

2025 Helena Valley Earthquake sequence



February 14 (Friday), 2025

Weather/Time/Date: High of 20°F; A recent winter storm deposited 1 foot of fresh snow in mountains; an incoming cold front is expected to arrive that night and remain for a few of days with lows dipping to -25°F.

- 8:15am: All K-12 kids are inside classrooms throughout Helena School district.
- 8:30-9:30am: Most staff and students arrive on campus at Carrol College
- 10:00 am: Most business and offices are now fully staffed and people are indoors. Legislature at the State Capitol is in session.
- **10:20 am: A strong earthquake occurs in the Helena Valley**

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Initial Shaking (0-30 secs)

- **People feel strong to severe shaking throughout the city:**
 - Many ceiling light fixtures and shelves fall down. In some buildings, non structural roofs collapse. Windows shatter. In downtown buildings, parapets and cornices fall onto sidewalks. Parts of historic brick buildings collapse...
 - Teachers tell all students to drop/cover and hold on.
 - In downtown, many people run outside.
 - In many commercial stores, people start taking videos of falling objects and post on social media.



[Link to video](#)



Panel Discussion Notes

Helena schools participate in drop, cover, hold on; this year more than in years past
School safety officer (Neal M.) plans to make this a mandatory practice in all schools

Whether or not schools participate in Great Shakeout seems to depend on who is in charge
Frustrating to fall short of opportunity – which school officials are qualified to check building to determine if it's compromised?

- what do you do with a bunch of school kids?

- some evacuation sites are older than schools – need to identify other evacuation sites

Shakeout “plus 1” – non-structural hunt: teacher points to things around classroom, what things could fall? Follow through with more than just getting under desk

Fire safety: stop, drop and roll – kids preach to parents and it catches on
do same with EQs – is that TV strapped down, etc.

Which schools participate? Or offices?

Most dangerous thing during EQ is falling debris

Injuries to people walking around in stores

First evidence of EQ is on social media...news picks this up quickly

Panel Discussion Notes

In areas with a lot of earthquakes and preparation, do they take cautions against things in shelves in big box stores?

These things are often so heavy they don't fall

Can add netting so boxes don't fall; can put a lip on shelves, e.g. in liquor stores, to prevent mess

What was magnitude of Lincoln EQ? → 5.8
biggest EQ since Hebgen Lake
centered 30 miles SE of here

In Bay area, scientists farm tweets about EQs to produce a preliminary location more quickly than they can calculate from waveforms

Phone and apps might be helpful way to go – they contain accelerometers – cheap, everyone has them

EEW is geared towards automated processes (valve shutoffs, transportation, etc) – won't help PEOPLE

EQs are less predictable than other hazards which you can see coming to an extent

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Initial Detection (30-60 secs)

- Surrounding seismic network detect strong P and S waves
- Surrounding towns (Butte, Anaconda, Lincoln, Boulder, Townsend) feel moderate shaking but not immediate damages.
- Earthquake shaking is felt by MBMG staff in their offices, who react by dropping/covering/holding on.
- MBMG staff right away know that a potentially significant earthquake just occurred in SW Montana or from surrounding parts of Idaho or Yellowstone.
- Mike Stickney runs to the Earthquake Studies Office and looks at the first detection of large P and S wave, and estimates it occurs near Helena!
- Seismic software at the Earthquake Studies Office provides a preliminary hypocenter location and magnitude: Mw 6.3, 3 km north of downtown Helena at a depth of 10 km

Panel Discussion Notes

USGS posts location within minutes

Can we get more info more quickly than USGS?

- maybe if sitting at desk...it would be a race

- MBMG solution might be different than USGS

- USGS has 24/7 staff

USGS has worked very hard to post solutions rapidly; but not so rapidly that they have to make big changes in location or magnitude

- if they said it was a 6 and it was actually a 6.5, lots of people upset

- goal is to get good answer as quickly as possible and not have to refine too much

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Initial Detection (<10 mins)

- MSRN and seismic software at the Earthquake Studies Office provide preliminary information of location and size:
→ Mw 6.3, 3 km north of Helena, and 10 km depth
- USGS provide similar preliminary solution on their website but slightly different solution (Mw 6.0, 7 km north of Helena, and 12 km depth)
→ Moment tensor solution indicates slip on a NW-trending normal fault
- Hundreds of posts on social media shows videos and tweets about the earthquake (Twitter, Facebook, etc.)

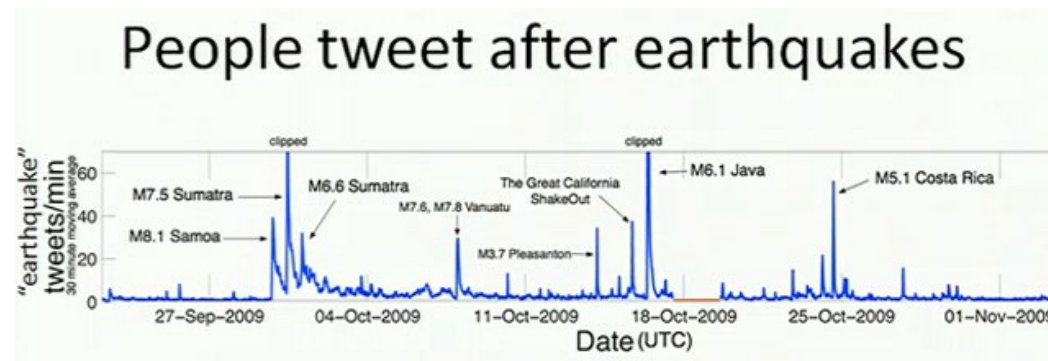


Image by Paul Earle (USGS)
via wired.com

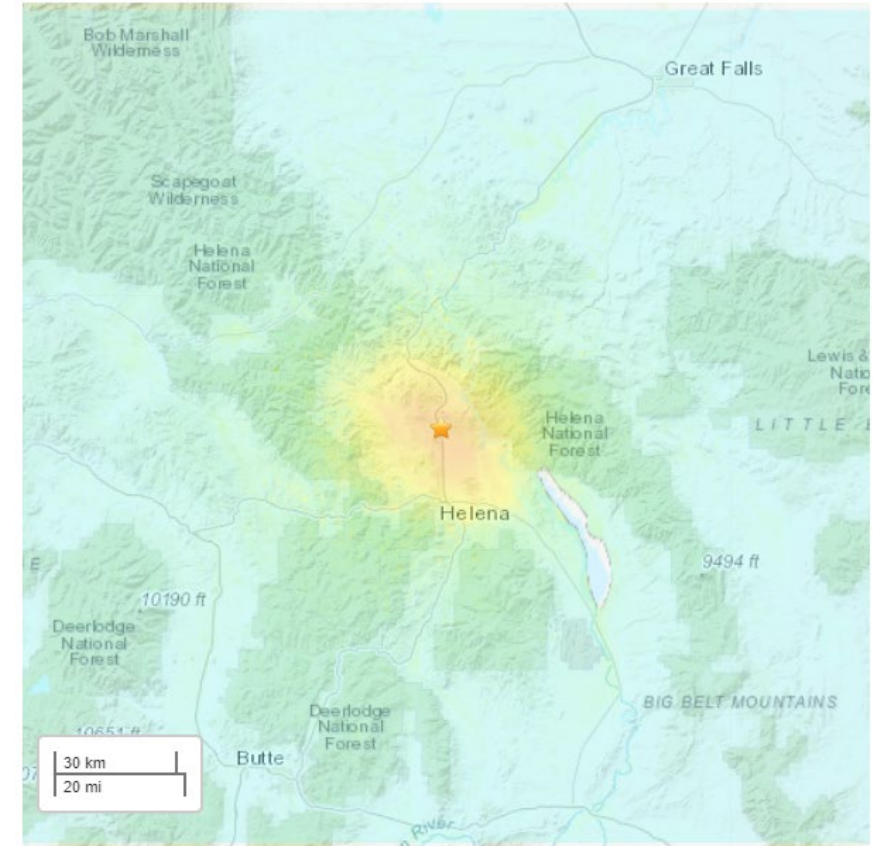
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Initial Public Reports (15-20 mins)

- USGS releases **Shakemap** product of the Helena Valley Earthquake
 - Predicts Shaking intensity, ground acceleration, and damages
 - Many people report on the “Did you feel it?” website
- USGS provide similar preliminary solution on their website but slightly different solution (Mw 6.0, 7 km north of Helena, and 12 km depth).
- Earthquake Studies Office/Mike Stickney receive numerous phone calls asking for information and press interviews.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Panel Discussion Notes

Does FEMA/USGS automatically send ShakeMap, PAGER, etc. to MT DES?

can have this information automatically delivered – should improve this connection

Shakecast – USGS – actively notifies agencies about expected damages/losses to bridges, etc.

Shakecast – kind of like a mini PAGER – can also use building inventory

helps people figure out where to inspect

Shakecast is automatic, free

Would be helpful for Dave (?) from USGS to give overview of this

Obligation to call FEMA region 8

Cell system gets inundated locally

Calls going out are easier; calls coming in don't always come through

If there is a big quake, cell towers may be damaged

Flooding a compromised system

Communication is really important

In a lot of MT, dead zones, no communication

Landlines not affected by cell network jams

Panel Discussion Notes

1959 Hebgen Lake EQ – some of first communication about EQ was via HAM radios

DES's first call aside from getting as much local info – reach out to federal govt for help – FEMA – get support
locals will be telling us what they need immediately
resources taken care of through local or federal govt
before damages though: what happened??

DES looks to social media for level of impact

MBMG communicates seismic data to USGS

if you can't get ahold of Mike, you can contact USGS

Ed – district field officer – contact with locals

COW – temporary/mobile cell tower – not a conversation in first 10 min of event
something to plan out ahead of time

In social media world – important to get accurate info right away – want it to be CORRECT information to develop repair
if we screw it up, then they don't trust us; they're trying to cover stuff up

Panel Discussion Notes

In Magna, misinformation about the next one being a M 9

high level, well connected people feeding this info to public

astounding how quickly (baseless) misinformation can be spread and catch people's attention

some of this is malicious

Important to have a place where people can be directed → clearinghouse

explains geology, explains what's going on

Lots of apps that provide information right away

need to know where to look for this though

Shakecast is important because it pushes the data to you automatically

→ need inventories though

School safety manager: ultimately, would already have a team to call on to do assessments right away

in the event of a large EQ, these are the structures we need to look at right away

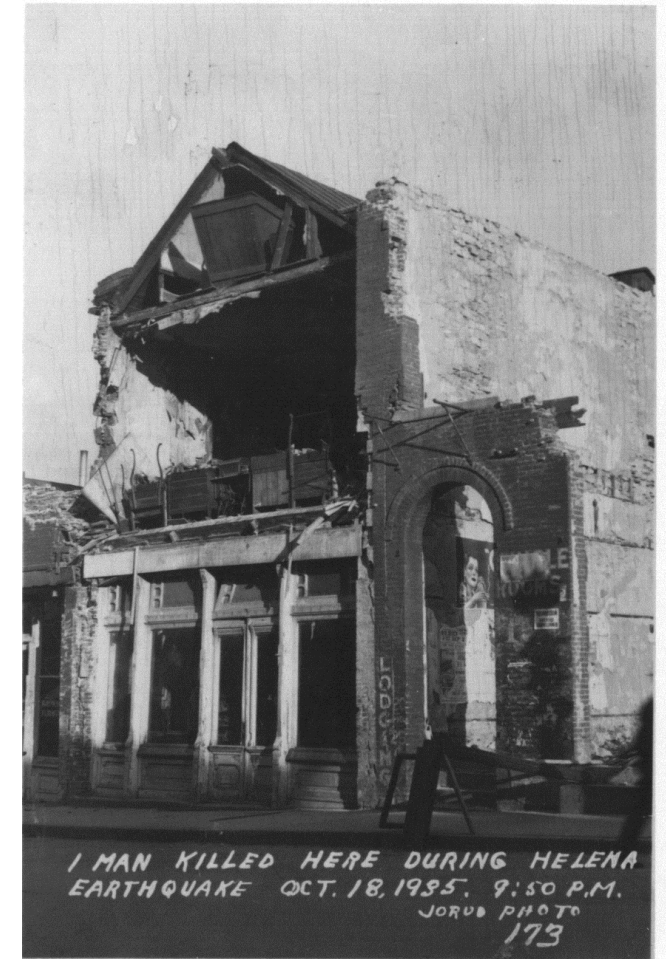
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Breaking news, Press Release, Emergency notification (30-60 mins)

- Local TV news release videos from social media and information provided by MBMG/USGS
 - First report of casualties and injuries:
 - 3 kids, 1 teacher, and 1 custodian at Bryant Elementary school (crushed partial ceiling collapse). Many injuries.
 - 2 people in pedestrian street in downtown (falling debris). A few injuries.
 - 2 store clerk and 1 shopper at Home Depot (falling hazardous tools).
 - A few residential homes collapses (10 casualties).
 - Report of a landslide at Rimini damaging 2 homes and breaking water flume at the Ten Mile Water Treatment Plant (2 casualties)
 - Snow avalanche near Basin, blocks I-15, reports of car crashes with injuries.
 - 1 Ice fishermen drown falling through broken ice on Lake Helena



Panel Discussion Notes

Schools have been built after 1935?

Important to know which schools are potential risk

Single family homes pose less of a risk; condos, etc. could have damage

Resources will be so taxed – only so many ambulances; only so much capability for SAR
bridges all standing and OK – resources will STILL be tapped out almost instantly

Water delivery system – overhead piping system; flumes
fire mitigation work a couple of years ago – replace wood sections with metal
did they look into buried system? No seams – create resilient water delivery system
DNRC using funds to address fire safety – funds to bury line? Is this on their radar?

Paradise fire in CA freaked out Helena a lot

Mobile home community – not anchored – more vulnerable

Walkups – not anchored

Maybe will not cause homelessness but will cause displacement

If they are not anchored and shear gas/water lines, concern for fire...

Panel Discussion Notes

Water lines in Helena – fixed 12 yrs ago – if PGA hits certain threshold, water gets cut off at reservoir so not losing water that is stored

Seismic shut off infrastructure for gas lines?

Given the age of Helena, water and wastewater distributions are aging
as communities go through and do capitol improvement projects, is seismic code part of requirements for consideration?

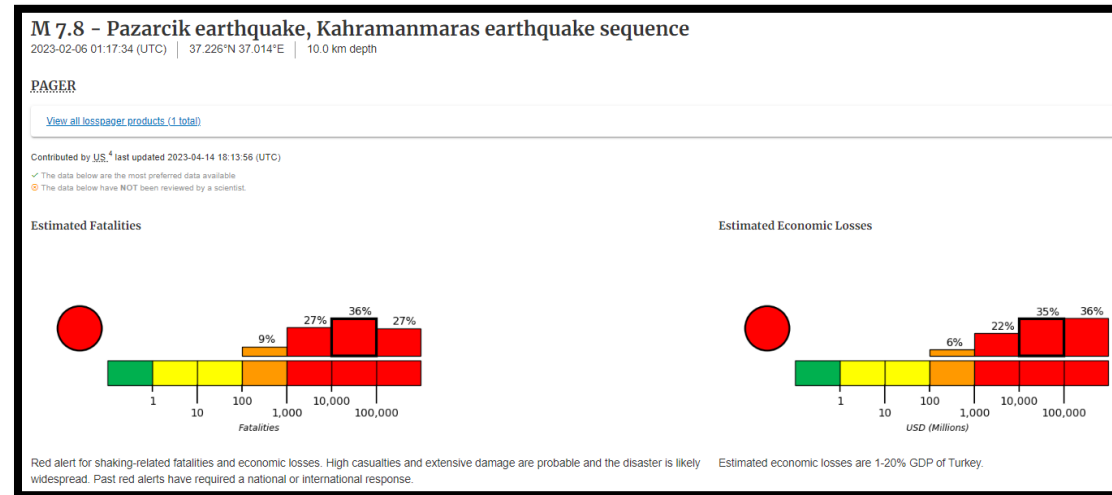
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Breaking news, Press Release, Emergency notification (30-60 mins)

- MBMG provide press release on their website. USGS updates information page about the Helena Valley Earthquake (Technical and Impact summary, slip model).
- Various state agencies make preliminary (remote) assessment using Shakemap and MBMG information to remotely assess potential damages to local infrastructure (Dams, Pipelines, Electric transmission, highways).



Example of USGS Prompt Assessment of Global Earthquakes for Response (PAGER) from M 7.8 earthquake in Turkey on Feb. 6, 2023

Panel Discussion Notes

Dam safety worker: uses PGA contours overlaid onto map of dams
three different priorities for different PGAs and dam ratings
does this all over state regardless of dam owner

After Lincoln EQ, sent inspectors to that area to look at all dams

DES coordinator at MDT – maintenance guys all out plowing snow; they have 2 way radios
Lots of folks working remotely, scattered around
engineering responding thru DES coordinator, maintenance, director's office

During flooding last year, daily meetings
maintenance chiefs calling in to report findings
people coming from other areas to help
bridge inspectors
150 licensed engineers
being in Helena would be good because there would be a lot of boots on the ground
ancillary problems

Want to make sure people aren't going into dangerous situation

5 regional engineers throughout state

Response protocol initiated for EQ over M 4

MDT traffic control center – if this is in Helena, does it get damaged?

Panel Discussion Notes

Need to allow time for everyone to do internal checks, then check in with each other
communication flows up through chain

State emergency coordination center – full activation depending on level of anticipated damage
multi agency group

Ex: reaching to Salt Lake – Urban SAR group

FEMA could send in some of their SAR teams

Things are moving outside of Helena even though nobody's made a call
they know things are happening

Assess and see what needs are

waiting to hear from MDT about bridges

once all info is there and needs are known, reach out to mutual aid partners – closest first

assumption is that even if contact cannot be established, help will be loaded up and on the way right away

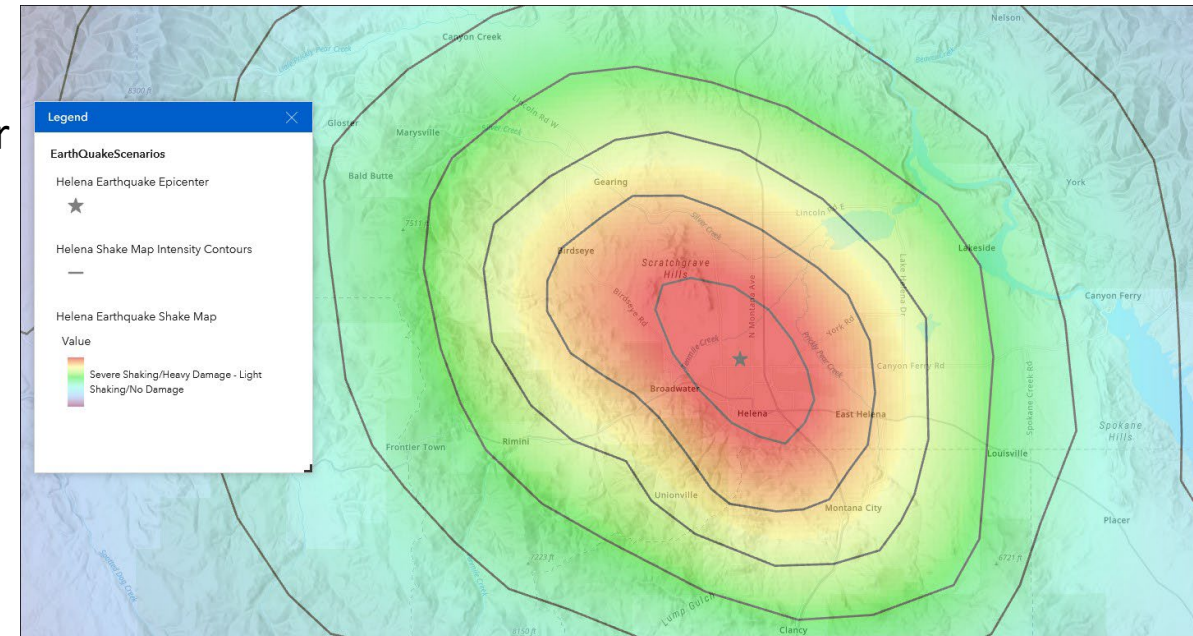
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Field dispatch – Damage assessment (within a few hours)

- City of Helena sends field crew to investigate damage assessment within the city on a block by block basis.
- **Electric Transmission:** Several neighborhoods without power (expecting -25F). Possible transmission line downs.
Questions: How long to restore power? Would NW Energy shut off certain transmission lines in certain areas of city to prevent fire risk?
- **Hydro-electric Dams:** Unknow damages or cracks.
Questions: Would the dam owners/operators or DNRC Dam Safety Program inspect dams? Precautions?
- **Gas Pipelines:** Unknow damages or leaks.
Questions: Precautions? Emergency shut off?



Panel Discussion Notes

What does strong-severe shaking mean? Or feel like?

difficult to stand, disorientation

MMI maps provide narratives

Does USGS have capability to overlay ShakeMap with USFS Wildfire WFTA system?

utility infrastructure with WFTA system

utility providers are starting to put their infrastructure into that system

data layer could be shared from forest service to USGS

Don't want "bad guys" to know about certain infrastructure

if we approach GIS layers from a lifeline approach, can make these things more accessible

Cutting off power vs shutting it off

risk of leaving power on and having fires

risk of things being harder to turn back on if they are all turned off

Do you shut off hydroelectric? Are there precautions? Do we need to know damage before we shut things off?

this is on a federal level – falls out of state's scope – Canyon Ferry is above the state

Measures in place for breakage?

If you smell gas in your house, you need to shut your gas line off and here's how to do it

Panel Discussion Notes

Do natural gas pipelines have a series of shut off valves like water lines do?
they can

Mac pass – got very close to gas pipeline
have to shut off flow and pump in oxygen
time consuming, doesn't just happen within minutes
process to shut down line

In future, BOR or Northwestern would be good to have at this meeting

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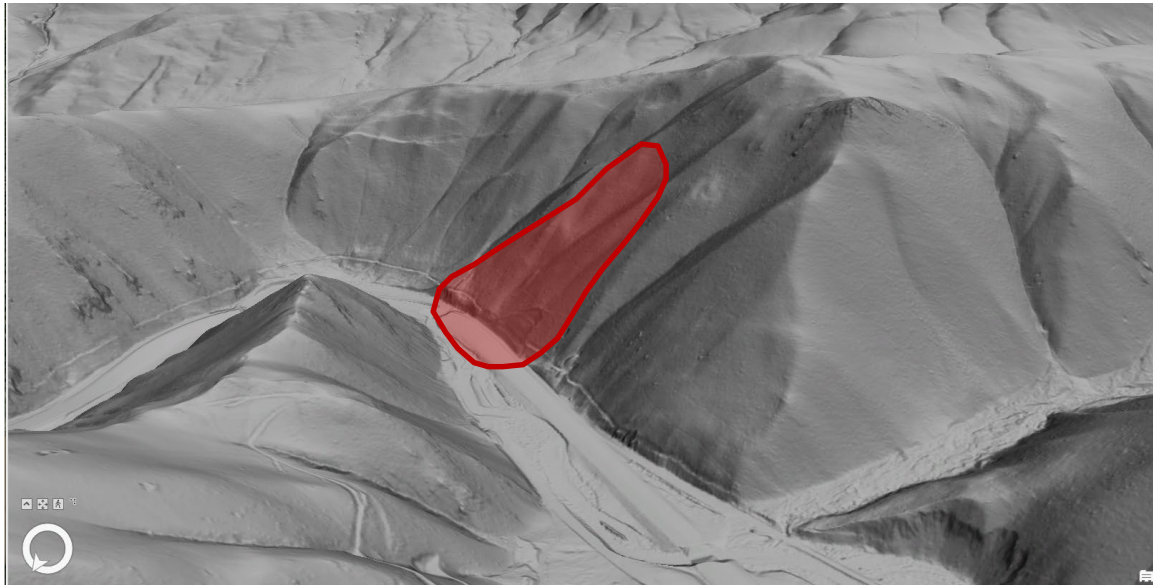
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Field dispatch – Damage assessment (within a few hours)

- MDT sends field crew to report road damages and closures:
 - Multiple road cracks and closure within city limit
 - Multiple rock avalanche and snow debris on I-15.

Questions: Response times, how much time to clear up (road cracks vs landslides), mitigation plans?

Rock/snow slide along Highway 21. Photo by Zach Lifton (Idaho Geological Survey), 2020, accessed through EERI photo archive



Panel Discussion Notes

Transportation corridors/lifelines potentially cut off

Interstate is always priority #1 for MDT

MDT recently started to keep “crossovers” – can run head to head traffic on one side of interstate
in old days, maintenance would take them out
now leaving them in a lot more

Maintenance closes road, safety first

geotechnical personnel contacted to assess
start reaching out to contracting community if it's big and needs help
go start cleaning up

I-70 in CO – took months to get road cleaned up – different land owners did not play nicely so it took longer
special use permits to do work on others' property?

Hope/expectation is that MT folks would be cooperative

Zach Lifton from IGS is a good person to work with for EQ clearinghouse

3 day table-top exercise to set up clearinghouse

MDT uses drones to help with snow plowing

If the airport is compromised, all things are kept in same place. Would have to rely on other agencies with planes

Panel Discussion Notes

Does govt have authority to access land for safety?

→ really tricky...

flooding that washed out roads near Stillwater

land owner was uncooperative and would only cooperate if paid a large sum

Doing work to prevent further damage on private property?

state of MT has emergency clause – try to find landowner but ranches are huge

in times of emergency, State can do what we need for safety

private agencies are a different story

For every hour that you shut down I-15, it costs 10's or 100's of thousands...

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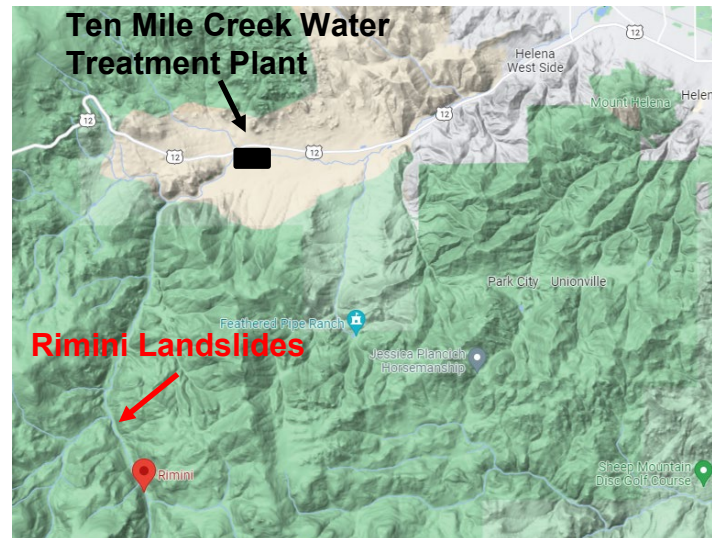
Field dispatch – Damage assessment (within a few hours)

- City of Helena sends field crew to investigate Ten Mile Creek following reports of landslides near Rimini:
 - Landslide destroys water flume and destroy 2 residence.
 - No water supply to Ten Mile Treatment Plant.
 - Rimini slowly starts to get flooded behind landslides

Questions: Response times; emergency procedures; mitigation plans?



2016 Elk City Landslide on state highway [\(video link\)](#)



Rimini (~50 residents)

Panel Discussion Notes

Tenmile Treatment Plant is primary water source

Landslide takes out flume

Could be weeks-months of no water supply

Can the Missouri sustain all of Helena?

If landslide is big enough and blocking valley, maybe lake starts to build up? Flood valley

Even though Helena has a secondary water source, water rights are complicated. How much water can they draw off Missouri, and how long can they do that?

If you deviate so far off of water use, this can affect historic water rights

Treatment coming out of Tenmile is different than water coming out of river

A lot cheaper to get water from Tenmile than Missouri – economic impact – long lasting effects

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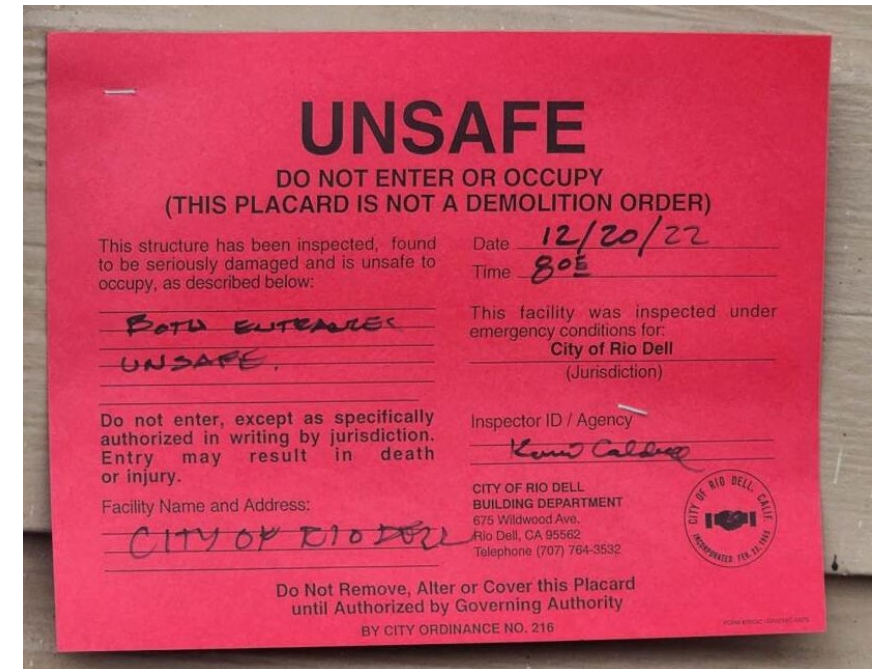


February 15-16 (Saturday-Sunday), 2025

Earthquake Disaster Responses coordination (within 24-48 hrs)

- Disaster and Emergency Services set up an official Earthquake Clearinghouse with various emergency managers and FEMA.
 - Various emergency response teams are deployed around Helena. Emergency shelters are set up. Homes and building are red tagged.
 - MBMG provides technical information on earthquakes. USGS will assist with information about earthquake and possible aftershocks.

Example of a red tag affixed to a building with unsafe entrances. Photo by Andrea Wisley via LA Times.



Panel Discussion Notes

Who is responsible for building tags? → building official administers this program

How many people can be dispatched? Do we have enough resources?

Once they determine how many people they need, local emergency manager reaches out to SEC, then to mutual aid partners

Liability – authority comes from Helena building dept – does every county have this?

without building department, has to be a volunteer basis?

does another state agency deputize people?

no process in place for this

could learn a lot from Utah

Utah structural assessment process – Utah Seismic Safety Commission does this

How to do we pull people together to do this so that it's ready in case we need it?

Have people across the state and you pull from other places

How long does it take to get people in here? Days? Hours? Relatively quick

have you exhausted all of your resources internally? And mutual aid?

Panel Discussion Notes

ATC 20 training does not require a licensed structural engineer

Process is more fluid –

system set up for deployment – don't want 2 inexperienced people working together

Evidence has shown that looking at houses is first priority so people can get back in houses

looking at residential stuff; not high rises

Deputized by building official – shield of liability

good Samaritan law

if you don't feel qualified to rate a building, then declare it needs more detailed inspection

Handshake agreement between structural engineers to help each other when needed

trained people can train others

Does Helena have a shelter? Where and how many can it house?

Red Cross has preidentified facilities that can be used

does not guarantee that these facilities will not be damaged

Red Cross can set things up quickly, but is there enough space?

school gyms

Next time invite Red Cross + DPHHS (Sara Hartley suggestion)

Survivability and accessibility of shelters...

Temporary relocation outside of Helena? Not the most feasible. FEMA public assistance program

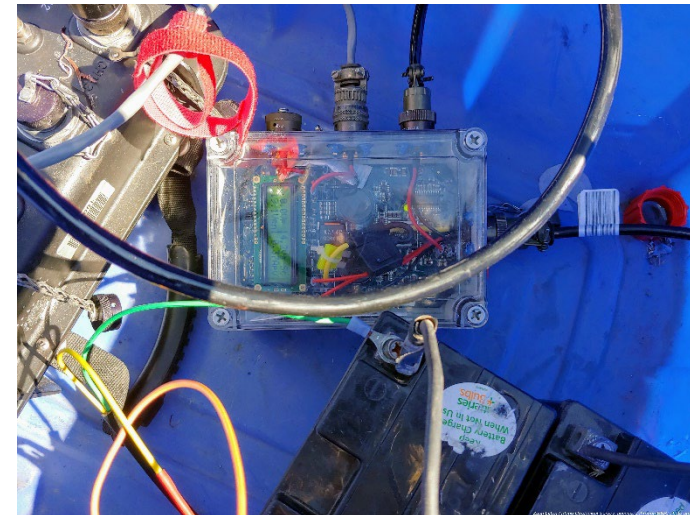
States intention to use schools....with no understanding of if those schools will be usable

2025 Helena Valley Earthquake sequence

February 15-16 (Saturday-Sunday), 2025

Earthquake Disaster Reponses coordination (within 24-48 hrs)

- MBMG, volunteer scientists, and USGS sets up science response team.
 - MBMG Geohazards team is deployed for initial field reconnaissance.
 - All data collection is shared in real time through GIS-platform and web application.
 - Rapid deployment of portable seismic sensors from UM are installed. USGS is sending more sensors to install within next few days.



Temporary seismometer installation in Idaho following 2019 Stanley earthquake. Photo by Zach Lifton (IGS).

Panel Discussion Notes

Scientific response

EQ clearinghouse – scientists and emergency responders all in same room – talk about potential for significant aftershocks
need to monitor the area

Hilary Martens – deploy temporary network quickly

Scientists trying to document ground deformation

2025 Helena Valley Earthquake sequence

Ground deformation – What would it look like?

NOT LIKELY



2016 Mw 7.8 Kaikoura earthquake, New Zealand (source GNS Science).

MORE LIKELY



2018 Mw 7.0 Alaska earthquake (source AGU).

2025 Helena Valley Earthquake sequence



February 16 (Sunday), 2025

8:06pm: A strong aftershock occurs near East Helena

- **Weather:** Low -30F, arctic front.
- **Ground shaking:** Residential homes in Helena Valley feel strong shaking with some roofs collapse, and lots of falling objects. Most people were at home.
- **Earthquake Information:** Within 15-20 mins, MBMG and USGS provide preliminary reports
 - Mw 6.0, 10 km northeast of Helena, and 8 km depth.
 - USGS provides Shakemap



2025 Helena Valley Earthquake sequence



February 17 (Monday), 2025

- **Breaking News:** No reported casualties; several minor injuries; several homes damages; many fields around Lake Helena show signs of liquefaction
- **Damage Assessment/Cascading effects:**
 - **City of Helena**
 - City sends field crew to Helena Regulating Reservoir and report water leakage at base of earth filled dam. Water flow appears to be increasing through the cracks. Emergency procedures/precautions? Nearby dams?
 - Already strained power grid and gas for residents (emergency shut off?) with cold temps. Risk of hypothermia? Home plumbing freezes?
 - Limited water supply (Ten Mile Creek water supply is out).
 - **DOT responds to various calls on highways**
 - major cracks at the I-15 and Highway 287 overpass.
 - Extensive soil collapse beneath the overpass caused by lateral spread. Need to close highway overpass.
 - Minor cracks and sand boils are observed around East Helena.
 - A large rock fall with house-size boulders blocks part of I-15 in Wolf Creek Canyon.

2025 Helena Valley Earthquake sequence



February 17-21, 2025

- **Earthquake Disaster Responses coordination:**

- Earthquake Clearinghouse already in place. No immediate emergency response needed for aftershock, but growing concerns with possible failure of Helena Regulating Reservoir dam.
- Geotechnical teams are deployed to document damages and assess if infrastructure is at risk of failures (Helena Regulating Reservoir Dam)

- **Science response**

- Science team coordination already in place. MBMG Geohazards team and other volunteers scientists continue document ground deformation, including liquefaction sites from aftershock.
- Additional portable seismic sensors from the USGS are being installed.

Panel Discussion Notes

Recovery time = YEARS

Aftershocks continue, people are stressed

Action Items

- Find a person to pull everything together; everyone here has our specialties
- Building inventory: first step is to apply for DES grant – project manager built into application
 - Preidentify buildings, put into deliverable/database
 - Prioritize buildings, craft application around that
- Who does inventories? Can procure a contractor to do that work
 - Feds will fund 75%, local entity has to provide commitment letter
 - Can meet match multiple ways
- Helpful to identify end goal – fix the bricks fund, requirements for URM retrofits
 - Match funding through city council? Creates buy in...ulterior motives
 - FEMA grants to DES (DES is passthrough entity, passes on to county, then on to school district)
- Building inventory – public outreach and education campaign as a deliverable – Utah has example
 - How did Utah do public school inventories?
 - Volunteer help was huge – volunteer structural engineers
 - Will you come do this for free? Great response
 - 60% of schools were URM – unsafe – parlayed into another project that got URM schools into another pub
 - Easy to garner support of engineering communities

Panel Discussion Notes

- Outreach – playbook for how officials can discuss things alongside school shootings, weather events, etc.
- Schools are a tool, not the end goal – flagship project
- Seismic Safety Commission helps Helena school district through this process, then use this as a template
 - SSC start out as a guidance document – legal documents need buy in – present at next legislative session
 - “Strategic Plan” – these are the things that have to happen, we know because we’ve studied this
 - Publish strategic plan every couple of years
- Model plans from USSC available
- BRIC set aside
 - FEMA relies on quantifying historic damages – have to be able to predict future losses
 - Solidify benefit cost predictions for events that don’t happen very often
- MBMG and MT DES sit down and draft grant – identify issues
 - Best chance is with Helena school district
- Form MSSC as a working group, come up with strategic plan – do this at same time as we start working on pilot program with Helena SD
 - Stakeholders: DES, MBMG, DNRC, MDT, DEQ, HSD, industry? – need preliminary statement (MOU) for top of each agency to agree with
 - Start with working group, get buy in, then transition into SSC
- Letters of support/interest -

Panel Discussion Notes

1. Working group statement/letter of interest
2. BCA (benefit-cost analysis) #s for Helena to DES by June
Stakeholders – see previous page
3. Guidance document/strategic plan
present at next legislative session
updated every 2 (?) years
Model after Utah

Goals/Outcomes:

- A story document – “Putting down Roots” (Utah)
- Pilot – help facilitate Helena SD – identify lessons learned
- Mitigation/retrofit program (MT DES)
- Robust SAP

Working groups can put out recommendations

Panel Discussion Notes

Ideas for next meeting:

- Suggestion to do this somewhere we can see field work that's been done
- Bitterroot valley?
- Missoula?
- Kalispell ?