ENGINEERS WITHOUT BORDERS USA

Building A Better World

Dave Cook, LG, CPG – 2016 President
EWB-USA

OUR WORLD TODAY

GLOBAL CHALLENGES

748 million
lack clean water

1.4 billion
lack access to electricity

2.5 billion
lack adequate sanitation

2.7 billion
rely on biomass energy for cooking

OUR WORLD TODAY

EWB-USA'S MISSION

Build stronger communities

Build stronger global leaders

EWB-USA Programs

Engineering Service Corps (ESCorps)

Community ENGINEERING CORPS™

American Water Works Association

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

International Community Programs (ICP)

COMMUNITY ENGINEERING CORPS

CONTRIBUTE YOUR SKILLS TO THOSE IN NEED

In February 2014 ASCE launched the Community Engineering Corps (CECorps), an exciting alliance with Engineers Without Borders USA and the American Water Works Association (AWWA). The CECorps harnesses the expertise of thousands of volunteers by providing pro bono engineering services that address the infrastructure needs of underserved communities in the United States.

Community ENGINEERING CORPS®

The CECorps works collaboratively with communities to design solutions to problems that the community has identified. The CECorps only partners with communities that do not have the financial resources to access engineering resources in a traditional manner.

VOLUNTEER OPPORTUNITIES

- Lend your technical expertise to communities – review community project applications or provide technical review of project plans
- Form or join a project team through your ASCE Section, Branch or Institute Chapter – work with underserved communities on improvement projects.
- Mentor student groups – guide university-based student chapters in the technical aspects of their community projects.

GET INVOLVED

CE Corps is seeking enthusiastic volunteers to use their skills and expertise to help underserved communities across the United States.

VIEW OPEN PROJECTS

waiting for adoption by a project team.

American Water Works Association | ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS | ENGINEERS WITHOUT BORDERS USA

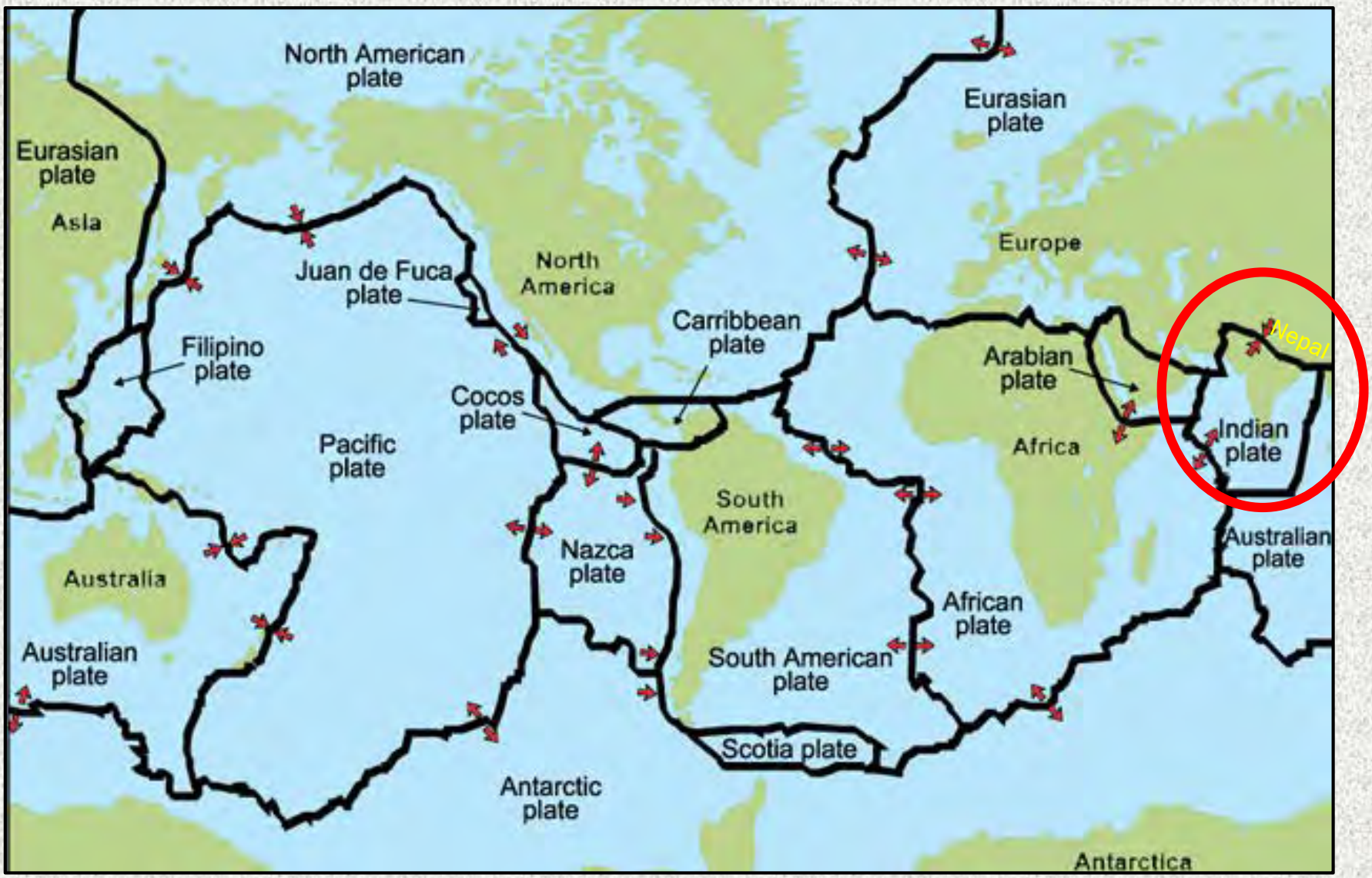
ENGINEERS WITHOUT BORDERS USA

Engineering Service Corps

Post-earthquake geologic hazards reconnaissance & preliminary recommendations for villages of Duguna Gadi, Sindhupalchowk District, Nepal

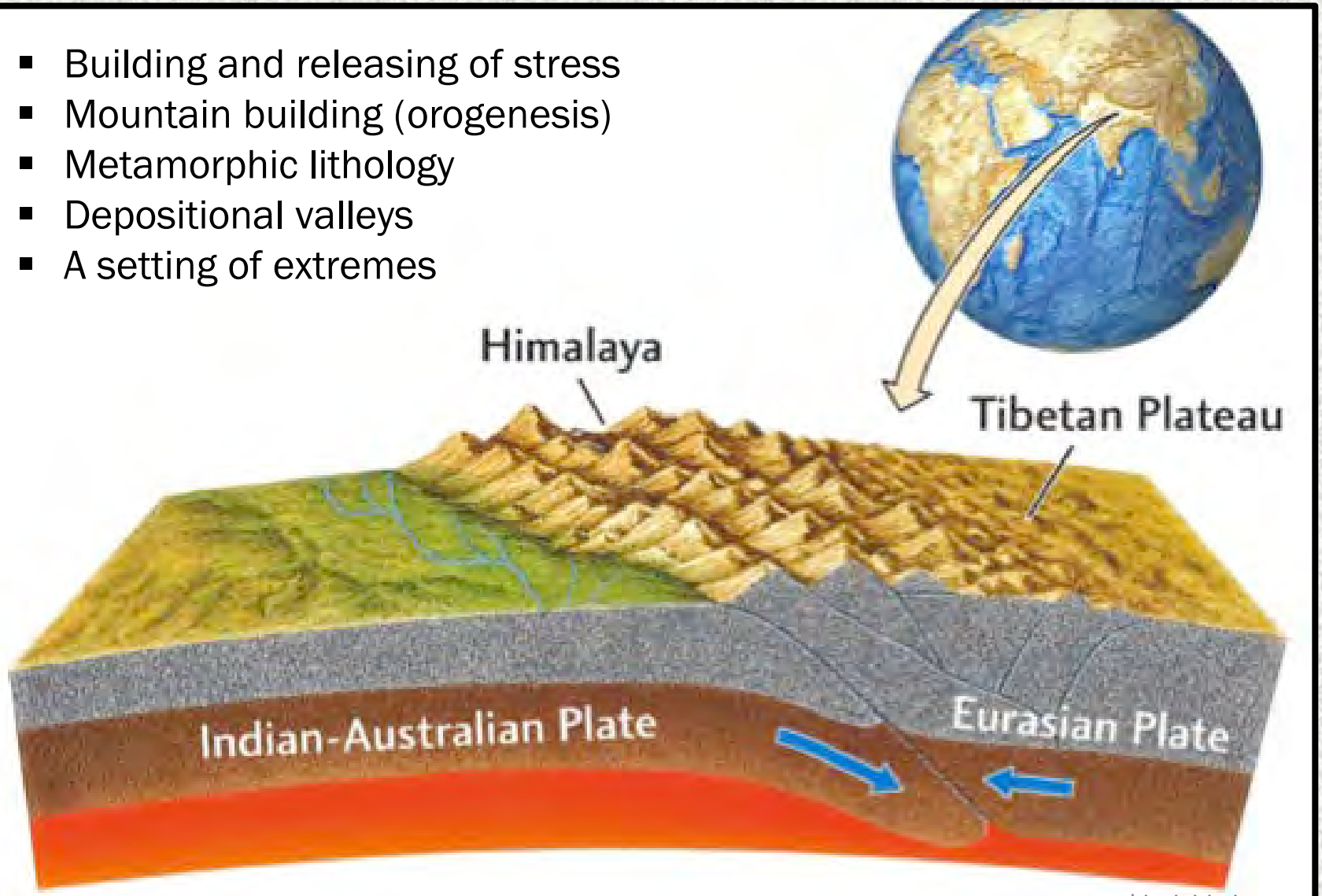
Geographic setting

Geologic setting



Geologic setting

- Building and releasing of stress
- Mountain building (orogenesis)
- Metamorphic lithology
- Depositional valleys
- A setting of extremes



A setting of extremes

- 8 of the worlds 10 highest mountains are found in Nepal
- Mt. Everest
  - elev. 29,000 ft (8,840 m)
- Kathmandu Valley
  - elev. ~4,600 ft (~1,000 m)
- Seasons
  - Autumn (late Sept. to late Nov.)
  - Winter (Dec. & Jan.)
  - Spring (Feb. to mid-April)
  - Pre-monsoon (mid April to early June)
  - Monsoon (mid-June to late Sept.)
- Rainfall
  - 0.4” (Dec., plains)
  - 33.5 “ (Aug., western hills)

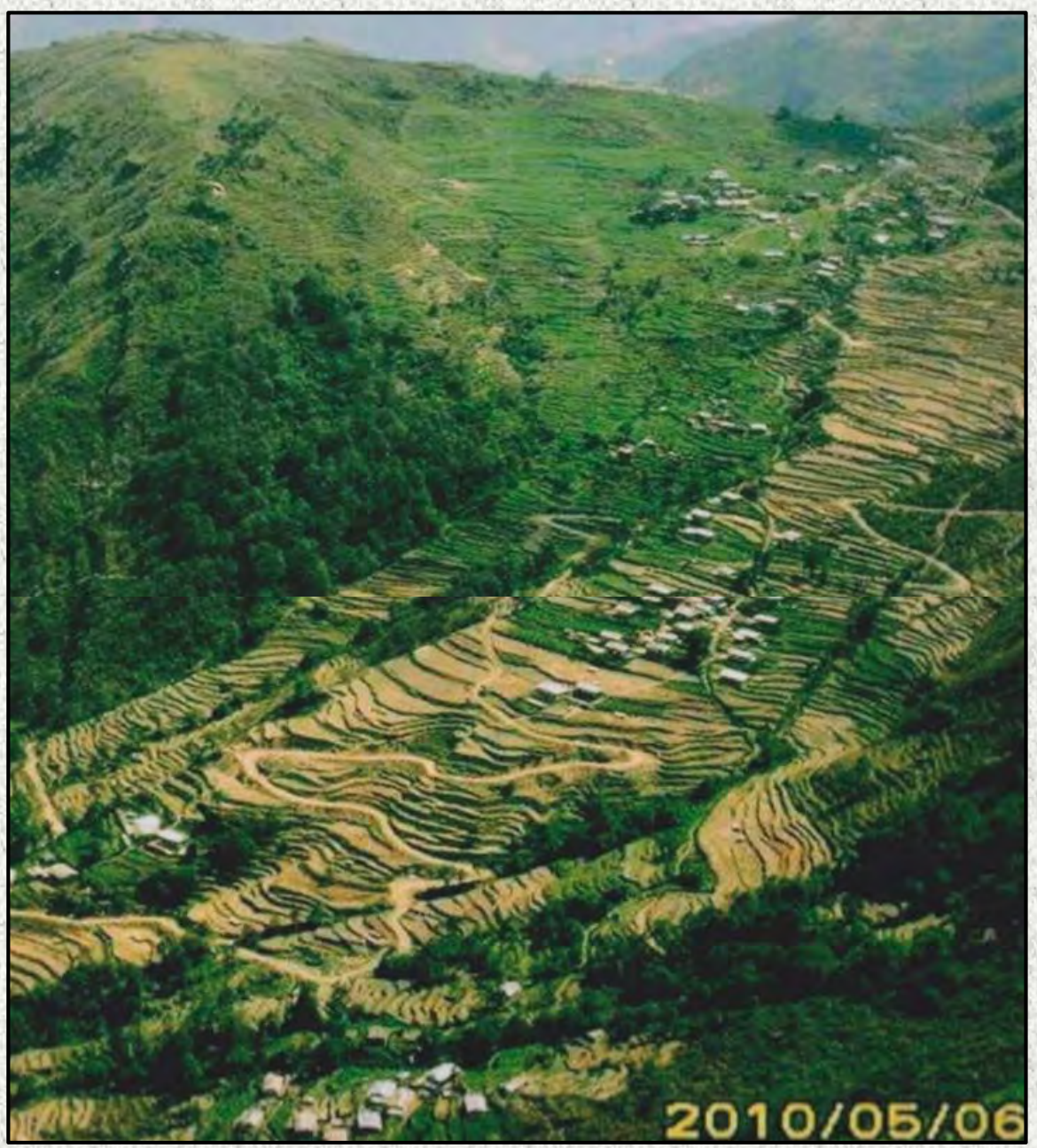
Cultural setting

- Nearly 2/3 of all Nepalis make their living from agriculture
- Top foreign-exchange earner is tourism
- Average annual per capita income is $730
- More than 50 languages
- Multiple ethnic groups, dispersed across the country in many geographical contexts
- National pride
- Strong sense of community
- Vibrant culture
- Resilient spirit
- Religious core
  - Hinduism, Buddhism, Newari, Shamanism, Islam, Christianity

Dispersed population

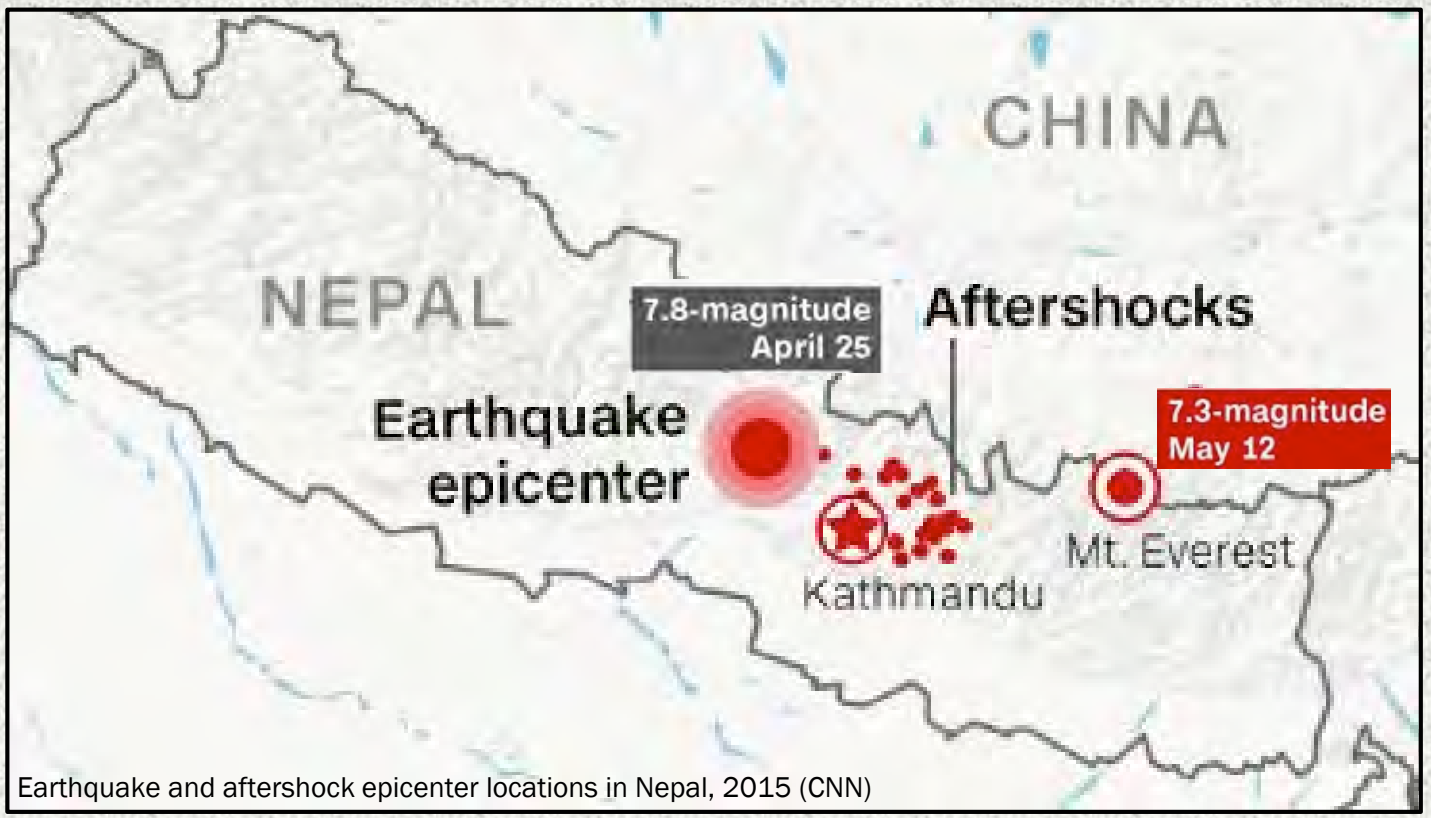
Duguna Gadi Himalayan foothill

- ~ 80 km NW from Kathmandu
- ~2 km from China border
- ~1000 people
- 12 distinct villages
- 5 distinct castes
- Generational history
- Concentrated source of livelihood



The people of Duguna Gadi

April 25, 2015



Earthquake and aftershock epicenter locations in Nepal, 2015 (CNN)

2015 Nepal earthquakes stats

- 8,790 fatalities
- 22,300 injured
- 750,000 damaged or destroyed homes
- Lost livelihoods of thousands of people
- Initiated avalanches, landslides, and rock fall in the Himalayan Mountains

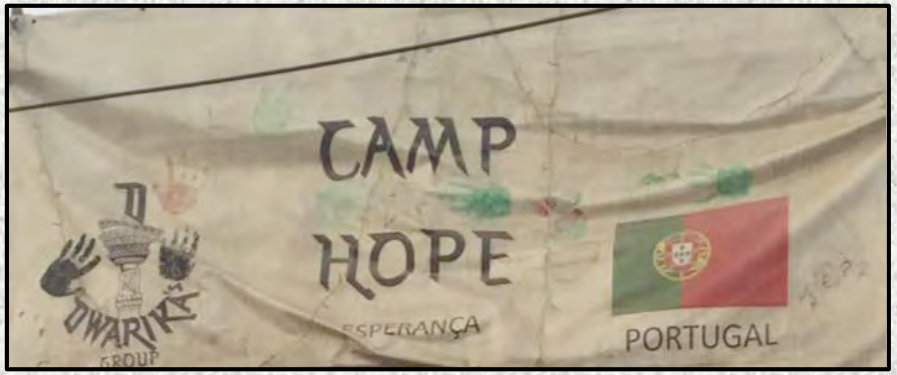

Tatopani, Sindhupalchowk. May 2015

The Response





- Dwarika's Foundation
- Association Obrigado Portugal
- Camp Hope
- Engineers Without Borders -USA






Bob Burk


Eliya Gangar


Roshan Raj Bhattarai


Danda Pani Adhikari


Leyla Safari

EWB-USA : Nepal Goals:

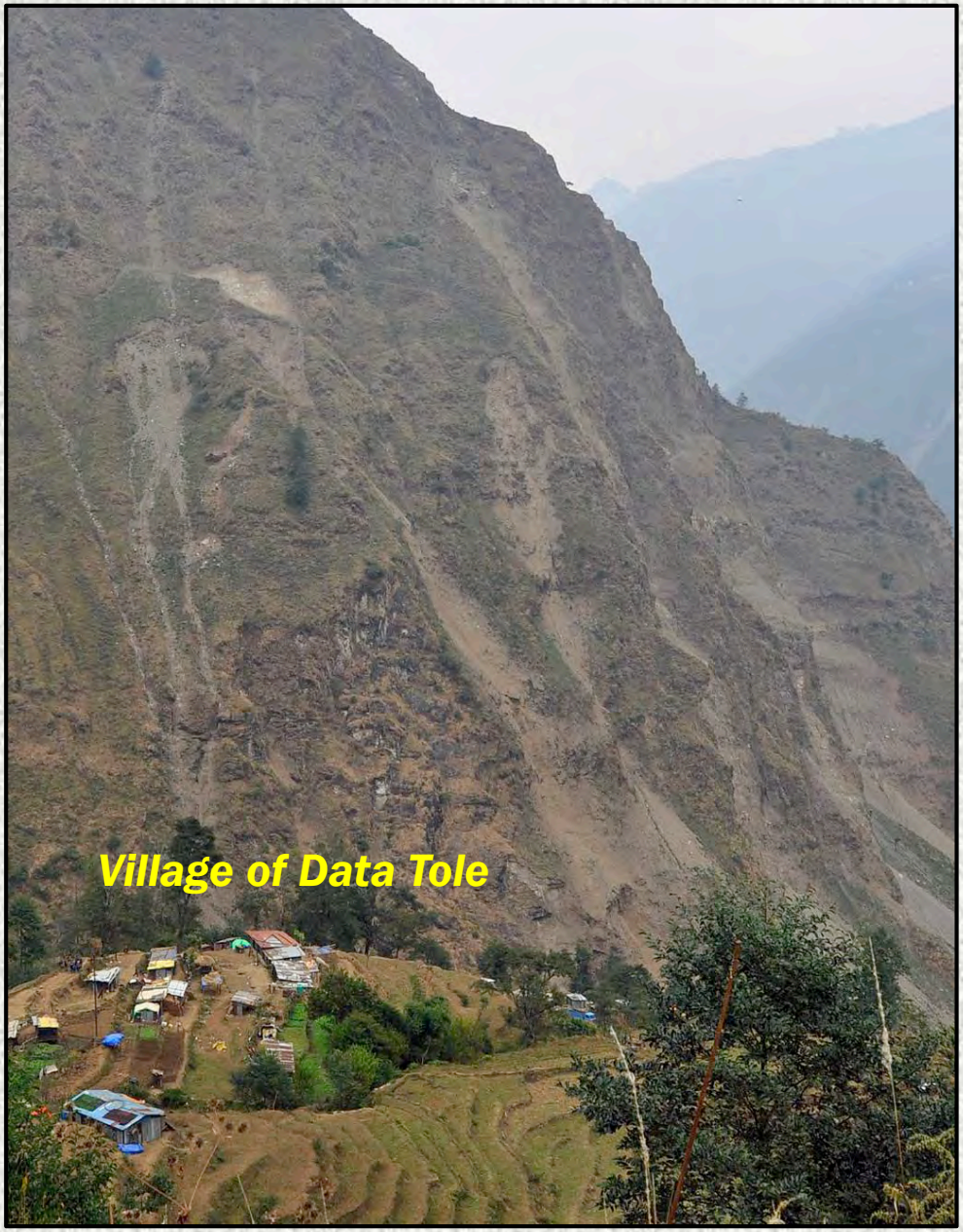
- Collaboration between US and Nepali geo-professionals
- To establish a methodology for evaluating geohazards in isolated communities
- To leave a launching point for future success

Objectives

- Evaluate 14 locations
- 1 week of field mapping
  - Bedrock geology
  - Process geomorphology
  - Active instability
- Identify features, hazards, and relative risks
- Develop recommendations for improving stability and increasing safety
- Establish method(s) of monitoring hazards

Deliverable

- Geohazard report submitted to EWB-USA, Dwarika's Foundation, and Association Obrigado Portugal



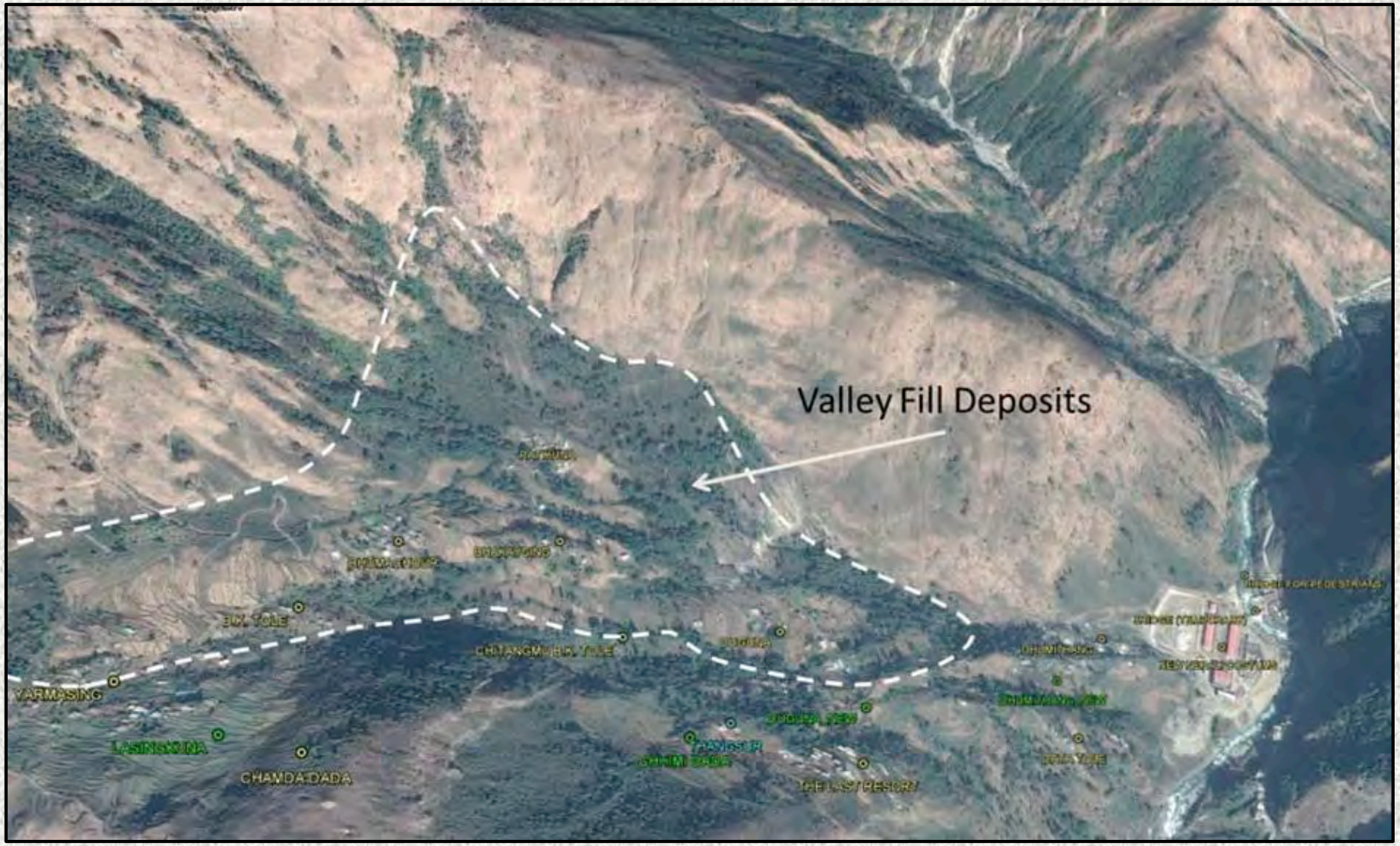
Methods

Overview

- Identify geomorphic and geologic features contributing to hazards and risks
- Delineate areas with similar characteristics
- Provide potential mitigation options


THE FORT (GOVERNMENT AREA)
CHAMDA DADA
LASINGKUNA
YARMASING
Google earth
Image © 2016 CNES / Astrium
N
500 ft

Identifying Duguna Gadi geologic hazards



Identifying Duguna Gadi geologic hazards

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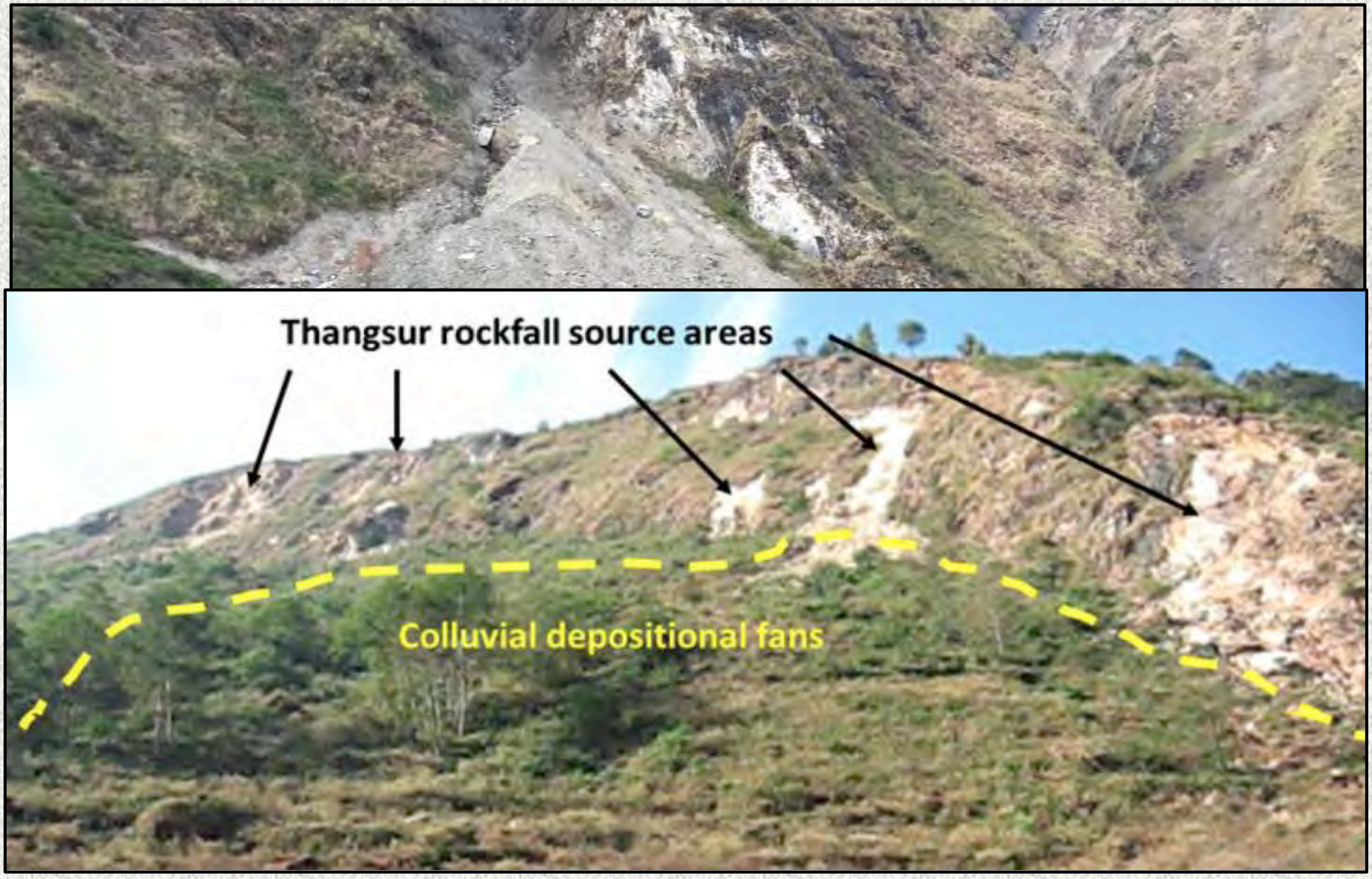


Identifying Duguna Gadi geologic hazards

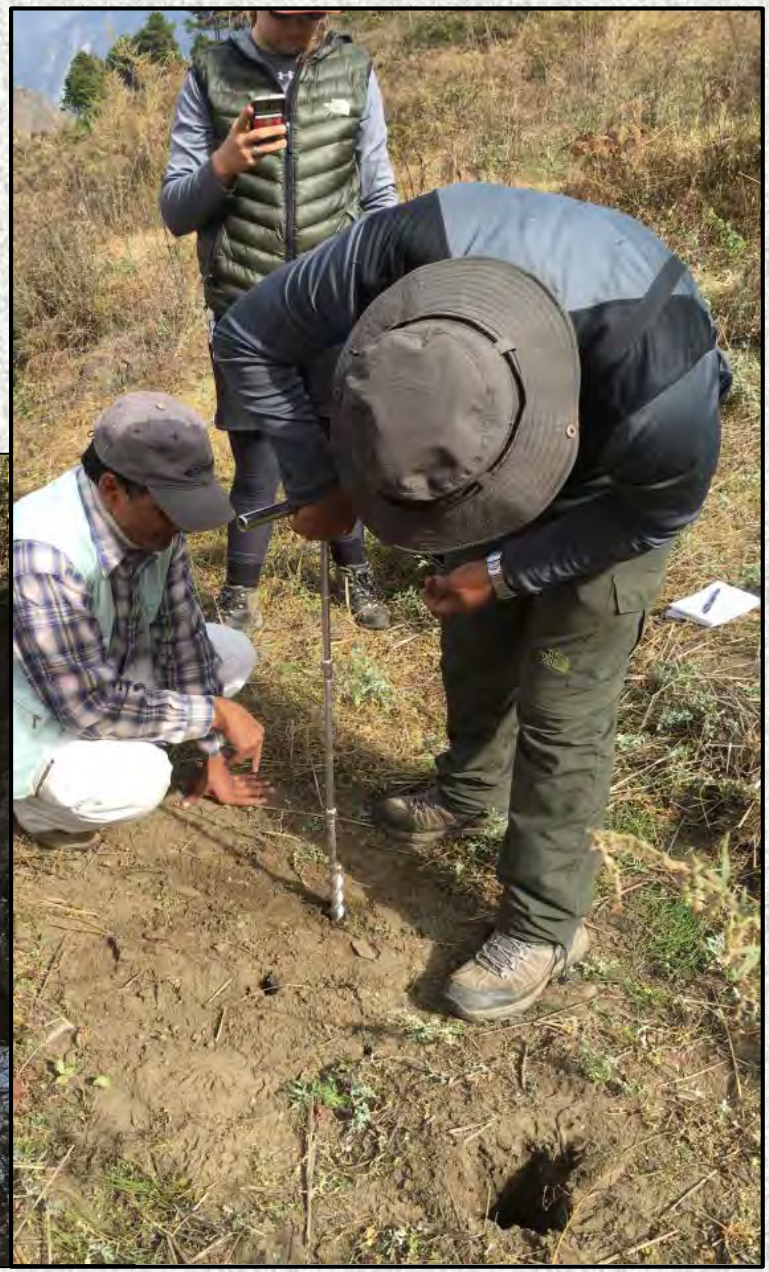
Earthquake damage in Duguna Gadi

Earthquake damage in Duguna Gadi

Earthquake damage in Duguna Gadi

Data collection

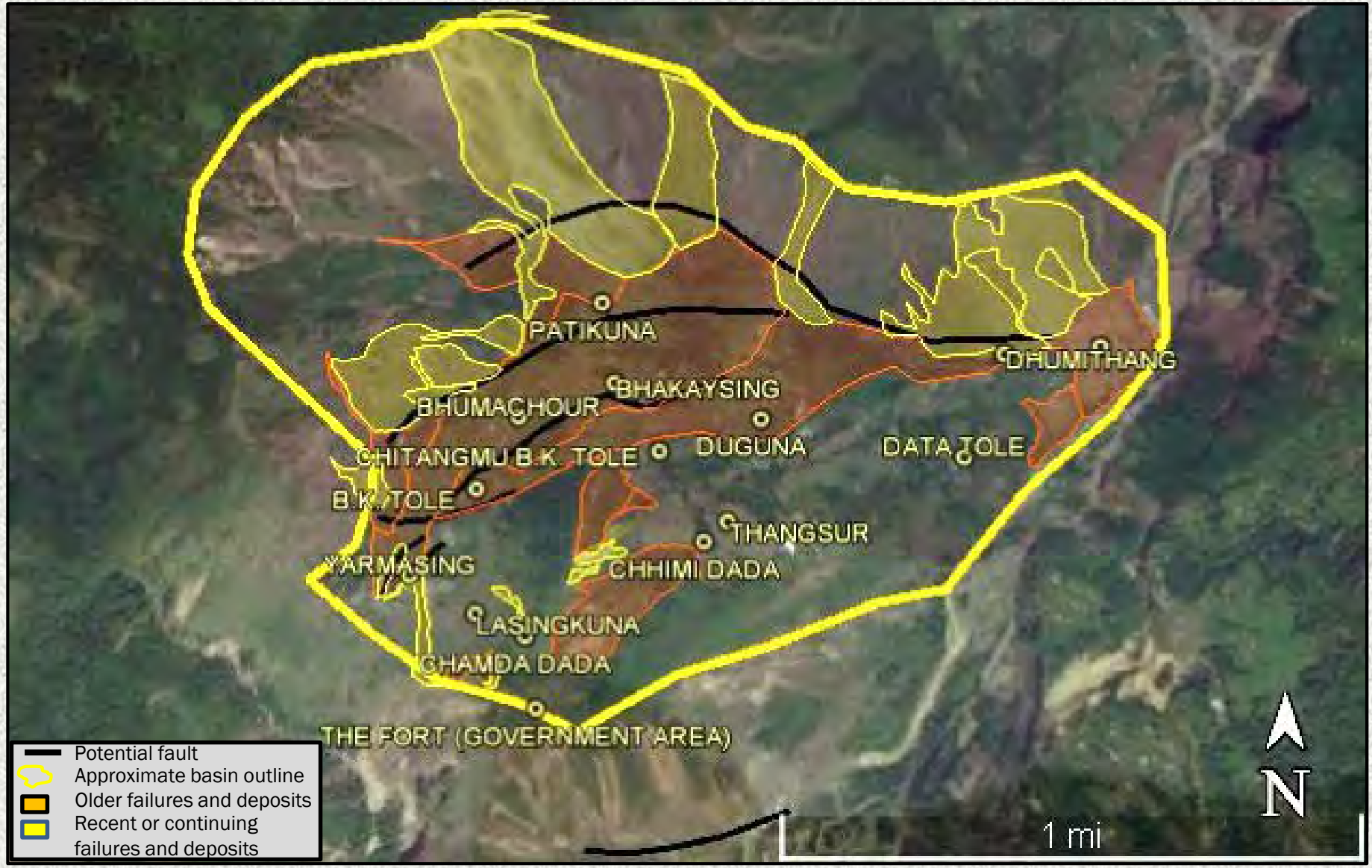
- Test pits
- Percolation tests
- Rock identification
- Strike and dip data



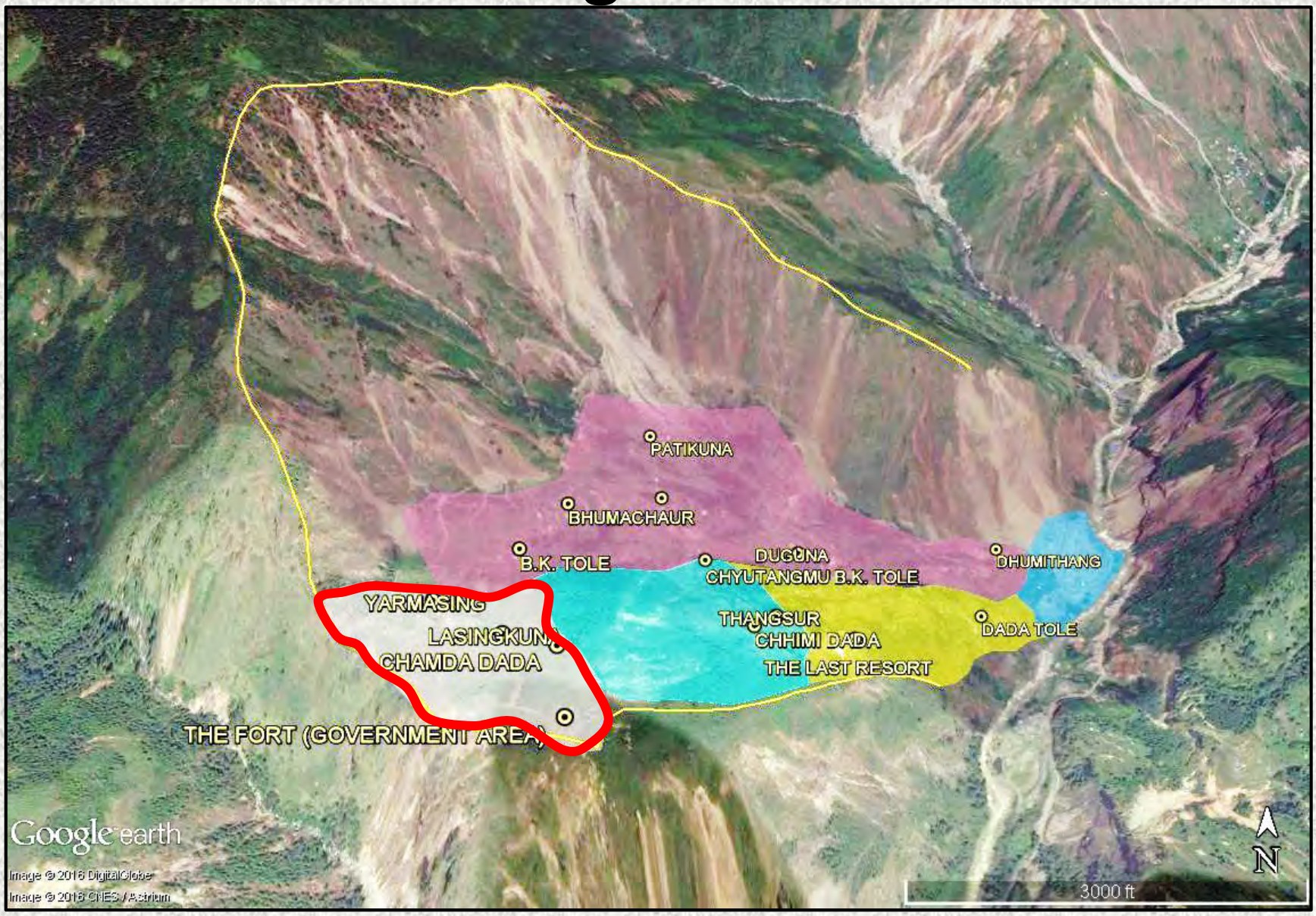
Data collection

- Test pits
- Percolation tests
- Rock identification
- Strike and dip data

Field Mapping Results



Region 1


PATIKUNA
BHUMACHAUR
B.K. TOLE
DUGUNA
CHYUTANGMU B.K. TOLE
DHUMITHANG
YARMASING
LASINGKUNA
CHAMDA DADA
THANGSUR
CHHIMI DADA
DADA TOLE
THE LAST RESORT
THE FORT (GOVERNMENT AREA)
Google earth
Image © 2016 DigitalGlobe
Image © 2016 CNES / Astrium
3000 ft
N

Risks for Regions 1 & 2

- Village-specified summaries
- Identified primary features and hazards
- Developed a triage of risk

Areas and Villages	Observations*
	REGION 1 VILLAGES
Fort Areas	Shallow bedrock is talc rock which promotes sliding of overlying surficial soils.
Chamda Dada	Shallow bedrock is talc rock which promotes sliding of overlying surficial soils.
Lasingkuna	Surficial soils supported by shallow bedrock.
Yarmasing	Two slope failures initiated from higher on the slope and evidence of sliding of surficial soils over talc rock.
	REGION 2 VILLAGES
Chhimi Dada	Upslope areas of concern for slope failures that could affect this area.
Chitangmu Tole	Location is in valley fill deposits that under the right saturation conditions could fail catastrophically over a wide area.
Thangsur	Boulders up to 2-3 meters throughout the village area demonstrate long history of rockfall reaching the village.

Lowest relative risk of potential geohazard, based on observations
Moderate relative risk of potential geohazard, based on observations
Highest relative risk of potential future geohazard, based on observations

Risks for Regions 3, 4, & 5

- Village-specified summaries
- Identified primary features and hazards
- Developed a triage of risk

	REGION 3 VILLAGES
Bhakaysing	Location is in valley fill deposits that under the right saturation conditions could fail catastrophically over a wide area.
Bhumachour	Location is in valley fill deposits that under the right saturation conditions could fail catastrophically over a wide area.
B.K. Tole	Upslope areas of concern for slope failures that could affect this area.
Dhumithang	Up-drainage valley fill, if mobilized would overwhelm this area with mudflows and landslide debris.
Duguna	Up-drainage valley fill, if mobilized would overwhelm this area with mudflows and landslide debris.
Patikuna	Upslope rockfall hazard. Also site is on the edge of valley fill that could be mobilized.
	REGION 4 VILLAGES
The Last Resort	Some gentle slopes above the area where there are existing structures appears to be relatively stable.
Dada Tole	Steep slopes may be unstable without appropriate water management and control.
	REGION 5
Customs	Rockfall has damaged some of the existing buildings and covered the road. Up-drainage valley fill, if mobilized could overwhelm this area. Site is built on river terrace deposits.

Lowest relative risk of potential geohazard, based on observations

Moderate relative risk of potential geohazard, based on observations

Highest relative risk of potential future geohazard, based on observations

Areas and Villages	Observations*	Recommendations*
	REGION 1 VILLAGES	
Fort Areas	Shallow bedrock is talc rock which promotes sliding of overlying surficial soils.	If allowed because of archaeologic significance of the area, remove surficial soils and create building pads in the talc bedrock. If available, good area for resettlement.
Chamda Dada	Shallow bedrock is talc rock which promotes sliding of overlying surficial soils.	Remove surficial soils and create building pads in the talc bedrock. With bedrock pads, good area for resettlement.
Lasingkuna	Surficial soils supported by shallow bedrock.	With drainage control and avoiding saturation of surficial soil, then suitable for settlement in areas without tension cracks in the soil.
Yarmasing	Two slope failures initiated from higher on the slope and evidence of sliding of surficial soils over talc rock.	Abandon existing and new settlement in this area.
	REGION 2 VILLAGES	
Chhimi Dada	Upslope areas of concern for slope failures that could affect this area.	Reevaluate after 2016 monsoon season and redefine any evidence of slope failures.
Chitangmu Tole	Location is in valley fill deposits that under the right saturation conditions could fail catastrophically over a wide area.	Abandon existing and new settlement in this area.
Thangsur	Boulders up to 2-3 meters throughout the village area demonstrate long history of rockfall reaching the village.	Abandon existing and new settlement in this area unless a well-designed containment embankment is built upslope.
	REGION 3 VILLAGES	
Bhakaysing	Location is in valley fill deposits that under the right saturation conditions could fail catastrophically over a wide area.	Abandon existing and new settlement in this area.
Bhumachour	Location is in valley fill deposits that under the right saturation conditions could fail catastrophically over a wide area.	Abandon existing and new settlement in this area.
B.K. Tole	Upslope areas of concern for slope failures that could affect this area.	Reevaluate after 2016 monsoon season and redefine evidence of fault ground rupture. Result could be to abandon existing and new settlement in this area.
Dhumithang	Up-drainage valley fill, if mobilized would overwhelm this area with mudflows and landslide debris.	Abandon existing and new settlement in this area.
Duguna	Up-drainage valley fill, if mobilized would overwhelm this area with mudflows and landslide debris.	Abandon existing and new settlement in this area.
Patikuna	Upslope rockfall hazard. Also site is on the edge of valley fill that could be mobilized.	Abandon existing and new settlement in this area.
	REGION 4 VILLAGES	
The Last Resort	Some gentle slopes above the area where there are existing structures appears to be relatively stable.	With control of soil saturation and general water handling area is potentially suitable for settlement except for the steep slopes below the resort.
Dada Tole	Steep slopes may be unstable without appropriate water management and control.	Reevaluate after 2016 monsoon season.
	REGION 5	
Customs	Rockfall has damaged some of the existing buildings and covered the road. Up-drainage valley fill, if mobilized could overwhelm this area. Site is built on river terrace deposits.	Properly designed rockfall fence could prevent rocks from reaching buildings. Over time this area not immune from large debris flow from mobilized valley fill. Recommend ensuring that rip rap or other bank protection is present at maximum discharge river level

Recommendations

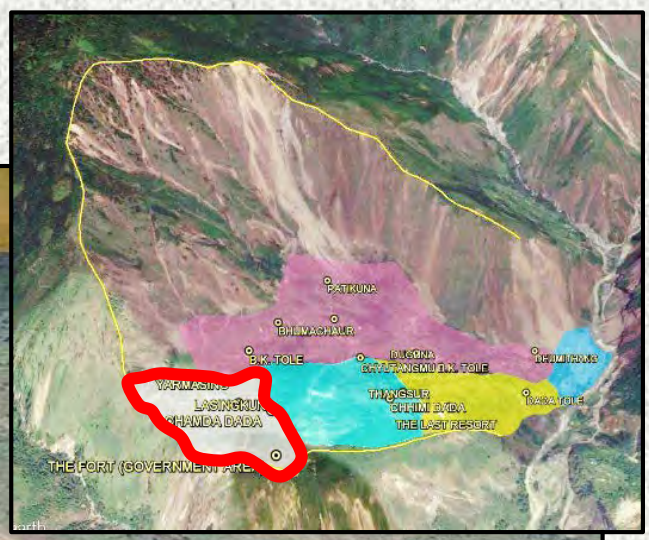
- Potentially suitable for building, with provisions
- Potentially suitable for farming
- Not suitable or safe; abandon (!)

Lowest relative risk of potential geohazard, based on observations

Moderate relative risk of potential geohazard, based on observations

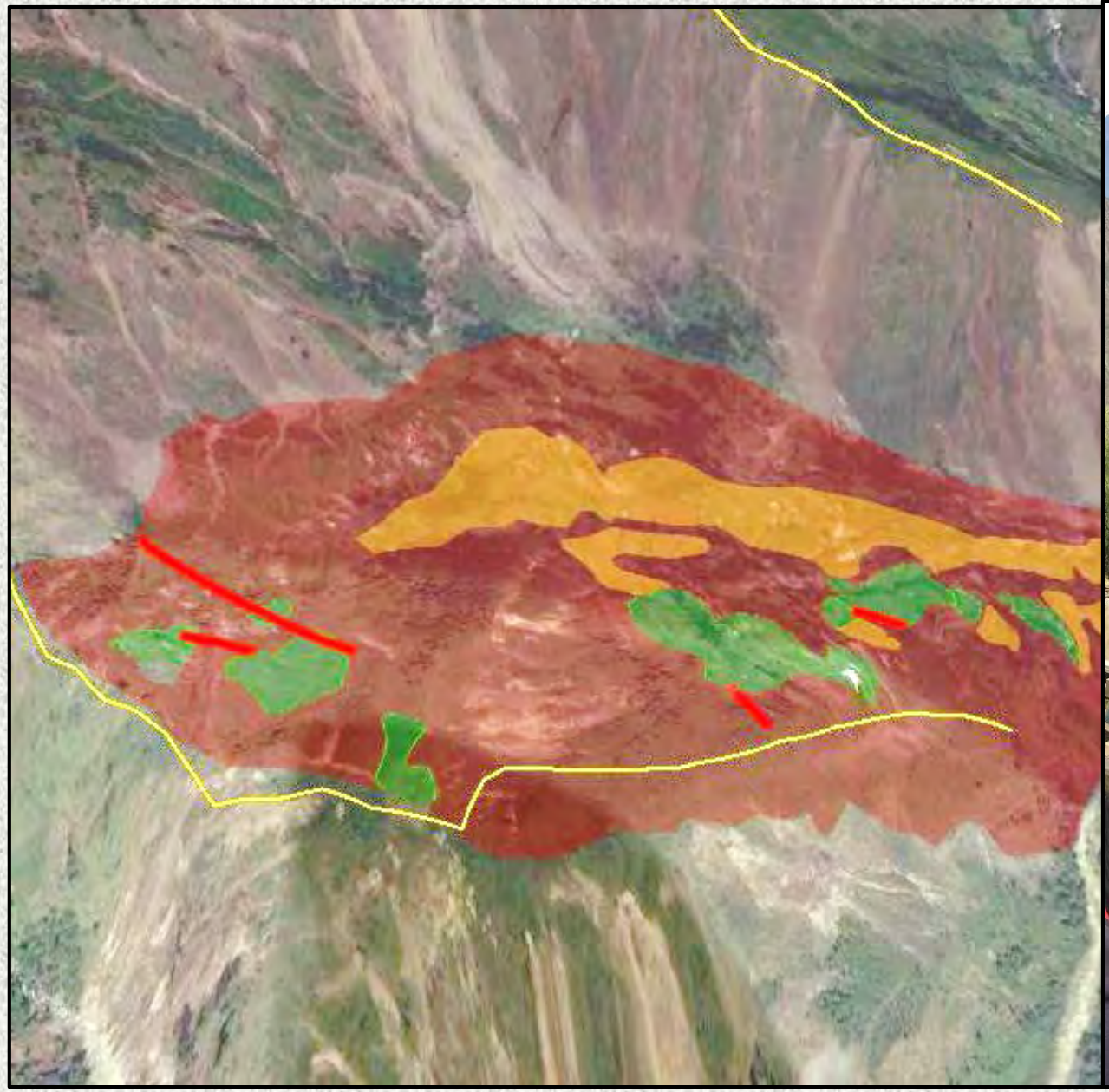
Highest relative risk of potential future geohazard, based on observations

Region 1 - Recommendations

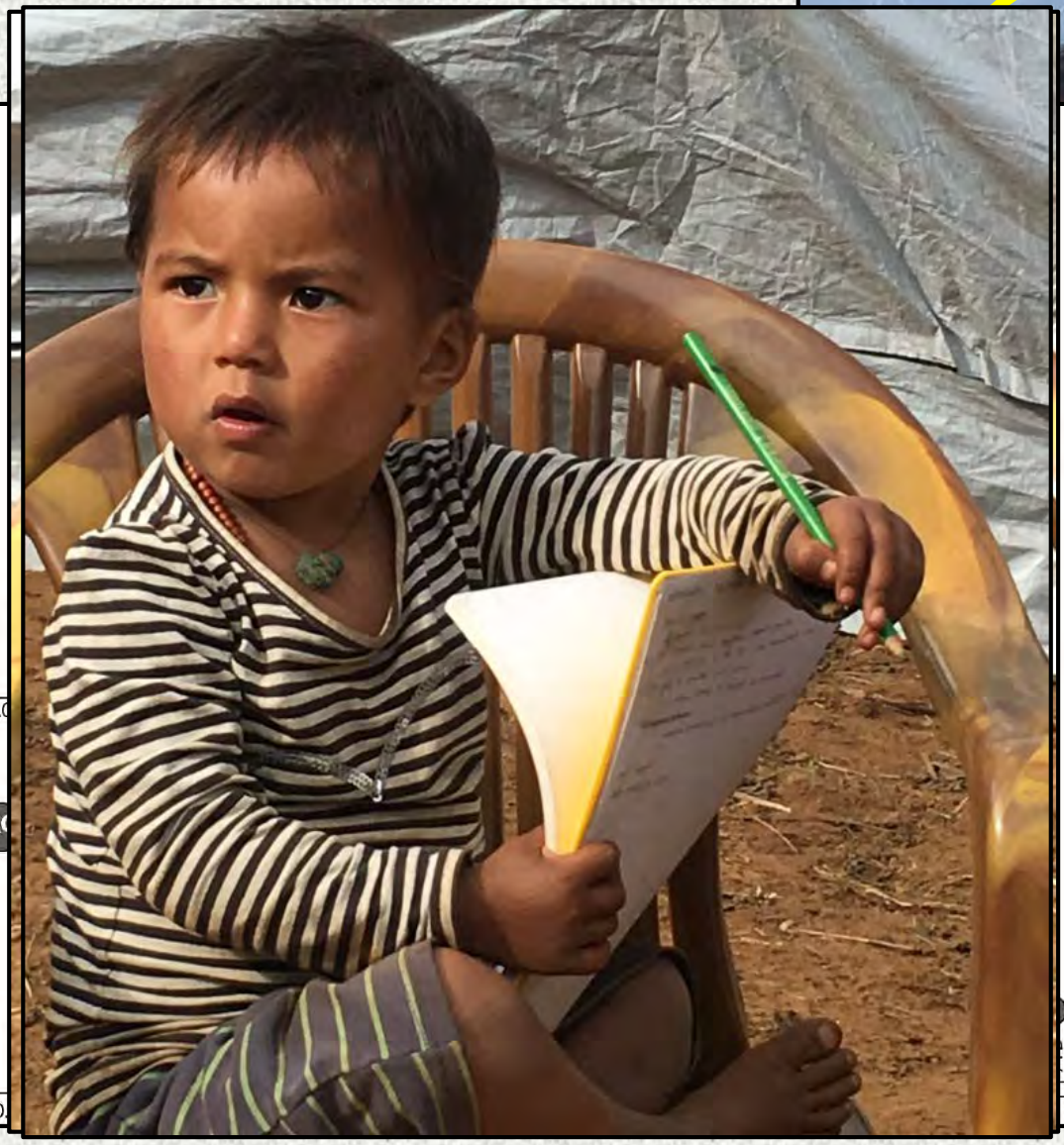


Fort Areas	If allowed (in light of archaeological significance of the area), remove surficial soils and create building pads in the talc bedrock.
Chamda Dada	Remove surficial soils and create building pads in the talc bedrock.
Lasingkuna	With drainage control and avoiding saturation of surficial soil, then suitable for settlement in areas without tension cracks in the soil
Yarmasing	Abandon existing and new settlement in this area

Summary (green zone for resettlement) and Slope Monitoring



Training villagers



End Products

Comprehensive report

- Geologic background
- Methods
- Observations
- Hazard ranking
- Preliminary recommendations
- Maps
- Examples of mitigation
- Suggested future work
  - Long term
  - Short term
    - Wait and watch…

Monitoring system

- Slope monitoring
- Villager involvement
- Established procedures

Aerial view of Yarmasing area from July 7, 2015 (post-earthquake)

DECEMBER 2015

GEOLOGIC HAZARD EVALUATION

DUGUNA GADI, NEPAL

Post April/May 2015 Earthquake Report

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ABSTRACT

On April 25, 2015 and May 12, 2015, two high-magnitude earthquakes (M_w 7.8 Gorkha earthquake and M_w 7.3 aftershock) struck Nepal. These events initiated landslides, rockfalls and avalanches in the Himalayan Mountains, flattened villages, and severely damaged structures in the central region of Nepal (Sindhupalchowk District). Together the earthquakes resulted in approximately 8,790 fatalities, the injury of 22,300 people, 750,000 damaged or destroyed homes, and lost livelihoods of thousands of people (Government of Nepal, 2015). After the immediate emergency response phase slowed by the fall of 2015, Engineers Without Borders USA was contacted to evaluate geohazards at 14 locations including 12 villages in the Duguna Gadi region of Nepal. The focus of the field reconnaissance was to work side-by-side with Nepali geoprofessionals and establish a methodology for evaluating geohazards so that communities could rebuild or resettle in lower risk areas. This report is the result of a one-week field visit to the Duguna Gadi area during November-December 2015 by three geoprofessionals with Engineers Without Borders USA who worked directly with Nepali geoprofessionals to observe the effects of the earthquakes so that recommendations could be made to reestablish in lower risk areas communities that lost homes, farms, infrastructure and livelihoods.

USER

For the Communities of Duguna Gadi, Nepal

February 26, 2016

2016 monsoon season

Lessons Learned

- EWB USA in-country representative invaluable.
- Mix of US and Nepali experts.
- Connection with University in Nepal.
- Logistics not always easy.
- Maps needed before field.
- Report harder than you think.
- Teamwork and Care Prevail over Politics.

Future work

- Continued slope monitoring
- Revise recommendations if needed
- New or reinforced road
- Bridge across river capable of transporting heavy equipment
- Rock fall retention near the customs area
- Trenching across the sackung
- Fostering relationships

Consider

- How can you contribute your skills in this or other similar scenarios?
- Utilizing other experts, such as geologists and hydrogeologists, when developing an engineering solution

Questions?

ENGINEERS WITHOUT BORDERS USA

Working Together to Build a Better World