of site terrain for certain

facilities, an analysis of system hydraulics that will be impacted by sea level rise, considering sea level rise in planning for major asset rehabilitation or conveyance planning, and review of sea level rise literature every five years when updating the Conveyance System Improvement Program.

King County Wastewater Treatment Division Facilities Potentially Vulnerable to Sea Level Rise
Source: US GAO Report: Climate Change: Future Federal Adaptation Efforts Could Better Support Local Infrastructure Decision Makers

As part of a grant from the US Federal Highway Administration (FHWA), the Washington State Department of Transportation (**WSDOT**) conducted an assessment of state-owned facilities and assets. They worked with regional staff to identify areas where there were already problems and where additional problems were likely to occur with increased flooding or stream flows, etc.

According to FHWA[1], WSDOT "developed a structured, stakeholder-based approach to qualitatively assess facility risk. The project team held 14 workshops in all regions of the state. WSDOT staff rated all state-owned highways and other transportation assets for climate vulnerability. WSDOT is integrating the results of its vulnerability assessment into many areas of transportation decision making, including planning, environmental review, design, and asset management."

Sound Transit is investing millions of dollars in public transportation improvements. In order to protect assets and to assist in decision-making for continued investments, they conducted a vulnerability assessment.

In a presentation at the PNW Climate Science Conference, the recent project was highlighted. The presenters noted they found:

- Climate change will exacerbate many existing issues already facing Sound Transit
- The probability, timing, and degree to which climate change may affect Sound Transit will depend on many factors
- Many climate change impacts on Sound Transit services will likely be minor to moderate, although more significant impacts are possible
- Sound Transit already possesses some degree of climate resilience and capacity to address climate impacts

[1] http://www.fhwa.dot.gov/environment/climate_change/adaptation/adaptation_framework/resources/washington_state/

They also identified potential adaptation strategies, including:

- *Raise* sensitive ground-level infrastructure
- *Build* berms around sensitive ground-level infrastructure
- *Increase* visual & electronic monitoring of infrastructure in vulnerable areas
- *Move* or relocate infrastructure in hazard zones
- *Modify drainage patterns* to redirect flows, improve drainage
- *Add flexibility* by building in capacity to relocate, raise, or add higher capacity in future
- *Modify design standards* to provide higher level of flood & stormwater management, seepage management, and address heat impacts
- *Partner* with communities to target problem drains/drainages

The **Swinomish Tribe** prepared a vulnerability and risk assessment in 2009. They followed that up in 2010 with a Climate Action Plan. They face inundation of homes and cultural sites, as well as impacts to access and transportation facilities. Some of the regional impacts anticipated include:

- Short-term threat to connectivity and mobility (storm/surge)
- Long-term risk, potential isolation from mainland (sea level rise)
- Collective population of ~ 45,000 potentially affected
- Impacted communities – Swinomish, LaConner, Anacortes, Oak Harbor, Coupeville, etc.
- Impacted facilities – ferry terminals, services, refineries, Whidbey Naval Air Station

Additional Resources

Pacific Northwest Climate Change Vulnerability Assessment: http://www.climatevulnerability.org/

Climate Change Vulnerability Assessment Resource Center: http://www.dfg.ca.gov/Climate_and_Energy/vulnerability_assessments/

US GAO Report: Climate Change: Future Federal Adaptation Efforts Could Better Support Local Infrastructure Decision Makers http://www.gao.gov/assets/660/653741.pdf

Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments (Ch. 8 and 9 specifically) http://www.icleiusa.org/action-center/planning/adaptation-guidebook

King County Vulnerability of Major Wastewater Facilities to Flooding from Sea-Level Rise http://your.kingcounty.gov/dnrp/library/archive-documents/wtd/csi/csi-docs/0807_SLR_VF_TM.pdf

Preparing Your (Small) Community for Climate Impacts, by Mary L. Walsh

United Nations Framework Convention on Climate Change *Assessing Climate Change Impacts and Vulnerability: Making Informed Adaptation Decisions* (See summary of good practices and lessons learned in Table 4) http://unfccc.int/resource/docs/publications/pub_nwp_making_informed_adaptation_decisions.pdf

WSDOT Climate Impacts Vulnerability Assessment Report and Fact Sheet

US FHWA Climate Change Adaptation Case Studies webpage: http://www.fhwa.dot.gov/environment/climate_change/adaptation/case_studies/index.cfm

Sound Transit Climate Risk Reduction Project – Summary Findings presentation http://pnwclimateconference.org/2014presentations/Whitely-Binder.pdf

Washington Chapter of the American Planning Association webpage: Sustainable Washington 2009: Planning for Climate Change http://www.washington-apa.org/sustainable-washington

US Environmental Protection Agency (EPA), Climate Ready Water Utility http://water.epa.gov/infrastructure/watersecurity/climate/index.cfm

US EPA Climate Change Impacts and Adapting to Change, including impacts and adaptation by region or by sector, plus adaptation resources http://www.epa.gov/climatechange/impacts-adaptation/

US EPA Climate Resilience Evaluation & Awareness Tool (CREAT) http://water.epa.gov/infrastructure/watersecurity/climate/creat.cfm

US EPA Adaptation Strategies Guide for Water Utilities http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817k11003.pdf

Swinomish Climate Change Initiative Impact Assessment Technical Report http://www.swinomish-nsn.gov/climate_change/Docs/SITC_CC_ImpactAssessmentTechnicalReport_complete.pdf

Swinomish Climate Change Initiative Climate Adaptation Action Plan http://www.swinomish.org/climate_change/Docs/SITC_CC_AdaptationActionPlan_complete.pdf

Infrastructure Crisis, Sustainable Solutions: Rethinking Our Infrastructure Investment Strategies http://www.evergreen.edu/sustainableinfrastructure/docs/CSI-Infrastructure-Crisis-Report.pdf

Center for Sustainable Infrastructure http://www.evergreen.edu/sustainableinfrastructure/home.htm

City of Olympia Engineered Response to Sea Level Rise http://olympiawa.gov/community/sustainability/~/media/Files/PublicWorks/Sustainability/Sea%20Level%20Rise%20Response%20Technical%20Report.ashx