

5. ÜPİ 2) eə0²ÜəÜ⁰ðE Ø²Üð²î ðî Aî Đô 2½âî àôÂÚàôÜÜ⁰ð

5.1 ¶áß · ØáøØç ëáØ³ ÝùÝ»ñÁ

5.1.1 Ì ³ ÝáÃáõÃÛáõÝ

¶áB · lláOÖA ī »Ö³ μ³ BÉÍ³ I ī ³Í áOBç Ù³ nÍáOÙ, ³ÍY · ī YÍ áOÙ ī ê³³ YÍ Éxçó NÍáOeÇé: p³I
½maë³ BñçÇÍ Y»ñ ³ lló»ÉáOÙ »Y ¶áB · eñm. ¶íán· i ³ Yù, áñA · ī YÍ áOÙ ī ¶áB · lláOÖC I »Yí náYáOÙ(UÍ .-1):

¶áß. ÙáôÓÁ ī ³½ÙÍ ³Í ɿ 3 Ñ³ ī ³Í »ñCÓ` ī »ñCÝ, ØCçCÇÝ .. Ü»ñùCÝ . ÙáôÓ»ñ (Üİ -.1

Ð³ Ù³ ñÙ³ ì »ñÇÝ . ÙáðÖÇ þáÉÁñ µÝ³ ÌÇäÝ»ñÁ ³ ãñáðÙ »Ý ÑÇÝ eáð³ ÝùÇ ì ³ ñ³ ÞùáðÙ, Ü»ñÌ ³ ÍáðÙë, . ÙáðÖÇ
ÙÇ Ù³ eáðÙ Ì ³ ß³ ì ³ ÌÍ ÇÍ eáð³ Ýù³ ïçÝ ì ³ ñ³ Þù: Ð»ì ³ ð³ µ³ ñ, eáð³ ÝùÇ áñÍ áðÝ»áðÃ³ Ý
ã³ ì ³ eáí . ÙáðÖÇ x³ Ýã³ ñÑÝ»ñÁ ³ ß³ ì ³ Ý»ñ aðÝ»Ý añáß í Ý³ eí ³ ÞùÝ»ñ:

5. Detailed Studies for Selected Landslides

5.1 Gosh village Landslides

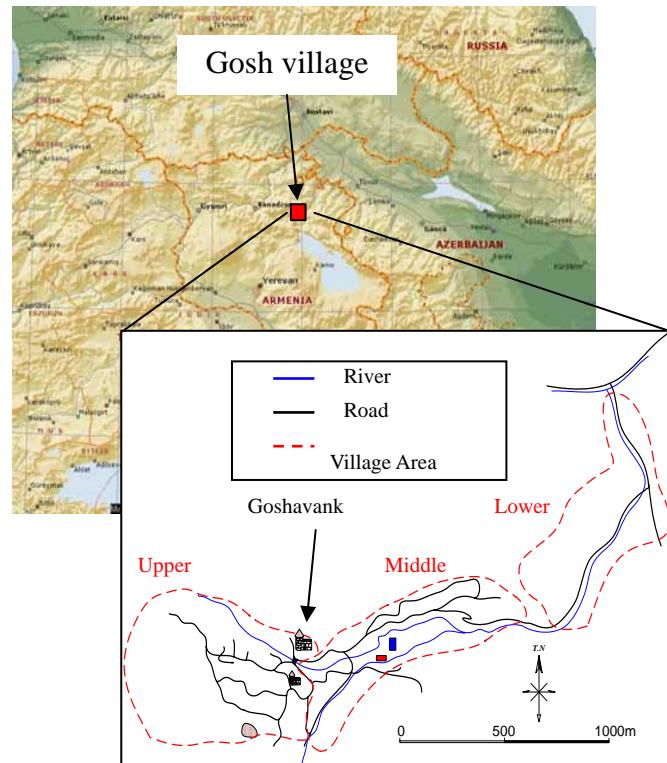
5.1.1 Introduction

Gosh village is located in Tavush Martz that is in the north of the Sevan Lake. Many tourists visit Gosh to see the St. Gevorg Monastery that is located at the center of Gosh village (Fig-1).

Gosh village is sectionalized to 3 areas as Upper, Middle and Lower village (Fig-1).

Almost all the residents of the upper village live on an old landslide block. At present, there is a

very active landslide block on a part of the village. Therefore, village roads and many houses have been damaged by landslide activity.



ÜT 3 گ 5.1.1 Պաթ · ԱճօԾԱ ն³ դի՝ »ԿածԱ

Figure 5.1.1 Location Map of Gosh village

5.1.2 ÀÝ¹³ Ñ³ Ýáõñ °ñí³ ñ³ µ³ ÝáõÃÙáõÝ .. êáÓ³ Ýù

АÝ1Ñ3 Ýñ3 Å»ë, Å3 Э»á. »Ý Ññ3 µË3 0çÝ 3 Å3 ñÝ»ñÁ .. Ññ3 µË3 0çÝ Ýëi 13 Íù3 0çÝ 3 Å3 ñÝ»ñÁ Э3 0Ý
Í 3 ñ3 Í13 Í »Ý: 13 ñ3 ÍùáðÙ µ3 ½3 Эí » Í áóÝÇ µñ3 äll3 Ý 13 ñ3 Í13 Í ì áñå»ë ÑçùÝ3 Í3 Ý 3 Å3 ñ ..
· 3 µñá-åáñýçñci Á Ñ3 ëi Ý3 µ»ñí 3 Í ì ÑçùÝ3 Í3 Ý 3 Å3 ñáðÙ áñå»ë ÇÝi ñáð½çí 3 Å3 ñ:
¶3 µñáÝ Ñ3 ëi Ý3 µ»ñí 3 Í ì ñçÝ · ðáðÖç Ñ3 ñ3 1-3 ñ .. ÚáðÙ ñáðÙ: 1 »ñçÝ · ðáðÖç 3 13 ½ç ÑçÝ Ñ3 ÝùáðÙ
¶3 µñáÝ Í3 ñáð ì áðëáðÙÝ3 èçñí 3 Í ÉçÝ»É: ¶3 µµñáÝ Í3 ñ3 Í13 Í ì N60W áðÖðáðÄll3 Úµ: 2ñë
Í 3 ñ3 Íùç »ñí ñ3 µ3 Ý3 Í3 Ý 3 éáðóí 3 Í ñáð òáðòí 3 Í
ì ê..3 ÝÇ ÷ Éáð½ù3 Ý Ñ»í, áñÝ 3 ÝóÝáðÙ ì ê..3 Ý3 ÈxÇ Ññáðëçëáí: éáð3 Ýù3 0çÝ ÍáðÙ 3 Í ñáðÙÝ»ñÁ
µ3 0ñ3 03 Í ì 3 13 ½ç Ýëi 13 ÍùÝ»ñçó, ÑçùÝ3 Í3 Ý 3 Å3 ñÁ 13 Í ñáðÙ ì 0.5-1Ù Èçxáí: ¶3 µµñáðçó ..
µñ3 äll3 Í áóÝçó 500Ù-åðÙ · Í Ýáð 3 Å3 ñÁ ëi 3 óí 3 Í ì Ñç1ñá-ç»ñÙ3 0çÝ Í3 ½ùç .. Í3 éáðóí 3 Íùç
÷ á÷á ÈáðÄñáðÝçó: 2Å3 ñÁ 3 Í1 Í 3 ñ3 ÍùáðÙ 13 eÝáðÙ ì Í3 13 0çÝ 3 Å3 ñ Í3 Ú µñáðñ»Ù3 Å3 ñ 3 Å3 ñç
Í 3 ½ùç .. Í3 éáðóí 3 Íùç ÷ á÷á ÈáðÄñáðÝçó: Đ3 Ù3 03 0Ý »ñí ñ3 µ3 Ý3 Í3 Ý Ñ»í 3 ½áíí áðÄñáðÝY»ñçÝ ..
ù13 0çÝ Éáðë3 ÝÍ3 ñÝ»ñç Ú»í Ý3 µ3 ÝáðÙÝ»ñçÝ, 3 ÍÝ ùÝÝ3 ñí Í áðÙ ì áñå»ë Ú»í Ú3 eëßí 3 µç éäð3 Ýù
(1,000Ù Э3 0ÝáðÄñáðÝ * 500 »ñí 3 ñáðÄñáðÝ), áñÁ 3 Ýò3 ÉáðÙ 3 Í Íçí Í »ñåáí 0..3 Í áñí »É ì
Ñç1ñá-ç»ñÙ3 0çÝ Ú»í 3 Ùáñýçí · áí áðÙ: éñ3 Ýçó Ñ»í á »ñí ñáñ13 Í3 Ý éäð3 ÝùÝ»ñ »Ý 0..3 Í áñí »É 3 Íë
Ú»í Ú3 eëßí 3 µç éäð3 Ýù3 0çÝ Ñ3 Í 13 Í áðÙ: 1 »ñçÝ · ðáðÖç Ñ3 Ù3 ñl3 µáéñá í Ý»ñÁ í »Ø3 µ3 ßËí 3 Í »Ý
Ú»í Ú3 eëßí 3 µç éäð3 Ýùç Ñ3 Í 13 Í áðÙ .. 1 Ý3 ëi 3 Í »Ý ñáðÖç Ýëi »Éáð Ñ»í ..3 Ýùáí :.

5.1.2 General Geology and Landslide

Generally, Paleogene volcanic rock and volcanic sedimentary rock are widely distributed. In the area, basaltic tuff breccia is distributed as basement rock and gabbro-porphyrite is found in the basement rock as intrusive rock.

Gabbro is found in the south-west of the upper village. The gabbro can be observed in old sand mine on the upper village. The gabbro is distributed in the N60W direction. The geological structure of this area shows N40W - 70W. This structure is parallel with Sevan fault that runs through north of Sevan Lake. Landslide deposit that consists of silt sand with 0.5m to 1m boulder covers the basement rock. The rock in the range of 500 m from boundary of the gabbro and the tuff breccia is received hydro thermal alteration. The rock in the zone becomes clayey rock or crystalline rock by the alteration. According to the result of the geological study and aerial photograph interpretation, it is considered that big scale landslide (1,000 m wide * 500 length) happened on the hydrothermal metamorphic zone in the past. After this, secondary landslides have happened in the big scale landslide block. Almost all the houses of the upper village are located on the big scale landslide block, and are damaged by land subsidence.

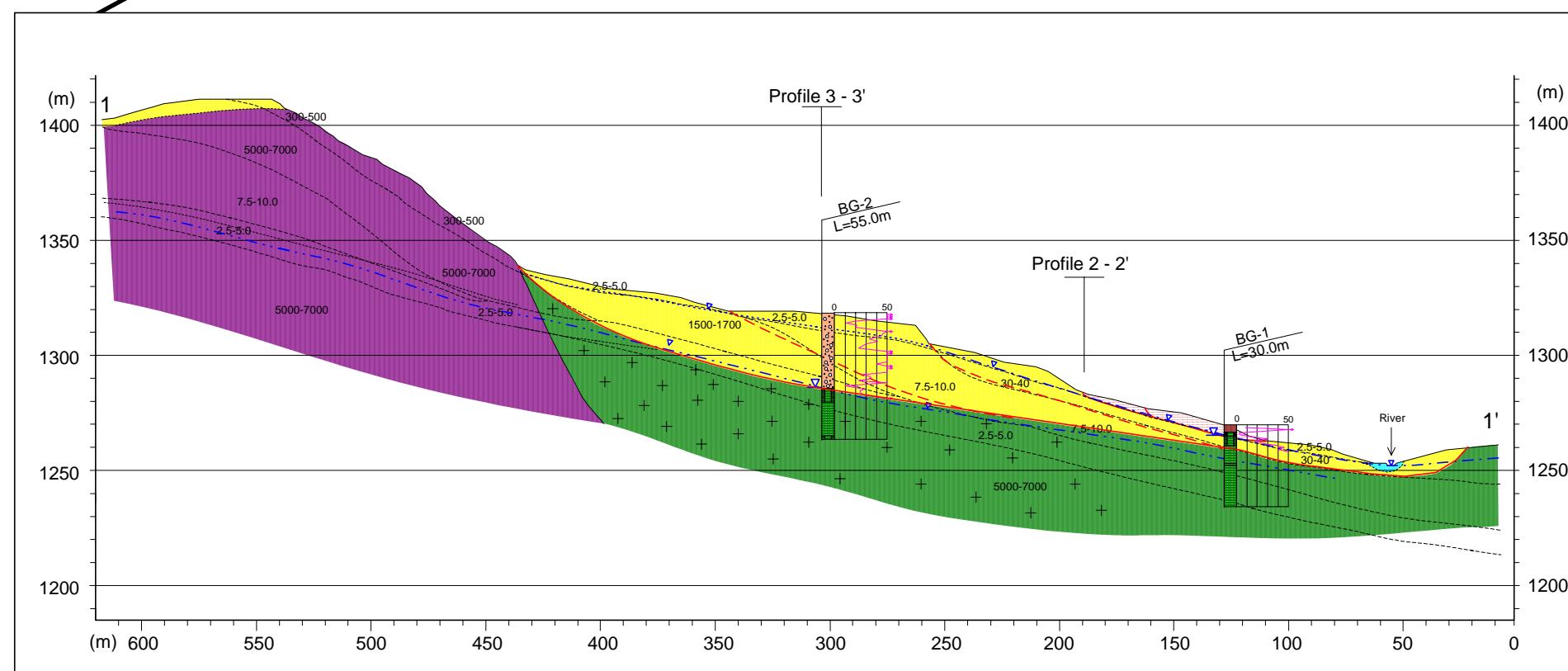
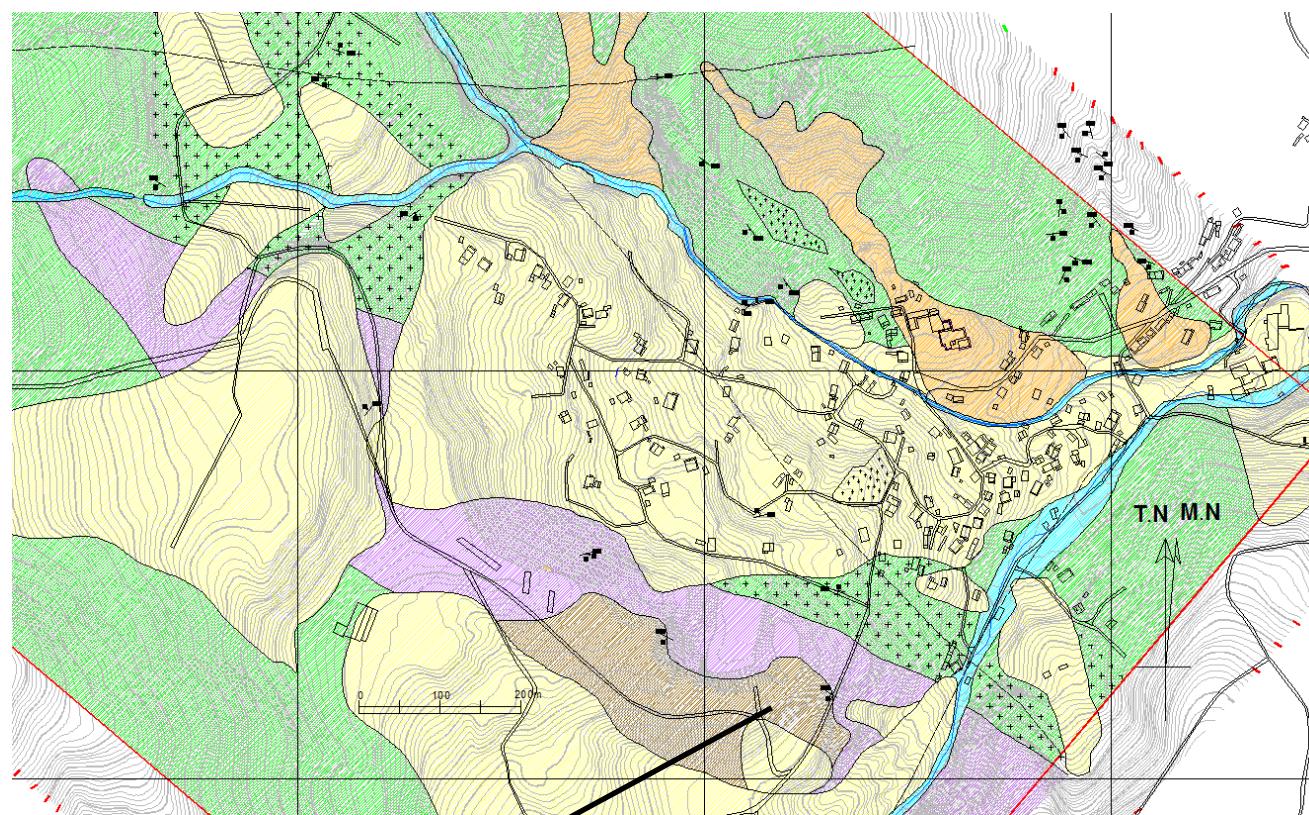


Figure 5.1.2 **ÆÝÁÇÝ»ñ³ Ì³ Ý.-ññ³ ñ³ µ³ Ý³ Ì³ Ý Ø³ ññ »½ .. äñáýÇÉ**
Figure 5.1.2 Engineering Geological Map and Profile

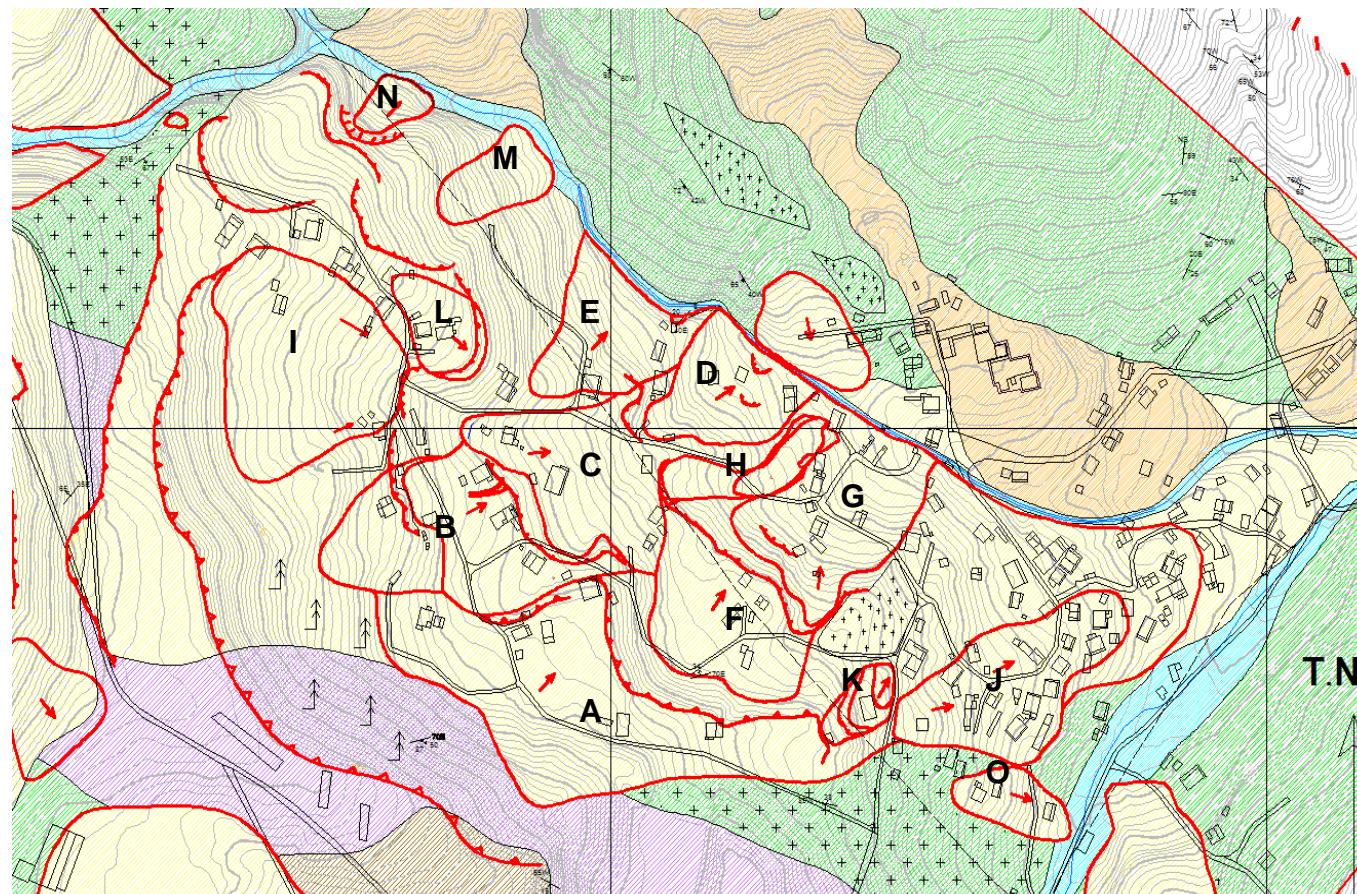
5.1.3 êáÓ³ ÝùÇ 2é³ çÝ³ ÙÝáoÃÙáoÝÁ

(1) êáÓ³ Ýù³ ÙçÝ Ð³ í ³ í ³ íç ¶áñÍ áõÝ»áõÃÙáõÝ

éáð³ Ýù³ ÙçÝ Ð³ Í ³ Íç Ø³ ñii »½ i óáðÙó ï i ñí ³ Í Üi³ ñ 5.1.3

éáÓ³ ŸuÇ ÜáÝÇí áñçÝ· Á, ÇÝåá»é ïùëi »Ý½áÙ»í ñÝ , B³ ñÁ³ Í³ Y T ³ Eí ³ I GPS I ³ ÚçÝ Ñ»í ³ ïái áoÅlláoÝÁ, áoÓ»I óí áoÙ i áoëáoÙY³ eçñí áO i ³ ñ³ ÍùáoÙ eáÓ³ ŸuÇ · áñÍ áoÝ»áoÅlláoÝÁ ÇU³ Y³ Éao Ñ³ Ù³ ñ: ïùëi »Ý½áÙ»í ñÁ ÜáÝÇí áñçÝ. i ³ YáoÙ B, C, F, H, J K eáÓ³ Ÿu³ ÚçÝ Ñ³ I ³ ÍY»ñC · áñÍ áoÝ»áoÅlláoÝÁ: ²lë ÜáÝÇí áñçÝ. Ç I ³ Ù³ ÉY»ñA ¹Çí ³ ñIÍ »E »Ý ÜáI 12 ³ Ùçé 2004Á. ¹»I I »Ùµ»ñCó èëë³ I: Åeí YlláoÃ»ñC, B³ ñÁÁ eáÓ³ ŸuÇ Ñ³ I ³ ÍY»ñC, µ³ óç H J Ñ³ I ³ ÍY»ñCó, óáôló ã»Ý I ³ Eçë B³ I Ù»Í B³ ñÁ` ûñ³ I ³ Y 1ÙÙ-çó ûçä: I ³ Y 5 ïùëi »Ý½áÙ»í ñY»ñ H eáÓ³ Ÿu³ ÚçÝ Ñ³ I ³ ÍáoÙ: ïùëi »Ý½áÙ»í ñY»ñC I ³ Ù³ ÉY»ñA óáôló »Ý I ³ Eçë Ù»Í B³ ñÁ»ñ` ³ é³ I »E³ · áoÅlláoÝÁ 20ÙÙ ûñ³ I ³ Y ³ Ø³ ñI ÇY ÖÝÑ³ ÉC e»½áÝÇÝ ÜçççÝÁ 5ÙÙ ûñ³ I ³ Y:

Þ³ ñÅ³ Í ³ Ý Í ³ ËÍ ³ ÍÝ»ñÁ ÇÝëi ³ É³ óí ³ Í »Ý C, G, H „ K ëáÖ³ Ýù³ ÙçÝ Ñ³ Í ³ ÍÝ»ñÇ ÜáÝÇi áñÇÝ. Ç Ñ³ Ù³ ñ: 2ñ1ÜáöÝùáðÙ, C ëáÖ³ Ýù³ ÙçÝ Ñ³ Í ³ Á óáðló ï ³ Éçë 1.5ÙÙ ûñ»Í ³ Ý ß³ ñÅ, „ H ëáÖ³ Ýù³ ÙçÝ Ñ³ Í ³ Á óáðló ï ³ Éçë ½³ Éçí ³ Ùñ „ ÍáØñç Ù³ ö»ñáðÙ ÙçççÝÁ 20ÙÙ ûñ»Í ³ Ý: G „ K Ñ³ Í ³ ÍÝ»ñÁ óáðló »Ý Í ³ Éçë ÙçççÝÁ 1ÙÙ-çò ùçâ ûñ»Í ³ Ý ß³ ñÅ:



5.1.3 Priority of Landslide

(1) Activity of Landslide Block

Landslide Block Map is shown in Figure 5.1.3.

Landslide monitoring as extensometer, movable board and GPS point survey is conducted to know landslide activity in the study area. Extensometer is monitoring B, C, F, H, J and K landslide block activity. These monitoring data are obtained about 12 months from December 2004. As the data, movement of the landslide blocks except H and J blocks do not shows striking movement as less than 1 mm per day. There are 5 extensometers on H landslide block. The data of the extensometers show a striking movement as 20 mm per day maximum and 5 mm per day average in March “snow melting” season.

Movable boards are installed for monitoring C, G, H and K landslide block activity. As the result, C landslide block shows 1.5 mm per day movement, and H landslide block shows 20 mm per day average at scarp part and side scarp part. G and K block shows less than 1 mm per day average movement.

GPS point survey is monitoring A, B, C, D, E, F, I, J, L and M landslide block. The points have been installed at places where it is hard to install other monitoring instruments. As the result, all data show less than 2 mm per 2 months. Therefore, striking movement has not been recorded.



Ակտիվ սողանքային զանգվածի ընդհանուր տեսքը

Ակտիվ սողանքի զլիամասը
Զմունը բնակիչները չեն փակել
օրամատակարարման խողովակի
փականը, և ջուրը շարունակաբար հնաել
է այգում:

Զրի հոսքը փափկացրել է հողը, և
սողանքային զանգվածը ծանրացել է:
Այսպիսով, շրի հոսքը դարձել է սողանքի
ակտիվացման պատճառ:

General view of the active landslide block in Gosh Village

(February 20, 2005)

Head/scarp of active landslide.

In winter, the resident doesn't close faucet tap for the freeze proofing of water supply pipe and power throw water the garden continuously. The seepage water softens the ground and sliding force grows by saturated depleted mass becoming heavy.

Thus, the seepage water has activated the landslide.

5.1.4. èÇëÍÇ ûµÛ»ÍÍ Ý»ñÁ

Úáðñ³ ù³ Ýáðáðñ eáð³ Ýù³ ïçÝ Ñ³ i³ Í³ Ý»ñáðÙ T³ Y µÝ³ T³ »ÉC i³ Ý»ñ, ÙB³ T³ áO¹³ B³ »ñ .. Ùáðñ³ Ùççç
 x³ Ý³ á³ ññÝ»ñ: „Áí³ ñ i³ é³ çÝáðñáðóY i³ É i³ Ý»ñçÝ .. ÙB³ T³ áO¹³ B³ »ñçÝ: ¶Ùáðñ³ Ùççç µáéáñ
 x³ Ý³ á³ ññÝ»ñ Á a»i³ ù i³ ÉçÝ»Ý T³ ñ³ áñ, µ³ ïó 1çí³ ñi³ í³ Í x³ Ý³ á³ ññÝ»ñ Á³ i³ »ÉC T³ ñ³ áñ »Ý:
 Ö³ Ý³ á³ ññÁ Ññ³ á³ ñ³ T³ ñ³ 1»áç³ i³ ½C Ñ³ ÝùÁ³ YóÝáðÙ i³ J eáð³ Ýù³ ïçÝ Ñ³ i³ Íáí, Ö³ Ý³ á³ ññÁ
 Ññ³ á³ ñ³ T³ ñ³ 1çó³ ÚçÝá .. I eáð³ Ýù³ ïçÝ Ñ³ i³ Íç³ Y»ñùçÝ Ù³ èA³ YóÝáðÙ i³ F, H, C .. b eáð³ Ýù³ ïçÝ
 Ñ³ i³ Í³ Ý»ñáí: èllë x³ Ý³ á³ ññÝ»ñ Á u³ i³ . áñÍ³ »É »Ý µÝ³ T³ çäÝ»ñç TáðÙçó .. Ñ½áñ µ»éÝ³ i³ ñÝ»ñç
 TáðÙçó³ i³ »ÉC Ñ³ x³ È³ T³:
 eáð³ Ýù³ ïçÝ Ñ³ i³ Í³ Ý»ñç³ é³ çÝ³ ÙÝáðñáðóY Á añáðB³ i³ i³ »ñÁ Yßí³ I ÈÝ¹ ÇñÝ»ñáí añå»e³
 eáð³ Ýù³ ïçÝ éçëéT³ ûµÛ³ T³ Ý»ñç³ . áñÍ³ áðóY»áðñáðóY .. T³ ñ³ áñáðñáðóY: 2ñ³ ÙáðñáðÙ, H eáð³ Ýù³ ïçÝ
 Ñ³ i³ Í³ Á³ 1çí³ ñi³ i³ i³ i³ añå»e³ µ³ ñòñ³. áññÝ³ é³ çÝ³ ÙÝáðñáðóY: (2ñ³ Ùáðñ³ 1.5.1.1):

200áðe3 ū 5.1.1 éáð3 Ýù3 ÞCÝ Ñ3 ū í3 ÍÝ»ñC 3 é3 cÝ3 ÞÝáðAÞáðÝ

éá0³ Y ù³ ÙçÝ Ñ³ i í 3 í	211 Çí áóÁlláóYÁ			úµ»11 Ç á³ Nå³ YáóUA	úµ»11 Ç í³ ñ áñáó ÁlláóYÁ	í³ ñ· A
	%í ei »Y%á- Ù»í ñ	b³ ñA³ í ³ Èí ³Í	GPS Ñ»í ³ %á- í áóÁlláóYÁ			
A	àá ³ 11 Çí	àá ³ 11 Çí	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	C
B	5	àá ³ 11 Çí	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	C
C	5	4	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	B
D	àá ³ 11 Çí	àá ³ 11 Çí	5	í áóY, 1³ YÙ, x³ Ý³ á³ ñÑ	b³ í µ³ ñÓñ	B
E	àá ³ 11 Çí	àá ³ 11 Çí	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	ØÇçÇÝ	D
F	5	àá ³ 11 Çí	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	C
G	àá ³ 11 Çí	5	àá ³ 11 Çí	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	C
H	3	3	àá ³ 11 Çí	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	A
I	àá ³ 11 Çí	àá ³ 11 Çí	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	C
J	4	àá ³ 11 Çí	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	í³ ñÓñ	C
K	5	5	àá ³ 11 Çí	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	ØÇçÇÝ	D
L	àá ³ 11 Çí	àá ³ 11 Çí	àá ³ 11 Çí	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	ØÇçÇÝ	D
M	àá ³ 11 Çí	àá ³ 11 Çí	5	¶»í , 1³ BÍ , x³ Ý³ á³ ñÑ	ò³ Íñ	E
N	àá ³ 11 Çí	àá ³ 11 Çí	5	¶»í , 1³ BÍ , x³ Ý³ á³ ñÑ	ò³ Íñ	E
O	àá ³ 11 Çí	àá ³ 11 Çí	5	í áóY, 1³ BÍ , x³ Ý³ á³ ñÑ	ò³ Íñ	E

1	Øáí 4ÜÙ/Å (Øáí 56ÜÙ/ùñ)
2	Øáí 2ÜÙ/Å (Ùáí 48ÜÙ/ùñ)
3	Øáí 10ÜÙ/ùñ
4	Øáí 5 ÜÙ/ùñ
5	1ÜÙ/ùñCó ÙCá

5.1.4. Risk Object

There are residential houses, cultivated field and village roads on each landslide block. It is difficult to make prioritize houses and cultivated fields. All village roads also should be important, but the following roads are considered to be more important;

The road from the square to sand mine passing through J landslide block, the road from the square to bottom of I landslide block passing through F, H, C and b landslide block. These roads are frequently used by residents and heavy duty trucks.

Priority landslide block are identified by issues such as landslide activity and importance of risk objects. As the result, H landslide block is considered as the highest priority (Table 5.1.1).

Table 5.1.1 Priority of Landslide Block

Landslide Block	Activity			Conservation Object	Importance of the object	Rank
	Extensometer	Movable Beam	GPS Survey			
A	N.A	N.A	5	House, Field, Road	High	C
B	5	N.A	5	House, Field, Road	High	C
C	5	4	5	House, Field, Road	High	B
D	N.A	N.A	5	House, Monastery, Road	Very High	B
E	N.A	N.A	5	House, Field, Road	Moderately	D
F	5	N.A	5	House, Field, Road	High	C
G	N.A	5	N.A	House, Field, Road	High	C
H	3	3	N.A	House, Field, Road	High	A
I	N.A	N.A	5	House, Field, Road	High	C
J	4	N.A	5	House, Field, Road	High	C
K	5	5	N.A	House, Field, Road	Moderately	D
L	N.A	N.A	N.A	House, Field, Road	Moderately	D
M	N.A	N.A	5	River, Field, Road	Low	E
N	N.A	N.A	5	River, Field, Road	Low	E
O	N.A	N.A	5	House, Field, Road	Low	E

Activity	1	Over 4mm/hour (Over 56mm/day)
	2	Over 2mm/hour (Over 48mm/day)
	3	Over 10mm/day
	4	Less than 5mm/day
	5	Less than 1mm/day

NA Non Active

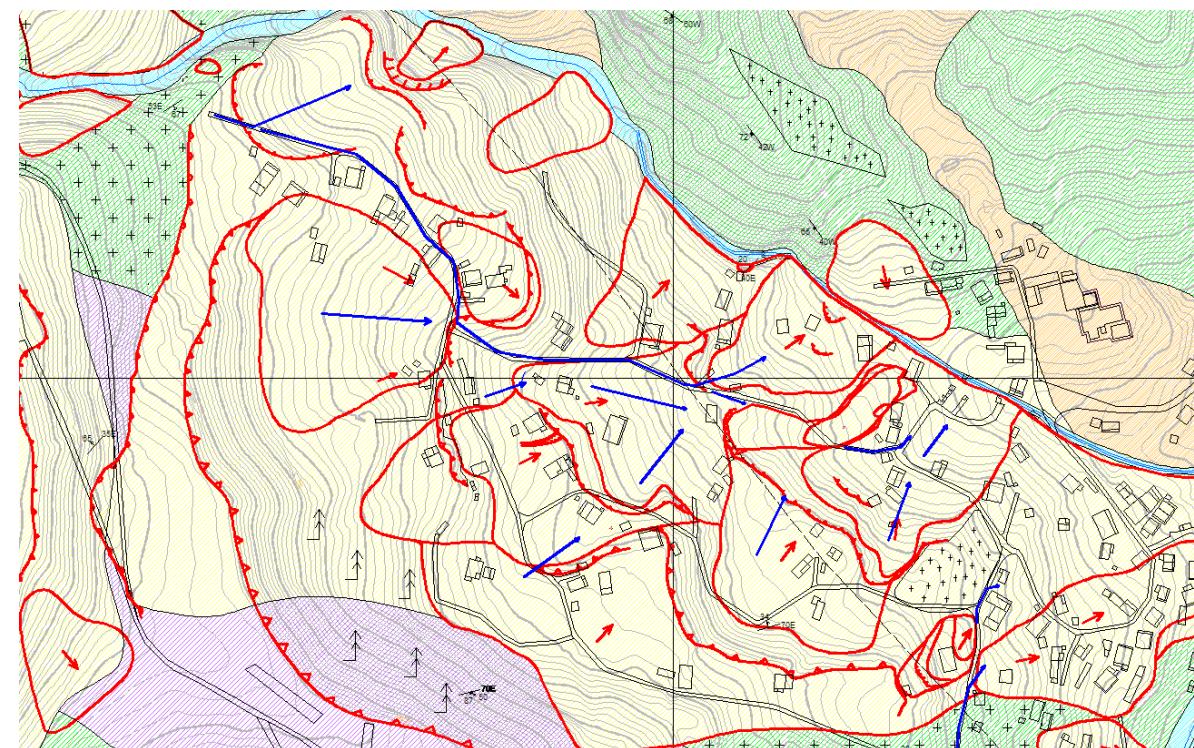
5.1.5 àéá· Ù³ Ý æñÇ ì Çx³ ī Á

»Í»Ý3 Á3 ÙÇÝ Ñ3 Ù3 T̄3 n̄. Á 1»é.. ÜB̄i 3 T̄3 Ȳ ãj muáEáñ i Ȳ»ñC Ñ3 Ù3 n̄ ÚÇȲ.. 3 ÙÅU: 2Ù1
å3 T̄ x3 éáí, i Ȳ»ñC Ñ3 Ù3 n̄l3 3 ÙmaÓç TálloÓ3 çñ»ñA .. 3 YÓñ.. 3 ÙÇY ûñ»ñCÝ
Ù3 T̄»e3 ÙÇY çñ»ñA NáeáoÛ »Y 3 ½3 i NáOÇ T̄3 Ù x3 Y3 å3 n̄NÝ»ñC Ín3 Ùlái: T̄3 Y
áñáB 1ñ»Y3 Á3 ÙÇY EáOáí 3 T̄Y»ñ T̄3 Ù NáOÇ Ñ»O»Ø3 i 3 n̄Y»ñ, µ3 Ùló éñ3 Yù µ3 13 h3 n̄
a»Y NáO3 ÙÇY T̄3 Ù x3 Y3 å3 n̄N3 ÙÇY í Çx3 T̄C å3 Ná3 YáoÁl3 Y Ñ3 Ù3 n̄: 2é13
1ñ»Y3 Á3 ÙÇY EáOáí 3 T̄Y»ñCó T̄3 çñC NáeùC Ñ3 13 Y3 T̄3 YáoÁláoY: 2é3 T̄
3 YÓñ.. 3 ÙÇY ûñ»ñCÝ T̄3 Ù ÓYñ3 ÉC e»%áYÇY, Ñ3 Ù3 n̄l3 3 ÙmaÓç çáoñA NáeáoÛ ?
x3 Y3 å3 n̄NÝ»ñáí T̄ »O3 1ñl3 1ñ NÇY 1ñ»Y3 Á3 ÙÇY Ñ3 Ù3 T̄3 n̄. C Ñ»i .. 3 Yúáí: 2Ù1
å3 T̄ x3 éáí, 3 éáo ? 3 é3 ç3 ó»É x3 Y3 å3 n̄NÝ»ñCÝ: éáí áñ3 µ3 n̄ NáeáoÛ ? Y»ñ
x3 Y3 å3 n̄NÝ»ñC 3 éí áí, NáOÇ Ñ»O»Ø3 i 3 n̄Y»ñáí T̄3 Ù 3 é13 1ñ3 Y3 Á3 ÙÇY
EáOáí 3 T̄áí, µ3 Ùló çáoñA Ñ3 x3 E Á3 ÷i áoÛ ? 1áoñë.. x3 Y3 å3 n̄NÝ»ñCÝ T̄3 Ù NáOÇY,
ñáá»3 T̄3 Y 3 é3 i 3 YÓñ.. C Á3 Ù3 Y3 T̄ (ÜT̄3 n̄ 5.1.4): O3 Y3 å3 n̄NÁ, áñA · ÙáoÓC
Ñ3 Ù3 n̄ T̄3 n̄.. áñ »YÁ3 T̄3 éáoÓi 3 lù . . i Yí áoÛ ? çñC 3 ½1»óáoÁl3 Y T̄3 T̄
1ñ»Y3 Á3 ÙÇY Ñ3 Ù3 T̄3 n̄. C 3 YI 3 i 3 náoÁl3 Y Ñ»i .. áYùáí: AÉYáå»ë Y3 .., çñC NáeùA
1Ci 3 n̄l3 3 i ? eáO3 Yù3 ÙÇY 3 T̄i Ci áoÁl3 Y i »Y1»Yó: D3 i T̄3 å»ë, i Y»ñC
TálloÓ3 çñ»ñA, áéá.. Ù3 Y çáoñA .. x3 Y3 å3 n̄NÝ»ñC Ù3 T̄»ñ»e3 ÙÇY çñ»ñA
Ñ3 Ùl3 3 µ»ñi 3 l »Y çñ3 Ñ»é3 óÙ3 Y i 3 n̄l3 lùáoÛ, H Ñ3 i 13 lC Ñ»i .. áoÛ, áñA 3 Ùlë
i 3 n̄l3 lùáoÛ . Y3 Ñ3 i 13 l ? áñá»ë µ3 n̄Oñ3. áoÝ 3 é3 çY3 ÙYáoÁl3 Y eáO3 Yù: 2Ùë
çáoñA T̄3 náO ? 3 ½1»É H eáO3 Yù3 ÙÇY Ñ3 i 13 lC 3 T̄i Ci áoÁl3 Y i 1ñ3:

5.1.5 Water Drainage Condition

Water supply system for all houses in this area had been adopted in 1974 to 1978. In the present, almost all system, however, had not been worked soon after installation due to problem of water supply tank. The water supply pipe is still remained under ground without maintenance.

Drainage system is not maintained to all houses yet so far. Therefore, almost all sewage water from houses and surface water in rainy day flow freely on ground or road. There are some drainage pipes or soil ditch, but these are not enough for conservation of ground or road conditions. There are possibility water leakages from existing drainage pipe. In heavy rainy day or snow melting season, almost water flow down on road due to the old drainage was installed on the road. Therefore, galley is developed on the road. Ordinary water flows down on the galley of road, soil ditch or existing drainage pipe, but the water often overflows on the road or ground in momentary heavy rain time (Figure 5.1.4). The road that is important infrastructures for the village is under the influence by water due to imperfection of drainage system. And also, the water flow is considered to affect landslide activity. Especially, Sewage water from houses, irrigation water and surface water on road are found on catchment area ,behind H block that is evaluated as the highest priority landslide in this area. These water would affect to H landslide block activity.



Ül 3 n 5.1.4 àéá. Ù³ Ý æñC 1 Cx³ TÁ

Figure 5.1.4 Water Drainage Condition

5.1.6 ՀԻՒ ԾԻ ԵԱՅՈՅ

Í እ³. ነፋዂ ጋንግዴ ተሸጥ የአዎን ፍቃድ ስርዓት አውጭ የሚያስፈልግ ነው፡፡

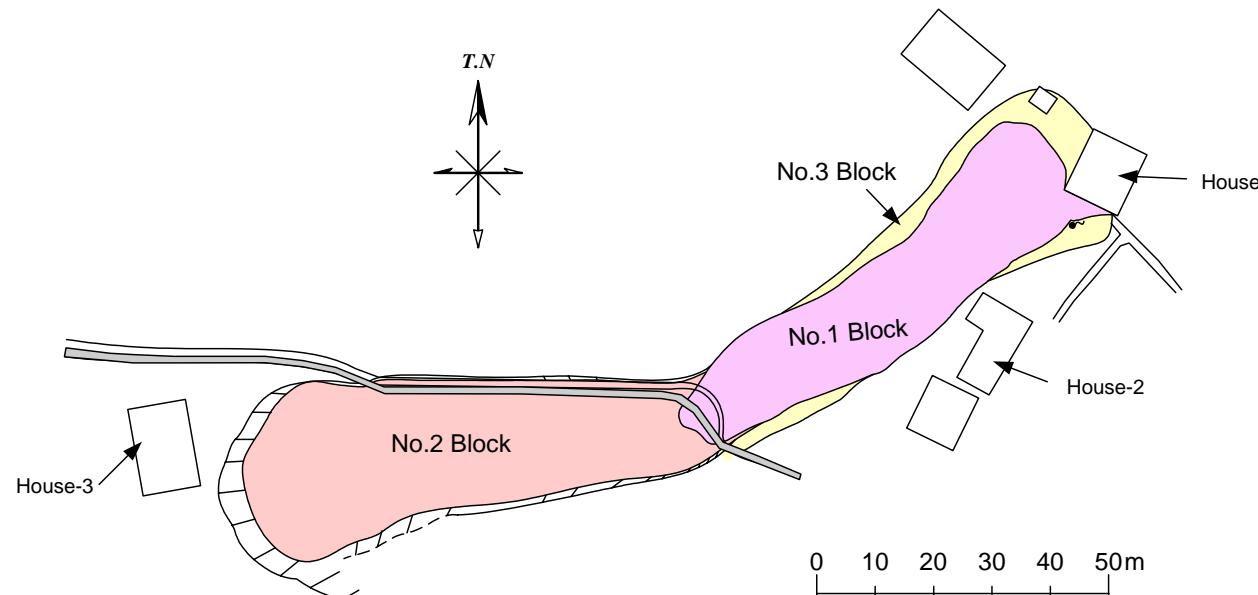
H eáð 3 Ÿu3 ðlçý ñ3 i 3 l Á µ3 Å3 Ý1 3 l { 3 ñ3 i 3 l Ý»ñç, CÝaå»ë óáðló { i ñí 3 l Ýl 3 ñ 5.1.5-áðló l) êi áñçý ð3 i 3 l (No 1 .. No 3 ñ3 i 3 l Ý»ñ)

éi áñcý Ñ³í í³ Á u³ Å³ ýí ³ í i 2 Ñ³í

el ançý N-1 T-T-A μ-A-YY-1 i 2 N-1 T-T-Y»ñç, çıraðæe No.1 No.3-A: Þ-Ü-Ü-Ü-Ü
ÜáYÇI áñç. ç 3 níláðÜñY»ñç, No.1 N³TÍ 13ÍÁ 3Í »ÉÇ 3Í ÇÍ i , ù³ Y No.3-A: T³ Y B³T
Eí 3 óí 3Í x³ù»ñ No.1 N³TÍ 13ÍÇ ÜCÇÝ³ Ü3 éáðÜ: Ü»ñTÍ 3 láðÜë éáð³ ÜY³ ÜÇY N³TÍ 13ÍÁ
B÷ÍáðÜ i T áðY-2-Ç ã³T Ç N»í : T áðY-1-Á, áñÁ T »Ó³μ³BÉÍ 3Í i Ó³³ ÷áEÍ 3Í N³TÍ 13ÍÇ
eí áñçY Ü3 éáðÜ .. áðYÇ B³T x³ù»ñ` éáð³ ÜY³ ÜÇY N³TÍ 13ÍÇ xÝBÜ³ Y N»í .. ÜùáÍ
%üeí »Ý%áÜ»í nç ÜáYÇI áñç. 3 ÜÇY Tí 1Ü³ EÝ»ñA` éáð³ ÜY³ ÜÇY N³TÍ 13ÍÇ eí áñçY Ü3 eç, óáðñó
T 3 EÇé éáðÜí 3Í B³ nÅ: Đ3T T 3 ã»é, T T 3 EÝ»ñA óáðñó »Ý T 3 EÇé, áñ B³ nÅÁ 3Í ÇÍ 3 YáðÜ
í 3 Õ. 3 nÝ³ YÁ (ÓÝN³ EÇ e»%áYÇY):

II) ī »ñÇÝ Đ3 ī ī 3 ī (No.2 Ñ3 ī ī 3 ī)

Î 3 Ý Ó. î 3 Í x³ Ù»ñ .. Ü3 ÙéçÙáôÙ 2Ù μ³ ñÙñáôÙ³ Üµ ½3 éÇÃ³ ÷ No.2 Ñ³Í î 3 ÍáôÙ: Đ3Í î 3 Íç
TáÔÙÝ³ ÙçÝ Ü3 eáôÙ Ñ³Ùí Ý³ μ»ñí 3 Í »Ý Ñei 3 Í ½3 éÇÃ³ ÷»ñÁ: ¼3 éÇÃ³ ÷»ñç î ñ³
Ñ³Ùí Ý³ μ»ñí 3 Í i Ñ³Ù»É3 ÙçÝ Ü3 Í»ñáôÙ, áñÁ óáôÙó i î 3 Éçë 15 3 eï çx³ Ý 1»åç
Ñ³ñÙ³ î 3 Ùñç TáÔÙA: Đei 3 Í Ñ³Ùí Ý³ μ»ñí 3 Í i Ý³ .. eáÔ³ Ýùç . ÉE³Í »ñç ½3 éÇÃ³ ÷ Á
eáÔ³ Ýùç 3 ÍÍ Çí áôÙ³ Ý»ñ .. Ýùáí ½3 éÇÃ³ ÷ Á Ó. î áôÙ i 1»åç Ñ»ñ .. Ü»ñí 3 ÙáôÙë, áî 3 Ý
Eáßáñ 1»ñÙ³ óç³ Ý»ñ î áôÝ-3-ç î ñ³: AEÝáçó, î áôÝÁ Ùáí 3 á³. 3 ÙáôÙ TÍ Ý³ eï ç
%ùëi »ÝÙáÙ»ñç ÙáYçí áñç. 3 ÙçÝ î 1Ù³ ÉÝ»ñÁ eáÔ³ Ýùç Ñ³í î 3 Íç . ÉE³Ù³ eç, óáôÙó i
î 3 Éçë Ó. î 3 Í B³ ñÙ: Đ3Í î 3 ã»ë, î 1Ù³ ÉÝ»ñÁ óáôÙó »Ý î 3 Éçë, áñ B³ ñÙ³ î 3 Íç
. 3 ñÙ³ ÝÁ (ÓÝÑ³ Éç e»ÙáYçÝ), ÝáôÙÁ ÇÙáã»ë %ùëi »ÝÙáÙ»ñç ÙáYçÝ Ñ³í î 3 Íç
eï áñçÝ î 1»ñç³ í áñáôÙ³ Ý:



ÜÍ³ ñ 5.1.5 2ÍÍ ÇÍ éáØ³ Ýù³ lÍçÝ Ð3Í Í 3Í H Ð3Í Í 3Í

Figure 5.1.5 Active Landslide Block H Block

5.1.6 Active Landslid

In the project, the simple countermeasure is planned to mitigate H landslide block activity mainly.

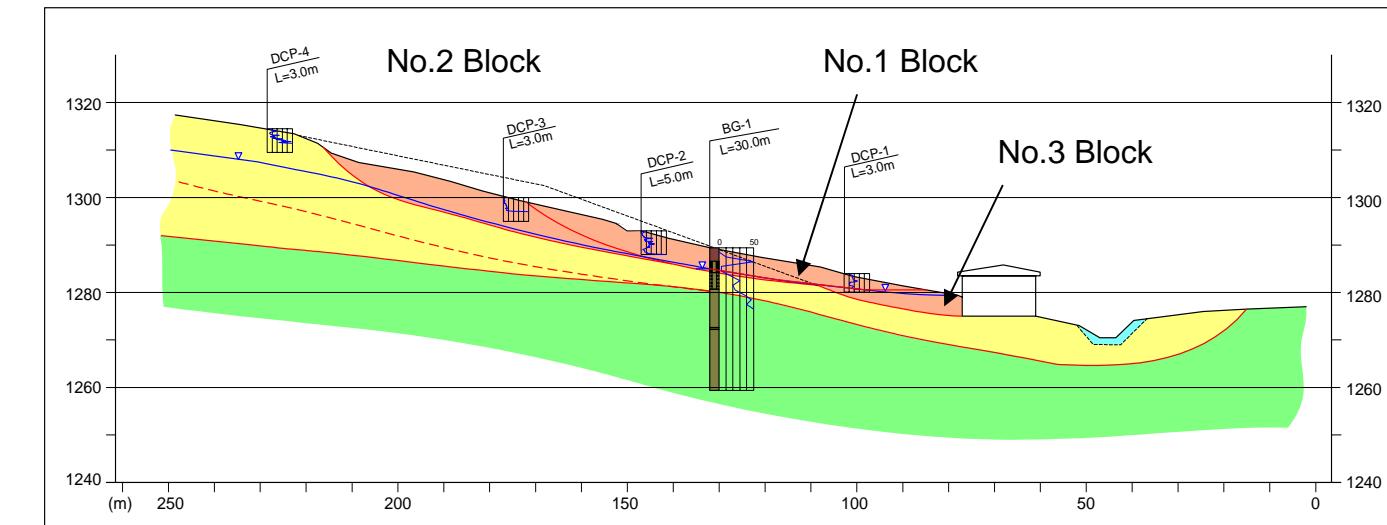
The H landslide block is divided 3 blocks as shown in figure5.1.

I) Lower Block (No.1 and No.3 block)

The lower block is divided 2 blocks as No.1 and No.3. According to the result of monitoring, No.1 block is more active than No.3. There are many compressive cracks on middle part of No.1 block. The landslide block is contact with House-2 wall in the present. The house-1 that is located on toe part of the block deformed and has many cracks due to pressure of landslide block. Monitoring data of extensometer on toe part of the landslide block shows compressibility movement. Especially, the data shows that the movement becomes active in early spring (snow-melting season).

II) Upper Block (No.2 block)

There are tension cracks and max 2m height scarp in the No.2 block. On the side of the block, scarps are found clearly. Slickenside whose strike shows 15 degrees to valley side is found on the scarps. Scarp on the head part of landslide also is found clearly. The scarp is extending to behind due to landslide activity. In the present, there are not major deformations on house-3. However, the house also will be damaged in near future. Monitoring data of extensometer on head part of the landslide block shows tensional movement. Especially, the data shows that the movement becomes active in early spring (snow-melting season) same as extensometer on toe part of landslide block.



ÜÍ³ ñ 5.1.6 2ÍÍ ÇÍ éáÓ³ Ÿu³ ÙçÝ Ð³Í Í 3Í H Ð³Í Í 3Í Ç äñáýçí
Figure 5.1.6 Profile of Active Landslide Block H Block

5.1.7 ä³ ñ½ Đ³ ī³ éáõ³ ýú³ üçý ùççáó³ éáõl

(1) ĐÇÙÝ³ Ė ³ Ý Ø³ Ø³ Ù³ Ė ³ ÝáºÃÙáºÝ

ĐáÓC Ủ³ T»»ëÇ çñ»ñC Ý»ñNáëùÇ Ñ»T ³Ýùáí, eëi áñ»ñT ñÙ³ çñ»ñC Ủ³ T³ ñ¹³ TÇ µ³ ñØñ³ óÙ³ Ủµ¹ÇT ³ñTÍ áðÙ ïëáÓ³ ÝùÇ ³TÍ ÇÍ áðÅÙ³ ÝÁ å³T x³ ÉA:

(2) Ø³ Í »ñ.. áóñÙ³ ÙçÝ .. ñ»Ý³ Å³ ÙçÝ æÉ³ Ýç Í ³ ñ.. áñ ÜßáøÙ

- „ñ»Ý³ ÅÇ ī »ë³ ī ï »õ»É ÙÇ 1ñ»Ý³ Å, áñÅ áðÝÇ ×íáðÝ ī³ éáðóí 3 í ù Ñ³ ī³ é³ ī ëáð³ Ýùç ß³ ñÅçÝ
áñå»ë 1ñ»³ Å³ ïçÝ . »í Ý³ Ýòú:
 - ĐçÙÝ³ ī³ Ý 1ñ»Ý³ ÅÅ »õ»É ï »õ³ 1ñí 3 í No.2 Ñ³ ī 1³ ïç Ñùáðéçë³ ïçÝ Ù³ ëáðÙ, áñÝ 3 Ýóñáí
ùñ»ñçÝ áðÝÇ çñ»ñç Ñáëù»ñ, ī³ Ý áä ß³ ī 0³ ÷ á ÈáðÅùáðÝÝ»ñ` Ñ³ Ù»Ù³ ī 3 í Ùùáðé Ù³ ë»ñç Ñ»í : °Å»
ÑçÙÝ³ ī³ Ý 1ñ»Ý³ ÅÅ ī »õ³ 1ñí 3 í ëçÝ»ñ ÑçÙÝ³ ī³ Ý Ñ³ ī 1³ ïç ī »ýí ñáÝáðÙ, 3 ïÝ 3 Ýùçç³ å»ë
ÍÍÝ³ ëí »ñ Ñ³ ī 1³ ïç ī »ýí ñáÝáðÙ · ī ÍÍ áð ëáð³ Ýùç »ÝÅ³ É³ Ýç»ñç Ñ»í ³ Ýùáí :
 - Đ³ ī 1³ ÍáðÙ 3 Ýóñçó Ñ»í á ³ çñ³ ÕµùáñÝ»ñçó çñç Ñáëùç 1ñ»Ý³ ÅÇ áðóçÝ åÈ³ Ý³ Íáñí 3 í ï
»õ»É ÙÝ³ ñí Ù³ Ý Ù»ç:
 - æñ³ Ñ³ Í 3 ù 3 Í 3 ½³ ÝÝ»ñÅ ī »õ³ 1ñí 3 í »Ý ÑçÙÝ³ ī 3 ÝáðÙ Ùáðñ³ ù³ Ýùáññ 30Ù-Á:
æñ³ Ñ³ Í 3 ù 3 Í 3 ½³ ÝÝ»ñÅ ī »õ³ 1ñí 3 í àÝ ëáð³ Ýù³ ïçÝ Ñ³ ī 1³ ÍáðÙ:

5.1.7 Simple Countermeasure

(1) Basic Policy

Landslide activity is thought to be caused by increasing of groundwater level due to inflow of ground surface water because of the following issues.

- The area where the landslide happened has formed a drainage basin by broad view of the landform. The any traces of ground surface water flow are not found near the old woman's house that is located on the upper part of No.2 block. On the other hand, some traces of water spring or water flow are found under the scarp of No.2 block.
 - Water flows on the road on the northern part of No.2 block during rainy day. The water flow reaches until No.1 and No.3 block.
 - Even during days without rain, water springs and swamps are found on No.1 and No.2 blocks. In rainy days, spring water quantity increases and some water springs are found on other places also.
 - The result of monitoring shows active movements during rainy season and snow melting season.

As the above mentions, groundwater level is usually high in these blocks, and the groundwater level increases further due to much ground surface water inflow during the rainy season and the snow melting season.

Therefore, surface drainage to avoid the water that infiltrates into the landslide block, and horizontal drainage to discharge the water that infiltrates into landslide blocks are planned for the countermeasure.

(2) Important Notice of Surface Drainage Plan

- The drainage should be of a type that has flexible structure against landslide movement, such as a drainage culvert.
 - Main drainage has been installed on the north part of No.2 block that has water flows during rainy days, and where there are not many deformations compared with other parts. If the main drainage was installed at the center of the block, the drainage would be damaged immediately due to many sub-scarps of landslide at the center of the block.
 - The route of the drainage has been planned taking into consideration the water flow route after rain and the situation of water springs on the block.
 - Catchment pits have been installed of at least each 30 m in diameter.

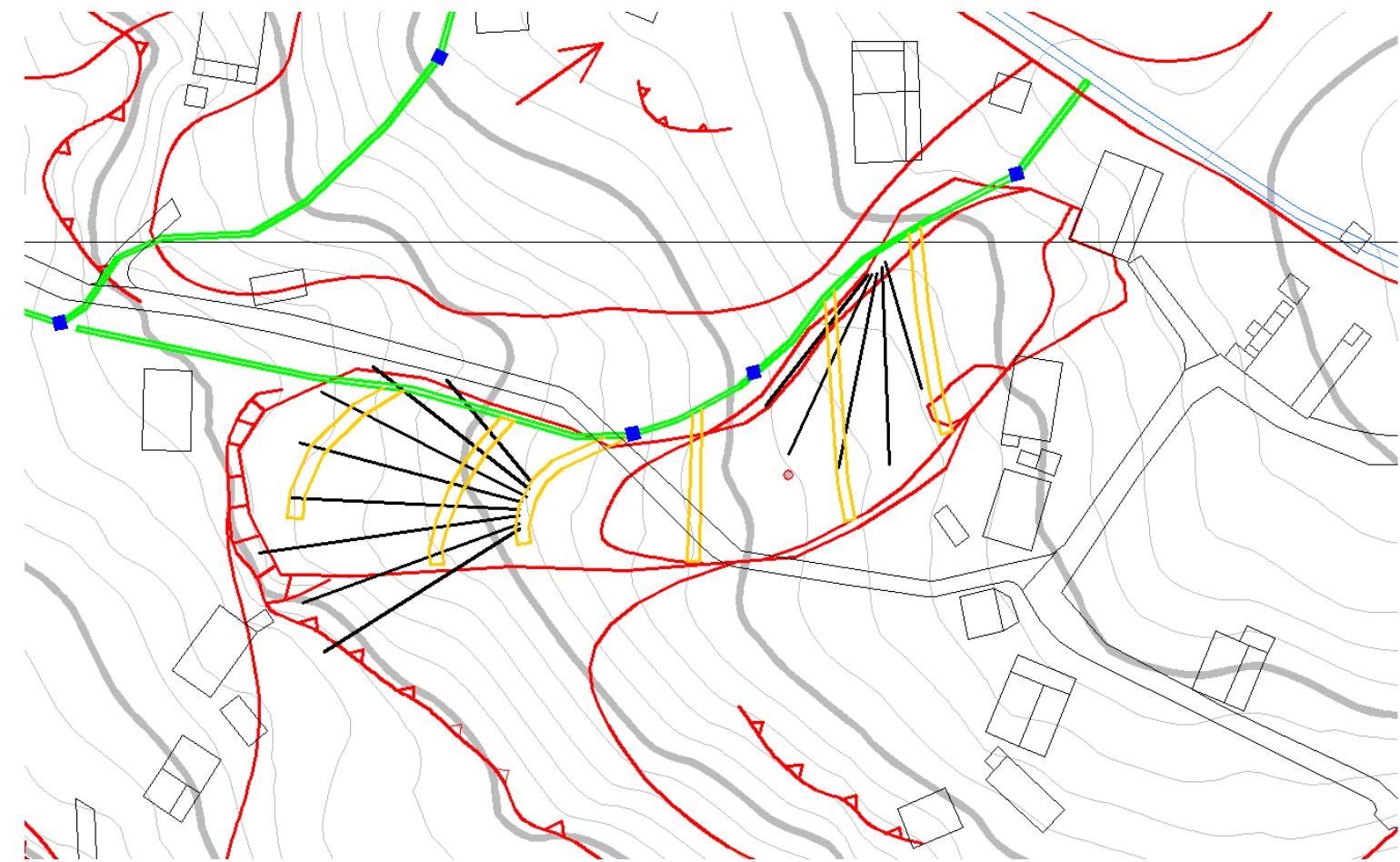
Catchment basin has not been installed on the landslide block.

(3) ĐáñÇ½áÝ³ Ŧ³ Ý „ñ»Ý³ Å³ lÇÝ Đáñ³ Ŧ Ù³ Ý Ŧ³ ñ„áñ ÜBáøÙ
 ĐáñÇ½áÝ³ Ŧ³ Ý 1ñ»Ý³ Å³ lÇÝ Náñ³ Ŧ³ ÝóÙ»ñÁ Ŧ »Ö³ 1ñí³ Ŧ »Ý »Ö»É eii áñ»ñIñl³
 çñ»ñC Ü3 Ŧ³ ñ1³ Ŧç µ³ ñØñ³ oáøÙçó Eáøe³ ÷ »Éáø N³ Ü3 ñ: „ñ»Ý³ Å
 ÇÝeii³ E³ óí³ Ŧ ¿ »Ö»É No.1 „ No.2 N³ Ŧ Ŧ³ Ŧ»ñáøÙ, áñÁ oáøÙó ¿ Ŧ³ EÇe³ Ŧiç
 B³ ñÅ:

- ĐáñÇ%áÝ³ ḥ³ Ý ¹ñ»Ý³ Å³ ÙÇÝ Ñáñ³ i³ Ýóù»ñ ḥñ³. ñí³ Í »ñì³ ñáôÅláôÝ Å»í ù i ÈÇÝÇ³ Í »ÉÇ ù³ Ý 5Ù eáÔ³ Ýúç eáÔùç Ù³ ḥ»éáí³ ÝóÝ»Éáôô Ñ»í á:
 - ĐáñÇ%áÝ³ ḥ³ Ý ¹ñ»Ý³ ÅÇ ÇÝeï³ É³ óçáÝ ḥ»í Á Ùáï i³ ë³ çñ³ Ôµláôñ ÇÝ: No.1 Ñ³ i³ Íç ¹ñ»Ý³ Å³ ÙÇÝ ḥ»í Á Í³ ñ. ñí³ Í i³ Ñ³ i³ Íç Ñláôëçë³ ÙÇÝ ḥáÔùáôÙ: No.2 Ñ³ i³ Íç ¹ñ»Ý³ Å³ ÙÇÝ ḥ»í Á Í³ ñ. ñí³ Í Ñ³ i³ Íç çñ³ ÔµláôñÇÝ Ùáï : Úáôñ³ ù³ Ýáûáôñ ÑáñÇ%áÝ³ ḥ³ Ý ¹ñ»Ý³ Å ÇÝi »ñí³ Ä 5-10Ù-C e³ ÑÙ³ ÝÝ»ñáôÙ ;

(3) Important Notice of Horizontal Drainage Drilling

- The horizontal drainage drilling holes have been installed to avoid groundwater level increase. The drainage has been installed at No.1 and No.2 block that show active movement.
 - The planned length of horizontal drainage drilling holes should be more than 5m after pass through slip surface of landslide.
 - Installation point of horizontal drainage is near the existing water spring point. The point of the drainage for No.1 block is planned north side of the block. The point of the drainage for No.2 is planned near the water spring on the block. Interval of the each horizontal drainage pipe is within 5 to 10m.



ä³ ñ½ Đ³ Ķ³ äáÖ³ Ýù³ ॥CY ÜCçáö³ éáöÙ

Simple Countermeasure

Open Ditch Drainage Culvert

„ñ»Ý³ Å³ ØÇÝ ¶»í Ý³ Ýóù

ĐáñÇ½áÝ³ ḥ 3 Ý 1ñ»Ý³ Å³ llÇÝ Náñ³ i ³ Ýóù»ñ Horizontal Drainage Drilling Holes

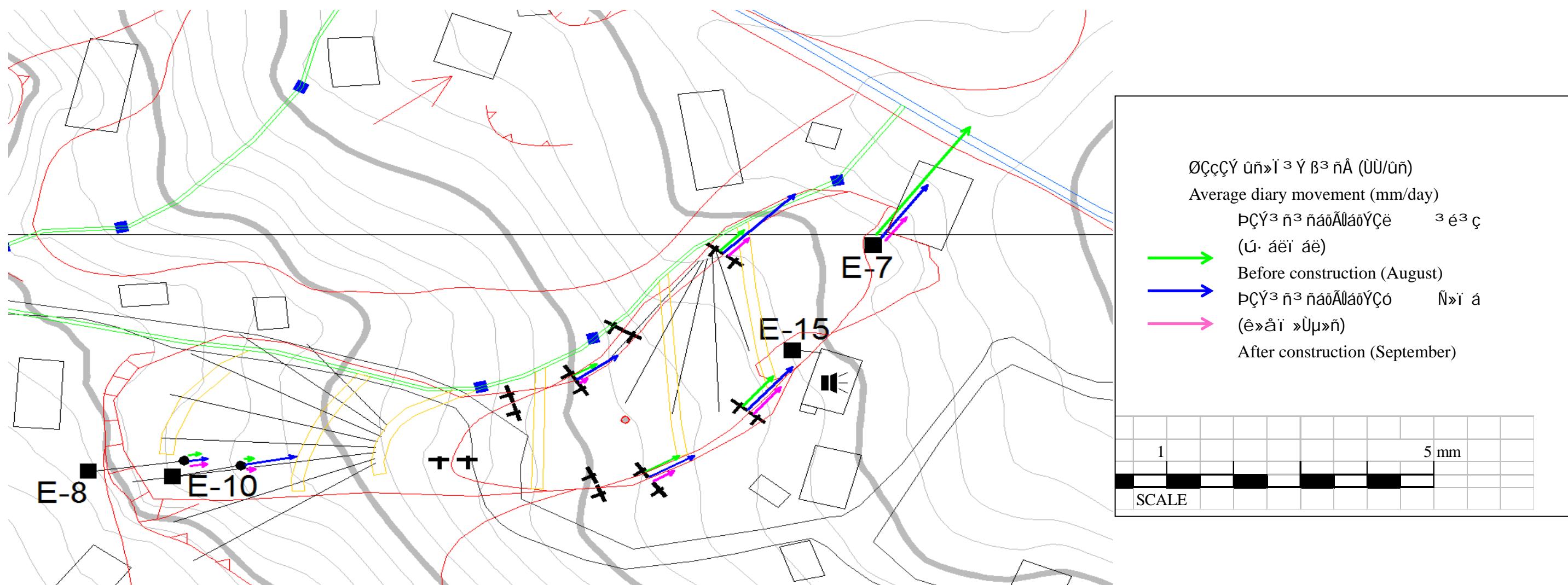
(4) Đ3 Ī3 ēáÖ3 Ÿu3 ÙÇY ÙÇçáó3 éÙ3 Y ½Y» ī ī Á
 ä3 n½ Đ3 Ī3 ēáÖ3 Ÿu3 ÙÇY ÙÇçáó3 éáöÙÁ eī eí »É ī 2005Á. ê»ā ī »Ùm»ñçó: Đ3 Ù3 Ö3 ÙY ÙáYçí áñçY. Ç
 3 n¹ÙáöÙY»ñç (ÜÍ3 n 5.1.8), ēáÖ3 Ÿuç B3 nÅC 3 nÅ»ùÁ Yí 3 ½»É ī, YáöÙYçë ī »Ã» 3 Ùe» ī 3 Y
 ī »ÙáöÙY»ñç ī i Ù3 ÉY»ñA ê»ā ī »Ùm»ñçó eī e3 Í 3 Í »ÉçY »Y ù3 Y 80ÙÙ/3 ÙçéA: °í Y3 ,
 h3 l3 ēáÖ3 Ÿu3 ÙÇY ÙÇçáó3 éÙ3 Y 3 BË 3 i 3 Ÿuç eī e» Éäöö Ù» ī 3 Ùçé N» ī á ÙáYçí áñçY. Ç
 ī i l3 ÉY»ñA óáöölo ī i i »É, áñ B3 nÅC a3 ÷ Á Yí 3 ½»É ī 13 Y13 Ö Yí 3 ½áöÙáí :
 ä3 i x3 eA 1çí 3 níl 3 i ī, áñ Ù3 ī »ñ» e3 ÙÇY çñ»ñç NáëüÁ 3 YÖn aí uñ»ñçY Yí 3 ½»É ī
 Y»ñA 3 ÷ Y»É ēáÖ3 Ÿu3 ÙÇY N3 ī 13 i :
 éáÖ3 ŸuÁ 13 éYáöÙ ī 3 é3 i »É 3 i ī cí 03 níi 2åñçé 3 ÙçéY»ñçY (ÓYñ3 Éç e» YáYçY): 2j1
 à3 i x3 eáí, éáÖ3 Ÿuç ÙáYçí áñçY. Á à» ī ù ī B3 náöÙ3 ī i c N3 ī 3 ēáÖ3 Ÿu3 ÙÇY ÙÇçáó3 éÙ3 Y
 BCY3 n3 náöÙáöÙçó N» ī á, N3 eī 3 i »Éäö N3 Ù3 n N3 ī 3 ēáÖ3 Ÿu3 ÙÇY ÙÇçáó3 éÙ3 Y ½Y» ī ī Á
 YáöÙYçë ī OÝñ3 Éç e» YáYçY:

(4) Effect of Countermeasure

The simple countermeasure is started in September 2005. According to the result of monitoring (Figure 5.1.8), Landslide movement value is decrease even though monthly rainfall data from September are more than 80mm/month. And also, after 1 month from start countermeasure work, the monitoring data shows that the movement value is decrease by slow decrease.

The reason is considered that surface water flow in rainy day is avoided to infiltrate to landslide block.

The landslide becomes the most active in March and April (snow-melting season). Therefore, landslide monitoring shall be continued after the countermeasure construction to confirm effect of the countermeasure even snow-melting season.



5.2 Ø³ ñáðÝC · ðáðÖC ëáØ³ ÝùÝ»ñÁ

5.1.1 Ü»ñ³ ÍáõÃÙáõÝ

Ø³ ñí áóÝÇ · lláðÓÁ · í Yí áðÙ { ¶»Ø³ ñùáðÝÇù
Ù³ ñ½áðÙ, áñáðÙ { Y³ .. ê..³ Y³ ÉCxÁ (ä³ í ¶»ñ
5.2.1). ¶lláðÓÁ í »Ø³ í áñí ³ l { Ù³ ñ½ç
Ñlláðeçë³ llçY Ù³ eáðÙ, °ñ..³ Yçó Ùáí 150 í Ù
Ñ»é³ í áñáðÙ³ Y í ñ³, Ø³ Ùµ³ ñ³ lçó 12 í Ù
³ ñ..Ùáðí ù, .. ¶láß · lláðÓçó 30 í Ù ³ ñ..»Éù:
¶lláðÓÁ ÑçÙY³ 1ñí »É { 1921 Á. °Ó»éÝç
Ñ»í ..³ Yùáí 2ñ..Ùí l³ Y Đ³ l³ eí ³ Yçó . 3 ØÃ³ l
÷³ Eeí 3 í ³ YY»ñç lláðÙçó, .. lñáðÙ {
Đ³ l³ eí 3 Yç Y³ E³. 3 Ñ 2E»ùe³ Y1ñ Øl³ eÝç l³ Y
Ø³ ñí áóÝáó ³ YáðÝÁ:

କ୍ଷେତ୍ର ମାପ 5.2.1 ଯେଉଁଳିଏ କ୍ଷେତ୍ର ମାପ

5.2 Martuni village Landslides

5.1.1 Introduction

Martuni village is located in Gegharkunik Martz that is surrounding the Sevan Lake (Figure 5.2.1). The village is located in the northern part of Martz, about 150 km from Yerevan, 20 km west from Chembarak, 30 km east from Gosh village.

The village was established in 1921 for refugees of Western Armenia who escaped from genocide, and the name Martuni was given for the President of Armenia, Alexander Measnikyan Martuni.

5.1.2 Ø³ ñi áºÝC · ÙáºOC ³ BE ³ hN ³ · ñáºÃÙáºÝA

Ø³ ñír áóÝÇ · lláooÁ Bñç³ å³ ï i³ í { ¶láé, Øç³ í áñ
.. 2ñ»· áóÝÇ É»éÝ»ñáí, áñáÝó í ñ³ ì³ ý
µ³ ½ù³ Áçí éäoÓ³ ýùý»ñ: »åç ³ ñ ½áoñi ù
· i ýí áóù { ¶»i çi · »i Á, µý³ i³ i³ llñ»ñç ù»i ³ ù:
· ý³ i³ i³ llñ»ñç ù»i ³ ù 3 eýáoñlláoÝÁ · i ýí áóù { ñe
çéi É³ llýáoñlláoÝÁ 1.5iù, áñÁ B³ nÅí áóù { 1»åç
· »i Á 1»åç lláoñéçé:

5.1.2 Geography in Martuni village

Martuni village is surrounded by Gor, Miavor, and Areguni Mountains which have many landslides. Getik River flows westwards and most of the residences are near the river.



କ୍ଷେତ୍ର ମାପ 5.2.1 ଯେଉଁଳିଏ କ୍ଷେତ୍ର ମାପ



Figure 5.2.2 Schematic View of Martuni village Landslide (view from NE)

Most of the residential areas are located on the toe of huge landslide, whose length is about 8 km and width is about 1.5 km, moving northwards (Figure 5.2.2). This landslide bends the river to the north

5.1.3 Ø³ ñii áóÝáó i³ ñ³ ÍùÇ ÁÝ1Ñ³ Ýáõñ »ñi³ ñ³ µ³ ÝáõÃÙáóÝÁ

Ø³ ñí áðÝáô ï ³ ñ³ ÍùÁ µ³ ØÍ³ ð³ Í ï Nñ³ µÈ³ ÙçÝ ³ å³ ñÝ»ñçó: »åÇ ¶»í ÇÍ · »í Á ÁÝÍ³ Í x³ Ý³ å³ ññç áðØÓáôÃÙ³ Ùµ ï ³ ñ»Éç ï YÍ³ ï »É ³ Ý¹»½çÍ ³ ÙçÝ È³ Í ³, µñ»óç³ ÙçÝ .. í áðý³ ÙçÝ yáñÙ³ óç³ Ý»ñ:

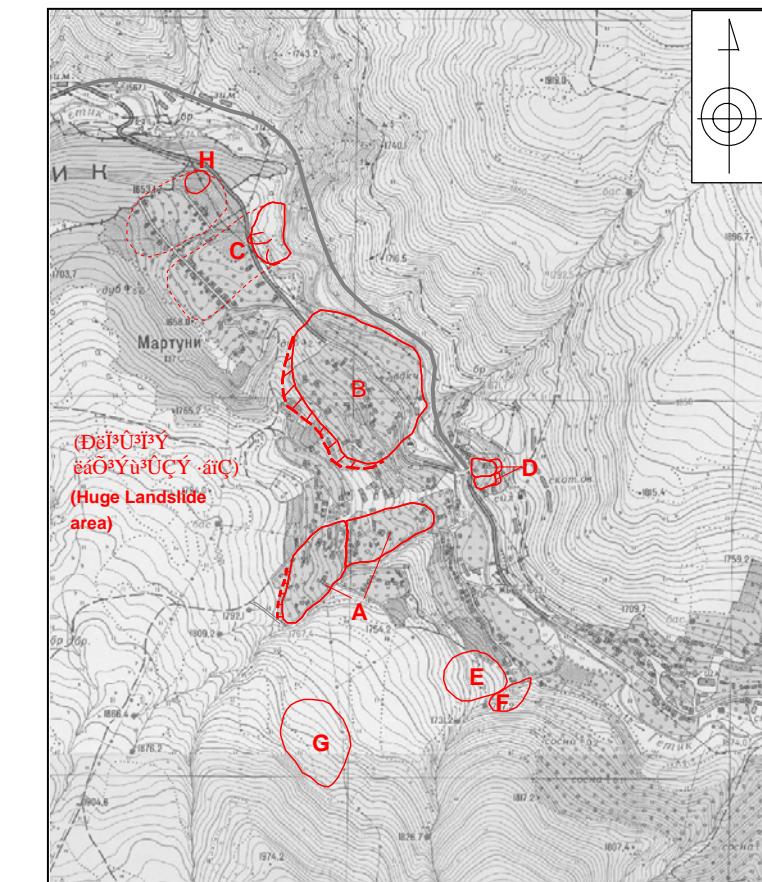


Figure 5.2.3 Landslide Distribution Map

Poorly sorted soil, sand, gravel and boulder deposit can be seen in the landslide body. Boulder and gravel consist of andesite, but not similar to the former one, its color gray to light gray, silicified and rich in plagioclase, indicating that this deposit is not original but emplaced from some other places.

in rocks which have undergone low-grade metamorphism.

5.1.4 êáØ³ ÝùÝ»ñÁ „ Ýñ³ Ýó í Ý³ eÝ»ñÁ Ø³ níi áoÝÇ . lláoØáoÙ

ØÇ ß³ ñù ÷áùñ eáØ³ ÝùÝ»ñ »Ý i »ØÇ áØÝ»ó»É µÝ³ i »ÉÇ í³ ïñ»ñáðÙ, áñáÝù íÝ³ e»É »Ý ß³ i iÝ»ñ: Ø³ Ú³ ð³ ðÝ iÝ»ñç íÝ³ eí ³ ïáðÅ³ ðÝ ñ»i i ³ ½á i ðÅ³ ðÝ 196 iÝçó 108-Á íÝ³ e»Ý iñ»É: °ÝÅ³ ¹ñí áðÙ ï, áñ ³ ïë iÝ»ñçó ß³ i »ñç íñ³ ³ ½¹»É ; eáØ³ ÝùÝ»ñç ß³ ñÅÁ:

î ³ ëÁ (10) ³ Tí Çí ëáØ³ ÝùÝ»ñ ÁÝ¹. níTí »É »Ý ¹3 BÍ ³ ØÇÝ Ñ»í ³ hái áóÅÙ³ Ý Ù»ç ¹ ¹3 ë³ T ³ n. í »É »Ý áóÅ ëáØ³ Ýù³ ØÇÝ í ³ n³ ÍùÝ»ñC Ù»ç` »ÉÝ»Éáí ÝÙ³ Ý³ í Çá µÝáóÅ³. ñCáÝ»ñCó: (ä³ í T»ñ 5.2.3):

5.1.4 Landslides and their damages in Martuni village

Some small landslides have occurred in residential areas and have damaged many houses. According to a house damaged survey, 108 out of 196 houses are damaged. It is considered that many of these houses are affected by landslide movement.

There are ten (10) active landslides included in this field investigation, and they are classified into eight landslide areas due to the similar characteristics (Figure 5.2.3).

5.1.5 êáÖ³ ÝùÝ»ñÇ ³ é³ çÝ³ Ñ»ñÃáoÃÛáoÝÁ

ÉáÓ³ ÝùÝ»ñç ³ é³ çÝ³ Ñ»ñÁáóÃúáóÝÁ áñáBÍ áóÙ ɿ · ñáóÝí Ç ¹»ýáñÙ³ óÇ³ lláí, áñÁ . Ý³ Ñ³ tÍ áóÙ ɿ
 1³ BÍ ³ ÙÇÝ Ñ»í ³ ½áí áóÃÙ³ Ý Á³ Ú³ Ý³ tÍ, . Úáó³ óÇÝ»ñç Ñ»í Ñ³ ñó³ ½ñáóÓÝ»ñç ÁÝÁ³ óùáóÙ ..
 1Ý³ èí ³ tÍ tÍ Y»ñç .. x³ Ý³ ¾³ ñÑÝ»ñç ù³ Ý³ tÍáí (2Ólláóé³ tÍ 5.2.1):

ĐÇÙÝÍ »ÉÁÍ ³ Æé ³ Ñ¹ÙáØÝÙÝ»ÑÇ ́Ù³, ́I ³ Ù³ ÍÙáØÙ ÇÙ³ ́I ³ Ý³ ÓÍ »É »Ý éáØ³ ÝùÝ»ÑÇ Ù³ ÝÙ³ Ù³ èÝ Ñ»Í ³ ÿáí áóÙáØÝ ³ Ñ³ ́I ³ éáØ³ Ýù³ ÙçÝ ³ ßE³ ́I ³ ÝùÝ»Ñ:

20é 3 ñ1ñáðÝùÝ»ñÁ Ý»ñÍ 3 03 óí »É »Ý . ñáð03 óçÝ»ñçÝ, .. Ýñ3 Ýù Ñ3 Ù3 03 ÝÍ »É »Ý 3 01 Í 3 ñ3 Íñç Ñ»Í 3 ïáíí áðññ3 Ý Ù3 Ýñ3 Ù3 èÝ»ñç Ñ»Í :

5.1.5 Priority of Landslide

Priority of Landslide is decided based on deformation of ground as assessed by field investigation, interview from the villagers, and numbers of houses and roads affected (Table 5.2.1).

Based on this result, landslide detail investigation and countermeasure works are carried out in an area.

These results are explained to the villagers and they agreed with detail investigation in this area.

Table 5.2.1 Priority of Landslide

Name of Landslide éáÓ³ÝùÇ ³Ý³ÝáðÙÁ	A	B	C	D	E	F	G	H	ä³ÛÙ³Ý³ÝáðÙÁ
Considered Activity ·Çí³ñÍáð ·áñÍáðÝ»áðÃÛáðÝÁ									Legend
Consequence Đ»í³Ýù	Houses in Landslide Area íÝ»ñ éáÓ³Ýù³ÛÇÝ ·áñÍáðÙ			-	-	-	-	-	³ñÓñ ³ííÇíáðÃÛáðÝ High-Activity, þí éÇëí³ÛÇÝ ûµÛ»ííÝ»ñ Many Risk Objects
	Houses below Landslide Area éáÓ³ÝùÇ ·áí áðó ó³ í ·í Ýí áðí íÝ»ñ		-	-	-			-	ØÇçÇÝ ³ííÇíáðÃÛáðÝ Medium-Activity, àñáß éÇëí³ÛÇÝ ûµÛ»ííÝ»ñ Some Risk Objects
	Ó³ÝåñN Road					-	-		ð³Íñ ³ííÇíáðÃÛáðÝ Little-Activity øÇã éÇëí³ÛÇÝ ûµÛ»ííÝ»ñ Few Risk Objects
éáÓ³ÝùÝ»ñÇ ³éíçÝ³Ñ»ñAáðÃÛáðÝÁ	1	4	5	6	2	3	8	7	Priority of Landslide

5.1.6 æñ»ñÇ í Ç×³ ŦÁ

(1) æñ³ Ù³ ī³ ī³ ñ³ ñáõÙ

Ø³ ñíi áóÝÇ · ÙáðÓáðÙ çñ³ Ù³ ì 3 Ì³ ñ³ ñÙ³ Ý Ñ³ Ù³ ì³ ñ· Á ÑçÙÝ³ ¹ñí »É ï 1970-³ Ì³ Ý ÁÁ.-»ñCÝ: æáðñÁ · ³ Éçë ï ³ ØµÙáðñÝ»ñCÓ, áñáÝù · ì Ýí áðÙ »Ý · ÙáðÓÇ í »ñCÝ Ù³ éáðÙ · Ñ³ ì³ ñí ñÙ³ ì 3 ì 3 ½³ ÝÝ»ñC Ù»ç: æñC ³ ì 3 ½³ ÝÁ · ì Ýí áðÙ ï µÝ³ Í»Éç ì 3 ñ³ Íùç í »ñY³ Ù³ éáðÙ, Çéïl µ³ ßEÇä Èáðáí 3 Ì³ Ý»ñA Ùí ÝáðÙ/1áðñë »Ý · ³ Éçë Ùáðñ³ ù³ ÝäÙáðñ i áðÝ: ¹Ý³ Í»Éç ì 3 ñ³ ÍùáðÙ Ì³ Ý Ùç ß³ ñù çñC ³ ØµÙáðñÝ»ñ` Ñ³ Ýñ³ ïçÝ ù· ì 3 · áñÍ Ù³ Ý Ñ³ Ù³ ñ: 2ÝÓñ³ ³ ïçÝ »Ø³ Ý³ Íç Á³ Ù³ Ý³ Íç áðñÁ 3 ì 3 ½Ýçó ¹áðñë ï ÑáéáðÙ · Ñáðñ³ ïçÝ ¹ñí »Ý³ Áç Ùccáðáí ó³ Í ; ÑáéáðÙ ¹ñí »Áç ¶»í CÍ : »í Á:

(2) \hat{I} $\hat{a} \hat{l} \hat{a} \hat{o} \hat{O} \hat{C}$

Í álláðóð Ñ³ Ù³ Í³ ñ· . álláðálláðáY áðÝC Ùç³ ÙY · lláðóC í »ñCÝ Ù³ eáðÙ, çéÍ eí añCÝ Ù³ eáðÙ ³ ÙY ³ eÍ³ aþ:
Í álláðó³ çñ»ñA ÑáeáðÙ »Y ÷ áuñ í í³ ÍY»ñC Ù»ç` ³ e³ Yó añ..? í »ñ³ ÑeÍÙ³ Y: 2Í¹ å³Í x³ eáÍ í Y»ñCó
Ñáeáð Ñ³ Ù³ hÍ³ áðC Íálláðó³ çñ»ñA, ÇÝåå»ë Y³ .. í »ñ· »í YÙ³ ³ YÓñ..³ çñ»ñA ³ h³Í añ»Y ÑáeáðÙ »Y
¹»åC x³ Y³ å³ hñY»ñA Í³ Ù³ YÓñáðÙ »Y : »í YC Í³Í:

(3) Ø³ Í »ñ áóÙÃ³ ÙCY cñ»ñC ¹ñ»Ý³ Å

‘Ý3 ī »ÉC í 3 Ùñ»ñáðÙ ī 3 Ý ÙÇ B3 ñù ÑáÖ3 ÙÇÝ ÷ áñí 3 ÍùÝ»ñ, µ3 Ùó 1ñ3 Ýù µ3 í 3 ñ3 ñ á»Ý Ù3 ī »ñ áðÄ3 ÙÇÝ çñ»ñÁ . »í Ñ3 ëoÝ»Éáð Ñ3 Ù3 ñ: 2í »ÉCÝ, áðÄ»Ö 3 ÝÓñ·Ý»ñÇ ÇÝåå»ë Ý3 · ÓÝÑ3 ÉC Å3 Ù3 Ý3 ī . ÙáðÖÇ x3 Ý3 å3 ññÝ»ñÇ Ùççáí B3 ī çáöñ ï ÑáëáðÙ . ÙáðÖÇ í »ñÇÝ Ñ3 ī 3 ÍÝ»ñÇó (ä3 ī ī»ñ 5.2.4), ÇÝåÇ 3 ñ1ÙáðÝùáðÙ x3 Ý3 å3 ññÝ»ñÇÝ 3 é3 ç3 ÝáðÙ »Ý çñ3 ÷ áë»ñ: , ñ3 ÝóÇó Ñ3 ī ī3 å»ë í Ý3 ëí 3 Í ï A èáðÖ3 Ýù3 ÙÇÝ . áíi áðÙ . í Ýí áð x3 Ý3 å3 ññÁ: oÝÅ3 1ñí áðÙ ï, áñ 1»åÇ x3 Ý3 å3 ññÁ Ñáëáð Çñ»ñÁ ÝáðÝå»ë 3 ½1áðÙ »Ý èáðÖ3 Ýù3 ÙÇÝ 3 ī Cí áðÄÙ3 Ý í ñ3:

5.1.6 Water Condition

(1) Water supply

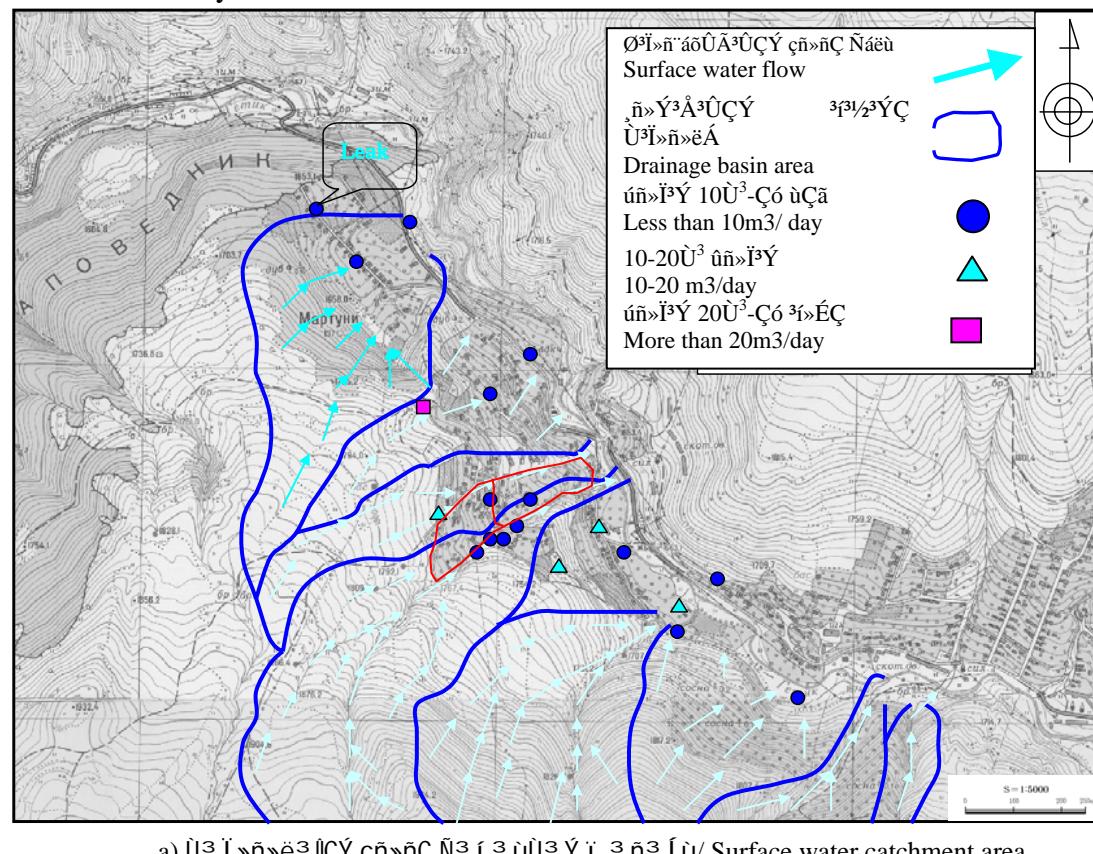
A water supply system was established in Martuni village in the 1970s. Water comes from the stream which is located in the upper part of the village, and is collected in a water tanks. The water tank is located at the highest portion in the residential area, and distribution pipes run inside/outside of each house. There are some water points in residential area for public use. In rainy season, water flows over the tank and flows down to the Getik river through soil drainage.

(2) Sewage

Sewage system exists only for the upper part of the village, and are not available in the lower part. Sewage water flows into the small stream without treatments. Therefore, almost all sewage water from houses, and surface water on rainy days, flow freely on the ground or road.

(3) Drainage of surface water

There are some soil ditches inside the residential area, but these are not sufficient to drain the surface water to the river. Furthermore, during heavy rainy days and the snow melting season, much water comes from upper areas of the village through the village roads (Figure 5.2.4). Thus, a gully is developed on the road, especially the road besides a landslide block. Water flowing on the road is also considered to affect landslide activity.



a) Ü3 İ »ñ»ë3 İçÝ çñ»ñÇ N3 í 3 üÜ3 Ý i 3 ñ3 í ù/ Surface water catchment area



5.1.7 êáÓ³ ŸùÝ»ñÇ Ñ»í̄ ³ %áí̄ áóÙ
êáÓ³ ŸùÝ»ñÇ Ñ»í̄ ³ %áí̄ áóÙÝ
Çñ³ Í̄ ³ Ý³ óí̄ »É ¿ A êáÓ³ Ÿù³ ÍçÝ · áí̄ áóÙ, ..
Ñáñ³ Í̄ Ù³ Ý ³ Ùñ»ñÇ »ñÍ̄ ñ³ µ³ ÝáôÅúáôÝÁ
óáôñó ¿ Í̄ ñí̄ ³ Í̄ eí̄ áñ ..

5.1.7 Landslide Investigation

Landslide investigation was carried out in A landslide block and geology of drilling sites are as follows;

Figure 5.2.4 Drainage of surface water

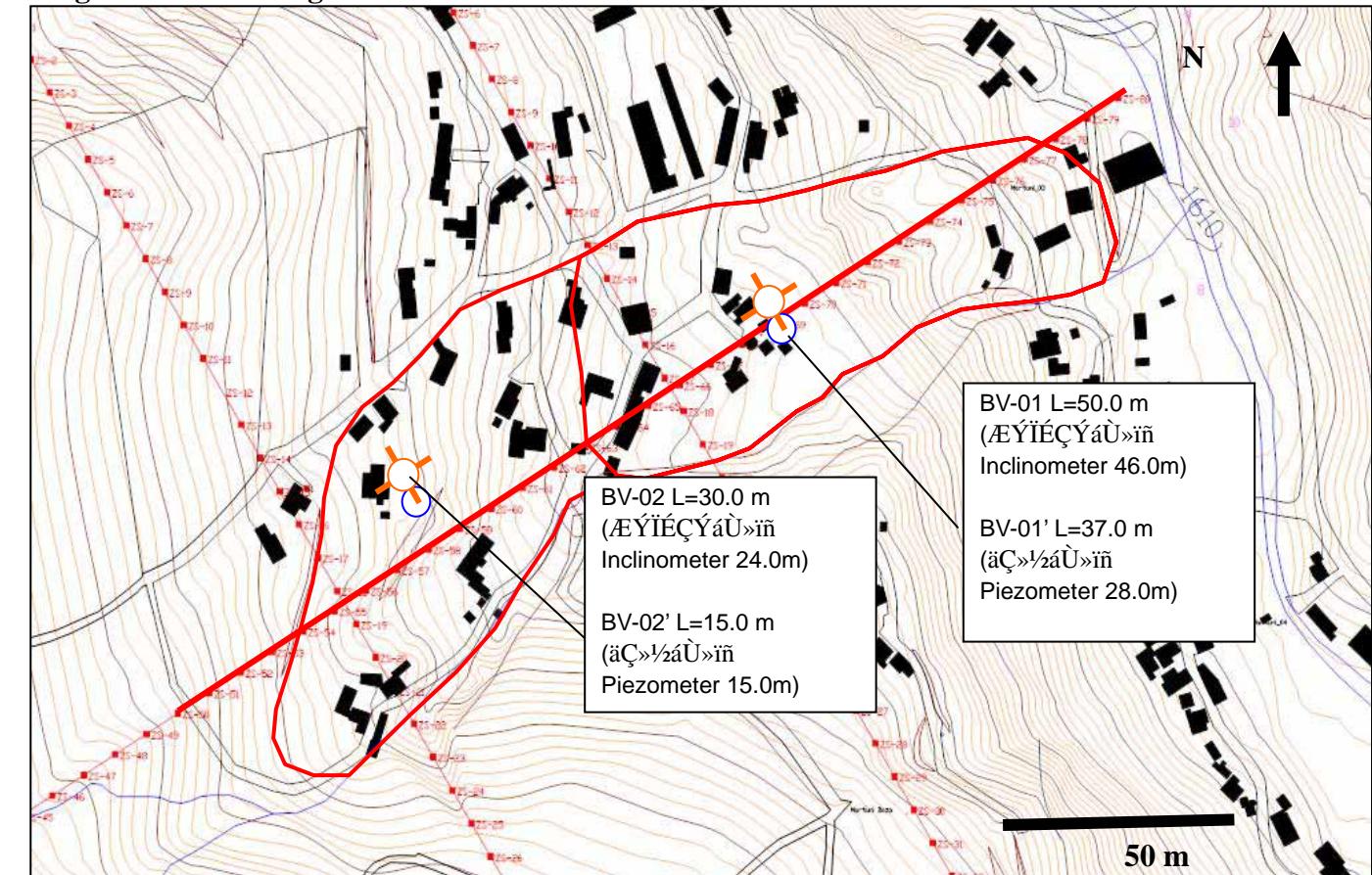
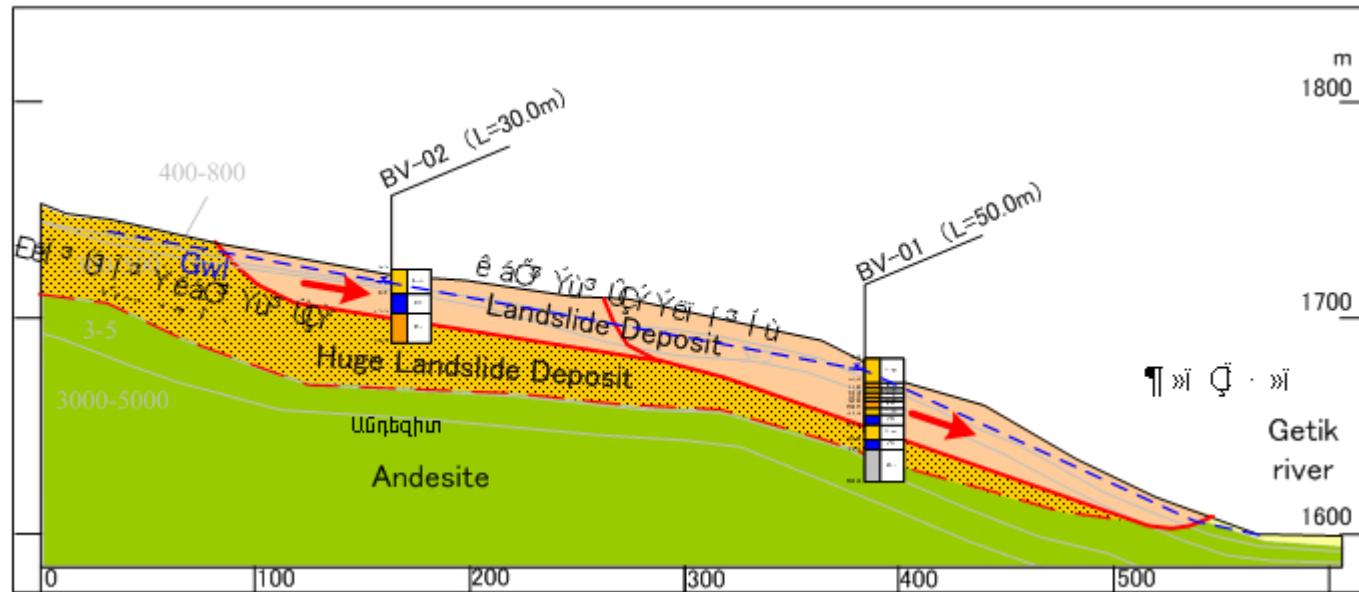


Figure 5.2.5 Location of Section and Drilling sites in A Landslide Block

Table 5.2.2 Monitoring Equipment installed in Martuni Village



ä³í ī»ñ 5.2.6 È³ áí áÖ »ñíñ³ µ³ Ý³ ī³ Ý µ³ ÅÇÝÝ»ñÁ A éáÖ³ ÝüÝ³ ÜÇÝ . áí áöÙ

Figure 5.2.6 Geological Cross Section in A Landslide Block

5.1.8 êáñ³ ÝùÝ»ñÇ ÙáÝÇí áñÇÝ.

¶॥áðÓáðÙ ተ »Ó³ ¹ኩí ³ ድ ዕáÓ³ ÝuÝ»ኩÇ ቂaÝCt አñCÝ. ሲ ዕ³ ክu³ እ áñáðÙÝ»ኩÇ ሁáí ³ Ý¹³ ተáðAñáðÝÁ ዓáðMó የ
ተኩí ³ ድ ²Ó॥áðዕ³ ተ 5.2.2:

5.1.8 Landslide Monitoring

Landslide monitoring equipment have been installed in the village and contents are shown in Table 5.2.2.

Equipment	Quantity	Location	Period	Movement
Ö³ Ùí » Ñ»Í³ Y (Nuki-Ita) Wooden Beam (Nuki-Ita)	3	Ý³ ñÝç³ · áóÙÝ · ÇÍÁ ä³ i Í»ñ 5.2.3-áóÙ orange line in Figure 5.2.3	Ø³ Ùçë 2005Å. -ÜÇÝä Í »ñç»ñë May 2005 - Recent	å³ ñ³ . ³ óáÖ ß³ ñÅ No Acceration movement
%ù³ i »Ý%áÙ»i ñ Extensometer	5	i³ åáóÙi · ÇÍÁ ä³ i Í»ñ 5.2.3-áóÙ blue line in Figure 5.2.3	»i i »Ùµ»ñ 2005Å.(1), ĐáoÝçë 2005Å.(4) - ÜÇÝä Í »ñç»ñë December 2005(1), June 2005(4) - Recent	í i ù³ ÉÝ»ñÅ óáóÙó »Y i ³ Éçë TñiÝí áÖ ß³ ñÅ Ùáï 0-2ëÙ Ñ³ BÍ C ³ eÝ»Éáí eáÖ³ Yù»ñç ß³ ñÅÇ ÷áùñ Ñ³ i ³ Ý³ -i ³ YáoÅláoÝÁ Data indicate recurrence movement about 0 to 2 cm, considered low possibility of landslide movement
í »ÓáóÙÝ»ñç å³ ÷çä Rain gauge	1	i³ åáóÙi Bñç³ YÁ ä³ i Í»ñ 5.2.3-áóÙ blue circle in Figure 5.2.3	ú· áëi áë 2005Å. - ÜÇÝä Í »ñç»ñë August 2005 - Recent	-
ÆÝÍ ÉÇÝáÙ»i ñç áóÙáñ¹áÖ TáOáí³ i Inclinometer guide pipe	2	Ý³ ñÝç³ · áóÙÝ Bñç³ YÁ ä³ i Í»ñ 5.2.5-áóÙ orange circle in Figure 5.2.5	ÜáÙ»Ùµ»ñ 2005Å. - ÜÇÝä Í »ñç»ñë November 2005 - Recent	í i ù³ ÉÝ»ñç Ñ³ i ³ ù³ . ñáóÙ Data collecting
æç»%áÙ»i ñ Piezometer	2	i³ åáóÙi Bñç³ YÁ ä³ i Í»ñ 5.2.5-áóÙ blue circle in Figure 5.2.5	é»åi »Ùµ»ñ 2005Å. - ÜÇÝä Í »ñç»ñë September 2005 - Recent	éi áñ· »i ÝÙ³ Ù³ i ³ ñ¹³ TÁ T³ ÙáÙi, GL-3.9Ù BV01áÙ (Y»ñù'áóÙ), GL-4.4Ù BV02-áóÙ' (í »ñ'áóÙ) Groundwater level is almost stable, GL-3.9m in BV01'(lower), GL-4.4m in BV02'(upper)

Đ3 Ù3 Ø3 ÙY í »ñÁ ÝBí 3 í í 1Ø3 ÉÝ»ñÇ` »ÝÄ3 1ñí áðÙ ï, áñ 2005Å.-Ç ÑáðÉÇë ÝáÙ»Ùµ»ñ 3 ÙÇëÝ»ñÇÝ
ëáØ3 ÝùÝ»ñÁ Ø3 ñí áðÝÇ . ÙáðØáðÙ Ñ3 Ù3 ñØ3 Ä» Í3 ÙáØÝ »Ý:

It is considered that the landslides in Martuni village are almost stable from July to November 2005 according to the above-mentioned results.