**SUMMARY**
**NINTH MEETING**
**WORKING GROUP ON UTAH EARTHQUAKE PROBABILITIES**
**Wednesday & Thursday, February 6 & 7, 2013**
**Utah Department of Natural Resources Building**
**1594 West North Temple, Salt Lake City, Utah**

## WELCOME AND INTRODUCTION

Working Group on Utah Earthquake Probabilities (WGUEP) Chair Ivan Wong called WGUEP Meeting Nine to order at 8:30 a.m. After welcoming the Working Group members and Utah Geological Survey (UGS) staff (attachment 1), Ivan reviewed the meeting agenda (attachment 2), and stated that the principal goals of Meeting Nine were to (1) review the most recent preliminary earthquake probability numbers for the WGUEP Wasatch Front study region, (2) come away from the meeting satisfied with the input parameters used to calculate the probabilities, and (3) set a firm schedule for completion of the consensus Wasatch Front earthquake catalog, and the currently outstanding draft sections of the WGUEP final report.

Mark Petersen stated that he is concerned about the timing of the release of the WGUEP final report (~ end of 2013) with respect to the release of the next update of the U.S. Geological Survey (USGS) National Seismic Hazard Maps (NSHMs) in November 2013. Mark would like to have the WGUEP probability and input data for preparation of the NSHMs, so the two products aren't radically different when they are released just a few months apart. The UGS will provide Mark with the parameters for the fault sources that are common to both the WGUEP study area and the NSHMs.

## ISSUE DISCUSSIONS

Technical presentations and the ensuing discussions they generated are summarized below. The input data and results of the earthquake recurrence and probability calculations are proprietary to this process and are not part of public records under the Utah Government Records Access and Management Act until released in the final WGUEP report. Therefore, PowerPoints and other information relevant to the input data and preliminary recurrence and probability calculations are not posted on the WGUEP page at http://geology.utah.gov/ghp/workgroups/wguep.htm. Additionally, some non-proprietary technical presentations did not include a PowerPoint presentation.

### Update on Consensus Wasatch Front Earthquake Catalog
### Walter Arabasz and Jim Pechmann
### (No PowerPoint presentation)

Walter Arabasz summarized the tasks required to create a consensus earthquake catalog, with the ultimate goal of unifying the University of Utah Seismograph Stations (UUSS) catalog with the USGS NSHM catalog to create a multi-purpose, unified catalog for the entire Utah

region (larger than the WGUEP Wasatch Front study area). The complexity of project has been far greater than originally anticipated, particularly regarding deriving relationships between $M_w$ and other magnitude-size measures, assessing magnitude uncertainties and rounding errors, assessing catalog completeness including removing duplicates and non-tectonic events, and assessing magnitude scaling issues. Additionally, assistance is required from the USGS with integrating their catalog, and the USGS staff has had competing priorities for their time and have been unable to provide the required assistance.

Jim Pechmann stated that it had been assumed that $M_L$ and $M_C$ magnitudes in the UUSS catalog were equivalent to $M_W$ magnitudes, but recent work by Katherine Whitten at the UUSS has shown that the $M_W$ to $M_L$ relation is not 1:1, particularly for earthquakes with $M_L$ greater than 5.0. Further efforts are underway to develop a $M_W/M_L$ scaling relation. The UUSS is also investigating the possibility of developing an $M_L$ distance correlation factor for earthquakes outside the Utah region (Montana and Idaho).

Walter stated that the priority now is to develop a time frame to deal with the magnitude issues and to have an integrated, consensus catalog before the 2013 Seismological Society of America Annual Meeting in April.

**Determining Recurrence Using Small Number Statistics**
**Nico Luco**
**(No PowerPoint presentation)**

Nico reported on his effort to develop recurrence interval probability distributions from the small earthquake data set (22 events) available for the five central segments of the Wasatch fault zone (WFZ) using both the Poisson rate parameter λ (lambda) and the Brownian Passage Time (BPT) repeat time parameter μ (mu). Nico has adopted the approach used in the Central and Eastern United States (CEUS) Seismic Source Characterization (SSC) report (http://pbadupws.nrc.gov/docs/ML1204/ML12048A804.pdf) for calculating those parameters.

**Poisson Rate Parameter**

Nico noted that λ is an uncertainty function, which includes uncertainty in time (T), but that for the five central WFZ segments, the uncertainty due to T is swamped by the uncertainty introduced by the small earthquake data set (x events in y years or x inter-event intervals in y years). Nico noted that with fewer events, the earthquake distribution gets wider and less specific.

The CEUS SSC study uses two approaches to develop probability distributions for λ. Approach 1 (A1) is based on number (N) of earthquakes in time (T); Approach 2 (A2) requires earthquake timing information and is based on the inter-event intervals between individual earthquakes. Both approaches include the open time intervals since the most recent and oldest events in the earthquake record for each segment. Nico noted that the two approaches have not given the same answer, and he is not sure why this is the case other than the basic data are different (total events over time [average intervals] versus actual inter-event intervals between dated earthquakes).

Since information is available on earthquake timing for the five central segments of the WFZ, Nico used A2 for this round of recurrence calculation, rather than A1, which he used for the calculations presented at Meeting Eight. Applying A2 to the individual central WFZ segments results in large differences in the length of the recurrence intervals compared to A1. A1 typically produces recurrence intervals that are shorter than the segment recurrence intervals obtained from paleoseismic trenching data, while A2 typically gives recurrence intervals that are longer than those obtained from either A1 or the paleoseismic data. It seems logical that the two CEUS methods should produce results that are close to the actual paleoseismic segment recurrence intervals. Nico is not sure why they do not, other than it may be a consequence of very small samples (N) and the statistics of small numbers. Nico stated that he can see what the CEUS did, but he is not yet comfortable with the basic methodology. So at this point, he recommends applying the CEUS methodology for the WGUEP process because it is published and referenceable, but he is not happy with the results obtained to date and will investigate it further.

Ivan contacted Bob Youngs (USGS) via email, and reported that it was Bob's opinion that A2 is more consistent with the BPT renewal model because it honors the information available for individual earthquakes. Therefore, Bob considers A2 the preferred methodology for the WGUEP analysis where the necessary data are available.

Some of the extreme tail values ($95^{th}$ percentile) for Nico's recurrence probability distributions determined using A2 are greater than 17,000 years. Ivan questioned whether we want to report those values in our final report. Mark stated that we need to check "participation rates" to ensure that we do not need unreasonably large ruptures to maintain our slip rates (i.e., our rupture scenarios don't include enough earthquakes).

Nico then presented the results of using A2 to calculate recurrence for the five central WFZ segments as a whole by grouping the data for the 22 segment earthquakes without regard to the segment on which the individual earthquakes occurred. The expectation being that grouping the data will provide a larger and more robust data set. The CEUS SSC study provides no guidance for applications using grouped data for either A1 or A2. Using the grouped data, A2 produced a larger recurrence value than that obtained by using A1, and likewise larger than the value obtained by simply averaging the five individual segment recurrence values. This may be due in part to Nico's inclusion of open intervals from each segment in the grouped data. Jim Pechmann stated that in his opinion, calculating a single Poisson rate for all five central WFZ segments should not include individual segment open intervals, but rather only the oldest of the old and youngest of the young intervals for the five segments as a whole.

Nico also applied A2 to the WGUEP multisegment rupture scenarios using grouped data and discovered the same effect; A2 gave higher recurrence values than A1. Considerable discussion ensued about why this was so, and Nico stated that he was not satisfied with his results, but is unaware of other efforts to use grouped data in a similar way that could provide guidance for our project.

Patricia Thomas stated that it is not clear that we are applying A2 correctly when we use grouped data for the multisegment ruptures. There are too many unanswered questions, and the

final probabilities of the grouped versus non-grouped data aren't that different. The Working Group decided to discontinue using grouped data for calculating recurrence probability distributions for the WGUEP multisegment rupture scenarios, but to continue using grouped data for the single segment rupture scenario. Nico will look into the issue of how to handle the open intervals for that calculation.

**BPT Rate Parameter**

The BPT repeat time parameter μ (arrival times) combines earthquake inter-event intervals and α (coefficient of variation [aperiodicity]) in a renewal model to develop time dependent recurrence interval probability distributions. The BPT renewal model will be applied to the WGUEP single segment rupture model for the five central WFZ segments, to the segments of the WFZ multisegment rupture models that are not involved in multisegment ruptures, and to the Antelope Island and Fremont Island segments of the Great Salt Lake fault. The multisegment rupture portions of those models will be treated in a Poissonian manner. A methodology that allows multisegment ruptures to be treated in a time dependent manner is not currently available.

The WGUEP has adopted a value for α of 0.5 ± 0.2. Using examples from the five WFZ central segments, Nico demonstrated how varying α produces different recurrence times for the segments. Similarly to the Poisson model discussed above, grouped earthquake data for the five central WFZ segments will only be used to calculate a recurrence time for the single segment rupture model.

**Preliminary Probability Results: Part 1 Wasatch Fault**
**Patricia Thomas**
**(No PowerPoint available)**

Patricia made a PowerPoint presentation showing the results of the WGUEP earthquake probability calculations to date. These data are proprietary to the WGUEP process, and therefore the PowerPoint is not available on the UGS website. Patricia began by reviewing the component parts of the WGUEP WFZ earthquake forecast model:

- Fault models
- Deformation models
- Earthquake rate models
- Magnitude recurrence models for faults and floating ruptures
- Calculation sequence to obtain rupture source rates
- Probability models – Poisson and BPT model probabilities

**Five Central WFZ Segments**

Patricia reviewed the input characteristics of the five central WFZ segments used in the probability calculations: segment length and average displacement for single and multisegment rupture models, slip rate, seismogenic thickness, and fault dip. She discussed the weights assigned to the unsegmented and segmented rupture models of the WFZ, and the weights

assigned to the five segmented submodels – a single segment model and four alternative multisegment models.

Patricia discussed the characteristic magnitude ($M_{CHAR}$) values (weighted mean and 5$^{th}$ and 95$^{th}$ percentiles) for the five central WFZ segments individually and for the multisegment ruptures that she obtained from the four $M_{CHAR}$ magnitude relations currently adopted by the WGUEP (Hanks and Kanamori, 1979; Stirling and others, 2002; Wells and Coppersmith, 1994; and Wesnousky, 2008). She reviewed the magnitude distributions for the $M_{CHAR}$ values, and the two methods used to calculate rupture source rates (a-priori based on paleoseismic recurrence intervals and moment-balanced rupture rates derived from slip rates). A significant difference between the current probability calculations and those presented at Meeting Eight is the use of recurrence intervals for the five central WFZ segments that are based on the intervals between individual earthquakes, rather than average intervals based on N events in T time. The new recurrence intervals (A2) are systematically longer and have a wider distribution than the previous intervals (A1). See recurrence interval discussion above for details. Patricia then showed a series of graphs displaying the rate distributions obtained from various methods of determining recurrence rates for the five central WFZ segments, and a table that showed the implied slip rates obtained from the recurrence intervals for the single segment rupture model.

Patricia reviewed the slip-rate approach using moment-balanced recurrence intervals for the single segment rupture model, and their sensitivity to the $M_{CHAR}$ and slip-rate relations. The moment–balanced rates based on seismic moment ($M_O$) (Hanks and Kanamori, 1979) and censored surface rupture length (Stirling and others, 2002) $M_{CHAR}$ relations compare well with the a-priori rates, but the grouped rates are high. Patricia showed graphs that displayed the moment rates obtained for the five central WFZ segments for each of the $M_{CHAR}$ relations and for a composite weighting of the four relations. The Weber and Provo segments had consistently higher moment rates due to their longer lengths. Using recurrence intervals for the Poisson model (1/wt. mean rate), Patricia showed similar graphs for the four multisegment models and a comparison of the four model moment rates with the available segment moment rates using slip-rate distribution and 5$^{th}$ and 95$^{th}$ percentile slip rates. The available segment moment rate using slip-rate distribution plots above the four individual multisegment moment rates, and the 5$^{th}$ and 95 percentile bracket all but the tails of the minimum (fewest total events) model.

**Antithetic Faults**

Patricia then reviewed the manner in which antithetic faults are being handled in the WGUEP earthquake forecast model – either as rupturing independently or coseismicly with their master fault. The $M_{CHAR}$ relations used for the antithetic faults are the Wells and Coppersmith (1994) area relation and the Stirling and others (2002) censored surface rupture length relation. For coseismic rupture of the master and subsidiary faults, Patricia computes $M_{CHAR}$ for both faults, combines their moment, and computes $M_{CHAR}$ for the coseismic rupture. The rate is based on the recurrence interval of the master fault. Patricia showed a table of average separation distance, subsidiary fault length, and $M_{CHAR}$ for both the subsidiary and master faults for the five fault pairs in the WGUEP study area. Patricia asked for additional input regarding the Western Bear Lake (WBLF)/Eastern Bear Lake (EBLF) fault pair – specifically "with which EBLF

segment does the WBLF rupture? Or, does part of the WBLF rupture with each EBLF segment?" Mike Hylland and others will look into those questions and get back to Patricia.

**Probabilities – Central Wasatch Models/Recurrence Intervals ($M_T$)**

Patricia computed conditional probabilities for $M_T > 6.5$ and 7.0 in 30, 50, and 100 years for the five central WFZ segments using recurrence intervals. The Poisson model was weighted 0.8 and the BPT model 0.2. Probabilities for the Salt Lake City and Provo segments include coseismic rupture of the West Valley fault zone and Utah Lake faults, respectively. Patricia showed a series of tables with the probabilities for each segment, and a series of tornado plots showing sensitivity to input parameters for each of the five segments for M > 7.0 in 50 years using a-priori rates. Patricia then showed the probabilities for all of the WFZ central segment rupture models and for the unsegmented model using recurrence intervals for M > 6.5 and 7.0 in 50 years.

**Probabilities – Central Wasatch Models/Slip Rates (moment-balanced rates)**

Patricia next showed probabilities computed using slip rates (moment-balanced rates). For the WFZ single segment model, rupture rate is the segment moment rate (μ*area*slip rate) divided by the mean moment of the characteristic event. Patricia showed tables presenting Poisson and BPT probabilities for the Wasatch single segment model using slip rates for M > 6.5 and 7.0 in 50 years, and a composite table (combined Poisson and BPT probabilities) for the Wasatch single segment model for 30, 50, and 100 years. A series of tornado plots for the five central WFZ segments for a Poisson probability of M > 7.0 earthquake in 50 years using slip rate showed the sensitivity of the probability values to various input parameters. A final table showed a comparison of Poisson probabilities based on recurrence interval and slip rate for the Wasatch single segment model for M > 6.5 in 50 years. The probabilities based on slip rate were higher for all of the segments.

**Wasatch End Segments**

Patricia then discussed the WFZ end segments. For the northern end segments (Malad City, Clarkston Mountain, Collinston), the segmented and floating rupture fault models are weighted equally. The floating rupture model has a surface rupture length of 60 kilometers. The southern end segments (Levan and Fayette) also have segmented and floating rupture models weighted equally; the floating rupture model has a surface rupture length of 46 kilometers. The $M_{CHAR}$ magnitude relations applied to the WFZ end segments are the same relations used for the five central WFZ segments, but the relations are weighted differently. Patricia presented a table of WFZ end segment lengths (mean and $5^{th}$ and $95^{th}$ percentiles) and segment slip rates (mean and $5^{th}$ and $95^{th}$ percentiles). A second table showed weighted mean $M_{CHAR}$, slip rate, and recurrence ($1/\lambda$) values for the end segments and probabilities based on slip rates for M > 6.5 for 30, 50, and 100 years.

**Wasatch Unsegmented Model**

Patricia presented Poisson probabilities for three WFZ floating rupture models for a M > 6.5 earthquake in 30, 50, and 100 years. The floating rupture is represented by a truncated exponential model with an $M_{MIN}$ of 6.5, $M_{MAX}$ of 7.6, and b-value of 0.8. The three rupture models were (1) entire fault, (2) five central segments, and (3) unsegmented. Additionally, two floating ruptures were used to model higher slip on the central segments.

**Summary**

To summarize her presentation, Patricia showed a table of total Wasatch fault probabilities for M > 6.5 and 7.0 earthquakes in 30, 50, and 100 years – they are significant.

## "Final" Preliminary Results: Part 2 Oquirrh-Great Salt Lake and Other Faults
## Patricia Thomas
## (No PowerPoint available)

**Oquirrh-Great Salt Lake Fault Zone**

Patricia described the current model for the combined Oquirrh and Great Salt Lake fault zones (O-GSLFZ), which consists of four segmented and one unsegmented rupture scenarios. Rupture rates for the Oquirrh fault zone (OFZ) comes from slip rates, recurrence intervals for the Great Salt Lake fault zone (GSLFZ), and slip rates for the unsegmented scenario (higher slip rate on the GSLFZ). A time-dependent BPT branch of the logic tree will be included for the Fremont Island and Antelope Island segments of the GSLFZ.

Patricia then reviewed the five rupture scenarios for the combined O-GSLFZ, the weights assigned to each, and the rupture source characteristics (rupture length, slip rate, and recurrence interval) for each scenario. She also reviewed the magnitude recurrence models used for the segmented ($M_{MAX}$ and Uniform Distribution [boxcar]) and floating earthquake (Truncated Exponential) scenarios.

Patricia presented the moment-balanced rates (recurrence intervals) obtained from slip rates for the O-GSLFZ segmented rupture scenarios using the Stirling and others (2002), Wells and Coppersmith (1994), Wesnousky (2008), and Hanks and Kanamori (1979) $M_{CHAR}$ relations. This was followed by two graphs demonstrating the impact of the different $M_{CHAR}$ relations on rupture rate and moment rate. Patricia also showed a table that presented implied slip rates derived from recurrence intervals for the GSLFZ segmented rupture sources, and a table that compared the segment moment rates for all of the O-GSLFZ rupture models.

Patricia then presented a table of O-GSLFZ segment probabilities for a M > 6.5 earthquake in 50 years. The table included time-dependent probabilities for single segment ruptures of the Fremont Island and Antelope Island segments of the GSLFZ. As expected, the final weighted mean probabilities were highest for the GSLFZ segments and became progressively lower from north to south for the OFZ segments.

**Other Faults**

Patricia summarized the characteristics of the "Other" faults in the WGUEP study area as follows.

- Fault Characteristics:
  - No length uncertainty
  - Seismogenic thickness
    - West of Wasatch: 12 km (0.2) 15 km (0.7) 18 km (0.1)
    - East of Wasatch: 12 km (0.1) 15 km (0.7) 18 km (0.2)
    - Joes Valley fault zone and Snow Lake graben:
      3 km (0.8) 12 km (0.02) 15 km (0.14) 18 km (0.04)
    - Antithetic subsidiary faults: rupture width controlled by truncation of master fault
  - Fault dips: 35 (0.3) 50 (0.4) 65 (0.3)
    - Hansel Valley: 35 (0.3) 50 (0.4) 90 (0.3)
    - Joes Valley fault zone and Snow Lake graben: 55 (0.3) 70 (0.4) 85 (0.3)
- Magnitude Recurrence Models
  - 0.8 wt. $M_{MAX}$
  - 0.2 wt. Truncated Exponential with b-value = 0 (uniform/boxcar)

Patricia then presented a table of $M_{CHAR}$ relation weights as they apply to category B, C, and antithetic faults in the WGUEP study area. A series of follow-up tables summarized rupture length for the segmented "Other" faults, and presented weighted mean $M_{CHAR}$ values for those faults based on Stirling and others (2002), Wells and Coppersmith (1994), Wesnousky (2008), and Hanks and Kanamori (1979). Those tables were followed by additional tables that presented the weighted mean slip rate, weighted mean recurrence, weighted mean $M_{CHAR}$ values, and Poisson probabilities for a M > 6.5 earthquake in 30, 50, and 100 years for the "Other" segmented faults.

Similar summary tables were then presented for the WBLF/EBLF antithetic fault pair, for independent models of the WVFZ and Utah Lake faults, and for the non-segmented "Other" faults in the WGUEP study area.

Finally, Patricia presented a table of Wasatch Front region fault (earthquake) probabilities for M > 6.5 and 7.0 in 30, 50, and 100 years for the WFZ, O-GSLF, "Other" faults, and for all faults combined. They are high and of significant concern.

Based upon Patricia's review of the fault parameters used as input to the probability calculations for faults in the WGUEP study area, the following parameter modifications were either made or will be further investigated for possible future modification.

- Re-evaluate segment boundary uncertainty limits for the five central segments of the WFZ
- Change all segmented "Other" faults to B category faults.

- Joes Valley fault zone
  - Probability of activity: 0.4
  - Rupture model: 0.6 shallow penetrating (4 km), 0.4 deep penetrating (15±3 km)
- Hansel Valley fault
  - Change dip to 15±3 km (W)
  - Weight slip rate at 1.0 to remove recurrence from the fault model
- Bear River fault
  - Use single closed recurrence interval and the open interval since the most recent earthquake as determined from the timing of most recent and penultimate events (West, 1994) rather than the Utah Quaternary Fault Parameters Working Group (2005) slip rate.

With regard to the recurrence intervals for the five WFZ central segments, Nico will continue to evaluate the effect of open intervals (young and old) on his recurrence calculations. Additionally, Ivan will consult with Bob Youngs (USGS) regarding grouping methodologies and the proper way to proceed with our recurrence analysis.

## FINAL REPORT PREPARATION SCHEDULE

Ivan stated that there will be one more round of probability calculations and those values will be used for the final report. Once a draft report is complete, it will be given to the Working Group members for review, and the group will then meet in June (Meeting Ten ) to deal with any final issues before submitting the report for outside review.

Ivan than reviewed the remaining inputs required for the report, the individual(s) responsible for each input, and the schedule for receiving the information. Required inputs and schedule are as follows:

- Finalize paleoseismic data for the Provo segment – Susan/late March
- Update the Wasatch fault zone end segments data and write up – Mike/early March
- Write section on fault segmentation – Dave/late February
- Write section on depth to seismogenic faulting – Jim/late March
- Finalize recurrence interval calculations – Nico/middle March
- Write Calculating Magnitude section – Chris and Susan/late March
- Get O-GSLF revised slip-rate and recurrence numbers to Patricia and write Oquirrh-Great Salt Lake fault zone section – Susan and Jim/late April
- Update "Other" faults section – Bill/late March
- Complete consensus earthquake catalog and write Historical Seismicity Catalog and Addressing Background Earthquake section – Walter, Jim, and Mark/late April
- Write Crustal Deformation from Geodetic section – Jim and Bob/late March
- Finalize probabilities and write Calculating Earthquake Probabilities section – Ivan and Patricia/late April
- Write Methodology and Models section – Ivan and Patricia/late March

- Write Future Directions and Limitations section – Ivan/late April

The goal is to have a completed draft report by middle May, after which the Working Group members will have one month to perform their reviews followed by a meeting in June to resolve any remaining issues before submitting the report to outside review.

## MEETING ADJOURNED

WGUEP Meeting Nine was adjourned at 2:30 p.m. The date for Meeting Ten is scheduled for June 17-18, 2013.

## REFERENCES


Hanks, T.C., and Kanamori, H., 1979, A moment magnitude scale: Journal of Geophysical Research, v. 84, p. 2348-2350.

Lund, W.R., 2005, Consensus preferred recurrence-interval and vertical slip-rate estimates, Review of Utah paleoseismic-trenching data by the Utah Quaternary Fault Parameters Working Group: Utah Geological Survey, Bulletin 134, 109 p., available at http://ugspub.nr.utah.gov/publications/bulletins/B-134.pdf.

Stirling, M., Rhoades, D., and Berryman, K., 2002, Comparison of earthquake scaling relations derived from data of the instrumental and preinstrumental era: Bulletin of the Seismological Society of America, v. 92, no. 2, p. 812-830.

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Wells, D.L., and Coppersmith, K.J., 1994, New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement: Bulletin of the Seismological Society of America, v. 84, p. 974-1002.

Wesnousky, S.G., 2008, Displacement and geometrical characteristics of earthquake surface ruptures—Issues and implications for seismic-hazard analysis and the process of earthquake rupture: Bulletin of the Seismological Society of America, v. 98, p. 1609–1632.

West, M.W., 1994, Seismotectonics of north-central Utah and southwestern Wyoming – Paleoseismology of Utah, Volume 4: Utah Geological Survey Special Study 82, 93 p., available at http://ugspub.nr.utah.gov/publications/special_studies/SS-82.pdf.

## ATTACHMENT 1

**Attendance**
**Working Group on Utah Earthquake Probabilities**
**Meeting 9**

Walter Arabasz, UUSS
Tony Crone, USGS
Chris DuRoss, UGS
Mike Hylland, UGS
Nico Luco, USGS
Bill Lund, UGS, Coordinator
Susan Olig, URS Corporation
James Pechmann, UUSS
Steve Personius, USGS
Mark Petersen, USGS
Dave Schwartz, USGS
Bob Smith, UUGG
Patricia Thomas, URS Corporation
Ivan Wong, URS Corporation, Chair

Others presenting or assisting the Working Group
Steve Bowman, UGS Liaison to WGUEP

**ATTACHMENT 2**
**AGENDA**
**WORKING GROUP ON UTAH EARTHQUAKE PROBABILITIES**
**MEETING 9**
**Wednesday/Thursday 6 & 7 February 2013**
**Utah Department of Natural Resources Building, Room 2000 (2nd floor)**
**1594 West North Temple, Salt Lake City**

**Wednesday, 6 February**

| | | |
|---|---|---|
| 8:00 – 8:30 | Continental Breakfast | |
| 8:30 – 9:00 | Overview of Agenda and Review of Last Meeting's To Do List | Ivan |
| 9:00 – 9:30 | Update on Consensus Wasatch Front Earthquake Catalog | Walter |
| 9:30 – 10:15 | Calculation of Recurrence Intervals | Nico |
| 10:15 – 10:30 | Break | |
| 10:30 – 12:00 | Preliminary Results and Discussion of Final Model Weights | Patricia |
| 12:00 – 1:00 | Lunch | |
| 1:00 – 5:00 | Preliminary Results and Discussion of Final Model Weights (continued) | Patricia |

**Thursday, 7 February**

| | | |
|---|---|---|
| 8:00 – 8:30 | Continental Breakfast | |
| 8:30 – 10:00 | Preliminary Results and Discussion of Final Model Weights (continued) | Patricia |
| 10:00 – 10:15 | Break | |
| 10:15 – 12:00 | Report | Ivan |
| 12:00 – 1:00 | Lunch | |
| 1:00 – 3:00 | To Do List/Schedule | Ivan |

WGUEP Members

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|---|---|---|
| Ivan Wong, URS (Chair) | Mark Petersen, USGS | Chris DuRoss, UGS |
| Bill Lund, UGS (Coordinator) | Steve Personius, USGS | Mike Hylland, UGS |
| Walter Arabasz, UUSS | David Schwartz, USGS | Susan Olig, URS |
| Jim Pechmann, UUSS | Nico Luco, USGS | Patricia Thomas, URS |
| Tony Crone, USGS | Bob Smith, UUGG | |

Other Participants
Steve Bowman, UGS