Mayor Mim McConnel
C/B Sitka
100 Lincoln Street
Sitka AK 99835

9/15/15

Dear Mim,

Re: Sitka's Natural Hazards

On 9/11/15 I sent you a fairly detailed letter concerning geophysical hazards in Sitka. As you know, it primarily focused on mass wasting (landslides and slumps), and included some discussion of flooding.

I have come to the realization that it was a mistake to include Granite Creek flooding, for several reasons: 1) my understanding of that development is not current, 2) I should not have raised the issue until I reviewed the updated Granite Creek master plan, and 3) it is an unnecessary distraction from the municipality's priority consideration of Sitka landslides.

I have revised the letter to remove that portion. Please discard the original and substitute the 9/15 revision.

I have enclosed an extra set of the original attachments which concern mass wasting, and should be included with the revision.

I hope you will accept my apologies for any confusion.

Sincerely,

Dave Hardy

907-747-6525

Cc: Mark Gorman, Mike Scarcelli, Planning and Zoning Commission

Attachments:
9/15 letter re: Sitka's Natural Hazards
Dr. Dave Petley Landslide Evaluation
Golder Associates Test Pit layout map
Pit profile test pit 20

Mayor Mim McConnell
C/B Sitka
100 Lincoln St
Sitka AK 99835

9/15/2015

Dear Mim,

Re: Sitka's Natural Hazards

Like most residents of this caring community, I have been greatly distressed by the tragic landslide of August 18. In the weeks since, I have invested a fair amount of time in trying to understand 'why'.

I overheard someone at a grocery store describe the landslide as an act of God, but I know that geologists look at landslides as the result of natural processes occurring on a landscape scale and geological timeframe. The main difference seems to be one's perspective on processes and time. Mass wasting is predisposed by existing geophysical conditions, and can be triggered by earthquakes, heavy rainfall and wind, or manmade disturbance such as logging and road-building. The risk of mass wasting is greater in some areas than others, and scientific tools can help assess risk, but unfortunately with less spatial and temporal precision than you might hope for. Experts can advise you on the strengths, weaknesses, and costs of available tools, and what each method may contribute to forecast precision.

Sitka's benchlands development is the product of a long series of manmade processes, i.e. public, bureaucratic, planning and engineering processes defined by ordinance, SOPs, etc. and implemented by city staff with the aid of consultants. Hopefully, these processes included multiple safety gates where potential hazards such as landslides and floods were evaluated and addressed in project planning and design. I do not know where or when in the history of benchlands development specific decisions regarding the risk of landslides were made, or what evidence was considered. I would be especially interested in knowing what evidence supported the core decision to develop housing lots at the base of a landslide prone slope.

I undertook this superficial review of municipal standards, guidelines and processes for several reasons. I wanted to 1) learn more about the framework of municipal landslide safety decisions, 2) provide the assembly with background information that might not otherwise surface, and 3) make the complex web of municipal processes somewhat more transparent. If you find any errors of fact or have any questions, please give me a call.

The 1999 Sitka Comprehensive Plan (SCP) was generally silent on geophysical hazards, although section (2.1.9) directed the C/B of Sitka to, "seek, facilitate and maintain... safety from fire, flood and other disasters." That policy was retained in the 2007 SCP update. In November 2005 two slides between Davidoff Street and the City shop destroyed the DOT shop building and blocked HPR. The 2007 update addressed this on p.92 by asking that DOT/PF facilitate a slope stabilization project "along the entire slide prone hillside".

As evidence of the public's tendency to avoid thinking about natural hazards, in 2006 voters approved a proposal to dedicate the land to affordable housing. As you know, the planning and zoning commission is currently considering a 15 unit development. It places the communal parking area atop the previous slide path, presumably because drafters considered this the most likely place for the next wasting event to occur.

An article in the Sep.3, 2015 Sentinel reported that "Geologists are here to consult with city officials about future hazard mitigation that should be considered in plans for future building development." Perhaps this small, accessible slide prone site could serve as a field test for geophysical experts working on the larger Sitka issues. Key questions include, where specifically and in what timeframe can we expect future mass wasting events? What if any slope stabilization measures should be applied to reduce risk, at what cost? Should we develop any, all or only a portion of this flat for housing? And if we do proceed with affordable housing development, what restrictions should be in project approvals?

The most detailed geophysical hazard guidance I found was in Sitka's original Coastal Management Plan (SCMP), which was incorporated into the SCP by reference (SCP section 2.4.2.B.) The primary purpose of the CZM Program is to encourage cities to better plan for coastal development. The carrot is that an approved plan gives local communities some say in planning for development that affects their communities. This opportunity is not carte blanche; plans must jump through a number of hoops and agency approvals before adoption.

Sitka's CMP included the goal, "**To protect the lives and property of the people of the C/B of Sitka from geophysical hazards." Enforceable Policy 2.1** said, "**Development in areas with known geophysical hazards shall not be approved by the appropriate local, state or federal authorities until siting, design and construction measures for minimizing property damage and protection against loss of life have been provided." 2.2** said, "**No building permit shall be issued by the municipal building official in any area containing any geophysical hazard... until the remedies for such hazards have been incorporated into project design documents.**" (emphasis added).

This goal clearly expresses the public trust responsibility of government to provide for public safety. These enforceable policies sound good on paper, but lack essential components. The main problem is that they only apply to places with known geophysical hazards. The 2.1 process does not indicate how such knowledge is to be acquired, or specify a site specific review if an overall hazard map is not available. 2.2 places too much responsibility on the shoulders of the building official to determine if an area contains any geophysical hazards, and then to deny a permit unless appropriate remedies have been incorporated. I ask you to consider whether, in the interplay of public authority and responsibility, that process is entirely appropriate or potentially effective.

I doubt that these policies were ever used. The apparently missing feedback loop would have asked, 'Do these enforceable policies achieve the city's goal?' 'And if not, why not?' More effective policies would clearly define natural hazards and where specifically they apply. Such policies would also specify who has what duties to ensure that a project meets clearly stated hazard safety standards.

This version of the SCMP remained in effect until a passionately pro-development governor decided to bowdlerize or eliminate coastal plans, in order to prevent municipalities from impeding development. Sitka and some other communities chose to revise rather than drop their plans. Marlene Campbell can fill in the details about politics, process and outcome. The Sitka CMP was amended to the governor's satisfaction in April of 2007.

Unfortunately the "Natural Hazards" section of the revised SCMP, pp37-40, is technically weak, and presents information and analyses that significantly understate the nature and severity of natural hazards to Sitkans. For example, "Slope Instability: Numerous landslides have occurred in the Sitka Area. The volcanic ash covering much of the area is prone to sliding and flowing, both naturally and

when artificially disturbed. Landslides do not currently affect developed areas. Many snow avalanches occur within the Borough area, but as with landslides, they do not impact presently inhabited areas". And, "Flooding: Future stream-flooding hazard can be reduced by floodplain management practices. There is some potential for local flooding, should an earthquake dislodge a snow or landslide that could give way, sending a wall of water downstream."

The amended SCMP identifies no natural hazard areas, and includes no enforceable policies. "Because the district is not proposing enforceable policies or designating natural hazard areas at this time, the application of enforceable policies is not addressed." "Without specific designation and mapping by the City and Borough of Sitka, the state standard 11AAC112.210 (see SCMP p.40) will be applied by the state agencies on a case by case basis" during ACMP consistency reviews." I would be greatly surprised if a state agency ever applied this standard to any Sitka project during an ACMP review. In sum, the State ordered revisions eliminated two local geophysical hazard policies, and substituted a state controlled process. I would emphasize that process does not guarantee an unbiased outcome.

I can't tell you much about the history of geotechnical work contracted for or conducted by the City during the long history of benchlands development. Sitka's web site makes publicly available a 2008 report by engineering subcontractor Golder and Associates, "Geotechnical Investigation Whitcomb Heights Subdivision, Sitka AK", which focuses primarily on subdivision construction features such as road and water tank siting and design.

The site investigation included 21 test pits excavated in and adjacent to the proposed subdivision. Of these 5 showed perched water tables associated with "ancient landslides". Pit 20 at proposed tank site 2 displayed "large volumes of ancient landslide and volcanic ash deposits." This pit was located about 200 feet uphill from the junction of Kramer Avenue and Emmons Street (see attached). The pit profile revealed three separate landslide strata composed of varying materials layered between 1 and 19 feet down. The 21 test pits were not designed to assess the frequency, timing and severity of past slides that reached this portion of Kramer Avenue, but they do provide concrete evidence. If desired, carbon dating could generate timelines for wasting events uncovered by test pits.

Attached is a photogrammetric analysis posted 30 August, 2015 on the American Geophysical Union blog site by Dr. Dave Petley of the University of East Anglia in the UK, titled "Sitka Landslide in Alaska – the potential power of simple geomorphic mapping." It includes a high resolution SPOT7 satellite image of the slide path, and commentary on the site's geomorphology as it relates to landslide risk. Comparing the satellite photo to the test pit map makes me wonder if test pit 20 was obliterated by the slide.

My first thought on seeing the satellite photo was how fortunate it was that the slide did not quite reach Sand Dollar Drive. My second thought was 'What if the slide had slammed into the water tank and entrained 1 million gallons of water?" Experts can better answer that question than I, but I expect landslide damage would have continued a lot further downslope, perhaps all the way to the ocean.

The geotechnical analysis of water tank siting alternatives focused on substrate bearing capability; landslide risk was not discussed. It is indeed fortunate that landslide debris is an inadequate bearing surface, and sites with significant quantities of past landslide debris were rejected. I suggest that any Sitka landslide risk analysis pay particular attention to water tanks.

Dr. Petley noted: "To me as a geomorphologist, the presence of those gullies on the slope, and their shape is enough to ask serious questions about the site. Combined with ancient landslide deposits in the

vicinity of the houses themselves my concern would increase. And note that the ancient landslide deposits lie above glacial drift (i.e. the remains from a recent ice age), and ash from one or more volcanic eruptions. This suggests to me that these landslide deposits may not be very ancient in geological terms."

The last major eruption of the Mount Edgecumbe Volcanic Field occurred 11,900 years ago, followed by two separate, relatively minor eruptions between 4000 and 5000 years ago. (USFS and USGS, 1996, *The Mount Edgecumbe Volcanic Field, A Geologic History*, pp. 23-24*)*. Soil scientists who have studied the formation of SE AK soils can estimate the time required to produce approximately 1 foot of organic cap soil over a landslide debris field.

Whitcomb Heights' location at the base of a steep, landslide prone slope prompted Dr. Petley to comment, "I have no idea whether a simple geomorphic analysis was undertaken of the slope, but I would be interested to find out." The public record identifies at least one. Golder and Associates 2008 reported that, "Stereo pairs of aerial photos of the Whitcomb Heights Subdivision were examined to identify potential landslide paths and deposits."

Unfortunately the risk of landslides was not discussed in the report, which prompts the questions: What did the consultants conclude? Were any findings or concerns reported to the primary contractor or to city staff? In the history of benchlands development, were any other formal or informal geophysical hazard analyses conducted, with what results?

Another municipal project involving mass wasting is the Gavan Hill Subdivision. Significant portions are characterized by a landslide debris field comprising the usual unconsolidated mass of trees, dirt and ash. As noted in the 2008 geotechnical investigation of Whitcomb Heights p.10, "Landslide deposits commonly exhibit characteristics of disturbed volcanic ash and are generally unsuitable as a bearing surface or for fill material." Also (p.11) in the event of an earthquake, "It is expected that liquification is possible in large volumes of volcanic ash that have been excavated and reused as fill." At the very least, it seems to me that landslide deposits present a technically challenging and expensive substrate on which to build hopefully stable home foundations.

No geophysical evaluation is required to know that this is a slide area; the slide path is visible uphill. Also the nature and distribution of the unconsolidated substrate would have been clearly delineated during road and utility construction, if not before. The questions I would ask are: Was a geophysical hazard analysis conducted for this development? What did it conclude, and was any mitigation applied? I was told that at least one lower lot purchaser did not know of the landslide debris when he bought the property. What efforts did the municipality make to inform prospective buyers of substrate characteristics?

Flooding is another common hazard in the rainforest environment of SE AK. A partial, one day listing of mass wasting and floods in the developed portions of Sitka will be provided by applications to the State for disaster relief from the August 18 slide and flood events.

Road and cross drain design and maintenance can have a significant effect on the location and severity of floods. Drainage issues regularly combine with mass wasting to cause problems with Blue Lake and Harbor Mountain roads. Perhaps you remember the Sawmill Creek Plaza flood engendered by an inadequate SMC road culvert partially plugged by flood debris. The Sitka Lutheran Church has flooded multiple times when high water and runoff combined with high tides to back up flows from an ocean

outlet, etc. A detailed public and private inventory would help clarify the nature and distribution of flooding events in Sitka. I believe you will find that flooding is quite common in Sitka, and predominantly characterized by relatively small scale events that cause some property damage, as opposed to major floods that threaten homes. Our short island streams carry substantially less water than larger, mainland systems.

On a related subject, I would like to commend the city's diligent efforts to upgrade Sitka's inflow and infiltration infrastructure to better handle storm water, and to better separate I&I from wastewater.

Staff can tell you more than I about municipal processes and guidelines, and the history of geophysical hazard analyses and decision making in city projects. Please understand that I did not evaluate municipal ordinances, codes, or administrative guidelines (SOPs), solicit detailed input from city staff, or attempt to access the wealth of information available in project files.

I can say however that Sitka's Comprehensive Plan and Coastal Zone Management Plan contain no effective standards and guidelines, and establish no clear administrative processes to evaluate geophysical hazards in the planning, development and disposition of municipal property. Sitka has no official natural hazard map to red flag projects, a long term deficiency that apparently rendered the original SCMP standards inoperative. It may be that a geophysical hazard risk assessment is not required for municipal project planning and development.

I have been told that the assembly at one time debated whether or not to accept federal funds to study Sitka's geophysical hazards, but decided to reject that opportunity. You'll have to review the minutes to understand what and why. I can't give you a date, but I believe that was back when Pete Esquiro was on the assembly; perhaps he can add his recollections to the discussion.

Please understand that my focus is on public property projects planned for and implemented by the city. On the other hand, mass wasting and floods pay no attention to property lines on a plat map. Sitka's responsibility to ensure public safety in developing private lands should not be overlooked.

Based on my limited understanding, I would say that "Why?" is a complex question that apparently involves long term shortcomings in municipal leadership, beginning with the assembly, and includes planning, project engineering and administration.

I do not know what specific mechanism the assembly will adopt to better meet the City's responsibilities, but I ask that it be effective, and not a placebo.

It seems likely that a comprehensive geophysical analysis will produce a set of hazard maps that identify other Sitka developments as situated in geophysical hazard areas. In that case, HPR residents will not be the only Sitka downslopers who feel exposed to landslide risk. Absent a major catastrophe, I presume that once an area is developed, it will remain dedicated to human use. In other words, it is waiting in geological time for the next event to arrive.

Dr. Petley concluded his review by saying, "... knowing that this is a slope that is prone to landslides does not necessarily preclude development of the benchlands area of Sitka, but appropriate mitigation would be essential." Until a comprehensive geophysical hazard review is undertaken, I recommend cancelling additional lot sales in Whitcomb Heights. The next one is scheduled for December 13.

I do not know the extent to which municipal staff complied with applicable standards, guidelines and processes during the long history of benchlands development. I presume that, absent a clearly mandated municipal process, the primary responsibility for geophysical hazard assessment and mitigation devolves to project engineer(s) assigned to design, develop and administer project construction.

I strongly support the city's efforts to consult with geotechnical experts and implement an effective process to ensure that this tragic occurrence is the last of its kind in Sitka.

I will say that, absolutely, the City should not develop or dispose of publicly owned lands in geophysical hazard areas.

Thank you for accepting the responsibility to make difficult decisions for the good of the community.

Sincerely,

Dave Hardy
Box 6032
Sitka, AK 99835
Phone: 907-747-6525

Cc: Mark Gorman, Mike Scarcelli, Planning and Zoning Commission

Attachments:
Dr. Dave Petley Landslide Evaluation
Golder Associates Test Pit layout map
Pit profile, test pit 20

30 AUGUST 2015

Sitka landslide in Alaska – the potential power of simple geomorphic mapping

Posted by dr-dave

Sitka landslide in Alaska

Heavy rainfall in Alaska on Tuesday 18th August triggered landslides in the town of Sitka in Alaska, the worst of which killed three men. The Alaska Dispatch News has the best image of the landslide that I've seen to date:

Alaska Dispatch News

It is clear that this is a flow type slide that has originated on the steep forested flanks of Harbor Mountain. The landslide tore through a new housing development on the so-called benchland area of Sitka, which it had been hoped would provide a solution to the housing problems faced by the town. There is a good account of the disaster declaration for the landslides in Sitka on KTVA Alaska, and of the likely implications of the landslides in an article on the Alaska Dispatch News website. Part of the development of the housing project included the construction of a water tower. The geotechnical report for this project is also available online and makes interesting reading. This is a part of the documentation that was provided for the auction of lots in the housing subdivision.

The aftermath of the landslide itself has captured in a high resolution SPOT7 satellite image, and is available in annotated form on the GeoNorth website:

SPOT 7 via Geonorth

A few things to note here. First, it was lucky that the landslide didn't travel a little further. Second, and more importantly, the landslide started very close to a ridge in a forested section of the slope, possibly as a reasonably small landslide that appears to have entrained debris to become a high energy flow. Thirdly, the water tank is clearly visible on the image. And fourthly, the slope appears to have very interesting geomorphology, with multiple gullies. So let's take a look at the Google Earth image, which is of a high quality for this site:

Google Earth

It is clear that the slope is characterised by multiple incised channels, many of which extend from the ridgeline. Note that at least some have a broader crown area and then a narrow track. These look to me to be classic debris flow channels, at least some of which come extend down to the roads associated with potential housing developments. The Sitka landslide itself is very close to one of these channels, and may even have occupied one. And interestingly, the geotechnical report identifies "ancient landslide" deposits:

> ***Ancient Landslide***
> *This unit is composed of varying mixtures of volcanic ash, glacial drift, and organic materials. These deposits are typically reddish brown, moist to wet,*

- Weare Cliffs in Dorset – rockfall video
- The West Salt Creek Landslide, Mesa County – implications for hazard management
- West Salt Creek Landslide: Colorado Geological Survey report

CATEGORIES

Categories

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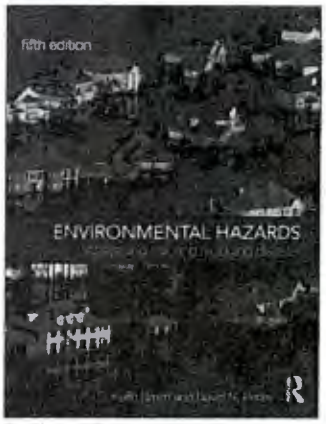
BLOGROLL

Durham University Tipping Points project
The Institute of Hazard, Risk and Resilience Blog

MY BOOK



Smith and Petley (2009): Environmental Hazards - Assessing risk and reducing disaster is my new book - the 5th edition of this best selling text. The book is a highly accessible, undergraduate level text that provides an introduction to the natural, social and technological events that combine to cause disasters. It draws on the latest research findings to guide the reader from common problems, theories and policies to explore practical, real-world situations. In writing it we aimed to capture both the complexity and the dynamism of environmental hazards.

NEW MASTERS PROGRAMMES IN RISK

compact to dense, and vary in thickness from 1.5 ft to 18.5 ft. The average moisture content was 27%. Landslide deposits commonly exhibit characteristics of disturbed volcanic ash and are generally unsuitable as a bearing surface or as fill material.

To me as a geomorphologist, the presence of those gullies on the slope, and their shape, is enough to ask serious questions about the site. Combined with ancient landslide deposits in the vicinity of the houses themselves, my concern would increase. And note that the ancient landslide deposits lie above glacial drift (i.e. the remains from a recent ice age), and ash from one or more volcanic eruptions. This suggests to me that these landslide deposits might not be very ancient in geological terms.

I have no idea whether a simple geomorphic analysis was undertaken of the slope but I would be interested to find out. Not unusually perhaps, it seems it wasn't part of the brief for the geotechnical report, which seems to me to be a perfectly competent document within the scope of such a study. O

I would also add that , of course, knowing that this is a slope that is prone to landslides does not necessarily preclude development of the benchland area of Sitka, but appropriate mitigation would be essential.

Simple engineering geomorphic mapping is a very powerful tool. It is used far too infrequently in my view. I have no idea how this slope was assessed. Was geomorphic mapping used here, and if so what did it show? If not, how have the hazards associated with this slope been assessed?

Posted in: landslide report

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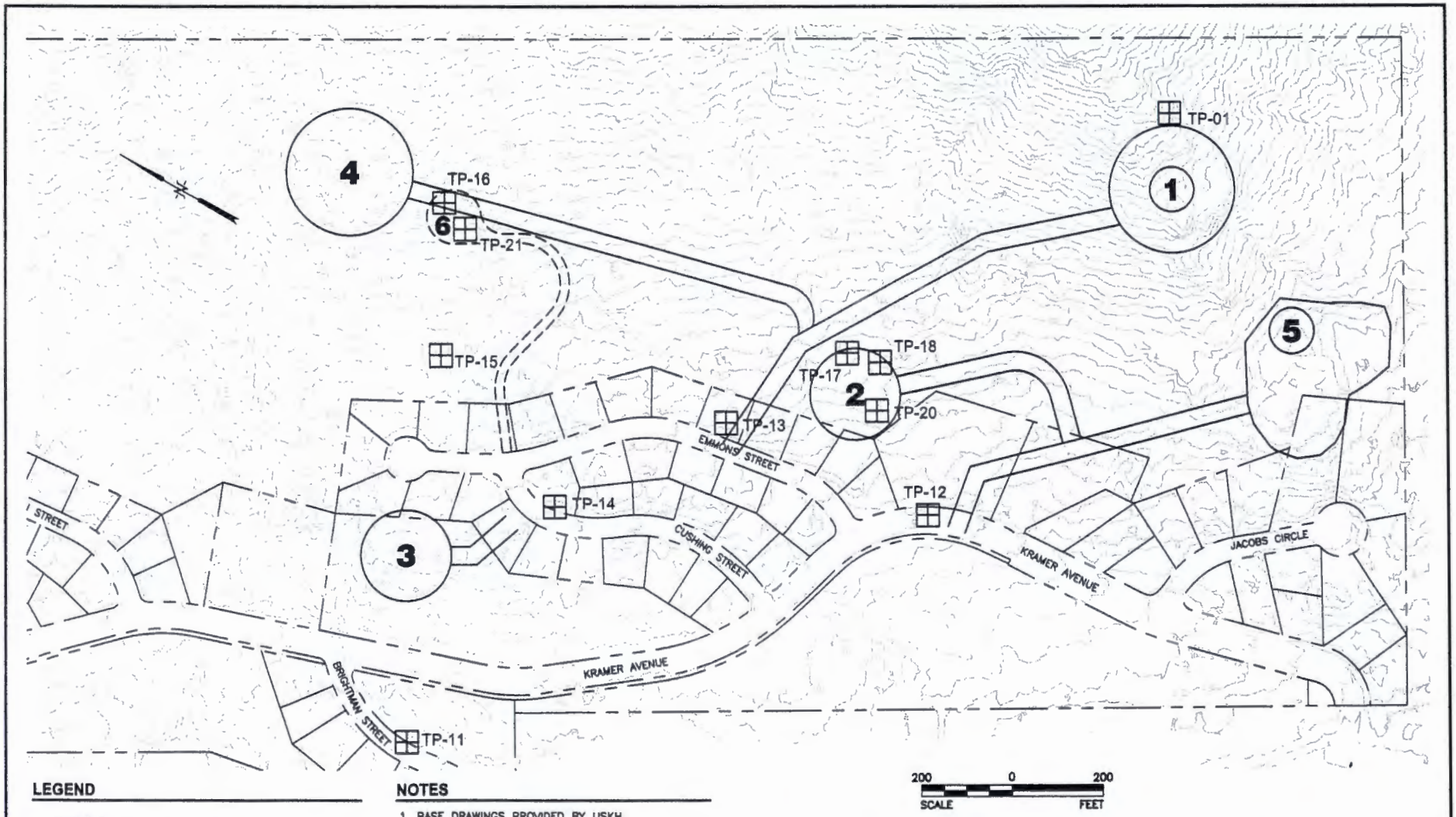

LEGEND

TP-01 TEST PIT LOCATION

(1) PROPOSED WATER TANK LOCATION

NOTES

1. BASE DRAWINGS PROVIDED BY USKH.
2. TEST PIT TP-19 (NOT SHOWN) IS LOCATED ABOUT 50 FT SOUTHEAST OF TEST PIT TP-18.

Golder Associates
Anchorage, Alaska

SCALE	AS SHOWN
CADD	JMT
DATE	11/13/07
CHECK	SLA
DATE	01/31/08
REV.	1
FILE No.	TPITLOCS_R1.DWG
PROJECT No.	073-95050

TITLE

TEST PIT LOCATIONS - SOUTH

WHITCOMB HEIGHTS SUBDIVISION GEOTECH
SITKA, ALASKA

USKH / WHITCOMB HEIGHTS GEOTECH / AK

FIGURE 2

PHOTO 1: Proposed Tank Site #2 is located in an area dominated by thick landslide and volcanic ash deposits. Trees in background of photo are unstable due to near saturated ground conditions.

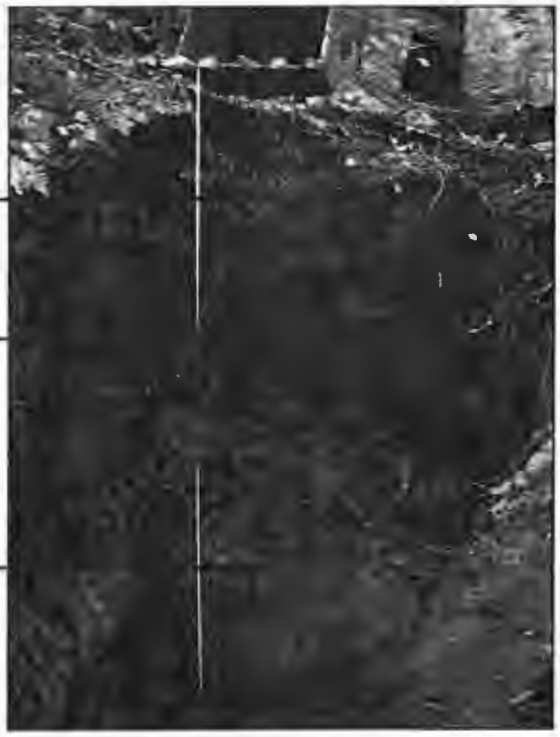

PHOTO 2: Test Pit TP-20 at proposed Tank Site #2. Three separate landslide strata are visible composed of varying materials. Glacial till encountered at 23 ft depth.

Golder Associates
Anchorage, Alaska

SCALE	NTS
DRAWN	SLA
DATE	11/14/07
CHECK	RGD
DATE	11/28/07
REV.	0

TITLE

TANK SITE #2 PHOTOGRAPHS

WHITCOMB HEIGHTS SUBDIVISION GEOTECH
SITKA, ALASKA

FILE No.	TANK2PHOTO.CDR
PROJECT No.	073-95050

USKH / WHITCOMB HEIGHTS GEOTECH / AK

FIGURE 6