

1	01:29:21:02	01:29:24:13	Annenberg Media
2	01:29:24:15	01:30:17:11	§
3	01:30:17:13	01:30:20:18	<i>THE DATE IS NOVEMBER 13, 1985.</i>
4	01:30:21:28	01:30:23:29	<i>AT 9:08 THAT NIGHT,</i>
5	01:30:24:01	01:30:26:00	<i>THE NEVADO DEL RUIZ VOLCANO</i>
6	01:30:26:02	01:30:28:13	<i>IN COLOMBIA, SOUTH AMERICA, ERUPTS.</i>
7	01:30:28:15	01:30:30:06	<i>THE INTENSITY OF THE HEAT</i>
8	01:30:30:08	01:30:32:12	<i>MELTS THE GLACIER ATOP THE VOLCANO,</i>
9	01:30:32:14	01:30:35:13	<i>SENDING A TORRENT OF WATER RUSHING DOWN THE MOUNTAIN.</i>
10	01:30:35:15	01:30:38:14	<i>SOIL, TREES, AND BOULDERS ARE RIPPED FROM THE GROUND.</i>
11	01:30:38:16	01:30:40:29	<i>THE MASS OF DEBRIS PICKS UP SPEED,</i>
12	01:30:41:01	01:30:43:14	<i>BEARING DOWN ON THE NEARBY TOWN OF ARMERO</i>
13	01:30:43:16	01:30:45:03	<i>AT 30 MILES PER HOUR.</i>
14	01:30:47:02	01:30:48:14	<i>THEN, SHORTLY BEFORE MIDNIGHT,</i>
15	01:30:48:16	01:30:50:16	<i>THE UNSUSPECTING RESIDENTS ARE AWAKENED</i>
16	01:30:50:18	01:30:53:15	<i>BY THE ROAR OF A WALL OF MUD</i>
17	01:30:53:17	01:30:56:15	<i>ABOUT TO BURY ANYTHING IN ITS PATH.</i>
18	01:31:03:12	01:31:04:26	<i>BY MORNING,</i>
19	01:31:04:28	01:31:07:17	<i>THE DESPERATE PANIC AND CONFUSION OF THE NIGHT</i>
20	01:31:07:19	01:31:10:01	<i>HAVE GIVEN WAY TO THE CHILLING REALITY</i>
21	01:31:10:03	01:31:12:00	<i>OF JUST WHAT HAS HAPPENED.</i>
22	01:31:14:09	01:31:16:28	<i>OF THE 25,000 WHO LIVED HERE</i>
23	01:31:17:00	01:31:18:10	<i>WHEN THE DAY BEGAN,</i>
24	01:31:18:12	01:31:21:05	<i>ONLY 3,000 REMAIN ALIVE.</i>
25	01:31:24:26	01:31:26:24	<i>IN A MATTER OF SECONDS,</i>
26	01:31:26:26	01:31:28:25	<i>THE PROUD COMMUNITY OF ARMERO</i>
27	01:31:28:27	01:31:32:29	<i>HAS BEEN WIPED FROM THE FACE OF THE EARTH.</i>
28	01:31:33:01	01:31:36:00	<i>THE TRAGEDY AT ARMERO WAS AN EXTREME EXAMPLE</i>
29	01:31:36:02	01:31:38:16	<i>OF A GEOLOGIC PROCESS KNOWN AS MASS WASTING--</i>
30	01:31:38:18	01:31:41:16	<i>THE DOWN-SLOPE MOVEMENT OF EARTH MATERIALS</i>
31	01:31:41:18	01:31:43:01	<i>UNDER THE INFLUENCE OF GRAVITY.</i>
32	01:31:43:03	01:31:45:00	<i>MASS WASTING CAN TAKE MANY FORMS--</i>
33	01:31:45:02	01:31:46:14	<i>FROM A DEADLY MUD FLOW</i>
34	01:31:46:16	01:31:47:29	<i>RUSHING DOWN</i>

35 01:31:48:01 01:31:50:00 SUCH AS WE SAW AT ARMERO
 36 01:31:50:02 01:31:52:16 TO DESTRUCTIVE LANDSLIDES
 SUCH AS THIS ONE
 37 01:31:52:18 01:31:55:16 WHICH, IN A FEW SECONDS,
 DELIVERED TONS OF DEBRIS,
 38 01:31:55:18 01:31:58:00 INCLUDING THESE BOULDERS,
 ONTO THE ROAD BELOW
 39 01:31:58:02 01:31:59:15 TO MORE SUBTLE FORMS
 40 01:31:59:17 01:32:01:14 IN WHICH
 THE DOWN-SLOPE MOVEMENT
 41 01:32:01:16 01:32:02:29 IS ALMOST IMPERCEPTIBLE.
 42 01:32:03:01 01:32:05:29 SLOPES ARE THE MOST COMMON
 OF LAND FORMS,
 43 01:32:06:01 01:32:07:15 SO MASS WASTING OPERATES
 44 01:32:07:17 01:32:10:16 OVER VIRTUALLY THE ENTIRE
 SURFACE OF THE EARTH.
 45 01:32:10:18 01:32:13:16 THINK OF MASS WASTING
 AS A CONTINUOUS CHAIN
 46 01:32:13:18 01:32:16:00 OF PROCESSES
 THAT MOVE EARTH MATERIALS
 47 01:32:16:02 01:32:18:13 FROM THE TOPS
 OF THE HIGHEST MOUNTAINS
 48 01:32:18:15 01:32:20:28 DOWN TO THE DEEP
 OCEAN FLOOR.
 49 01:32:21:00 01:32:23:13 THE TWO DRIVING FORCES
 BEHIND MASS WASTING
 50 01:32:23:15 01:32:24:28 ARE TECTONIC ACTIVITY--
 51 01:32:25:00 01:32:26:28 THE UPLIFT
 AND MOUNTAIN BUILDING
 52 01:32:27:00 01:32:28:24 THAT CONTINUOUSLY
 MAINTAINS THE SLOPES--
 53 01:32:28:26 01:32:31:24 AND GRAVITY, WHICH TENDS
 TO PULL THE SLOPES DOWN
 54 01:32:31:26 01:32:33:08 AND EVEN OUT THE LANDSCAPE.
 55 01:32:33:10 01:32:35:23 MASS WASTING
 IS A NATURAL PROCESS
 56 01:32:35:25 01:32:37:25 THAT CONTINUOUSLY SHAPES
 THE LANDSCAPE,
 57 01:32:37:27 01:32:39:25 AND IT OCCURS
 WITHOUT HUMAN INVOLVEMENT.
 58 01:32:39:27 01:32:42:10 HOWEVER, IT'S IMPORTANT
 FOR US TO RECOGNIZE
 59 01:32:42:12 01:32:43:24 THAT OUR DECISIONS,
 60 01:32:43:26 01:32:46:24 SUCH AS WHERE WE BUILD
 OUR ROADS AND STRUCTURES
 61 01:32:46:26 01:32:49:24 AND THE WAYS IN WHICH
 WE ALTER NATURAL LANDSCAPES,
 62 01:32:49:26 01:32:51:09 CAN AFFECT THIS PROCESS
 63 01:32:51:11 01:32:54:06 AND SOMETIMES TRIGGER
 MASS-WASTING EVENTS.
 64 01:32:56:02 01:32:59:01 *LAND HAS ALWAYS BEEN*
A VALUABLE COMMODITY.
 65 01:32:59:03 01:33:02:10 *SOME WANT IT SIMPLY*
AS A PLACE TO LIVE.
 66 01:33:02:12 01:33:03:26 *OTHERS ARE MORE INTERESTED*

67 01:33:03:28 01:33:06:23 *IN DEVELOPING IT
FOR PROFIT.*

68 01:33:06:25 01:33:08:08 *BUT REGARDLESS OF MOTIVE,*

69 01:33:08:10 01:33:10:23 *ANYONE ABOUT TO UNDERTAKE
A BUILDING PROJECT*

70 01:33:10:25 01:33:12:29 *NEEDS AT LEAST
A FUNDAMENTAL UNDERSTANDING*

71 01:33:13:01 01:33:15:01 *OF HOW
MASS WASTING OPERATES.*

72 01:33:16:11 01:33:17:19 *A NUMBER OF FACTORS
CONTRIBUTE*

73 01:33:17:21 01:33:19:06 *TO MASS-WASTING PROCESSES.*

74 01:33:19:08 01:33:21:06 *ONE OF THE MOST IMPORTANT*

75 01:33:21:08 01:33:23:26 *IS THE ANGLE
OF A GIVEN SLOPE.*

76 01:33:23:28 01:33:26:18 *SOME SLOPES
ARE NATURALLY STEEP,*

77 01:33:26:20 01:33:29:04 *SUCH AS THOSE
ALONG GLACIAL VALLEYS,*

78 01:33:29:06 01:33:31:23 *RIVERBANKS...*

79 01:33:31:25 01:33:33:09 *OR AT THE SHORE,*

80 01:33:33:11 01:33:36:11 *WHERE WAVES
CUT BACK THE CLIFFS.*

81 01:33:36:13 01:33:37:29 *BUT IN MANY AREAS,*

82 01:33:38:01 01:33:40:28 *THE PRIMARY FORCE RESPONSIBLE
FOR STEEPENING THE SLOPES*

83 01:33:41:00 01:33:42:18 *IS HUMAN ACTIVITY.*

84 01:33:43:29 01:33:45:27 *WHEN BULLDOZERS
CUT INTO HILLS*

85 01:33:45:29 01:33:48:11 *TO CREATE HOME SITES
OR ROADS,*

86 01:33:48:13 01:33:51:08 *THEIR STABILITY IS
SOMETIMES GREATLY REDUCED.*

87 01:33:51:10 01:33:54:24 *OVERSTEEPENING IS NOT
THE ONLY PROBLEM, HOWEVER.*

88 01:33:54:26 01:33:57:26 *THE HEAVY WEIGHT
OF A BUILDING ITSELF*

89 01:33:57:28 01:34:00:26 *CAN DIMINISH THE STABILITY
OF AN UNDERLYING SLOPE,*

90 01:34:00:28 01:34:03:10 *AS CAN THE PRESENCE
OF WATER.*

91 01:34:03:12 01:34:05:24 *AS WATER SEEPS
INTO THE GROUND,*

92 01:34:05:26 01:34:08:10 *IT BEGINS TO FILL UP
PORE SPACES.*

93 01:34:08:12 01:34:11:15 *THE SURFACE TENSION
OF WATER ACTUALLY HELPS*

94 01:34:11:17 01:34:14:00 *TO HOLD FRAGMENTS
OF ROCK AND SOIL TOGETHER.*

95 01:34:14:02 01:34:16:15 *BUT IF A LOT OF WATER
IS PRESENT,*

96 01:34:16:17 01:34:18:08 *IT COMPLETELY
FILLS THE PORES*

97 01:34:18:10 01:34:20:09 *AND FORCES
THE FRAGMENTS APART,*

98 01:34:20:11 01:34:22:01 *THUS WEAKENING THE SLOPE.*

99 01:34:22:03 01:34:24:15 *WHETHER IT COMES
FROM A SPRINKLER,*

100 01:34:24:17 01:34:27:00 *A SEPTIC SYSTEM,
OR A RAINSTORM,*

101 01:34:27:02 01:34:29:15 *AN EXCESSIVE AMOUNT
OF WATER IN THE SOIL*

102 01:34:29:17 01:34:31:29 *CAN TRIGGER
A MASS-WASTING EVENT.*

103 01:34:33:11 01:34:34:23 *PROCESSES OF MASS WASTING*

104 01:34:34:25 01:34:36:24 *ARE OFTEN TRANSITIONAL
IN NATURE.*

105 01:34:36:26 01:34:39:08 *WHAT BEGINS AS ONE FORM
OF MASS WASTING*

106 01:34:39:10 01:34:41:07 *CAN ULTIMATELY EVOLVE
INTO ANOTHER.*

107 01:34:41:09 01:34:42:23 *FOR THIS REASON,*

108 01:34:42:25 01:34:44:23 *THESE PROCESSES
ARE SOMETIMES DIFFICULT*

109 01:34:44:25 01:34:46:25 *TO CLASSIFY
WITH ABSOLUTE PRECISION.*

110 01:34:46:27 01:34:47:28 *TYPES OF MASS WASTING VARY*

111 01:34:48:00 01:34:49:11 *ACCORDING
TO SEVERAL FACTORS--*

112 01:34:49:13 01:34:50:25 *THE COMPOSITION
OF THE MATERIAL,*

113 01:34:50:27 01:34:52:25 *THE MANNER
IN WHICH IT MOVES,*

114 01:34:52:27 01:34:54:10 *AND THE SPEED
OF MOVEMENT.*

115 01:34:54:12 01:34:56:25 *IN SOME CASES,
THE MOVEMENT IS SO SLOW*

116 01:34:56:27 01:34:58:25 *THAT IT'S EXTREMELY
DIFFICULT TO DETECT,*

117 01:34:58:27 01:35:00:25 *BUT THE ABSENCE
OF OBVIOUS MOVEMENT*

118 01:35:00:27 01:35:02:10 *DOESN'T NECESSARILY MEAN*

119 01:35:02:12 01:35:04:26 *THAT AN AREA IS UNAFFECTED
BY MASS WASTING.*

120 01:35:06:15 01:35:08:13 *AT FIRST GLANCE,
FOR EXAMPLE,*

121 01:35:08:15 01:35:11:00 *THIS SITE APPEARS TRANQUIL
AND UNDISTURBED,*

122 01:35:11:02 01:35:14:14 *BUT A CLOSER LOOK REVEALS
THE PRESENCE OF CREEP,*

123 01:35:14:16 01:35:16:29 *A SLUGGISH FORM
OF MASS WASTING*

124 01:35:17:01 01:35:18:27 *THAT SOMETIMES MOVES
AS SLOWLY*

125 01:35:18:29 01:35:20:27 *AS 1 CENTIMETER PER YEAR.*

126 01:35:20:29 01:35:23:25 *CREEP OPERATES EVERY DAY,
EVERYWHERE,*

127 01:35:23:27 01:35:26:08 *NO MATTER
HOW GENTLE THE SLOPE.*

128 01:35:27:18 01:35:29:16 *CREEP OCCURS
WHEN THE SOIL*

129 01:35:29:18 01:35:33:00 *AND UPPERMOST PART*

OF THE BEDROCK WITHIN A SLOPE
 130 01:35:33:02 01:35:34:17 MOVE SLOWLY DOWNHILL
 131 01:35:34:19 01:35:37:16 UNDER THE INFLUENCE
 OF GRAVITY AND WATER.
 132 01:35:37:18 01:35:39:02 THE WETTING AND DRYING
 133 01:35:39:04 01:35:41:01 OF THE UPPERMOST
 GROUND MATERIAL
 134 01:35:41:03 01:35:43:16 RESULTS IN ALTERNATE
 EXPANSION AND CONTRACTION,
 135 01:35:43:18 01:35:45:16 WITH GRAVITY PULLING
 THE CONTRACTING EARTH
 136 01:35:45:18 01:35:47:01 IMPERCEPTIBLY DOWN-SLOPE.
 137 01:35:47:03 01:35:48:16 THIS CAN HAPPEN
 138 01:35:48:18 01:35:51:00 EVEN WHEN THE ANGLE
 OF THE SLOPE ITSELF
 139 01:35:51:02 01:35:52:17 IS VERY SMALL,
 140 01:35:52:19 01:35:55:08 ALMOST TO THE POINT
 OF BEING HORIZONTAL.
 141 01:35:55:10 01:35:57:24 CREEP IS ESPECIALLY ACTIVE
 IN REGIONS
 142 01:35:57:26 01:36:01:22 WHERE MOIST GROUND
 SEASONALLY FREEZES AND THAWS,
 143 01:36:01:24 01:36:03:29 SUCH AS HERE IN ALASKA.
 144 01:36:04:01 01:36:05:22 EACH FREEZE/THAW CYCLE
 145 01:36:05:24 01:36:08:09 MOVES SOIL PARTICLES
 DOWNHILL
 146 01:36:08:11 01:36:09:23 IN MINUTE INCREMENTS.
 147 01:36:09:25 01:36:11:09 AND DESPITE THE FACT
 148 01:36:11:11 01:36:14:08 THAT NO ONE HAS EVER DIED
 FROM CREEP,
 149 01:36:14:10 01:36:17:08 IT DOES MORE
 LONG-TERM ECONOMIC DAMAGE
 150 01:36:17:10 01:36:20:06 THAN ALL OTHER FORMS
 OF MASS WASTING COMBINED.
 151 01:36:20:08 01:36:23:21 THIS CAN TAKE THE FORM
 OF BUCKLING RAILROAD TRACKS
 152 01:36:23:23 01:36:25:09 OR CRACKED
 BUILDING FOUNDATIONS,
 153 01:36:25:11 01:36:29:01 AS WELL AS BROKEN UNDERGROUND
 WATER AND SEWER LINES.
 154 01:36:29:03 01:36:33:00 IF WE THINK OF MASS WASTING
 AS A KIND OF CONTINUUM,
 155 01:36:33:02 01:36:35:21 WITH CREEP REPRESENTING
 THE SLOWEST FORM OF MOVEMENT,
 156 01:36:35:23 01:36:38:05 THE NEXT FASTEST
 WOULD BE SLUMP.
 157 01:36:40:13 01:36:42:10 FREQUENTLY,
 SLUMP OCCURS ON HILLSIDES
 158 01:36:42:12 01:36:45:25 THAT HAVE A THICK COVER
 OF LOOSE, ROCKY DEBRIS.
 159 01:36:45:27 01:36:47:25 THIS TAKES PLACE
 MOST COMMONLY
 160 01:36:47:27 01:36:50:10 AFTER HEAVY RAINS
 SATURATE THE GROUND.
 161 01:36:50:12 01:36:53:26 WHAT STARTS OUT AS A BLOCK
 OF SLUMPING EARTH

162 01:36:53:28 01:36:56:25 *OFTEN SPREADS OUT AS
AN EARTH FLOW DOWN-SLOPE.*

163 01:36:58:21 01:37:01:04 *DEPENDING ON THE AMOUNT
OF WATER,*

164 01:37:01:06 01:37:04:05 *THIS TYPE OF MASS WASTING
CAN BE ACTIVE*

165 01:37:04:07 01:37:07:04 *OVER A PERIOD OF HOURS,
DAYS, OR MONTHS.*

166 01:37:07:06 01:37:08:20 *IN SOME EARTH FLOWS,*

167 01:37:08:22 01:37:11:15 *INTERMITTENT SLOW MOVEMENT
CONTINUES FOR YEARS,*

168 01:37:11:17 01:37:13:03 *WITH LARGE QUANTITIES*

169 01:37:13:05 01:37:17:03 *OF SOFT OR EASILY WEATHERED
BEDROCK ON THE MOVE.*

170 01:37:17:05 01:37:19:16 *ONE OF THE MOST DRAMATIC
EXAMPLES OF SLUMP*

171 01:37:19:18 01:37:22:16 *CAN BE FOUND AT
POINT FERMIN, CALIFORNIA.*

172 01:37:22:18 01:37:25:01 *WAVE EROSION HERE
HAS CUT AWAY*

173 01:37:25:03 01:37:27:02 *AT THE MOIST,
SOFT ROCK BEDS*

174 01:37:27:04 01:37:28:19 *UNDERLYING
THE COASTAL BLUFFS,*

175 01:37:28:21 01:37:32:02 *AND THIS HAS CREATED
AN OVERSTEEPENED CONDITION.*

176 01:37:33:20 01:37:35:03 *IN THIS AREA,*

177 01:37:35:05 01:37:37:18 *DUBBED "THE SUNKEN CITY"
BY RESIDENTS,*

178 01:37:37:20 01:37:39:19 *WHAT BEGAN AS A SLUMP*

179 01:37:39:21 01:37:42:19 *EVENTUALLY LED TO
A FASTER RATE OF SLIPPING*

180 01:37:42:21 01:37:45:11 *AND MUCH MORE EXTENSIVE
MASS-WASTING ACTIVITY.*

181 01:37:45:13 01:37:48:11 *GEOLOGIST PERRY ELIG
HAS A LONGSTANDING INTEREST*

182 01:37:48:13 01:37:51:10 *IN THE GEOLOGIC HISTORY
OF POINT FERMIN.*

183 01:37:52:23 01:37:55:05 *THIS IS
THE POINT FERMIN
LANDSLIDE.*

184 01:37:55:07 01:37:58:03 *IT STARTED MOVING
IN 1929.*

185 01:37:58:05 01:38:00:18 *IT MOVED ONLY
A SMALL AMOUNT,*

186 01:38:00:20 01:38:03:18 *AND, UH,
PEOPLE CONTINUED
TO LIVE HERE.*

187 01:38:03:20 01:38:07:02 *BUT THEN IN 1940,
IT STARTED MOVING
VERY EXTENSIVELY.*

188 01:38:07:04 01:38:09:03 *AND AS YOU
CAN SEE HERE,*

189 01:38:09:05 01:38:11:17 *IT'S BROKEN
INTO NUMEROUS
SMALL BLOCKS.*

190 01:38:11:19 01:38:15:03 IN FACT,
MOST OF THE MOVEMENT
WAS IN 1940

191 01:38:15:05 01:38:16:19 AND THEN STOPPED.
192 01:38:16:21 01:38:20:00 AND THEN THE AREA
THAT WE SEE
OVER HERE

193 01:38:20:02 01:38:22:01 THAT'S ALL SUNKEN...
194 01:38:22:03 01:38:25:00 HAS CONTINUED
TO MOVE
SINCE THAT TIME.

195 01:38:25:02 01:38:28:01 NOW, THIS IS THE OLD ROAD,
THE COAST HIGHWAY?

196 01:38:28:03 01:38:31:02 WE'RE STANDING
ON PASEO DEL MAR
RIGHT HERE,

197 01:38:31:04 01:38:32:17 THE REMNANTS OF IT.
198 01:38:32:19 01:38:35:17 AND YOU CAN SEE
THE SLABS OUT THERE

199 01:38:35:19 01:38:38:16 THAT REPRESENT
THE OFFSET PORTION
OF PASEO DEL MAR.

200 01:38:38:18 01:38:41:16 IF SOMEBODY WANTED
TO PUT ENOUGH MONEY
INTO IT,

201 01:38:41:18 01:38:44:00 THEY COULD REMOVE
AND RECOMPACT
THE SLIDE MATERIAL

202 01:38:44:02 01:38:46:17 AND FOUND IT
ON FIRM MATERIAL

203 01:38:46:19 01:38:48:02 BELOW
THE BEACH LEVEL.

204 01:38:48:04 01:38:50:08 IT MIGHT WELL BE
SOMETHING

205 01:38:50:10 01:38:52:08 THAT COULD BE DONE
ECONOMICALLY

206 01:38:52:10 01:38:55:00 IF THIS WERE TO BE
A HOTEL SITE

207 01:38:55:02 01:38:56:15 OR SOMETHING
LIKE THAT.

208 01:38:56:17 01:38:59:00 *IF AN AREA
HAS BEEN DESIGNATED*

209 01:38:59:02 01:39:00:29 *AS A POSSIBLE
BUILDING SITE,*

210 01:39:01:01 01:39:02:18 *IT'S ESPECIALLY CRITICAL*
211 01:39:02:20 01:39:05:16 *THAT POTENTIAL MASS-WASTING
PROBLEMS BE IDENTIFIED*

212 01:39:05:18 01:39:08:13 *BEFORE THE DECISION IS MADE
TO START BUILDING.*

213 01:39:08:15 01:39:09:23 *UNFORTUNATELY,*
214 01:39:09:25 01:39:11:09 *IN THE SPECTACULAR
MOUNTAINOUS*

215 01:39:11:11 01:39:14:01 *OR COASTAL LOCATIONS
MOST PRONE TO MASS WASTING,*
216 01:39:14:03 01:39:17:27 *THESE PROBLEMS OFTEN GO
UNDISCOVERED OR IGNORED.*

217 01:39:17:29 01:39:19:27 *FREQUENTLY, DEVELOPERS
AND FUTURE RESIDENTS*
 218 01:39:19:29 01:39:22:02 *ARE SO TAKEN
BY AN AREA'S SCENIC BEAUTY*
 219 01:39:22:04 01:39:24:02 *OR INVESTMENT POTENTIAL*
 220 01:39:24:04 01:39:26:16 *THAT THEY NEVER STOP
TO CONSIDER*
 221 01:39:26:18 01:39:28:02 *THE CONSEQUENCES
OF BUILDING.*
 222 01:39:28:04 01:39:31:02 *IN FEW PLACES
IS THIS MORE TRUE*
 223 01:39:31:04 01:39:32:18 *THAN IN AN AREA*
 224 01:39:32:20 01:39:34:18 *OF CALIFORNIA'S
PALOS VERDES PENINSULA*
 225 01:39:34:20 01:39:36:03 *CALLED PORTUGUESE BEND.*
 226 01:39:36:05 01:39:39:03 *ITS WIDE-OPEN SPACES
AND MAGNIFICENT VIEWS*
 227 01:39:39:05 01:39:42:02 *WOULD MAKE THIS
AN IDEAL PLACE TO LIVE*
 228 01:39:42:04 01:39:45:02 *WERE IT NOT FOR THE PROBLEM
OF LANDSLIDES,*
 229 01:39:45:04 01:39:47:02 *WHICH ARE
MASS-WASTING EVENTS*
 230 01:39:47:04 01:39:50:18 *THAT MOVE FASTER
THAN EITHER CREEP OR SLUMP.*
 231 01:39:50:20 01:39:53:18 *HERE IN THE 1950s,
A SLUMP OCCURRED*
 232 01:39:53:20 01:39:56:03 *WHICH LATER SPREAD OUT
DOWN-SLOPE*
 233 01:39:56:05 01:39:57:18 *AS AN EARTH FLOW,*
 234 01:39:57:20 01:40:00:02 *BUT THAT
WAS JUST THE BEGINNING.*
 235 01:40:02:00 01:40:03:13 *IN MORE RECENT TIMES,*
 236 01:40:03:15 01:40:06:08 *THE SITUATION HAS GROWN
MUCH MORE SERIOUS*
 237 01:40:06:10 01:40:09:09 *AS LARGER MASSES OF EARTH
VE SHIFTED.*
 238 01:40:09:11 01:40:10:24 *PERRY ELIG ACKNOWLEDGES*
 239 01:40:10:26 01:40:13:09 *THAT PORTUGUESE BEND
WAS ONCE THE SITE*
 240 01:40:13:11 01:40:14:23 *OF ANCIENT SLIDE ACTIVITY*
 241 01:40:14:25 01:40:17:08 *LONG BEFORE THERE WERE
ANY PEOPLE AROUND,*
 242 01:40:17:10 01:40:21:06 *BUT HE CONTENDS THAT MODERN
SLIDE PROBLEMS IN THE AREA*
 243 01:40:21:08 01:40:24:06 *ARE A DIRECT RESULT
OF ROAD BUILDING.*
 244 01:40:24:08 01:40:27:26 *A GREAT DEAL
OF FILL DIRT WAS PLACED*
 245 01:40:27:28 01:40:30:28 *ON THE UP-SLOPE EDGE
OF THE SLIDE*
 246 01:40:31:00 01:40:34:13 *WHERE THE SLIDE BASE
HAS A VERY STEEP SLOPE,*
 247 01:40:34:15 01:40:36:13 *AND THIS LOADED THE SLIDE*
 248 01:40:36:15 01:40:39:12 *AND CAUSED IT
TO START TO MOVE.*

249 01:40:39:14 01:40:40:26 THE MOVEMENT
PROPAGATED SEAWARD
250 01:40:40:28 01:40:43:26 AND EVENTUALLY DEVELOPED
INTO THE LARGE LANDSLIDE
251 01:40:43:28 01:40:47:01 THAT OCCURS THROUGHOUT
THIS AREA RIGHT NOW.
252 01:40:48:19 01:40:51:15 INITIAL ATTEMPTS TO CONTROL
THE SLIDE ACTIVITY
253 01:40:51:17 01:40:53:12 CENTERED AROUND
THE INSERTION
254 01:40:53:14 01:40:56:11 OF NUMEROUS 3-FOOT-WIDE
CONCRETE AND STEEL NAILS
255 01:40:56:13 01:40:58:25 AT THE BASE OF THE SLIDE.
256 01:40:58:27 01:41:00:25 WHEN THESE EFFORTS
PROVED UNSUCCESSFUL,
257 01:41:00:27 01:41:02:11 THE FOCUS THEN CHANGED
258 01:41:02:13 01:41:04:27 TO STRATEGIES FOR LIVING
WITH THE SLIDE,
259 01:41:04:29 01:41:07:27 WHICH IN SOME PLACES
HAD SHIFTED HOMES
260 01:41:07:29 01:41:11:05 AS MUCH AS 200 METERS
FROM THEIR ORIGINAL POSITIONS.
261 01:41:11:07 01:41:13:04 ONE OF THE MORE
VISIBLE APPROACHES
262 01:41:13:06 01:41:14:20 WAS PUTTING UTILITIES,
263 01:41:14:22 01:41:16:20 SUCH AS GAS
AND SEWER LINES,
264 01:41:16:22 01:41:19:15 ABOVE GROUND IN ORDER
TO PREVENT RUPTURE.
265 01:41:19:17 01:41:20:23 UNFORTUNATELY,
266 01:41:20:25 01:41:23:06 MOST OF THE HOMES
IN THE AREA
267 01:41:23:08 01:41:25:08 HAD ALREADY BECOME
VIRTUALLY UNINHABITABLE.
268 01:41:25:10 01:41:27:21 OF THE 156 HOUSES
BUILT HERE,
269 01:41:27:23 01:41:31:06 MOST HAVE BEEN TORN APART
BY THE SHIFTING GROUND
270 01:41:31:08 01:41:33:05 OR RELOCATED
TO OTHER AREAS.
271 01:41:34:25 01:41:37:21 WHILE SOME RESIDENTS
SAY THEY REMAIN IN THE AREA
272 01:41:37:23 01:41:39:21 BECAUSE
OF ITS AESTHETIC APPEAL,
273 01:41:39:23 01:41:42:05 THE FACT IS
THAT MANY OF THOSE
274 01:41:42:07 01:41:44:07 WHO LIVE
IN PORTUGUESE BEND
275 01:41:44:09 01:41:46:23 HAVE NO HOPE
OF SELLING THEIR HOMES.
276 01:41:46:25 01:41:48:23 STEVE NURICH'S HOUSE
WAS BUILT
277 01:41:48:25 01:41:50:08 IN THE EARLY 1950s,
278 01:41:50:10 01:41:53:03 AND THE TROUBLE BEGAN
SHORTLY THEREAFTER.
279 01:41:53:05 01:41:57:04 THERE USED TO BE ROUGHLY

280 01:41:57:06 01:41:58:20 THREE TIMES AS MANY HOUSES
 281 01:41:58:22 01:42:01:19 THROUGH THIS VALLEY,
 282 01:42:01:21 01:42:05:04 AND SOME HOUSES
 MET THEIR DEMISE VERY FAST,
 283 01:42:05:06 01:42:07:04 WERE TORN APART BY THE LAND
 MOVEMENT QUITE FAST.
 284 01:42:07:06 01:42:09:05 SOME PEOPLE,
 UH, SOLD OUT,
 285 01:42:09:07 01:42:11:20 INSURANCE WRECKED DOWN
 OTHER HOUSES,
 286 01:42:11:22 01:42:13:19 AND A FEW PEOPLE
 BOUGHT HOUSES
 287 01:42:13:21 01:42:16:16 THAT WERE STILL
 288 01:42:16:18 01:42:19:28 REMAINING UPRIGHT--
 LIVED IN THEM CHEAPLY,
 289 01:42:20:00 01:42:21:14 UH, UNTIL THE HOUSE
 290 01:42:21:16 01:42:23:14 WAS READY TO FALL APART.
 ABOUT 18 YEARS AGO,
 291 01:42:23:16 01:42:25:10 SOMEONE CAME UP
 292 01:42:25:12 01:42:27:21 WITH THE IDEA
 TO TAKE THE HOUSE
 293 01:42:27:23 01:42:30:05 AND LIFT IT UP
 OFF THE GROUND
 294 01:42:30:07 01:42:31:20 AND BUILD A STEEL FRAMEWORK
 UNDERNEATH IT
 295 01:42:31:22 01:42:35:04 TO HOLD IT TOGETHER.
 AND THEN ALL WE DO IS,
 296 01:42:35:06 01:42:38:04 ONCE IN A WHILE--
 AND IT'S ONLY BEEN ONCE
 SINCE I'VE LIVED HERE
 297 01:42:38:06 01:42:40:15 THAT WE'VE ACTUALLY
 LEVELED THE HOUSE OFF
 298 01:42:40:17 01:42:43:14 AND ADJUSTED THE BLOCKS
 THAT REST AT CERTAIN AREAS
 299 01:42:43:16 01:42:46:06 AND BROUGHT IT BACK DOWN
 TO SOMEWHAT LEVELNESS.
 300 01:42:47:15 01:42:49:11 *OTHER RESIDENTS*
IN THE AREA
 301 01:42:49:13 01:42:51:11 *HAVE DEVELOPED*
EQUALLY INVENTIVE METHODS
 302 01:42:51:13 01:42:53:26 *OF COPING*
WITH THE RESTLESS GROUND.
 303 01:42:53:28 01:42:56:08 *BOB McJONES*
HAS PLACED HIS HOME
 304 01:42:56:10 01:42:57:22 *ATOP THREE*
LARGE CONTAINERS,
 305 01:42:57:24 01:43:00:16 *THE KIND USED*
ON CARGO SHIPS.
 306 01:43:02:02 01:43:04:10 THE THREE CONTAINERS
 WERE WELDED
 INTO A TRIANGLE.
 307 01:43:04:12 01:43:06:03 THE CONTAINERS
 ARE STRONG ENOUGH
 308 01:43:06:05 01:43:07:17 THAT THEY
 WILL SUPPORT
 309 01:43:07:19 01:43:10:02 THE WEIGHT

OF THE HOUSE
 COMFORTABLY,
 310 01:43:10:04 01:43:13:02 AND THE HOUSE
 IS NOW RESTING
 ON THE GROUND
 311 01:43:13:04 01:43:15:16 AT ONLY
 THREE PLACES,
 LIKE A TRIPOD.
 312 01:43:15:18 01:43:17:01 THE RESULT OF THIS
 313 01:43:17:03 01:43:20:15 IS THAT
 IF ONE SUPPORT
 SETTLES OR GOES UP
 314 01:43:20:17 01:43:22:01 DUE TO
 LANDSLIDE ACTION,
 315 01:43:22:03 01:43:24:02 IT'S ONLY
 A FEW MINUTES' WORK
 316 01:43:24:04 01:43:27:01 TO RAISE OR LOWER
 THAT CORNER
 OF THE HOUSE,
 317 01:43:27:03 01:43:29:00 AND THE HOUSE
 IS BACK LEVEL.
 318 01:43:32:16 01:43:35:13 *THESE ARE, AT BEST,*
ONLY TEMPORARY SOLUTIONS.
 319 01:43:35:15 01:43:36:29 *ATTEMPTS*
TO PERMANENTLY STABILIZE
 320 01:43:37:01 01:43:39:17 *THE LANDSLIDE ITSELF*
CONTINUE.
 321 01:43:41:04 01:43:43:17 *PERRY ELIG*
REGULARLY MONITORS WELLS
 322 01:43:43:19 01:43:45:02 *THAT HAVE BEEN INSTALLED*
 323 01:43:45:04 01:43:47:24 *TO DRAIN WATER*
FROM THE SLIDE AREA.
 324 01:43:49:29 01:43:51:07 *THUS FAR,*
 325 01:43:51:09 01:43:53:16 *LOWERING THE LEVEL*
OF THE WATER TABLE
 326 01:43:53:18 01:43:56:28 *IS AN EFFORT THAT SEEMS*
TO HAVE PAID OFF.
 327 01:43:57:00 01:43:59:13 *MEASUREMENTS MADE ALONG*
THE EDGE OF THE SLIDE
 328 01:43:59:15 01:44:01:14 *INDICATE THAT THE MOVEMENT*
HAS SLOWED
 329 01:44:01:16 01:44:03:28 *TO A FRACTION*
OF ITS FORMER SPEED.
 330 01:44:04:00 01:44:05:13 *ELIG HOPES*
TO COMPLETELY STOP
 331 01:44:05:15 01:44:07:28 *THE UPPER PORTION*
OF THE LANDSLIDE
 332 01:44:08:00 01:44:10:03 *WITHIN THE NEXT*
FEW YEARS.
 333 01:44:10:05 01:44:11:22 *THE LOWER EDGE, HOWEVER,*
 334 01:44:11:24 01:44:14:18 *IS A DIFFERENT, SOMEWHAT*
MORE COMPLICATED MATTER.
 335 01:44:14:20 01:44:17:02 *THE PROBLEM HERE*
IS THAT WAVE EROSION
 336 01:44:17:04 01:44:19:17 *UNDERMINES THE BASE*
OF THE LANDSLIDE,

337 01:44:19:19 01:44:22:17 WHICH WEAKENS
 ITS UP-SLOPE AREA FURTHER.
 338 01:44:22:19 01:44:24:02 WITHOUT PROTECTION,
 339 01:44:24:04 01:44:26:23 COASTAL EROSION WILL
 CONTINUE TO BE A FACTOR
 340 01:44:26:25 01:44:28:07 CONTRIBUTING TO MOVEMENT.
 341 01:44:30:25 01:44:33:07 ROCK-FILLED CAGES
 CALLED GABIONS
 342 01:44:33:09 01:44:36:08 HAVE BEEN TESTED ALONG
 PART OF THE SHORELINE,
 343 01:44:36:10 01:44:38:08 SUCCESSFULLY REDUCING
 THE WAVE EROSION
 344 01:44:38:10 01:44:40:26 AND HELPING
 TO STABILIZE THE SLIDE.
 345 01:44:42:19 01:44:44:17 WITH THE CONTINUED
 MITIGATION EFFORTS
 346 01:44:44:19 01:44:46:08 OF RESIDENTS
 AND GEOLOGISTS,
 347 01:44:46:10 01:44:48:08 IT'S CONCEIVABLE
 THAT PORTUGUESE BEND
 348 01:44:48:10 01:44:51:04 COULD ONE DAY
 BE ENTIRELY STABILIZED.
 349 01:44:54:09 01:44:56:24 AS DESTRUCTIVE
 AS THE SLIDE ACTIVITY
 350 01:44:56:26 01:44:58:24 AT PORTUGUESE BEND
 HAS BEEN,
 351 01:44:58:26 01:45:01:08 IT'S SOMETHING
 THAT HAS HAPPENED GRADUALLY
 352 01:45:01:10 01:45:03:08 OVER A PERIOD OF TIME.
 353 01:45:05:01 01:45:07:01 THIS IS WRIGHTWOOD,
 CALIFORNIA.
 354 01:45:07:03 01:45:10:03 IN CONTRAST TO
 THE GRADUAL SLIDE ACTIVITY
 355 01:45:10:05 01:45:11:17 AT PORTUGUESE BEND,
 356 01:45:11:19 01:45:13:18 THE MUD AND DEBRIS FLOWS
 357 01:45:13:20 01:45:16:00 THAT DAMAGED WRIGHTWOOD
 IN 1941
 358 01:45:16:02 01:45:18:21 LEFT THEIR MARK
 WITH TERRIFYING SWIFTHNESS.
 359 01:45:21:00 01:45:23:28 TODAY, THIS COMMUNITY LIVES
 WITH THE ONGOING FEAR
 360 01:45:24:00 01:45:25:27 THAT THE NEXT
 SEASON'S STORMS
 361 01:45:25:29 01:45:29:11 MAY BRING ON A REPRIS
 OF THE 1941 DISASTER.
 362 01:45:30:20 01:45:32:16 MUD AND DEBRIS FLOWS,
 363 01:45:32:18 01:45:35:00 WHICH MOVE FASTER
 THAN CREEP, SLUMP,
 364 01:45:35:02 01:45:36:15 AND SOME LANDSLIDES,
 365 01:45:36:17 01:45:39:19 ARE THE PRODUCT
 OF LOOSE, UNSTABLE MATERIAL
 366 01:45:39:21 01:45:41:03 MIXED WITH WATER.
 367 01:45:41:05 01:45:43:18 THEIR CONSISTENCY RANGES
 FROM STIFF MUD
 368 01:45:43:20 01:45:46:09 TO A SOUPLIKE FLUID.
 369 01:45:46:11 01:45:48:23 BECAUSE OF THEIR VISCOSITY

AND HIGH DENSITY,
 370 01:45:48:25 01:45:51:23 MUD AND DEBRIS FLOWS
 ARE A FORM OF MASS WASTING
 371 01:45:51:25 01:45:54:12 THAT CAN TEAR HOMES
 FROM THEIR FOUNDATIONS
 372 01:45:54:14 01:45:56:26 AND CARRY LIGHTER OBJECTS,
 LIKE AUTOMOBILES,
 373 01:45:56:28 01:45:58:26 FOR SUBSTANTIAL DISTANCES.
 374 01:46:00:13 01:46:02:26 THE DEBRIS
 THAT COMPRISES THESE FLOWS
 375 01:46:02:28 01:46:04:11 CAN RANGE IN SIZE
 376 01:46:04:13 01:46:06:18 FROM GRAINS
 OF SILT AND SAND
 377 01:46:06:20 01:46:07:24 TO BOULDERS.
 378 01:46:10:25 01:46:12:23 ONCE THE DEBRIS
 HAS ACCUMULATED,
 379 01:46:12:25 01:46:15:12 ALL THAT'S NEEDED
 IS AN INTENSE RAINSTORM
 380 01:46:15:14 01:46:16:26 OR SNOW MELT
 381 01:46:16:28 01:46:18:29 TO SATURATE THE AREA
 WITH WATER.
 382 01:46:19:01 01:46:20:16 AT THAT POINT,
 383 01:46:20:18 01:46:22:16 GRAVITY
 CAN MOVE THE DEBRIS,
 384 01:46:22:18 01:46:25:15 AND, AS FLOWS OVERWHELM
 LOW-LYING AREAS,
 385 01:46:25:17 01:46:28:14 THE MASS-WASTING PROCESS
 IS SET IN MOTION.
 386 01:46:29:27 01:46:31:22 THIS FLOOD-CONTROL CHANNEL
 WAS BUILT
 387 01:46:31:24 01:46:34:06 TO PROTECT THE COMMUNITY
 OF WRIGHTWOOD
 388 01:46:34:08 01:46:35:23 FROM THE MUD FLOWS
 389 01:46:35:25 01:46:38:04 THAT COME OFF
 THE NEARBY MOUNTAINS
 390 01:46:38:06 01:46:39:21 AFTER PARTICULARLY WET
 WINTERS.
 391 01:46:39:23 01:46:42:25 WADE WELLS IS A U.S.
 FOREST SERVICE HYDROLOGIST
 392 01:46:42:27 01:46:45:25 CONCERNED WITH THE CONTROL
 OF MUD FLOWS.
 393 01:46:45:27 01:46:47:25 THESE CHANNELS
 HAVE PROVEN THEMSELVES
 394 01:46:47:27 01:46:49:11 TO BE VERY EFFECTIVE
 395 01:46:49:13 01:46:50:25 AT PROTECTING
 MOST COMMUNITIES.
 396 01:46:50:27 01:46:53:09 IT'S ONLY
 IN THE WORST YEARS
 397 01:46:53:11 01:46:54:25 THAT WE HAVE A PROBLEM
 398 01:46:54:27 01:46:56:24 WITH THE CHANNELS
 BEING OVERTOPPED
 399 01:46:56:26 01:46:59:21 AND HOUSES BEING COVERED
 WITH MUD OR DESTROYED.
 400 01:46:59:23 01:47:01:20 CHANNELS LIKE THIS ONE,
 HOWEVER,
 401 01:47:01:22 01:47:05:04 DO REQUIRE A GREAT DEAL

OF COSTLY MAINTENANCE.
402 01:47:05:06 01:47:08:04 DURING EVERY YEAR AND
AFTER EVERY RAINY SEASON,
403 01:47:08:06 01:47:11:04 WE COME IN WITH BULLDOZERS,
SKIP LOADERS, AND TRUCKS,
404 01:47:11:06 01:47:14:20 AND WE TAKE THE MATERIAL
AND CARRY IT AWAY
405 01:47:14:22 01:47:16:20 TO A SUITABLE
DISPOSAL SITE.
406 01:47:16:22 01:47:18:18 ONE REASON
THE WRIGHTWOOD AREA
407 01:47:18:20 01:47:20:18 IS VULNERABLE
TO MUD FLOWS
408 01:47:20:20 01:47:23:13 IS THE PROXIMITY
OF THE SAN ANDREAS FAULT,
409 01:47:23:15 01:47:25:27 WHICH HAS DEEPLY
SHATTERED THE BEDROCK
410 01:47:25:29 01:47:28:10 COMPOSING THE MOUNTAINSIDE
ABOVE THE COMMUNITY.
411 01:47:28:12 01:47:30:27 THE FLOWS THAT DAMAGED
WRIGHTWOOD IN 1941
412 01:47:30:29 01:47:33:27 CAME FROM ABOUT THE EASTERN
THIRD OF THAT SCAR.
413 01:47:33:29 01:47:36:26 IT'S WIDENED TO THE WEST
SINCE THAT TIME
414 01:47:36:28 01:47:39:11 UNTIL IT'S REACHED
ITS PRESENT SIZE.
415 01:47:39:13 01:47:41:26 THIS INDICATES THAT
THE WHOLE AREA IS ACTIVE.
416 01:47:41:28 01:47:43:25 THE FACT THAT
THERE'S NOTHING GROWING
417 01:47:43:27 01:47:45:12 IN THE SCAR AREA
418 01:47:45:14 01:47:47:27 MEANS THAT IT MOVES
SO MUCH, SO OFTEN,
419 01:47:47:29 01:47:49:12 AND SO RAPIDLY,
420 01:47:49:14 01:47:50:27 IT'LL PROBABLY
BE THAT WAY
421 01:47:50:29 01:47:52:28 FOR SEVERAL
HUNDREDS OF YEARS HENCE.
422 01:47:54:27 01:47:57:25 NUMEROUS PREVENTIVE MEASURES
HAVE BEEN PUT IN PLACE
423 01:47:57:27 01:47:59:25 SINCE THE 1941 MUD FLOWS.
424 01:47:59:27 01:48:02:10 BUT EVEN
WITH THE VIGILANT USE
425 01:48:02:12 01:48:03:26 OF FLOOD-CONTROL CHANNELS
426 01:48:03:28 01:48:05:13 AND OTHER
MITIGATION EFFORTS,
427 01:48:05:15 01:48:08:11 THERE STILL ISN'T A WAY
TO COMPLETELY NEUTRALIZE
428 01:48:08:13 01:48:11:02 THE RAW POWER
OF SUCH AN EVENT.
429 01:48:11:04 01:48:13:02 THIS SIGN WAS PUT IN PLACE
430 01:48:13:04 01:48:15:02 FOLLOWING A SERIES
OF ROCK SLIDES.
431 01:48:15:04 01:48:16:18 LIKE MUD FLOWS,
432 01:48:16:20 01:48:19:00 ROCK AND DEBRIS SLIDES

433 01:48:19:02 ARE MASS-WASTING EVENTS
 01:48:21:00 THAT TAKE PLACE
 434 01:48:21:02 IN MOUNTAINOUS AREAS,
 01:48:22:15 BUT THEY MOVE
 435 01:48:22:17 01:48:25:00 AT AN EVEN FASTER RATE
 OF SPEED.
 436 01:48:25:02 01:48:26:25 ROCK SLIDES
 LIKE THIS ONE
 437 01:48:26:27 01:48:28:11 ARE A MAJOR PROBLEM
 438 01:48:28:13 01:48:30:25 ON HIGHWAYS BUILT
 THROUGH MOUNTAINOUS TERRAIN
 439 01:48:30:27 01:48:33:24 WHERE THE OVERSTEEPENED
 SLOPES OF THE ROAD CUTS
 440 01:48:33:26 01:48:36:09 ARE ESPECIALLY SUSCEPTIBLE
 TO SLIDE ACTIVITY.
 441 01:48:39:06 01:48:41:20 SOME ROCK SLIDES
 TRAVEL ONLY A FEW METERS
 442 01:48:41:22 01:48:43:26 TO THE BASE OF THE SLOPE,
 443 01:48:43:28 01:48:45:26 WHILE IN COUNTRY
 WITH HIGH RELIEF,
 444 01:48:45:28 01:48:48:11 A ROCK SLIDE
 MAY TRAVEL HUNDREDS
 445 01:48:48:13 01:48:50:12 OR EVEN THOUSANDS
 OF METERS
 446 01:48:50:14 01:48:52:12 BEFORE REACHING
 THE VALLEY FLOOR.
 447 01:48:52:14 01:48:55:11 AND IF THE MOVEMENT
 BECOMES EXTREMELY RAPID,
 448 01:48:55:13 01:48:57:10 THE ROCK SLIDE
 MAY BREAK UP
 449 01:48:57:12 01:48:59:09 AND BECOME
 A ROCK AVALANCHE.
 450 01:49:01:11 01:49:02:24 IN SOME CASES,
 451 01:49:02:26 01:49:05:18 THE POTENTIAL FOR
 MASS WASTING IS SO GREAT
 452 01:49:05:20 01:49:09:10 THAT BUILDING PROBABLY
 SHOULD NOT BE DONE AT ALL.
 453 01:49:09:12 01:49:10:23 IN OTHER AREAS,
 454 01:49:10:25 01:49:13:25 IT ISN'T NECESSARY
 TO SUSPEND ALL BUILDING,
 455 01:49:13:27 01:49:15:25 BUT DEVELOPERS
 MUST IDENTIFY AND PREVENT
 456 01:49:15:27 01:49:17:09 POTENTIAL
 MASS-WASTING PROBLEMS
 457 01:49:17:11 01:49:19:24 AT EVERY PHASE
 OF THE PROJECT,
 458 01:49:19:26 01:49:21:28 FROM INITIAL PLANNING
 THROUGH FINAL CONSTRUCTION.
 459 01:49:22:00 01:49:24:24 IT WAS WITH JUST THAT
 IN MIND
 460 01:49:24:26 01:49:27:08 THAT A MAJOR
 REAL ESTATE DEVELOPER
 461 01:49:27:10 01:49:29:10 HIRED ANN MEEKER
 AND HER COLLEAGUES
 462 01:49:29:12 01:49:30:25 AT SCHAEFER DIXON
 ASSOCIATES

463 01:49:30:27 01:49:32:24 TO ASSESS
THE GEOLOGIC STABILITY
464 01:49:32:26 01:49:35:24 OF A 60-ACRE PARCEL
OF LAND.
465 01:49:35:26 01:49:38:24 THE DEVELOPER PLANNED
TO BUILD 150 HOMES
466 01:49:38:26 01:49:41:25 WORTH BETWEEN
\$300,000 AND \$500,000 EACH.
467 01:49:41:27 01:49:43:25 ORDINARILY,
IF A PARTICULAR SITE
468 01:49:43:27 01:49:46:25 IS FOUND TO BE UNACCEPTABLE
FOR BUILDING,
469 01:49:46:27 01:49:49:09 THE DEVELOPER CAN
ALWAYS LOOK ELSEWHERE.
470 01:49:49:11 01:49:52:24 BUT IN THIS CASE,
THAT IS NOT AN OPTION
471 01:49:52:26 01:49:55:24 BECAUSE THE DEVELOPER HAS
ALREADY BOUGHT THE LAND.
472 01:49:55:26 01:49:58:25 SO, AS ANN MEEKER
BEGINS HER WORK,
473 01:49:58:27 01:50:01:09 THE FINANCIAL STAKES
ARE UNUSUALLY HIGH.
474 01:50:01:11 01:50:04:10 WHEN WE COME OUT
TO A SITE,
475 01:50:04:12 01:50:07:09 WE'LL TYPICALLY
MAP THE AREA
FIRST ON FOOT
476 01:50:07:11 01:50:10:02 TO LOOK
FOR FEATURES SUCH
AS THESE LANDSLIDES,
477 01:50:10:04 01:50:12:19 TO MAP OUTCROPS
THAT WE SEE,
478 01:50:12:21 01:50:15:18 GET AN IDEA
OF WHAT DIRECTION
THE BEDDING
479 01:50:15:20 01:50:18:14 IS DIPPING
THE STRUCTURE
IN THE AREA.
480 01:50:18:16 01:50:21:15 WE'LL BE LOOKING
FOR ANY EVIDENCE
OF FAULTING,
481 01:50:21:17 01:50:24:18 ANY EVIDENCE
OF SURFICIAL CREEP
482 01:50:24:20 01:50:26:03 WHERE
THE SURFACE SOILS
483 01:50:26:05 01:50:28:04 HAVE SLOWLY MOVED
OVER TIME,
484 01:50:28:06 01:50:30:19 CAUSING SLUMPING
OR AN IRREGULAR
SURFACE.
485 01:50:30:21 01:50:33:07 I DON'T
SEE MUCH OF
ANYTHING HERE.
486 01:50:33:09 01:50:36:08 WE'VE STILL GOT
GOOD MATERIAL
IN THE BOTTOM.

487 01:50:36:10 01:50:38:17 DURING THE COURSE
 OF THEIR INVESTIGATION,
 488 01:50:38:19 01:50:40:02 MEEKER AND HER ASSOCIATES
 489 01:50:40:04 01:50:42:02 FIND EVIDENCE
 OF MASS WASTING.
 490 01:50:42:04 01:50:44:01 THEIR SUBSURFACE WORK
 REVEALS IRREGULARITIES
 491 01:50:44:03 01:50:46:27 IN THE UPPER SECTION
 OF THE MATERIAL.
 492 01:50:46:29 01:50:48:12 IN OTHER WORDS--CREEP.
 493 01:50:48:14 01:50:50:23 THEY ALSO FIND EVIDENCE
 OF SLUMP.
 494 01:50:50:25 01:50:52:00 OK. LET'S GO ON
 495 01:50:52:02 01:50:54:08 AND TAKE A LOOK
 AT ANOTHER EXPOSURE.
 496 01:50:54:10 01:50:57:07 I CAN'T GET THROUGH IT.
 IT'S SO DEEPLY WEATHERED.
 497 01:50:57:09 01:50:59:07 MATERIAL
 THAT WAS ONCE IN PLACE
 498 01:50:59:09 01:51:01:06 HAS CLEARLY
 MOVED DOWN-SLOPE,
 499 01:51:01:08 01:51:02:17 CREATING
 A SHALLOW DEPRESSION
 500 01:51:02:19 01:51:03:27 IN THE ORIGINAL LOCATION
 501 01:51:03:29 01:51:06:03 AND LEADING TO
 A THICKENING OF GROUND
 502 01:51:06:05 01:51:07:27 IN THE DOWN-SLOPE AREA.
 503 01:51:07:29 01:51:09:10 THIS COULD BE
 A PROBLEM.
 504 01:51:09:12 01:51:11:25 WHAT WORRIES THE DEVELOPER
 505 01:51:11:27 01:51:14:07 IS THAT IF
 THE MASS-WASTING PROBLEMS
 506 01:51:14:09 01:51:16:07 GO BEYOND CREEP AND SLUMP,
 507 01:51:16:09 01:51:19:05 THE MITIGATION COSTS
 COULD BE TOO HIGH
 508 01:51:19:07 01:51:21:04 TO COMPLETE
 THE BUILDING PROJECT.
 509 01:51:23:07 01:51:25:16 THE MAIN CONCERN
 AT THIS POINT
 510 01:51:25:18 01:51:28:15 IS THE POSSIBILITY OF
 MAJOR LANDSLIDE ACTIVITY.
 511 01:51:28:17 01:51:31:15 CREEP AND SLUMP
 CAN BE EASILY MITIGATED
 512 01:51:31:17 01:51:33:00 BY GRADING THE SLOPE,
 513 01:51:33:02 01:51:35:05 PROVIDED, OF COURSE,
 THAT THEY'RE DISCOVERED
 514 01:51:35:07 01:51:36:22 PRIOR TO BUILDING.
 515 01:51:36:24 01:51:39:20 BUT THERE ARE NO SUCH
 GUARANTEES WITH LANDSLIDES,
 516 01:51:39:22 01:51:41:20 WHICH TEND
 TO BE MUCH LARGER
 517 01:51:41:22 01:51:43:01 AND MORE DEEPLY ROOTED.
 518 01:51:44:13 01:51:47:12 SO ONCE THEY COMPLETE
 THEIR MAPPING WORK,
 519 01:51:47:14 01:51:50:20 MEEKER AND HER CREW BEGIN
 THE PROCESS OF DRILLING.

520 01:51:50:22 01:51:53:04 *THE GEOLOGIST BEING
LOWERED INTO THE HOLE*

521 01:51:53:06 01:51:55:20 *EXAMINES THE STRUCTURE
OF THE SOIL.*

522 01:51:55:22 01:51:57:05 *THIS HELPS
DETERMINE THE HISTORY*

523 01:51:57:07 01:51:59:01 *OF LANDSLIDE ACTIVITY
IN THE AREA.*

524 01:51:59:03 01:52:02:10 *AND AS WE DRILL
THE HOLE IN THAT AREA,*

525 01:52:02:12 01:52:04:24 *WE WILL BE
SAMPLING THE MATERIAL*

526 01:52:04:26 01:52:06:20 *TO DETERMINE
HOW STRONG--*

527 01:52:06:22 01:52:08:04 *HOW STRONG IT IS.*

528 01:52:08:06 01:52:10:20 *WE WILL ALSO
BE DESCRIBING IT*

529 01:52:10:22 01:52:13:17 *IN TERMS OF ITS
SOIL CHARACTERISTICS,*

530 01:52:13:19 01:52:16:05 *SUCH AS GRAIN SIZE,
MOISTURE, COLOR,*

531 01:52:16:07 01:52:18:17 *A VARIETY OF TYPES
OF CHARACTERISTICS*

532 01:52:18:19 01:52:20:04 *WHICH WILL BE USEFUL*

533 01:52:20:06 01:52:22:04 *TO ENGINEERS
IN THE OFFICE*

534 01:52:22:06 01:52:23:19 *WHEN THEY DETERMINE*

535 01:52:23:21 01:52:25:04 *WHETHER
THE MATERIAL'S SUITABLE*

536 01:52:25:06 01:52:27:03 *TO STAND IN A SLOPE*

537 01:52:27:05 01:52:30:03 *OR BE REUSED AS FILL
ELSEWHERE ON THE SITE.*

538 01:52:30:05 01:52:33:18 *IF IT TURNS OUT THAT
THERE ARE LANDSLIDES PRESENT,*

539 01:52:33:20 01:52:36:04 *A DECISION WILL
HAVE TO BE MADE*

540 01:52:36:06 01:52:38:04 *AS TO WHETHER
MITIGATION IS POSSIBLE*

541 01:52:38:06 01:52:41:12 *BOTH FROM A GEOLOGIC
AND A FINANCIAL STANDPOINT.*

542 01:52:41:14 01:52:44:03 *NORMALLY, A LANDSLIDE
CAN BE MITIGATED*

543 01:52:44:05 01:52:45:23 *EITHER BY BEING REMOVED*

544 01:52:45:25 01:52:48:18 *OR THROUGH THE CONSTRUCTION
OF SOME FORM OF SUPPORT.*

545 01:52:48:20 01:52:50:02 *BUT IF CORE SAMPLES*

546 01:52:50:04 01:52:52:19 *AND OTHER DATA
OBTAINED DURING DRILLING*

547 01:52:52:21 01:52:54:19 *REVEAL THAT
LANDSLIDE ACTIVITY HERE*

548 01:52:54:21 01:52:57:04 *HAS BEEN MORE EXTENSIVE
THAN ANTICIPATED*

549 01:52:57:06 01:52:59:18 *OR EXTENDS
BEYOND THE PROPERTY LINE,*

550 01:52:59:20 01:53:01:11 *MITIGATION EFFORTS
MIGHT PROVE IMPOSSIBLE.*

551 01:53:01:13 01:53:02:26 WHEN WE LEAVE THE FIELD,
552 01:53:02:28 01:53:05:02 WE'LL TAKE THE
INFORMATION WE'VE GAINED
553 01:53:05:04 01:53:06:19 AND PLOT
THAT INFORMATION
554 01:53:06:21 01:53:09:19 IN BOTH MAP FORM
AND CROSS-SECTION FORM.
555 01:53:09:21 01:53:11:19 BASED ON
THOSE CROSS-SECTIONS,
556 01:53:11:21 01:53:14:03 WE WILL HAVE
OUR ENGINEERING STAFF
557 01:53:14:05 01:53:17:09 EVALUATE THE STABILITY
OF PROPOSED CUT SLOPES,
558 01:53:17:11 01:53:19:24 ANY REMOVALS
WHICH WILL BE NECESSARY
559 01:53:19:26 01:53:22:09 OF LANDSLIDE AREAS
SUCH AS THESE.
560 01:53:23:18 01:53:25:01 *HAVING ANALYZED THEIR DATA,*
561 01:53:25:03 01:53:26:16 *MEEKER AND HER COLLEAGUES*
562 01:53:26:18 01:53:28:15 *WILL PRESENT*
THEIR FINAL RECOMMENDATIONS
563 01:53:28:17 01:53:30:01 *TO THE CLIENT.*
564 01:53:30:03 01:53:32:27 *THE NEWS*
IS BOTH GOOD AND BAD.
565 01:53:32:29 01:53:35:23 *THE BAD NEWS IS*
THAT THERE IS EVIDENCE
566 01:53:35:25 01:53:37:13 *OF LANDSLIDING*
THAT CROSSES OVER
567 01:53:37:15 01:53:38:28 *TO THE ADJACENT PROPERTY.*
568 01:53:39:00 01:53:41:12 *BECAUSE THE DEVELOPER*
HAS NO LEGAL RIGHT
569 01:53:41:14 01:53:44:11 *TO MITIGATE PROBLEMS*
THAT ARE NOT ON HIS LAND,
570 01:53:44:13 01:53:47:00 *SOME HOMES IN THE TRACT*
CANNOT BE BUILT.
571 01:53:47:02 01:53:49:11 *IT'S TOO WET*
OR TOO DRY.
572 01:53:49:13 01:53:52:11 *THE GOOD NEWS IS THAT*
WITH CAREFUL GRADING,
573 01:53:52:13 01:53:54:13 *THE RIGHT DRAINAGE,*
AND USE OF VEGETATION,
574 01:53:54:15 01:53:57:13 *THE REST OF THE HOMES*
CAN BE BUILT...
575 01:53:57:15 01:54:00:12 *THIS WILL HELP*
THEM UNDERSTAND
WHAT'S PROPOSED.
576 01:54:00:14 01:54:01:21 *LET'S SHOW*
THE CLIENT.
577 01:54:01:23 01:54:02:23 *OK. GREAT.*
578 01:54:04:05 01:54:06:11 *AND RESIDENTS*
OF THIS HOUSING TRACT
579 01:54:06:13 01:54:08:11 *WILL PROBABLY*
NOT HAVE TO WORRY
580 01:54:08:13 01:54:10:25 *ABOUT ANY MAJOR*
MASS-WASTING PROBLEMS.
581 01:54:13:18 01:54:16:14 *BUT THAT IS NOT*

582 01:54:16:16 01:54:19:15 *SOME DON'T KNOW THE FACTS
ABOUT MASS WASTING*
 583 01:54:19:17 01:54:22:15 *OR CHOOSE TO IGNORE THEM
AND BUILD ANYWAY,*
 584 01:54:22:17 01:54:23:29 *AND, AS WE'VE SEEN,*
 585 01:54:24:01 01:54:25:29 *MASS WASTING
CAN BE A PROBLEM*
 586 01:54:26:01 01:54:27:14 *OF MAJOR PROPORTIONS,*
 587 01:54:27:16 01:54:29:28 *NO MATTER
WHAT FORM IT TAKES.*
 588 01:54:38:02 01:54:39:15 *CREEP, FOR EXAMPLE.*
 589 01:54:39:17 01:54:41:29 *THE CONTINUOUS
DOWN-SLOPE MOVEMENT OF SOIL*
 590 01:54:42:01 01:54:44:28 *OFTEN PROCEEDS TOO SLOWLY
TO BE DETECTED*
 591 01:54:45:00 01:54:47:19 *UNTIL THE DAMAGE
HAS BEEN DONE.*
 592 01:54:47:21 01:54:50:18 *SLUMP AND EARTH FLOWS
OFTEN MOVE LARGE AMOUNTS*
 593 01:54:50:20 01:54:53:24 *OF SOFT OR EASILY
WEATHERED BEDROCK*
 594 01:54:53:26 01:54:55:14 *IN SLOW,
INTERMITTENT FASHION*
 595 01:54:55:16 01:54:57:29 *OVER A LONG PERIOD
OF TIME.*
 596 01:54:58:01 01:55:02:11 *DAMAGE IN COASTAL AREAS
IS FREQUENTLY VERY SERIOUS.*
 597 01:55:02:13 01:55:05:11 *AT PORTUGUESE BEND,
JUST WEST OF POINT FERMIN,*
 598 01:55:05:13 01:55:07:10 *WHAT BEGAN AS A SLUMP*
 599 01:55:07:12 01:55:10:00 *EVOLVED INTO A FASTER-MOVING
LANDSLIDING EVENT*
 600 01:55:10:02 01:55:14:08 *THAT IS AN EVEN MORE SERIOUS
FORM OF MASS WASTING.*
 601 01:55:14:10 01:55:16:08 *AS AREA RESIDENTS
HAVE LEARNED,*
 602 01:55:16:10 01:55:18:21 *THE IMPACT OF LANDSLIDES
ON PROPERTY*
 603 01:55:18:23 01:55:20:05 *CAN BE DEVASTATING.*
 604 01:55:23:05 01:55:25:02 *CAPABLE OF SPEEDS
FAR GREATER*
 605 01:55:25:04 01:55:28:22 *THAN CREEP OR SLUMP
AND EVEN SOME LANDSLIDES*
 606 01:55:28:24 01:55:30:13 *ARE MUD AND DEBRIS FLOWS.*
 607 01:55:30:15 01:55:34:03 *THESE FLOWS ARE OFTEN
THE RESULT OF HEAVY RAINS*
 608 01:55:34:05 01:55:35:17 *SATURATING THE GROUND*
 609 01:55:35:19 01:55:37:24 *IN MOUNTAINOUS CANYONS
OVER TIME.*
 610 01:55:37:26 01:55:40:23 *BECAUSE OF THEIR VISCOSITY
AND HIGH DENSITY,*
 611 01:55:40:25 01:55:43:23 *MUD AND DEBRIS FLOWS
CAN MOVE LARGE OBJECTS*
 612 01:55:43:25 01:55:45:07 *AND BE EXTREMELY
DESTRUCTIVE.*

613 01:55:46:17 01:55:48:28 FINALLY,
AT THE VERY RAPID END

614 01:55:49:00 01:55:50:28 OF THE MASS-WASTING SCALE

615 01:55:51:00 01:55:53:13 ARE ROCK SLIDES
AND AVALANCHES.

616 01:55:53:15 01:55:56:00 IN THESE FORMS
OF MASS WASTING,

617 01:55:56:02 01:55:58:28 ROCKS MAY TRAVEL HUNDREDS
OR EVEN THOUSANDS OF METERS

618 01:55:59:00 01:56:00:26 BEFORE REACHING
A VALLEY FLOOR,

619 01:56:00:28 01:56:02:13 AND ON THE WAY DOWN,

620 01:56:02:15 01:56:03:27 THEY SOMETIMES
ATTAIN SPEEDS

621 01:56:03:29 01:56:06:12 OF SEVERAL HUNDRED
KILOMETERS PER HOUR.

622 01:56:08:29 01:56:11:27 PEOPLE TEND TO VIEW
EPISODES OF MASS WASTING

623 01:56:11:29 01:56:14:11 AS ISOLATED
UNEXPECTED DISASTERS,

624 01:56:14:13 01:56:15:28 AND YET THESE EVENTS

625 01:56:16:00 01:56:17:10 ARE ACTUALLY
INDIVIDUAL FRAMES

626 01:56:17:12 01:56:19:26 IN A CONTINUOUSLY RUNNING
MOTION PICTURE

627 01:56:19:28 01:56:21:11 OF LANDSCAPE EVOLUTION.

628 01:56:21:13 01:56:23:26 MASS WASTING
IS A NATURAL PROCESS,

629 01:56:23:28 01:56:25:11 AND YET ALL TOO FREQUENTLY,

630 01:56:25:13 01:56:28:10 PEOPLE PLAY A ROLE
IN TRIGGERING THESE EVENTS,

631 01:56:28:12 01:56:29:24 SOMETIMES
UNDERMINING SLOPE STABILITY

632 01:56:29:26 01:56:33:24 BY MAKING IT TOO STEEP
OR BY ADDING EXCESS WATER.

633 01:56:33:26 01:56:36:09 WHILE WE ARE
CERTAINLY NOT ABLE

634 01:56:36:11 01:56:38:11 TO PREVENT
MASS WASTING ALTOGETHER,

635 01:56:38:13 01:56:40:20 WE CAN AT LEAST PLAN
INTELLIGENTLY

636 01:56:40:22 01:56:44:01 AND GREATLY LIMIT THE LOSS
OF NOT ONLY PROPERTY,

637 01:56:44:03 01:56:46:00 BUT ULTIMATELY,
OF HUMAN LIFE.

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