CAUSE V Experiment Design Document

Draft – May 2017

Introduction

The Canada-United States Enhanced (CAUSE) Resiliency experiment series is a collaborative effort between Defence Research and Development Canada's Centre for Security Science (DRDC CSS), Public Safety Canada, and the United States (US) Department of Homeland Security (DHS) Science and Technology (S&T) Directorate First Responders Group. The current iteration of the experiment, CAUSE V, will be conducted along the border between the Canadian province of British Columbia (BC) and the US state of Washington (WA).

The experiment is scheduled to be held on November 15-16.

Primary Objectives

The primary objectives of CAUSE IV are to measure progress and validate the Canada–U.S. BTB Action Plan goals and activities related to communications interoperability. Specifically, the experiment plans to address the following objectives:

- Examine smart alerting capabilities, by integrating LTE-enabled real-time monitoring sensors with existing local, state and provincial alert and warning systems;
- Leverage LTE networks to create a common operating picture to enhance decision making and increase the ability of various EOC's and other agencies to receive information from all responding agencies;
- Provide live, or near real time data and imagery from the field leveraging robots and human to Common Operating Picture (COP) applications in EOC's via LTE network;
- Explore the use of digital volunteers to support emergency operations;
- Test the Pacific Northwest Emergency Management Arrangement (PNEMA) for state-to-provincial mutual aid requests leveraging the EMAC Operating System;
- Test the process for moving specialized resources and personnel across the Canada-U.S. border and expediting the pre-vetting process.

The experiment will weave together threat and hazard modeling, mutual aid pre-planning, public alerting, notification, and warning. A next generation public safety broadband / FirstNet-type capability will be established to provide the network for first responders to communicate (voice + data) in the field, and from the field to the EOC using hand-held devices.

Participants will leverage a public safety broadband network capability, which will enable first responders in the field to maintain voice/data communications independent of the commercial cellular network. Smart alerting will be tested, by integrating seismic sensors with local alerting capabilities to send geo-targeted alerts to citizens most at risk, as well as the appropriate first responders. Participants will leverage an online information sharing platform, where stakeholders can share and access essential, real time information pertaining to the incident location. Data collection for this

online platform will be gathered and compiled from various existing sensor-type data, including live-feeds obtained by aerial UAVs/robots, hydrologic sensors, and seismic sensors located on Mt. Baker. In addition, locations of field personnel and critical infrastructure will be included in the common operating picture.

Experiment Description

This document will describe the processes that will (or may) be explored during the following distinct phases of the experiment based on a Sherman crater collapse scenario:

- Planning and Baseline Monitoring
- Initial Event: Alert & Warning
- Response
- Recovery

CAUSE V Scenario

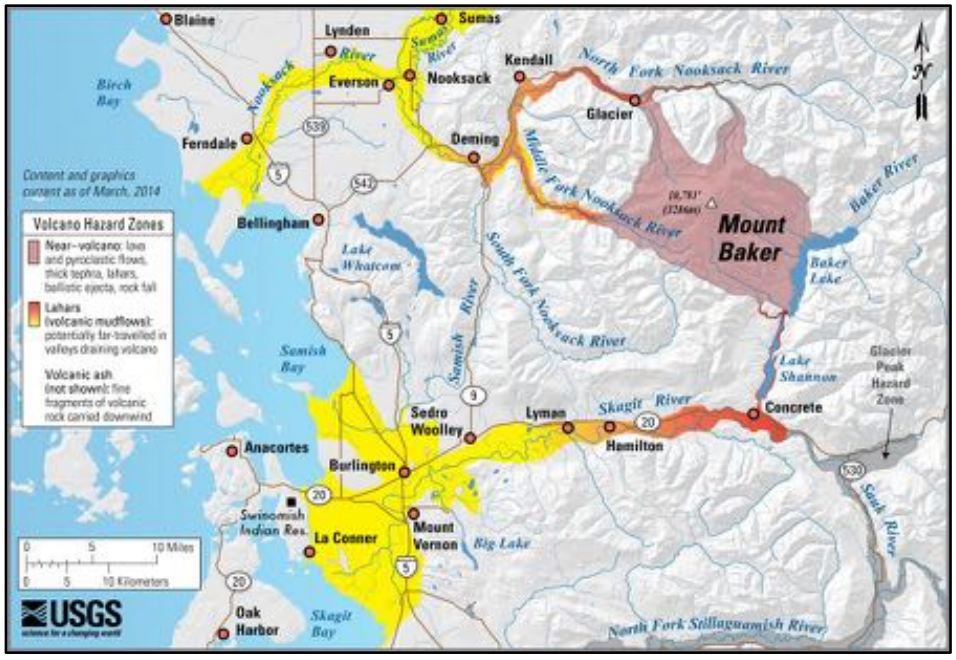
Unrest begins in early August when campers at Baker Lake campground report smell of rotten eggs. Prompts Cascades Volcano Observatory (CVO) gas flight that shows increased CO_2 and H_2S from the volcano and increased thermal activity. However, earthquake activity low and no sense of deformation, so big question is whether this is a repeat of 1975-1976 unrest or something different. However, based on thermal and gas anomaly, CVO raises alert level to Advisory/Yellow.

Between mid-August and early October, CO_2 fluctuates between 900-8,000 t/day with little earthquake activity of deformation. Early Oct, first major earthquake swarm. CO_2 increases sharply and first good SO_2 measurements. Earthquakes ramp up, but not at the level of MSH in 2004 and nowhere near as large as 1980 MSH (most under M2.0). Winter is beginning with some snow in mountains down to 3,000 feet.

November 5th, first steam-and-ash emission: lasts 8 minutes, winds are to the east, barely dusts dams. Two days later, NWS forecasts an atmospheric river hitting the area. Some folks become confused with the terminology of the Weather Service's and volcano alert levels. Others hear that a lahar is forecast.

November 9-11th, atmospheric river hits the area. Major flooding on Nooksack River that spills over at Everson and through Sumas into Abbotsford – not as destructive as the 1990 flood, but still a pretty good flood. Again, some panic as some folks think flood is the lahar.
During atmospheric river, some indication that another steam-and-ash emission has occurred, but difficult to tell because of all the noise on the seismometers.

U.S. Thanksgiving Day (Nov. 23), beautiful clear, cold day and large vapor plume over the volcano seen by residents from Vancouver, B.C. to Mount Vernon. At 2:30 p.m., 20-minute steam-and-ash emission. Winds north-northwest, puts two mm of ash on Abbotsford airport. Afterward a couple-hour pause, seismicity really ramps up. Limited views and with all the snow, appears that some avalanching off glaciers near Sherman Crater occurs and perhaps appearance of a crack on west side of Sherman Crater. Over next two weeks have 6 more steam-and-ash emissions, all smaller than the first one and most going east to northeast. Volcano continues to show signs of restlessness, but no more steam-and-ash-emissions after 7 December.



December 20, flank failure of west and southern portions of Sherman Crater wall sends lahar down Middle Fork Nooksack. Due to aggradation during flood in early November and log jams, 70% of lahar goes north into Sumas valley, 30% downstream. Part of the lahar also goes down Sulphur Creek into reservoir, but relatively small volume. 12 hours later, east portion of Sherman Crater collapses down Boulder and Park Creeks transforming to lahars that enter Baker reservoir. Almost immediately after, a 3-hour eruption sends tephra to the east. High winds result in narrow plume that funnels plume towards Ross and Diablo Dams.

The crater collapse will cause extensive damage in both WA and BC, which will require response from numerous response agencies. The event is responsible for millions of dollars of property damage and significant loss of life, and recovery efforts will span from months-years.

Cities/Towns impacted:

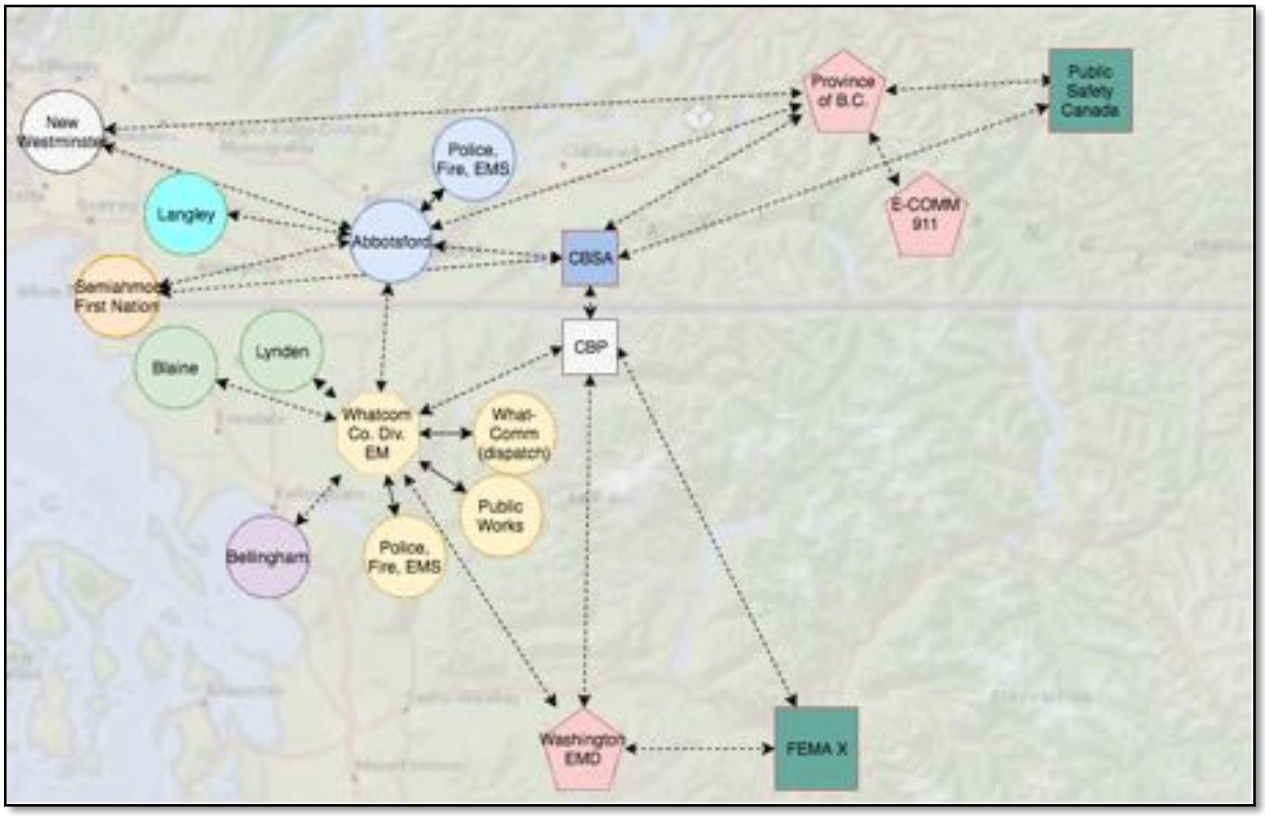
- Glacier
- Kendall
- Deming
- Nooksack
- Sumas
- Everson
- Abbotsford
- Bellingham
- Vancouver

Impacts

The lahars resulting from the Sherman Crater Collapse have the following impacts:

- # Fatalities
- # minor and # serious injuries
- # homes and other structures lost
- Impact to cellular towers
- Impact to local hospitals, schools, nursing homes, and shelters
- Impact to hydropower facility at Baker Lake and Lake Shannon.
- Loss of power in Glacier, Deming, Everson, Nooksack, Sumas, Lynden, Ferndale and Abbotsford.
- Loss of commercial cellular service to the affected area due to stressed network.
- Loss of PSBN service to the affected area because PSBN share same cell sites as the commercial operators

Figure 1. Diagram representing Information Sharing pathways for Jurisdictions (Actors) involved in CAUSE V (NOTIONAL ONLY – NEEDS participants input)



Experiment Capability Needs

The capability needs identified below do not represent all the capabilities that would be required to plan for, respond, or recover from a volcanic incident, but rather the specific capabilities that will be considered for the experiment.

Situational Awareness

SA1. The ability to visualize the location of regional threats and hazards and critical infrastructure.

SA2. The ability to monitor real-time data from sensors in the incident scene and surrounding area (e.g., stream gauges, seismic sensors, etc.).

SA3. The ability to obtain critical information about the extent/perimeter of the incident

SA4. The ability to model and/or predict future characteristics of the incident

SA5. The ability to visualize information shared by first responders in the field in a common operating picture.

SA6. The ability to access real-time / near-real time photos or videos pertinent to the incident scene.

SA7. The ability to geolocate responders and emergency vehicles on the incident scene.

SA8. The ability to identify other pertinent information to the incident scene and add it to the common operating picture.

Communications and Information Sharing

CIS1. The ability to monitor social media during an incident to inform operations and investigations.
CIS2. The ability to maintain resilient communications systems in urban and rural areas.
CIS3. The ability to issue clear alerts and warnings to the public before, during, and after incidents.
CIS4. The ability to communicate with affected civilians and casualties on the incident scene.
CIS5. The ability to share information in real time among services and agencies.
CIS6. The ability to ingest, assess, and manage data from multiple sources.
CIS7. The ability to disseminate clear direction and tasking to responders on the incident scene, regardless of agency or service.
CIS8. The ability to access data and information (e.g. voice, text, images, video) on the incident scene, including from overhead aircraft/UAVs/robots.

Logistics and Resource Management

LRM1. The ability to pre-plan resource requirements and mutual aid agreements.
LRM2. The ability to coordinate resources needs across agencies and services.
LRM3. The ability to manage mutual aid resources on the incident scene.
LRM4. The ability to identify, acquire, and track resources sufficient for the size and scope of response activities.
LRM5. The ability to pre-vet personnel and resources requiring passage through border security.
LRM6. The ability to confirm credentials and training certifications for responders arriving on scene.

Risk Assessment and Planning

RAP1. The ability to conduct standardized cross-border assessments of threats, hazards, and risks related to a volcanic hazard.
RAP2. The ability to develop plans based on threat, hazard, and risk assessments, including the development of pre-scripted mission assignments.

Planning and Baseline Monitoring

The planning stage will involve evaluating existing risk assessments and hazard mitigation plans for the region, addressing the types of capabilities that would be required for the local communities to respond to a volcanic hazard. Geospatial data depicting the areas at risk from volcanic events will be gathered from subject matter experts and shared through a common platform (e.g., ArcGIS Online). The Mutual Aid Resource Planner tool, developed by DHS S&T First Responder Group, will be used to assist in developing pre-scripted resource plans representing local, state, federal, tribal, non-profit and private sector partnerships.

This stage will also cover baseline monitoring of situational awareness, including local volcanic activity.

Assumptions	*TBD*
Tech Dependencies	• ArcGIS Online • Mutual Aid Resource Planner • Incident Action Planner • Other?
Information/Data Dependencies	• THIRA • Mitigation plans • Resource Inventories • Mutual aid resource plans • Seismic Sensors • Other?

Actors	• Whatcom County DEM
	  ○ Planning
	  ○ GIS/IT
	• State of Washington EMD
	  ○ Planning
	• City of Abbotsford
	  ○ Planning
	• B.C. Province
	  ○ Planning
	• Semiahmoo First Nation
	  ○ Planning
	• USGS / Cascades Volcano Laboratory
	• Other?


Planning
Other U.S. Stakeholders
Whatcom County Unified Emergency Mngt.
Abbotsford
Other Canadian Stakeholders
Convene local and county planners
Convene local and district planners
Provide local input
Review/Revise Hazard Mitigation Plans
Review/Revise Hazard Mitigation Plans
Provide local input
Develop / aggregate geospatial data inventory for volcanic hazard
Develop Resource Need assumptions
Develop Resource Need assumptions
Review Plan
Develop shared cross-border resource plan using the Mutual Aid Resource Planner
Review Plan
Agree upon final resource plan
Determine cross-border information sharing requirements for stead-state monitoring
Steady-state monitoring
Steady-state monitoring

Alert and Warning

Increased volcanic activity on Mt. Baker will activate the Mt. Baker Coordination Plan, which will include establishing a temporary USGS Volcano Observatory at the Whatcom County Unified ECC to increase the volcano monitoring and establish close contact with emergency managers. Volcanic unrest can occur well in advance of the actual crater collapse. During this period, emergency managers will coordinate on ensuring accurate and clear public notifications are distributed through the appropriate channels.

As a large seismic event triggers a collapse of the Sherman Crater, sensors on Mt. Baker operated by USGS and the Pacific Northwest Seismic Network (PNSN) will initiate the emergency alert process. Whatcom county and nearby communities will receive notification, and based on the severity of the event will initiate their alert and warning process. An alert message will be relayed to other official notification groups, including EM officials, border security agencies (i.e., CBP and CBSA), and citizens (via IPAWS EAS and WEA alerts, as well as opt-in systems like AlertSense).

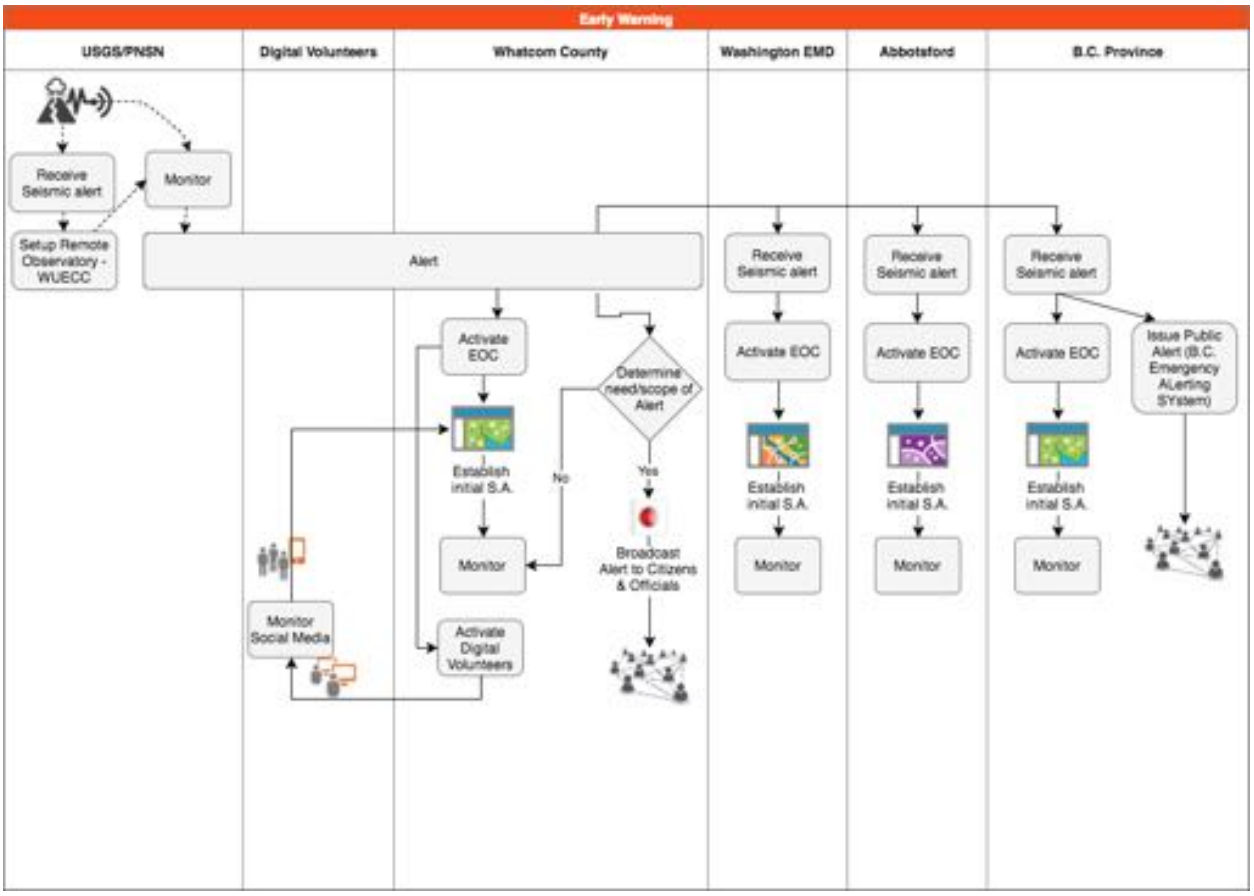
After the initial volcanic event, the alert/warning system will continue to be utilized to keep the public aware of new threats as they emerge (e.g., flooding, power outages, road closures resulting from lahars).

Digital Volunteers may play a role in the alert and warning phase, by amplifying information provided by official sources and monitoring social media for misinformation.

Assumptions	• Current configuration of seismic sensors will be in place during the event (Baker west, Ski area, and regional seismometers) • Communities will not be equipped with sirens • The communication system will not be disrupted by the ash cloud
Tech Dependencies	• AlertSense (Whatcom County) • BC Emergency Alerting System / Alert Ready (British Columbia) • ArcGIS Online • FEMA IPAWS • Incident Action Planner • *Other?*
Information/Data Dependencies	• Pacific Northwest Seismic Network (PNSN) operates 2 sensors located on Mt. Baker • USGS Stream gauges • FEMA IPAWS Service (JITC)

Actors	• Whatcom County
	  ▪ Dispatch; Communications
	  ▪ Emergency Management

- State of Washington EMD
  - Dispatch; Communications
- City of Abbotsford
- B.C. Province
  - E-COMM 911
- USGS; PNSN
- U.S. Forest Service
- Digital Volunteer teams
- Other?



Response

The response phase will begin immediately after detection of the seismic event, triggering the activation of Whatcom County EM. Reports from affected populations are received by 911-dispatch, as well as through social media channels indicate the fast-moving lahars in the Nooksack valley are causing extensive structural damage. Reports of homes being torn from their foundations and swept away, major damage to roads.

The response component of the experiment will be broken into the following subsections:

- Local Government Activation
- Tactical Response Operations
- Mutual Aid
- Digital Volunteer Support
- Damage Assessment

Local Government Activation

Whatcom County EM activates the Unified ECC, issues a local state of emergency, and subsequently issues evacuation orders for Sumas. Evacuation orders are relayed through the county's AlertSense program to citizens. Notifications are sent to a pre-identified notification group consisting of first responders and emergency management staff from neighboring areas (e.g., City of Bellingham, Skagit County, and the City of Abbotsford), the State of Washington EMD, and border services (CBSA, CBP). Initial situational awareness is established via the common operating picture by visualizing the seismic event and by defining the initial incident scene.

Assumptions	• Current configuration of seismic sensors will be in place during the event (Baker west, Ski area, and regional seismometers) • Communities will not be equipped with sirens • The communication system will not be disrupted by the ash cloud • Actors not participating in the experiment will be played by the SimCell
Tech Dependencies	• AlertSense • AlertReady • ArcGIS Online
Information/Data Dependencies	• Evacuation boundaries • Incident scene boundary • Sensor data (hydrologic, seismic) • IDs for first responders crossing border

Actors	• Whatcom County
	  ○ 911 Dispatch
	  ○ Communications; Public Alerting
	  ○ Evacuations

- City of Abbotsford
- City of Blaine
- City of Langley
- B.C. Provincial Gov't
- State of Washington
- Canada Customs and Border Security Agency (CBSA)
- U.S. Customs and Border Patrol (CBP)
- Kinder Morgan
    - Emergency Services
- Semiahmoo First Nation

Commercial cell networks have been affected, text messages will transmit but voice calls are not going through. An experiment public safety broadband network has been established along the border. First responders leverage experimental PSBN/FirstNet –compatible handheld devices to communicate with their own agency, other jurisdictions on-site, and with incident command. Incident command and the Whatcom County EOC also communicate over this network.

County, state, and provincial resources arrive next to set up temporary shelter, medical, and morgue facilities. The State of Washington and Province of British Columbia activate their Emergency Operations Centers. The Whatcom County EOC coordinates with Red Cross to set up food/water distribution centers, establish logistics and security for the staff and supplies, and set up "missing persons" registration sites.

Tactical Response Operations

Local first responders are the first to arrive at the scene to establish incident command, begin preliminary search and rescue operations, evacuations, and administer first aid. County utility workers are dispatched to shut off gas, water supply, and electrical power in the damaged areas. First responders can access situational awareness on their LTE devices in the form of online maps showing relevant information about the incident site. In addition, first responders can submit field reports, including photos and videos, to incident command and the EOCs.

Assumptions	• The communication system will not be disrupted by the ash cloud. • Actors not participating in the experiment will be played by the SimCell
Tech Dependencies	• PSBN/FirstNet type Wireless Capability • ArcGIS Online • Incident Action Plan
Information/Data Dependencies	• Location/status of critical infrastructure • Transportation status

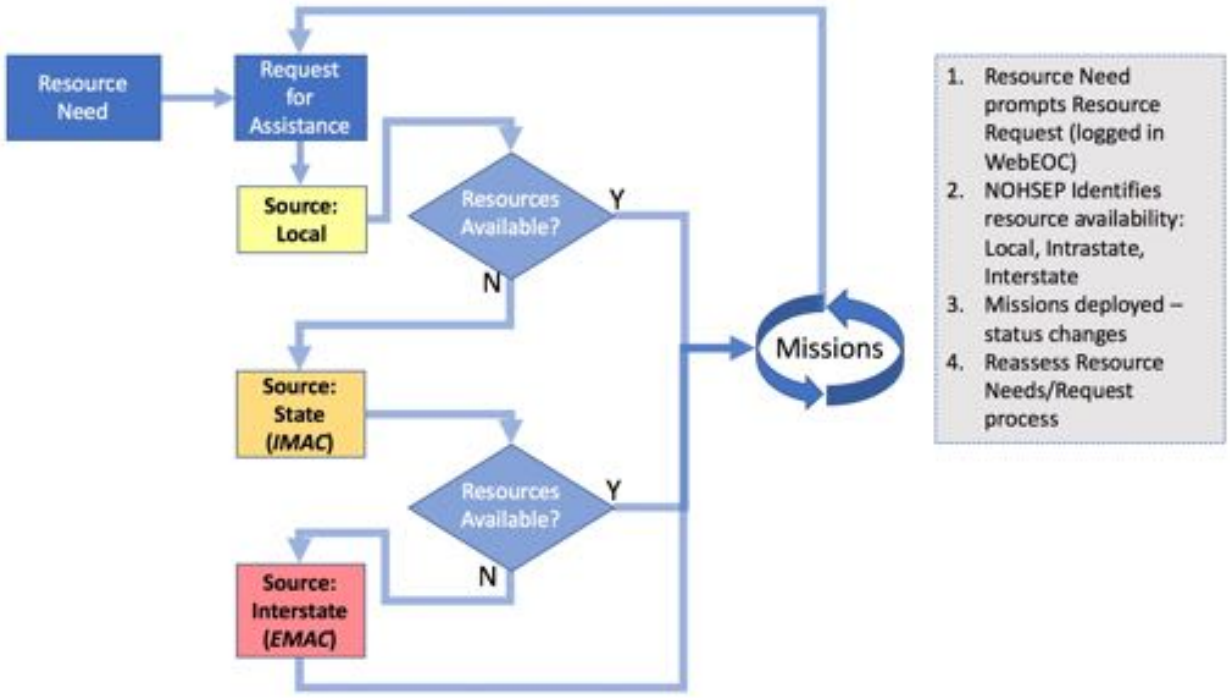
	• Communication status • Shelter status • Sensitive population data (e.g., dialysis)

Actors	• Whatcom County
	  ○ 911 Dispatch
	  ○ Fire Services; Search and Rescue
	• City of Bellingham
	  ○ Fire Services; Search and Rescue
	• City of Blaine
	• City of Langley
	  ○ Emergency Management
	  ○ Digital Volunteers
	• City of Lynden
	  ○ Police Department
	• City of Abbotsford
	  ○ Fire Services
	• City of New Westminster
	  ○ Fire Services

Mutual Aid

The requests for mutual aid will build upon the work done in the Planning Stage that defined the resource needs and partners for Whatcom County's pre-scripted mission needs for an incident on Mt. Baker.

Resource requests will be staged at various levels, initiating local mutual aid agreements, the State of Washington's Mutual Aid System (WAMAS) the interstate Emergency Mutual Aid Compact (EMAC), provincial mutual aid through Emergency Management Mutual Aid (EMMA) and state-provincial mutual aid through the Pacific Northwest Emergency Management Arrangement.



Assumptions	• Local, interstate, and cross-border mutual aid will be required during the response/recovery phases of the Sherman crater collapse scenario.
Tech Dependencies	• Incident Action Plan • WAMAS (WebEOC) • EMAC Operating System/MASS 2.0 • *Other?*
Information/Data Dependencies	• Resource Inventories • Mutual Aid /Resource Plan • MRPs / resource requests • Mission tracking information
Actors	• Whatcom County • Abbotsford • State of Washington • B.C. Province

Resource Needs:

The following vehicles and equipment are required for response activities within the first 72 hours after the event:

- # Fire apparatus
- # bulldozers
- # excavators

- # ambulances
- # helicopters
- # police cars
- # SAR command and support vehicles
- # skidders and water tanks
- # public works vehicles
- # utility vehicles
- # vehicles for personnel transport
- # water tenders
- # coroner vehicles
- # digital volunteers
- # robots/UAVs

Damage Assessments

Because the heavy ash cloud has grounded aircraft, a UAV/Aerial robot is deployed by Whatcom County to provide overhead reconnaissance of the scene, which is transmitted real-time to EOCs in Whatcom County, the State of Washington, the Province of British Columbia, and the city of Abbotsford.

Analysts in the EOC monitor real-time, and previously recorded video, aerial photos, and other remotely sensed data to map the extent of the affected area, as well as damaged infrastructure.

Damage assessment teams are deployed to collect reports on the ground of damaged and/or destroyed buildings, roads, bridges, and other infrastructure. Reports submitted by the assessment team is visualized back in the EOC.

Assumptions	• The communication system will not be disrupted by the ash cloud • Actors not participating in the experiment will be played by the SimCell
Tech Dependencies	• PSBN/FirstNet type Wireless Capability • ArcGIS Online • Incident Action Plan • Aerial robot / UAV capability
Information/Data Dependencies	• Location/status of critical infrastructure • Sensor data (hydro, seismic, vehicle tracking, personnel, etc.)
Actors	• Whatcom County ○ Damage assessment, recovery • City of Abbotsford

Digital Volunteer Support

Digital volunteers activated on both sides of the border (*Whatcom County and City of Langley, B.C.- TBD*) provide support to EOCs by monitoring social media for predetermined lanes of information (e.g., life/safety issues, transportation, utility, general damage, and misinformation) and reporting relevant information using specialized reporting forms. The digital volunteers can also support identifying important information contained in the aerial still and video footage collected by UAVs and other sources.

Assumptions	**TBD**
Tech Dependencies	• ArcGIS Online • Access to social media, traditional media sources • Tools for vetting social media
Information/Data Dependencies	TBD
Actors	• Whatcom County ○ CERT/Digital Volunteers • City of New Westminster

Recovery Phase

The recovery stage of the experiment will include a short table-top discussion of recovery planning activities.

References

MOUNT BAKER-GLACIER PEAK COORDINATION PLAN: Coordinating efforts between governmental agencies in the event of volcanic unrest at Mount Baker or Glacier Peak, Washington. 2015. http://bit.ly/2pa2Nip.

Mount Baker / Glacier Peak Coordination Plan: Coordinating efforts between governmental agencies in the event of volcanic unrest at Mount Baker or Glacier Peak, Washington. August 2012. Prepared by the Washington Military Department, Emergency Management Division https://on.doi.gov/2omq1Lk.

Potential Volcanic Hazards from Future Activity of Mount Baker, Washington. 1995. Cynthia A. Gardner, et. al – USGS. https://pubs.usgs.gov/of/1995/0498.

Is Mount Baker a hazard for Canada? 2016. Natural Resources Canada. http://bit.ly/2pyuopp.

Capabilities mapped to Technologies for CAUSE V

(Notional Only – to be vetted through technical working group meetings)

Capability	Incident Action Planner	AlertSense (Whatcom Co.)	AlertReady (B.C.)	ArcGIS - COP	Field Data Collection App	WASEOC (WebEOC)	Twitter Clicker	EMAC Operating System (EOS)	Surveillience Robots	FirstNet/PSBN Wireless	Mutual Aid Resource Planner
SA1											
SA2											
SA3											
SA4											
SA5											
SA6											
SA7											
SA8											
CIS1											
CIS2											

Capability	Incident Action Planner	AlertSense (Whatcom Co.)	AlertReady (B.C.)	ArcGIS - COP	Field Data Collection App	WASEOC (WebEOC)	Twitter Clicker	EMAC Operating System (EOS)	Surveillance Robots	FirstNet/PSBN Wireless	Mutual Aid Resource Planner
CIS3											
CIS4											
CIS5											
CIS6											
CIS7											
CIS8											
CIS9											
CIS10											
CIS11											
CIS12											
LRM1											

Capability	Incident Action Planner	AlertSense (Whatcom Co.)	AlertReady (B.C.)	ArcGIS - COP	Field Data Collection App	WASEOC (WebEOC)	Twitter Clicker	EMAC Operating System (EOS)	Surveillience Robots	FirstNet/PSBN Wireless	Mutual Aid Resource Planner
LRM2											
LRM3											
LRM4											
LRM5											
LRM6											
RAP1											
RAP2											