**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

**Lead Agency: Utah Department of Transportation**

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

|  |  |
| --- | --- |
| **Transportation Pooled Fund Program Project #****TPF-5(350)** | **Transportation Pooled Fund Program - Report Period:**\_Quarter 1 (January 1 – March 31, 2019**)**\_ Quarter 2 (April 1 – June 30, 2019)**x Quarter 3 (July 1 – September 30, 2019)**\_ Quarter 4 (October 1 – December 31, 2019) |
| **Project Title:**Development of Next Generation Liquefaction (NGL) Database for Liquefaction-Induced Lateral Spread |
| **Name of Project Manager(s):**David Stevens | **Phone Number:** 801-589-8340 | **E-Mail** davidstevens@utah.gov |
| **Lead Agency Project ID:**FINET 42080, ePM PIN 15017UDOT PIC No. PL05.350 | **Other Project ID (i.e., contract #):** UDOT Contract No. 17-8236  | **Project Start Date:** September 8, 2016 |
| **Original Project End Date:**March 31, 2019 | **Current Project End Date:** April 30, 2020 (43 months) | **Number of Extensions:**1 |

Project schedule status:

\_ On schedule **X** On revised schedule \_ Ahead of schedule \_ Behind schedule

Overall Project Statistics:

|  |  |  |
| --- | --- | --- |
|  **Total Project Budget** |  **Total Cost to Date for Project** |  **Percentage of Work**  **Completed to Date** |
| $140,000.00 (current contract)$140,000.00 (total TPF commitments, incl. Dominion Energy unlisted amount) | $65,000.00 (paid by UDOT)$51,420.45 (at the U. of Utah) | 75% |

***Quarterly*** Project Statistics:

|  |  |  |
| --- | --- | --- |
|  **Total Project Expenses**  **and Percentage This Quarter** |  **Total Amount of Funds**  **Expended This Quarter** |  **Total Percentage of**  **Time Used to Date** |
| This Quarter = 11% (paid by UDOT)This Quarter = 0% (at the U. of Utah)Total Project = 46% (paid by UDOT)Total Project = 100% (at the U. of Utah) | $15,000.00 (paid by UDOT)$0.00 (at the U. of Utah)(Funding for U of U student from MPC funds) | 86% |

|  |
| --- |
| **Project Description**:This research is being conducted in conjunction with the Pacific Earthquake Engineering Research (PEER) Center and various state DOTs via a pool-fund study managed by the Utah Department of Transportation (UDOT). The Mountain-Plains Consortium (MPC) is also providing funding for certain aspects of this study, under a separate contract with the University of Utah. The research topic addresses the need to improve empirical, semi-empirical, analytical, and numerical methods to estimate the amount of permanent ground displacement associated with liquefaction-induced lateral spread resulting from several major earthquakes. This scope of work addresses the development of a lateral spread community database as part of the PEER Next Generation Liquefaction Project (<http://peer.berkeley.edu/lifelines/projects/ngl/>). It does not address predictive model development for lateral spread evaluations, which is future effort planned by PEER but not included in this work plan. The primary outcome of this research is a vetted and community database of seismic, topographical, geotechnical and horizontal displacement measurements about case histories of liquefaction-induced lateral spread for further research and model development by other researchers and investigators under the auspices of the PEER Center (<http://peer.berkeley.edu/>). Secondary outcomes are web host and publishing required to house and disseminate this database and its supporting information. Phase I Tasks include:(1) Kickoff meeting and procurement of software (2) Development of data quality indicators/metrics, quality assurance, and database population protocols (3) Defining methods for quantifying the uncertainty of key inputs (4) Development and structuring of database (5) Selection of case histories (6) Obtaining and screening of case history information (7) Population of the case history database (8) Database dissemination (9) Screening criteria for lateral spread potential (10) Phase I ReportingPhase II Tasks are not finalized or funded.The principal investigators for this study are Drs. Steven Bartlett (U. of Utah), Steven Kramer (U. of Washington and PEER Research Executive Committee Member), Kevin Franke (Brigham Young University) and Daniel Gillins (NOAA and consultant). The technical advisory committee (TAC) for the study currently includes representatives from Utah, California, Oregon, and Washington State DOTs. The MPC is providing additional funding for the study. |

|  |
| --- |
| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):****Task 1** – Completed.**Task 2** – Completed. Draft documents to be included in the interim report. **Task 3** – In progress. This task will continue as other data are added to the dataset.**Task 4** – Completed.**Task 5** – Continuing.**Task 6** – Continuing.**Task 7** – Uploaded sample data set to UCLA database. Task 7 Progress Memo was submitted.**Task 8** – Not started.**Task 9** – Started – Technical approach defended to U of U graduate committee.**Task 10** – Draft interim report finalized.TAC meetings – None were held this quarter.Contract – No changes were made. |
| **Anticipated work next quarter**:**Task 1** – Completed.**Task 2** – Completed**Task 3** – Continue to inventory methods of quantifying uncertainty and data quality.**Task 4** – Completed.**Task 5** – In progress. BYU is working on 2010 Maule, Chile; 2011 Tohoku, Japan, 2010 Darfield and 2011 Christchurch Earthquakes.**Task 6** – Obtaining data in progress.**Task 7** – Continue the population of data set for U.S. Case histories and uploading to UCLA database.**Task 8** – Not started.**Task 9** – Begin work on screening criteria. Complete and submit the Task 9 Progress Memo.**Task 10** – Continuing. TAC meetings – Consider holding a TAC web conference to discuss progress to date, next steps, and questions.Contract – No changes are planned. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Significant Results:****University of Utah**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Case history** | **Site** | **Displacement vectors** | **Boreholes** | **Subsurface data rows** | **Topology points** | **Cross-checked** |
| **1964 Niigata** | F10 | 179 | 24 | 359 | 429 | In progress |
| G10 | 654 | 68 | 1574 | 256 | Completed |
| H9 | 155 | 4 | 92 | 235 | Completed |
| J9 | 442 | 45 | 192 | 297 | In progress |
| K8 | 285 | 4 | 62 | 302 |  |
| Total | 1715 | 145 | 2279 | 1519 |  |
|  |  |  |  |  |  |  |
| **1983 Noshiro** | South | 266 | 128 | 462 | 176 |  |
| North | 147 | 59 | 848 | 348 |  |
| Total | 413 | 187 | 1310 | 524 |  |
|  |  |  |  |  |  |  |
| **1971 San Fernando** | Jensen water plant | 69 | 33 | 494 | flatfile |  |
| Juvenile hall | 79 | 6 | 121 | flatfile |  |
| Total | 148 | 39 | 615 |   |  |
|  |  |  |  |  |  |  |
| **1964 Alaska** | Total | 14 | 20 | 411 |   |  |
|  |  |  |  |  |  |  |
| **1979 Imperial Valley** | Heber road | 29 | 7 | 135 | flatfile |  |
| River park site | NA | 4 | 62 | NA |  |
| Total | 29 | 11 | 197 |   |  |
|  |  |  |  |  |  |  |
| **1983 Borah peak, Idaho** | Whiskey springs | 3 | 3 | 54 | flatfile |  |
| Pence Ranch | 3 | 6 | 69 | flatfile |  |
|  | Total | 6 | 3 | 54 |   |  |
|  |  |  |  |  |  |  |
| **1906 San Francisco** | Mission creek zone | 9 | 8 | 92 | flatfile |  |
| South of market area | 7 | 7 | 80 | NA |  |
| Foot of market area | 3 | NOTE -> | NA |  |
| Total | 19 | 15 | 172 |   |  |
|  |  |  |  |  |  |  |
| **1987 Superstition Hills, California** |  | 7 | 2 | 53 | flatfiles |  |
|  |  |  |  |  |  |  |
| **1989 Loma Prieta, California** |  | 3 | 15 | 236 | flatfiles |  |
|  |  |  |  |  |  |  |
| **1999 ChiChi Taiwan** | Site C | 20 | 15 |  | flatfiles |  |
|  | Site C1 | 4 | 2 |  |  |
|  | Site B | 4 | 6 |  |  |
|  | Site M | 4 | 2 |  |  |
|  | Site N | 4 | 3 |  |  |
|  | Total | 34 | 23 | 2806 |   |  |
|  |  |  |  |  |  |  |
| **2010 Chile** | Lo Rojas port |  | 8 | 2494 | in progress | In progress |
|  | North and South Pier |  | 7 |  |
|  | Juan Pablo II Bridge |  | 8 | completed |
|  | La Mochita Bridge |  | 2 | completed |
|  | Llacolen Bridge |  | 6 |  |
|  | Mataquito Bridge |  | 6 |  |
|  | Tubul Bridge |  | 6 |  |
|  | Raqui 1 and Raqui 2 Tubul |  | 1 |  |
|  | Total | 0 | 21 | 2494 |  |  |
|  |  |  |  |  |  |  |
| **1990 Luzon Phillipines** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **1991 Costa Rica** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **1994 Northridge, California** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **1995 Kobe, Japan** |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| **1999 Kocaeli, Turkey** |  |  |  |  |  |  |
| **BIG SUM:** |  | **2381** | **479** | **10574** | **2043** |  |

 **Brigham Young University**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Case History** | **Site** | **Displacement Vectors** | **Boreholes** | **Subsurface Data Rows** | **Topology Points** |
| **2010 Maule, Chile** | Juan Pablo II | 1 | 7 | 685 | In Progress |
| La Mochita | 3 | 2 | 45 |
| Llacolen | 3 | 5 | 235 |
| Lo Rojas Port Coronel | 1 | 8 | 1732 |
| Mataquito | 3 | 6 | 556 |
| Port Coronel | 5 | 7 | 575 |
| Tubul Bridge | 2 | 6 | 185 |
| Tubul Raqui | 2 | 1 | 40 |
| Total | 20 | 42 | 4053 | 0 |
|   |
| **2011 Tohoku, Japan** | Hitachinaka | In Progress | 2 | 30 | In Progress |
| Isobe | 3 | 68 |
| Sodegaura | 2 | 36 |
| Tone | 1 | 26 |
| Tokyo Bay | In Progress | In Progress |
| Total | 0 | 8 | 160 | 0 |
|   |
| **2010 Darfield, New Zealand (September)** | Avon River | 37 | In Progress | In Progress | In Progress |
| Bottle Lake | 3 |
| Heathcote River | 2 |
| Styx River | 10 |
| Courtenay Stream/Kaiapoi River | 19 |
| Total | 71 | 0 | 0 | 0 |
|   |
| **2011 Christchurch, New Zealand (February)** | Avon River | 53 | In Progress | In Progress | In Progress |
| Heathcote River | 6 |
| Courtenay Stream/Kaiapoi River | 3 |
| Total | 62 | 0 | 0 | 0 |

 |
| **Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that** **might affect the completion of the project within the time, scope and fiscal constraints set forth in the** **the agreement, along with recommended solutions to those problems).**The contract extension was requested by BYU. Contract extension end date is April 30, 2020. U of U is assisting BYU in completing their case histories and work on the screening criteria task during this extension. |

|  |
| --- |
| **Potential Implementation:** None yet. |