



## **2020 UTAH EARTHQUAKE WORKING GROUP MEETINGS UTAH QUATERNARY FAULT PARAMETERS WORKING GROUP SUMMARY**

**Tuesday, February 4, 2020**

**Utah Department of Natural Resources Building, Auditorium (1<sup>st</sup> Floor)  
1594 West North Temple, Salt Lake City, Utah**

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### **WELCOME AND INTRODUCTION**

Emily Kleber (Utah Geological Survey [UGS]) called the 2020 Utah Quaternary Fault Parameters Working Group (UQFPWG) meeting to order at 8:30 a.m. After welcoming Working Group members and guests and allowing time for introductions, she summarized the UQFPWG's past activities and outlined the Working Group's purpose and goals for the future.

#### **UQFPWG Purpose and Goals**

- Serves as one of two standing committees created to help set and coordinate Utah's earthquake-hazard research agenda.
- Reviews ongoing paleoseismic research in Utah and updates the Utah consensus slip-rate and recurrence-interval database as necessary.
- Provides advice/insight regarding technical issues related to fault behavior in Utah.
- Identifies and prioritizes future Utah Quaternary fault paleoseismic investigations.

### **TECHNICAL PRESENTATIONS**

The following presentations were made on current paleoseismic research and related activities in Utah (presentations are available at:

[http://geology.utah.gov/docs/pdf/2020\\_UQFPWG\\_presentations.pdf](http://geology.utah.gov/docs/pdf/2020_UQFPWG_presentations.pdf)).

- Update on Quaternary Fault Mapping in Utah: Adam Hiscock, Utah Geological Survey
- Paleoseismic Investigation of the Levan and Fayette Segments of the Wasatch Fault Zone, Utah: Greg McDonald, Utah Geological Survey
- East Cedar Valley Fault Zone— New Fault Strands and Younger Events: Adam McKean, Utah Geological Survey
- A Field Test of Portable OSL— Using 345 Samples from the Deep Creek Colluvial Wedge Exposure to Explore Earthquake-Timing Uncertainty: Chris DuRoss, U.S. Geological Survey
- Topliff Hill Paleoseismic Site— Six Events Since 69.3 ka on the Topliff Hills Fault: Nathan Toké, Utah Valley University

## **U.S. Geological Survey Update and National Seismic Hazard Map Effort**

Ryan Gold, Intermountain West (IMW) Coordinator for the U.S. Geological Survey (USGS) Earthquake Hazards Program, gave a summary of ongoing collaborations of earthquake geology investigations in IMW states, including Utah. In 2023, the USGS plans to update the National Seismic Hazard Model (NSHM), which will require input from the intermountain states. Ryan gave funding updates for the fiscal years 2019 and 2020 Earthquake Hazards Reduction Program from the USGS External Grants Program, budget projections for 2021, and general advice.

Alex Hatem, USGS Mendenhall Postdoctoral fellow at the USGS Earthquake Hazards Program, presented more details about the effort to incorporate additional geologic data into the 2023 update of the NSHM. She presented information about the timeline for data submissions and discussed some areas of improvement in Utah for the NSHM.

### **GROUP DISCUSSION ITEMS**

Emily Kleber led a discussion addressing issues or topics of interest that were brought up throughout the morning and afternoon sessions. Prior to the meeting, working group members were polled about some of the topics that they would be interested in discussing as the working group. These topics included: fault special-study zones, seismic hazard of buried urban faults, and city ordinances related to faults. The poll results showed participants were the most interested in discussing all three.

The special-study zone discussion was led by Emily Kleber and Adam McKean. The conversation started with Adam McKean giving a brief presentation about the usefulness of being well connected with geotechnical consultants. When possible, some consultants provide reports and invitations for site visits during sub-surface investigations. These site visits are invaluable to Adam's geologic mapping of Quaternary units in urban areas. The conversation then moved to asking the consultants about their process using the special-study zones. Consultants in the room use fault special-study-zone maps generated by the city and county first, then look to other sources. They seemed to be interested in using the UGS-generated special-study zones that will soon be available for the Wasatch and West Valley fault zones through the UGS Geologic Hazards Portal.

New fault mapping and special-study zones are nearing publication by the UGS, so the conversation turned to how the information will be disseminated, and what stakeholders to get in touch with following the publication. Darlene Batatian recommended the Utah League of Cities and Towns as a good place to start networking with local officials. The group also discussed having a workshop for local officials and/or geotechnical companies to discuss special-study zones.

The discussion then moved to seismically imaged faults. This discussion was rather short because two key scientists contributing scientific work to this area, Lee Liberty of Boise State and Ivan Wong of Lettis Consultants International, were not able to attend the 2020 meeting. The group discussed the possibility of having a confidence threshold for geophysical faults and issues surrounding connecting geophysical faults with little geologic evidence.

### **UQFPWG 2021 FAULT INVESTIGATION PRIORITIES**

The Working Group's list of highest priority fault investigations for 2021 includes (not in priority order) (table 1):

- Acquire new paleoseismic information for areas with ongoing lidar fault mapping projects:
  - Cache Valley faults— East Cache fault zone and West Cache fault zone
  - Five central segments of the Wasatch fault zone
  - West Valley fault zone
  - Oquirrh fault zone
  - Sevier fault
  
- “Salvage paleoseismology” (i.e., earthquake timing investigations as rapid development is encroaching on un-modified paleoseismic trenching sites):
  - Faults in Cache Valley
  - West Valley fault zone
  
- Use recently acquired lidar data to more accurately map the traces of the:
  - Scipio Valley faults
  - Beaver Basin faults (partial coverage)
  - Hansel Valley
  - Mineral Mountains West-side faults
  - Stansbury fault zone

This does not include other priorities that have carried over from previous years. Those are identified in table 2.

## **WORKING GROUP PRODUCTS AND RELATED DATA**

The final agenda, speaker presentations, and this summary document are available on the UQFPWG web page at <https://geology.utah.gov/hazards/earthquakes-faults/utah-earthquake-working-groups/quaternary-fault-parameters/>. Paleoseismic investigations that developed out of the UQFPWG meetings and published by the UGS are available in the *Paleoseismology of Utah* series at <https://geology.utah.gov/hazards/technical-information/paleoseismology-of-utah-series/>. Most of the USGS NEHRP funded investigations for Utah that were not published by the UGS are compiled in UGS Miscellaneous Publication 13-03 ([https://ugspub.nr.utah.gov/publications/misc\\_pubs/mp-13-3/mp13-03.pdf](https://ugspub.nr.utah.gov/publications/misc_pubs/mp-13-3/mp13-03.pdf)).

### **Utah Quaternary Fault and Fold Database**

The UGS updated the *Utah Quaternary Fault and Fold Database* in May 2019, incorporating new mapping and fault attributes. Ongoing updates are being reviewed by the UGS for Quaternary faults mapped in peer-reviewed publications from 2013 to 2019. Users of any Quaternary fault trace and related data acquired from the UGS or the Utah Automated Geographic Reference Center (AGRC) State Geographic Information Database (SGID) in the past are advised to use the updated database available from the AGRC SGID (<https://gis.utah.gov/data/geoscience/quaternary-faults/>). This single, comprehensive feature class will be periodically updated as new or updated data become available and replaces the six previously available feature classes of variable completeness. A web mapping application for the database is available at <https://geology.utah.gov/resources/data-databases/qfaults/>.

### **Utah Lidar Elevation Data Availability**

A significant coverage of high-resolution ( $\leq 1$  meter) lidar elevation data in the state of Utah is now available totaling over 44,896 square miles (mi<sup>2</sup>) from AGRC (<https://gis.utah.gov/data/elevation->

[terrain-data/](#)) and OpenTopography (<http://opentopography.org>). UGS and AGRC led partnerships of multiple, diverse local, state, and federal agencies, and non-governmental organizations have been instrumental in acquiring new, high-quality public domain lidar data. Figure 1 shows the existing and planned lidar data available in Utah. The UGS is currently using lidar data to map fault traces of the East and West Cache fault zones (USGS G17AP00071, report due June 2020), the East and West Bear Lake, Oquirrh, and Topliff Hills fault zones (USGS G19AP00072, report due September 2020), and the Sevier, Washington, and Hurricane Faults in southern Utah (G20AP00008, report due March 2021). This mapping is being completed at a scale of 1:10,000, where possible, or 1:24,000, where the ground surface has been significantly disturbed by urbanization and other activities. The mapping is used to define special-study zones around fault traces, where paleoseismic investigations are highly recommended by the UGS for new development (see Lund and others, 2016, *Guidelines for Evaluating Surface-Fault-Rupture Hazards in Utah*, UGS Circular 122, pages 33 to 58, <https://ugspub.nr.utah.gov/publications/circular/c-122.pdf>).

**MEETING ATTENDANCE**  
**Working Group Members (\* Speaker)**

Steve Bowman	Utah Geological Survey
Michael Bunds	Utah Valley University
Chris DuRoss*	U.S. Geological Survey, Earthquake Hazards Program
Ryan Gold*	U.S. Geological Survey, Earthquake Hazards Program, IW Coordinator
Adam Hiscock*	Utah Geological Survey (UQFPWG UGS Liaison)
Michael Hylland	Utah Geological Survey
Emily Kleber	Utah Geological Survey (UQFPWG Chair)
William Lund	Utah Geological Survey, Emeritus
Greg McDonald*	Utah Geological Survey
Jim McCalpin	Geo-Haz Consulting
Jim Pechmann	University of Utah Seismograph Stations

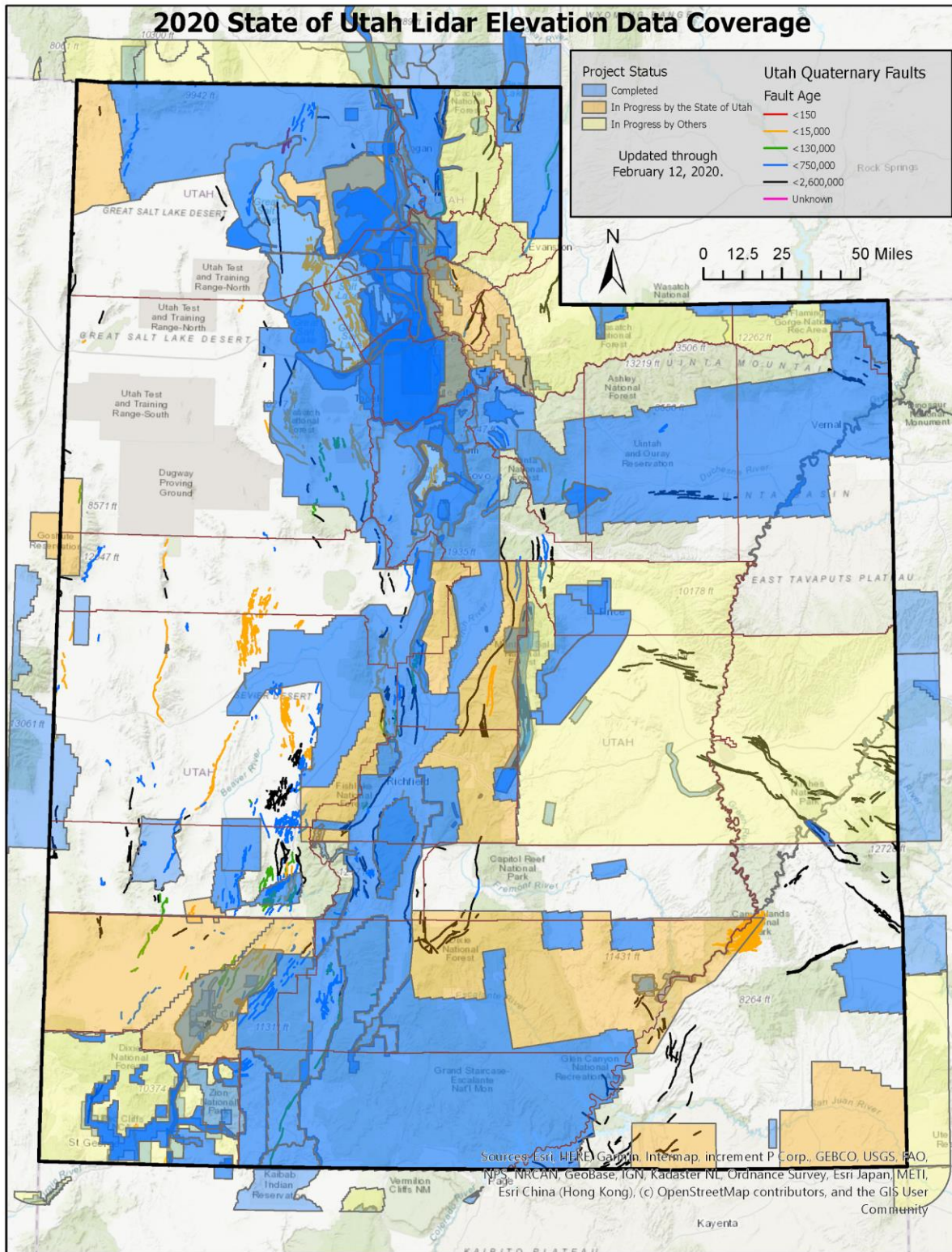
**Guests (\* Speaker)**

Zack Anderson	Utah Geological Survey
Darlene Batatian	Terracon Consultants, Inc.
Jack Bloom	Retired
Camille Collette	U.S. Geological Survey
Jordan Culp	Gordon Geotechnical Engineering
Gordon Douglass	Utah Geological Survey
Patrick Emery	Gordon Geotechnical Engineering
Rich Giraud	Utah Geological Survey
Alex Hatem*	U.S. Geological Survey
Julia Howe	U.S. Bureau of Reclamation
Bill Keach	Utah Geological Survey
Rich Koehler	Nevada Bureau of Mines and Geology / University of Nevada, Reno
Zach Lifton	Idaho Geological Survey
James Mauch	Wyoming Geological Survey
Adam McKean*	Utah Geological Survey
Matthew Morriss	Utah Geological Survey
Gordon Seitz	California Geological Survey
Mike Stickney	Montana Bureau of Mines and Geology
Grant Willis	Utah Geological Survey
Seth Wittke	Wyoming Geological Survey

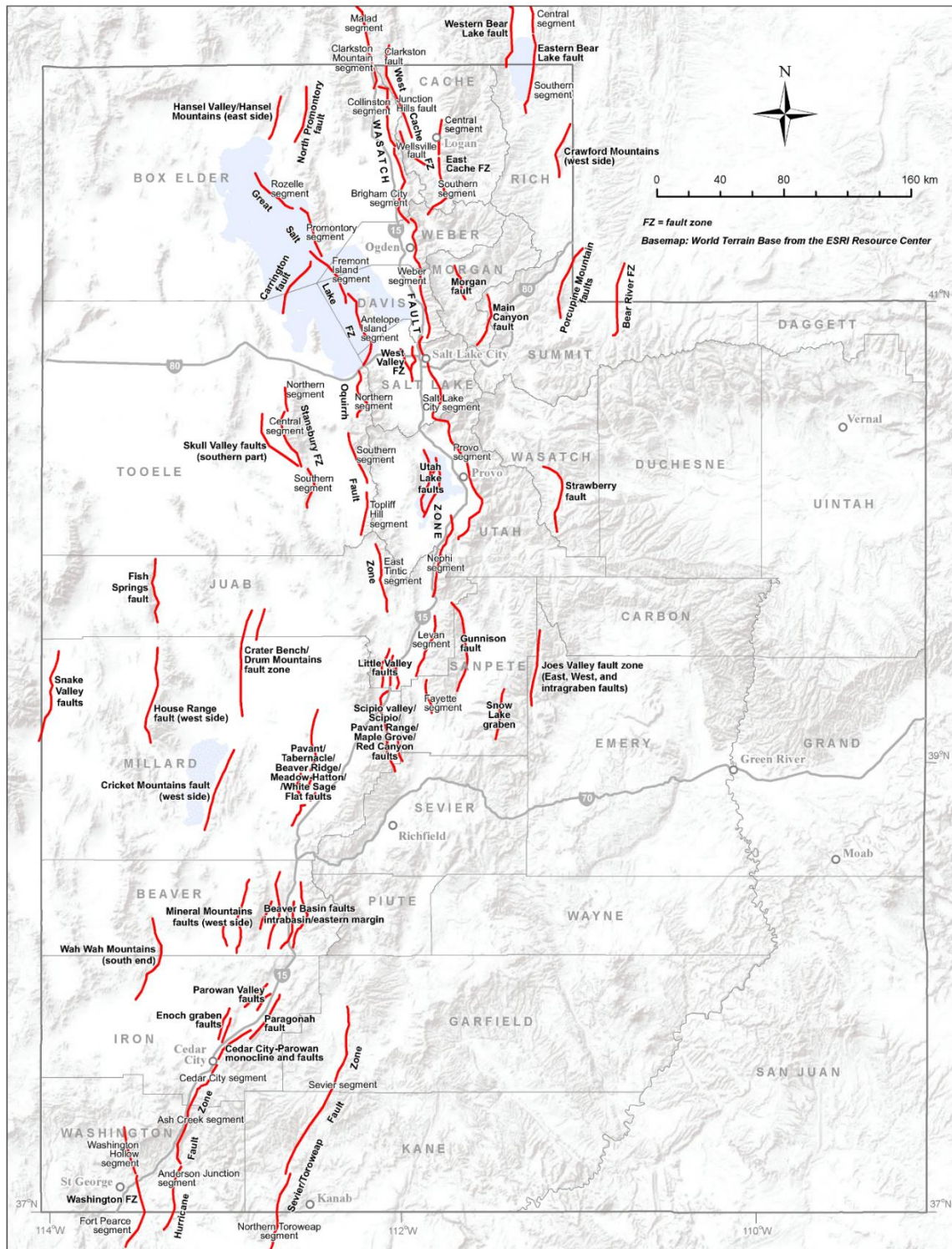
## **History of the Utah Quaternary Fault Parameters Working Group Since 2005**

The main goal of the UQFPWG is to characterize hazardous earthquake fault sources in Utah. The working group began in 2003 by developing consensus slip-rate (SR) and recurrence-interval (RI) data for all Utah trenched faults, based on a comprehensive evaluation of paleoseismic-trenching data available at that time for Utah's Quaternary faults, and where the data permitted, assigned consensus preferred RI and vertical SR estimates for the faults and/or fault sections reviewed. Trenching data were available for 33 of Utah's known 211 Quaternary faults/fault sections and related structures.

In 2005, the UQFPWG developed a list of Quaternary faults and fault segments (Lund, 2005, table 2; figure 2) that the working group identified as requiring additional investigation to adequately characterize Utah's earthquake hazard to a minimally acceptable level. Since then, the Working Group has added an additional 12 faults/fault segments to the list: five in 2007; one in 2009; one in 2010; four in 2011; three general recommendations regarding the five central segments of the Wasatch fault zone, fault zone mapping, and acquisition of high-resolution imagery in 2012, 2014, 2015, respectively; one in 2016, plus the relationship of salt tectonics to eight faults or fault zones; and slightly modified the existing list of highest priorities in 2017, 2018, 2019, and 2020. Table 1 lists the faults and fault segments (earthquake sources) incorporated in the USGS National Seismic Hazard Maps, and/or the UGS Hazus Utah fault database (updated through 2013, UGS Open-File Report 631). Faults not listed may need additional investigation.



**Figure 1.** Map of lidar data availability in Utah and the surrounding area. Utah has 44,898 mi<sup>2</sup> of completed lidar coverage, 12,203 mi<sup>2</sup> of lidar data collection in process by the State of Utah, and 16,063 mi<sup>2</sup> of lidar data collection by other groups.



**Figure 2.** Faults included in the UGS Hazus Utah fault database, except the Cedar City-Parowan monocline and faults were removed in 2016 (see table 1; database updated through 2013, [UGS Open-File Report 631](#)).



**Table 1.** Earthquake sources (faults and fault segments) in the USGS National Seismic Hazard Maps (NSHM) or the UGS Hazus Utah fault database ([UGS Open-File Report 631](#)). These faults may warrant additional investigation.

Utah Fault or Fault Segments	Included In	
	NSHM	Utah Hazus
Beaver Basin intrabasin/eastern margin faults	--	Yes
Crater Bench/Drum Mountains fault zone	--	Yes
Crawford Mountains (west side)	--	Yes
Cricket Mountains fault (west side)	--	Yes
Fish Springs fault	--	Yes
House Range (west side) fault	--	Yes
Joes Valley fault zone	Yes	Yes
Little Valley faults	--	Yes
Malad segment, Wasatch fault zone	--	Yes
Mineral Mountains (west side) faults	--	Yes
North Promontory fault	Yes	Yes
Oquirrh fault zone	--	Yes
Oquirrh-Southern Oquirrh Mountains fault zone	Yes	Yes
Parowan Valley faults	--	Yes
Pavant/Tabernacle/Beaver Ridge/Meadow-Hatton/White Sage Flat faults	--	Yes
Porcupine Mountain faults	--	Yes
Scipio/Pavant Range/Maple Canyon/Red Canyon faults	--	Yes
Skull Valley faults (southern part)	--	Yes
Snake Valley faults	--	Yes
Snow Lake graben	--	Yes
Stansbury fault zone	Yes	Yes
Strawberry fault	Yes	Yes
Wah Mountains (south end)	--	Yes
West Cache fault, Wellsville section	Yes	Yes
Western Bear Lake fault	--	Yes

**Table 2.** Status of proposed and published paleoseismic-related investigations based on priorities developed by the UQFPWG since 2005. If there are any missing publications, please send the reference to [ekleber@utah.gov](mailto:ekleber@utah.gov).

Study Type	Utah Fault or Fault Segment	UQFPWG Priorities		Investigation Status (as of 3/2020)
		2005	Additions	
Earthquake Timing	Nephi segment, Wasatch fault zone	1	2012 2017	<a href="#">UGS FTR Report, 05HQGR0098 (2005)</a> <a href="#">USGS SI Map 2966 (2007)</a> <a href="#">UGS Special Study 124 (2008)</a> <a href="#">UGS FTR Report, G12AP20076 (2014)</a> <a href="#">UGS Special Study 151 (2014)</a> <a href="#">UGS Special Study 159 (2017)</a> <a href="#">UGS FTR, G17AP00001 (2018)</a>
	West Valley fault zone	2	2017	<a href="#">UGS Special Study 149 (2014)</a>
	Granger fault		2011 2017	<a href="#">UGS FTR, G15AP00117 (2017)</a>
	Taylorsville fault			
	Weber segment, Wasatch fault zone – most recent event and multiple events	3 4	2012 2017	<a href="#">UGS Miscellaneous Publication 05-8 (2006)</a> <a href="#">UGS FTR, 07HQGR0093 (2007)</a> <a href="#">UGS Special Study 130 (2009)</a>
	Utah Lake faults and folds	5	2015 2017	<a href="#">UUGG FTR Report, G08AP0016 (2014)</a>
	Acquire earthquake timing information to investigate the relation of earthquakes to large earthquakes on the Provo segment.			
	Great Salt Lake fault zone	6	2007	<a href="#">UUGG FTR Report, G08AP0016 (2014)</a> <a href="#">Janecke and Evans (2017)</a>
	Rozelle section, East Great Salt Lake fault Carrington fault, Great Salt Lake fault zone			
	Collinston and Clarkston Mountain segments, Wasatch fault zone	7	--	<a href="#">UGS Special Study 121 (2007)</a> <a href="#">UGS Open-File Report 638 (2015)</a>
	Sevier and Toroweap faults	8	2016	<a href="#">UGS Special Study 122 (2008)</a>
	Washington fault zone (includes Dutchman Draw fault)	9	--	<a href="#">UGS Open-File Report 583 (2011)</a> <a href="#">UGS Miscellaneous Publication 15-6 (2015)</a>
	Cedar City-Parowan monocline (removed 2016) and Paragonah fault	10	--	<a href="#">UGS Map 270 (2015)</a> <a href="#">2016 presentation file</a> Paragonah fault, no activity
Enoch graben	11	--	<a href="#">UGS Open-File Report 628 (2014)</a>	
East Cache fault zone	12	2013	<a href="#">USU FTR Report, 07HQGR0079 (2012)</a>	
Clarkston fault	13	--	<a href="#">UGS Special Study 98 (2000)</a> <a href="#">UGS Special Study 121 (2007)</a> <a href="#">UGS Open-File Report 638 (2015)</a> <a href="#">UGS FTR, G17AP00001 (2018)</a>	

Study Type	Utah Fault or Fault Segment	UQFPWG Priorities		Investigation Status (as of 3/2020)
		2005	Additions	
Earthquake Timing	Wasatch Range back-valley faults (includes Morgan fault and Main Canyon fault)	14	--	<a href="#">UGS Miscellaneous Publication 11-2 (2011)</a> <a href="#">UGS Miscellaneous Publication 10-5 (2010)</a>
	Hurricane fault zone	15	--	<a href="#">UGS Special Study 119 (2007)</a>
	Levan and Fayette segments, Wasatch fault zone	16	--	<a href="#">UGS Map 229 (2008)</a> <a href="#">UGS Open-File Report 640 (2015)</a> <a href="#">UGS FTR G17AP00071 (2019)</a>
	Gunnison fault	17	--	No activity
	Scipio Valley faults	18	2017	No activity
	Faults beneath Bear Lake	19		No activity
	Eastern Bear Lake fault zone	20	--	No activity
	Provo segment, Wasatch fault zone			
	Penultimate event and long-term earthquake record	--	2007 2011 2012 2017	<a href="#">UGS Map 02-7 (2002)</a> <a href="#">URS FTR Report, 02HOGRO109 (2011)</a> <a href="#">UGS FTR Report, G13AC00165 (2015)</a> <a href="#">Bennett, and others, 2018 (BSSA)</a>
	Fort Canyon fault, Traverse Mountains salient	--	2012	<a href="#">UVU FTR, G16AP00104 (2017)</a>
	Brigham City segment, Wasatch fault zone			
	Most recent event and rupture extent	--	2007 2011	<a href="#">UGS Special Study 142, (2012)</a>
	Salt Lake City segment, Wasatch fault zone	--	2009	
	Penrose Drive	--	2012	<a href="#">UGS FTR Report, G10AP00068 (2010)</a> <a href="#">UGS Special Study 149 (2014)</a>
	Corner Canyon site	--	2012	<a href="#">UGS FTR Report, G14AP00057 (2014)</a>
	Bear River fault zone	--	2007	AGU Abstracts: 2012 and 2013
	Acquire new paleoseismic information to address data gaps for the five central segments of the Wasatch fault zone	--	2012	<a href="#">DuRoss and Hylland, 2015 (BSSA)</a> <a href="#">DuRoss and others, 2018 (GRL)</a>
	Topliff Hills fault	--	2016	Trenching by Toke, Bunds, and UVU students, ongoing
	Northern Oquirrh fault zone	--	2015 2017	Bunds and others, <a href="#">Poster 1</a> and <a href="#">Poster 2</a>
	High Res. Mapping & Trench Site ID	Wasatch and West Valley fault zones	--	2014 2017
Hansel Valley fault zone		--	2011	No activity

Study Type	Utah Fault or Fault Segment	UQFPWG Priorities		Investigation Status (as of 3/2020)
		2005	Additions	
High Resolution Fault Mapping and Paleoseismic Trench Identification	Eastern Bear Lake fault zone	--	2015 2017	USGS/UGS co-op award G19AP00072 (FTR due fall 2020)
	East and West Cache fault zones	--	2015 2017	USGS/UGS co-op award G17AP00071 (summer 2020)
	Hurricane fault zone	--	2014 2017	USGS/UGS co-op award G20AP00008 (FTR due 2021)
	Oquirrh fault zone	--	2015 2017 2018	Bunds and others, <a href="#">Poster 1</a> , <a href="#">Poster 2</a> , and <a href="#">Poster 3</a> , and presentation Bunds, USGS/UGS co-op award G19AP00072 (FTR due September 2020)
	Southern Utah faults			
	Sevier/Toroweap faults		2018	USGS/USG/AZGS co-op award G20AP00008 (FTR due Spring 2021)
	Mineral Mountains (West Side) faults		2018	None
	Beaver Basin		2018	None
	Crater Bench/Drum Mountain		2018	None
	Scipio		2018	None
Little Valley		2018	None	
Salt Tectonics	Levan and Fayette segments of the Wasatch fault zone	--	2016	<a href="#">UGS FTR G17AP00071 (2019)</a>
	Main Canyon fault Sevier detachment/Drum Mountains fault zone Bear River fault zone Spanish Valley (Moab area) Joes Valley fault zone Scipio Valley faults Gunnison fault	--	2016	Scipio Valley and Bear River lidar data collected in 2018
Other	Warm Springs fault/East Bench fault subsurface geometry and connection	--	2010	<a href="#">BSU FTR G15AP00054 (2015)</a> <a href="#">BSU FTR G17AP00052 (2017)</a>