1999 Colorado Springs, Colorado Landslides – federal, state and local government response; public involvement; and future long-term risks and challenges

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Colorado Springs
Number of homes demolished or relocated - Federal Emergency Management Agency (FEMA) Landslide Mitigation Project - $5.5 million

Legend:
Number of Homes Removed: 3

Total Homes Removed = 27

Not included in the project:
Additional homes required for buffer zone around active landslides = 35 – 50

Approx 15 miles or 24 km
Cheyenne Mountain 2,915 meters

Pikes Peak 4,302 meters

Hofstead

Regency Penhurst Appian

Arid Environment;
Less than 16 inches/40 cm/year precipitation

Colorado Springs

Front Range
Southwest Colorado Springs

Cheyenne Mountain 9,560 feet (2,915 meters)

Pikes Peak 14,110 feet (4,302 meters)

Regency Drive
Penhurst Place
1995 & 1999 slope failures

Southwest Colorado Springs

North
Colorado Springs Landslide Mitigation Project

• April – May 1999 Presidential Disaster
  – Flooding, not landslide
• Initial Estimate August 1999: > $50 million, revised estimate > $80 million
• Preliminary Approval January 2000
• Registration of Applicants February 2000
• Site & Structural Inspections & Validation of Damage/Destruction February 2000
• Environmental Assessments March 2000
• Independent Geological Assessment
Colorado Springs Landslide Mitigation Project

- Federal Emergency Management Agency (FEMA) funded- final project was $5.5+ million with 25% cost-share
- “Unmet Needs Program”
- 75% of approved Cost - Federal
- 25% of approved Cost – Local
- Public Process
  - General Information Meetings
  - Ground Rules & Prioritization of Acquisition
Colorado Springs Landslide Mitigation Project

• Ground Rules
  – Voluntary, no eminent domain
  – Owner’s contribute 25%
  – City pays 25% for project wide expenses
  – Pre-Disaster Structure Value – 15 April 1999
  – Permanent deed restriction on the property after acquisition

• Priorities of Acquisition
  – 2 Priorities for acquisition
  – Rental units lower in priority than owner occupied
Colorado Springs Landslide Mitigation Project

• Other Factors
  – Insurance does not cover landslides
  – Mortgage companies have varying policies
  – Developed detailed scopes of work to eliminate ambiguity and reduce cost
  – Acquire as many structures as possible
  – Perform mitigation to protect remaining structures/properties
Regency Drive Landslide

Main Scarp

Toe

Movement
Regency Drive Landslide
Toe
Main Scarp
Movement
Attempted Mitigation
Detail in following slide
Regency Drive Landslide

Main Scarp

Toe
Regency Drive Landslide

Main Scarp

Post 1999 Landslide Tension Crack

Remnants 4270 Regency Drive
Destroyed in 1995
Demolished in 1998
Landslide homes are always 100% occupied - pictured below is a raccoon that has many friends which ensure the homes remain occupied until the home is demolished.
Main Scarp Regency

Regency Drive Post Demolition Photo

Destroyed 1995
Demolished 1998

Legend:
Homes Acquired & Removed - XX
850 Appian Court Heavy Damage 1999
Destroyed/Condemned 2000

840 Appian

810 Appian
Destroyed 1999

860 Appian

Appian Court Landslide

Tennis Courts - Destroyed
850 Appian Court
Heavy Damage 1999
Destroyed/Condemned 2000

840 Appian Court

Appian Court Landslide

860 Appian Court
850 Appian Court Beam Pull-out
850 Appian Garage Area

Plumb Bob

Concrete Grade Beam Arched

Concrete Slab Garage

12”+
Sheared Connection between Grade Beam and Pier #5

North

850 Appian Court
Sheared Connection-Grade Beam to Pier

850 Appian Court
Approximate maximum movement of plumb bobs
From pre-demolition to complete demolition and no weight on foundation elements
Disassembly of 850 Appian Court
850 Appian Court

- Joist Pull-Out
- Missing Pier
850 Appian Court

Repair prior to Presidential Disaster in 1999 by use of Temporary Beam & Column that failed as well
5 inch Gap in firewall between 850 & 860 Appian Court
Rebuilding of roof and wall for adjacent unit (860 Appian) that was not demolished
850 Appian Court removal of frame almost complete. 840 Appian in the background.

840 Appian Common Wall being converted to exterior stucco wall
Note rods used in previous repair for stability (this was totally ineffective)
Buckled Beam

Column is off center and there is a gap underneath

850 Appian Court
Grade Beam/Pier connection sheared

850 Appian Court
Grade beam that could not be removed due to pier in wrong location.

Grade beam is perpendicular to subsurface flow channel and is like an oar in the water.
Pier Design Location (under common grade beam for 850 & 860 Appian)

Pier Actual Location – under 850 Appian Court

850 Appian

860 Appian
Post Demolition Photo of 850 Appian Court and repair of adjacent structures

860 Appian

840 Appian
Honey Locust Court homes being moved for reuse for affordable housing in Colorado Springs
Post Relocation Honey Locust Court.
Cheyenne Mountain

Friendship Lane Main Scarp Area looking South
Legend:
Structures Removed - XX

Post Demolition Photo Friendship Lane 3 Duplexes
Hofstead Terrace

Hofstead Court

General Direction of Movement
Hofstead Court & Hofstead Terrace

Legend: Acquired & Demolished - XX

Natural Gas Line

Movement
Tension Cracks above Hofstead
1263 Hofstead Terrace

Listing Chimney
3576 Hofstead Court was lifted 6 inches from foundation.
Interior, lower level 3576 Hofstead Court concrete slab buckled
Final use of 3576 Hofstead Court prior to demolition
Post Demolition Hofstead Court & Terrace
Installation of Horizontal Wick Drains at Penhurst Place
Wick Drains just prior to burial Penhurst Place
Wick Drains Penhurst Place prior to burial note water that is being drained via wick drains
Takk,

Merci,

Danke,

Grazie,

Thank you

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