



Republic of the Philippines
Department of Environment and Natural Resources
MINES AND GEOSCIENCES BUREAU
Regional Office No. XIII

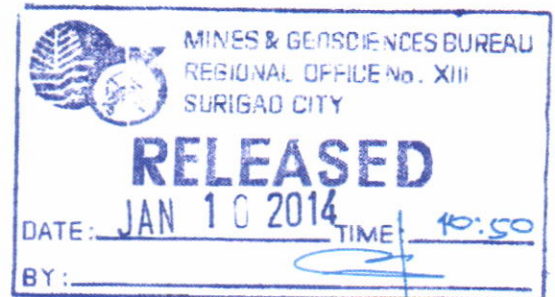
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January 9, 2014

RD-G-14-01-10

HONORABLE SALIMAR T. MONDEJAR

Municipal Mayor
Municipality of Veruela
Province of Agusan del Sur



Dear Hon. Mayor Mondejar:

Respectfully furnishing your end the document entitled "Results of the MGB Landslide and Flood Assessment and Mapping (1:10,000 scale) of the Municipality of Veruela, Agusan del Sur". The assessment is in line with the government's effort aimed at reducing, if not totally mitigating the destructive effects and impacts of natural hazards to the populace.

The Office expresses its deep gratitude for the support and assistance rendered to the Geohazard Mapping and Assessment Team of our Regional Office during the conduct of the field survey.

We look forward to a continuing partnership and collaboration with the LGU of Veruela, Agusan del Sur in the nation's overall disaster risk reduction program.

Very truly yours,

BY THE AUTHORITY OF THE REGIONAL DIRECTOR:


NOLI N. ARREZA
OIC, Mine Management Division

GSD-13-01-Ghz-09



Cc: **DIRECTOR, MGB CO**
HON. GOVERNOR, Agusan del Sur
HON. REPRESENTATIVE, 2nd District, ADS
Office of Civil Defense, RDRRMC Caraga

REGIONAL EXECUTIVE DIRECTOR, DENR, R-XIII
PENRO, Agusan del Sur
CENRO, Bunawan, ADS
REGIONAL DIRECTOR, DILG-Caraga

RESULTS OF THE MGB LANDSLIDE AND FLOOD ASSESSMENT AND MAPPING (1:10,000 SCALE) OF THE MUNICIPALITY OF VERUELA, PROVINCE OF AGUSAN DEL SUR

The Mines and Geosciences Bureau-Department of Environment and Natural Resources (MGB-DENR) conducted landslide and flood assessment and mapping (1:10,000 scale) of areas within the municipality of Veruela on September 25, 2013 to October 9, 2013 . The assessment is in line with the government's efforts aimed at reducing, if not, totally mitigating the destructive effects and impacts of natural hazards on the populace. Comprising the geohazard assessment team are Joel A. Calugcugan, Melvin A. Mantilla, Elaine L. Galido, geologists from MGB – Caraga Region XIII with the assistance of GSD personnel Mr. Evangelino M. Morales, Jr. ,Dionesio A. Surigao and Julius A. Sulapas

The MGB-DENR particularly covered the following areas:

- Puroks 1 to 3 in Barangay Anitap
- Puroks 1 to 4 in Barangay Bacay II
- Puroks 1 to 7 in Barangay Binongan
- Puroks 1 to 7 in Barangay Caigangan
- Puroks 1 to 7 in Barangay Candiis
- Puroks 1 to 9 in Barangay Del Monte
- Puroks 1 to 8 in Barangay Don Mateo
- Puroks 1 to 6 in Barangay Katipunan
- Puroks 1 to 12 in Barangay La Fortuna
- Puroks 1 to 7 in Barangay Limot
- Puroks 1 to 4 in Barangay Magsaysay
- Puroks 1 to 7 in Barangay Masayan
- Puroks 1 to 21 in Barangay Poblacion
- Puroks 1 to 10 in Barangay Sampaguita
- Puroks 1 to 9 in Barangay San Gabriel
- Puroks 1 to 5 in Barangay Santa Cruz
- Puroks 1 to 9 in Barangay Santa Emelia
- Puroks 1 to 12 in Barangay Sawagan
- Puroks 1 to 8 in Barangay Sinobong
- Puroks 1 to 6 in Barangay Sisimon

The assessed areas were rated as having low, moderate, high or very high (critical) susceptibility to landslide. The landslide susceptibility rating parameters are as follows:

Very High : Areas usually with steep to very steep slopes and underlain by weak

materials. Recent landslides, escarpments and tension cracks are present. Human initiated effects could be an aggravating factor.

High : Areas usually with steep to very steep slopes and underlain by weak materials. Areas with numerous old/inactive landslides.

Moderate : Areas with moderately steep slopes. Soil creep and other indications for possible landslide occurrence are present.

Low : Gently sloping areas with no identified landslides.

Likewise, the assessed areas were also rated as having low, moderate or high susceptibility to flooding. The flood susceptibility parameters are as follows:

High : Areas likely to experience flood heights of greater than 1.0 meter and/or flood duration of more than 3 days. These areas are immediately flooded during heavy rains of several hours; include landforms of topographic lows such as active river channels, abandoned river channels and areas along river banks; also areas prone to flashfloods

Moderate : Areas likely to experience flood heights of 0.5 to 1.0 meter and flood duration of 1 to 3 days. These areas are subject to widespread inundation during periods of prolonged and extensive heavy rainfall or extreme weather condition. Fluvial terraces, alluvial fans, and infilled valleys are areas subjected to moderate flooding

Low : Areas likely to experience flood heights of less than 0.5 meter and/or flood duration of less than one day. These areas include low hills and gentle slopes. They also have sparse to moderate drainage density

The barangay officials were presented with a *Landslide and Flood Threat Advisory* when appropriate. This advisory informs them of their area's susceptibility to landslides and floods and contains the corresponding recommendations.

Summarized below are the results of the assessment of the covered areas:

Table 1. Results of Landslide and Flood Assessment at Barangay Anitap

Purok	Landslide Susceptibility Rating	Flood Susceptibility Rating	Recommendations
1	High	None; Partly Moderate	The area is highly prone to landslide and partly prone to flooding; Construct proper concrete drainage canals and concrete road on this area to facilitate surface run-off;

			<p>Identify and construct permanent evacuation site which is safe from flooding and landslide; Prohibit settlement along intermittent/perennial creeks/rivers should be implemented which is prone to flooding; Observed for sunken or displaced road surfaces; Develop an early warning (e.g., signages) at (for critical areas only) on steep-slopes where houses situated foot-slopes; Prohibit settlement directly located on foot-slopes; Develop an early warning device/system; Activate BDCC all the time for quick response during emergency; Acquiring at-least two (2) mobile dump-trucks are badly needed for rescue operation and mobilization.</p> <p>Geographic location of Purok 1 situated along the ridge line parallel to the barangay road and underlain by highly weathered/fractured tuffaceous siltstone-mudstone interbeds that make the slope unstable. Series of active soil-creeping were noted on the area. GPS reading is 7°57'55.8"-N/125°49'54.7"-E.</p>
2	High	None; Partly Moderate	<p>The area is highly prone to landslide and partly prone to flooding; Construct proper drainage canals and concrete road on this area to facilitate surface run-off; Identify and construct permanent evacuation site which is safe from flooding and landslide; Prohibit settlement along intermittent/perennial creeks/rivers should be implemented which is prone to flooding; Observed for sunken or displaced road surfaces; Develop an early warning (e.g., signages) at (for critical areas only) on steep-slopes where houses situated foot-slopes; Prohibit settlement directly located on foot-slopes; Develop an early warning device/system; Activate BDCC all the time for quick response during emergency; Acquiring at-least two (2) mobile dump-trucks are badly needed for rescue operation and mobilization.</p> <p>Geographic location of Purok 2</p>

			<p>situated along the ridge line parallel to the barangay road and underlain by highly weathered/fractured tuffaceous siltstone-mudstone interbeds that make the slope unstable. Series of active soil-creeping were noted on the area. GPS reading is 7°57'49.2"-N/125°49'54.9"-E.</p>
3	Moderate; Partly High	None; Partly Moderate	<p>The area is highly prone to landslide and partly prone to flooding; Construct proper drainage canals and concrete road on this area to facilitate surface run-off; Identify and construct permanent evacuation site which is safe from flooding and landslide; Prohibit settlement along intermittent/perennial creeks/rivers should be implemented which is prone to flooding; Observed for sunken or displaced road surfaces; Develop an early warning (e.g., signages) at (for critical areas only) on steep-slopes where houses situated foot-slopes; Prohibit settlement directly located on foot-slopes; Develop an early warning device/system; Activate BDCC all the time for quick response during emergency; Acquiring at-least two (2) mobile dump-trucks are badly needed for rescue operation and mobilization.</p> <p>No further development to done at the back of Anitap Elementary School (Veruela) due to active soil creeping, highly weathered/fractured bedrock and situated steep slope. Retaining wall with wet holes should be constructed at the western, northern and southern sections in order minimized slope failure and erosion. School buildings damaged were also observed due to the effect of typhoon "Pablo" hit on the area. Construction of big covered court is highly recommended on this area serve for local evacuation center. Immediate GPS reading is 7°57'44"-N/125°49'51.9"-E.</p> <p>Geographic location of Purok 3 situated along the ridge line parallel to the barangay road and underlain by highly weathered/fractured tuffaceous siltstone-mudstone inter-</p>

			beds that make the slope unstable. Series of active soil-creeping were noted on the area. GPS reading is 7°57'44.4"-N/125°49'54.2"-E.
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Table 2. Results of Landslide and Flood Assessment at Barangay Bacay II

Purok	Landslide Susceptibility Rating	Flood Susceptibility Rating	Recommendations
1A (Poblacion)	Low	Low	Recommend to provide proper drainage canals to facilitate surface run-off especially during heavy precipitation.
1B	Portion Low; Portion Moderate	Low	Observe for presence of mass movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Report such observations at the concerned municipal authorities or to the MGB; for vigilance of the residents located at slopes and foot of slopes during inclement weather conditions. Prohibit future settlement directly located at the foot of slopes. Provide an evacuation site which is safe from landslide and flooding. Recommend to provide proper drainage canals to facilitate surface run-off especially during heavy precipitation.
2	Portion Low; Portion Moderate	Low	Observe for presence of mass movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Report such observations at the concerned municipal authorities or to the MGB; for vigilance of the residents located at slopes and foot of slopes during inclement weather conditions. Prohibit future settlement directly located at the foot of slopes. Provide an evacuation site which is safe from landslide and flooding. Recommend to provide proper drainage canals to facilitate surface run-off especially during heavy precipitation.
3	Low	Low	Recommend to provide proper drainage canals to facilitate surface run-off especially during heavy precipitation.
4	None	Gen. Low; portion High along Bacay Creek	Observe for rapid increase/decrease of water level along Bacay Creek, possibly accompanied with increased

			turbidity (soil content). Prohibit future settlement along creek embankments. For relocation of houses directly located at Bacay Creek. Also prohibit putting up of additional classrooms and/or school site expansion towards Bacay Creek. Provide an evacuation site which is safe from landslide and flooding. Recommend to provide proper drainage canals to facilitate surface run-off especially during heavy precipitation.
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Table 3. Results of Landslide and Flood Assessment at Barangay Binongan

Purok	Landslide Susceptibility Rating	Flood Susceptibility Rating	Recommendations
1	None	High	Observe for rapid increase/decrease of water level along Agusan River, possibly accompanied with increased turbidity (soil content). Develop an early warning system and flood preparedness plan thru periodic conduct of evacuation drills. Pre-emptive evacuation is recommended when advised during extreme weather events or abnormalities in water level along Agusan River is observed; thus provision of evacuation sites is highly recommended. Strictly prohibit settlement along Agusan River embankments. For long term solutions, relocation of the entire purok is highly recommended. Activate BDCC at all times. The barangay is recommended to provide rubber boats and/or mobile trucks for rescue operation purposes.
2	None	High	Observe for rapid increase/decrease of water level along Agusan River and Binongan Creek, possibly accompanied with increased turbidity (soil content). Develop an early warning system and flood preparedness plan thru periodic conduct of evacuation drills. Pre-emptive evacuation is recommended when advised during extreme weather events or abnormalities in water level along Agusan River

			and/or Binongan Creek is observed; thus provision of evacuation sites is highly recommended. Strictly prohibit settlement along river/creek embankments. For long term solutions, relocation of the entire purok is highly recommended. Activate BDCC at all times. The barangay is recommended to provide rubber boats and/or mobile trucks for rescue operation purposes.
3 (Rosemarie)	None	High	Observe for rapid increase/decrease of water level along Agsao Creek, possibly accompanied with increased turbidity (soil content). Develop an early warning system and flood preparedness plan thru periodic conduct of evacuation drills. Pre-emptive evacuation is recommended when advised during extreme weather events or abnormalities in water level along Agsao Creek is observed; thus provision of evacuation sites is highly recommended. Strictly prohibit settlement along Agusan River embankments. For long term solutions, relocation of the entire purok is highly recommended. Activate BDCC at all times. The barangay is recommended to provide rubber boats and/or mobile trucks for rescue operation purposes.
4 (Agsao)	None	High	Observe for rapid increase/decrease of water level along Agsao Creek, possibly accompanied with increased turbidity (soil content). Develop an early warning system and flood preparedness plan thru periodic conduct of evacuation drills. Pre-emptive evacuation is recommended when advised during extreme weather events or abnormalities in water level along Agsao Creek is observed; thus provision of evacuation sites is highly recommended. Strictly prohibit settlement along Agsao Creek embankments. For long term solutions, relocation of the entire purok is highly recommended. Activate BDCC at all times. The barangay is recommended to provide rubber boats and/or mobile trucks for rescue operation purposes.
5	None	Moderate to High	Observe for rapid increase/decrease

(Agsao)			of water level along Agsao Creek, possibly accompanied with increased turbidity (soil content). Develop an early warning system and flood preparedness plan thru periodic conduct of evacuation drills. Pre-emptive evacuation is recommended when advised during extreme weather events or abnormalities in water level along Agsao Creek is observed; thus provision of evacuation sites is highly recommended. Strictly prohibit settlement along Agsao Creek embankments. For long term solutions, relocation of the residents experiencing high flooding close to Purok 4 Agsao is recommended. Activate BDCC at all times. The barangay is recommended to provide rubber boats and/or mobile trucks for rescue operation purposes.
6	Low	Low to Moderate	Observe for rapid increase/decrease of water level along Agsao Creek, possibly accompanied with increased turbidity (soil content). Develop an early warning system and flood preparedness plan thru periodic conduct of evacuation drills. Pre-emptive evacuation is recommended when advised during extreme weather events or abnormalities in water level along Agsao Creek is observed; thus provision of evacuation sites is highly recommended. Strictly prohibit settlement along Agsao Creek embankments. Recommend to stabilize the road cut slopes for the safety of the motorists passing the highway and to some houses opposite to it. Activate BDCC at all times. The barangay is recommended to provide rubber boats and/or mobile trucks for rescue operation purposes.
7 (Mahabo)	None	High	Observe for rapid increase/decrease of water level along Agusan River, possibly accompanied with increased turbidity (soil content). Develop an early warning system and flood preparedness plan thru periodic conduct of evacuation drills. Pre-emptive evacuation is recommended when advised during extreme weather events or abnormalities in

			water level along Agusan River is observed; thus provision of evacuation sites is highly recommended. Strictly prohibit settlement along Agusan River embankments. For long term solutions, relocation of the entire purok is highly recommended. Activate BDCC at all times. The barangay is recommended to provide rubber boats and/or mobile trucks for rescue operation purposes.
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Table 4. Results of Landslide and Flood Assessment at Barangay Caigangan

Purok	Landslide Susceptibility Rating	Flood Susceptibility Rating	Recommendations
1	Low; portion High along Bacay Creek	Low	Monitor for progress of mass movements on the identified tension cracks and landslide along Bacay creek. Observe for other presence of mass movements (tension cracks, landslides, ground depressions). Report such observations to the concerned municipal authorities or to the MGB; for vigilance of residents located near the identified tension crack and landslides. Also observe for rapid increase/decrease of water level along Bacay Creek possibly accompanied with increased turbidity (soil content). Prohibit future settlement along Bacay Creek embankments especially at the identified mass movements. Conduct regular maintenance on existing drainage canals at the barangay; provision of concrete line canals is recommended to facilitate surface run-off more sufficiently. Activate BDCC at all times.
2 (Macopahan)	None	Moderate (with scouring at Bacay Creek)	Observe for rapid increase/decrease of water level along Bacay Creek possibly accompanied with increased turbidity (soil content). Prohibit future settlement directly located along Bacay Creek embankments. The barangay should provide an evacuation site which is safe from landslide and flooding. Pre-emptive evacuation is recommended when storm signal warnings are

			raised and/or abnormalities in water level along Bacay Creek are observed. A gabion structure is recommended to prevent further scouring at the embankment of Bacay creek. Conduct regular maintenance on existing drainage canals at the barangay; provision of concrete line canals is recommended to facilitate surface run-off more sufficiently. Activate BDCC at all times.
3	Low	High	Observe for rapid increase/decrease of water level along Bacay Creek and Camilie Creek possibly accompanied with increased turbidity (soil content). Prohibit future settlement directly located along the creeks embankments. The barangay should provide an evacuation site which is safe from landslide and flooding. Pre-emptive evacuation is recommended when storm storm signal warnings are raised and/or abnormalities in water level along Bacay Creek are observed. Conduct regular maintenance on existing drainage canals at the barangay; provision of concrete line canals is recommended to facilitate surface run-off more sufficiently. Activate BDCC at all times.
4 (Camili)	Low to Moderate	High	Observe for presence of mass movements (tension cracks, landslides). Observe for saturated ground s or seeps. Report such observations to the concerned municipal authorities or to the MGB; for vigilance of residents located at the foot of slopes during inclement weather conditions. Observe for rapid increase/decrease of water level along Bacay Creek and Camilie Creek possibly accompanied with increased turbidity (soil content). Prohibit future settlement directly located along the creeks embankments. The barangay should provide an evacuation site which is safe from landslide and flooding. Pre-emptive evacuation is recommended when storm storm signal warnings are raised and/or abnormalities in water level along Bacay Creek are observed. Conduct regular maintenance on existing drainage

			canals at the barangay; provision of concrete line canals is recommended to facilitate surface run-off more sufficiently. Activate BDCC at all times.
5	Low	Low	Conduct regular maintenance on existing drainage canals at the barangay; provision of concrete line canals is recommended to facilitate surface run-off more sufficiently. Activate BDCC at all times.
6 (Sabilao)	Portion Low; Portion High	Low	Observe for presence of mass movements (tension cracks, landslides). Observe for saturated ground s or seeps. Report such observations to the concerned municipal authorities or to the MGB; for vigilance of residents located at the foot of slopes during inclement weather conditions. Prohibit future settlement at the foot of slopes. Residents of Purok 6 which are located at foot slopes and are at the bounadary near Loreto Municipality are recommended to be relocated. For Purok 6 located at the barangay proper, provision of concrete line canals are recommended to facilitate surface run-off during heavy precipitation.
7 (Aknit)	None	Moderate	Observe for rapid increase/decrease of water level along the traversing creeks at the purok. Pre-emptive evacuation is recommended if unusual water level at the creeks is observed especially during inclement weather conditions. For long term solutions, the remaining houses of Purok 7 Aknit which are scattered at the rice field and are affected by moderate flooding are recommended to be relocated and staying on the farm houses during inclement weather conditions should be prohibited. Activate BDCC at all times.

Table 5. Results of Landslide and Flood Assessment at Barangay Candiis

Purok	Landslide Susceptibility Rating	Flood Susceptibility Rating	Recommendations
1	Moderate	None	Observe for presence of mass

			<p>movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Also observe for ground depressions and/or sinkholes. Report such observations at the concerned municipal authorities or to the MGB; for vigilance of the residents located at slopes and foot of slopes during inclement weather conditions. Prohibit future settlement along foot of slopes and ridge edges with steep slopes. Also prohibit future construction of classrooms and school site expansion at Candiis Elementary School towards the ridge edges. The barangay should provide an evacuation site which is safe from landslide and flooding. Proper drainage canals are recommended to facilitate surface run-off especially during heavy rainfall. Activate BDCC at all times.</p>
2	Moderate	None	<p>Observe for presence of mass movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Also observe for ground depressions and/or sinkholes. Report such observations at the concerned municipal authorities or to the MGB; for vigilance of the residents located at slopes and foot of slopes during inclement weather conditions. Prohibit future settlement along foot of slopes and ridge edges with steep slopes. The barangay should provide an evacuation site which is safe from landslide and flooding. Activate BDCC at all times.</p>
3	High	None	<p>Observe for presence of mass movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Also observe for ground depressions and/or sinkholes. Report such observations at the concerned municipal authorities or to the MGB; for vigilance of the residents located at slopes and foot of slopes during inclement weather conditions. Prohibit future settlement along foot of slopes and ridge edges with steep slopes. The barangay should provide an evacuation site which is safe from landslide and flooding. Proper</p>

			drainage canals are recommended to facilitate surface run-off especially during heavy rainfall. Activate BDCC at all times.
4 (Balite)	High	None	Observe for presence of mass movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Also observe for ground depressions and/or sinkholes. Report such observations at the concerned municipal authorities or to the MGB; for vigilance of the residents located at slopes and foot of slopes during inclement weather conditions. Prohibit future settlement along foot of slopes and ridge edges with steep slopes. The barangay should provide an evacuation site which is safe from landslide and flooding. For long term solution, relocation of the purok is highly recommended since the purok is characterized with steep slopes. Proper drainage canals are recommended to facilitate surface run-off especially during heavy rainfall. Activate BDCC at all times.
5	High	None	Observe for presence of mass movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Also observe for ground depressions and/or sinkholes. Report such observations at the concerned municipal authorities or to the MGB; for vigilance of the residents located at slopes and foot of slopes during inclement weather conditions. Prohibit future settlement along foot of slopes and ridge edges with steep slopes. The barangay should provide an evacuation site which is safe from landslide and flooding. For long term solution, relocation of the purok is highly recommended since the purok is characterized with steep slopes. Proper drainage canals are recommended to facilitate surface run-off especially during heavy rainfall. Activate BDCC at all times.
6	Moderate	None	Observe for presence of mass movements (e.g. landslide, tension cracks). Observe for saturated ground and/or seeps. Also observe for ground depressions and/or sinkholes. Report such observations