Supplementary Material

# Workshop Details

The NHERI RAPID Facility Community Workshop "*Identifying Data Gathering Opportunities and Facility User Needs*" was held on January 26-27, 2017, on the campus of the University of Washington, in Seattle, WA, USA.

# List of Workshop Participants

*Name, Title, Affiliation*

Ann Bostrom, Professor, University of Washington

Charles Huyck, Senior Vice President, ImageCat, Inc.

Chris Massey, Institute of Geological and Nuclear Science (GNS Science)

David Frost, Professor, Georgia Institute of Technology

David Johnston, Professor, Massey University and GNS Science

David Mendonca, IMEE Program Director, NSF

David Swanson, Reid Middleton/SEAW/UW

Dawn Lehman, Professor, University of Washington

Don Resio, Director, Taylor Engineering Research Institute University of North Florida

Dorothy Reed, Professor, University of Washington

Ellen Rathje, Professor, University of Texas

Herman Fritz, Associate Professor, Georgia Institute of Technology

Ian Robertson, Professor, University of Hawaii

Jay Berger, EERI

Jeffrey Berman, Associate Professor, University of Washington

Jennifer Irish, Associate Professor, Virginia Tech

Jesse McNinch, Researcher, USACE-ERDC Field Research Facility

John van de Lindt, Professor, Colorado State University

Jonathan Godt, Program Coordinator, Landslide Hazards, U.S. Geological Survey

Joseph Wartman, Associate Professor, University of Washington

Joy Pauschke, Program Director, NHERI and ENH, NSF

Kent Yu, Principal, SEFT Consulting Group

Kristin Ludwig, Staff Scientist, US Geological Survey

Kurtis Gurley, Associate Professor University of Florida

Laura Lowes, Professor, University of Washington

Lori Peek, Director and Professor, Natural Hazards Cent. and Univ. of Colorado-Boulder

Marc Eberhard, Professor, University of Washington

Maria Esteva, Data curator, Texas Advanced Computing Center

Mark Pierepiekarz, President, MRP Engineering

Michael Lindell, Affiliate Professor, University of Washington

Michael Olsen, Associate Professor, Oregon State University, RAPID

Nicole Errett, Lecturer, University of Washington

Patrick Lynett, Professor, University of Southern California

Rachel Davidson, Professor, University of Delaware

Rebekah Paci-Green, Western Washington University

Richard Fragaszy, Program Director, National Science Foundation

Robert Kayen, Professor/Senior Scientist, UCLA/US Geological Survey

Scott Miles, Senior Research Scientist, University of Washington.

Stephen Mock, Director of Advanced Computing Interfaces, TACC

Tim Cockerill, DesignSafe Deputy Project Director University of Texas, TACC

Troy Tanner, Senior Engineer Applied Physics Lab, University of Washington, APL

Yong Wei, Principal research scientist, University of Washington & NOAA PMEL

Jonathan Bray , Professor, Univ. of California Berkeley

Adda Athanasopoulos-Zekkos, Associate Professor, University of Michigan

Andre Barbosa, Assistant Professor Oregon State University

Andrew Graettinger, Professor, The University of Alabama

Andrew Kennedy, Associate Professor, University of Notre Dame

Chris Poland Consulting Engineer Chris D. Poland Consulting Engineer

Costas Synolakis, Professor, University of Southern California

Craig Glennie, Associate Professor, University of Houston

David Prevatt, Associate Professor, University of Florida

Dhiraj Murthy, Associate Professor, University of Texas at Austin

Frank Lombardo, Assistant Professor, University of Illinois at Urbana-Champaign

Gilberto Mosqueda, Professor, University of California, San Diego

Jon Heintz , Executive Director, Applied Technology Council

Jonathan Stewart, Professor, UCLA

Julie Demuth Project Scientist, National Center for Atmospheric Research (NCAR)

Justin Marshall, Associate Professor Auburn University

Leonardo Duenas-Osorio, Associate Professor, Rice University

Pamela Murray-Tuite Associate Professor, Virginia Tech

Richard Wood Assistant Professor University of Nebraska, Lincoln

Robert Weiss Associate Professor of Geoscience Virginia Tech

Tara Hutchinson, Professor, UC San Diego

Youssef Hashash, Professor, University of Illinois at Urbana-Champaign

Khalid Mosalam, Taisei Professor & PEER director, UC Berkeley & PEER

# Transcriptions of Sticky Notes from Session "Reconnaissance Challenges & Successes Timelines Activity"

**Summary of instructions to participants (day 1 break-time activity)**

***Part 1: Reconnaissance Timeline Challenges***

• Think back to previous reconnaissance missions and tell us about challenges or pain points you have faced Before, During, and After working in the field. Write one challenge per sticky note and post each one on the appropriate board.

For example….

Before

- Submitting a proposal, gathering information about a locale’s culture, lack of equipment knowledge

During

- Poor internet connection, language barriers, bulky technology

After

- Translating data, transmitting data, emotional toll

***Part 2: Reconnaissance Timeline Successes***

• Think back to previous reconnaissance missions and tell us about successes or positive experiences you have had Before, During, and After working in the field. Write one success/experience per sticky note and post each one on the appropriate board.

For example….

Before

- A successful proposal, learning about the locale, an opportunity to try a new method

During

- Collaboration with colleagues, gaining access to sites, functioning technology

After

- New insights, a publication, further research in the locale

• Write one answer per sticky note and post on the appropriate poster board.

• Post at least one answer on each board.

• Walk the boards to learn about your colleagues’ challenges and successes.

**2. Format and legend for transcriptions**

Each line below represents response or comment written on a sticky note. Each line contains: (1) sticky note unique identifier code, (2) transcribed response from participant, (3) primary discipline of participant (g = geotechnical engineering, c = coastal engineering, s = structural engineering, and o = social sciences)

Challenges Before Reconnaissance

SS1 Getting IRB approved. Getting IAA agreements in place across multiple institutions with one lead o

SS2 Contracting(often totally overwhelmed) community leaders in a meaningful way and ethical way to achieve success o

SS3 Training all team members on ethics + practice of field research o

SS4 Knowing who to interview in the locale o

SS5 How to look for data related to community resilience o

SS6 Adopting/creating of metadata standards for documenting scientific or social recon data o

SS7 Time Zone support when making appointment o

SS8 Educating non-social/scientists in what IRB is and why approval is important o

SS9 Establishing structural baseline data that is collected regularly o

SS10 Getting human subjects approval in such short time, especially because some interview questions needed to be specific to the event(so couldn't get approval on advance o

SS11 Getting there fast enough o

SS12 Network with locals c

SS13 Communication on large groups c

SS14 Having access permits in place c

SS15 Funding in time to get perishable data c

SS16 Perform recon while funding is not yet certain c

SS17 Having funding in place -short fuse c

SS18 No transportation in affected area c

SS19 Budgets c

SS20 defining a clear scope of work that is adaptable c

SS21 Hydrodynamic and erosion data during event needs pre-deployment c

SS22 Planning for the whole trip to dial with miscellaneous. Knowing what equipment to bring, and get them ready for the trip c

SS23 Delays with days waiting for Indonesian research vessel off Sumatra (Mentanai 2010) c

SS24 Shipping g

SS25 Funding geo data for overseas sites g

SS26 I would like to use remote sensing data but do not know how to process g

SS27 Coordination of multiple research objectives from multiple teams g

SS28 Visas and vaccines g

SS29 Appropriate team size + composition g

SS30 Securing sufficient funding g

SS31 Navigating local politics/fends among in-country investigators during team building g

SS32 Confirming meetings with utility operators g

SS33 Coordination with other field teams g

SS34 Going through "official" channels g

SS35 Lack of local contacts and authorization g

SS36 Where are all the damaged buildings? s

SS37 Funding ORGs "do not" support multi-disciplinary work or may not s

SS38 Getting immunizations before trip(to Haiti) s

SS39 Documenting objective for data collection for specific research objective -would be nice to have this done s

SS40 Natural Hazards do not mind calendar s

SS41 Being prepared for the actual situation on the ground(i.e. Living, equipment) s

SS42 Need invitation from host country or organization -fast! s

SS43 Prioritizing sites for detailed investigation s

SS44 Have a "host" agency s

SS45 Assembling a diverse team s

SS46 Locating structures of interest during early visits-planning route s

SS47 Site access/scheduling for optimal time management s

SS48 Where to find damage/nondamage worth looking at and gathering data s

SS49 Getting all medical issues - i.e. vaccines- before travel to Haiti s

SS50 Access to large spatial lifetime data s

SS51 Identifying critical areas of damage for more detailed analyses s

SS52 Getting team and equipment together rapidly(<1 week) get to damaged region s

SS53 Obtaining strong motion records s

SS54 Best practices for data collection s

SS55 Shipping our equipment for laser scanning to Haiti s

SS56 Clearing schedule to go! s

SS57 Obtaining strong motion records that were taken s

SS58 Identication of recon targets s

SS59 Acquiring aerial/satellite imagery shortly after event for recon planning s

Challenges During Reconnaissance

RR1 Ensuring effective & efficient communication across disciplinary boundaries o

RR2 Don't Know when audio recording stops o

RR3 Difficult to access high-level decision makers o

RR4 Buggy hand-writing recognition on iPad o

RR5 Copying with the emotions of talking to people whose family and friends has died in the tornado o

RR6 Coordination with local/state/federal authorities o

RR7 People are busy! too many claims on their time. solutions? research might/could interfere o

RR8 Metadata standard for documentation of scientific and social science data. DDIdata documentation initiative. GIS standards o

RR9 watching a guy(an interviewer) physically abusing his dog o

RR10 traumatized populations. Dealing with all affected people in an ethical manner o

RR11 getting a true perspective about what happened o

RR12 Asking questions that are truly perishable. If not must ask whether rapid response is necessary o

RR13 Finding geolocated images produced by those in affected areas o

RR14 fielding media inquires o

RR15 No money for public health related reconnaissance. Need to add health/well-being to interdisciplinary work/proposal o

RR16 Finding where the power is out o

RR17 Rapid(fast) peer review g

RR18 very large geographical areas to cover, given the networked nature of lifeline systems g

RR19 Legal property access "by work", is often impossible. In truth, best judgment is used in many case. Can this be better addressed? g

RR20 Speed cameras in New Zealand g

RR21 weather/personal safety g

RR22 data QA/QC g

RR23 coordinating media messaging between/among agencies/academics g

RR24 access to enclosed facilities of utility operators g

RR25 technophobia g

RR26 Poor communications between teams because of mountains terrain g

RR27 Foreign translation (For non-English Spanish nations) g

RR28 Coordinating of large team, so as to avoid visits to the highest profile sites g

RR29 Battery weight charging + storage for lidar, UAV, surface wave systems g

RR30 In geotech, the linchpin to really making an impact, and what is often missing, in-site testing. What are the challenges to performing in site testing move routinely? g

RR31 Balancing the need to get the first paper on the event published with providing data/advice to same lives g

RR32 Getting people to buy-in to the importance/value of documenting non-failure sites g

RR33 Media questions when I am very busy g

RR34 Team(s) coordination while in field g

RR35 lack of general aviation in country g

RR36 powering devices g

RR37 Universal/Need for "official" site visit credential g

RR38 Land access g

RR39 Team member going "rogue"! g

RR40 Flow velocity measurement during storm surge & tsunami c

RR41 Fast peer review c

RR42 Access to site c

RR43 Access given roads impassable c

RR44 Having small footprint to not interrupt recovery operations c

RR45 Staying on schedule c

RR46 Ensuring that data were collected and "good"! requires some level of in the field processing c

RR47 Access to required infrastructure(vessels, generators) expensive to get needed infrastructure to site c

RR48 Have hard time to access dense plantation. Have restrict rules of flying drones c

RR49 Injury c

RR50 Anticipated problems. Serious injuries c

RR51 Got sick during the trip s

RR52 Collection comprehensive data without enough time s

RR53 Multi-talent team s

RR54 Renting the right vehicle for the task s

RR55 Communication between teams in the field and at home. And data transfer s

RR56 How can I see/expose their beam-column connection s

RR57 Laser scanning in a busy square in port an price with lots of traffic and people moving our targets s

RR58 Having so efficient time to process/digest observations and data on the fly. (to support next days planning) s

RR59 Power source for electronic data collection s

RR60 Clean and reliable power s

RR61 Carrying equipment s

RR62 Power Infrastructure people hate researchers s

RR63 Getting access to buildings-damaged and undamaged s

RR64 Connect with data with reconnaissance: time, location, informing photo wrapping, video, oral info s

RR65 Transporting equipment s

RR66 Maintaining research focus with all interesting/valuable data present s

RR67 No craft beer availability s

RR68 Visualizing damage distribution within a structure s

RR69 Unable to access damaged buildings! s

RR70 Too Late to investigate collapsed buildings s

RR71 Coordinating with other teams and local officials s

RR72 Comprehensive documentation of structural damage s

RR73 Access to buildings and closed areas. Not enough time to gather all the information needed s

Challenges After Reconnaissance

QQ1 Takes a long time to find best photographs o

QQ2 Distilling technical infor for different audiences o

QQ3 Communicating and disseminating results to stakeholder who need it o

QQ4 How to pass the data on so it is usable by others o

QQ5 funding to collect data but not analyze o

QQ6 Having to transcribe notes o

QQ7 General standards for describing scientific and social data o

QQ8 Why is data collected? to what end? Who are you helping? how are you furthering services? o

QQ9 Data archiving and curation so that is sharable, useful to hazards and risk researchers o

QQ10 Identifying citizen stakeholders o

QQ11 Writing up challenges after and disseminating results. Time constraints, team members in different locations, etc. o

QQ12 TIME! c

QQ13 Communication with a large group c

QQ14 Funds to sustain equipment and personnel for next event and questions c

QQ15 Capturing post event recovery c

QQ16 Found out my DGPS devices was all wrongly set up and all measurements were wrong c

QQ17 Formatting data (once) and distributing it once c

QQ18 Analyzing "imperfect" data c

QQ19 Drawing conclusions given error in observed data (tradeoff of accuracy vs. access) c

QQ20 Data Sharing with distributed colleagues g

QQ21 Data analysis of restoration time-series: too short, too coarse, etc. g

QQ22 Getting team members to upload data and contribute to reports g

QQ23 Photo dump (100s -1000s) g

QQ24 Report prep, 1/2 life decay of team motivation g

QQ25 Field data attribution g

QQ26 Supporting students to help with data processing g

QQ27 Data processing is time intensive g

QQ28 Lack of data on decision making by lifeline operators to explain restoration process g

QQ29 Data not able to be used a year later due to lack of documentation g

QQ30 lack of baseline data (before event) to compare with new data g

QQ31 Not writing report (guess who?) g

QQ32 Completing report writing after recon g

QQ33 lack of mental health services g

QQ34 Difficulty in getting follow-up trips...need re-visits for a period of years g

QQ35 team members non responsive g

QQ36 Accurately reducing large amounts of data into usable knowledge s

QQ37 Handling various data types/formats s

QQ38 Point cloud processing power s

QQ39 How to deal with redundant data (1000 photos of the same building) s

QQ40 No money to support data analysis s

QQ41 Knowing where to look for "good" data s

QQ42 Lack of funding for student help with post-processing data s

QQ43 Finding detailed information about specific buildings, time and resources to process and study the information gathered s

QQ44 Curation of large volume of data s

QQ45 Funding for analysis of data and structural modeling and analysis s

QQ46 Staying in touch with host organization after field work to learn and give back s

QQ47 Recalling metadata not recorded s

QQ48 Poor qualification and quantification of structural damage in individual components s

QQ49 Missing/incomplete data...knowledge of critical data (connections hide!)...knowledge of material characteristics s

QQ50 Insufficient damage data, cannot identify location of damage in building layout s

QQ51 Processing all of that data s

QQ52 No money, Mo' problems, data analysis decayed as a result s

QQ53 Keep in touch with "host" on recovery before and lessons s

QQ54 Getting information about building design (i.e. drawings) so that in depth evaluation is possible s

Successes Before Reconnaissance

ID Note Discipline

PP1 Participating in emergency exercises (keep blades sharp, learn ICS) o

PP2 Able to coordinate around 50 interviews in 2 weeks before field o

PP3 At NIST Center, we trained engineers, economists, and social scientists on ethical practices, got IRB+RAA in place... were ready to so in the field o

PP4 Identifying engineering collaborators o

PP5 Early identification of team lead and then handling control/responding over to that individual g

PP6 communication with local scientists/engineers g

PP7 Creating a large interdisciplinary team c

PP8 Community sense of mission of GEER S.C c

PP9 Access to official government briefs on utility restoration (power, telco, etc.) c

PP10 Understand local building code c

PP11 Information on areas with and without damage c

PP12 Pulling together great people who had self-funding to add to a team with limited resources c

PP13 Accessing remote sensing and ground motions to guide reconnaissance planning c

PP14 Leveraging federal contacts c

PP15 On top of NSF-RAPID for Japan zoll received, RIEAL LIDAR from NSF supported UNAVEO-Facility c

PP16 First Iran export license for any Geo-tech faculty received from state department, Iran Desk, and US treasury at 10pm Friday 1 hour before flying to Iran c

PP17 Have modality results available for the site so that we know where to go, which saved a lot of time c

Have a good project manager to make good plans

PP18 Field technicians that had expertise c

PP19 Equipment that works c

PP20 Needed equipment is available on time! c

PP21 Working with local agency government and locals c

PP22 Found good satellite pictures s

PP23 Contacting appraiser in the affected community to download ArcGis maps and property parcels s

PP24 Temporary equipment "import" s

PP25 Coordination and relationships with local entities/partners s

PP26 Collaboration with local (Japan) engineers to assist with logistics and survey s

PP27 Embedding with US army to provide security (in Haiti) s

PP28 Having people (students) on the teams who speak the language s

PP29 Able to join a multidisciplinary team s

PP30 Identifying local contacts before leaving s

PP31 Availability of data to guide robust planning of the trip -satellite -pilot teams, etc. s

PP32 Contacting people before our visits to guide us s

PP33 Know "Host Country" culture s

PP34 Established team partner - ships with university of government institutions before reconnaissance trip s

PP35 Working with local engineers to gain access s

PP36 Integrating with USGS + US Army in Haiti s

PP37 Good Email coordination with native groups (essentially for determining sites to visits) s

PP38 Secured wind speed maps to Identify hazard intensity - stratified target zones s

Successes During Reconnaissance

OO1 Used hand writing recognition on iPad- made interviews more natural o

OO2 Openness, people willing to talk o

OO3 Knowing how research fits into event/hazard specific research agenda o

OO4 Processing the challenges of being in the field and interviewing tornado survivors w/ a colleague o

OO5 Pizza & beer o

OO6 Collaborating with local field teams/enrich data/minimizes ethical harm o

OO7 New colleagues /collaborations o

OO8 Used Evernote to record audio & type at some time o

OO9 Forming new & unexpected connections+applications of technical info o

OO10 Commitments of data sharing from utility operators on network layouts and service restoration g

OO11 Find your friends g

OO12 Collaboration/ Before, During, After g

OO13 Exposure to new/diverse ideas+methods from a multi discipline team g

OO14 Capturing building settlement measurements with laser floor level g

OO15 Small hazard-focused teams with availability of equipment g

OO16 End-of-day full team briefings over dinner, followed by planning next day activities g

OO17 Working with local media to disseminate findings to locals g

OO18 Success of iPhone/Android App to centralize + geotag observations g

OO19 Fast landslide inventory g

OO20 Use of drones to 'access' sites that are difficult or dangerous to get a person to g

OO21 Local cooperation g

OO22 Shared use of technology so for example LIDAR teams are arranged specific targets and can optimize data collection g

OO23 Breakthrough in data and rapidly adapting staff to take advantage of this a

OO24 Opportunities for multi-disc interaction c

OO25 Collaboration between teams=more effective data gathering c

OO26 Elders provided access with local armed guards facilitations Somalia tsunami survey c

OO27 Equipment and ancillary support gear works! limited shot to collect short lived data c

OO28 Recovered instruments post- storm c

OO29 Good local guides c

OO30 Data QA/QC c

OO31 Inspire young student to study natural hazards c

OO32 Block-by-block intensive survey of a representative area s

OO33 Team work, hard working multi-disciplinary teams work was culturally sensitive to impact on citizens and ambassadors s

OO34 Availability of strong motion records during reconnaissance s

OO35 Multiple teams assess each structure for variance s

OO36 Technical staff (outside domain, e.g. computer scientists) on the ground w/ team, offer...- outside perspective -relieve an SE/GE to allow them to focus on EQ-damage issue s

OO37 Having teams to do quick overview surveys and prioritize sites for detailed investigation s

OO38 Found a building owner w/ drawings s

OO39 Detailed 3D field data from damaged or undamaged structures s

OO40 Collection of material property data ( Concrete & steel) to perform nonlinear analysis of building s

OO41 Equipment redundancy especially for laptop/ hot summer (110 degree F) in Haiti s

OO42 Finding buildings that out perform expectations/ Interaction with other disciplines s

OO43 Working with local academic & practicing structural engineers s

OO44 Communicating w/o words due to foreign languages s

OO45 Integrating w/ local efforts to provide better access s

OO46 "Experienced" Recon team Members s

OO47 Found accidentally left equipment from day before s

OO48 Gathering building data most important drawings s

OO49 Using a blog for daily communication of the team s

OO50 Wearing a hard hat means you're official s

Successes After Reconnaissance

NN1 New and long-lasting friendships and work relationships with people who were in the field with you... especially given the difficulty of what we saw (as we interviewed tornado survivors) o

NN2 Created an apple script to turn recording to text o

NN3 When local communities feel that their contributions made a difference! o

NN4 Able to use data in a journal article o

NN5 New and lasting collaborations/ relationships o

NN6 New applications of results (often unanticipated) o

NN7 Gathering data that led to follow on research that had significant impact g

NN8 Team interactions with key people in affected country's; government officials help in its response to disaster g

NN9 Quick and coordinated final report amongst all field/ RAPID teams g

NN10 Data available for follow on research g

NN11 Progressing the recon data into modeling and the results being used to inform policy! Four years after the initial earthquake g

NN12 Elevating web based report and data delivery g

NN13 Local collaborators provide missing data/ gaps g

NN14 Rapid perishable data leading to significant follow on funding and new insights g

NN15 Follow on RAPID proposals to examine issues in more detail g

NN16 Publication of paper and report g

NN17 provision of actionable info to decision makers g

NN18 Small cadre of team members gets out rapid report that has large impact. g

NN19 Policy and management change c

NN20 First hand data availability, publications c

NN21 Good publications and building a long-term team c

NN22 Learning and understanding increased c

NN23 Improved understanding of processes and impacts c

NN24 Tsunami hydro-graph from eyewitness video and lidar 3D point cloud collected after Japan 2011 c

NN25 Improved public understanding of coastal structure (hard and soft) roles c

NN26 Multi-national and multiuniversity dissemination of data share s

NN27 Communicate lessons learned to public / media (uniform MSG) s

NN28 Coordinate and analyze data from disparate sources: ground motion, site, building damage, building geometry and reinforcement/ detailing s

NN29 Continued interaction and collaboration with local researchers s

NN30 Robust central data repository (GEER-ftp offers a simple sharing resource for all example) s

NN31 Published results before momentum is lost s

NN32 Creating a unified "lessons learned" documenting to be used to educate researchers, public officials and media s

NN33 Creation of abbreviated set of reference data for quick future reference s

NN34 Applying what is learned to codes and standards under development s

NN35 Confidence gained related to being able to predict performance s

NN36 Development of Asce7-16 Tsunami design standard s

NN37 Coordination with other teams and new collaborations s

NN38 Analyzing data with interdisciplinary team who genuinely liked each other s

# Transcriptions of Sticky Notes from Session "Grand Challenges Reconnaissance Data Needs Activity"

1. Summary of instructions to participants (day 2 group activity)

• Focus on the Four National Research Council grand challenges:

- Community Resilience Framework

- Hazard and Impact Simulation and Decision Making

- Mitigation

- Design Tools

• Two tables for each grand challenge, each with a facilitator

• Four 30 minute rounds, facilitator rotates each round

- Brainstorm

- Refine and Cluster

- Cluster and Prioritize

• One idea per sticky note; use color for your discipline

• Report Out and Discussion of Priorities

2. Format and legend for transcriptions

Each line below represents a response or comment written on a sticky note. Each line contains: (1) sticky note unique identifier code, (2) transcribed response from participant, (3) total number of "dots" - group members "voted" for high priority items using "sticky dots"—items with a high dot count were deemed by the group to be most important (4) primary discipline of participant (g = geotechnical engineering, c = coastal engineering, s = structural engineering, and o = social sciences)

Design Tools

FF3 Measurements of dynamic demand: earthquake load, wind load, storm surge velocities, tsunami height 7 s

FF29 Design performance goals for structures, infrastructure, and critical systems 6 o

FF41 Performance of existing systems including protective technologies (isolation) 4 s

FF1 Data on disaster experience 3 o

FF38 Perishable social data 3 o

HH6 What are values and priorities of community for retrofitting and rebuilding; how does this differ before and after the disaster 3 o

HH52 Performance of specific existing geotechnical mitigation structure (e.g., debris basins) 3 g

HH53 Detailed case studies that can be used for model validation for buildings 3 s

FF4 Geotechnical demand: landslides, fault rupture, liquefaction....and interactions 2 c

FF10 Materials and details of structural systems 2 s

FF11 Regional scale building performance data to evaluate PBEE 2 s

FF14 Data form embedded sensors or cameras 2 c

FF28 Acceptable risk by population 2 o

FF30 Local construction practices and building process and formal building codes 2 s

FF37 Geocoded social data 2 o

HH23 In-storm information: photos etc. 2 c

HH31 Pre-event LIDAR and post-event LIDAR 2 c

HH32 Drones for different uses 2 g

HH35 Random sampling of damaged versus undamaged buildings 2 s

HH36 Geospatial data of strong motion (existing and new sensors) 2 s

HH59 Material properties for response analysis 2 s

FF12 Neighborhood level PBE modeling that goes beyond individual building performance 1 s

FF13 Improved sensor and data collection systems for instrumenting many more buildings; not just new ones; embedded in building components 1 s

FF31 Spatially and temporally coded data of all kinds 1 g

FF43 How businesses respond to damage or service interruptions 1 o

FF46 Remote sensors for human data 1 o

HH22 Sample along periphery of damage-no damage zone 1 c

HH25 Flow velocities from videos 1 c

HH57 Material samples to analyze later 1 c

FF2 Measurement of human response o

FF5 Ethics issues and citizens data o

FF6 Geocoded exposure monitors o

FF7 High density and closely spaced temporal data sets c

FF8 Citizen science data o

FF9 As built drawings of buildings, infrastructure affected s

FF15 High quality, high density geotechnical subsurface data g

FF16 n/a o

FF17 Instrumented infrastructure g

FF21 Metadata standards o

FF22 High computing capabilities for fast post processing of data g

FF23 Social norms and practices and expectations about systems c

FF24 Observations during an event c

FF25 Automated data collection systems during events c

FF26 People's emotions, discussions, and actions o

FF27 Data capture tools from citizens during disasters and exercises to feed agent based models o

FF32 Big qualitative data collection analysis tools such as natural language processing o

FF33 Data about communication streams (email, snapchat etc.) o

FF34 Data fusion of multimodal data streams o

FF35 In the field app for documenting field observations c

FF36 Understanding of dynamic demand: earthquake intensity, wind speed etc. o

FF39 Social data o

FF40 Data assimilation tools s

FF42 n/a o

FF44 Tools for capturing business continuity data that do not burden owners o

FF45 Health outcomes tracking data o

FF47 Satellite or remote data on patterns of evacuation o

FF48 Consistently validated survey data o

FF49 Tools to deal with 4D o

HH1 What were decisions in materials selection o

HH2 Community and place-based values for resilient buildings or places o

HH3 Contact information of building owners and occupants s

HH4 Public and public officials' perceptions of structural safety and resultant decision making o

HH5 What were the design decision that lead to performance g

HH7 Data related to NIST community resilience planning guide o

HH8 General building damage characteristics s

HH9 High water marks c

HH10 Performance as achieved versus assumed; get information on codes at the time of construction s

HH11 Find the already instrumented structures and get more data s

HH12 Look at models for design and work backwards; focus on new unproven models and design tools s

HH13 What tag was placed on each structure s

HH14 Data to evaluate HAZUS output s

HH15 Some initial data to estimate down time o

HH16 Local building codes and actual building practices s

HH17 As-builts of assessed structures and material properties of the structure s

HH18 Pre-storm building information s

HH19 Building occupancy and function o

HH20 Did the structure have a sustainability rating? s

HH21 n/a g

HH24 Surveillance videos; social media data s

HH26 Surrounding environment (hills, terrain) s

HH27 x, y, z photos of structural failure and flooding depths and inundations c

HH28 Media and social media generated during and just after the event s

HH29 Drone footage for structure from motion o

HH30 Satellite data; IWSMR, optical, multi spectral g

HH33 LIDAR survey of building displacement (or UAV) s

HH34 Detailed information on outlier structures (perform better than expected) s

HH37 Performance of official messaging systems g

HH38 Knowledge, mechanisms, tools to quickly sample and analyze social media data to guide reconnaissance o

HH39 Rapid damage survey and categorization of damage: wind, surge, waves, erosion, combined c

HH40 Performance of high voltage transformers c

HH41 Priorities used to restore utilities o

HH42 What customers were on what sub-stations/circuits o

HH43 Soil cores to bring back to lab g

HH44 Counts of power poles damaged s

HH45 Identification of damage to buried utilities s

HH46 Damage to critical infrastructure c

HH47 Data on the structure's building materials; how they were selected s

HH48 Wind hazard: tree fall direction and location s

HH49 Data about ground displacement g

HH50 Inundation heights, direction, and velocity on buildings c

HH51 Detailed measurements of building geometry and damage (sorted by typology) s

HH54 Data about building displacement g

HH55 Detailed surveys of damage: spatial variation and type of damage s

HH56 Performance and success rate of systems for situational awareness (e.g., warning systems) g

HH58 Data to understand soil-structure interface g

HH60 Stakeholder perspectives of the damage (not engineers) g

Community Resilience Framework

II3 Temporal recovery; how long does it take 6 c

II34 Data collection that addresses equity 6 g

II6 Baseline pre-event data: social, infrastructure, topography 5 g

II8 Large-scale data at community or regional scale that shows intersections between built, natural, social, political, cultural environments (connectivity) 5 o

GG38 Casualties, injuries, hospital admits, percent functional 4 o

GG21 Building tags in comparison to independent assessments 3 s

GG48 School opening and enrollment 3 o

GG52 Weekly aerial photography 3 s

II21 Key indicators of recovery over time 3 o

II32 Built environment structural data about building back better and faster 3 o

GG20 Predominant characteristics of damaged and undamaged buildings, vintage, height, archetype, material 2 s

GG35 Prior community preparedness 2 o

GG39 Restoration time to full operability of community services 2 o

II12 Need fragility curve data 2 g

II22 Data on infrastructure (lifelines) damage and rate of recovery 2 s

GG44 In building equipment performance and functionality 1 s

GG45 Percent road and bridge closure; time to repair and reopen 1 g

GG53 Performance of coastal landscape; LIDAR 1 c

II2 Data collection to better quantify resilience 1 s

II7 Data on redundancy of transportation, energy, communication networks 1 g

II11 Influence of aftershocks on decision making of individual decision to stay in structures 1 s

II14 What influences building back better after an event 1 o

II35 Loss of life as metric for resilience 1 g

GG1 Structural characteristics and damage 0 s

GG2 Port accessibility; time to full operation 0 c

GG3 Regional economic recovery metrics and data 0 o

GG4 Social vulnerability: human capital, social capital, economic capital 0 o

GG5 Impact on vulnerable populations 0 o

GG6 Expected restoration of economic sector 0 o

GG7 Utility restoration expectation times 0 o

GG8 Baseline topology of lifelines systems 0 g

GG9 Infrastructure recovery 0 o

GG10 Time scales of recovery by entity: houses, hospitals, transportation, businesses, utilities 0 s

GG11 Damage by economic sector and temporal recovery 0 s

GG12 n/a 0 s

GG13 Resources: NGO, domestic, insurance, other; public services commission 0 o

GG14 Long-term data collection 0 c

GG15 Forecast of hazard occurrence 0 g

GG16 Baseline supply and demand flows per utility systems 0 g

GG17 What survived and why 0 o

GG18 Major disrupt to lifelines that impact daily life and economic life 0 s

GG19 Year built inventory 0 s

GG22 Disaster recovery; short term recovery; long term reconstruction; recovery management 0 o

GG23 Logs of emergency management offices with decisions and actions 0 o

GG24 Statistics regarding secondary events 0 o

GG25 MOUs with utility companies for future data sharing 0 o

GG26 Permanent relocation with time 0 o

GG27 Smart meter data with time 0 s

GG28 Effects of service interruptions in terms of community functioning; how are households affected exactly? businesses? industry? emergency services? 0 o

GG29 Ways that people adapted to service interruptions of utilities 0 o

GG30 Improvised emergency responses 0 o

GG31 Pre-event efforts made to improve resilience 0 o

GG32 Emergency preparedness practices: plans, staffing, organization, facilities, equipment, training 0 o

GG33 Community knowledge levels with respect to perception of risk 0 o

GG34 Who are decision makers or crisis managers across utilities? Need contacts ahead of time. 0 o

GG36 Social impacts: psychologies, demographic, economic, political 0 o

GG37 Population recovery over time; percent returning over time 0 c

GG40 Time to full operability of critical buildings 0 s

GG41 Characteristics of service of ports and associated services after the event 0 c

GG42 Volume and types of buildings permits after the event over time 0 s

GG43 Physical impacts: casualties, damage 0 o

GG46 Insured losses 0 s

GG47 Surveillance video 0 o

GG49 Sheltered population through time; number of people in shelters and shelter capacities 0 o

GG50 Hazard mitigation practices; hazard source, community protection works, land use practices, building construction practices, contents protection practices 0 o

GG51 Engage medical information with physical and engineering damage; mortality versus engineering damage 0 o

GG54 Emotional sentiment; measured via social media 0 o

GG55 Airport traffic to vacation destinations 0 o

GG56 Data to evaluate building codes: hazard intensity, design level 0 s

GG57 Humanitarian impact: loss, injured, displaced 0 o

GG58 Reconstruction through time by economic sector 0 s

GG59 Pre-impact conditions: hazard exposure, physical vulnerability, social vulnerability 0 o

GG60 Community level infrastructure performance metrics 0 s

GG61 Translate engineering to consequences for society 0 s

II1 Temporal aerial fly over pictures 0 g

II4 Time-dependent change in structural conditions (repair, demolition, etc.) 0 s

II5 Quantify at macro level: clean up, % building damage, retrofit programs 0 s

II9 Health care access; physical health; family structure; population change/displacement; employment; school attendance; political participation 0 o

II10 What proportion of damaged structures build back better? 0 s

II13 Data for ground improvement strategies and performance 0 g

II15 Pre-existing data on population demographics, health indicators etc. to give sense of community before the event 0 o

II16 Lessons and issues related to lifeline recovery 0 s

II17 Thermal imaging of neighborhoods to assess occupancy over time 0 s

II18 Need to know total inventory of facilities and buildings; undamaged as well as damaged 0 g

II19 Establish data sources for social vulnerability 0 g

II20 Urban planning and policies 0 o

II23 Interface with jurisdiction building departments data about tagging and construction permits 0 s

II24 Where people were at the time 0 g

II25 Develop electronic library of all relevant hazards studies so we know where things may occur 0 g

II26 Community buy out options and policies 0 o

II27 Social capital and desire to build back 0 o

II28 Comprehensive documentation of infrastructure and building damage through satellite imaging and UAV 0 s

II29 Prior vulnerability studies 0 s

II30 Collect data of ground situation, inundation extent during the survey 0 c

II31 Investigate local's versus responder's contribution to recovery 0 g

II33 Neighborhood preparedness to support individual and families; measures to compare with post-event behavior

II36 Post-disaster health and wellbeing 0 g

II37 Large scale regional performance of structures 0 s

II38 Physical and non-physical system functionality 0 s

II39 Survey teams at different times to collection data on structural performance parameters and best practices 0 c

II40 Building damage, down time, relocation, income loss, contents loss 0 g

II41 Data that is ethical to collect 0 o

II42 Change of usage of cellphones after the disaster; population movement 0 o

Mitigation

KK17 Evaluation of pre-existing hazard maps for "everything": shaking, flooding, faults, etc. 8 o

JJ19 Damage with respect to hazard forcing and structural characteristics 7 c

KK10 What worked? What didn't work? 7 o

JJ12 Document unsuccessful performance 6 g

KK1 Lifeline performance vulnerability curve design vs. performance 6 g

KK5 Multi-scale analyses; coarse information across large areas; detailed and certain sites 6 s

JJ4 Risk communication; messages out (number, quantity, source, content); messages received (social media, networks, surveys); behavior change (surveys observable behavior) 5 o

KK28 Focused data collection on mitigation measures that says now worked after event 5 o

JJ1 Understanding cultural norms as they relate to built environment 4 o

JJ5 Cost data for structural mitigation (not loss but how much does it cost to strengthen a building, for example) 4 c

KK18 Fin and identify what structures have had retrofit...allow for paired comparison 4 s

JJ2 Post-event topography and bathymetry 3 c

JJ10 Situational awareness for lifeline systems 3 g

KK13 Inventory of prior mitigation actions 3 s

KK19 Measurement of performance of retrofitted building to compare if mitigation worked 3 s

JJ11 Population location before, during and after event 2 o

JJ28 Insurance data on losses and successes 2 o

KK25 Carry out local focused geotechnical observation; how do these observations fit with the current research ideas 2 g

JJ7 Citizen awareness of hazards, risks, and mitigation options 1 o

JJ15 Mapping inundation field: wrack lines, flooding elevations 1 c

JJ22 Ability for postdoc or student to stay behind and work with building department, DOT etc. to accelerate post-survey data collection 1 s

JJ25 Which infrastructure segments failed: spatial location, function, connectivity 1 o

JJ26 Detailed damage reports by structure class and vulnerability: lifelines, buildings; Damaged in low intensity areas; Undamaged in high intensity areas 1 s

JJ27 Window of opportunity to champion for mitigation 1 o

KK11 Detailed interdisciplinary case studies 1 s

KK14 Where has ground improvement occurred 1 g

KK16 Accurate measure of hazard intensity during event throughout region 1 s

KK24 What political and economic forces are influencing whether mitigation science actually is used 1 o

KK30 Cost difference between retrofit and non-retrofit 1 o

KK31 Data on specific or general pattern of incremental development and construction in developing countries 1 o

KK35 Documentation of mitigation measures in comparative context; deploying equipment to multiple sites for empirical comparison 1 o

KK37 Down time for businesses and residents 1 o

JJ3 Post-event 3D imaging of affected sites (LIDAR etc.) 0 g

JJ6 Social perception and uptake of insurance (e.g., high cost earthquakes) 0 o

JJ8 Demographics, census data, tenant status (use of structure) 0 s

JJ9 What programs and policies were in place to encourage mitigation and structural upgrades or govern how reconstruction reconstruction is done 0 c

JJ13 Ground displacements including vertical and lateral 0 g

JJ14 Lessons learned from previous and historical mitigation efforts (lifelines, structures, and community) 0 g

JJ16 Resistance to dissemination of hazard information: hotels/motels, restaurants, reactors 0 o

JJ17 Aftershock damage statistics 0 s

JJ18 Response of structures during prior events and the current event (i.e. to compare) especially for retrofits 0 s

JJ20 Design code used for each component or system 0 s

JJ21 As-built, structural plans 0 s

JJ23 "Report card" style public reporting (ASCE, etc.) 0 s

JJ24 Impediments to land ownership, place attachment, social ties 0 o

JJ29 Improve landscape and geomorphological models for rebuild design 0 c

JJ30 Research community packaging to the community 0 o

JJ31 Population willingness to accept large scale mitigation 0 o

JJ32 Access to good geology maps 0 g

JJ33 Perceived relevance of other communities' disaster experience 0 o

JJ34 Validate survey data 0 o

JJ35 Societal capacity and commitment: national, regional, local, household 0 o

JJ36 Tools for decision making assessment 0 o

JJ37 Pre-event soil testing database from affected or neighboring locations 0 g

JJ38 Liquefaction evidence: extent and location 0 g

JJ39 Contact details of decision makers 0 g

JJ40 Mass movements: landslides, debris flows 0 g

JJ41 Community-level stakeholders' contact information and roles; local universities 0 o

JJ42 Disclosure of fine-grained hazards 0 g

JJ43 Mitigation measures; hazard source; community protection works; land use practices; building construction practices 0 o

JJ44 Local codes and compliance 0 s

JJ45 Output of simulation models (losses) fore lifelines, society, etc. 0 o

JJ46 Number of buildings by damage state by structure type and hazard level 0 s

JJ47 Building or other structure retrofit plans and details 0 s

JJ48 Statuses of isolation, damper or other retrofit method building survivability and response 0 s

JJ49 Information on relationships between hazards and impacts 0 s

KK2 Statistically meaningful surveys; sets of similar structures or soil \_\_\_\_; ground surveys; LIDAR and satellite; leverage data collection by others 0 s

KK3 Measure of hazard intensity actually happened; vulnerability dataset 0 c

KK4 Detail versus big picture patterns; multiple scales 0 c

KK6 Need to figure out liability and rights to information on engineered buildings and systems 0 s

KK7 Quality of reporting; sampling of structures with official assessment to see if report of damage accurate 0 o

KK8 Uncertainty documentation of observations (bias, training, etc.) 0 g

KK9 Detail look at performance of individual buildings and systems 0 s

KK12 Promote a system or area of city approach to pre-event assessment (all impacts are local) 0 g

KK15 Documentation of efforts to improve or replace buried pipe before event 0 g

KK20 Documentation of foundation retrofits before event 0 g

KK21 Facilitate a better picture of the before situation (baseline data) 0 c

KK22 Use iShake (cell phone accelerometers) to record level of shaking at local scale 0 g

KK23 Fieldwork to collect data on how ground mitigation measures performed: both good and bad 0 g

KK26 Pre-deployed instrumentation to measure effects of event on structures 0 s

KK27 Geotechnical performance: how things worked in the event 0 g

KK29 Does tagging system adequately account for retrofit 0 o

KK32 Provide mitigation data for sound policies 0 o

KK33 Were mitigation incentives introduced after the event? 0 o

KK34 Hazard impacts in natural and built environments 0 c

KK36 Maintenance and use of retrofit buildings 0 o

KK38 Economic benefits of retrofit and mitigation incentives 0 o

KK39 Did the community incentivize mitigation pre-event? 0 o

KK40 What policy or funding supported retrofits 0 o

KK41 (Need Credentials) RAPID needs organized pre-arranged agreements with key Federal and state organizations to enable access to teams 0 g

Hazard and Impact Simulation and Decision Making

LL38 Population distributions at time of event (how does this influence death, damage, and loss) 4 o

LL42 Spatial distribution of hazard; all hazards 4 g

LL30 Multi-disciplinary timing and time histories of event: soil characteristics, wind speed and direction, ground motion, human behavior, structural behavior 3 s

LL39 Distribution of large debris from wind and landslides 3 c

LL16 Overarching uncertainty quantification 2 o

LL40 Spatial distribution of damage versus hazard intensity 2 s

LL62 Pre-event LIDAR data archiving (letting teams know where data exists) 2 g

MM4 Data on run-up and flow velocity during storm surge, flooding and tsunamis 2 s

MM8 Interconnectivity 2 o

MM21 Citizen science participation and related data collections: feeding agent based models 2 o

MM28 Public officials and utility managers 2 o

LL25 Inundation depths, velocities, and pressures in built up regions 1 c

LL35 Interaction of wind and flood damage on one building 1 s

LL37 Temporal resolution of monitoring to capture cascading hazards and interdependencies 1 g

LL46 Aftershock response of instrumented buildings 1 s

LL47 LIDAR (TLS) resolution for different needs 1 g

LL48 Identify, provide access, knowledge of satellite data and availability 1 g

LL49 Real time windborne debris distribution and intensity using video 1 g

MM2 Design and construction practice and codes; pre-event retrofit status; drawings and specs 1 s

MM3 Structural drawings and material properties for structure analysis 1 s

MM9 Damaged buildings by vulnerability and hazard classification; structure type, demand/hazard 1 s

MM10 Sampling strategy based on simulation scale needs 1 s

MM11 Increased data collection from damaged buildings or from minor events to refine fragility curves that inform HAZUS and other tools 1 s

MM22 Emergency response and coordination across jurisdictions 1 o

MM25 Economic consequences of event 1 o

MM29 People's behavior 1 o

MM36 Suite of apps for citizen-level consequence report 1 g

MM40 Document damage so insurance assessor can quantify loss, and so loss can be parsed by mechanism 1 g

MM41 Load; granular detail of PGA, PGV, tau-wind, time histories, pore water pressure 1 g

MM43 In situ test data 1 c

LL1 Social perceptions of hazard impacts and intentions over time 0 o

LL2 Appropriate data on community awareness of forecast/warning information 0 g

LL3 Real time social response data (e.g., mortality, food shortages, etc.) 0 o

LL4 Protective action decisions (e.g., person's decision to evacuate before hurricane) 0 o

LL5 Individual perceptions of response to co-occurring hazards (e.g., tornadoes and flash floods) 0 o

LL6 Transit flow population movement; population distribution at time of event 0 o

LL7 Behaviorally parameterized agent based modeling of information flow, perceptions and response given hazard uncertainty and reconnaissance data for model validation 0 o

LL8 How consumers adaptive to lifeline service disruptions; how service disruptions affect people's' lives 0 o

LL9 Detailed (4D) position of all relevant variables 0 s

LL10 Detailed case study 0

LL11 Collect by disaggregated demographics 0 o

LL12 Longitudinal social effects data (causality, homelessness, etc.) 0 o

LL13 Social media data by disaster types and real time data 0 o

LL14 Longitudinal social data: census and other government data 0 o

LL15 Data fidelity in forecast models; ground truth of model inputs (geology, soil, etc.) 0 g

LL17 High water marks 0 c

LL18 Rapid survey of gradations of damage 0 c

LL19 Historical social response data by disaster types and contents (mortality rates, homelessness, etc.) 0 o

LL20 Detailed loss estimation of buildings and repair costs by component 0 s

LL21 Pre and post subsurface data 0 g

LL22 For debris source and point information 0 s

LL23 Temporal distributions 0 o

LL24 Time series of inundation 0 c

LL26 High temporal resolution longitudinal reports using any method, including social media data, of people's information access and decision making 0 o

LL27 Photo and video image data of social effects 0 o

LL28 Morbidity and mortality by location and time 0 o

LL29 Damage and outages and service interruptions; interventions operators make and when 0 o

LL31 Data acquisition for aftershocks in case studies 0 s

LL32 Failure modes of inundated structures 0 c

LL33 Large scale erosion and deposition 0 c

LL34 Collect data that allows as direct comparison to simulations as possible 0 c

LL36 Videos of the flow condition (velocity, direction) taken during event 0 c

LL41 Building measurements where available and documented damage together 0 s

LL43 Ground acceleration and spatial variability of recordings; building response 0 s

LL44 High spatial resolution data on inundation to validate surge models 0 o

LL45 ID metrics for performance specific to communities; collect data that helps quantify actual performance 0 c

LL50 As built information 0 g

LL51 Structural details for wind damage not in census or tax data 0 s

LL52 Elevations of structures 0 c

LL53 Data repository of building construction documents to provide for modeling needs 0 s

LL54 Building code and design practice and regulatory standards 0 s

LL55 General geological conditions and ground failure hazards 0 g

LL56 Lifeline locations 0 g

LL57 Age of structures and building codes 0 g

LL58 Use simulations before events to Identify vulnerability and optimize decision objectively 0 c

LL59 Specific structural details; corrections and building shape 0 s

LL60 Contents value information for loss modeling 0 s

LL61 Disaggregate data by: gender, family structure, race, population density, disability, rural/urban, health care dependent, income, age, etc. 0 o

MM1 Anticipated cascading consequences 0 c

MM5 After shock performance of damaged buildings; real-time accelerations 0 s

MM6 Anchor bolt pull test equipment for anchor bolt testing in field after disasters 0 s

MM7 Structural surveys for public and owners about system performance vs. time 0 s

MM12 Performance of retrofit techniques 0 s

MM13 Have ability to field deploy shakers for in situ testing of weakened buildings 0 s

MM14 Structural evidence-based data to better inform video game or scenario type of community analysis 0 s

MM15 Data to develop fragility relationship for buildings and infrastructure systems 0 s

MM16 More data to improve accuracy of fragility curves 0 s

MM17 Temporal: before, during, after (years) 0 o

MM18 Shifts in transportation patterns after event 0 o

MM19 Data from re-routing operations to inform models looking at capacity maintenance following events 0 o

MM20 Data on community expectations of recovery and reconstruction 0 o

MM23 Gaming: develop realistic gaming programs for homeowners to learn effects of preparedness 0 o

MM24 App for business owner to share weekly revenues etc. to track business disruptions 0 o

MM26 Social capital, economic capital available for recovery before and after 0 o

MM27 Socioeconomic dynamics of affected area before, during, and after 0 o

MM30 History and culture of affected area 0 o

MM31 Pre-event LIDAR of targeted areas: liquefaction prone landslide prone, etc. 0 g

MM32 Documenting case studies for both successes and failures for validating codes 0 g

MM33 Capacity non-invasive Vs. (Vs. strength relationships); p-wave s-wave modeling critical state soil parameters 0 g

MM34 Land use policy 0 g

MM35 Soil boring catalogs; landslide databases; design/as-built drawings 0 g

MM37 Permanent ground movement 0 g

MM38 Deformation; LIDAR/SfM; automated damage detection with LIDAR 0 g

MM39 Framework geologic site model of study area; geophysical site models; 0 g

MM42 Quantifying uncertainty 0 g

MM44 Boundary conditions: water level, topography, bathymetry; forcing conditions: waves, surge 0 c

MM45 Offshore changes (e.g. scouring that affects sand replenishment); high resolution bathymetry 0 c

MM46 Data for hind cast verification 0 c

MM47 Environmental impacts and policies that this may trigger 0 c

MM48 Shoreline changes (beaching, etc.) 0 c

MM49 Storm history and frequency 0 c

# Transcriptions of Sticky Notes from Session "Discipline-Specific Tools and Support Needs Activity

1. Summary of activity details and instructions to participants (day 2 group activity)

• Tables organized by disciplines

– Structural, Geotechnical, Coastal, Social

• Brainstorm individually using worksheet

- Place sticky notes on poster boards; describe & review ideas

• Refine as Group

– Identify redundancies and similarities

– Add more detail / replace ideas

– Cluster

– Name clusters

• Rank as Group

- Discuss priorities

- Dot vote: 5 dots, one dot per idea

2. Format and legend for transcriptions

Each line below represents a response or comment written on a sticky note. Each line contains: (1) sticky note unique identifier code, (2) transcribed response from participant, (3) total number of "dots" - group members "voted" for high priority items using "sticky dots"—items with a high dot count were deemed by the group to be most important (4) primary discipline of participant (g = geotechnical engineering, c = coastal engineering, s = structural engineering, and o = social sciences)

Geotechnical Engineering

A23 Drone deploy processing. Distributed Computing for SFM 4

A9 Training Equipment - Training Ethics - Training PPE First Aid 3

Aa Strong Motion. Camera. cGPS. Extensometers 3

A16 Frames, solar panels, batteries boxes, data loggers, etc. 3

A4 Geoprobe-CPT Borings/Soundings 2

A5 Mobile CPT (no sws, no dcpt, no toys) 2

A6 NGS-Collab. Identify Opus Rapid Static 2

A18 Lidar moderate range 500m-2km 2

A29 "SASW-in-a-Box". H/V & Ambient V. Swedish Sounding 2

A10 Ethics Training 1

A17 Terrestrial radar. Standing contract with vendor? 1

A20 Terrestrial mobile LIDAR 1

A26 Survey 123, ArcGIS 1

A27 360 Fly 1

A32 Write poling. Policy/legal help 1

A1 Hand Auger 0

A2 Satellite Phone 0

A2 Safety Kit 0

A3 Helicopter Work 0

A7 App show where teams have been - Sync with devices 0

A8 Robotic total station + prisms 0

A11 Paintball guns for control targets 0

A12 Equipment Security (locks) 0

A13 Flight Software (drone deployment) 0

A14 Media Training 0

A19 Apps for systematic data collection 0

A21 Network RTK 0

A22 Helicopter uav 0

A24 Target Packets 0

A25 Agreements with us6s on shakemaps 0

A28 Rock(GAP) Extensometer monitor system 0

A30 Several Lidar small units 0

A31 Security enclosures "theft for safe" deployment 0

Structural Engineering

C11 Robotic Assessment for Hazardous Environment 5

D7 Supplemental Power & Hard Drives 5

D8 Laptop w/ Internet connection- Backup storage 5

D9 Communication 5

D10 Satellite, Laptops/Phones (Data) 5

D11 Satellite Communication Field-to-Field & Field-to-Home 5

D12 Real-time Data Upload 5

D13 Lidar for Building material 5

D14 Laser Scanners for 3D geometry characterization 5

D15 Structure for motion to generate 3D images to enable visualization of damage & post-event measurement 5

D16 Hardware for 3D visualization of building damage+Post-event interrogation 5

E8 Backpack (lightweight) LIDAR 5

E6 UAV with high resolution camera 5

C1 Acc. Loggers, Remote Power 4

C2 Free-field FF Portable Seismic Station, Battery For 1 Week 4

E13 Street View cam 4

C12 Ground Penetrating Radar: For walls 3

C17 Onsite Expert Services (Operators)+ Offsite 3

D1 Go-Pro + Audio, High Resolution Cameras w/ GPS 3

D2 Geologist Pick ,Tape Measure, Clocked Comparator 3

D3 Digital Electronic Level 3

D4 Rap Pack 3

D5 Portable Scanner for Drawings 3

D6 High Quality Camera w/ Wide Angle & Telephoto lenses, provide direction information 3

D17 Software/Service that provides real time upload of "data" that describe what data have been collected -so no duplicates- or allows real-time follow up 3

D18 Collaborative communication app based on building location:(Ground motion, site damage, building geometry, structural damage, material prop) 3

D19 App for in-field communication & collaboration 3

D20 In field mapping to track progress damage & photos 3

D21 Drones 3

D22 Pre-Programmable Drones that doesn't require technician support 3

E20 Local group leaders: access, guides, language 3

E16 Useful apps: navcam, solocator, map.me, theodolite 3

C3 UAC-Photo Lidar, Operator Processing 2

C4 Green Lidar 2

C7 Rugged Laptop+Data Storage (i.e. Toughbook) 2

C9 Core Sampling & Direct Shear Testing 2

C10 Shaker 2

C21 IRB 2

D31 Building Inspectors have app to record information & provide daily reports of damage & more data 2

E14 Ipad with sketching tools, google earth, geotag, google translate 2

E10 In-Field MAT'L characterization equipment 2

E2 Backpack ready SI equipment: 10-12 magnitude acceleration (high frequency), NI-DAQ, mini laptop with MEScope (or other SS), hard drive 2

C5 Goose-Neck Video/Photo Multi-Spec 1

C6 IR Camera 1

C8 Pachometer (Metal Detector) 1

C13 Real-time' Analysis of Spatial Damage Identify Key Structures to Study 1

C15 Access to Building Dept Databases 1

C18 Export & Legal Guidance 1

D26 Computer Vision machine learning AI to automate feature recognition 1

D27 Frame Net for auto captioning using machine learning 1

D28 Easy Interface with 3D point cloud data 1

E21 Training: confined spaces, photography for forensics, interviewing style + ethics, ethics 1

E19 Event portal: contacts, log, clearing house 1

E7 image scanner bar (take photos of plans + other documents) 1

E5 Solar panel for charging 1

C14 Standardized Damage "App" For Rapid 0

C16 DYFI' Style Location for Citizen Scientists to Input/Rate Large Damage Datasets 0

C19 Provision for Portable Power 0

C20 Coordinate w/ NSF Pascal/IRIS 0

D23 Tools for Sampling Material Properties 0

D24 Material Characterization Equipment 0

D25 Apps Notes, Pictures, Videos and other data 0

D29 STEER Administrative Support w/ the field to manage data, site visits appointments 0

D30 Social Media Platform to ID Damage ('Citizen Engineers') 0

E23 US/NSF/ Identification for researchers 0

E22 Security 0

E18 Location sharing app (software) 0

E17 ARCGIS Maps 0

E15 Survey 123 ARCGIS 0

E12 Sample bags + Notation Systems (Various sizes) 0

E11 Portable printer 0

E9 Voice recorders 0

E4 FCMP (Florida Coastal Monitoring Program - University of Florida) 10m + 15m towers for hurricane wind measurement 0

E3 GPS (base reference units) 0

E1 Pre backed old school "rap-pack"- camera, gps, flashlight, plumbomb, crack width, laserdisc device, batteries, vests (safety), tape, etc.… 0

Social Sciences

F30 validated survey tools/ standard QS 11

F31 Develop a standardized consensus template for assessing societal response and physical / social impacts 11

F7 Sets of tablets for social survey, data collection (Android) 7

G3 Ethics and cultural competence training 5

G13 Applications for citizen science data collection 5

G14 Applications for citizen science with validated survey questions (well being) 5

G15 Application feature that provides useful information to citizens as part of citizen science 5

F6 12" iPad pro pre-loaded for social 5

F8 Laptop/ Ipad & Printer 5

F9 iPads or some other mobile platform for real time data collection (and software for organization) E.g. survey data collection 5

F23 Live GPS tracking with before/ after remote sensing and critical / GIS data 5

F22 Drones for longitudinal and spatial data collection on human activity 5

F32 Questionnaire/ survey software 5

F33 Software that syncs audio and text 5

F34 Survey platforms and damage assessment platforms on one app 5

F36 App to link photo, text, geocoding (like field notes Pro) 5

F35 Survey apps 5

F37 Audio Software- geolocates respondent 5

G10 Application to report utility service levels 4

G11 Citizen science app for children or other population subgroups 4

G12 Applications that allow residents to upload/share information that will help with response or recovery 4

F1 Ethics guidelines for social data collection 4

F2 Ethics training for community interaction (not for data collection) 4

F3 Ethical guidelines for data collection + data use 4

F4 Data use, release privacy, archiving protocols + training 4

F5 Ethics / IRB training for all team members before event 4

F26 Social network analysis -> Hose 4

F27 Methods and infrastructure to quickly collect sample and analyze social media data collection to guide recon efforts / sampling (e.g. areas / populations affected) 4

F28 Social media analysis software (E.g. radian6, used by American Red Cross digital Operations Center) 4

F29 Natural Language processing (NLP) of media and other data 4

F20 Mapping/ geolocation hardware and software 3

F21 GIS 3

G1 Local Contacts (for local knowledge like where to go, neighborhoods, info on sense of place 2

G17 Citizen science initiatives driven by community based needs. connected to scientific exploration 2

G18 Citizen science --> process for reporting back to community 2

F16 Tools to capture overhead and underground pipe layouts 2

F17 Links to cascading effects from life line or other failures 2

F19 Tools to monitor restoration by industry 2

G4 Training for non-social scientists to do social data collection 1

G9 Training: Emergency management protocols 1

G16 Leverage ongoing citizen science data (e.g. mPING, CocoRahs) 1

G21 "Agency Science" logs of OEM'S decision making 1

G2 Training about what to look for and how 0

G5 Marketing & training for social scientists for "non-social" tools 0

G6 Training & advance knowledge of culture, socio-economic dynamics of affected area 0

G7 Training in cultural sensitivity & awareness 0

G8 Train social scientists to collect some standard/cross-case data 0

G19 How are we going to train citizens to do data collection? 0

F10 Device (iPad/ tablet) to record field notes + backup (can also use to share info) 0

F11 Smart pens for rappack 0

F12 Handwriting recognition- find the best 0

F13 Recording devices (snowball and Sony handheld digital Vo16 recorders) 0

F14 Transcription, software or service 0

F15 Mobile eeg 0

F18 Exposure assessment (e.g. air quality monitors) 0

F24 External backup batteries 0

F25 Video/ GPS integration 0

F38 Business restoration surveys 0

F39 Development of survey instruments (pre IRB approved) for citizen science collection 0

Coastal Engineering

B8 Multibeam Fathometer 7

B9 Surface telephone. AUV. DGPS. Cameras 7

B11 Multi-beam bathymetric system 7

B12 Multi Beam 7

B13 Multi Beam 7

B29 Pressure sensors + ADCP/ADV 7

B30 Easy to use (or handmade) tide gape 7

B43 Wave and water level gages 7

B44 Rapidly deployable wave gauges (AK) 7

B45 Paros Pressure Sensors (with real time telemetry) 7

B47 Deeper Smart Sonar. Portable Depth-Sounders (1 per team). AK/HF. RapPack 7

B1 Mobile(Flight Plans). INS-Atlans IXBlue. Regal Lidar Scanner - Small Aircraft 6

B2 pre-post storm. topo/bathy 6

B3 Laser --> mobile, airborne, terrestrial 0--> not 1550nm 6

B4 Lidar with ability to use airborne or on car 6

B5 Lidar 6

B6 "Mobile" Lidar (Lidar + IMO) 6

B7 Aircraft- mounted SFM + Lidar 6

B18 Range Finder: DGPS 5

B19 Stand-alone RTK + BS 5

B20 RTK-GPS 5

B21 RTIc GPS 5

B22 Urban cell or satellite-connected RTK rover 5

B23 RTK 5

B24 Trimble Centerpoint RTX 5

B25 Differential GPS correction via satellite service subscription. i.e. centerpoint RTX with compatible DGPS 5

B10 Side Scan Sonar. Mapping Sediment & debris field underwater 3

B32 Sediment shallow core or surface grab sampler 3

B35 Drones or kite if drones are not allowed 3

B36 Drone DJI Phantom 4 with camera + structure for motion + DGPS 3

B40 Magic ID Card (Local Access) 3

B41 Clearances/permissions 3

B42 Local Support: Guiding person. Trucks or even helicopter 3

B26 Photo & Video cameras 2

B27 High Quality SLRs 2

B28 High consumer grade cameras --> GoPro, hyperspectral?, GPS/Compass 2

B37 Pre-event exercise 2

B38 Training (Lidar + RTK) 2

B39 Emergency training (accidents, de escalation) 2

B14 Optical level + survey rods 0

B15 Edgetech CHIRP Sub-Bottom Profiler & GPR 0

B16 Post-measurement data correction and QA/QC procedure 0

B17 Processing tools for evaluating 4D data (during & After) 0

B31 Lodging + supplies 0

B33 Data Service 0

B34 Data & Image processing tool 0

B46 Record/Collection of eyewitness accounts (video records) 0

B48 Surface travers (for currents pc) 0

B49 Application for property owners to document inundations & erosion damage 0

B50 Post Storm damage survey 0

# Transcriptions of Sticky Notes from Session "Interdisciplinary Reconnaissance Needs Activity

Activity details and instructions to participants (day 2 group activity)

• Brainstorm individually using worksheet

• Start with “Before” phase poster board

- May need to label the board

• Write and place sticky notes on board

- Use discipline-specific sticky note color

- Describe & review ideas

• Refine as group

- Identify redundancies and remove

- No time for clustering

• Discuss as group

• Dot vote: 3 dots, one dot per idea

• Repeat for “During” and “After”

• 15 minutes per phase

2. Format and legend for transcriptions

Each line below represents a response or comment written on a sticky note. Each line contains: (1) sticky note unique identifier code, (2) transcribed response from participant, (3) total number of "dots" - group members "voted" for high priority items using "sticky dots"—items with a high dot count were deemed by the group to be most important (4) primary discipline of participant (g = geotechnical engineering, c = coastal engineering, s = structural engineering, and o = social sciences)

Before Reconnaissance

Y13 Local knowledge/info/contacts, a pre-event coordinating unit 8

U7 Satellite data with before and after images, support for processing these data 5

Y14 Training: ethics, alpine, wilderness 1st aid, media, legal, technical, training videos 5

Y18 Rapidly searchable database of pre-event data 5

O2 Ethics and cultural sensitivity training 5

I3 Contacts of local authorities (e.g., Fema, NWS) and community leaders (e.g., churches, schools) 4

U13 Checklist for equipment (RAPPACK), checklist for "issues associated with equipment, export/import control, etc. 4

O7 Transportation logistics 4

EE1 Aerial/Satellite Imagery 3

EE12 Telecommunication (Local cell, Satellite) 3

BB3 Imagery 3

BB9 Onsite coordination with local agencies 3

I1 Ethics Training (Human Subjects, Community/Culture) IRB Training 3

I8 A survey question-bank 3

I17 A coordination aoo - maybe like SLACK to encourage collaboration 3

U11 Formal authorization letters 3

Y2 Streamlined archived communication software (e.g. Slack) 3

Y5 Intercept areas of other teams, schedules especially, overlap times 3

Y16 Develop standardized instruments for collection of systematic data across scale, time, and context 3

O3 Legal paperwork - drilling subsurface - IRB - etc. 3

O4 Geographic information including satellite photos 3

O5 Background on community -its infrastructure, -blogs -codes, -... 3

O11 Early damage reports/impacts 3

EE5 Est. Safety Protocols + Training + Certifications (Include CPR/First Aid) 2

EE7 Logistics( Travel, Hotel, Vehicles, Permits) 2

BB2 GIS/Maps 2

BB7 Baseline data integration software/reposition (geotagged, time-tagged) including prior rates of change 2

I14 List of legal restrictions in various locale \*maybe don't post 2

I16 Scheduling service that identifies methods of various disciplines to encourage collaboration 2

M2 Inventory, structures & infrastructure, instrumented structures 2

M3 Reconnaissance App for iPhone or similar with capabilities for: strong terrain data in cache, geological photo, navigation / track log 2

M4 Ethics training: cultural sensitivity, working in disaster, human subjects 2

M5 Safety training and field work 2

M6 Emergency training 2

M12 Tide and other flow measuring devices 2

U1 Ethics and cultural competency training 2

U4 Links to common data sources: weather, satellite images, and geology 2

U10 Recon guideline documents 2

U12 General recon training 2

Y7 Training on how to use the equipment, training on emergency response, training on obtaining licenses, permits, etc. 2

Y15 Training workshop, app for IRB/ethics, training for all researchers regardless of discipline 2

Y17 Database for compiling contextual data from: media, emergencies, social media, secondary data sets 2

EE3 Apps-Package, User manual, multi platform, universal 1

EE6 Vaccines, Travel Insurance 1

EE11 Access to Regional/ In country Emergency Man. Maps of Landslides, pipeline breaks, Structure collapse etc. 1

EE14 Ethics Training Liability 1

EE16 Training in emergency management protocols (IE. Expose Team to Concepts of ICS, Hierarchy/Structure, etc.) Engage EM community 1

EE18 Training Material 1

EE19 NHERI Reconnaissance training general & Inst. Specific 1

BB12 Best practice lists / procedures 1

I7 Building, Infrastructure Damage Classification App 1

I9 Aggregated data describing locales 1

I10 Identification of key structures/locales for detailed interdisciplinary reconnaissance 1

I11 Develop contacts of collaborators at universities around the world 1

I12 Post-event but pre-deploy; satellite imagery for planning 1

I15 Boilerplate paragraphs about RAPID to use in proposals 1

M1 Compile pre-event data: accelerometer location, hazard zones, locations, ground improvement 1

M7 "Event" portal: situational data, who is in the field 1

M9 Equipment training (RTK, lidar) 1

M10 Data collection training, awareness for cross-disciplines, what damage photo the social scientists can take, what question the engineer could ask 1

M11 Capabilities for: monitoring (portable accelerometer), surface wave testing, 3D point cloud + operator at lidar / drone 1

M13 Taxonomy training for data typo, captioning, etc. 1

U6 Common communication platform (for email, planning before deployment) 1

U9 Scheduling/route app for field (updateable) 1

Y4 Data preparation and compilation, downloading relevant data 1

Y6 IRB help for engineers 1

O6 Early approvals from NSF 1

EE2 Synthesis of Citizen Data.(Twitter Mining etc.( 0

EE4 RAPID "Hotshot" Personnel List 0

EE8 Universal IRB 0

EE9 Shipping Permits for Equipment 0

EE13 Media Training 0

EE15 Advance Knowledge(Distilled so easy to digest quickly!) of culture + socioeconomics of affected area. Develop Template? 0

EE17 Training in How to take Usable photos +standardized protocols geolocation photos for both eng. & social science 0

BB1 Bathy/Topo 0

BB4 Logistics plan 0

BB5 Online video training (on demand) 0

BB6 Hazard estimates (before you go) 0

BB8 Social media observations 0

BB10 Reconnaissance ethics policy 0

BB11 General reconnaissance guideline or manual 0

BB13 Ethics + cultural training 0

BB14 Geolocated data / tool / legal rules, guidelines, restrictions 0

BB15 Central organization for team formation, communication 0

BB16 Relevant data standards 0

BB17 Tool descriptions capacity, data production 0

BB18 Examples of data collection 0

I2 Mechanisms (channels and content) designed to report back to communities (that's NOT a peer-reviewed journal article) 0

I4 Communication protocols; Best Practices 0

I5 Engage media before events 0

I6 Research to develop valid coding schemas to guide natural language processing of social media data 0

I13 Current list of embassy science/economics officers 0

I18 Lists of the best smartphone apps to use 0

I19 Google service (won't have access in China) 0

I20 Open source alternatives for Google services 0

M8 Tool training / exercise 0

M14 "New scientist" soliciting tool, applications of "success stories" 0

U2 Code of ethics document and training 0

U5 Links to data for region: structural drawings, demographics 0

U8 Overall planning app 0

Y1 Simple remote sensing images viewer 0

Y3 Tables for pre-landing with event/local data 0

Y8 Establish connection with local authorities, universities, or government agencies 0

Y9 Local contacts, state department, assistance, on the ground networking 0

Y10 Contacts at the site, Information about damaged locations, other teams in route 0

Y11 List of equipment available and its capabilities 0

Y12 Risk awareness, aftershock frequency, storm history, in country knowledge 0

Y19 Web access event area information and contacts 0

O1 Access to group insurance - injury/death 0

O8 Emergency training First Aid kits 0

O9 Local contacts 0

O10 Local team guide 0

S1 Immediate mobilization 0

S2 NSF/ RAPID FEMA credentials for access 0

S3 Service facilitate moves with government agencies, munic, for access… NHERI council? 0

S4 Pre-Event Cit. Sc. (?) Tools for infrastructure data 0

S5 TEEX- Model disaster city training OR Virtual Reality training 0

S6 Basic training boot camp: Google Earth, GPS, etc. at annual meeting 0

EE10 NHERI Ethics Document

During Reconnaissance

*ID Text # of Dots*

V7 Short-term (daily) summary of activities / data to assist in planning the next day 9

X3 24/7 internet connectivity 6

X14 Data backup and transfer tools and making field data available to other teams 5

X4 Effective communications with teams and local contacts and landowners (contact lists) 4

X20 Establish protocol for data collection timing of data release; RAPID may have relevant data to inform population return 4

X22 Help at home (e.g., an office team) 4

J7 Satellite phones, SPOTs 4

J8 "Long-range" communications tools not requiring phone/net 4

J9 Mesh network antenna for smart phones 4

DD6 Real time GPS/map app with location of each team member 4

V3 App for communication within teams on ground 4

V4 Standardized easy upload link for reconnaissance data (photos or others), (APP) 4

L7 Equipment redundancy 4

L10 Event portal -situational data; -who in field; -what/where data is being collected and where/what still needed 4

J5 Overnight gear, -backpacks, -dehydrated food, - steripens/water purification straws, - sleeping bags/pads 3

AA1 Real time data hosting 3

AA3 Mapping app 3

L1 Equipment trouble-shooting support 3

L2 At UW, personnel scouring social media to get data from local citizen scientists 3

X8 Creation of interdisciplinary sub-teams as needed to investigate specific topics 2

X9 Catalog of areas needing follow on data gathering 2

X12 App that allows for collection of engineering and social science data; cross-train engineers and social scientists to get both forms of data 2

X21 Knowledge sharing in a timely manner; effective communications with in-country people 2

J1 12'' ipad pros - rugged case - pre-load with software 2

J2 Support for RAPID equipment (i.e., UAV, LIDAR...)technology remote support 2

J3 Apps (maybe citizen science or social media) to locate where to collect data 2

J4 Situational watch at home UW - TEAM 2

J6 Rappack 2

P4 Communication among field team members and between teams and home base 2

P7 Tools for sharing local information, contact, and sites of interest 2

P9 GPS Track 2

DD3 Communications (e.g., satellite phones) 2

DD5 Cloud data storage; DesignSafe 2

DD12 Local contacts to facilitate access and situational awareness 2

V1 Data newer 2

V8 Geolocation tools / GPS for all types of data 2

X11 Software or method to share data and images with other teams 1

X15 Ability to share or transfer information between teams 1

X17 App that accepts data dump from folder on a pc 1

X18 Provide event-videos that convey impacts 1

P2 Lodging and food 1

P3 Rugged Communications 1

P5 Field notes pro (or similar) 1

P6 Field Application for smartphone 1

P8 Coordination of field and research activities 1

DD2 Daily map update or refresh (thumbnails on maps) 1

DD4 Hotspot data stick; access to upload and download 1

DD7 First aid kits in all vehicles 1

DD9 Communication and information sharing among different groups 1

DD10 Electronic daily situation report; protocol for check in call among all field team members 1

AA5 App based on GPS and building locations 1

AA10 DesignSafe 1

AA11 Shared field clear house 1

V2 Recording devices 1

V9 Route plans vs. completion app 1

L3 Trained personnel to operate specialized equipment (Lidar, etc.) 1

L4 Analysis capability to convert image data (with GPS) to 3D model 1

L9 High Resolution camera system 1

L12 Communication (data, +voice) 1

L13 Team locations "communication" 1

X1 Site access 0

X2 Mine current media reports (e.g., google news alerts) 0

X5 Daily interdisciplinary briefings focused on new findings 0

X6 In person meetings and briefings at night to discuss and share findings 0

X7 Communications tools to stay in contact with teams 0

X10 Communications or interviews with eyewitnesses 0

X13 Involve citizens and residents in crowdsourcing data relevant to affected community needs and scientific needs 0

X16 Connection to local engineers and building inspectors 0

X19 Provide ground motion or demand parameters if not available 0

J10 Smart pens 0

J11 Real time' damage analysis/aggregate software 0

J12 GPS - enabled cameras/tools 0

P1 Time stamping and geo-coordination, metadata 0

DD1 Backup hard drives 0

DD8 Battery transport issues 0

DD11 iPads and backup batteries and chargers 0

DD13 International power adapters 0

AA2 Assistance with equipment problems 0

AA4 Social media for damage reporting 0

AA6 Team coordination 0

AA7 Data processing at DesignSafe 0

AA8 Power sources, backup power sources for essential equipment 0

AA9 Backup tools and equipment to increase reliability of data collection 0

AA12 Data storage and backup 0

AA13 DesignSafe 0

AA14 DesignSafe 0

AA15 Notification of relevant international, national, local agreements for data coordination, collection and sharing 0

AA16 Liaison protocols 0

AA17 Data uploading assistance 0

AA18 SSEER and STEER (XEER) 0

V5 Citizen science Apps 0

V6 App for property owners to document damage (location, category) 0

R1 Remote sensing capabilities 0

R2 Protocols (And hardware) for redundant data storage in field 0

R3 App Geocoded Data collaboration 0

R4 Essentials, software, package on design safe for download 0

R5 Ground support for data process, E.G., LIDAR, UAV 0

R6 Satellite communication hardware 0

R7 Solar panels for charging 0

R8 Satellite real-time GPS correction software and success service 0

L5 Access to local contacts/people 0

L6 Local "contact" sharing 0

L8 Information sharing 0

L11 Lidar or RTK 0

After Reconnaissance

*ID Text # of Dots*

T6 Motivation for quick data archive 6

CC3 Report Writing Multi-User Google Docs Model 5

CC2 Getting Samples Home 4

W3 Debriefings: Science, social, logistics, what worked or not 4

W4 Interdisciplinary team meetings to share findings 4

W5 Self-assessment: What tools, tech, teamwork could be improved for the next time? 4

W11 Education session or lessons for local communities 4

W13 Computer processing power for analysis of data 4

W17 Data sharing 4

W18 Publicizing availability of data and what is available 4

W20 Data visualization; user friendly output for decision makers; what was learned and why does it matter 4

K10 Rapid data and lessons learned, sharing with future teams 4

K11 Communicate additional opportunities for data collection 4

T2 Self reporting - recovery, functionality, well-being, health 4

CC1 Easy Cloud-Based 3D Point Cloud Visualization & Measurement Query 3

CC7 Mental Health Resources (Encourage PI's to connect local resources if/ as needed 3

H1 Tools for data cleaning 3

H5 SQL/GPS 3

H6 Data visualization techniques 3

H11 Guides on getting equipment back to RAPID 3

H12 Protocol to hand off equipment's to another team 3

W25 Listen to the other disciplines especially the social scientists 3

K3 Way to visualize type and location and time of data collected thus far and who to contact 3

T7 Recovery metrics data 3

Z8 Keep in touch with your local hosts 3

H7 App to solicit lessons learned 2

H9 How to push results to media, etc. 2

N3 Software to see all photos for one location over time, imap of all photos (over all times) 2

W1 Media training 2

W2 Public meetings or talks -- Public relations 2

W8 Thanking host institutions + collaboration into the future 2

W14 Sanity check of equipment 2

W19 Method for sorting or curating redundant data 2

K2 Tool for rapid and consistent photo/video tagging 2

K4 Data clearing house and standards 2

K6 Reflection, what worked and what did not to RAPID center 2

K7 Assessment of methodology (post mortem for improvement) 2

K13 Maintaining equipment 2

T1 Citizen science APP 2

T3 Support for data processing 2

T4 Support for processing structure for motion data; Support for lidar data processing 2

T5 Periodic aerial / satellite images 2

Z12 Lessons learned by team upon arrival 2

H2 Data structure/format ease at query/use 1

H3 Tools and mechanisms to share coding schemes across social science teams 1

H8 Design Safe 1

N1 Event viewer spare/time (Google Earth like) 1

N2 Report writing template 1

N4 Data Archive 1

N5 Data repository with visualization tools 1

W7 Debrief on what worked and what went wrong 1

W12 Report and publish often; incorporate what you learn in your research and practice 1

W21 Scientific report and public policy and community-specific briefing after each RAPID deployment 1

W24 Student support to study event 1

K9 Summarize lessons learned in equipment use 1

T9 Interface with design safe 1

T10 Support for collecting data from utilities; damage due to network 1

Z1 Post mission data sharing 1

Z2 Data processing support 1

Z6 Share data safely 1

Z10 Data integration guidance, tools, support 1

CC4 Box/Dropbox 0

CC5 Archiving Info 0

CC6 Copyright Transfer 0

CC8 Data QA/QC 0

H4 Transcription 0

H10 A way to report back to communities 0

N6 Compiling Data 0

W6 Experience or report of the survey success and problems 0

W9 Communicate quickly with follow on teams 0

W10 Conference sessions dedicated to finding from an event 0

W15 Verification of data quality 0

W16 Equipment maintenance 0

W22 Big data archiving tools 0

W23 Data processing, modeling, sharing, discussion 0

W26 Change and evolve your perceptions 0

Q1 Data process and support (SFM, Geotag, LIDAR, etc.) 0

Q2 C.I. GEER-like, World map guide to final all Reconn data in spatial format (reports, metadata) 0

Q3 facilitate relationship with SIM Center to interpret reconn data 0

Q4 Access to streaming data left in field. EG leave some accelerometers and remote monitors 0

K5 Label/organize data/photos ASAP 0

K8 Archiving data, publishing with DOI 0

K12 Getting back to affected communities (lessons learned) 0

T8 Go back months / years later, collect data about recovery 0

Z3 Make sure help/keep host country/state involved 0

Z4 Presentations 0

Z5 Central data (design safe) 0

Z7 Publishing opportunities 0

Z9 Director of scientists involved (local and international) 0

Z11 Help/platform for report back to communities 0

Z13 United data collection tool for case studies upon record 0

Z14 EERI 0

Z15 Support for media interactions (press releases) 0

Z16 Home country summary for team upon return? 0

Z17 Track publications from RAPID data collection 0