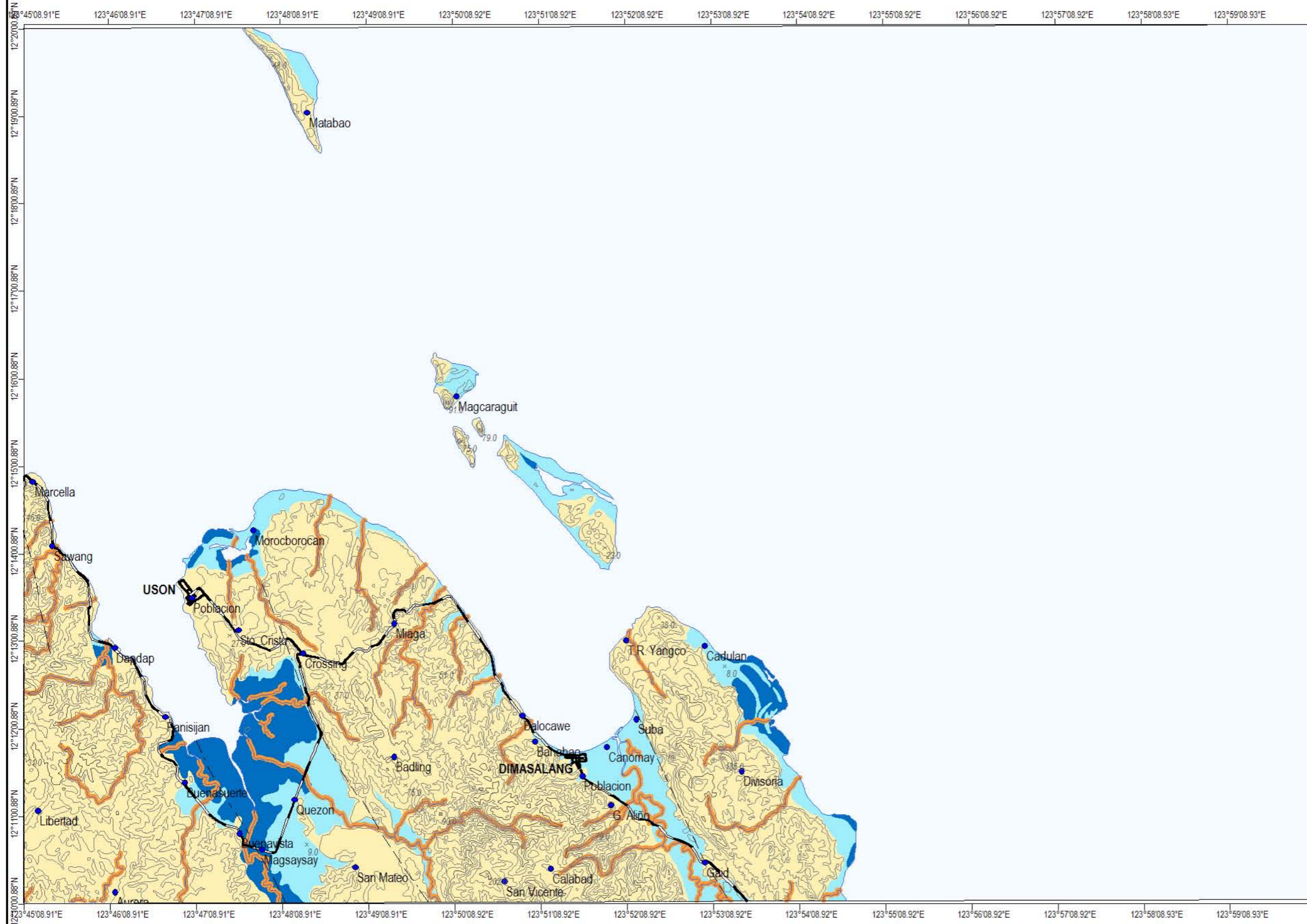


# FLOOD HAZARD MAP OF USON QUADRANGLE



**MAP LEGEND:**

**Flood Hazard Zones:**

- Regularly to Frequently Flooded Areas
- Occasionally to Rarely Flooded Areas
- Non Flood Prone Areas
- Areas Prone to Riverbank Erosion

— river  
— road  
— contour

**EXPLANATIONS:**

Flood hazard susceptibility zones were derived based on the geomorphological analysis of landforms and the fluvial system. Information on flood occurrences, flood depths, duration of inundation as well as topographic information supported the geomorphologically-based flood hazard mapping.

**Regularly to Frequently Flooded Areas:**  
Areas that are frequently flooded. Mere heavy rains of 1 to 2 days could bring about flooding in these areas. Moderate to strong typhoons could submerge these areas 0.5 to 2.0 m. in flood waters for a few days to a few weeks. Development of urban settlements in these areas is not recommended.

**Occasionally to Rarely Flooded Areas:**  
Areas that become inundated during moderate to strong typhoons. Flood depths vary from a few centimeters to 1 m. Floods last from a few hours to a few days.

**Non Flood Prone Areas:**  
Areas with no reported flood occurrences except along low lying areas adjoining rivers and creeks.

**Areas Prone to Riverbank Erosion:**  
Areas 0 to 50 m. from river banks that are prone to scouring and erosion.

Field data collection by: A.E. Dayao, J.M.S. Laud, E.T. Avila, M.N.L. Miraballes, E.G. Basilan & J.N. Malto  
 Geomorphological interpretation by: M.N.L. Miraballes  
 Digital cartographic processing by: M.N.L. Miraballes  
 GIS processing by: M.N.L. Miraballes  
 Checked by: A.E. Dayao  
 Approved by: R.A. Juan

Other sources of information:  
 1:50,000 NAMRIA Topographic Map  
 1951 B/W Aerial Photos



Published by:  
 Department of Environment and Natural Resources  
 MINES AND GEOSCIENCES BUREAU-RO5  
 Rawis, Legazpi City  
 2008

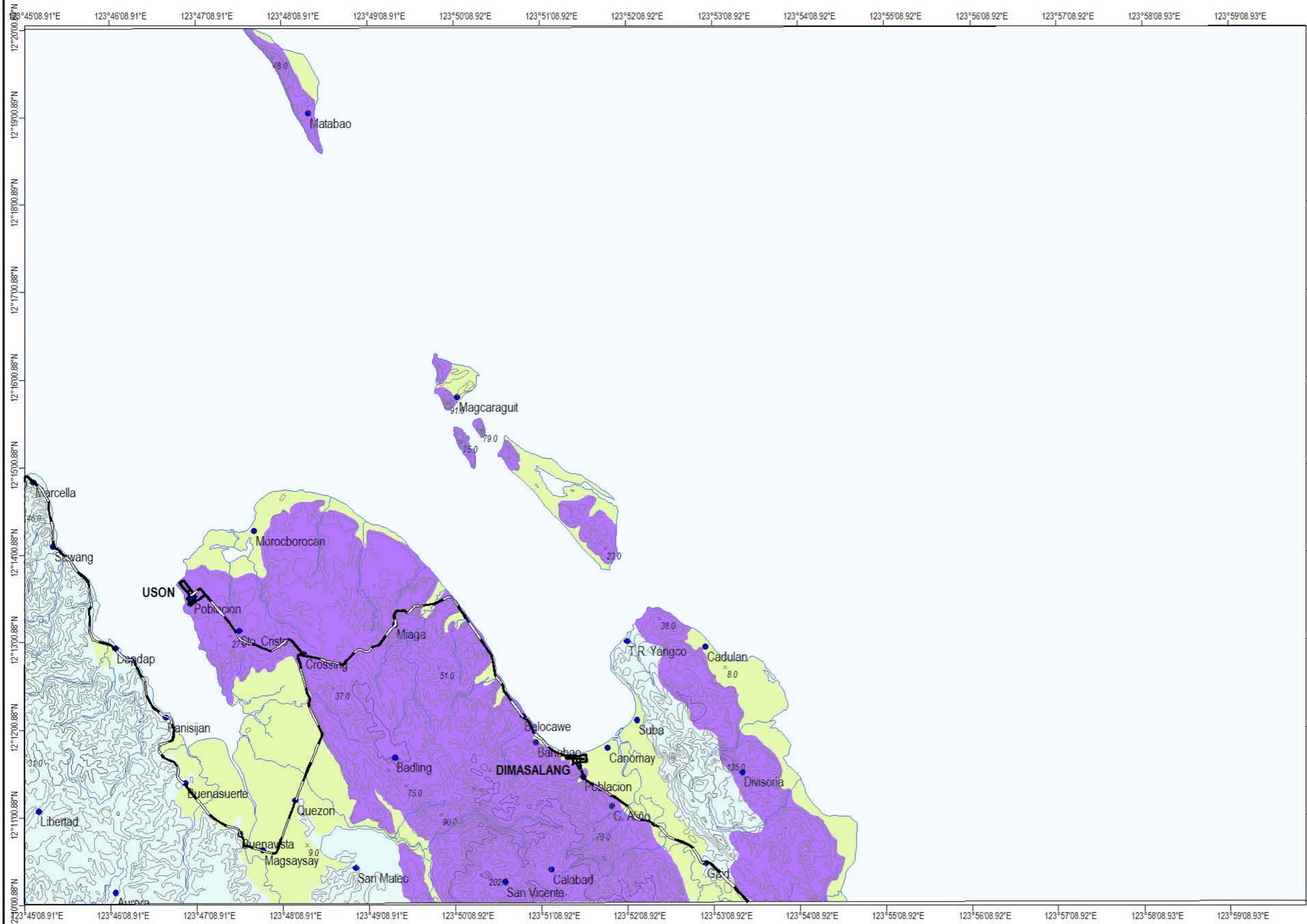


UNIVERSAL TRANSVERSE MERCATOR PROJECTION  
 Clarke 1866, Luzon Datum





# GROUND SUBSIDENCE AND GROUND SETTLEMENT SUSCEPTIBILITY MAP OF USON QUADRANGLE



**MAP LEGEND:**  
**Ground Subsidence and Ground Settlement Susceptibility Zones:**

- Areas susceptible to ground subsidence
- Areas susceptible to ground settlement
- Areas not susceptible to settlement/subsidence
- river
- road
- contour

**EXPLANATIONS:**

Susceptibility map for ground subsidence due to karst or solution processes was primarily derived from the lithologic map of the study area. Field observations on sinkholes and ground subsidence observed on concrete roads and damaged houses supported the mapping. Areas of possible ground settlement were delineated through the analysis of the geomorphological lay of the study area, the sub-surface soils and the ground water levels.

**Areas Susceptible to Ground Subsidence:**  
 Areas that are prone to ground cavitation, sinkhole formation and ground subsidence in areas underlain by limestone and calcareous siltstones and shales.

**Areas Susceptible to Ground Settlement:**  
 Areas where fluviatile and fluvio-marine sands, silts and clays coupled with shallow ground water table are sites of possible ground settlement. Ground settlement may be reduced through appropriate foundation design. Buildings having 3 storeys or more should be tested for settlement and/or consolidation. Buildings having 5 storeys or more should undergo detailed geotechnical studies.

**Areas not Prone to Ground Settlement/Subsidence:**  
 Areas where the possibility of occurrence of ground settlement or ground subsidence is unlikely.

Field data collection by: A.E. Dayao, J.M.S. Laud, E.T. Avila, M.N.L. Miraballes, E.G. Basilan & J.N. Malto  
 Geomorphological interpretation by: M.N.L. Miraballes  
 Digital cartographic processing by: M.N.L. Miraballes  
 GIS processing by: M.N.L. Miraballes  
 Checked by: A.E. Dayao  
 Approved by: R.A. Juan

Other sources of information:  
 1:50,000 NAMRIA Topographic Map  
 1951 B/W Aerial Photos



Published by:  
 Department of Environment and Natural Resources  
 MINES AND GEOSCIENCES BUREAU-RO5  
 Rawis, Legazpi City  
 2008

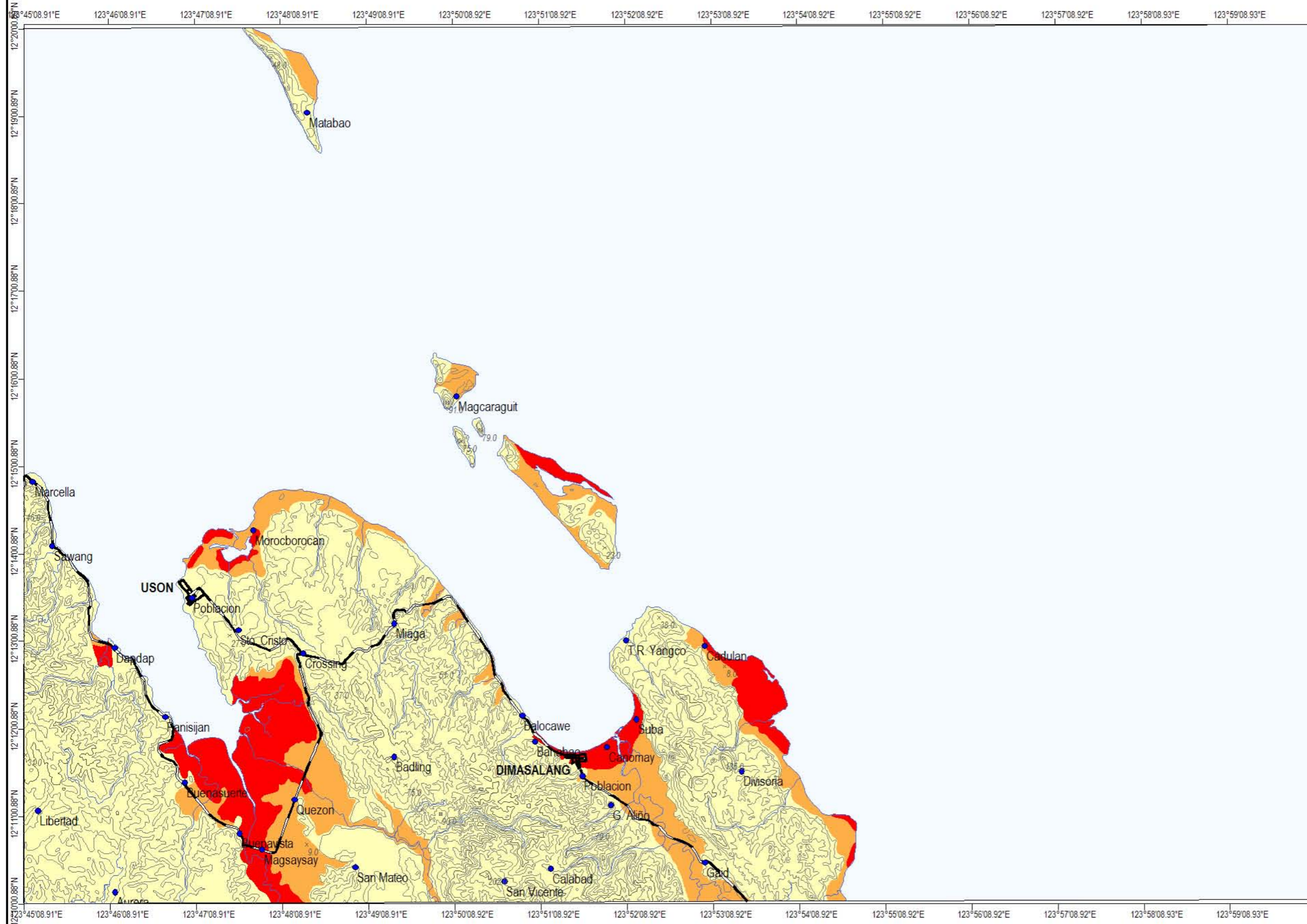


UNIVERSAL TRANSVERSE MERCATOR PROJECTION  
 Clarke 1866, Luzon Datum





# LIQUEFACTION POTENTIAL MAP OF USON QUADRANGLE



**MAP LEGEND:**

**Liquefaction Potential Zones:**

- Areas where liquefaction is likely
- Areas where liquefaction is possible
- Areas where liquefaction is not likely

- river
- road
- contour

**EXPLANATIONS:**

There are no reported liquefaction occurrences in the mapped area based on several field interviews. However, zones of different liquefaction potential were derived based on the geomorphological analysis of the study area following previous studies made by Iwasaki and Yasuda.

**Areas where Liquefaction is Likely:**  
Areas where liquefaction is likely include active/young tidal flats with nipa and mangroves, beach ridge and swale complex and spit. These areas are unsuitable for urban development. Multi-storey buildings should be required of geotechnical studies addressing or mitigating the effects of liquefaction.

**Areas where Liquefaction is Possible:**  
Coastal plains and the alluvial plains are areas where liquefaction is possible. Buildings having 5 storeys or more should be required a full geotechnical study.

**Areas where Liquefaction is not Likely:**  
Areas where the occurrence of liquefaction is unlikely.

Field data collection by: A.E. Dayao, J.M.S. Laud, E.T. Avila, M.N.L. Miraballes, E.G. Basilan & J.N. Malto  
 Geomorphological interpretation by: M.N.L. Miraballes  
 Digital cartographic processing by: M.N.L. Miraballes  
 GIS processing by: M.N.L. Miraballes  
 Checked by: A.E. Dayao  
 Approved by: R.A. Juan

Other sources of information:  
 1:50,000 NAMRIA Topographic Map  
 1951 B/W Aerial Photos



Published by:  
 Department of Environment and Natural Resources  
**MINES AND GEOSCIENCES BUREAU-RO5**  
 Rawis, Legazpi City  
 2008

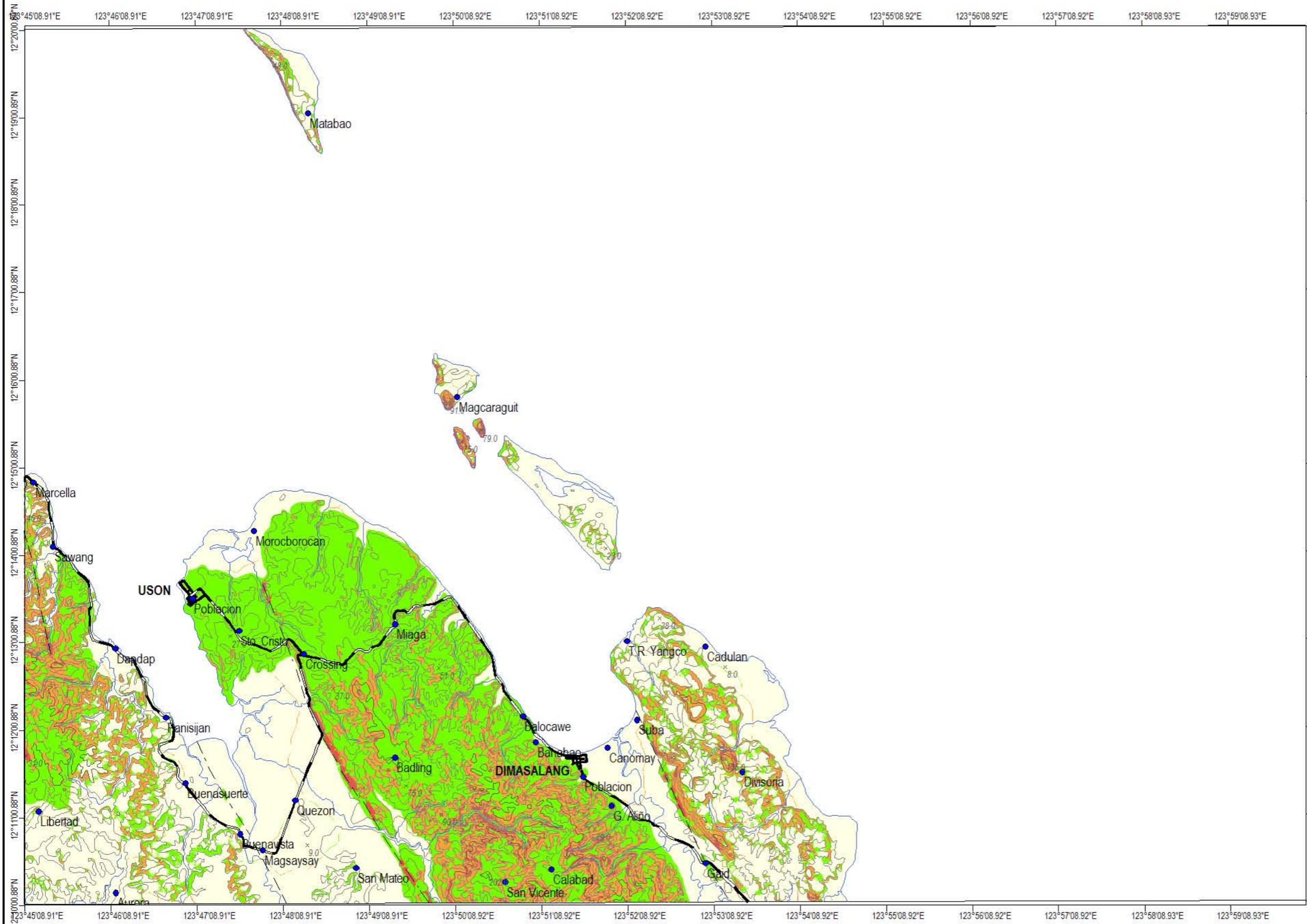


UNIVERSAL TRANSVERSE MERCATOR PROJECTION  
 Clarke 1866, Luzon Datum





# LANDSLIDE SUSCEPTIBILITY MAP OF USON QUADRANGLE



**MAP LEGEND:**

**Landslide Susceptibility Zones:**

- Low to Absent
- Low Susceptibility to Landslides
- Moderate Susceptibility to Landslides
- High Susceptibility to Landslides

— road  
 - - - fault  
 ~~~~~ river  
 --- contour

**EXPLANATIONS:**

Landslide hazard susceptibility zones were derived through qualitative map combination using lithology, geomorphology, slope gradient, road distance and fault distance. GIS was used in the map combination and subjective weights were assigned to each unit in the parameter map.

**Areas with High Susceptibility to Landslides:**  
 Areas with equally high probability of occurrence of mass movements particularly rock slides and slumps. Very steep to nearly vertical slopes and areas along faultlines are rated high susceptibility areas and are unsuitable for housing and human settlement. Detailed engineering geological and geohazard assessment is needed.

**Areas with Moderate Susceptibility to Landslides:**  
 Areas having moderate likelihood of landslide occurrence and are recommended for more detailed engineering geological and geohazard assessment prior to housing development.

**Areas with Absent or Low Susceptibility to Landslides:**  
 Areas where the likelihood of landslide occurrence is either absent or low.

Field data collection by: A.E. Dayao, J.M.S. Laud, E.T. Avila M.N.L. Miraballes, E.G. Basilan & J.N. Malto  
 Geomorphological interpretation by: M.N.L. Miraballes  
 Digital cartographic processing by: M.N.L. Miraballes  
 GIS processing by: M.N.L. Miraballes  
 Checked by: A.E. Dayao  
 Approved by: R.A. Juan

Other sources of information:  
 1:50,000 NAMRIA Topographic Map  
 1951 B/W Aerial Photos



Published by:  
 Department of Environment and Natural Resources  
 MINES AND GEOSCIENCES BUREAU-RO5  
 Rawis, Legazpi City  
 2008



UNIVERSAL TRANSVERSE MERCATOR PROJECTION  
 Clarke 1866, Luzon Datum

