Scope of Work

GRANTEE and FISCAL AGENT (if different) – Fourmile Watershed Coalition (grantee), Four Mile Fire Protection District (fiscal agent).

PRIMARY CONTACT- Maya MacHamer, Watershed Coordinator

ADDRESS- 1740 Fourmile Canyon Drive, Boulder Co 80302

PHONE- 303-817-2261 (cell), 303-449-3333 (office)

PROJECT NAME- Debris Flow Early Warning System Pilot Project

GRANT AMOUNT- $20,600

INTRODUCTION AND BACKGROUND

Geologic hazards such as debris flows and landslides are difficult emergencies to manage and recover from. Natural hazards do not respect jurisdictional lines. Debris flows, in particular, are not commonly experienced, difficult to predict and can cause multiple hazards such as structural collapse, hazardous materials, infrastructure failures, fires, mass casualty & fatalities. Response to these emergencies often include difficult operational coordination when the incident occurs, resource scarcity and access issues. Evacuating downslope, at risk communities prior to the disaster is the best way to minimize impact. The question emergency managers are faced with is where and when initiate public warnings and what messaging should be included.

The Debris Flow Early Warning System project integrates science and the human element. It is a data collection, utilization and communication project that strives to provide a new, innovative way of transmitting soil data to be effectively used and communicated by emergency managers through public warning systems. There are two other locations where the Colorado Geological Survey is working on early warning systems for landslides, but they do not incorporate the real time communication of soil saturation data that could be helpful in determining if areas should be evacuated due to the imminent risk of a landslide or debris flow. A debris flow early warning system has the potential to reduce risk and transform fire and flood recovery strategies for emergency managers.

An early warning system for debris flows, if successful, could be utilized state-wide and would positively impact multiple sectors including community, economic, health and social, housing, infrastructure, watersheds and natural resources.

OBJECTIVES

1. Improve the safety of communities.
2. Improve preparedness and response to future natural hazards.
3. Contribute to and expand data sets associated with debris flow modeling and prediction.
4. Close the communication gap between scientists and emergency managers.
5. Evaluate and improve warning system effectiveness.

TASKS

TASK 1: Evaluation and Assessment

Description of Task: Evaluate existing relevant data, existing warning systems, and existing operational procedures for geologic hazards and evacuations.

Method/Procedure

1. Determine pilot areas that meets the following criteria: clear hazard to life and property, detailed knowledge of events (ground truth) and meteorological conditions (rain gauges, weather radar coverage).
2. Evaluate meteorological and geotechnical monitoring needs. These would likely include monitoring of rain gage, soil moisture, and/or pore pressure.
3. Evaluate available weather radar coverage.
4. Evaluate early warning systems already in place.
5. Utilize data from the concurrent CGS landslide and debris flow susceptibility maps of the Colorado Front Range, including Boulder County.
6. As detailed subsurface investigations are costly and difficult in steep terrain, research and develop effective site-specific methods for mapping relevant soil material properties (including hydrologic) on steep hillsides.
7. Evaluate sites for soil sampling and instrumentation installation.
8. Field map geologic conditions

Deliverable: Map of project areas and report discussing existing conditions.

Task 2: Soil Sampling (Task Funded with CDBG-DR funds)

Description of Task: Obtain soil samples from multiple locations within the general debris flow study areas. Soil samples will assist in determining appropriate locations for instrumentation to be installed. NRCS will also use soil sampling for further data analysis.

Method/Procedure:

1. Collect soil samples.
2. Analyze sample results.

Deliverable: Map with soil sampling locations and analytical results.

Task 3: Instrumentation (Task Funded with CDBG-DR funds)

Description of Task: Determine the most appropriate instrumentation required to acquire relevant data. Purchase and install the instrumentation.

Method/Procedure

1. Research instrumentation beyond rain gauges (i.e. soil saturation or other geotechnical components) with potential to refine the early warning system.

2. Install instrumentation and selected sites.

Deliverable: Map of instrument locations.

TASK 4: Communication Technology

Description of Task: Determine appropriate technology to communicate real time data from pilot sites to the Boulder Office of Emergency Management so that it is compatible with their Alert 5 system.

Method/Procedure:

1. Research the computer and communications networks required to support the operation.
2. Evaluate Alert 5 to determine compatibility needs for data communications.
3. Refine the geographically specific warning thresholds (cumulative rainfall threshold, intensity duration thresholds and antecedent water relationships) for pilot areas.

Deliverable: Outcomes addressed within the Final Report.

TASK 5: Develop Data Thresholds and Trigger Points

Description of Task: Determine appropriate data thresholds and trigger points to inform warning levels and evacuation criteria. Assure that these can be well understood and usable for emergency management procedures. As debris flow and landslide risk increase public warnings should be communicated when the following conditions exist.

Method/Procedure:

1. Refine the geographically specific warning thresholds (cumulative rainfall threshold, intensity duration thresholds and antecedent water relationships) for pilot areas.
2. Review "storm intensity" thresholds for public warnings in conjunction with new data.
3. Evaluate soil saturation levels: currently when antecedent levels of saturation are present and four inches of rain or more is possible as seen trending by rain gauge measurements or is communicated in a forecast (QPF) action should be taken to communicate a weather advisory.
4. Evaluate total rain fall amounts: short measurement interval (hours) or a longer duration event (days) or total cumulative amount of rain.
5. Evaluate normal and post-fire conditions to understand varying conditions and how data implications vary in post-fire landscapes.

Deliverable: Discussion of data thresholds and trigger points in the final report. These will also be integrated into the decision-making framework.

TASK 6: Decision Making Framework Development

Description of Task: Work with emergency management partners to develop a decision-making framework to create a procedural framework for using data to make decisions about when to use early warning systems for evacuations.

Method/Procedure:

1. Define and describe data implications, usage and limitations.
2. Review existing operational procedures associated with evacuation and geologic hazards.
3. Determine appropriate public messaging: Identification of public safety authority, Clear description of the hazard or threat, proper construction and delivery of public warnings including specificity about the location, time to the threat or hazard impacts, protective or direct actions to take.
4. Create visual depictions of decision-making trees or graphs to streamline process.

Deliverable: Decision-making framework document.

TASK 7: Coordinate with School of Mine and Colorado Geological Survey

Description of Task: Coordinate project management, data acquisition and reporting and communication with other partners.

Method/Procedure:

1. Coordinate project tasks, site visits, landowner outreach timelines,
2. Facilitate meetings and partner communication,
3. Assist with reports and other needs/requirements.

Deliverable: Final report that includes description of partner roles.

TASK 8: Grant Administration

Description of Task: Prepare all required financial and reporting documents to assure grant compliance.

Method/Procedure:

1. Review grant requirements,
2. Track financial expenditures and budgets,
3. Compile accurate reimbursement requests,
4. Prepare deliverables and reports,
5. Project close out.

Deliverable: Accurate and timely requests for reimbursement and reports.

REPORTING AND FINAL DELIVERABLE

Reporting: The applicant shall provide the CWCB a progress report every 6 months, beginning from the date of the executed contract. The progress report shall describe the completion or partial completion of the tasks identified in the statement of work including a description of any major issues that have occurred and any corrective action taken to address these issues.

Final Deliverable: At completion of the project, the applicant shall provide the CWCB a final report that summarizes the project and documents how the project was completed. This report may contain photographs, summaries of meetings and engineering reports/designs.

STATE OF COLORADO

Department of Natural Resources

ORDER

Number: POGG1,PDAA,202100002179

Date: 7/24/21

Description:

WSR Grant Debris Flow early warning system

Effective Date: 09/01/20

Expiration Date: 06/30/22

*******IMPORTANT*******

The order number and line number must appear on all invoices, packing slips, cartons, and correspondence.

BILL TO

COLORADO WATER BOARD CONSERVATION
1313 SHERMAN STREET, ROOM 718
DENVER, CO 80203

BUYER

Buyer:

Email:

VENDOR

FOUR MILE FIRE PROTECTION DISTRICT
Watershed Coalition
1740 FOURMILE CANYON DR
BOULDER, CO 80302-9831

Contact: .

Phone: 3034440882

SHIP TO

COLORADO WATER BOARD CONSERVATION
1313 SHERMAN STREET, ROOM 718
DENVER, CO 80203

SHIPPING INSTRUCTIONS

Delivery/Install Date: -

FOB: FOB Dest, Freight Allowed

VENDOR INSTRUCTIONS

EXTENDED DESCRIPTION

Line Item	Commodity/Item Code	UOM	QTY	Unit Cost	Total Cost	MSDS Req.
1	G1000		0	0.00	$20,600.00	☐

Description: WSR Grant Debris Flow early warning system

The Debris Flow Early Warning System project integrates science and the human element. It is a data collection, utilization and communication project that strives to provide a new, innovative way of transmitting soil data to be effectively used and communicated by emergency managers through public warning systems. There are two other locations where the Colorado Geological Survey is working on early warning systems for landslides, but they do not incorporate the real time communication of soil saturation data that could be helpful in determining if areas should be evacuated due to the imminent risk of a landslide or debris flow. A debris flow early warning system has the potential to reduce risk and transform fire and flood recovery strategies for emergency managers.

Service From: 09/01/20 Service To: 06/30/22

TERMS AND CONDITIONS

https://www.colorado.gov/osc/purchase-order-terms-conditions

STATE OF COLORADO

Department of Natural Resources

REASON FOR MODIFICATION
Change Order Number: 1
Roll Document from 2021 to 2022
DOCUMENT TOTAL = $20,600.00